

Staff Report
on
In-Bay Dredge Disposal
at Alcatraz

May 1987

San Francisco Bay Conservation and Development Commission
Thirty Van Ness Avenue, Suite 2011
San Francisco, California 94102-6080

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FOREWORD

The U. S. Army Corps of Engineers has requested the Commission's views on resolving the mounding problems at the Alcatraz disposal site that occurred in 1982 and in 1985. To gain a better understanding of the mounding problems, the Commission invited 15 experts to brief the Commission on various aspects of the problem. The testimony presented to the Commission indicated that in addition to the mounding problem, disposal of dredge spoils at Alcatraz can raise water quality issues.

During the Commission briefings and subsequent staff evaluations, the following peripheral issues were also raised: continual recycling of dredge material and repeated suspension of those sediments in the water column; the overall health of the Bay waters as it is affected by pollutants entering the system; and the overall balance of sediment transport throughout the Bay. Although these peripheral issues are important, this report is limited to three issues: (1) causes of the mounding, (2) solutions to the mounding problem, and (3) the adequacy of the present testing of the disposal material.

This report is not intended to be the definitive study of all problems arising from the deposition of dredge material into the Bay, but offers only recommendations toward solving the mounding problems and adequacy of testing for pollutants in the disposal material.

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SUMMARY

About 10 million cubic yards of sediment flows into San Francisco Bay each year. Only 30 percent of this sediment is carried out the Golden Gate by tides. The rest settles to the Bay bottom and must be dredged to keep navigational channels, boat berths, and marina basins open. In addition to this maintenance dredging, additional material is dredged for harbor expansions, new navigational channels, and to deepen existing channels to accommodate larger ships.

Dredged materials, usually called "dredge spoils", are sometimes used as fill material or deposited on land. But most often the spoils are dumped in a part of the Bay where there will be as few impacts as possible.

The U. S. Army Corps of Engineers is responsible for designating and managing in-Bay disposal sites -- Carquinez Strait, Central San Pablo Bay, and a site near Alcatraz Island. The Alcatraz site receives the most use because much of the deposited material is theoretically carried out the Golden Gate, and the site is close to Central Bay ports which require extensive maintenance dredging.

In late 1982 it became apparent that instead of dispersing, the material at the Alcatraz site was accumulating or "mounding." To address this problem, the Corps of Engineers restricted both the location and the method of disposal at the site and dredged the excess material from the mound. Despite these efforts, the mounding problem recurred in early 1985. Because of concerns that the Alcatraz site might be closed and the effect that this closure could have on Bay dredging costs and environmental resources, in mid-1986, 15 experts on various aspects of dredging were invited to brief the Commission on

the causes of the mounding, possible solutions to the problem, and the environmental impacts of dredging and in-Bay disposal.

From the information presented at these briefings and the staff's further investigation of this matter, the staff has concluded that a suitable in-Bay dredge disposal site is needed to accommodate the maintenance dredging that is essential to keeping San Francisco Bay an economically viable port area. To achieve this goal:

1. State and federal agencies with the technical expertise should jointly conduct the necessary biological, hydrological, and sediment transport studies so that a dredge disposal site in the Pacific Ocean outside the Golden Gate can be quickly designated should in-Bay disposal be found unacceptable.
2. Prior to designating an "annex" disposal site near the Alcatraz site or designating any other in-Bay disposal site, joint state and federal agency biological, hydrological, and sediment transport studies should be conducted. If an Alcatraz "annex" is designated, it should be used only if the mounding problem at the primary Alcatraz site recurs.
3. The planning for new dredging projects should be undertaken with the understanding that the spoils may have to be disposed on land or at an ocean site if mounding recurs at Alcatraz or in-Bay disposal is found unacceptable. If the cost of ocean disposal or suitable inland disposal cannot be accommodated

in the economic feasibility of new dredging projects, the project should not be undertaken.

4. The Regional Water Quality Control Board, the U. S. Environmental Protection Agency, the Corps of Engineers, and other agencies should continue their current study of appropriate testing methods to assess chemical components of Bay sediments proposed to be dredged in order to establish the testing protocol for material to be dredged from and possibly deposited in the Bay.
5. To establish standards that will protect Bay water quality, as part of the National Estuary Program, the Environmental Protection Agency Bay Delta project should include a study of the dispersal of toxic material in Bay waters resulting from dredging and dredged material disposal and its impacts, if any, on aquatic and wildlife resources. To fill any gaps in information, the Environmental Protection Agency program should be coordinated with the hydrodynamics studies currently being carried out by the Interagency Ecological Study Program, as part of the broader Delta Outflow/San Francisco Bay Study.
6. Ongoing interagency studies of the hydrodynamics of the Bay should be augmented to include studies of sediment transport in order to determine the overall effectiveness of in-Bay disposal of dredged material, particularly at the Alcatraz site.

7. The Commission should not consider issuing a regionwide permit for maintenance dredging because all dredging projects, whether new or maintenance, should be considered on a case-by-case basis until there is certainty that the mounding problem at Alcatraz and the water quality implications of dredging and in-Bay disposal of dredge materials have been satisfactorily resolved.

The following report, which was prepared by Norris B. Millikin, the Commission's staff engineer, explains the mounding problem in further detail and describes the analysis which supports the preceding conclusions.

CHAPTER I. THE REGULATION OF DREDGING

Applicants for Commission dredging permits vary widely, both in terms of the purpose of the dredging and the amount dredged. The applicants can be classified, according to their predominant activity, into the following categories: ports, recreation facilities, public works (flood control, sewage, etc.), public transportation, and federal agencies (facilities and navigational channels). The federal government is not required to apply for permits from the Commission, but under the federal Coastal Zone Management Act, it is required to carry out its activities in a manner that is consistent, to the maximum extent practical, with the Commission's coastal management program. Although the number of applications for port-related dredging is about the same as for recreational and public works dredging, the volume of dredging for ports is much greater than all other categories except the federal government category.

Applicants also vary widely in their ability to contend with the governmental requirements relating to dredging. Those with skilled personnel, financial capacity, and familiarity with the process--ports, petroleum companies, utilities, government agencies, and special districts--are able to deal with the existing requirements, however complex they may be. The smaller applicant, on the other hand, such as the private owner of a small marina, who generally must meet the same requirements as the more sophisticated dredger, finds these requirements much more formidable. He must usually retain a consultant to assist him, which adds significantly to the project cost, or to face delay, which can be even more

costly. Some very small dredgers who wish only to clear a narrow berth, may even find the cost and complexity of the application process prohibitive.

There are three common types of dredges. Each has different operating characteristics and potentially different environmental impacts. The clamshell dredge is essentially a crane mounted on a barge. It picks up material with its bucket and releases it either on land (if within boom length), or into an adjacent scow. The scow is towed by tug to the disposal area for dumping. Maneuvering the dredge, scow, and tug requires adequate room and water depth. The spoils are dropped into the scow in a near solid condition allowing only a small water, if any, to spill from the scow at the dredge site. The effect of water washing over the sediment as the bucket is brought to the surface causes some turbidity at the dredge site.

The hydraulic, or suction dredge, operates like a vacuum cleaner, drawing sediment and large quantities of water through the suction pipe and pumping them to the disposal site. After the sediment settles, the water is usually returned to the Bay. Hydraulic dredges offer three advantages over clamshells: they cause less turbidity at the dredge site; they can transport spoils a long distance to the spoils site; and they can remove large quantities of material without requiring maneuvering space for a scow and a tug. Disposal of the spoils on land, however, requires a large pond area for the sediment to settle. The solid and chemical content of the water returned to the Bay after settlement is also of concern.

The self-propelled hopper dredge, used primarily by the Corps, is similar to the hydraulic dredge in that it also uses a vacuum to remove material. The hopper dredge excavates by sucking the dredged material through trailing scrapers into hoppers. The water in the material is returned to the Bay at the dredge site, and the sediments are then carried

in the dredge to the disposal site. As an ocean-going vessel, the hopper dredge needs adequate depth and space to maneuver and is generally not usable for work in confined or shallow areas. As with hydraulic dredging, the solid and chemical content of returned water is of concern.^{1/}

CHAPTER II. THE MOUNDING PROBLEM AT ALCATRAZ

Much of the bottom of San Francisco Bay is covered with sediment--silt, sand, and clay--that has been carried by tributaries from dry land upstream. Sediment continues to flow into the Bay at the rate of about 10 million cubic yards a year.^{2/} Only 30 percent of the sediment entering the Bay is carried out the Golden Gate by the tides.^{3/} The remainder settles to the bottom of the Bay. Eventually, much of the sediment lodges in harbors and shipping channels from which it must be dredged at considerable cost. Dredged mud is sometimes used as a fill material, but most often, the sediment is simply dumped in a part of the Bay where it is expected to cause as little harm as possible.

The Corps of Engineers has responsibility for regulating dredging operations, including locating and managing dredge disposal sites in San Francisco Bay Area pursuant to Section 404 of the Federal Clean Water Act. The Corps has designated three in-Bay dredge disposal sites--one in Carquinez Strait, one in San Pablo Bay, and one near Alcatraz Island.

The best of these is the Alcatraz disposal site. It receives the most use because it is exposed to strong tidal currents, is near the outlet to the ocean, and is near major ports which require extensive dredging. Even at this most effective disposal site, less than half of the sediment is carried out to sea by the tides.^{4/} Many experts believe there is considerably less than half of the sediment going out the Golden Gate. The U. S. Geological Survey has conducted studies that indicate some of the sediment which initially drifts seaward drifts back into the Bay as it moves downward through the water column. As a result, the Survey has concluded that at certain times and

circumstance there is a net inflow transport of sediment through the Golden Gate.^{5/} The remaining sediment is simply recirculated in the Bay by the tides, and eventually settles to the bottom where it may have to be dredged again. The average volume of dredge material to be deposited at the Alcatraz disposal site for the next five years is estimated to be seven million cubic yards per year--five million cubic yards per year from maintenance dredging projects and two million cubic yards per year from new dredging projects. The five million cubic yards of maintenance dredging material is a historical average and it is expected to be that amount in 1987. For 1987, the new dredging projects will equal 1.717 million cubic yards and include the following projects: Port of San Francisco, 1.4 million cubic yards; Chevron outfall project at Richmond, 230,000 cubic yards; and Oakland Army Base, 87,000 cubic yards.^{6/}

Problems at the Alcatraz disposal site first occurred in 1982 when an accumulation of dredged material occurred primarily in the eastern half of the site. Corps divers and hydrologic surveyors examined the peak and confirmed the existence of large chunks of concrete in the mound.

To address this problem, the Corps restricted disposal to the western half of the site, and specified that the material dredged from the Baldwin Ship Channel had to be disposed in a "slurry" (a soupy mixture which currents can disperse more readily). The large chunks of concrete were raised to a barge and deposited upland.

Despite those precautions, early in 1985, after approximately three months of disposal, the Corps discovered that there was mounding again at the Alcatraz site. Of the three million cubic yards of material deposited at Alcatraz from the first contract of the Baldwin Ship Channel project, approximately one fourth of the material remained as a mound at the site. In

evaluating this new mounding problem, the Corps speculated that the material being deposited was more dense than had been anticipated, so dense that it fell quickly to the bottom instead of dispersing through the site. This material originated from the Southampton Shoal area located between Angel Island and Point Richmond and was classified as silty sand.

It was expected that the second contract for the Baldwin Ship Channel, which was for the turning basin at Richmond, would cause considerably less mounding. The material from the second contract was classified as silt and was less dense than that from the Southampton Shoal. As expected, the material from the second contract did not accumulate in the north part of the site where it was disposed. However, at the same time, material from other projects and maintenance dredging was disposed in other parts of the site and some accumulation was noted in the western part of the site.

When mariners detected the subsurface mound on the north side of the Alcatraz disposal area, it became apparent that there was a threat to navigation. The location was noticeable because of the formation of eddies that resulted from the current interacting with the subsurface mound. The Coast Guard immediately placed a buoy near the peak of the mound and notified mariners of the restricted navigational depth. When currents failed to reduce the mound, the Corps reduced the peak in July 1984 by dredging it to -40 feet mean sea level.

Because of the necessity to maintain a -40 foot depth for navigational safety, any mounding above that -40 foot line could threaten the continued use of Alcatraz as an in-Bay disposal site. The loss of the Alcatraz site would have serious impacts in regards to future new and maintenance dredging in the Bay. New dredging projects, such as Oakland harbor, Richmond harbor, the Navy's Homeporting project, and several maintenance dredging projects might

have to be postponed or eliminated if an alternative disposal site cannot be made available in a short time.

The Alcatraz site receives the major proportion of the disposal material generated by Bay dredging. If the Alcatraz site is lost, the Alcatraz problem becomes a disposal problem for the entire Bay.

Although several solutions have been suggested to deal with the problem of mounding at the Alcatraz site, each has costs, either monetary or environmental. The suggested solutions, which are discussed in detail in Chapter IV of this report, are: (1) designating alternative in-Bay disposal sites, (2) using upland disposal sites, (3) designating an annex to the Alcatraz site, (4) designating an ocean disposal site, and (5) amending the Corps' Disposal Management Plan.

Upland disposal sites, near the Bay and economically feasible for this use, are all but nonexistent. The Corps' Disposal Management Plan is intended to improve the function of the Alcatraz disposal site but is not an alternative to the site. The alternative in-Bay disposal sites, the annex to the Alcatraz site, and the ocean disposal site all must be designated before they would be available for use as disposal sites. If the Alcatraz site is lost to use in the very near future, none of these suggested solutions would provide an alternative in time to preclude the postponement or elimination of the previously mentioned dredging projects.

CHAPTER III. COMMISSION BRIEFINGS

To gain a better understanding of the mounding problems at Alcatraz, at its meetings of July 17, 1986 and September 4, 1986, the Commission was briefed by 15 experts on various aspects of the problem.

The following individuals presented their perspectives on the problem, its causes, and possible solutions:

Lt. Col. Andrew M. Perkins, District Engineer, U. S.

Army Corps of Engineers

Patrick J. Cotter, Ocean and Estuaries Studies, U.S.

Environmental Protection Agency

Daniel L. Tempelis, Planner, San Francisco Bay Regional

Water Quality Control Board

Eugene Gartland, Executive Director, Port of San

Francisco

William Mueser, Smith-Rice Company

Keith Quan, Chief Planner, Port of Oakland

Alan Ramo, Legal Director, Citizens for Better

Environment

The following individuals focused on the environmental impacts of dredge spoil disposal:

Donald Lollock, Chief, Environmental Services Division,

California Department of Fish and Game

Lt. Paul P. Steele, Chief of Hydrographic Party,
National Oceanic and Atmospheric Administration
William Hannum, Manager of the Pacific Division, Great
Lakes Dredge and Dock Company
David Rubin, Marine Geologist, U. S. Geological Survey
Lawrence Kolb, Assistant Executive Officer, San
Francisco Bay Regional Water Quality Control Board
Capt. Frank Georgio, Homeporting Coordinator, U. S. Navy
James McKeivitt, Field Supervisor, U. S. Fish and
Wildlife Service
James Bybee, Environmental Coordinator, National Marine
Fisheries Service

CHAPTER IV. CAUSES OF THE MOUNDING

Although problems at the Alcatraz site occurred in late 1982, and again in 1985, the causes of the mounding appear to be quite different.

According to Colonel Edward Lee of the U. S. Army Corps of Engineers, who testified during the Commission's May 17, 1984 public hearing on the central San Francisco Bay segment of the Baldwin Ship Channel near Richmond, the mounding in 1982 was caused by an accumulation of dredged material that had occurred primarily in the eastern half of the site, because of unauthorized disposal of concrete and dumping of large quantity of consolidated sediment in one small portion of the site. In contrast, based on tests conducted by the Corps of Engineers, the problem in 1985 seemed to result from an accumulation of dense spoils dredged from the Southampton Shoal near Point Richmond as part of the Baldwin Ship Channel project, and ongoing permitted dredging and disposal activities.^{7/}

In preparation for placing the disposal material from the Baldwin Ship Channel project at Alcatraz, the Corps of Engineers San Francisco District, sent all available information relating to the Alcatraz site, such as tidal and current data, bottom topography, along with samples of disposal material to be placed to the Corps' Waterway Experiment Station (WES), in Vicksburg, Mississippi. Using this data, a WES mathematical model was used to replicate conditions at Alcatraz. With the model, WES studied the release of the material into the water column. The mathematical model suggested that the Baldwin Ship Channel material, to be deposited at Alcatraz, which originates from the Southampton Shoal area and which is classified as silty sand, might be so dense that it might fall quickly to the bottom and cause some of the

mounding problem. In order to relieve the mounding problem, the Corps specified that the material dredged from the Baldwin Ship Channel be disposed in a slurry.

Another cause of the mounding may be that sediment is gradually accumulating because material is being deposited at a rate that exceeds the natural dispersion rate. This conjecture is supported by the experience during the second contract of the Baldwin Ship Channel when only two thirds of the material was dispersed by the currents during the disposal period.^{8/} The long-term accumulation of material has also been documented by the National Atmospheric and Oceanic Administration (NOAA) in its survey of the area around the Alcatraz disposal site in 1947, 1978, and 1983. In reviewing this data, it can be seen that accumulation of material in this area has been taking place even prior to 1982 and that there has been continual and significant shoaling in the area.^{9/}

It appears that the mounding problem is directly related to the type of material disposed at Alcatraz. The WES experiments showed that some material, especially that dredged from the Southampton Shoals near Richmond, was so dense that it fell quickly to the bottom without dispersing.

Even though the 1982 mounding was originally thought to be caused by the unauthorized disposal of concrete, that problem was also probably caused mainly by the type of material disposed at the site. Core samples, taken in 1985, extended into the material that remained from the 1982 mound. The core samples contained layers of dispersible material alternated with layers of non-dispersible dense sand. Even though considerable dispersible material was deposited at the site, the lighter material was trapped by the layers of dense sand. Furthermore, the Corps found and extracted only 30 tons of debris--concrete chunks and panels, and reinforcing steel bars--when the mound

was dredged in 1982. This is not enough material, by itself, to prevent the mound from being eroded by two years flow of currents and tides.

The shoaling at the site and the near vicinity that was documented by NOAA as having taken place for the past 40 years is also probably the result of dense sand being disposed of at Alcatraz over the years.

Unfortunately, depositing material in a slurry will not effectively prevent mounding if the material contains a large amount of dense sand. The Corps concluded from their WES flume tests, completed in the spring of 1986, that material will not disperse if its density exceeds 1.3 grams per cubic centimeter. This condition probably led to the situation cited earlier when only two-thirds of the material from the second contract of the Baldwin Ship Channel was dispersed by the currents during the disposal period. The Corps limited its slurry requirement to those sediment types that are fine grained and consolidated. When a sieve analysis of the material indicates the material to contain 80 percent or greater of sand, the material is not to be slurried, but will be required to be disposed in a site reserved for non-dispersive spoils.^{10/}

Finally, it must be accepted that Alcatraz or any alternative in-Bay disposal site will experience some gradual reduction in capacity because of the accumulation of dredge material which will not readily disperse. To offset this condition, the Corps should be prepared to dredge the Alcatraz site periodically and have alternative sites designated to provide the needed capacity for dredge material.

CHAPTER V. SOLUTIONS TO THE MOUNDING PROBLEM

Several solutions have been suggested to deal with the problem of mounding at the Alcatraz disposal site. These suggested solutions are: (1) designating alternative in-Bay disposal sites; (2) using upland disposal sites; (3) designating an annex to the Alcatraz site; (4) designating an ocean disposal site; and (5) amending the Corps' Disposal Management Plan. All of the solutions, except the last, which amends the Corps' Disposal Management Plan, have associated aquatic and/or wildlife impacts that should be addressed during the environmental impact process for the respective sites.

When the 1982 mounding occurred, the Corps began looking for alternative in-Bay disposal sites. Twelve sites were studied, but most were eliminated from further consideration. Two sites in the Bay, one near Point Bonita, west of the Golden Gate Bridge offshore from the Marin Headlands, and the other near the south tower of the Golden Gate Bridge are still being investigated. However, while both are in deep water and experience sufficient current, based on preliminary data, concerns over fisheries have virtually ruled out these sites. A potential South Bay disposal site between Hunters Point and Yerba Buena Island is still under consideration. A site in this area would probably not pose environmental or navigational impacts however, the absence of deep water and strong currents would possibly leave the site subject to mounding problems. Further investigation is required to establish whether a South Bay site is acceptable.

There is strong support for the Commission's Bay Plan policies that call for placement of dredge materials on dry land as the first priority for

dredge material disposal.^{11/} However, the existence of dry land disposal sites near the Bay are all but nonexistent and their use is economically infeasible.

The Corps is also studying the designation of an "annex" disposal site, which would be a 1,500 feet by 1,500 feet square, lying roughly 300 feet northeast of the existing Alcatraz site. It is the Corps' intention to use this annex for the disposal of sediments predicted to be nondispersive. The annex is seen as a short-term solution for accommodating nondispersive material until an ocean site or an alternative in-Bay site can be designated. However, the Corps expects to complete the environmental impact statement for in-Bay dredge material disposal, which will evaluate impacts on a number of disposal alternatives, by August 1989.

The Environmental Protection Agency (EPA) has authority to designate ocean disposal sites, pursuant to the Ocean Disposal Site Guidelines. The Corps studies various sites and makes its recommendation to the EPA. The Corps is presently engaged in detailed oceanographic studies at four locations offshore and hopes to recommend one to the EPA for an ocean disposal site by December 1987.

The EPA believes, from a policy perspective, that ocean disposal is the most viable long-term solution to the dredge disposal problem in the Bay. There is support for the Bay Plan policies which calls for disposal at an ocean site if an upland site is unavailable,^{12/} but the Navy and the Port of Oakland believe ocean disposal is too costly.^{13/} To put the cost of ocean disposal in perspective, Mr. Muesar presented the following comparative costs of transporting dredge material to Alcatraz versus an ocean disposal site:^{14/}

<u>Disposal Location</u>	<u>Per Cubic Yard Disposal of Soft Material</u>	<u>Per Cubic Yard Disposal of Hard Material</u>
Alcatraz	\$1.33	\$4.00
14 Miles outside the Golden Gate	\$2.66	\$4.80
28 miles outside the Golden Gate	\$3.33	\$5.60
36 miles outside the Golden Gate	\$4.00	\$6.20

The Corps uses a Disposal Management Plan (DMP) to set forth the policies and conditions for the disposal of spoils in the Bay. When mounding occurred at Alcatraz in 1985, the DMP was amended to include the following interim measures to be taken at the three in-Bay sites: (1) dumping of material from new projects must be minimized; (2) dumping must be directed to the deepest areas; (3) water quality requirements must be reviewed; (4) notification by permittees of disposal schedules is required to assess disposal rates; (5) pre- and post-hydrologic surveys are required; and (6) slurry disposal must be used for deposit of consolidated fine grain material. These measures are still in effect except the requirement for dumping in the deepest areas of Alcatraz is waived occasionally to allow the Corps to conduct tests of the material deposited at the site.

In assessing those measures, while there is support for slurry disposal to protect aquatic and wildlife resources,^{15/} dredgers believe it has no beneficial use and is too costly.^{16/}

Although the Corps does not require it in the DMP, there is some support for requiring that material be deposited only during ebb tide flows. That would ensure the suspended material would pass out through the Golden Gate quicker and drift seaward before settling to the bottom.^{17/}

The Corps opposes requiring ebb tide disposal because the approach does not appear to be cost effective. There is only one hour a day, when the ebb flow is strongest, that significantly greater amounts of suspended material pass out through the Golden Gate. Overall, there is little difference in the amounts of material that passes through the Golden Gate during the 12 hour ebb tide and the 12 hour flood tide. However, with ebb tide disposal, extra barge waiting time is required and the cost-per-yard is nearly doubled. Therefore, the Corps of Engineers has concluded that the minimum improvement in the amount of suspended material being removed from the Bay on the ebb tide does not warrant the additional cost.^{18/}

CHAPTER VI. WATER QUALITY

In addressing the mounding problem, several of the experts who appeared before the Commission indicated that dredging and in-Bay disposal of dredge spoils can present water quality problems.

The Commission's staff report, Water Quality in San Francisco Bay, points out that the Bay contains "hot spots" of polluted sediments that are often found at or near industrial and harbor areas where dredging is common. To detect pollutants that will be released into the water column during the dredging process, the Corps presently tests sediment samples from dredge areas. Samples of sediments are shaken in Bay water, producing an elutriate which is then tested for pollutants. If significant levels of pollutants are detected, then more rigorous tests are applied and dredging may not be allowed.^{19/}

However, use of the elutriate test as the sole test to first identify polluted sediments is coming under increasing question. Despite passing elutriate testing and being dredged twice in the last decade, Lauritzin Canal in Richmond was recently found to contain organisms polluted with DDT at extremely high levels.^{20/} Although Lauritzin Canal may be an isolated case, it raises the question of whether there other "hot spots" that may be passing the elutriate test and yet be contaminated.

The difficulty with using the elutriate test as the sole indicator of sediment pollution is that it can only register pollutants that dissolve or resuspend out of sediments. Pollutants that are insoluble or bound to sediments will likely remain undetected. These undetected pollutants may still have the potential to cause adverse impacts in Bay organisms. For

example, pollutants can be introduced into the marine food-chain by sediment dwelling organisms. Therefore, it is possible that the elutriate tests will not detect pollutants that, while not readily dissolvable, can result in adverse impacts on Bay organisms.^{21/}

The Regional Water Quality Board believes it is necessary to require tests that go beyond elutriate testing, and two major options are being considered. One is bulk sediment analysis, where the whole sediment is assessed chemically without reference to whether it dissolves in water. The second one is assay testing on sediments in which standard tests are compared to establish the response to any pollutants that may be present in the sediment.^{22/}

Bulk sediment testing evaluates the actual sediments for pollutants. Bioassays test the sediment effects on selected marine organisms. These tests may be used instead of, or in combination with, the elutriate test.

Some of the experts believe that testing for toxicants in dredge spoils is not adequate because the same sediments are dredged and disposed in the Bay repeatedly.^{23/} The water column is subjected to multiple exposure to toxicants which can build up to dangerous levels.

There is a considerable body of scientific evidence and opinion suggesting the existence of biological degradation due to long-term exposure to toxics, which have been discharged into the San Francisco Bay-Delta system. The Summary Report of the Cooperative Striped Bass Study indicated that contaminants such as petroleum hydrocarbons, PCBs, heavy metals, and chlorinated pesticides have been found in Bay-Delta striped bass and other aquatic organisms for many years. However, the study did not indicate that dredge materials disposal is the cause of this problem. In fact, the study did not examine dredge materials disposal as one of the pollutant sources, but

looked only at oil spills, waste discharges, and pesticide use.^{24/} This situation has led one expert to conclude that the Bay has a cumulative toxic problem and that most of the studies on toxics in the Bay are nonconclusive.^{25/} On the other hand, other experts contend the inconclusiveness of the Corps studies may indicate that the Bay environment is not being destroyed.^{26/}

To provide more definitive conclusions, one expert believed that it is necessary to update and refine the methodology for testing and monitoring of potential dredge spoils pollutants and improve the standards for spoils disposal. There especially is a need to develop testing and disposal standards for contaminants that have the capacity to accumulate and harm fishery resources over the long-term. These types of materials may not be measured by the elutriate test.^{27/}

Another expert believes bulk sediment analyses should be conducted in all instances, and solid phase bio-assay conducted when the bulk sediment analyses suggests they are appropriate.^{28/}

The usual testing by standard water elutriate analysis may not be adequate in all instances. To overcome this problem, material could be tested with a weak acid or bulk sediment analysis. If sediments pass standard elutriate tests, but analysis from weak acid elutriate or bulk sediment analysis show suspect results, then bioassay tests using appropriate test organisms could be required on a case-by-case basis.^{29/}

The experts generally agree that the standard water elutriate analysis may not be adequate in all instances and suggest the use of bulk sediment analysis in all cases and additional bioassay tests when indicated.

At this time, there is neither conclusive evidence that the present testing is inadequate and that the Bay is being adversely impacted by toxics in the dredge disposal material or that the testing is adequate and that the Bay is

free from the adverse impacts of toxics which may be in the dredge disposal material. However, there is considerable suspicion (as expressed by Mr. Ramo, Mr. Kolb, Mr. Lollock, Mr. McKeivitt, and Mr. Bybee) that the elutriate test might not be discerning enough to detect all the toxics in the dredge spoils, or that the pollutants are insoluble or bound to the sediment, so that they will remain undetected given the existence of highly contaminated Bay sediments spread unevenly and unpredictably through the Bay. Therefore, it is prudent to take a conservative approach to dredge spoil testing.

Because significant levels of pollutants in sediments have been found in areas that have already been dredged, testing should be extended to both new and maintenance dredging. And because pollutants are not evenly distributed in Bay sediments and to minimize testing costs, a tiered system should be employed that requires more extensive testing where contamination is suspected or has been revealed by initial tests.^{30/}

Introducing a new system of testing raises the following questions: what tests should be required? which pollutants should be tested for? which proposed dredge areas should be tested? and what is the economic feasibility of the testing? The Commission does not have the technical expertise or resources to make these evaluations. While concerned with the effects of dredging on water quality, the Commission has properly relied on the Regional Board and the EPA to advise it on water quality issues, and should continue to do so.^{31/}

The Commission's water quality report also noted that the Corps' criteria for disposal in the Bay (pursuant to the Clean Water Act) are less restrictive than the Corps' ocean disposal criteria (pursuant to the Ocean Dumping Act).^{32/} Rather than maintain this unfortunate bifurcation, higher standards should be set for testing the dredge spoils to be deposited in the

Bay and the EPA and the Regional Board should be encouraged to require bulk sediment analysis and bioassays of dredge spoils to be deposited in the Bay.

The Corps of Engineers has initiated an interagency technical working group, representing those state and federal agencies responsible for regulating the environmental impacts of dredging, to formulate and standardize new testing requirements for Bay dredging and disposal of dredged material to open water. It is anticipated that the new standards will form the basis of the state and federal testing requirements for Bay dredging work and will provide the "adequate testing" of proposed dredging required by the Commission's San Francisco Bay Plan dredging policies. Public review and comment on any new dredging and disposal testing requirements proposed by the interagency working group will be provided through the Corps of Engineers Public Notice process and a public hearing on any proposed standards may be held if warranted. Circulation of the Public Notice is expected in early summer.

Currently, a cooperative study called the Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary is being carried out by the Department of Fish and Game, the Department of Water Resources, the U. S. Fish and Wildlife Service, and the U. S. Bureau of Reclamation. The program contains four primary study elements: fisheries, water quality, Suisun Marsh, and fish facilities; and is focused on an evaluation of the impacts of present operations of the federal Central Valley Project and State Water Project. A major new element of this program was added in 1979--the Delta Outflow/San Francisco Bay Study--to determine how the timing and magnitude in Delta outflows affect aquatic resources in San Francisco and San Pablo Bays through flow-related, as contrasted with pollution-related, processes. While focusing on Delta diversion related topics, this program is generating new biological

and hydrodynamic information about the Bay that may be applicable to other peripheral or unrelated topics such as dredge and dredge spoil disposal.

In addition, in April of 1986, the U. S. Environmental Protection Agency initiated "the San Francisco Bay-Sacramento/San Joaquin River Delta Project." This project is part of the National Estuary Program, which was created to develop sound management practices leading to the maintenance, protection, and restoration of water and sediment quality and living resources in the nation's estuaries. The goals of the project are to: (1) develop a comprehensive understanding of the environmental and public health values attributable to the Bay and Delta, and consider how these values interact with social and economical factors; (2) achieve effective, united, and ongoing management of the Bay and Delta; (3) develop a comprehensive conservation and management plan to restore and maintain the chemical, physical, and biological integrity of the Bay and Delta, including restoration and maintenance of water quality, a balanced and indigenous population of shellfish, fish, and wildlife, and recreation of activities in the Bay and Delta, and assure that the beneficial uses of the Bay and Delta are protected; and (4) recommend priority corrective actions and compliance schedules addressing point and non-point sources of pollution. To date, the project is focusing on the formation and composition of its various committees, identification of project goals, and identification of priority study elements to be included in a five-year work plan and public participation program. This program will be closely coordinated with the Interagency Ecological Study Program and other federal, state, and regional studies now underway or soon to be initiated.

CHAPTER VII. CONCLUSIONS

The Bay Plan policies indicate that dredge spoils should be disposed at an upland location, a suitable disposal site in the ocean, or at one of the Corps' in-Bay disposal sites, in order that spoils are not placed in intertidal areas, seasonal wetlands, or at locations where they would not be adequately dispersed. These policies are still fundamentally sound and are supported by the California Department of Fish and Game, U. S. Fish and Wildlife, and National Marine Fisheries Service.

At the same time, the continued operation and efficient dispersion of spoils dumped at the federally-approved in-Bay sites should be continued for two reasons. First, spoils should be disposed of at sites where the maximum amount of sediment is carried out to the ocean in order to minimize redeposition of sediments in the Bay. Second, dredgers should have a convenient and acceptable alternative to depositing spoils on wetlands or in-Bay locations where disposal could have significant adverse environmental impacts.

The Alcatraz disposal site historically has received the most use of the in-Bay sites because of its location in a high energy area, near the outlet to the ocean and near major dredging projects. The majority of the participants at the Commission briefings expressed the belief that the Alcatraz site should be kept available as a disposal site for at least the maintenance dredging requirements of the Bay.

The McAteer-Petris Act and the Bay Plan require that the Commission minimize the adverse water quality impact of dredging projects. Dredging and subsequent Bay disposal of contaminated sediments can resuspend pollutants or

make them accessible to Bay organisms, resulting in possible adverse impacts on the beneficial uses of the Bay. While concerned with the effects of dredging on water quality, the Commission has properly relied on the Regional Board and the EPA to advise it on water quality issues, and should continue to do so. To ensure that the significant unavoidable adverse impacts of dredging are lessened, the Commission should require (1) environmental review of proposed dredging projects to address possible effects caused by any significant pollution of dredging and (2) testing adequate to reveal significant levels of pollutants and probable effects on Bay organisms of all sediments proposed for dredging, as specified by the Regional Board and the EPA.

To carry out these conclusions:

1. State and federal agencies with the technical expertise should jointly conduct the necessary biological, hydrological, and sediment transport studies so that a dredge disposal site in the Pacific Ocean outside the Golden Gate can be quickly designated should in-Bay disposal be found unacceptable.
2. Prior to designating an "annex" disposal site near the Alcatraz site or designating any other in-Bay disposal site, joint state and federal agency biological, hydrological, and sediment transport studies should be conducted. If an Alcatraz "annex" is designated, it should be used only if the mounding problem at the primary Alcatraz site recurs.
3. The planning for new dredging projects should be undertaken with the understanding that the spoils may

have to be disposed on land or at an ocean site if mounding recurs at Alcatraz or in-Bay disposal is found unacceptable. If the cost of ocean disposal or suitable inland disposal cannot be accommodated in the economic feasibility of new dredging projects, the project should not be undertaken.

4. The Regional Water Quality Control Board, the U. S. Environmental Protection Agency, the Corps of Engineers, and other agencies should continue their current study of appropriate testing methods to assess chemical components of Bay sediments proposed to be dredged in order to establish the testing protocol for material to be dredged from and possibly deposited in the Bay.
5. To establish standards that will protect Bay water quality, as part of the National Estuary Program, the Environmental Protection Agency Bay Delta project should include a study of the dispersal of toxic material in Bay waters resulting from dredging and dredged material disposal and its impacts, if any, on aquatic and wildlife resources. To fill any gaps in information, the Environmental Protection Agency program should be coordinated with the hydrodynamics studies currently being carried out by the Interagency Ecological Study Program, as part of the broader Delta Outflow/San Francisco Bay Study.
6. Ongoing interagency studies of the hydrodynamics of the Bay should be augmented to include studies of sediment

transport in order to determine the overall effectiveness of in-Bay disposal of dredged material, particularly at the Alcatraz site.

7. The Commission should not consider issuing a regionwide permit for maintenance dredging because all dredging projects, whether new or maintenance, should be considered on a case-by-case basis until there is certainty that the mounding problem at Alcatraz and the water quality implications of dredging and in-Bay disposal of dredge materials have been satisfactorily resolved.

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