United States General Accounting Office 133549

GAO

Fact Sheet for the Honorable Vic Fazio
House of Representatives

June 1987

WATER QUALITY

Pollution of San Francisco Bay and the Sacramento-San Joaquin Delta

539234

GAO/RCED-87-156FS

GAO

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

San Francisco Regional Office

Suite 900, State Fund Building
1275 Market Street
San Francisco, CA 94103

B-227332

June 18, 1987

The Honorable Vic Fazio
House of Representatives

Dear Mr. Fazio:

In response to your September 12, 1986, letter and later discussions with your office, we addressed your questions on the sources and amounts of pollutants in the San Francisco Bay and Sacramento-San Joaquin Delta and the studies being done to better understand water pollution in this area. You were particularly concerned with federal contributions to overall bay and delta water pollution, especially major direct dischargers and leaking hazardous waste sites. This fact sheet describes the results of our work, discussed during the briefing we gave your office on May 11, 1987.

In summary, federal wastewater dischargers contribute less than 1 percent of the total wastewater directly discharged into the bay and delta. Further, state and federal environmental regulators told us that hazardous waste leaks from federal facilities have significantly less effect on overall water quality compared with other sources of bay and delta pollution. Although there is general agreement that these waters are polluted, there is no clear picture of the full extent of pollution. Federal studies are underway to better identify and quantify bay and delta pollution sources, but these are not intended to distinguish the federal contribution. One of these studies is part of a multiyear Environmental Protection Agency (EPA) project designed to identify and quantify pollution sources, set priorities among pollution problems, and develop a plan to enhance the bay's and delta's environmental health.

Sections 2 through 6 of this fact sheet provide detailed responses to your questions. We collected information to address these questions by interviewing officials at EPA, the National Oceanic and Atmospheric Administration (NOAA), and state regulatory agencies; and by reviewing the permit and self-monitoring files of direct dischargers, facility hazardous waste files, bay and delta pollution study documents, and other pertinent material at these agencies. We also interviewed officials at nine federal installations. We discussed the data presented in this fact sheet with these officials, who agreed that we had accurately presented

their information. Section 1 discusses our scope and methodology in more detail.

As arranged with your office, unless you publicly release its contents earlier, we plan no further distribution of this fact sheet until 30 days from the date of this letter. At that time we will send copies to the Administrator, EPA; the Assistant Secretary for Administration, Department of Commerce; and other interested parties; and, we will make copies available to others upon request. If you or your staff have questions regarding the information, please contact me at (415) 556-6200.

Major contributors to this fact sheet are listed in appendix I.

Sincerely yours,

Thomas P. McCormick

Thomas P. McCormick
Regional Manager

Contents

Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended
DOD	Department of Defense
DHS	Department of Health Services
EPA	Environmental Protection Agency
NOAA	National Oceanic and Atmospheric Administration
PCBs	polychlorinated biphenyls
RCRA	Resource Conservation and Recovery Act of 1976, as amended

Introduction

Water pollution experts and federal and state regulators agree that pollution in the San Francisco Bay and the Sacramento-San Joaquin Delta is a problem, but that the full extent of the problem and its impact on the overall health of the bay is not fully known. According to these experts and regulators, the complex relationships between pollutant discharges, physical factors such as freshwater inflow, and the health of aquatic life must be better understood if further long-term improvements in bay and delta water quality are to be attained. One step in this direction is a study, being conducted by EPA as part of its National Estuary Program, to quantify the types and relative contributions of bay and delta pollution sources.

Bay and delta pollution problems stem from various types and sources of pollutants entering the waterways, and are influenced by physical factors controlling the movement and concentration of these pollutants. (See table 1.1.)

Table 1.1: Factors in Bay and Delta Pollution

I. Types of Pollutants[a]
A. Conventional—naturally occurring biodegradable materials such as biochemical oxygen demand
B. Toxic—126 chemicals specified by EPA, including heavy metals and organic compounds
C. Nonconventional—other substances, such as ammonia and nitrogen, that are not designated as conventional or toxic
II. Sources of Pollutants
A. Point sources—municipal and industrial wastewater treatment plants
B. Nonpoint sources—e.g., urban and nonurban runoff
III. Physical Factors
A. Tidal action
B. Freshwater inflow from rivers feeding into the system
C. Surface winds
D. Other

[a]As defined under the Clean Water Act.

Since the enactment of the Clean Water Act in 1972, regulators agree that municipal and industrial wastewater treatment plants (point sources) have drastically reduced their discharges of conventional pollutants into the bay and delta. Gross bacterial pollution from these point sources, widespread in the 1950s, has all but disappeared. Water quality has improved sufficiently in most areas of the bay and delta to allow safe water-contact recreation and some recreational harvesting of shellfish.

While conventional pollutants have decreased, toxic pollutants discharged from point sources remain a concern to state and federal regulators, partly because of the persistent nature of these pollutants and the

lack of sufficient information to predict their impact on the water quality of the bay and delta. Additionally, both conventional and nonconventional pollutants originating from nonpoint sources still present a problem. By nature, these pollutant sources are more difficult to identify and control than point sources. Currently available information is inadequate for an accurate assessment of the extent, causes, and effects of the nonpoint pollution problem, according to experts and regulators.

Pollution Control Laws, Programs, and Agencies

Three major laws—one governing water quality and two governing hazardous wastes—deal with activities discussed in this fact sheet. Water quality is regulated under the Clean Water Act and hazardous wastes under the Resource Conservation and Recovery Act of 1976, as amended (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA), commonly known as Superfund.

Water Quality

The Clean Water Act established the National Pollutant Discharge Elimination System and required

- EPA to publish water quality criteria for pollutants that reflect the latest scientific knowledge; and
- each state to set water quality standards, using EPA criteria as guidance, for every significant body of surface water within its borders.

State water quality standards establish the goals that pollution controls are meant to achieve. States set these standards by specifying the uses of each body of water and determining maximum pollution levels that can be tolerated without impairing those uses. States also issue permits to dischargers such as municipal sewage systems and industries operating their own wastewater treatment facilities. These permits limit the concentration or quantity of specific pollutants in the wastewater to be discharged.

Permittees are required to submit periodic "self-monitoring" reports showing the actual volume of wastewater discharged and the actual concentration or quantity of each pollutant listed in their permits. Regulators use these reports to determine if a permittee has complied with its permit provisions. State regulators and EPA classify facilities receiving permits as major or minor on the basis of the volume of wastewater and types of pollutants discharged, the population served (for municipal treatment plants), and the regulators' judgment.

Administratively, the State Water Resources Control Board and its nine semi-autonomous regional water quality control boards are responsible for regulating direct dischargers, authority delegated to it by EPA, which has this responsibility nationwide. The regional boards have day-to-day responsibility for issuing, monitoring compliance with, and enforcing permits. The Central Valley regional board has responsibility for almost all the delta, while the San Francisco Bay regional board is responsible for the bay and part of the western delta.

Hazardous Waste

Two laws, RCRA and CERCLA, authorize EPA to regulate the management, disposal, and cleanup of hazardous wastes at both federal and nonfederal facilities. EPA may authorize states to administer their own hazardous waste programs under RCRA, but not CERCLA.

Resource Conservation and Recovery Act

RCRA authorizes EPA to establish controls over the generation, transportation, treatment, storage, and disposal of hazardous waste. EPA has issued regulations and established a permit process for facilities subject to RCRA and is ultimately responsible for monitoring compliance with its regulations and permits. Although California is not currently authorized to have its own RCRA program, EPA relies heavily on the state's Department of Health Services (DHS) to manage the federal program. DHS is the primary California agency for regulating hazardous wastes, but it contracts with the State Water Resources Control Board for technical assistance if the hazardous wastes threaten or reach waters above or below ground.

Comprehensive Environmental Response, Compensation, and Liability Act

While RCRA primarily provides for regulation of ongoing hazardous waste handling activities, CERCLA is primarily concerned with identifying and cleaning up uncontrolled or abandoned hazardous waste disposal sites. EPA is responsible for managing the CERCLA program, including issuing regulations, compiling a list of sites, and responding to emergencies. Under CERCLA, potential hazardous waste sites are reported to EPA; EPA confirms suspected contamination, develops cleanup plans, and identifies the parties responsible for cleanup. CERCLA provides that EPA can bring action to require the responsible party to clean up the site, or EPA may clean up the site and bring an action against the responsible party to recover the costs of cleanup. CERCLA also provides for a fund (Superfund), developed from taxes on petroleum and certain chemicals and from federal appropriations, to pay for cleanup activities if a responsible party cannot be identified or is insolvent. However, if the

waste is on federal property, the agency involved must use its own funds for the cleanup.

Though EPA's management of hazardous waste cleanup under CERCLA cannot be delegated to the states, states can have their own laws. California has such a law, administered by DHS, that authorizes Superfund-type functions. DHS, EPA, and the water boards coordinate their regulatory activities. When the contamination threatens or reaches waters above or below ground, the water boards are more likely to take the lead.

Objective, Scope, and Methodology

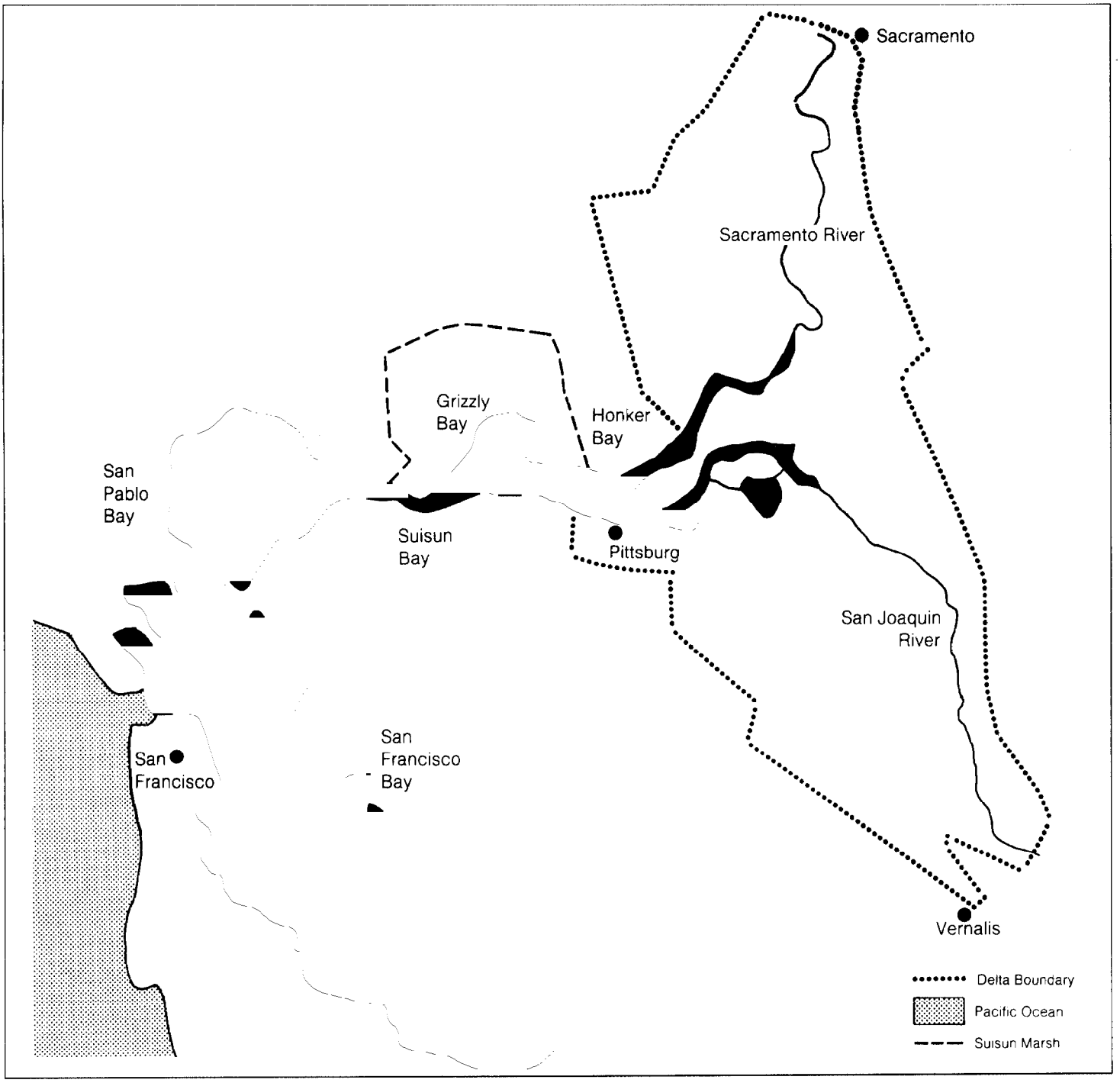
Our objective was to answer your questions on pollution in San Francisco Bay and the Sacramento-San Joaquin Delta, as outlined in your September 12, 1986, letter and later discussions with your office. You were concerned with federal sources of bay and delta water pollution, particularly federal sources of pollution from major direct dischargers and leaking hazardous waste sites. With the agreement of your office, we did not look at some federal sources of pollution, including minor direct dischargers, nonpoint sources, leaking underground storage tanks, and pretreated wastewater discharged into municipal sewage systems. We grouped the questions into five issues:

- the status and results of EPA and NOAA studies on sources and amounts of bay and delta pollution,
- major federal and nonfederal direct dischargers into the bay and delta and the types of pollutants they discharged,
- Treasure Island Naval Station's violations of its major direct discharge permit and enforcement actions taken against the facility,
- the capital improvement expenditures reported by the Department of Defense (DOD) to comply with the Clean Water Act in the bay and delta area, and
- the effect on bay and delta water quality of leaking hazardous waste sites at federal facilities.

The geographic area we covered, shown in figure 1.1, actually includes the waters of five bays—San Francisco Bay, San Pablo Bay, Suisun Bay, Grizzly Bay, and Honker Bay—Suisun Marsh, and the waters inside a triangle formed by Pittsburgh to the west, Sacramento to the north, and Vernalis to the south.

Our work was performed primarily at EPA Region IX (San Francisco), the State Water Resources Control Board in Sacramento, the Central Valley

Figure 1.1: San Francisco Bay and Sacramento-San Joaquin Delta



and San Francisco Bay regional water quality control boards in Sacramento and Oakland, and the DHS headquarters in Sacramento and sectional offices in Emeryville and Sacramento. We also obtained information from EPA headquarters in Washington, D.C., NOAA headquarters in Rockville, Maryland, and the San Francisco Bay-Delta Aquatic Habitat Institute, a nonprofit corporation under contract to both EPA and the state board, in Richmond, California.

To determine the status and results of the EPA contractor's pollution source study, we reviewed program documents and interviewed officials at EPA Region IX and the contractor, the Aquatic Habitat Institute. The preliminary results of the Institute's study were not available in time to be included in our work. As of June 1, 1987, according to an official, the Institute was still gathering and evaluating pollution data. To obtain information on the NOAA study, we interviewed NOAA headquarters officials. Additionally, NOAA provided us preliminary data on its inventory of bay and delta pollution sources, and our summary of these data is included in this fact sheet.

To answer the questions on direct wastewater discharges into the bay and delta, we relied on EPA regional office records and studies by the bay board and NOAA. To estimate the volume and pollutant content of permitted discharges, we obtained a copy of EPA's data base, Permit Compliance System, dated October 20, 1986. We reviewed the data base records for the identified 65 major direct dischargers who had permits for the year ending July 31, 1986. We verified that these dischargers' pollutant limits were included in the system by comparing them to the permit documents in EPA's files, when these documents were available, and made corrections to the data base where appropriate. In the 2 cases (out of 1,321 records) where there were discrepancies, we relied on the permits. To estimate the average wastewater flow of these dischargers, we averaged the actual 30-day average wastewater flows reported in the EPA data base for the year ending July 31, 1986, but substituted data obtained from the dischargers' self-monitoring reports when (1) no data for a facility were in the data base or (2) the data base record appeared to be inaccurate. To identify and quantify types of pollutants discharged, we estimated maximum pollutants discharged by multiplying permitted concentrations by the average estimated flow of wastewater. To gauge the significance of toxic discharges, we reviewed a 1986 bay board study on toxic chemicals discharged by municipal treatment plants, as well as the NOAA data.

As noted above, the Permit Compliance System data base contained some errors and inconsistencies. However, on the basis of the adjustments we made to the data base, we believe the information provided in this fact sheet is reasonably accurate for the purposes intended.

To answer the questions on Treasure Island, we (1) reviewed its self-monitoring discharge reports for October 1983 through December 1986, and the bay board's permit and enforcement files; (2) interviewed bay board officials on actions taken against the naval facility; and (3) reviewed EPA permit and enforcement files.

To answer the question on DOD's capital improvement expenditures under the Clean Water Act, we asked DOD to provide a list of annual capital improvement expenditures for fiscal years 1972 through 1986 for each facility in the bay and delta area. As agreed with your office, we did not independently verify the data DOD provided.

To identify hazardous waste sites at federal facilities in the bay and delta area that had leaked during 1984, 1985, or 1986, we interviewed officials and reviewed documents at regulatory agencies. Finally, to determine the effect of these leaks on the bay and delta, we (1) interviewed officials and reviewed facility files at the EPA regional office, the two regional water boards, and the two DHS sectional offices; (2) interviewed officials at the three facilities identified by the regulatory agencies as having one or more sites that had leaked into the bay; and (3) obtained written comments from officials at the five facilities identified as having sites that might leak into the bay or delta.

We obtained comments on the accuracy of the material presented in this fact sheet from program officials at DOD headquarters and nine Defense facilities in the bay and delta area, EPA headquarters and regional officials, DHS, and the regional water boards and incorporated their comments where appropriate. We conducted our review between September 1986 and June 1987.

EPA and NOAA Studies on Bay and Delta Pollution Sources

Question

What are the results and status of studies being conducted by EPA and NOAA on sources of bay and delta pollution?

Response

Studies being conducted or sponsored by EPA and NOAA are designed to provide a comprehensive overview of the sources and extent of bay and delta pollution. The EPA contractor is scheduled to complete its study in August 1987 as part of a larger EPA project to improve the bay's and delta's environmental health. Preliminary data from this study were not available as of June 1, 1987. However, preliminary data NOAA provided to us on their study show the relative contributions of various pollution sources to the bay and delta.[1] The data indicate that most of the pollutant loads included in NOAA's study originate within the boundaries of the bay and delta. As a result, bay and delta regulators have greater potential to correct pollution problems—according to NOAA estimates—than do regulators in those areas where the pollution source is largely outside the boundaries of their jurisdiction. NOAA is scheduled to complete the data base in June 1987 and to report on its results in September 1987.

EPA-Sponsored Study

EPA added the San Francisco Bay/Delta Estuary Management Project to its National Estuary Program in April 1986. Based on EPA's experience in cleaning up Chesapeake Bay, the Estuary Program employs a basinwide approach toward quantifying and controlling pollutant sources and recommending actions to maintain, restore, or enhance the estuary's environmental health. The project's goals are to (1) develop an understanding of the environmental, social, economic, and public health values attributable to the bay and delta; (2) achieve united management of the bay and delta; (3) develop a plan to restore and maintain the chemical, physical, and biological integrity of the bay and delta; and (4) recommend corrective actions and compliance schedules addressing point and nonpoint sources of pollution.

To develop an understanding of bay and delta water pollution problems, EPA signed an agreement with the nonprofit San Francisco Bay-Delta Aquatic Habitat Institute in September 1986. The Institute was already undertaking a study for the State Water Board to identify and quantify bay and delta pollution sources and to evaluate all existing scientific studies concerning those sources. EPA provided additional funding to the Institute to (1) include more detailed data, especially on toxic pollutant

[1]The geographic coverage of NOAA's data for the bay and delta is slightly larger than that used in this fact sheet.

concentrations from nonpoint sources, and (2) broaden the geographic area covered. The Institute's study report is due to EPA and the state board in August 1987.

NOAA's National Coastal Pollution Discharge Inventory

As part of its National Coastal Pollution Discharge Inventory, NOAA began in 1981 to compile a data base of all point and nonpoint pollution sources on the West Coast, the East Coast, and the Gulf of Mexico. The inventory is designed to be used as a screening mechanism for assessing the relative contributions of various sources to pollutant discharges throughout the nation's coastal zone, and is part of NOAA's effort to identify and evaluate conflicts over the use of coastal and oceanic resources so that the resources can be developed or conserved in an efficient manner while minimizing environmental damages.

According to NOAA officials, the data base for the West Coast, including information on the bay and delta, will be completed in June 1987, and information on the bay and delta published in September 1987. NOAA, however, made preliminary data available to us, which we aggregated to show the relative contribution of bay and delta pollution sources as shown in table 2.1. The preliminary data for biochemical oxygen demand and total suspended solids from point sources were based on routine self-monitoring data provided to the regional water boards. For the remaining point source pollutants included in the inventory, NOAA's figures were based on engineering estimates of the typical pollutant concentrations found in the discharges of municipal and industrial treatment plants and the characteristics of the source.

Data for nonurban, nonpoint pollution sources were estimated using a simulation model, which specifies amounts and types of pollutants likely to enter a waterway, given the relative proportions of land use around it. This model was applied to each small drainage basin[2] within the bay and delta area using local precipitation records and site characteristics. NOAA estimated urban runoff using local precipitation patterns and five types of urban land use (residential, commercial, industrial, open land, and mixed). The amount of pollutants contained in the urban runoff was estimated using data from EPA's National Urban Runoff Program.

[2]This results in a more precise estimate than applying the model to the entire San Francisco Bay drainage basin.

Table 2.1: Sources of Bay and Delta Pollution by Pollutant Type, Preliminary Data

Pollutant category	Point sources[a]		Nonpoint Sources[b]			Estimated annual pollution (in short tons)
	Municipal treatment plants %	Industrial treatment plants %	Urban runoff %	Nonurban runoff %	River-borne	
Conventional						
Biochemical oxygen demand	9	1	9	47	33	197,000
Total suspended solids	0	0	1	79	20	26,830,000
Petroleum hydrocarbons	53	2	44	0	0	26,000
Nonconventional						
Nitrogen	11	0	4	54	31	105,000
Phosphorus	56	0	4	6	34	14,000
Toxic						
Arsenic	11	0	3	60	25	c
Cadmium	15	0	0	7	78	d
Chromium	2	0	1	76	21	3,000
Copper	3	0	4	48	45	2,000
Iron	0	0	1	86	13	840,000
Lead	5	1	26	50	18	1,000
Zinc	5	0	6	41	48	5,000
Mercury	3	1	1	15	80	e
Chlorinated hydrocarbon pesticides	44	0	5	51	0	f
PCBs	0	0	100	0	0	f

[a]Point sources include both major and minor treatment plants.

[b]The base year for the nonpoint sources, 1982, was wetter than normal. Precipitation was 30 to 50 percent greater than the long-term average. The data for nonpoint sources therefore, according to NOAA officials, represents a "worse case scenario" for nonpoint sources; that is, the percentages for pollutants are higher than usual.

[c]Approximately 300 tons.

[d]Approximately 100 tons.

[e]Less than 20 tons.

[f]Less than 1 ton.

Source: NOAA data aggregated by GAO.

NOAA officials told us that the preliminary data show that the pollution of the bay and delta is largely caused by events and activities within the area, more so than for other systems, such as Long Island Sound or the Chesapeake Bay. According to these officials, this high degree of self-containment increases bay and delta regulators' opportunities for improving the quality of waters within their jurisdiction.

Another factor to consider in interpreting the data is the pollutant's chemical form. NOAA officials said that a chemical discharged by a municipal or industrial plant is in a form that may be more harmful to aquatic life than the same chemical bound up in eroded sediment from runoff.

NOAA officials said the preliminary data for point sources will be updated in its report to show actual data based on the dischargers routine self-monitoring reports. They added, however, that they have confidence in these estimates and do not expect the relationship between point and nonpoint sources to change because these reports include very little data on many heavy metals, chlorinated hydrocarbons, or even nonconventional pollutants.

Major Direct Dischargers Into the Bay and Delta

Questions

How many major federal and nonfederal facilities are permitted to discharge wastewater into the bay and delta?

What percent of the total wastewater discharged into the bay and delta by major dischargers is attributable to federal facilities?

What are the most common pollutants and amounts (tons, etc.) that major federal and nonfederal facilities are permitted to discharge into the bay and delta?

To what extent is there evidence of significant levels of toxic chemicals and heavy metals being detected in wastewater discharged by major sewage treatment plants?[3]

Response

As of July 31, 1986, 65 major facilities were permitted to discharge directly into the bay or delta. Only one of these was a federal facility. Other federal facilities in the bay and delta area were either considered minor direct dischargers or discharged to a municipal treatment plant that treated the wastewater.

We estimated these 65 facilities discharged an average of 2.6 billion gallons of wastewater per day into the bay and delta, 1.5 billion of which was cooling water discharged by power plants.[4] Treasure Island Naval Station, the only major federal permittee, accounted for 700,000 of the remaining 1.1 billion daily gallons, or less than 1 percent of the total discharge.

The most commonly permitted pollutants included conventional and nonconventional pollutants and, less frequently, toxics. The overall effect on the bay and delta of toxic pollutants has not been assessed, and we were not able to address the significance of these pollutants being discharged by municipal treatment plants.

[3]We refer to sewage treatment plants as municipal treatment plants throughout this fact sheet.

[4]Cooling water is used to cool down the electric power generating process, but does not normally pick up contaminants from the process because it does not come into contact with the process. Cooling water, as used in this fact sheet, was regulated only for acidity, temperature, and chlorine residual.

Direct Discharges to the Bay and Delta

Table 3.1 shows the major facilities' estimated average daily discharges to the bay and delta between August 1, 1985, and July 31, 1986. We calculated this estimate by averaging the 30-day average flows included in the EPA data base for the year ending July 31, 1986.

Table 3.1: Major Facilities' Estimated Average Daily Discharges

Type of facility (number of facilities)	Estimated average daily discharge (gallons in millions)	Estimated average daily discharge (percent)
Municipal wastewater treatment plants (41)	844.8	33
Industrial wastewater treatment plants (23)		
Cooling water	1,533.3	59
Other wastewater	199.9	8
Federal wastewater treatment plant (1) (Treasure Island Naval Station)	.7	-
Total	**2,578.7**	**100**

Source: GAO analysis based on EPA Permit Compliance System data base.

Most Common Permitted Pollutants and the Significance of Toxic Chemicals Discharged

The two regional boards commonly require facilities to monitor and limit their discharges of conventional pollutants. They also require about half the facilities to monitor and limit their discharges of some toxic chemicals, including 10 heavy metals. There is little evidence on the significance of the effects of either the routinely monitored toxic chemicals or those that are not monitored.

The 19 Most Commonly Permitted Pollutants

Permits for the 65 major facilities limited the discharge to 30 different pollutants.[5] The 19 pollutants most frequently regulated appeared in at least 29 of the 65 permits. The remaining 11 pollutants were limited in 10 or fewer permits. Table 3.2 shows the estimated average daily permitted amount for the 19 most frequently regulated pollutants for all major facilities and for Treasure Island. This estimate was calculated by multiplying the maximum amount of each pollutant that could legally be discharged by the estimated wastewater flow of each facility. Our estimates do not represent the actual pollutant amounts discharged. According to the bay board's executive officer, the actual pollutant discharge by treatment plants is typically less than permitted amounts.

[5]In addition, 8 of the 65 permits limited the temperature of wastewater.

Table 3.2: The Most Common Pollutants Permitted for Discharge Into the Bay and Delta, August 1, 1985, Through July 31, 1986

Pollutant	Number of permits limiting the pollutant	Estimated total daily permitted discharge (in pounds)	Estimated Treasure Island daily permitted discharge (in pounds)[a]
Conventional			
Acidity	63	[b]	[b]
Total suspended solids	57	224,214	165.00
Oil and grease	52	79,058	55.00
Biochemical oxygen demand	49	200,095	165.00
Coliform	45	[c]	[c]
Nonconventional			
Settleable solids	52	98,841[d]	66.00[d]
Chlorine residual	47	31	0
Toxic			
Chromium	43	152	.03
Zinc	40	1,743	1.65
Phenolics	39	2,584	2.75
Lead	37	519	.55
Copper	35	1,024	1.10
Nickel	34	516	.55
Arsenic	33	52	.05
Cadmium	33	102	.11
Cyanide	32	511	.55
Mercury	32	5	.01
Silver	32	102	.11
Chlorinated hydrocarbons	29	10	.10

[a]This discharge is included in the total estimated daily permitted discharge amounts.

[b]Acidity pertains to the total wastewater discharged. It cannot be measured in gallons or pounds per day, but is measured in pH. Many of these permits limit the acidity range to between 6.0 and 8.5 pH. Pure water has a pH of 7, and lower numbers indicate acidity, while higher numbers indicate increasing alkalinity.

[c]Coliform cannot be measured in pounds or gallons. It is measured by a statistical test that estimates the number of organisms. We did not include daily permitted amounts for coliform because state and federal regulators said that coliform, while classified as a pollutant, is an imprecise indicator of harmful bacteria present in wastewater. Thus, the total coliform figure would have been misleading.

[d]Gallons per day.

Source: GAO analysis of EPA data.

Toxics Discharged by Municipal Treatment Plants

Our literature review and discussions with state and federal water regulators indicate that there is no complete or conclusive evidence on the impact of toxic chemicals discharged by major bay and delta municipal

treatment plants on human health or the environment. Plants are not required to routinely monitor and report on many toxic pollutants; and for those pollutants that are monitored, there is no consensus among the regulators and water experts on how to assess their impact. Two studies, one from NOAA and one from the bay board, have shed some light on toxic discharges from bay and delta municipal treatment plants, but neither provide a comprehensive picture of the effect of toxic chemicals on the bay and delta.

NOAA data provide some perspective on the relative significance of municipal treatment plant discharges of toxic pollutants into the bay and delta compared to industrial treatment plants and nonpoint sources. The data show, for example, that municipal treatment plants contributed 15 percent or less of the estimated total annual pollution to the bay and delta for 9 of the 10 toxic pollutants included in NOAA's inventory. (See section 2 for a more detailed discussion of NOAA's data.)

A 1986 bay board study of 126 toxic pollutants discharged by 32 municipal treatment plants provides additional perspective on the relative significance of these discharges. The board found that municipal plants' wastewater discharges were not immediately toxic to fish, and that concentrations of toxic pollutants in the effluent were well below federal water quality criteria (where criteria existed) for saltwater and freshwater aquatic life.

The bay board compared its findings with a similar 1982 EPA study of 40 municipal treatment plants located throughout the nation. The board concluded that concentrations of toxic pollutants discharged by bay municipal treatment plants were on the lower end of the EPA study range. The board's data showed that, in general, local plants discharged fewer organic toxic pollutants, and discharged them less frequently, than the plants included in the EPA study. The board did not reach a general conclusion about the discharge of inorganic toxic pollutants by local plants compared to the plants included in the EPA study.

Treasure Island's Compliance With Its Discharge Permit

Questions

Are the major federal facilities in compliance with their discharge permits?

What enforcement actions were taken against major federal facilities that violated their discharge permits?

Response

Treasure Island Naval Station is the only federal facility that is a major direct discharger into the bay or delta. Although Treasure Island has been cited for violating its discharge permit in the past, the facility generally was in compliance with its permit as of mid-April 1987, according to bay board officials. The one exception was an overdue plan, which board officials judged a minor infraction because other documents submitted to the board included the information required in the plan.

Between October 1983 and December 1986, Treasure Island committed various violations of its discharge permit, including

- four instances during 1984-86 in which the permitted 30-day average for a pollutant was exceeded;
- three incidents in 1983-84 in which partially treated wastewater was discharged into the bay because of a mechanical failure to the filtering system; and
- three types of "noneffluent" violations, cited in a 1984 bay board report.

The 30-day average violations did not meet EPA's significant noncompliance criteria; and, therefore, no formal enforcement action was taken. EPA defines significant noncompliance as a violation of two or more 30-day average pollutant limits within a 6-month period.[6]

The partially treated wastewater and noneffluent violations were considered to be significant and were addressed by formal bay board enforcement actions. The board obtained Treasure Island's compliance through a cease and desist order issued in 1984. Further, the bay board referred the case to the state attorney general to collect monetary penalties against the Navy for permit violations.

[6]Three exceptions to the 30-day average test are coliform, color, and temperature. To be classified as significant, the effluent limits must be exceeded by 40 percent for conventional pollutants and 20 percent for toxic pollutants.

Effluent Limit Violations

Treasure Island's plant discharged partially treated wastewater from October to November 1983, May 7 to 11, 1984, and May 17 to July 11, 1984, according to EPA and bay board records. The bay board's review of Treasure Island's self-monitoring discharge reports showed 124 effluent violations on 122 days between October 1983 and July 1984.[7]

The violations resulted from three breakdowns of the plant's trickling filter, which is designed to remove organic wastes. During these breakdowns, wastewater was diverted around the trickling filter at an estimated rate of 700,000 gallons per day. As a result of the breakdowns and subsequent diversion, Treasure Island violated pollutant permit limits.

According to an October 1984 bay board report, no direct damage to the bay and its aquatic life was observed during Treasure Island's bypass incidents. Further, potential acute or severe water quality degradation resulting from Treasure Island's bypass incidents should have been reduced by the high dilution and rapid dispersion characteristics of the treatment plant's discharge pipe.

Between July 1984—when Treasure Island corrected the mechanical problem that resulted in the bypasses—and December 1986, the plant violated its 30-day average effluent permit limits for two conventional pollutants (oil and grease, and coliform) on two occasions. We analyzed Treasure Island's self-monitoring discharge reports from October 1983 to December 1986 to determine the amount of pollutants discharged in excess of effluent limits.[8] Table 4.1 shows the amount of each pollutant discharged in those months in which Treasure Island exceeded the permit's maximum 30-day average for that pollutant, except for coliform. The two 1984-86 30-day average coliform violations are not included in the table. Both federal and state regulators said that, while coliform is classified as a pollutant, it is an imprecise indicator of harmful bacteria.

[7]Coliform violations comprised 70 of the 124 effluent limit violations.

[8]We analyzed 30-day average effluent limits only. We did not analyze other effluent limit violations, such as the 7-day average, daily maximum, or instantaneous maximum effluent limit violations. EPA and bay board officials stated that the calculation of the amounts of pollutants discharged to the bay over and above the 30-day average limit is the best measure of the pollutant quantity.

Table 4.1: Amount and Percent Discharged in Excess of Treasure Island's 30-Day Average Effluent Limits, October 1983 to December 1986

	Biochemical oxygen demand		Suspended solids		Oil and grease	
Violation	Pounds	%	Pounds	%	Pounds	%
Oct. 1983	3,296	61	–	–	–	–
Nov. 1983	4,056	75	214	4[a]	–	–
Dec. 1983	498	9[a]	–	–	–	–
May 1984	–	–	–	–	3,120	183
June 1984	12,848	280	3,671	80	352	23[a]
July 1984	10,169	173	2,542	43	–	–
May 1985	–	–	–	–	162	10[a]
Dec. 1986	–	–	–	–	1,601	100[a]

[a]These violations do not meet EPA's criteria for significant noncompliance because less than two 30-day averages had been violated within a 6-month period.

Other Permit Violations

Treasure Island violated three permit provisions other than effluent limits, according to a July 1984 bay board report. These provisions required (1) maintaining the treatment facility in efficient working order, (2) prohibiting plant bypasses, and (3) submitting various reports.

The bay board noted that the three bypass incidents in 1983 and 1984, as well as inspection observations, demonstrated that the facility had not met the first requirement of maintaining the facility in efficient working order. The second requirement was also violated by these bypass incidents, as well as a separate mechanical failure—a lift station failure—in April 1984 that resulted in an overflow in the wastewater collection system. The overflow probably went into the storm drains bypassing the treatment plant on its way to the bay.

Treasure Island's violations of its reporting requirements, as cited in bay board documents, are listed in table 4.2.

Table 4.2: Treasure Island's Reporting Violations

Document due	Date due[a]	Date submitted
Plant bypass report for Oct. through Nov. 1983	10/17/83	7/13/84
Self-monitoring discharge report for Oct. through Dec. 1983	1/15/84	5/24/84
Annual self-monitoring discharge report for 1983	1/30/84	No record
Self-monitoring discharge report for Jan. through Mar. 1984	4/15/84	6/1/84
Plant bypass report for May 7 through May 11, 1984	5/21/84	5/31/84
Plant bypass report for May 17 through July 11, 1984	5/31/84	7/13/84
Initial contingency plan[b]	10/30/80	12/13/84

[a]Plant bypass reports are due 14 days after the bypass begins.

[b]This plan, which must be updated annually, addresses backup actions to take when a problem occurs.

Treasure Island has remained in compliance with its noneffluent permit provisions since May 1985, according to bay board records and officials. The only exception is an overdue long-term treatment plant reliability plan, which the board officials judged a minor infraction because other documents submitted to the board included the information required in the long-term plan.[9]

Enforcement Action

The bay board took several informal enforcement actions as a result of Treasure Island's violations of its effluent and noneffluent permit provisions, including telephone calls and letters to Navy officials directing them to come back into compliance. These actions did not result in compliance, and the bay board took two formal enforcement actions—a cease and desist order and a lawsuit to assess penalties.

Cease and Desist Order

The first formal action occurred when the bay board adopted a cease and desist order on July 18, 1984, to require Treasure Island to comply with its discharge permit. This order did not require the plant to stop operations, but rather it included requirements for the facility to (1) submit all self-monitoring discharge reports, (2) cease bypassing treatment units, and (3) submit a technical report by December 18, 1985, evaluating the plant's ability to comply with all requirements. On May 15, 1985, the bay board, finding that Treasure Island had complied with these requirements, rescinded the order.

[9]This plan is supposed to address the long-term mechanical reliability of the plant, according to bay board officials.

Treasure Island Lawsuit

The second formal action was to seek monetary penalties for Treasure Island's violations. California law gives the state and regional boards the authority to levy civil penalties against nonfederal facilities, but not against federal facilities. Therefore, the state decided to use a provision of the Clean Water Act that allows "citizens" to sue for monetary penalties. According to the bay board's executive officer, the plant bypasses had been repetitive and significant, and the board resolved to treat all permittees—federal or nonfederal—the same.

Following its October 17, 1984, meeting, the board asked the state attorney general to sue the Navy for civil monetary penalties. On June 13, 1985, the state attorney general filed a complaint against the Navy in the U.S. District Court for Northern California, seeking civil penalties of up to $10,000 per day for each day that Treasure Island violated its discharge permit provisions.

The District Court dismissed the state's suit against the Navy on April 2, 1986. The court reasoned that the Clean Water Act does not authorize states to bring a citizens suit to seek civil penalties against federal dischargers for violations of state permits and that the District Court lacked jurisdiction in the matter.

The state filed an appeal on April 23, 1986, with the U.S. Court of Appeals for the Ninth Circuit. Oral arguments were heard on April 14, 1987. The Navy's attorney told us a decision was likely within 3 to 9 months after the oral arguments.

DOD Capital Improvement Expenditures Under the Clean Water Act

Question

What are the reported capital improvement expenditures made by the Department of Defense in the bay and delta area in order to achieve greater compliance with the Clean Water Act since its inception in 1972?

Response

For fiscal years 1972 through 1986, DOD units—the Air Force, Army, Navy, and the Defense Logistics Agency—reported spending about $65 million for capital improvements in the bay and delta area under the Clean Water Act. According to DOD, these costs were for improvements made at 21 of 31 DOD installations in the bay and delta area. DOD reported spending no funds at 10 installations. We did not verify DOD's figures.

Table 5.1 shows the costs of capital improvements for the 21 installations. According to DOD, these costs include funds spent to connect installations' wastes to the sanitary sewer, storm drain systems, or municipal treatment plants; improve municipal treatment plants to which installations were connected; prevent oil and hazardous waste spills; or make other improvements to their facilities.

Table 5.1: DOD-Reported Capital Improvement Costs Under the Clean Water Act—Fiscal Years 1972-86

Dollars in thousands

Installation	Costs
Air Force	
Mill Valley Air Force Station	$40
Travis Air Force Base	10,658
Total	**10,698**
Army	
Oakland Army Base	951
Presidio of San Francisco	81[a]
Sharpe Army Depot	85
Total	**1,117**
Navy	
Naval Air Station Alameda	3,816
Naval Weapons Station Concord	861
Hunters Point Naval Shipyard	9,132
Mare Island Naval Shipyard	8,672
Naval Air Station Moffett Field	200
Oakland Naval Supply Center	4,050[b]
Oakland Naval Regional Medical Center	62
Naval Security Group Activity, Skaggs Island	1,046
Navy Communication Center Stockton	721
Oakland Naval Supply Center, Point Molate Site	7,638
Treasure Island Naval Station	583
Western Division, Naval Facilities Engineering Command	3
Sunnyvale Naval Industrial Reserve Ordnance Plant	750
Hamilton Field, Novato	13,295
Total	**50,829**
Defense Logistics Agency	
Tracy Defense Depot	507
Defense Fuel Support Point Ozol	2,227
Total	**2,734**
Total	**$65,378**

[a]Expenditures for Rio Vista Defense Facility and Parks Reserve Forces Training Center are included under the Presidio.

[b]Expenditures for Naval Supply Center, Alameda, are listed under the Oakland Naval Supply Center.

Bay and Delta Pollution From Leaking Hazardous Waste Sites at Federal Facilities

Question

What evidence exists that federal facilities with leaking hazardous waste sites contribute significant levels of toxic chemicals and heavy metals to the bay and delta or have the potential to do so?

Response

As of December 31, 1986, 8 federal facilities had at least 1 leaking hazardous waste site—a total of 53 contaminated sites—with the potential to pollute the bay or delta, according to files and interviews at state and federal regulatory agencies. (See fig. 6.1.) Further, these records and interviews indicate that toxic chemicals—including heavy metals—from nine waste sites at three of the eight facilities reached surface waters leading to the bay and delta between January 1, 1984, and December 31, 1986. However, officials at these agencies told us that bay and delta pollution from hazardous waste at the eight federal facilities is not as significant as other pollution sources, such as direct dischargers or the more numerous commercial hazardous waste sites. Bay board officials believe, however, that "in very localized areas" the effects on water quality could be significant.

Table 6.1 shows which contaminants leaked or could leak into the bay or delta from the 53 contaminated waste sites at the 8 federal facilities. Not shown are an additional 69 sites for which documentation did not indicate a potential or actual leakage into the bay or delta. However, because all 122 sites are still under investigation, the actual number of sites that have either polluted or have the potential to pollute the bay is not known. EPA regional officials, for example, told us that all of the suspected hazardous sites had the potential to pollute the bay or delta.

Figure 6.1: Federal Facilities With Leaking Hazardous Waste Sites That Polluted or Could Pollute the Bay and Delta

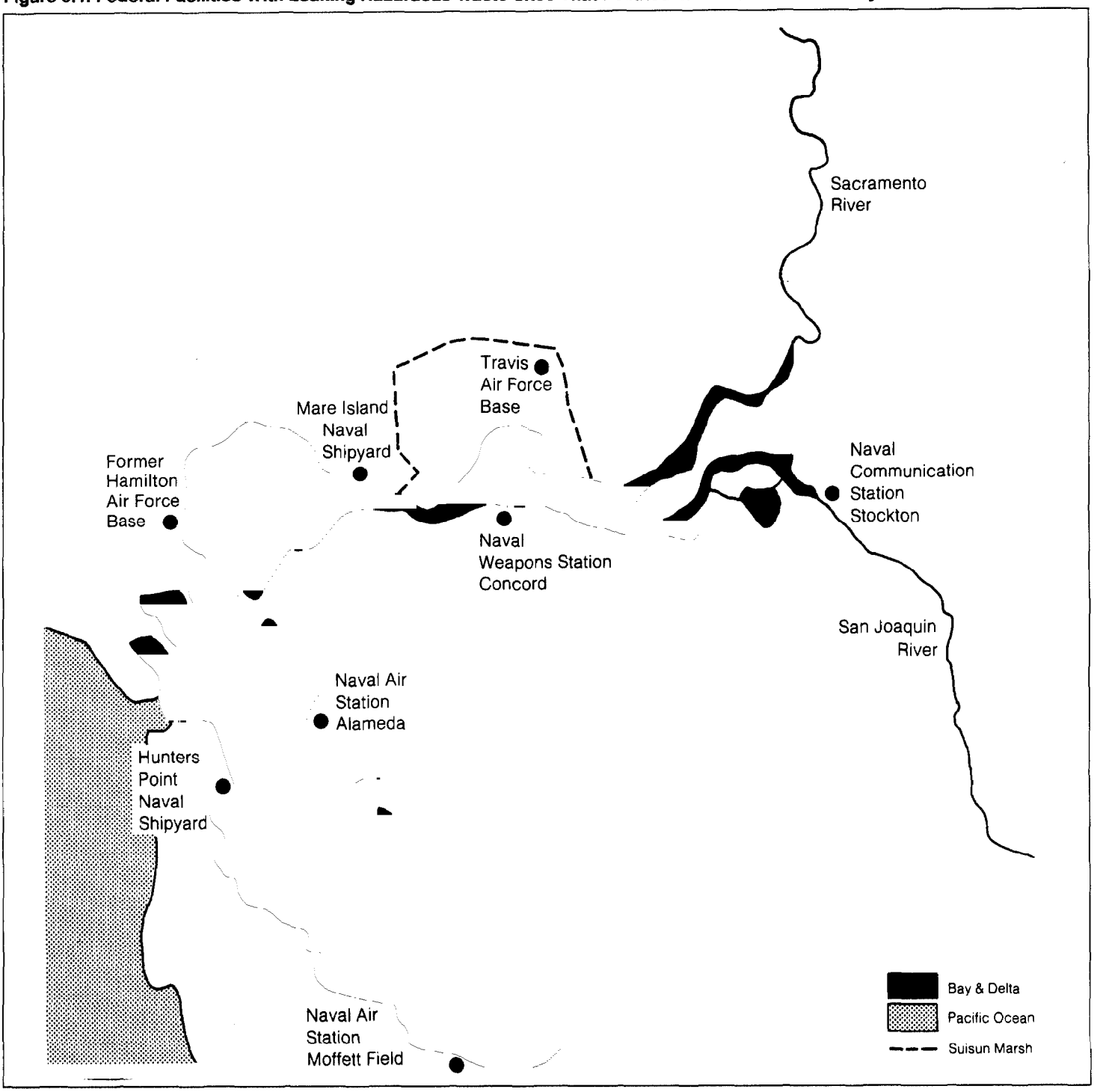


Table 6.1: Leaking Hazardous Waste Sites at Federal Facilities That Polluted or Could Pollute The Bay or Delta

Facility	Site types (number of sites)	Type of contamination
Former Hamilton Air Force Base	Landfill and storage tank area (2)	Heavy metals, petroleum hydrocarbons, and other organic and inorganic compounds
Mare Island Naval Shipyard	Landfill, oil sumps, berth area, sandblasting area, and land disposal area (5)	Heavy metals, explosive compounds, and volatile and other organic compounds
Travis Air Force Base	**Storm sewer system (1)** Oil and solvent spill areas, sewage treatment plant area, landfills, and fire training areas (10)	**Volatile organic compounds, oil, and grease** Heavy metals, petroleum hydrocarbons, pesticides, herbicides, and volatile organic compounds
Naval Communication Station Stockton	Landfill and burning area (1)	Heavy metals, solvents, paint, PCBs, petroleum, pesticides, and herbicides
Naval Weapons Station Concord	**Soil contamination areas (6)** Landfill, land disposal area, and soil contamination areas (4)	**Heavy metals** Heavy metals, solvents, acid, paint, creosote, asbestos, and ordnance
Naval Air Station Alameda	Landfill, land disposal area, and soil contamination areas (8)	Heavy metals, volatile and other organic compounds, PCBs, cyanide, acids, oil, and grease
Naval Air Station Moffett Field	**Soil contamination area and waste sump (2)** Landfills, drainage ditch, wastewater ponds, fuel drainage area, soil contamination area, and land disposal areas (9)	**Heavy metals** Volatile organic compounds and other priority pollutants
Hunters Point Naval Shipyard	Landfill, waste oil ponds, scrap yard, land disposal area, and bay sediment (5)	Volatile, semivolatile, and other organic compounds; heavy metals; PCBs; oil; and grease

Note: Bold words indicate known pollution of the surface waters leading to the bay or delta. The remaining sites and pollutants could leak into the bay or delta.

Source: EPA, DHS, and bay and Central Valley regional boards file information and interviews with officials at these agencies.

Typically, hazardous waste sites at these facilities were contaminated with organic chemical compounds and heavy metals, generated through maintenance activities such as paint stripping or sandblasting. Contamination can reach the bay or delta through several migration pathways. For example, contaminated groundwater underneath the site may flow toward the bay, storm water runoff from a site with soil contamination could reach surface waters leading to the bay, or hazardous waste may be discharged directly to storm sewers or bay tributaries. Additionally, sites situated directly adjacent to the bay could be inundated by severe storms or other types of flooding, which could transport contaminants into the bay.

None of the 53 contaminated sites have been completely cleaned up, although the activities or circumstances causing the contamination have been corrected at all but 3 sites. Bay board officials were not satisfied with the progress of cleanup studies at five of the facilities. They said that commercial facilities are generally more responsive than the federal facilities to regulatory guidance and directives. Base and command level

DOD officials told us that responding in a timely manner is a problem because of funding constraints.

DHS has taken enforcement action and also filed suit against Mare Island Naval Shipyard, asserting that the Navy inadequately monitored the contaminated sites. Bay board officials said they are considering enforcement action against the four other federal facilities.

Facilities With Sites That Have Polluted the Bay or Delta

Three facilities—Naval Weapons Station Concord, Naval Air Station Moffett Field, and Travis Air Force Base—are recognized by regulatory officials and records as having polluted the bay or delta with toxic chemicals, including heavy metals, from leaking hazardous waste sites. Problems at each of these facilities are described below.

Naval Weapons Station Concord

Naval Weapons Station Concord, adjacent to Suisun Bay, is the Navy's major ammunition shipping port on the West Coast. In 1982 the Navy's consultants identified 26 potential hazardous waste sites at Concord through a records search, site inspections, and limited soil sampling. Their report indicated that contaminants at every site could eventually reach Suisun Bay through the groundwater or surface water runoff and recommended that 13 of the 26 sites be investigated further. In addition, the Navy plans to investigate an additional 7 of the 26 sites. In May 1987, the bay board asked the Navy for additional information on all identified sites in order to determine if these sites warrant further investigation.

Six of the sites recommended for followup are located on land purchased between 1968 and 1971 to create a buffer zone around Concord. Since the 1982 investigation, an additional three sites in the buffer zone were investigated, bringing the total to nine. Consultants working for the Navy have determined, on the basis of clam bioassay tests, that of the nine identified sites, six have the potential to pollute surface waters leading directly into the bay. Bay board officials told us, however, that the consultants' data indicate actual pollution of the bay. According to the Navy, the Justice Department has sued the former landowners to recover $30 million in economic damages.

A 1986 hydrological evaluation for the entire base showed that other hazardous waste sites at Concord have the potential to pollute the bay, and storms and high tides allow substantial movement of hazardous substances into surface waters. Further, contaminated soil is suspended

in storm water runoff and carried into streams and drainage ditches. Finally, extreme high tides that occur, on average, once in 10 years, could flood the marsh plain, erode contaminated surface sediments, and redistribute them throughout the marsh and bay.

Naval Air Station Moffett Field

Moffett Field, adjacent to south San Francisco Bay, is the largest U.S. antisubmarine aircraft base in the world. A 1986 Navy consultant's report on Moffett Field's industrial waste engineering practices said that most of the industrial wastewater treatment system could be classified as a RCRA hazardous waste treatment facility. The consultant's report identified two sites—one at the vehicle steam-cleaning area and the other at a paint shop—that discharged polluted wastewater into the storm drainage system that leads to the bay. According to the Navy, the discharge of hazardous wastes to the bay at both sites has been stopped, but contamination at the sites has not yet been cleaned up.

An earlier Navy study of past hazardous waste handling activities at Moffett Field indicated that nine sites have contaminated groundwater in the shallow aquifers that flow to the bay. In addition, contamination from a drainage ditch could reach the bay. According to the Navy, its consultants are drilling underground wells to further determine the type and concentration of the contamination from these sites.

Travis Air Force Base

In April 1986, Air Force consultants reported that 10 hazardous waste sites at Travis had contaminated groundwater. Because groundwater in the shallow aquifer beneath Travis flows towards Suisun Marsh and the bay, all of these sites could pollute the bay. According to bay board and DHS officials, one site, the storm sewer system, has carried storm water into Union Creek, which flows into the bay.

Travis officials noted several problems with their consultants' study. In some cases, the study's conclusions were based on results from a single sample. Further, the naturally occurring amounts of various chemicals in the soil and groundwater were not conclusively established for comparison with the samples. Finally, the sampling equipment may not have been decontaminated prior to use at Travis.

The Air Force is planning to contract for another study to conduct sampling at the 10 sites whose contaminated groundwater could reach the bay, according to Travis officials.

Major Contributors to This Report

San Francisco Regional Office	Linda G. Darby, Evaluator-in-Charge Elise F. Plate, Evaluator Julie M. Devault, Evaluator Donald J. Porteous, Evaluator Jonathan M. Silverman, Reports Analyst
Resources, Community, and Economic Development Division, Washington, D.C.	Hugh J. Wessinger, Senior Associate Director Robert S. Procaccini, Advisor Robert P. Cavanaugh, Advisor Carol Herrnstadt Shulman, Writer-Editor

Glossary

Acidity	The acidity, or pH, of a solution is a condition measured by a scale from 0 to 14. Numbers less than 7 indicate increasing acidity.
Bioassay	A test to determine the toxicity of water by observing its effect on a test organism such as a fish.
Biochemical Oxygen Demand	A measure of oxygen consumed in the biological processes that break down organic matter.
Chlorinated Hydrocarbon	An organic compound containing only carbon, hydrogen, and chlorine.
Coliform	Bacteria that indicate pollution and resemble or are related to colon bacteria.
Conventional Pollutant	As defined under the Clean Water Act, includes biochemical oxygen demand, suspended solids, fecal coliform bacteria, acidity, oil, and grease.
Effluent	The wastewater discharged by an industry or municipality.
Effluent or Permit Limit	Restrictions established by EPA or a state on quantities, rates, and concentrations of chemical, physical, biological, and other constituents discharged by wastewater treatment plants.
Hazardous Waste	Waste products, often generated by industrial processes, that can harm human health or the environment.
Heavy Metal	Metal with a high specific gravity, such as copper, silver, zinc, lead, and nickel.
Industrial Waste	Liquid waste from industrial processes, as distinct from domestic or sanitary sewage.

Leaking Hazardous Waste Site	Any hazardous waste site that has contaminated the environment—especially the surrounding soil, groundwater, or surface water. To be classified as leaking, the contamination must have been present between January 1, 1984, and December 31, 1986.
Major Dischargers	
Industrial	Industrial plants are classified as major dischargers on the basis of the volume and type of wastewater discharged, the amount of conventional pollutants discharged, and the proximity of the discharge to public drinking water supplies downstream.
Municipal	Municipal wastewater treatment plants are classified as major dischargers if they produce at least 1 million gallons of wastewater per day or serve a population of at least 10,000.
Nonconventional Pollutants	Those pollutants that do not fit the conventional or toxic categories, such as phosphorus, nitrogen, and ammonia.
Nonpoint Sources	Sources of pollution that can be difficult to pinpoint and measure. Common examples include runoff from agricultural and forest lands, runoff from mining and construction, and storm runoff from urban areas.
Organic Compound	A chemical compound that contains the elements hydrogen and carbon.
Organic Wastes	Wastes generated by living organisms.
Phenolics	A class of poisonous acidic compounds.
Point Sources	Specific sources of pollution that can be readily identified, such as factories and municipal treatment plants.

Polychlorinated Biphenyls (PCBs)	A group of poisonous compounds that are environmental pollutants and tend to accumulate in animal tissues.
Pollution (of Water)	Contamination or other alteration of the physical, chemical, or biological properties of water that may create a nuisance or cause the water to be detrimental or injurious to public health, safety, or welfare.
Settleable Solids	Materials heavy enough to sink to the bottom of wastewater.
Sewage Treatment Plant	See major discharger, municipal.
Suspended Solids	Small particles of solid pollutants in sewage that resist separation by conventional means.
Toxic Chemical	A chemical or mixture that may present a risk of injury to health or the environment. As used in this report, 1 of 126 chemicals listed by EPA regulations under section 307(a)(1) of the Clean Water Act.
Trickling Filter	A device for the treatment of wastewater, consisting of a bed of rocks or stones that support bacterial growth. Sewage is trickled over the bed, enabling bacteria to break down the organic wastes.
Volatile Organic Compound	An organic compound that readily vaporizes at relatively low temperatures.

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