Water Quality Management

Drinking water. Under the Interstate Quarantine Act of 1893, the U.S. Public Health Service (PHS) was empowered to make and enforce regulations to prevent the spread of communicable diseases. Interstate regulations were first promulgated in 1894 and the first water-related regulation (prohibiting the use of the "common cup" on interstate carriers) was adopted in 1912. The first federal drinking water regulation was adopted in 1914. It established limits for bacterial contamination. In 1925, still acting under the 1893 Act, the PHS tightened the bacteriological standard and added physical and chemical standards. These were reviewed and updated periodically through the 1940s. In 1962, a comprehensive update of the standards was completed. These standards were accepted by all the states but were binding on only about 2 percent of the communities, that is those that served interstate carriers.

The Safe Drinking Water Act of 1974 (SDWA) also identified as Title XIV of the U.S. Public Health Service Act, was the first congressional act focused on drinking water. It directed the newly formed EPA to revise drinking-water regulations to protect the public health. The Congress specified a two step process. First, it was to publish recommended maximum contaminant levels (RMCLs) for contaminants believed to have an adverse effect on health based on a study of health effects by the National Academy of Science. The RMCLs were to be set, with an adequate margin of safety, at a level that known or anticipated health effect would occur. The Congress specified that these levels were to be health goals and were not to be federally enforceable. EPA was then to set *maximum contaminant levels* (MCLs) as close to the RMCLs as the agency thought feasible. These became the National Primary Drinking Water Regulations. These standards applied to public water systems serving 25 or more people year-round or having 15 or more year-round service connections.

The SDWA was amended and/or reauthorized in 1977, 1979, and 1980. The 1986 revision of the SDWA resulted in significant changes. The congressional focus was on strengthening the regulation-setting process which had lagged significantly under the Reagan administration. The 1986 Act required:

1. Mandatory standards for 83 contaminants by June 1989.
2. Mandatory regulation of 25 contaminants every 3 years.
3. Designation of best available technology (BAT) for each contaminant regulated.
4. Specification of criteria for deciding when filtration of surface water supplies is required.
5. Disinfection of all public water supplies.
6. Monitoring for contaminants that were not regulated.
7. Banned lead solders, flux, and pipe in public water systems.
8. New programs for wellhead protection and protection of sole source aquifers (Pontius, 2003).

The mandate to regulate 25 contaminants every 3 years could not be met, and after 1992 regulations ceased to be issued. The 1986 SDWA amendments authorized

congressional appropriations for implementation through fiscal year 1991. Reauthorization was not completed until 1996.

The 1996 SDWA amendments were signed into law by President Clinton as PL 104–182. The amendments made substantial revisions to the act. Eleven new sections were added. The amendments strengthened and expanded the protection of drinking water by providing grants for compliance and enforcement, enhanced water-system capacity, operator training, and development of solutions to source pollution. In addition, it provided for public notification of violations within 24 hours (rather than 2 weeks under the old act), and annual reporting of levels of regulated contaminants to consumers. Relief from analysis of contaminants that have never been found and are unlikely to occur was given to reduce analytical costs. EPA was funded to conduct research on health effects and treatment for arsenic, radon, and Crytosporidium. In addition, EPA was required to develop a screening program to identify the risks posed by substances that have an effect similar to that produced by naturally occurring estrogen and to screen pesticides and other chemicals for estrogenic effects. In a major shift from all preceding environmental rule making, Section 1412(b)(6) of the act requires that environmental regulations include an assessment of the costs and benefits. Furthermore, it permits the EPA administrator to "promulgate a maximum contaminant level for the contaminant that maximizes health risk reduction benefits at a cost justified by the benefits." Prior to the enactment of this legislation, cost was not to be considered in the protection of human health and the environment.

Water pollution control. The federal role in water pollution control began with the Public Health Service Act of 1912. This act established the Streams Investigation Station at Cincinnati to carry out water pollution research. The Oil Pollution Act was passed in 1924 to prevent oily discharges on coastal waters. During the 1930s and 1940s, there was a continuing debate over whether the federal government should take a greater role in controlling water pollution. This debate led to the limited expansion of federal powers expressed in the Water Pollution Control Act of 1948 (Table 1-1). The Federal Water Pollution Control Act (FWPCA) of 1956, passed by overriding President Eisehower's veto (Percival, 2003), was the cornerstone of early federal efforts to reduce pollution. Key elements of the act included a new program of subsidies for municipal treatment plant construction and an expanded basis for federal legal action against polluters. Increased funding for state water pollution control efforts and new support for research and training activities were also provided. Each of these programs was continued in the many amendments to the Federal Water Pollution Control Acts in the 1960s and 1970s.

The Water Quality Act of 1965 carried forward many provisions of the earlier federal legislation, generally with an increase in levels of funding. The 1965 act also introduced important new requirements for states to establish ambient water quality standards and detailed plans indicating how the standards would be met. The act also shifted responsibility for administering the federal water quality program from the U.S. Public Health Service to a separate agency, the Federal Water Pollution Control Administration, within the Department of Health, Education, and Welfare (HEW). This was not a permanent change. In 1970, a presidential reorganization order placed the water pollution control activities and several other federal environmental programs in the newly created Environmental Protection Agency (EPA).

TABLE 1-1
Environmental Legislative History

Year	Title	Selected elements of legislation[a]
1948	Water Pollution Control Act	Funds for state water pollution control agencies Technical assistance to states Limited provisions for legal action against polluters
1956	Federal Water Pollution Control Act (FWPCA)	Funds for water pollution research and training Construction grants to municipalities Three-stage enforcement process
1965	Water Quality Act	States set water quality standards States prepare implementation plans
1972	FWPCA Amendments	Zero discharge of pollutants goal BPT and BAT effluent limitations NPDES permits Enforcement based on permit violations
1977	Clean Water Act	BAT requirements for toxic substances BCT requirements for conventional pollutants
1981	Municipal Waste Treatment Construction Grants Amendments	Reduced federal share in construction grants program

[a]The table entries include only the new policies and programs established by each of the laws. Often these provisions were carried forward in modified form as elements of subsequent legislation.

Legend:
BPT = Best Practicable Control Technology
BAT = Best Available Technology
NPDES = National Pollution Discharge Elimination System
BCT = Best Conventional Treatment

In Public Law 92-500 (Federal Water Pollution Control Act of 1972),* Congress introduced (1) national water quality goals, (2) technology-based effluent limitations, (3) a national discharge permit system, and (4) federal court actions against sources violating permit conditions.

The 1972 amendments aimed to restore and maintain "the chemical, physical and biological integrity of the nation's waters." The amendments specified, as a national goal, that the "discharge of pollutants into navigable waters be eliminated by 1985." This also included an interim goal:

> [W]herever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on the water [should] be achieved by July 1, 1983.

*Passed by override of President Nixon's veto (Percival, 2003).

The EPA administrator was required to set effluent restrictions that met the following general requirements of the 1972 amendments: By 1977, all dischargers were to achieve *"best practicable control technology currently available"* (BPT); and by 1983, all dischargers were to have the *"best available technology economically achievable"* (BAT). After delays caused by numerous legal challenges to the EPA administrator's effluent limitations guidelines, the BPT provisions were implemented. However, the BAT requirements were so heavily disputed that Congress modified them in the Clean Water Act of 1977.

The principal criticism of the original BAT effluent limitations was that the costs of the very high required percentage reductions in residuals would be much greater than the benefits. In defining BAT, costs were considered, but only in the general context of affordability by industry. Computations of the social benefits of stringent effluent controls were not a central factor. Congress presumed the benefits of eliminating water pollutants would be substantial. Congressional insistence on very strict effluent limitations can also be interpreted as an effort to guarantee the rights of Americans to high-quality waters.

In 1977, Congress responded to critics of BAT by requiring it only for toxic substances. A different requirement was introduced for "conventional pollutants," such as biochemical oxygen demand and suspended solids. The effluent limitations guidelines for these pollutants were to be based on the "*best conventional pollutant control* technology" (BCT).

The Clean Water Act of 1977 strongly endorsed the view that waterborne toxic substances must be controlled. The text of the act included a list of 65 substances, or classes of substances, to be used as the basis for defining toxics. This list resulted from a 1976 settlement of a legal action in which several environmental organizations sued the EPA administrator for failing to issue toxic pollutant standards. This list was subsequently expanded by EPA to include 127 "priority pollutants" (Table 1-2).

Effluent limitations required by the FWPCA amendments of 1972 (and later the Clean Water Act of 1977) formed the basis for issuing "*National Pollutant Discharge Elimination System*" (NPDES) permits. The permit system idea stemmed from actions taken by the Department of Justice in the late 1960s. With the support of a favorable interpretation by the Supreme Court, attorneys for the United States relied on the 1899 River and Harbor Act to prosecute industrial sources of water pollution. The 1899 act, which was drafted originally to prohibit deposits of refuse in navigable waters to keep them clear for boat traffic, was interpreted in the 1960s as applying to liquid waste as well. In December 1970, the EPA administrator issued an executive order calling for a water quality management program using permits and penalties based on the River and Harbor Act of 1899. Although this program was delayed by court challenges in 1971, Congress made it a central part of the federal strategy embodied in the FWPCA amendments of 1972.

Air Quality Management

Two factors stimulated the development of air pollution control legislation. The first was an air pollution episode at Donora, Pennsylvania, that killed 20 people and made several thousand ill. The second factor was the growing recognition of the linkage between automobile exhausts and photochemical smog. The legislative history is shown in Table 1-3.

TABLE 1-2
EPA's priority pollutant list

1. Antimony	**43.** Trichloroethylene	**86.** Fluoranthene
2. Arsenic	**44.** Vinyl chloride	**87.** Fluorene
3. Beryllium	**45.** 2-Chlorophenol	**88.** Hexachlorobenzene
4. Cadmium	**46.** 2,4-Dichlorophenol	**89.** Hexachlorobutadiene
5a. Chromium (III)	**47.** 2,4-Dimethylphenol	**90.** Hexachlorocyclopentadiene
5b. Chromium (VI)	**48.** 2-Methyl-4-chlorophenol	**91.** Hexachloroethane
6. Copper	**49.** 2,4-Dinitrophenol	**92.** Indeno(1,2,3-cd)pyrene
7. Lead	**50.** 2-Nitrophenol	**93.** Isophorone
8. Mercury	**51.** 4-Nitrophenol	**94.** Naphthalene
9. Nickel	**52.** 3-Methyl-4-chlorophenol	**95.** Nitrobenzene
10. Selenium	**53.** Pentachlorophenol	**96.** N-Nitrosodimethylamine
11. Silver	**54.** Phenol	**97.** N-Nitrosodi-n-propylamine
12. Thallium	**55.** 2,4,6-Trichlorophenol	**98.** N-Nitrosodiphenylamine
13. Zinc	**56.** Acenaphthene	**99.** Phenanthrene
14. Cyanide	**57.** Acenaphthylene	**100.** Pyrene
15. Asbestos	**58.** Anthracene	**101.** 1,2,4-Trichlorobenzene
16. 2,3,7,8-TCDD (Dioxin)	**59.** Benzidine	**102.** Aldrin
17. Acrolein	**60.** Benzo(a)anthracene	**103.** alpha-BHC
18. Acrylonitrile	**61.** Benzo(a)pyrene	**104.** beta-BHC
19. Benzene	**62.** Benzo(a)fluoranthene	**105.** gamma-BHC
20. Bromoform	**63.** Benzo(ghi)perylene	**106.** delta-BHC
21. Carbon tetrachloride	**64.** Benzo(k)fluoranthene	**107.** Chlordane
22. Chlorobenzene	**65.** bis(2-Chloroethoxy)methane	**108.** 4,4′-DDT
23. Chlorodibromomethane	**66.** bis(2-Chloroethyl)ether	**109.** 4,4′-DDE
24. Chloroethane	**67.** bis(2-Chloroisopropyl)ether	**110.** 4,4′-DDD
25. 2-Chloroethylvinyl ether	**68.** bis(2-Ethylhexyl)phthalate	**111.** Dieldrin
26. Chloroform	**69.** 4-Bromophenyl phenyl ether	**112.** alpha-Endosulfan
27. Dichlorobromomethane	**70.** Butylbenzyl phthalate	**113.** beta-Endosulfan
28. 1,1-Dichloroethane	**71.** 2-Chloronaphthalene	**114.** Endosulfan sulfate
29. 1,2-Dichloroethane	**72.** 4-Chlorophenyl phenyl ether	**115.** Endrin
30. 1,1-Dichloroethylene	**73.** Chrysene	**116.** Endrin aldehyde
31. 1,2-Dichloropropane	**74.** Dibenzo(a,h)anthracene	**117.** Heptachlor
32. 1,3-Dichloropropylene	**75.** 1,2-Dichlorobenzene	**118.** Heptachlor epoxide
33. Ethylbenzene	**76.** 1,3-Dichlorobenzene	**119.** PCB-1242
34. Methyl bromide	**77.** 1,4-Dichlorobenzene	**120.** PCB-1254
35. Methyl chloride	**78.** 3,3-Dichlorobenzidine	**121.** PCB-1221
36. Methylene chloride	**79.** Diethyl phthalate	**122.** PCB-1232
37. 1,2,2,2-Tetrachloroethane	**80.** Dimethyl phthalate	**123.** PCB-1248
38. Tetrachloroethylene	**81.** Di-n-butyl phthalate	**124.** PCB-1260
39. Toluene	**82.** 2,4-Dinitrotoluene	**125.** PCB-1016
40. 1,2-trans-dichloroethylene	**83.** 2,6-Dinitrotoluene	**126.** Toxaphene
41. 1,1,1-Trichloroethane	**84.** Di-n-octyl phthalate	
42. 2,4 Dichlorophenol	**85.** 1,2-Diphenylhydrazine	

Source: 40 CFR 131.36, July 1, 1993.

The first federal act was the Air Pollution Control Act of 1955 (PL 84-159). It established a program of federally funded research grants to be administered by the U.S. Public Health Service. The expansion of the federal government into air pollution control was a limited one. The legislative history of the act reveals that Congress intended to limit federal involvement in deference to the states, counties, and cities.

TABLE 1-3
Federal laws controlling air pollution

Year	Title	Selected elements of legislation[a]
1955	Air Pollution Control Act	Funds for air pollution research
1960	Motor Vehicle Exhaust Act	Funds for research on vehicle emissions
1963	Clean Air Act	Three-stage enforcement process Funds for state and local air pollution control agencies
1965	Motor Vehicle Air Pollution Control Act	Emission regulations for cars beginning with 1968 models
1967	Air Quality Act	Federally issued criteria documents Federally issued control technique documents Air quality and control regions (AQCRs) defined Requirements for states to set ambient standards for AQCRs Requirements for state implementation plans
1970	Clean Air Act Amendments	National ambient air quality standards New source performance standards Technology forcing auto emission standards Transportation control plans
1977	Clean Air Act Amendments	Relaxation of previous auto emission requirements Vehicle inspection and maintenance programs Prevention of significant deterioration areas Emission offsets for nonattainment areas Study ozone depletion National emission standards for hazardous air pollutants (NESHAP)
1980	Acid Precipitation Act	Development of a long-term research plan
1986	Radon Gas and Indoor Air Quality Research Act	Research program to gather data and to coordinate and assess federal action
1990	Clean Air Act Amendments	Sets attainment dates for criteria air pollutants Imposes new requirements for auto emissions and establishes clean fuels program Identifies 189 hazardous air pollutants to be regulated Establishes SO_2 allowances for acid rain control Establishes a national permit system Sets schedule for phase-out of ozone-depleting compounds

[a]The table entries include only the new policies and programs established by each of the laws. Often these provisions were carried forward in modified form as elements of subsequent legislation.

The federal role was further extended by the Clean Air Act of 1963, which allowed direct federal intervention to reduce interstate pollution. The form of intervention followed the enforcement process in the Federal Water Pollution Control Act of 1956.

The first federal restrictions on auto emissions came with the Motor Vehicle Air Pollution Control Act of 1965. Based on earlier auto emission control efforts in California, the 1965 act gave the Secretary of the Department of Health, Education, and Welfare authority to establish permissible emission levels for new automobiles beginning with the 1968 model year. The control of emissions from older vehicles was left to individual states.

The Air Quality Act of 1967 borrowed concepts from the Water Quality Control Act of 1965 by requiring states to develop ambient air quality standards and state implementation plans (SIPs) to achieve the standards. Implementation plans were to include emission requirements for controlling air pollution and a timetable for meeting the requirements. Deadlines were set for submitting ambient standards, which were to be established on a region-wide basis.

Although the Clean Air Act Amendments of 1970 continued many of the research and state aid programs established by prior legislation, several aspects of the amendments represented dramatic changes in strategy. These involved (1) the requirement that the administrator of EPA set national ambient air quality standards (NAAQS) and emission standards for selected categories of new industrial facilities, and (2) the explicit delineation (by Congress) of auto emission standards. Another manifestation of the expanded role of the federal government was the requirement of the 1970 amendments that the EPA administrator issue *new source performance standards* (NSPS). These standards were to control new stationary sources categorized by the administrator as contributing significantly to air pollution.

The Clean Air Act Amendments of 1977 relaxed the emission requirements somewhat and extended the compliance deadlines into the early 1980s. They also defined a concept of *prevention of significant deterioration* (PSD) areas and required that an area that meets the national ambient standards for a given air pollutant be declared a PSD area for that pollutant. The amendments also defined three classes of PSD areas. For each class, numerical limits indicated the maximum permissible increment of air quality degradation from all new (or modified) stationary sources of pollution in an area.

The 1977 amendments also indicated that significant new sources of pollution could locate in areas that did not meet the NAAQS, but only if certain conditions were satisfied. The amendments required that a significant new source locating in a nonattainment area (one which has not achieved the NAAQS) had to meet strict emission-reduction requirements developed by the EPA administrator. In addition, discharges from the new source had to be more than offset by reductions in emissions from other sources in the region.

In 1979, the EPA extended the concept of emission offsets, as used in nonattainment areas, to a different context: multiple sources of air pollution generated at a single site. This extension, known as the *bubble policy,* is illustrated in Figure 1-1. The figure depicts a firm that must control releases from smokestacks at two adjacent plants. Before the bubble policy, the firm had to comply with emission standards that allowed only 100 Mg/d from each plant.* The total discharge was 200 Mg/d. The unit cost of emission controls for Plant A was much higher than that for Plant B, but

*Mg/d = megagram per day. 1 Mg = 1,000 kg.

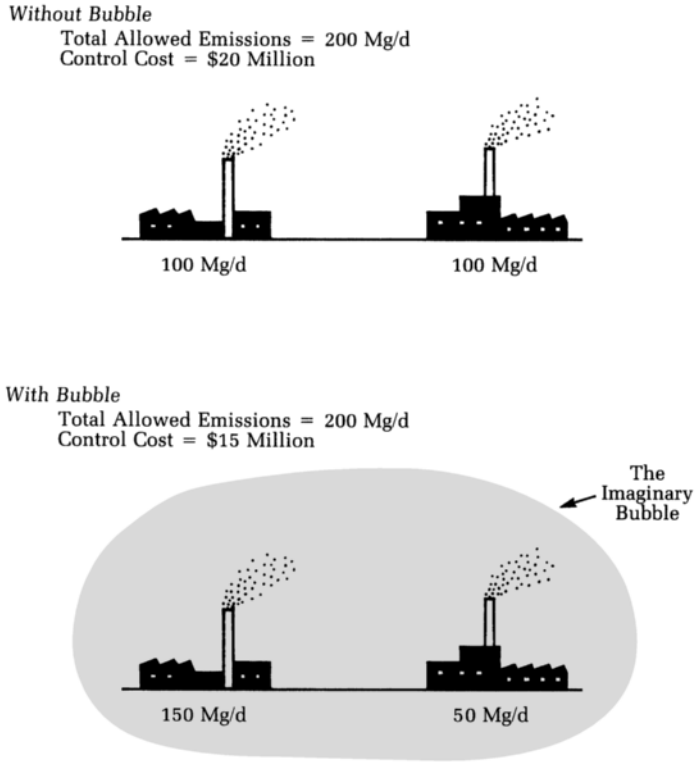

FIGURE 1-1
Illustration of bubble concept.

the emission requirements were insensitive to these cost differences. Using the bubble policy, the firm is free to decide how to reduce residuals at each plant. The only restriction is that its total discharge must be no greater than 200 Mg/d. Imagine that a bubble surrounds the two plants. The policy allows the firm to make choices within the bubble, but the total discharge from the bubble is restricted. In the early 1980s, the original bubble policy was extended to include plants that were not at the same location (multiplant bubbles).

The Clean Air Act Amendments of 1990 (CAAA) mandated that the EPA promulgate more than 175 new regulations, 30 guidance documents, 35 studies, and 50 new research initiatives. The Congressional mandates are categorized under eleven "*Titles*" in the Act. It has become common to refer to the requirements of the CAAA by title number.

In light of the fact that three previous deadlines for attainment had come and gone, Title I establishes 16 new deadlines. Although these are primarily aimed at ozone, there are also classifications for carbon monoxide and fine particulates.

Provisions relating to mobile sources are spelled out in Title II. Cars are required to have dashboard warning lights that signal whether or not pollution control equipment is working. These devices frequently have impregnated chemicals that react with the pollutants. The life expectancy of these devices, in terms of miles driven, is specified as 100,000 miles, rather than the previous requirement of 50,000 miles. Auto makers are

required to produce some cars that use clean fuels such as alcohol and some that are powered by electricity. In addition, *inspection and maintenance* (I/M) programs for metropolitan areas have been expanded.

Because the previous legislation establishing national emission standards for hazardous pollutants (NESHAPs) based on health risk proved too cumbersome, Title III established an initial list of 189 *hazardous air pollutants* (HAPs) shown in Table 1-4 and directed EPA to establish emission standards based on technology.* These standards are to be the *maximum achievable control technology* (MACT) for a given source category.

Under Title IV, the Act outlines a new nationwide approach to the problem of acid rain. The law sets up a market-based system to lower sulfur dioxide emissions. EPA will issue emission allowances to power plants listed in the act. The allowances are set below current emission levels. Plants may meet the allowances by installing control technology or by purchasing allowances from plants that have emissions below their allowance. For example, in November of 1994, Niagara Mohawk, which serves upstate New York, and the Arizona Public Service Co. traded emission allowances for carbon monoxide and sulfur dioxide.

Unlike the Clean Water Act, no provision for permits was included in the original Clean Air Act (1963). Title V remedies this deficiency by making it unlawful to operate one of the sources listed in the Act except by compliance with a permit.

Depletion of the ozone layer is addressed in Title VI of the Act. A schedule for phasing out the production of ozone-destroying chemicals was promulgated in the Act with provision that EPA could accelerate the schedule. In 1993, EPA established an accelerated schedule that eliminated production of these chemicals by 2001.

Noise Pollution Control

The federal government's activities in noise abatement are spread over several agencies by a variety of legislative acts. The emphasis is on specific activities already regulated separately by the various agencies.

The landmark legislation in the area of occupational noise abatement was enacted in 1942 and is known as the Walsh-Healey Public Contracts Act. This act established minimum working conditions for employees of contractors who supply the federal government with materials, supplies, and equipment in excess of $10,000. However, it was not until 1969 that the Secretary of Labor interpreted this as applicable to noise! (Note: These applied only to supply contracts and not to construction contracts.)

The Occupational Safety and Health Act of 1970 (OSHA) enabled the Secretary of Labor to apply the Walsh-Healey standards with new meaning. Walsh-Healey merely excluded from bidding on federal contracts those suppliers who failed to meet minimum work condition standards. OSHA provided penalties for those suppliers, including civil and criminal law sanctions. Construction noise was brought under federal consideration in the Construction Safety Act of 1970. This act carried the Walsh-Healey provisions to the supply of construction contracts.

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*Caprolactam was deleted from the list in 1996 (40 CFR 63.60).

TABLE 1-4
Hazardous air pollutants (HAPs)

Acetaldehyde	1,4-Dichlorobenzene(p)	Methoxychlor
Acetamide	3,3-Dichlorobenzidene	Methyl bromide (Bromomethane)
Acetonitrile	Dichloroethyl ether [Bis(2-chloroethyl)ether]	Methyl chloride (Chloromethane)
Acetophenone	1,3-Dichloropropene	Methyl chloroform (1,1,1-Trichloroethane)
2-Acetylaminofluorene	Dichlorvos	Methyl ethyl ketone (2-Butanone)
Acrolein	Diethanolamine	Methyl hydrazine
Acrylamide	N,N-Diethyl aniline (N,N-Dimethylaniline)	Methyl iodide (Iodomethane)
Acrylic acid	Diethyl sulfate	Methyl isobutyl ketone (Hexone)
Acrylonitrile	3,3-Dimethoxybenzidine	Methyl isocyanate
Allyl chloride	Dimethyl aminoazobenzene	Methyl methacrylate
4-Aminobiphenyl	3,3′-Dimethyl benzidine	Methyl tert butyl ether
Aniline	Dimethyl carbamoyl chloride	4,4-Methylene bis(2-chloroaniline)
o-Anisidine	Dimethyl formamide	Methylene chloride (Dichloromethane)
Asbestos	1,1-Dimethyl hydrazine	Methylene diphenyl diisocyanate (MDI)
Benzene (including benzene from gasoline)	Dimethyl phthalate	4,4′-Methylenedianiline
Benzidine	Dimethyl sulfate	Naphthalene
Benzotrichloride	4,6-Dinitro-o-cresol, and salts	Nitrobenzene
Benzyl chloride	2,4-Dinitrophenol	4-Nitrobiphenyl
Biphenyl	2,4-Dinitrotoluene	4-Nitrophenol
Bis(2-ethylhexyl)phthalate (DEHP)	1,4-Dioxane (1,4-Diethyleneoxide)	2-Nitropropane
Bis(chloromethyl)ether	1,2-Diphenylhydrazine	N-Nitroso-N-methylurea
Bromoform	Epichlorohydrin (l-chloro-2,3-epoxypropane)	N-Nitrosodimethylamine
1,3-Butadiene	1,2-Epoxybutane	N-Nitrosomorpholine
Calcium cyanamide	Ethyl acrylate	Parathion
Caprolactam (deleted 1996)	Ethyl benzene	Pentachloronitrobenzene (Quintobenzene)
Captan	Ethyl carbamate (Urethane)	Pentachlorophenol
Carbaryl	Ethyl chloride (Chloroethane)	Phenol
Carbon disulfide	Ethylene dibromide (Dibromoethane)	p-Phenylenediamine
Carbon tetrachloride	Ethylene dichloride (1,2-Dichloroethane)	Phosgene
Carbonyl sulfide	Ethylene glycol	Phosphine
Catechol	Ethylene imine (Aziridine)	Phosphorus
Chloramben	Ethylene oxide	Phthalic anhydride
Chlordane	Ethylene thiourea	Polychlorinated biphenyls (Aroclors)
Chlorine	Ethylidene dichloride (1,1-Dichloroethane)	1,3-Propane sultone
Chloroacetic acid	Formaldehyde	beta-Propiolactone
2-Chloroacetophenone	Heptachlor	Propionaldehyde
Chlorobenzene	Hexachlorobenzene	Propoxur (Baygon)
Chlorobenzilate	Hexachlorobutadiene	Propylene dichloride (1,2-Dichloropropane)
Chloroform	Hexachlorocyclopentadiene	Propylene oxide
Chloromethyl methyl ether	Hexachloroethane	1,2-Propylenimine (2-Methyl aziridine)
Chloroprene	Hexamethylene-1,6-diisocyanate	Quinoline
Cresols/Cresylic acid (isomers and mixture)	Hexamethylphosphoramide	Quinone
o-Cresol	Hexane	Styrene
m-Cresol	Hydrazine	Styrene oxide
p-Cresol	Hydrochloric acid	2,3,7,8-Tetrachlorodibenzo-p-dioxin
Cumene	Hydrogen fluoride (Hydrofluoric acid)	1,1,2,2-Tetrachloroethane
2,4-D, salts and esters	Hydrogen sulfide (clerical error; deleted 1991)	Tetrachloroethylene (Perchloroethylene)
DDE	Hydroquinone	Titanium tetrachloride
Diazomethane	Isophorone	Toluene
Dibenzofurans	Lindane (all isomers)	2,4-Toluene diamine
1,2-Dibromo-3-chloropropane	Maleic anhydride	2,4-Toluene diisocyanate
Dibutylphthalate	Methanol	o-Toluidine

TABLE 1-4
Hazardous air pollutants (HAPs) (*continued*)

Toxaphene (chlorinated camphene)	Vinylidene chloride (1,1-Dichloroethylene)	Coke oven emissions
1,2,4-Trichlorobenzene	Xylenes (isomers and mixture)	Cyanide compounds[1]
1,1,2-Trichloroethane	o-Xylenes	Glycol ethers[2]
Trichloroethylene	m-Xylenes	Lead compounds
2,4,5-Trichlorophenol	p-Xylenes	Manganese compounds
2,4,6-Trichlorophenol	Antimony compounds	Mercury compounds
Triethylamine	Arsenic compounds (inorganic, including arsine)	Fine mineral fibers[3]
Trifluralin		Nickel compounds
2,2,4-Trimethylpentane	Beryllium compounds	Polycylic organic matter[4]
Vinyl acetate	Cadmium compounds	Radionuclides (including radon)[5]
Vinyl bromide	Chromium compounds	Selenium compounds
Vinyl chloride	Cobalt compounds	

NOTE: For all listings above which contain the word "compounds" and for glycol ethers, the following applies: Unless otherwise specified, these listings are defined as including any unique chemical substance that contains the named chemical (i.e., antimony, arsenic, etc.) as part of that chemical's infrastructure.

[1]X′CN where X = H′ or any other group where a formal dissociation may occur. For example KCN or $Ca(CN)_2$

[2]Includes mono- and di- ethers of ethylene glycol, diethylene glycol, and triethylene glycol R-$(OCH2CH2)_n$-OR′ where

n = 1, 2, or 3

R = alkyl or aryl groups

R′ = R, H, or groups which, when removed, yield glycol ethers with the structure: R-$(OCH2CH)_n$-OH. Polymers are excluded from the glycol category. Ethylene glycol monobutyl ether and surfactant alcohol ethoxylates and derivatives delisted November 29, 2004, 69 FR 692988.

[3]Includes mineral fiber emissions from facilities manufacturing or processing glass, rock, or slag fibers (or other mineral derived fibers) of average diameter 1 micrometer or less.

[4]Includes organic compounds with more than one benzene ring, and which have a boiling point greater than or equal to 100°C.

[5]A type of atom which spontaneously undergoes radioactive decay.

Source: Public Law 101-549, Nov. 15, 1990, 40 CFR 63.60

In response to the Housing Act of 1949, the Federal Housing Administration's 1961 appraisal guidance identified noise as an issue to be considered in property appraisals. Under the Housing and Urban Development Act of 1965, the Department issued comprehensive noise standards in the 1971 Housing and Urban Development (HUD) circular 1390.2. These rules were updated to the current standard in 1979.

Control and abatement of aircraft noise and sonic booms was the focus of the environmental component of the Federal Aviation Act of 1958. The Department of Transportation Act (1966) included provisions to promote research on noise abatement with particular attention to aircraft. This was followed by the 1968 amendments to the Federal Aviation Administration Act that directed the Secretary of Transportation to prescribe rules for control and abatement of aircraft noise. The responsibility for noise abatement from airports was assigned to the EPA in the Noise Pollution and Abatement Act of 1970. It directed EPA to

1. Measure noise levels and exposure at airports.
2. Develop airport noise exposure maps.
3. Develop a land use noise compatibility program.
4. Develop noise standards.

Planning grant funds for noise compatibility surveys and the responsibility for noise standards for air carriers were assigned to the EPA in the Aviation Safety and Noise Abatement Act of 1979. The responsibility for airport noise abatement was assigned to the Federal Aviation Administration in the Airport Noise Abatement Act Amendments of 1994 (PL 103-s272).

In the 1962 amendments to the Federal Aid Highways Act, economic, social, and environmental impacts were included as requirements for consideration in the development of plans for construction. The Secretary of Transportation was directed to develop and promulgate standards for highway noise levels compatible with different land uses.

In 1970 Congress added Title IV to the Clean Air Act amendments. This act was entitled "Noise Pollution and Abatement Act of 1970," and it set up the Office of Noise Abatement and Control in the EPA. This was followed by the Noise Control Act of 1972 (PL 92-574). The major provisions of the act stipulated that EPA:

1. Develop and publish criteria for levels of noise requisite to the protection of public health.
2. Compile a list of noise sources, identify noise-producing products, and indicate techniques for control.
3. Set noise emission standards for products distributed in commerce including construction equipment, transportation equipment (including recreational vehicles), any motor or engine, and electrical or electronic equipment.
4. Set aircraft, railroad, and motor carrier noise standards.

In 1994, the Noise Control Act was amended to move airport noise abatement to the Federal Aviation Agency.

Solid Waste

Modern solid waste legislation dates from 1965 when the Solid Waste Disposal Act, Title II of Public Law 89-272, was enacted by Congress. The intent of this act was to

1. Promote the demonstration, construction, and application of solid waste management and resource recovery systems.
2. Provide technical and financial assistance in the planning and development of resource recovery and solid waste disposal programs.
3. Promote a national research and development program for improved management techniques.
4. Provide for the promulgation of guidelines for solid waste collection, transport, separation, recovery, and disposal systems.
5. Provide training grants in occupations involving the design, operation, and maintenance of solid waste disposal systems.

Enforcement of this act became the responsibility of the U.S. Public Health Service (USPHS) and the Bureau of Mines. The USPHS had responsibility for most of the

municipal wastes. The Bureau of Mines was charged with supervision of solid wastes from mining activities and the fossil-fuel solid wastes from power plants and industrial steam plants.

The Solid Waste Disposal Act of 1965 was amended by Public Law 95-512, the Resources Recovery Act of 1970. The act directed that the emphasis of the national solid waste management program be shifted from disposal as its primary objective to that of recycling and reuse of recoverable materials in solid wastes or to the conversion of wastes to energy.

Another feature of the 1970 act was the mandate of Congress to the Secretary of Health, Education, and Welfare to prepare a report on the treatment and disposal of hazardous wastes, including radioactive, toxic chemical, biological, and other wastes of significance to the public health and welfare.

Hazardous Wastes

The Resource Conservation and Recovery Act of 1976, commonly known as RCRA (and pronounced "rick-rah") addresses the handling of hazardous waste at facilities currently operating and at those yet to be constructed. The act was designed in large part to meet disposal needs resulting from the Clean Air Act and Clean Water Act, which require industries to remove hazardous substances from their air emissions and their wastewater discharges. Neither statute, however, ensures that the ultimate disposition of waste materials will be environmentally sound. RCRA was intended to provide that ensurance. RCRA does not, however, deal directly with abandoned sites or closed facilities where hazardous wastes have been handled or disposed of in the past. These locations are covered by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, pronounced "sir-klah"), commonly referred to as "Superfund," enacted by Congress in 1980. Finally, RCRA also does not control the disposition of hazardous substances within the productive stream of commerce. Such substances include chemicals covered by the Toxic Substances Control Act of 1976 (PL 94-469), pesticides regulated under the Federal Insecticide, Fungicide, and Rodenticide Act of 1972 (PL 92-516), or other hazardous products subject to the 1975 Hazardous Materials Transportation Act and to other types of federal regulation.

The five major elements in the federal approach to hazardous waste management are:

1. Federal classification of hazardous waste
2. Cradle-to-grave manifest (record-keeping) system
3. Federal standards for safeguards to be followed by generators, transporters, and facilities that treat, store, or dispose of hazardous waste
4. Enforcement of federal standards for facilities through a permit program
5. Authorization of state programs to operate in lieu of the federal program

The act directs the U.S. Environmental Protection Agency to promulgate regulations necessary to put the federal program into full effect.

Unhappy with the progress in implementing RCRA, Congress in 1984 passed the Hazardous and Solid Waste Amendments (HSWA, pronounced "hiss-wah"). The scope of RCRA was significantly increased. Under the legislation:

1. Waste minimization was established as the preferred method for managing hazardous waste.
2. Untreated hazardous waste was banned from land disposal and EPA was directed to establish treatment standards for land disposal.
3. New technology standards, such as double liners, leachate collection systems, and extensive groundwater monitoring, were established for land disposal facilities.
4. New requirements were established for small quantity generators.
5. The EPA was directed to establish standards for underground storage tanks.
6. The EPA was directed to evaluate criteria for municipal solid waste landfills and upgrade monitoring requirements.

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) provided authority for removal of hazardous substances from improperly constructed or operated active sites not in compliance with RCRA and from inactive disposal sites.

The most fundamental feature of CERCLA is that it provides basic operating authority to the federal government to take direct action to remove hazardous substances from dangerous inactive disposal sites and to assist with cleaning up emergency spills. This includes authority to carry out investigations, testing, and monitoring of disposal sites. It also includes authority to implement remedial measures to remove contaminants in the groundwater.

CERCLA earned its nickname, "Superfund," from the provision of a $1.6 billion Hazardous Substance Response Trust Fund. Seven-eighths of the money is to be provided by industry through taxes on crude oil, certain petroleum products, and 42 chemical feedstocks; one-eighth is to be provided by government through appropriations from general revenues.

In cases where responsibility for the wastes that cause contamination can be traced to companies with financial resources, CERCLA places financial responsibility for the cleanup on those companies. The statute establishes a set of federal laws under which liability can be imposed on such companies even when they are only indirectly involved in the ownership or operation of the facilities where the wastes were disposed. After the government has identified a site as a threat to the environment, it may call upon those liable companies to undertake the cleanup at their own cost. Alternatively, if such companies refuse to assume responsibility for the cleanup, the government can carry out the remedial program using money from the fund and then bring suit against the companies for reimbursement.

A National Contingency Plan (NCP) establishes the rules for how EPA will use its authority and spend its money. To qualify for expenditure of CERCLA funds, a site must appear on the National Priorities List (NPL). The EPA developed the Hazardous

Ranking System (HRS) as a method of assigning a site to the NPL. As of 2004, 1,244 sites had been placed on the NPL (U.S. EPA, 2005b). In addition, CERCLA contains notice requirements for all releases (spills) of reportable quantities of hazardous substances and creates a Post-Closure Liability Fund for qualified disposal facilities.

The Superfund Amendments and Reauthorization Act (SARA) of 1986 extended the provisions of CERCLA. In addition to establishing an $8.5 billion fund for cleanup, SARA directs or establishes that EPA:

1. Revise the NPL and the HRS on which it is based.
2. Revise the NCP.
3. Is authorized to subpoena documents and witnesses.
4. Can spend money to investigate sites and design remedies, and can permit private parties to conduct cleanup.
5. Has broad enforcement authority to require private parties to undertake cleanup.
6. Must impose the more stringent of federal standards or state standards.
7. May use mixed funding, that is, both federal and private money.
8. Develop an administrative record of decisions.

The Toxic Substances Control Act (TSCA) is unique in hazardous waste legislation in that it requires disclosure of information about the toxicity of new materials before they enter into commercial manufacture. It deals with hazardous waste in only one instance: polychlorinated biphenyls (PCBs). At the federal level, rules for the disposal of PCBs are set under TSCA (pronounced "tos-ka") rather than RCRA or CERCLA.

Atomic Energy and Radiation

Laws and regulations to manage radioactive materials and radiation exposure began with the Atomic Energy Act of 1946. The act established the Atomic Energy Commission (AEC) and directed it to conduct research and development on peaceful applications of fissionable and radioactive materials. The Atomic Energy Act of 1954 provided for control of uranium and thorium ("source material" for nuclear reactors), plutonium and enriched uranium (classified as special nuclear material because of their potential use in atomic weapons), and other by-products of the nuclear industry. The Energy Reorganization Act of 1974 divided the developmental and regulatory functions of the AEC between two agencies: the Energy and Research and Development Administration (ERDA) and the Nuclear Regulatory Commission (NRC). In restructuring the administration of energy-related matters after the Arab oil boycott, the Energy Organization Act of 1977 replaced ERDA with the Department of Energy (DOE). The NRC was given jurisdiction over reactor construction and operation. It regulates the possession, use, transportation, handling, and disposal of radioactive materials and wastes. The DOE is responsible for research and development and will operate defense and high-level waste repositories.

The diminishing space at low-level disposal sites led to the enactment of the Low-Level Waste Policy Act (LLWPA) in 1980. Each state is responsible for providing for the availability of capacity either within or outside the state for disposal of low-level radioactive waste generated within its borders. States were encouraged to enter into *compacts* with their neighbors to more efficiently manage the waste. The law allowed the compacts to exclude wastes from other regions and allowed existing disposal sites to impose surcharges for disposal of wastes from regions without sites. The surcharge was to be used for site development. Difficulties in negotiating the compacts prompted the enactment of the Low-Level Radioactive Waste Policy Act Amendments of 1985 (LLRWPAA). It stipulated that the three existing commercial sites remain open for use by all states through 1992. Annual and total limits on the volume of waste that can be sent from reactors were established. DOE is responsible for overseeing the compact arrangements with authority to allocate additional emergency capacity to reactors. The NRC can authorize emergency access to existing sites.

The Nuclear Waste Policy Act of 1982 directed DOE to develop a plan for storage of high-level radioactive waste. Following the requirements of the law, DOE began investigation of nine sites in the west and two in the east. Under the act, the EPA established standards that specified release limits for 1,000 and 10,000 years after disposal.

Because of loudly voiced concern over the direction of the DOE's mission plan and the decision to abandon the search for a repository site in the east, Congress passed the Nuclear Waste Policy Act Amendments of 1987. The amendments restructured DOE's high-level waste program. The only site that would be considered would be Yucca Flats, Nevada. Furthermore, spent fuel would be required to be shipped in NRC-approved packages after notification of state and local governments. During the years 2007-2010, DOE is to study the need for a second repository.

For mixed wastes, that is, both hazardous and radioactive, RCRA and HSWA apply to the hazardous characteristic. As of 1987, disposal rules must comply with both NRC rules for radioactivity and EPA rules for hazardous constituents. Before then, only the NRC rules applied. Likewise, for leaking disposal sites, CERCLA and SARA rules apply as well as the NRC rules.

Radiation exposure from x-rays and medical diagnosis and treatment are regulated under the Radiation Control for Health and Safety Act of 1968.