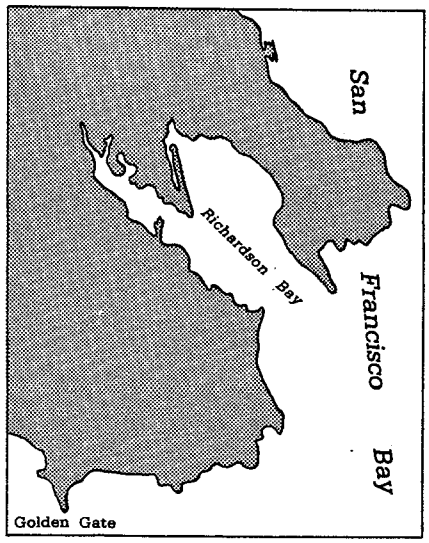
WATER QUALITY ISSUES IN RICHARDSON BAY



by

San Francisco Bay Conservation and Development Commission Staff

Prepared for the

Richardson Bay Special Area Plan Study

September 1983

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PREPARING A RICHARDSON BAY SPECIAL AREA PLAN

Richardson Bay, part of the San Francisco Bay system is situated in southern Marin County. Five local governments have jurisdiction over the water body and its shoreline: Marin County and the cities of Sausalito, Mill Valley, Tiburon, and Belvedere, as does the San Francisco Bay Conservation and Development Commission. Richardson Bay is experiencing an increased demand for pleasure boat marina and houseboat marina use. In addition, many vessels used as residences are anchoring out in the Bay. Recognizing the need for a unified set of planning policies and regulatory controls by the local governments and the Bay Commission for Richardson Bay and its shoreline, the agencies agreed that they should jointly prepare a Richardson Bay Special Area Plan which would recommend such unified policies and regulatory controls for adoption by each agency. This report, prepared by the Bay Commission staff, is the second in a series of planning background reports that will be used by the Richardson Bay Steering Committee, composed of representatives of each of the local governments and the Bay Commission, in preparing a recommended Richardson Bay Special Area Plan.

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INTRODUCTION

Clean estuarine water provides opportunities for recreational activities such as swimming, wading, wind surfing, fishing, and shellfish harvesting. In addition, shoreline recreation activities such as hiking, bicycling, and picnicking are far more enjoyable when the water is unimpaired with visible signs of water pollution. Clean estuarine water also provides a healthy habitat for aquatic life, such as resident and migratory fish, for shellfish, and for wildlife including many species of shorebirds, waterfowl, and even mammals such as harbor seals.

Estuarine water, particularly in urban areas, can become polluted and the values and uses of the water severely impaired. Improperly treated sewage discharged into the waters can carry coliform bacteria and biological oxygen demanding substances which can transmit diseases to humans that ingest the water or contaminate shellfish that, when eaten, can cause human illness. Moreover, improperly treated wastewater can deplete water oxygen necessary for aquatic life. Heavy metals washed into the waters from streets and parking lots, particularly during the rainy season, can contaminate many forms of aquatic life, particularly resident fish and shellfish. Sediments carried into the water from upland soil erosion can smother fish spawning grounds, increase water turbidity, and contribute to accretion in areas of minimal tidal circulation.

San Francisco Bay and Richardson Bay have suffered from water pollution for many years. Richardson Bay, because of its enclosed shape, shallowness, and minimal tidal flushing action, has poor pollutant dispersion capability and low assimilative capacity which makes it particularly susceptible to pollutant concentration.

Because of a number of federal, state and local water pollution abatement programs, the waters of the San Francisco Bay system and Richardson Bay are becoming significantly cleaner. However, pollution problems still exist in Richardson Bay as well as the San Francisco Bay system. This report identifies and discusses the water quality problems associated with Richardson Bay, discusses what steps have been taken to abate the problems, what changes are pending, and what additional steps should be taken to seek the water quality goals for Richardson Bay.

Chapter I identifies the water quality goals for Richardson Bay and the beneficial uses of its waters, as established by the State Water Quality Control Board. Chapter II summarizes briefly the history of water quality in Richardson Bay and finally Chapter III identifies the major Richardson Bay pollution sources and methods of pollution control.

CHAPTER I: WATER QUALITY GOALS FOR RICHARDSON BAY

Goals for the quality of water in California are set by the State Water Resources Control Board pursuant to the federal Clean Water Act and the State Porter-Cologne Water Quality Control Act.[1/] These goals are identified as beneficial uses of water and the State Board and its Regional Water Quality Control Boards have established water quality objectives and wastewater discharge standards for all waters of the State to achieve those goals.

Beneficial Uses

The San Francisco Bay Regional Water Quality Control Board has identified and the State Board has adopted the beneficial water uses of San Francisco Bay, including Richardson Bay. These uses are: (1) water contact recreation; (2) non-contact water recreation; (3) shellfish harvesting; (4) estuarine habitat; (5) wildlife habitat; (6) preservation of rare and endangered species; (7) fish migration; (8) fish spawning; (9) commercial and sport fishing; (10) navigation; and (11) industrial service supply.[2/] The Regional Board has established three of the beneficial uses as "key beneficial uses" for Richardson Bay: water contact recreation, non-contact water recreation, and shellfish harvesting. Specific water quality objectives are set by the Regional Board to protect these beneficial uses. The beneficial uses, beginning with the key beneficial uses and the most likely impairment of those uses are discussed below and summarized in Table 1 (see page 5).

1. Water Contact Recreation. These are all recreational uses involving actual body contact with the waters of Richardson Bay. Uses such as swimming, wading, water-skiing, wind surfing, and sport fishing are included within this category.

Water quality criteria are stringent for water contact recreation because of the risk to human health by the transmission of water-borne diseases. Human health is impaired by the transmission of coliform bacteria. The main source of this bacteria is sewage from municipal treatment plants, vessel discharges, and wet weather overflows.

Total coliform bacteria objectives for water contact recreation are maximum of 240 MPN (most probable number) per 100 of water sampled, with a MPN of 50 for fecal coliform bacteria.

2. Non-contact Water Recreation. These include recreational activities that use the water as an aesthetic recreational resource rather than actual human physical contact with the water. Such uses include picnicking, pleasure boating, and sunbathing. Non-contact water recreation use is impaired primarily by algae blooms, but also by oil slicks and floating debris. The sources of these pollutants include the same sources as water contact recreation pollution.

3. Shellfish Harvesting. The harvesting of shellfish in San Francisco Bay requires not only adequate water quality for the health of the shellfish, but to protect the health of humans who ingest the shellfish. Coliform bacteria and heavy metals absorbed by shellfish present serious health hazards to humans consuming the shellfish. Sources of these pollutants include wastewater discharges, untreated sewage discharges, and urban runoff.

TABLE 1

BAY WATER QUALITY PROBLEMS AND THEIR CAUSES

Beneficial Use	Water Quality Problems Resulting in Impairment of Beneficial Use	Probable Cause
Commercial and sport fishing—fish migration and spawning (Uses 7, 8, 9)	Oxygen depletion, effects of toxic materials, reductions in freshwater flow	Municipal and industrial discharges, surface runoff, accidental spills, freshwater diversion
Water contact recreation (Use 1)	High bacteria counts, particularly near the shoreline after storms	Municipal discharges, untreated vessel sewage discharges, surface runoff, combined sewer overflows
Non-contact water recreation (Use 2)	Floating debris, oil slicks, algae blooms	Surface runoff, accidental spills, vessel wastes, municipal and industrial discharges, improper trash disposal
Shellfish harvesting (Use 3)	High bacteria, virus, and metal concentration in shellfish flesh, meoplasms (abnormal growths) in mussels	Municipal and industrial discharges, surface runoff, vessel wastes, combined sewer overflows
Wildlife habitat (Use 4, 5, 6)	Oxygen depletion, effects of toxic materials, reduction in freshwater flow	Municipal and industrial discharges, surface runoff accidential spills, freshwater diversion
Industrial Process Supply Industrial Process Supply	Increased salinity	Reduction in freshwater outflow from Delta

Source: Association of Bay Area Governments (1977).

4. Estuarine Habitat. An estuarine habitat provides an environment for resident and anadromous fish, shellfish, waterfowl, shorebirds, and marine mammals such as harbor seals. This aquatic habitat is impaired by the water quality problems of all the beneficial uses discussed above.

5. Wildlife Habitat. Water provides a resting, nesting, and feeding habitat for many forms of wildlife in Richardson Bay, particularly shorebirds and waterfowl. Oxygen depletion, which leads to algae growth and development of botulism organisms, as well as toxicants and heavy metals adversely affect wildlife. Such pollutants are caused by wastewater discharges and surface runoff.

6. Preservation of Rare and Endangered Species. An aquatic habitat is necessary for the preservation of certain rare and endangered aquatic and wildlife species. The problems and causes of pollution which affect such species is the same as for wildlife habitat.

7. Fish Migration. Portions of Richardson Bay provide a migration route for anadromous fish. Water quality problems associated with commercial and sport-fishing uses are shared by fish migration uses. These problems include oxygen depletion and toxic materials entering the water system.

8. Fish Spawning. Waters with high amounts of dissolved oxygen are necessary for a fish spawning environment. Problems associated with fish migration also affect fish spawning.

9. Commercial and Sport-Fishing. Commercial and sport-fishing uses in Richardson Bay rely on the protection of water quality in fish spawning and feeding areas. Oxygen depletion and toxic substances, including heavy metals, can impair the Richardson Bay fishery. Oxygen is depleted from the water by

biological oxygen depletion substances (BOD) from wastewater discharge. Toxic substances and heavy metals can come from wastewater discharges and urban surface runoff.

10. Navigation. Includes commercial and naval shipping. No quality standards.

11. Industrial Service Supply. Water used in the manufacturing of products. Quality standards vary widely depending upon the product manufactured.

Water Quality Parameters

The measurement of water quality is a highly complex process. Standards for drinking water and other types of water uses are set by the U. S. Public Health Service and the State Water Resources Control Board. These include both bacteriological and bio-chemical standards. The most commonly used bacteriological standards are those for coliform bacteria. These are generally expressed as total coliform and fecal coliform counts in most probable number of bacteria which are almost exclusively attributable to human sewage. Other sources of coliform bacteria include wastes of domestic and native animals, wildfowl, and other organisms.

Of the bio-chemical standards, the biological oxygen demand (BOD) provides an overall indication of the amount of organic material in the water. Water samples are incubated for five days, and the amount of oxygen dissolved in the water is measured at the beginning and end of the incubation period. The difference in the amount of dissolved oxygen is the "demand" for oxygen created by the organic materials contained in that water. Generally,

the greater the organic materials content, the greater the BOD. Since human sewage and graywater (kitchen, bath, and shower wastewater) contain large amounts of organic matter, a high BOD is usually an indication of some water pollution.

Other chemical parameters include tests for various metals including lead, zinc, chromium, cadmium, and mercury. These chemicals enter water bodies through urban runoff, industrial and municipal discharges, and gas/oil spills from vessels. In addition, dredging may stir up metal contents of the bottom muds.

Biostimulants such as nitrogen and phosphorus may also be measured. These substances act as fertilizers to the organic materials in water. Plants and animals take in these elements and convert them along with carbohydrates into additional body tissue. Large amounts of biostimulants can, when combined with sufficient organic matter, create algae blooms. Secondary treatment plants, those with trickling filters, provide for fairly complete removal of these nitrates and phosphates by the bacteria and algae in the filters.

Miscellaneous contaminants which are not generally measured include grease, oil, floatables (debris, paper, trash, etc), although there are standards for grease and oil. Sources of grease and oil include municipal and industrial discharges, vessels (engines, bilge water and spills), graywater, and urban runoff.

Water quality in Richardson Bay is influenced by a number of human related processes. The most important factors include: release of untreated and treated wastewater; urban stormwater runoff; erosion and sedimentation; and dredging and dredge disposal. The water quality of Richardson Bay affects its attractiveness and recreational use for the population of the immediate area and the entire Bay Area. The critical pollutant measure of whether or

not the water is safe for human recreation use is the coliform bacteria count. The levels of coliform bacteria, representing mainly the release of untreated sewage and graywater, decreased dramatically during the period 1962 to 1973; however, during the period 1973 to 1981, levels of coliform bacteria in Richardson Bay increased in areas around some pleasure craft and houseboat marinas.

Over the past 25 years, water quality monitoring progrms have been carried out in Richardson Bay by the Regional Board. The only parameter which has been consistently measured are the coliform bacteria levels. The results of these studies are contained in the next chapter.

CHAPTER II: HISTORY OF RICHARDSON BAY BACTERIAL WATER QUALITY

The first comprehensive study of the bacterial quality of San Francisco Bay was carried out by the Sanitary Engineering Research Laboratory (SERL) for the Regional Board in the period 1958 to 1964. That study did not include Richardson Bay proper, but did include Raccoon Strait. Although bacterial testing of San Francisco Bay water quality has been carried out by the state Department of Health since the SERL study, only in the past decade have the waters of Richardson Bay been extensively studied. These studies, by the Regional Board, have measured coliform bacteria levels and include: (1) a 1973 survey of water quality in San Francisco Bay marinas, including marinas in Richardson Bay; (2) a 1976 bacteriological study of San Francisco Bay including Richardson Bay; (3) a program that monitored water quality in Richardson Bay in 1976-1977; and (4) a 1981 study of water quality at the Richardson Bay pleasure craft and houseboat marinas.

This chapter will review these studies and their results and specify what problems remain at this time.

Sanitary Engineering Research Laboratory Study

In the late 1950's, the San Francisco Bay Regional Water Pollution Control Board asked the State Water Quality Control Board's Marine Research Consulting Board to investigate possible adverse effects of water pollution on the water quality characteristics and the fishery resources of San Francisco Bay. In the years 1958 to 1964, the SERL carried out a comprehensive study of

the water quality of the entire Bay. The purpose of the study was to establish a baseline of water quality data for comparison in future years and to recommend parameters for a continuing monitoring program for the Bay.

At the time that the study was begun, the Bay served as a dumping area for an incredible amount of waste materials. The areas with the worst pollution problems were in the South Bay, site of large numbers of industries, such as canneries, which dumped wastes into the Bay, and the area east of the Carquinez Strait. At that time, 200 discrete units -- municipal plants and industrial plants -- were discharging into the Bay. Of the significant (large) municipal dischargers, 2.5 million people were served by plants with only primary treatment of sewage (minimal treatment involving grit removal and settling of solids only) while only .5 million people were served by plants with secondary treatment (biological treatment). Significant pollutants entering the Bay included 61 tons per day of oil and grease, 53 tons per day of nitrogen, 42 tons per day of phosphates, 11 tons per day of gross heavy metals, and an incredible amount of coliform bacteria (4×10^{17}), about 125 times the amount currently released.

At the time of the SERL study, Richardson Bay had seven dischargers. They included: (1) Sanitary District #5 of Marin; (2) Hawthorne and Tiburon Terrace (connected to Richardson Bay Sanitary District in January of 1964); (3) Richardson Bay Sanitary District; (4) City of Mill Valley; (5) Sausalito Arks; (6) American Distilling Company (cooling water only), and (7) Sausalito-Marin City Sanitary District.

Richardson Bay was not included in the Baywide study, however, one of the sampling points was located in Raccoon Strait, a site which has continued to be used in other studies and is close to Richardson Bay. The Raccoon Strait sampling station had a median measurement of coliform bacteria similar

to the levels measured in all of the Central Bay (the area between the San Mateo Bridge and the Benicia Bridge), while the southernmost part of the Bay and Suisun Bay had significantly higher levels. The SERL report concluded that only 9 of the 51 locations sampled would meet a total coliform standard of less than 1,000 most probable number (MPN) bacteria per 100 ml in at least 80 percent of the samples. The current standard for water-contact recreation is less than 240 MPN per 100 ml for total coliform bacteria and 50 MPN per 100 ml for fecal coliform bacteria (see Table 2). The current standard for shellfish harvesting, is less than 70 MPN per 100 ml total coliform bacteria and 14 MPN per 100 ml fecal coliform bacteria. Thus the first regional study showed that Baywide there were severe pollution problems and public health hazards due to poor water quality and particularly in regards to coliform bacteria (see Table 2).

1973 Regional Water Quality Control Board Study

The next study was prepared by the Regional Board in 1973. The study, Coliform Survey of San Francisco Bay Area Marinas, addressed the continuing problem of untreated wastewater entering Bay waters from houseboats. Although the study cannot be directly compared with the SERL study because the latter study had no sample stations in Richardson Bay, it is instructive because it shows the general change in Bay water quality. Although the study showed that Richardson Bay had some important and dangerous to human health water quality problems, the report showed a great improvement in overall bacterial quality since the SERL study. For example, the median total coliform MPN of the Central and lower Bays was 1.2 percent of the level found 10 years earlier. North San Francisco Bay, including Richardson Bay and San Pablo Bay, had .4 percent of the previous levels.

TABLE 2

BACTERIOLOGICAL OBJECTIVES FOR TIDAL WATERS
IN SAN FRANCISCO BAY BASIN

		Total Coliform	Fecal Coliform
WATER CONTACT RECREATION: (Uses include: swimming, water skiing, skin diving, surfing, sport fishing, uses in therapeutic spas, and other uses where ingestion of water is reasonably possible.)	5-sample median	240 MPN/100 ml	50 MPN/100 ml
	maximum allowed	10,000 MPN/100 ml	400 MPN/100 ml
SHELLFISH HARVESTING: (Conform to standards set in the National Shellfish Sanitation Program, Manual of Operation)	5-sample median	70 MPN/100 ml	14 MPN/100 ml
	maximum allowed	230 MPN/100 ml in 90 percent of samples	46 MPN/100 ml in 90 percent of samples

Source: Water Quality Control Plan, San Francisco Bay Basin (2), Amendments (1982)

Six sample sites were scattered throughout Richardson Bay, four in marina/houseboat areas and two in open water areas. The data collected for those sites is shown in Table 3. The median MPN of both total coliform and fecal coliform bacteria was much reduced from the time of the SERL study. For total coliform bacteria, all of the sample sites, except the houseboat area site, met both the current water recreation standard and shellfish standard. For fecal coliform levels, four of the six sites met the water contact recreation standard; the houseboat area site and Mill Valley Channel site both exceeded it. However, none of the sites met the fecal coliform standards for shellfish harvesting.

1976 Regional Water Quality Control Board Study

In 1976, the Regional Board prepared another Baywide study of water quality entitled, Report on Bacteriological Survey of San Francisco Bay. One site was in Raccoon Strait and another in Richardson Bay. This study showed even more decreases in coliform bacteria levels in the Bay generally, and in Richardson Bay. Overall, the study showed more water quality improvements resulting from the universal practice of sewage disinfection required by the Regional Board and from improved reliability in the disinfecting of the sewage. Baywide, bacteriological quality made five to sixteen fold improvements from the 1973 survey, and 28 to 130 fold improvements from the SERL study. In Central and San Pablo Bays (including Richardson Bay), median total coliform was 20 percent of the 1973 levels and 0.76 percent of the SERL levels, showing five fold improvement over 1973, and a 130 fold improvement from the 1962-64 period. The Raccoon Strait samples met all water contact recreation and shellfish harvesting standards. The Richardson Bay sample for

TABLE 3

DATA COLLECTED AT RICHARDSON BAY TEST SITES

	SITE	TOTAL COLIFORM Median per 100 ml	FECAL COLIFORM Median per 100 ml
1973			
	Mill Valley Channel	62	62
	Houseboat Area	620	500
	Bay water east of houseboats	23	23
	Sausalito Clipper Harbor	62	23
	Unknown Marina	38	15
	Sausalito Municipal Marina	62	18
1976			
	Raccoon Strait	4	3
		4	4
	Richardson Bay Channel Marker "8"	15	15
		23	23
1976-1977			
I	Open Bay south of Peninsula Point	4	6
II	Sausalito Yacht Club	70	3
III	Waters off Napa Street Pier	70	50
IV	Waters east of Strawberry Spit	70	50
IV	Waters off Strawberry Point	70	50
VI	HB End of Kappas Landfill (Parking) at Small Boat Harbor	930	143
VII	Off Eucalyptus Knoll	93	50
VIII	Mill Valley Sewage Treatment Plant	93	50
1981			
	Sausalito Yacht Harbor Pelican Yacht Harbor	79	23
	Napa Street Pier	540	46
	Marinship Clipper #2	101	49
	Clipper #3 Clipper #4	170	49
	Waldo Point Area Yellow Ferry Area	498	240
	Kappas Small Boat Marina	540	140
	Kappas east & west Piers	170	49
	Commodore	140	20
	Control Stations (4) in Richardson Bay	21	7

total coliform met both water contact recreation and shellfish harvesting standards. However, the fecal coliform bacteria level met only the water contact recreation standards; shellfish harvesting standards were not met.

1976-1977 Regional Water Quality Control Board Monitoring

For the year June 1976 to May 1977, the Regional Board monitored water quality in Richardson Bay at a series of eight sites, with one outside the Bay serving as reference station (see Table 3). In that study, the median number of total coliform bacteria met the water contact recreation standard at all but one station; the one near Kappas Small Boat Marina. Five of the eight met the shellfish harvesting standard. The stations that did not meet that standard included the one near Kappas Small Boat Marina, one near Eucalyptus Knoll, and one near the Mill Valley Sewage Treatment Plant. The fecal coliform standards for water contact recreation and shellfish harvesting were met at all stations except the one near Kappas Small Boat Marina. The lowest levels were measured at the stations nearest the open Bay where the water is deeper and tidal currents stronger.

During the year of monitoring, water quality in Richardson Bay did not change except that samples showed very high bacteria levels in the months of January and March, associated with wet weather overflows at the treatment plants (Mill Valley and Sanitary District No. 5) and increased urban runoff.

1981 Regional Water Quality Control Board Study

The most recent survey was conducted by the Regional Board staff in 1981. The report, Vessel Waste Discharges Survey, was a more detailed investigation around what the 1976-1977 monitoring indicated was a pollution source - the houseboat marinas. The study tested water quality levels in all

the major marinas in Richardson Bay to determine level and type of pollution problems associated with not only with houseboats, but recreation and live-aboard boats (see Table 3). The report concluded that shellfish beds located within half a mile of marinas may be polluted by discharges of untreated wastewater from boats in nearby marinas and water contact recreation use was being impaired. A comparison of stations tested in 1973 versus those tested in 1981 (see Table 3) shows a general increase in levels of total and fecal coliform. Of the 21 stations that were tested in both studies, 13 show an increase in bacteria counts, only eight show a decrease, and those eight sites were in areas that had been equipped with sewers or were located in deep water with better tidal circulation.

The results of the 1981 study, with some stations grouped into eight sites, show that for total coliform bacteria, five sites met the water contact recreation standards, three sites did not. None of the eight sites met the shellfish harvesting standards for total coliform bacteria. For fecal coliform bacteria, six of the sites met the standard, but three were measured at 49 MPN per 100 ml and the standard is "less than 50 MPN per 100 ml." None of the sites met the fecal coliform bacteria standard for shellfish harvesting.

The 1981 studies indicate that 14 of 24 stations met the water contact standards for total coliform (58.3%), and 11 met the fecal coliform standard (45.8%). In 1973, 14 of 18 stations met the water-contact recreation standard for total coliform (78%) and 11 of the 18 met the fecal coliform standards (61%). It should also be noted that three stations went from acceptable to unacceptable quality in total coliform bacteria, and five stations degraded to not acceptable in terms of fecal coliform bacteria. Only one station improved from non-acceptable fecal coliform levels to acceptable ones.

Although coliform bacteria is the major water pollutant associated with Richardson Bay, there are other primary sources of pollution that impair the beneficial uses of Richardson Bay. The next chapter will discuss the major sources of water pollution in Richardson Bay and measures being taken and should be taken to control pollution.

TABLE 4

1973 vs 1981 TOTAL AND FECAL COLIFORM RESULTS IN RICHARDSON BAY
(ALL VALUES IN MPN/100 ML)

	Total Coliform Bacteria		Fecal Coliform Bacteria	
Station	July 1973(1)	Sept. 1981(2)	July 1973(1)	Sept. 1981(2)
1	6	196	4.5	83
2	23	101	23	14
3	130	242	12	54
4	23	52	6	10
5	62	585	23	31
6	-	24	-	11
7	-	41	-	11
8	-	1,348	-	69
9	28	172	24	59
10	126	56	5	29
11	62	100	23	23
12	62	54	4.6	17
13	146	153	23	54
14	62	114	23	63
15	126	624	126	155
16	500	309	500	223
17	765	826	765	272
18	2,400	1,133	2,400	328
19	7,000	829	62	266
20	130	300	62	103
21	-	198	-	38
22	-	265	-	24
23	-	97	-	54
24	62	84	62	25
A	62	9	62	4
B	-	20	-	4
C	13	22	6	8
D	23	22	23	13

(1) 1973 results are single samples or log mean of 2 to 4 samples.
(2) 1981 results are log mean of 5 samples.

Source: Vessel Waste Discharge Survey, page 47

CHAPTER III: SOURCES AND CONTROL OF WATER POLLUTION IN RICHARDSON BAY

Richardson Bay has suffered from water quality problems for many years. Sources of pollution common throughout the Bay Area in the past are particularly troublesome here because of its enclosed shape, shallowness, poor tidal circulation and pollutant dispersion capability, and low assimilative capacity.

The major pollution sources in Richardson Bay include: (1) treated municipal wastewater; (2) wet weather overflows; (3) untreated wastewater; (4) urban runoff; (5) sedimentation and erosion; and (6) dredging and dredge disposal. Significant steps are being taken, particularly at the local level, to control pollution in Richardson Bay. This chapter describes the major pollution sources in Richardson Bay and their impacts, and discusses what current and future programs should control these problems.

Treated Municipal Wastewater

Treated municipal wastewater is the discharge released from sewage treatment plants serving urbanized areas. Wastewater, including raw sewage and graywater (kitchen, bath, and shower water) from homes and businesses, contains many pollutants in its untreated state including human body wastes, coliform bacteria, soap residues, biochemical oxygen demanding (BOD) substances, oil and grease, and biostimulatory substances (nitrogen and phosphorus). The danger associated with releasing untreated or partially treated wastewater is that it disrupts the balance of the natural system and lessens or destroys the value of the water environment for other living

things, ranging from microorganisms to birds and fish. For example, the BOD substances use up the oxygen in the water, choking out other oxygen-using organisms and depleting aquatic life. Coliform bacteria carry diseases that can make humans ill.

Modern techniques for treating wastewater -- secondary (biological) and tertiary (filtering) treatment -- remove much of the most dangerous and toxic materials prior to release. Treated wastewater does not present a danger to the aquatic environment if the wastewater is mixed with clean water in the proper proportions (the Regional Water Quality Control Board recommends a ratio of at least ten to one of clean water to wastewater discharges).

Richardson Bay is a relatively small body of water when compared with the Bay as a whole, is very shallow, has poor water circulation, and has poor capability for water mixing. Thus, when the Regional Board adopted its preliminary Water Quality Control Plan for the San Francisco Bay Basin in 1971, it prohibited direct discharge of treated wastewater into Richardson Bay. At that time, two plants were releasing treated wastewater into the shallow part of Richardson Bay: the Mill Valley plant in Mill Valley and the Richardson Bay plant in Tiburon. A third plant, Sanitary District No. 5, also in Tiburon, released treated wastewater into Raccoon Strait and a fourth, Sausalito-Marin City located just outside the southern city limits of Sausalito, released water offshore of Fort Baker (see Figure 1).

In 1971, the Regional Board issued a cease and desist order to the Mill Valley and Richardson Bay treatment plants. Under the order, these plants were required to find other locations than Richardson Bay for the release of their treated wastewaters. The Marin City-Sausalito and Sanitary District

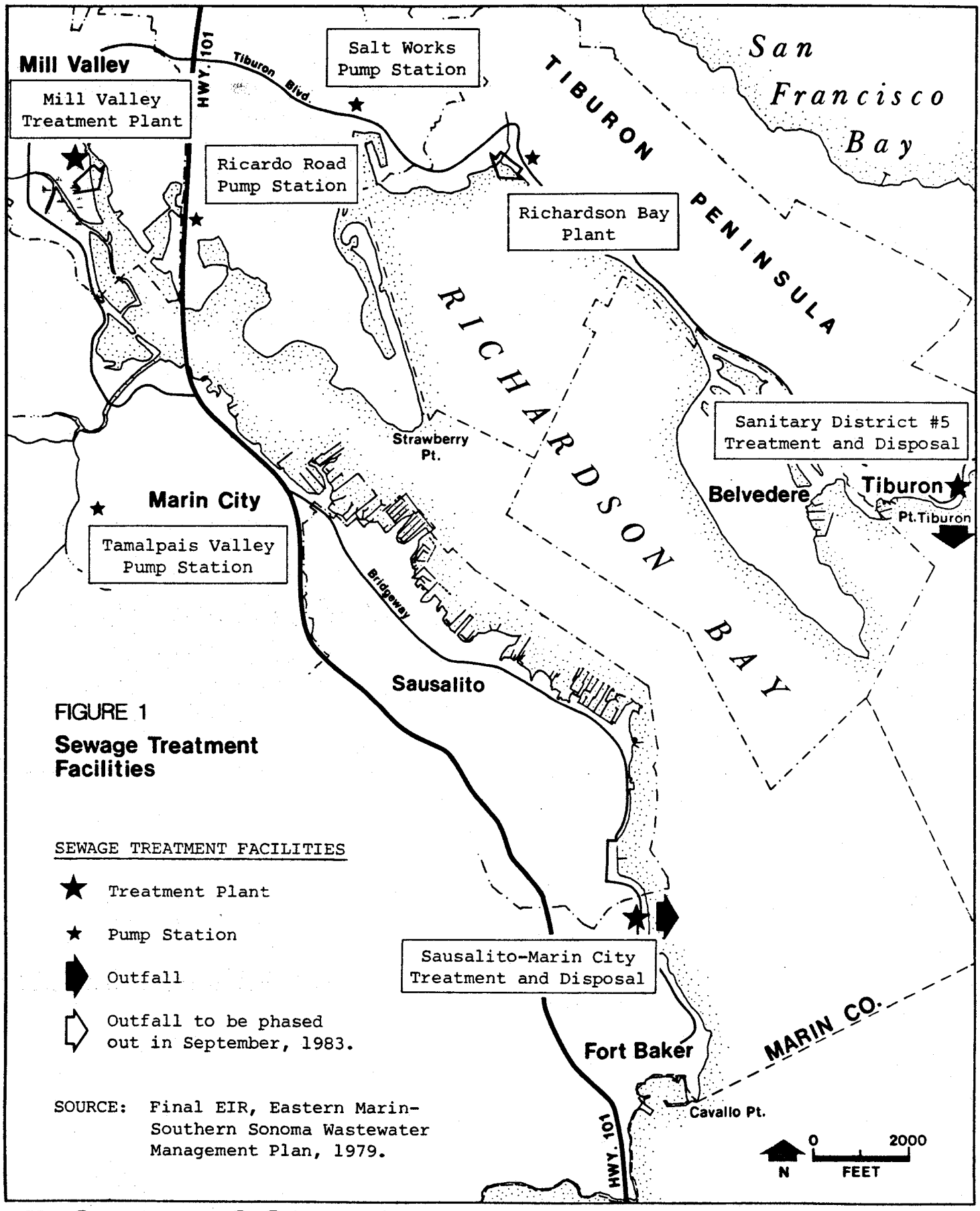

FIGURE 1

Sewage Treatment Facilities

SEWAGE TREATMENT FACILITIES

- ★ Treatment Plant
- ★ Pump Station
- Outfall
- Outfall to be phased out in September, 1983.

SOURCE: Final EIR, Eastern Marin-Southern Sonoma Wastewater Management Plan, 1979.

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No. 5 plants were required to upgrade treatment of their wastewater, but the location of the their discharges into deep water with good tidal circulation, was acceptable.

Following several years of Countywide study, a plan for wastewater treatment and discharge was prepared and adopted by the Sewerage Agency of Southern Marin. The goal of the plan was to improve the level and quality of treatment and to eliminate any discharges into Richardson Bay. The plan called for upgrading the treatment plants at Mill Valley, Sanitary District No. 5, and Sausalito-Marin City. The upgrading will allow for secondary treatment of wastewater at all southern Marin County treatment plants, resulting in discharges of water of much higher quality than in the past. Modifications will be made to the Tamalpais Valley, Ricardo Road, and Salt Works Pump Stations to increase efficiency and lessen problems of wet weather bypasses. New pipes will be placed to carry sewage to three plants for treatment: Sausalito-Marin City, Mill Valley, and Sanitary District No. 5. New pipes will carry the treated wastewater from the three plants to longer outfall pipes with diffusers located at the existing Raccoon Strait and Marin Headlands outfall sites. The longer discharge pipes with diffusers will ensure proper and thorough mixing of treated wastewater with the waters of the Bay at these sites with deep water and strong tidal currents (see Figure 1).

Excluding improvements to the Sausalito-Marin City Treatment Plant, cost of the new treatment and discharge system will be over $27.5 million. Completion of the project is imminent. The Raccoon Strait outfall should be in operation in September, 1983 and the upgraded treatment plants of Mill

Valley and Sanitary District No. 5 should be operational in March, 1984. The Sausalito-Marin City project designs have been completed and permits granted but the District is awaiting grant monies from the federal government before construction can begin. The District predicts up to two years for construction after a grant is received.

The process undertaken by federal, state, and local agencies to solve the water quality problems associated with the discharge of treated municipal wastewater into Richardson Bay has been long and expensive, but the benefits should be extremely beneficial to the health of the Bay. The improvements will include:

1. Improved treatment of wastewater resulting in "cleaner" discharges into San Francisco Bay;
2. Improved pump stations, plants, and pipelines to efficiently carry wastewater to the treatment plants and lessen wet weather bypasses; and
3. Discharge of all treated wastewater into deep, swiftly flowing parts of the Bay to assure proper mixing of treated wastewater and Bay water.

Wet Weather Overflows

The storms of the rainy season, generally October 15 to April 15, bring a burden to the sewage treatment systems of Richardson Bay which has had adverse impacts on water quality. In wet weather, the sewage treatment systems can carry up to ten times the flow of the dry season. The first problem is that the collection system (pipes) is inadequate to carry the volume of water flowing after a rainstorm. Second, the sewage treatment

plants have not had the capacity to store and treat the rainy weather flows, a combination of stormwater runoff and untreated sewage. Soon, both of these problems will be resolved through construction of additional facilities in the Richardson Bay area.

For example, the existing pipe system in Mill Valley is old and too small to carry the large flows of winter's wet weather. The existing pipes were placed in trenches lined with gravel, more gravel was placed on top, and the trenches were covered with earth. The pipes themselves are old, cracked in some places, and the joints are weak. In wet weather, huge flows fill the pipes and leak into the gravel-lined trench. This means that ground water and other water bodies become contaminated with raw sewage, and, in some cases, contaminated water ponds on the ground surface around the trenches. Understandably, this creates a severe health hazard both on land and in the Bay.

To solve this problem the Sewerage Agency of Southern Marin (SASM) will place a relief sewer parallel to the existing pipe, with overflow connections between; if the old pipe becomes too full, the extra water will flow into the parallel pipe and into the sewage treatment plant. SASM has recently received a $410,000 grant from the state to install the relief sewer and design work is underway.

The second wet weather problem also results from the large amounts of winter runoff stressing the existing system. The Regional Board is required to set standards for "wet weather maintenance levels" for the receiving waters. That is, under what circumstances can untreated sewage be discharged directly into the Bay, bypassing the treatment plants. Federal law requires

secondary treatment for all flows, but the federal agencies will not fund the massive treatment plants which would be necessary to meet those requirements.

The upgraded treatment plants around Richardson Bay are designed to be "A" level plants, under Regional Board requirements. Two equalization ponds at the Mill Valley Treatment Plant and at the Salt Works and Ricardo Road facility will store abnormally high wet weather flows. This means that the plants will be large enough to hold and treat almost all flows, but there may be one overflow or bypass of the treatment plant system every 20 years. This will greatly improve the existing situation, improve water quality in the Bay, and protect public health and safety.

Untreated Wastewater

Untreated wastewater includes sewage (human body wastes) and graywater 5/ (kitchen, bath, and shower water). Discharge of untreated wastewater has been a source of water pollution in Richardson Bay. According to the Regional Water Quality Control Board, Richardson Bay continues to experience high levels of coliform bacteria, especially in areas characterized by the presence of unsewered houseboats, live-aboards, and poor water circulation. 6/ The Regional Board concludes that the source of this bacteria are residential vessels that discharge untreated wastewater into the water.7/

Because direct discharge of untreated sewage and graywater into Richardson Bay was a primary source of water pollution, Marin County, BCDC, and the U. S. Army Corps of Engineers authorized in the early 1970's the development of four houseboat marinas in Marin County north of the Sausalito city boundary. Approximately 400 houseboats were authorized in 1971 with the

condition that they connect to the shoreside sewage treatment system. Today, most of the authorized houseboats are connected to a shoreside sewage system and the County is taking enforcement action to assure that the remaining boats will be connected. However, the Regional Board estimates that since the time of the houseboat permits, the houseboat areas have doubled in size and numbers.8/ Most, if not all, of the additional houseboats are not connected to a shoreside wastewater treatment system.

Many types of vessels (a watercraft capable of being used as a means of transportation on navigable waters) are used as as a residence permanently or occasionally. A houseboat, for the purpose of this report, is a vessel or structure on or in the water which may or may not float and is designed for and used as a permanent residence and not principally used for transportation. These vessels are normally not self-propelled and are normally moored for long periods of time at a single location such as a dock or mooring device. A live-aboard on the other hand, is a vessel, used as a primary place of residence but capable of self-propulsion and designed for recreation or commercial uses (such as transport of goods or fishing).

In Richardson Bay, houseboats are moored at docks in houseboat and pleasure craft marinas or are attached to a mooring device offshore. Live-aboards include vessels normally moored in pleasure craft marinas and yacht harbors and used as a pleasure cruising craft as well as a residence and vessels used for commercial fishing and a residence, normally moored at a pleasure craft marina, fishing facility dock, or attached to a mooring device offshore. Live-aboards can either be permanent resident craft or transient craft mooring in Richardson Bay for extended periods during a pleasure cruise or during the fishing season.

Live-aboards are located in most marinas. The precise number of live-aboards moored in Richardson Bay is difficult to ascertain, however, a survey of the Sausalito waterfront determined that approximately 190 people lived at approximately 145 of the 1,500 boat berths in the City.[9/] None of the live-aboards are authorized for the Sausalito City code does not allow live-aboards. Further none are hooked-up to a shoreline sewage system. Many of these boats have the Marine Sanitation Devices (MSD) required by the Coast Guard. Type I and II devices treat sewage with disinfectant before it is released. Type III devices are holding tanks which can be emptied at pump-out facilities. There are, however, only two existing pump-out facilities in Richardson Bay: at Pelican Yacht Harbor and at Sausalito Yacht Harbor. These pump-out stations are rarely used because of either inconvenient location or excessively high user fees. An additional pump-out facility will be installed at the Kappas Small Boat Harbor when it is redeveloped. Even though MSD's may be used on some live-aboards, graywater is not collected or processed in Coast Guard-required MSD's. Many live-aboard residents do use shoreline sanitary facilities where they are available.

Although no concrete information is available, some of the unsewered houseboats, including those moored offshore, may have Coast Guard-required MSD's. Others have "alternative" facilities such as composting toilets (usually a metal drum where layers of sawdust are placed over the human waste and when full, sealed and allowed to compost). Most of the unsewered houseboats however, have no sewage or graywater treatment devices and discharge wastewater directly into the Bay. Some of those houseboats that have and use MSD's or "alternative" sewage treatment facilities do not treat graywater which is discharged into Richardson Bay.

In their 1981 Vessel Waste Discharge Survey taken during the dry summer months, the Regional Board staff found bacteriological standards for water contact recreation unmet at: Waldo Point, Yellow Ferry, Kappas Small Boat Marina, and Napa Street Pier. Further, they found the shellfish harvesting bacteriological standards were violated at the following marinas located within half a mile of shellfish beds: Waldo Point, Yellow Ferry, Marinship, Clipper Yacht Harbor Nos. 2, 3 and 4, Kappas Small Boat Marina, Kappas East and West Piers, and Commodore Marina. While other sources are recognized, the unsewered houseboats, and live-aboards were identified as the primary source of these pollutants. Consequently, the Regional Board staff recommended that: (1) there should be no waste discharged from vessels into marina basins; and (2) measures should be taken to prevent vessel waste discharge including sewering of houseboats and live-aboards and the use of vessel holding tanks which are properly pumped out into dockside pump-out facilities connected to a sewer.

According to the Regional Board staff the most reliable method of assuring that sewage and graywater is properly treated and not discharged into Richardson Bay is to either hook up the sewage and graywater system through a continuous connection to a shoreside sewage treatment system, or to contain the sewage and graywater in a holding tank until it can be pumped out to a shoreside sewage treatment system. To assure that all wastewater is contained within a holding tank or piped to a shoreside sewage treatment system, through hull discharge valves and fittings, except the continuous flow system, should be sealed to prevent discharge into the water.

An alternate system of gathering sewage and graywater from houseboats and live-aboards has been advanced by some for use in Richardson Bay; floating a large holding tank with pump-out mechanism around to houseboats and live-aboards moored off-shore (commonly called a honey barge). Under this system sewage and graywater would be pumped from the individual vessel holding tank into the barge holding tank for transport to a shoreside pumpout facility and sewage treatment system. There is no reported existing system to use as an example, however, the system is theoretically possible. The system would involve the costs of installing and inspecting individual holding tanks, constructing a holding tank barge, and operating and administering the system. The system could not be left to volunteer effort and would have to be licensed by the Marin County Department of Environmental Health.

Other alternative onboard sewage treatment systems have been proposed for use on houseboats and live-aboards. These systems utilize a biological process to breakdown sewage. According to the County Department of Environmental Health, an unpublished study by the Environmental Protection Agency and the state Office of Appropriate Technology indicates that biological systems are not reliable enough to be counted on as an effective alternative system. The Regional Board and Environmental Health Department staffs have concluded that there are no alternative sewage treatment systems (toilets) of which they are aware that they would approve for use on houseboats or live-aboards.

According to the Regional Board staff, the most reliable residential vessel wastewater treatment system, and easiest to administer and enforce, is the connection of sewage and graywater systems to a shoreside wastewater treatment system.

Urban Runoff

Storm water and other urban water runoff is conveyed in storm sewers from the source of the runoff to receiving waters (e.g., creeks, channels, or the Bay itself) directly without being treated. Storm sewers are thus distinguished from sanitary sewers which carry sewage to sewage treatment plants for treatment prior to discharge. In the Richardson Bay area, much of the winter storm water runoff drains directly into the Bay through numerous storm sewer outfalls. This runoff, consisting of the water which drains from city streets, parking lots, and sidewalks, is released into the Bay untreated. To control pollution associated with urban storm water runoff, the pollutants should be retained on land and kept out of the Bay.

Research carried out locally shows that considerable quantities of contaminants, heavy metals in particular, may enter the Bay through urban runoff. Heavy metal emissions to the Bay are attributable to both point and diffuse sources. About one third the total load enters from point sources, such as treatment plants, while diffuse sources, such as surface runoff, account for the remainder. Heavy metals which enter the Bay include cadmium, cromium, copper, lead, mercury, nickel, and zinc. Other pollutants in stormwater runoff include five day BOD, bio-stimutants such as nitrogen and phosphorus, and oils and grease.

Heavy metal loads are of special concern in relation to urban runoff. The control of heavy metal emissions has become a topic of increasing concern in recent years. Any one of the heavy metals can, in sufficient concentration, have damaging effects on aquatic life and plants.

Phosphorus and nitrogen are plant nutrients which can be responsible for nuisance blooms of algae. These substances can only partially be removed in wastewater treatment plants.

BOD is a measure of organic material in the water available to bacteria as food. Elevated BOD levels enable bacteria to multiply and use up dissolved oxygen in the water which is also needed for fish, shellfish, and all other aquatic animal species.

The Regional Board's Basin Plan, identifies four basic ways to control pollutants in urban runoff:

1. Prevent contaminants from reaching urban land surfaces;
2. Improve street cleaning and the cleaning of other public areas where significant amounts of contaminants might be present;
3. Treat runoff prior to discharge to receiving waters; and
4. Place new controls on land use and development.

Preventing contaminants from reaching urban land surfaces has been implemented in many ways. To meet the 1975 federal emission standards, auto manufacturers now use a catalytic converter which requires nonleaded gasoline. The decrease in use of leaded gas in turn decreases the amount of lead entering Bay waters. Federal and state limits on the use of chlorinated hydrocarbon pesticides has reduced the amounts found on urban land surfaces and thus the amount carried into the Bay.

The second approach to reducing pollution involves improving street cleaning techniques. The typical street cleaning equipment removes larger objects which are aesthetically objectionable. However, to positively affect water quality it is necessary to adapt the sweeping equipment to collect the very fine material which accounts for most of the important contaminants. The collected material is then disposed of in a solid waste disposal site.

The third approach reducing the effect of urban runoff on receiving water quality involves collecting and treating runoff. Because of the intermittant flow and the large amounts of storm water runoff that would need treatment at one time (i.e., during an intensive rain storm) it is unlikely that treatment of all runoff will ever be possible. Although some runoff will be treated at the upgraded plants, most storm drains open into creeks and channels or directly into tidal waters. Where possible, screening to catch large objects should be used. The use of sedimentation basins and grease traps for new projects will also reduce unwanted material flowing into the Bay. While other more sophisticated and expensive techniques are available to trap and filter pollutants from runoff, such as simple sedimentation, sedimentation basins with chemical addition, and dissolved air floatation, it is unlikely any of these measures will be used in the near future because of the great expense of collecting and treating water.

The fourth approach is to enact controls on new projects to reduce the volume of storm water runoff or at least not increase runoff. Increased urbanization usually means increased intensity of runoff through replacement of natural permeable soils with impermiable surfaces such as roofs, paved parking lots, and streets. Techniques such as onsite ponding, storm water retention basins, and porous driveway and parking lot surfaces help retain stormwater on-site and let it slowly percolate into the ground or flow gently to the Bay.

Under Section 208 of the Federal Water Pollution Control Act Amendments of 1972, the Association of Bay Area Governments (ABAG) has prepared an areawide plan which addresses water quality. The Draft Environmental Management Plan for the San Francisco Bay Region (1977) proposed to "establish a program of surface runoff controls that emphasize low cost measures to reduce the pollution load from this source."

The Marin County Surface Runoff Management Plan was prepared in 1978 under contract to ABAG as the County's contribution to the ABAG Environmental Management Plan. The County Plan reviewed the nature of County surface water quality and other available data sources, and developed a set of conclusions and recommendations for the County and Marin County cities. Phase One measures of the County Plan included increased street sweeping efforts; repair of streets; cleaning of catch basins, storm drains, and roadside drains; and enforcement of erosion control requirements in grading ordinances. The Plan identified several minor problems at least partially attributable to surface runoff pollution. These problems included occasional excessive algae growth in Richardson Bay that caused visual and odor nuisances, possible dissolved oxygen problems, and prohibition of shellfish harvesting due to bacterial contamination. The Plan also concluded that Marin's County's surface runoff contains substantial quantities of suspended solids, BOD, nutrients, and possibly bacteria and lead.

To control urban runoff pollutants, the County recommended in the Surface Runoff Management Plan that: (1) the County and cities review their existing programs for concentrated street sweeping, catch basin and drain cleaning, roadside drainage improvement, and erosion control; (2) the County and cities develop a public information program concerning urban runoff; (3) Tiburon develop erosion controls; and (4) Mill Valley and Sausalito implement street sweeping parking restrictions.

The recommended runoff control measures, which will significantly improve the quality of surface runoff into Richardson Bay, are being implemented by the County and the cities.

Dredging and Dredge Disposal

Dredging is the act of removing solid material from the Bay bottom. Dredging is normally carried out to facilitate navigation and other water dependent activities and improve water flow and circulation. Large amounts of sediment are dredged from time to time from Richardson Bay to maintain appropriate depths for marinas and to maintain navigational channels.

Dredging and disposal of dredged spoils in the Bay have water pollution impacts and consequences. These include: (1) bottom habitat disruption and smothering of bottom aquatic life with sediment; (2) release of sediments into the water column impairing aquatic life respiratory systems; (3) reduction of dissolved oxygen necessary to aquatic life; (4) release of toxicants including heavy metals absorbed in bottom sediments into the water column which may accummulate in aquatic organisms; and (5) release of biostimulatory substances (nitrogen and phosphorus) which stimulate algae growth.

According to the Regional Board's Basin Plan, dredging by itself produces minimal water quality problems in comparision to the disposal of dredged material. Problems associated with dredging are generally localized and of a temporal nature. Generally, the impacts of initial and maintenance dredging are similar.

The three most frequently employed methods of dredging: hopper, hydraulic, and clamshell, have different impacts on the environment. Least environmentally damaging is the hopper method. A vacuum sucks up mud and water; the water is returned at the site and the sediments are carried to a disposal site. This method requires ample depth for equipment and is thus not suitable for shallow areas such as upper Richardson Bay. The hydraulic

suction method sucks up mud and water and pumps it directly to the disposal area. The mud sinks to the bottom and the water is drained or pumped back into the Bay. This method can be used in shallower water and creates relatively little turbidity at the dredging site. The major drawback is that it requires a large ponding area. The clamshell technique of dredging involves a large "bucket" scooping up the mud. Water and silt drains immediately back into the Bay and the mud is placed on land (often for levee repair) or on a barge to be deposited at another site. This process causes the most turbidity of any dredging method. Clamshell dredging is also the most commonly used technique, in the Bay. There is no one best dredging method. Depending on the location and configuration of each site, the least environmentally damaging and most cost effective technique is generally selected.

In 1971, during the permit application review procedure of Marin County, BCDC, and the Corps of Engineers, concerns were raised by the Department of Fish and Game and the Regional Water Quality Control Board that material to be dredged from the sites of houseboat marinas might be polluted with oxygen-demanding materials, heavy metals, and pesticides. To eliminate possible adverse impacts to fish and wildlife from the act of dredging, the material was left in place.

Because bottom sediments in other areas in Richardson Bay may be contaminated with pollutants, samples of the sediments to be dredged, particularly in initial dredging of the site, should be tested for pollutants as part of the environmental analysis of the project. These tests are not only helpful in determining what, if any, contaminants may be released at the dredging site, but where the dredge spoils should be deposited.

Land disposal avoids many of the potential adverse impacts associated with depositions in water and thus is the preferred disposal site under existing BCDC policies. However, the high cost of this alternative and the few sites near dredging locations results in infrequent use of this option. Most Bay dredging is disposed of in the Bay at one of the few U. S. Army Corps of Engineers approved spoiling sites. The Corps has adopted procedures for evaluating discharges of dredged materials and designated Bay disposal sites where, because of deep water and tidal currents, the sediments will be dispersed and the maximum amount carried out the Golden Gate.

No deposition of spoils is allowed in Richardson Bay. The closest Bay disposal site is off Alcatraz Island. "Not polluted" sediments or sediments polluted with organic matter (volatile solids, nitrogen, or oil-grease) may be deposited at Alcatraz under the Environmental Protection Agency's regulations. Sediments polluted with mercury or lead or both must be deposited at a land disposal site or in the ocean at greater than 100 fathoms depth.

Recently, an experimental project to allow deposition of dredge spoils from three projects: Belvedere Lagoon, Corinthian Yacht Club, and San Francisco Yacht Club into Raccoon Straits was approved by BCDC, the Regional Board, and the Corps. The theory was that flows at Raccoon Strait are strong and swift enough to move the sediments evenly across the Bay bottom. While, preliminary reports on the first project show that dredged material formed a mound on the bottom of Raccoon Strait, the mound diminished by about half in about five weeks. Raccoon Strait is not a Corps designated disposal site and the Corps and BCDC will continue to evaluate proposals for disposal of small amounts of spoil in Raccoon Strait only on a case-by-case basis.

Sedimentation/Erosion

Sedimentation can have a number of adverse impacts on estuarine systems. Sediments can cover and eliminate shellfish beds and fish spawning grounds. Sediments trapped in salt marsh vegetation at the waters edge hastens soil buildup and natural reclamation of water areas to land. Further sediments are deposited in navigation channels and marina and boat basins necessitating expensive and frequent maintenance dredging.

Erosion, the washing away of soil by surface water runoff, and sedimentation, the deposition of this suspended matter when water velocity slows, are both natural processes. However, these natural processes can be greatly increased by land disturbing activities, particularly construction. The natural erosion process is accelerated when the soil protecting vegetative cover is removed during the construction process and the soil mantle is broken and disturbed. Erosion is further exacerbated when the land is steep, such as around Richardson Bay. Erosion on land where construction activities are taking place is generally about 10 times greater than on cultivated row crop lands, 200 times greater than on pasture land, and 2,000 times greater than on unlogged timber lands.

Exposure of the unprotected soil surface to falling rain, channelized and sheet flows of storm water, and the impact of construction equipment during the wet season on construction sites lead not only to damage to the construction site but to stream channels to which the soil particles are carried and, ultimately, to the Bay.

However, the adverse impacts of human activity on the land can be substantially reduced and often eliminated by erosion and sediment control practices. The Association of Bay Area Governments (ABAG) adopted in 1980 a

"Manual of Standards for Surface Runoff Control Measures" which included model construction erosion and sediment control ordinances, plans, and standards for construction of erosion and sediment control measures. During the 1980-81 wet weather season the Regional Board noted a number of erosion problems associated with construction activities and concluded that these problems would have been far better controlled if local governments' erosion control ordinances and regulatory programs had been in line with those recommended by ABAG.4/ Consequently, in amending the Basin Plan the Regional Board adopted a strong position on erosion control. The Regional Board stated that local governments are responsible for taking the lead in controlling erosion and sedimentation from construction projects and that local governments must develop their erosion and sediment control programs for review and approval by the Board within a specific time schedule. Under the schedule adopted by the Board, Marin County, Mill Valley, and Tiburon are to have an erosion and sediment control program approved by the Board's Executive Officer by July 1, 1983. Sausalito and Belvedere are to have ordinances and programs approved by July 1, 1984. The ordinances among other things, must:

1. Be comparable to the ABAG model ordinances in the "Manual of Standards for Erosion and Sediment Control Measures;"
2. Require preparation of erosion and sediment control plans consistent with the manual of standards; and
3. Provide for the installation of approved erosion control measures prior to the rainy season (October 15 - April 15).

The most effective method of controlling erosion is to revegetate disturbed land prior to the rainy season and not disturb the land during the rainy season (October 15 - April 15). Thus, no grading should be allowed during the rainy season except in specific cases when extension of grading into the wet season or early grading is necessary or reasonable. The ABAG erosion and sediment control model ordinances and standards do not prohibit grading activity during the rainy season, the models seek to minimize soil exposure during the rainy season by timing of grading and construction. To protect Richardson Bay from undue sedimentation, grading during the rainy season would best be prohibited (except when necessary) and all disturbed soils should be stabilized and revegetated in advance of the rainy season.

Richardson Bay local governments are currently updating their existing grading ordinances or developing new erosion control ordinances. Marin County is developing a new grading ordinance which will require permits for smaller projects. Large projects are already required to have a grading plan as part of overall project development approval. For some projects, the new ordinance requires preparation of an erosion and sedimentation control plan incorporating temporary and permanent devices to avoid drainage and erosion related problems during and after construction. "Winterization plans" may be required for construction during the wet season (October 15 to April 15). Projects requiring a plan include those with more than 10,000 square feet of area with slopes greater than ten percent; grading within 50 feet of the top of bank of a watercourse; and those which the Director of Public Works determines may pose a significant erosion or sedimentation discharge hazard.

The City of Mill Valley is also preparing a new ordinance, but has some existing controls over grading. Grading requires a permit, except for a slope of less than 10 percent or grading of less than five cubic yards.

The City of Tiburon also has existing controls over grading. Any grading requires a permit and difficult situations require review by the Town Engineer who may place conditions and standards on any project. The City plans to amend its existing code, by adding erosion and sediment control provisions.

The cities of Sausalito and Belvedere will be preparing erosion and sedimentation control ordinances in the near future.

TABLE 5

SUMMARY

Following is a summary of the problems, sources and recommended controls of water pollution in Richardson Bay:

Problem	Source	Recommended Controls
High bacteria levels	Treated/untreated municipal waste Vessel discharges Wet weather overflows	Eliminate all municipal waste treatment plant outfalls from Bay. Require all permanently moored residential vessels to connect to sewers and all navigable residential vessels to either connect to sewers or install holding tanks. Provide adequate pump out facilities either stationery or on mobile barge.
High BOD and bio-stimulants	Treated/untreated municipal waste. Wet weather overflows	Eliminate all municipal waste treatment plant outfalls from Bay. Require all boats to connect to sewers or provide holding tanks. Provide adequate pump out facilities. Reduce contaminants in runoff by use of street sweeping, sedimentation basins and other methods suggested in Co. Surface Runoff Plan.
Toxic Metals and Chemicals	Urban runoff Dredging Municipal Waste	Reduce contaminants in runoff by use of street sweeping, sediment basins and other methods. Sample potential dredge areas for toxic substances before dredging. Eliminate municipal plant outfalls.

Turbidity and Sedimentation	Improper grading Erosion Dredging	Require grading controls. Use sedimentation basins. Use dredging methods wich create least amount of disturbance.

CHAPTER IV: TENTATIVE FINDINGS AND POLICIES

Findings

1. There are 11 categories of beneficial uses of Richardson Bay water established by the State Water Resources Control Board and the Regional Water Quality Control Board. Three of these uses -- water contact recreation, non-contact water recreation, and shellfishing harvesting -- have been identified as key beneficial uses" for protection in Richardson Bay.
2. Water quality in Richardson Bay is influenced by a number of human related processes. The most important factors include: release of untreated and treated wastewater; urban storm water runoff; erosion and sedimentation; and dredging and dredge disposal.
3. The water quality of Richardson Bay affects its attractiveness and recreational value for the population of the immediate area and the entire Bay Area. Two critical pollutant measures of whether or not the water is safe for human recreation use are coliform bacteria standards for human water contact recreation and for shellfish harvesting. The levels of coliform bacteria, representing mainly the release of untreated sewage and graywater, decreased dramatically during the period 1962 to 1973; however,

during the period 1973 to 1981, levels of coliform bacteria in Richardson Bay increased in some areas around certain pleasure craft and houseboat marinas.

4. Discharge of treated municipal wastewater into Richardson Bay has been a major source of water pollution in the form of coliform bacteria, biochemical oxygen demanding substances, and biostimulatory substances. Because of the shallowness of Richardson Bay, poor tidal circulation and capability for mixing, the Regional Water Quality Control Board has banned treated municipal wastewater discharges into Richardson Bay.

The Sewerage Agency of Southern Marin is currently carrying out an extensive municipal wastewater treatment plan and program which will improve treatment at all southern Marin treatment plants - Sausalito-Marin City, Mill Valley, and Sanitary District No. 5 - to secondary treatment level and discharge the treated effluent outside Richardson Bay in deep water in Raccoon Strait and offshore the Marin Headlands to assure proper mixing of treated wastewater and Bay water. The Raccoon Strait outfall pipe should be completed in September, 1983 and the upgraded Mill Valley and Sanitary District No. 5 treatment plants should be operational in March, 1984. Work on the Sausalito-Marin City treatment

plant will commence as soon as federal grant monies are secured and should be completed within 1-1/2 to 2 years after the grant is received.

5. Wet weather overflow discharge into Richardson Bay is a serious source of water pollution. Wet weather discharges occur during and after rainstorms when stormwater infiltrates sanitary sewers and overloads sewer and treatment plant capacity. The upgraded treatment plants at Mill Valley, Sanitary District No. 5, and Sausalito-Marin City are designed to accommodate and treat wet weather sewage outflow to the level required by the Regional Water Quality Control Board's Basin Plan.

6. Urban stormwater runoff can carry a variety of pollutants into Richardson Bay. Because most of this runoff cannot be treated before it enters the Bay, it is necessary to remove pollutants from land areas before they come into contact with stormwater runoff. Marin County and the cities of Sausalito, Mill Valley, Tiburon, and Belvedere are carrying out the urban runoff control measures recommended in the Marin County Surface Runoff Management Plan which will significantly improve the quality of surface runoff into Richardson Bay.

7. Although dredge spoils cannot be deposited in Richardson Bay, dredging is commonplace and necessary to maintain navigational channels and marina basins in the shallow Bay. Dredging often has short term, localized adverse impacts on the environment. In some locations Bay mud may contain pollutants and toxic materials.

8. Sedimentation, a product of soil erosion, can have an adverse impact on estuarine water bodies including Richardson Bay by covering and eliminating aquatic habitat such as shellfish beds and fish spawning grounds; increasing conversion of marshes to upland by becoming trapped and building up in stands of marsh plants; and filling in natural and navigational channels, and marina and boat basins.

9. The natural soil erosion process is accelerated when the soil surface is disturbed, particularly during construction, and when protective vegetative cover is removed. The exposed soil mantle is exposed to falling rain and sheet flows which results in the increased movement and loss of soil particles to stream channels and other storm water drainage system and ultimate deposition in the Bay as sediment.

10. In most cases, the impact of human activity on the land which results in erosion and sedimentation can be substantially reduced and often eliminated by

employing proper erosion and sediment control practices. The Association of Bay Area Governments has prepared and adopted a "Manual of Standards for Surface Runoff Control Measures" which includes model erosion and sediment control ordinances and control measure standards. The Regional Water Quality Control Board has directed Richardson Bay local governments to develop erosion and sediment control regulatory programs by July, 1984 which are consistent with the Manual and to provide for the installation of approved erosion control measures prior to the start of the annual rainy season (October 15 - April 15).

11. The most effective method of controlling erosion on disturbed land is to install erosion control measures, particularly revegetation of the disturbed land, in advance of the rainy season and to prohibit land disturbance particularly on hillsides, during the rainy season except when necessary.

12. Both sewage (human body wastes) and graywater (galley, bath, shower, and cleaning water) discharged from vessels in Richardson Bay pollute its waters. Some authorized houseboats as well as most, if not all, unauthorized houseboats and live-aboards are not connected to a Regional Water Quality Control Board or Marin County Department of Environmental Health

approved sewage and graywater treatment system; they may discharge sewage and/or graywater into Richardson Bay.

13. The number of unauthorized houseboats and live-aboards has increased in the last ten years, although numbers fluctuate. The Regional Board estimates that between 10 and 20 percent of recreational berths are used for live-aboard boats. Although many of these boats have marine heads (toilets) and other facilities such as galleys, none are hooked up to shoreline sewage systems. Some may be equipped with sewage and graywater holding tanks but few, if any, use the two existing shoreline pump-out facilities. While some houseboats and live-aboards may have "alternative" sewage disposal systems, these systems are probably unreliable and are not presently acceptable to the Regional Board or the Marin County Department of Environmental Health.

14. The most effective and reliable method of treating sewage and graywater and assuring the wastes are not discharged into Richardson Bay is the installation of a continuous connection system from vessel sewage and graywater source facilites to a shoreside sewage treatment system.

An additional effective method of treatment is the containment of sewage and graywater within a vessel holding tank which is pumped out into a shoreside sewage treatment system.

15. An alternate system of gathering sewage and graywater from houseboat and live-aboards may also be feasible; floating a large holding tank with pumpout mechanism around to vessels used as residences (commonly called a honey barge). Under this system, sewage and graywater is pumped from the individual vessel holding tanks into the larger barge holding tank for transport to a shoreside pumpout facility and sewage treatment system. Although there is little experience with such a system, the system is theoretically possible. It would involve costs of constructing a holding tank barge system and operating and administering of the system. Any such system would have to be licensed by the Marin County Department of Environmental Health. The staffs of the Regional Board and County Department of Environmental Health have both expressed scepticism about the economic feasiblity and reliability of such a system.

16. Other alternative onboard sewage treatment systems have been proposed for use on houseboats and live-aboards. These systems utilize a biological

process to breakdown sewage. According to the County Department of Environmental Health, an unpublished study, prepared by the Environmental Protection Agency and the State Office of Appropriate Technology, indicated that such systems were not reliable. The Regional Board and Environmental Health Department staffs have concluded that there are no alternative sewage treatment systems (toilets) that they would approve for use on houseboats or live-aboards at the present time.

Policies

1. The funding and construction of approved sewage treatment facilities to end treated municipal wastewater discharges into Richardson Bay should be expedited as much as possible by local, regional, state, and federal agencies.
2. Sewage collection systems should be upgraded and new treatment plants should be sized to accommodate most wet weather flows to prevent the discharge of untreated sewage on land or into Richardson Bay.
3. Local governments should carry out the urban runoff control measures recommended in the Marin County Surface Runoff Management Plan to the maximum extent feasible.

4. Samples of sediments to be dredged from Richardson Bay, particularly at initial dredging sites, should be tested for pollutants following the U. S. Army Corps of Engineers testing procedures as part of the environmental analysis of any proposed dredging project.

5. The Richardson Bay local governments should adopt erosion and sediment control ordinances and regulatory programs that are consistent with the ABAG Manual of Standards for Erosion and Sediment Control Measures as required by the Regional Board. In addition, the local governments should incorporate in their ordinance provisions prohibiting grading in the Richardson Bay watershed during the rainy season (October 15 - April 15) except when necessary or reasonable.

6. The San Francisco Bay Conservation and Development Commission should include erosion and sediment control conditions in its Richardson Bay shoreline permits consistent with the ABAG Manual of Standards of Erosion and Sediment Control Measures and prohibit grading in the Richardson Bay shoreline band during the rainy season (October 15 - April 15) except when necessary or reasonable.

7. There should be no discharge of untreated sewage or graywater into Richardson Bay marina basins or open waters and existing discharges should be eliminated. Houseboats should be equipped with and use a system that pipes all vessel sewage and graywater to a shoreside sewage treatment facility. Live-aboards should either: (a) be equipped with and use a sewage and graywater collection system continuously connected to a shoreside sewage treatment facility, or (b) be equipped with and use a holding tank to contain sewage and graywater, with no outlet to allow tank or device to be emptied except by pumping.

8. Marinas and yacht harbors should install in easily accessable locations and provide free of charge or at a reasonable fee sewage and graywater pumpout facilities. Marinas and yacht harbors with vessels used as residences should provide on land conveniently located restrooms, showers, and garbage disposal facilities adequate to serve authorized resident live-aboards and transient cruising craft. Commercial fishing fleet operations should provide onshore restrooms and shower facilities for resident fleet and transient fishing vessel crew use, and, if live-aboards are authorized at the facility, vessel continuous connection to a shoreline sewage treatment system or a sewage and graywater pump-out stations should be installed.

NOTES

1/ The Porter-Cologne Water Quality Control Act, as amended (California Water Code, Division 7); Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.).

2/ California Regional Water Quality Control Board, San Francisco Bay Region, Water Quality Control Plan San Francisco Bay Basin (2) Amendments (1982).

3/ Association of Bay Area Governments, Manual of Standards for Surface Runoff Control Measures (1980).

4/ California Regional Water Quality Control Board, San Francisco Bay Region, Water Quality Control Plan San Francisco Bay Basin (2) Amendments (1982).

5/ Untreated graywater, according to the Regional Board and the Marin County Department of Environmental Health, is just as significant a form of water pollution, if not worse, as untreated sewage. Graywater contains soap residues, high concentration of BOD, suspended solids, oil and grease, and coliform organisms. Although graywater typically contains lower concentrations of coliform bacteria than sewage, it contains higher concentrations of BOD, suspended solids, oil and grease, and biostimulatory substances such as nitrogen and phosphates.

6/ California Regional Water Quality Control Board, San Francisco Bay Basin, Vessel Waste Discharge Survey (1981).

7/ Ibid

8/ Ibid

9/ Art Zone, Residential Survey of the Sausalito Waterfront (1981).