Legacy Pollution

WHAT DOES IT MEAN FOR THE HEALTH OF THE BAY?

clean estuary partnership CEP

A collaborative effort of the San Francisco Bay Regional Water Quality Control Board, the Bay Area Clean Water Agencies, and the Bay Area Stormwater Management Agencies Association

Introduction: What makes the Bay so susceptible to Pollution?

Together, the vast San Francisco Bay and Delta form the West Coast's largest estuary, comprising almost 1600 square miles of waterways that drain fresh water from more than 40 percent of the land mass of California. The Sacramento River and San Joaquin River both flow into the Delta, creating a patchwork of islands, canals, and channels. The rivers then flow into the Bay and finally into the Pacific Ocean. This influx of fresh water from rivers and their tributaries carries with it rich nutrients and sediments. Within the Estuary, fresh water mixes with salt water from the ocean and with sediments deposited in the Bay—creating a uniquely rich and diverse aquatic ecosystem.

Because the Bay is an end point for waters from the urbanized Bay Area and urban and agricultural drainage from the Central Valley, it is especially vulnerable to pollution. Since the discovery of gold in the Sierra Nevada foothills in 1848, the San Francisco Bay-Delta watershed has been rapidly developed and permanently altered by urbanization, industrial manufacturing, agriculture, stream flow modification, and mining activities.

Since the Gold Rush, a number of substances associated with this ongoing history of human activity have settled into the stream beds and bottom sediments of tributaries and of the Bay. These substances have created a "legacy" of pollution that influences our ability to manage water quality in the Estuary today.

What are legacy pollutants and where did they come from?

Legacy pollutants in the Estuary are those that are primarily the result of historical contributions. They are pollutants that were used in the development of Northern California's industries before their negative aspects were understood. Legacy pollutants stem from agricultural, manufacturing, and mining activities no longer practiced and include some pollutants currently banned by regulation. They have the common characteristic of persistence in the environment and have an affinity for the sediments of the Estuary. As an example of the diversity of the original sources of legacy pollutants, the stories of three notable and significant legacy pollutants with numerous and diverse sources are described in this fact sheet: DDT, PCBs, and mercury.

DDT

DDT (dichloro-diphenyl-trichloroethane) entered the Bay primarily as a result of agricultural activities. Beginning in the 1940s, this insecticide was widely used throughout California until it was banned in 1972. More than 80 percent of California's freshwater resources are used to irrigate crops, consequently much of the water moving downstream toward the Bay throughout this time period passed through an agricultural field. Before DDT was banned, water diverted onto agricultural fields for irrigation purposes collected substantial quantities of DDT (and other pollutants) that later ended up in the Estuary.

DDT is a persistent synthetic chemical, meaning that naturally occurring bacteria in water and soil have a difficult time breaking it down. DDT is also fat soluble, and concentrates in the fatty tissues of living organisms. DDT's widespread use, persistence in the environment, and accumulation in living organisms has resulted in this chemical finding its way into just about every living organism in the Bay. DDT reaches highest concentrations in predators at the top of the food chain (such as hawks and pelicans), and can impair reproductive success when concentrations are too high.

PCBs

PCBs (polychlorinated biphenyls) were commercially developed in the late 1920s and have been used in numerous industrial and commercial applications. PCBs do not burn easily or conduct electricity. These characteristics made PCBs the insulator of choice for the burgeoning electric industry and as electricity came into widespread use during the first half of the century, so did PCBs.

PCBs are extremely stable, meaning they do not easily change their chemical form. PCBs' chemical stability made them ideal for electrical applications, such as electrical transformers and capacitors. But this characteristic also made PCBs very stable pollutants that do not break down in the environment. Like DDT, PCBs are highly soluble in fat and reach high concentrations in predators at the top of the food chain.

In time, researchers identified PCBs as significant pollutants that are suspected of causing cancer, that mimic hormones, and that can disrupt animal reproduction. Manufacturing of PCBs was finally banned in the U.S. in 1979. However, soils throughout the Bay Area are contaminated with PCBs, and these contaminated soils are regularly washed into waterways. Scientists refer to these diverse areas from which PCBs originate as "non-point sources." Although diffuse, the cumulative contribution of non-point sources to pollution in the environment can be significant.

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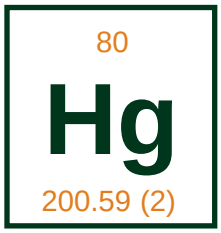
Mercury

Of all the pollutants in San Francisco Bay, the one that has received the most recent attention is mercury. Mercury contamination in the Bay is the legacy of California's "Gold Rush." Starting around 1848, liquid mercury, in a form known as quicksilver, was widely used to recover gold from mining operations. Though all forms of mercury are toxic, the most dangerous is an organic compound called methylmercury. This form is a potent neurotoxin that accumulates in the tissues of animals and bio-concentrates in the upper levels of the food chain. Mercury damages the nervous system causing developmental impairments and serious illness. Approximately 26 million pounds of mercury were pumped through gold mines in the 19th century, and as much as 8 million pounds of mercury made its way into the sediments of the Estuary.



However, gold mining practices are only one source of mercury contamination in the Estuary. In the South Bay, the New Almaden Mine in the Santa Cruz Mountains was once the largest producer of mercury in North America and provided the quicksilver for gold mines. Storm water runoff from this area continues to enter the South Bay via the Guadalupe River. Although the New Almaden Mine closed in 1975, through time, the South Bay has become a reservoir for mercury from this mine. Other mercury mines exist in the Coast Range Mountains north of the Estuary, and runoff from these sites has also been a source of mercury to the Bay watershed. In addition, natural flows from geothermal springs in various locations in the Central Valley watershed contribute ongoing inputs of mercury to the Estuary, as do urban inputs from storm water runoff, treated wastewater effluent, and deposition of mercury present in the air due to the burning of fossil fuels.

Other Pollutants

Although copper concentrations in Bay sediments are higher today than they were in pre-industrial times, recent assessments show that copper does not appear to impair the beneficial uses of San Francisco Bay. Consequently, regulators and watershed stewards are developing "Action Plans" designed to ensure that over time copper concentrations do not increase to impairing concentrations. For other pollutants, such as selenum, dioxins, and furans, the relative contributions of legacy versus contemporary sources are unresolved at this time.

Why are these pollutants still problems today?

If the Estuary were a deep, serene body of water, these pollutants could have been quietly buried under Bay sediments. However, the Estuary is constantly in motion. Seasonal rainfall constantly alters the inflow of fresh water from the Delta and local streams into the Estuary. Ocean tides, prevailing winds, and continual human activity constantly mix Bay sediments, causing legacy pollutants buried in layers of sediment to be re-suspended in Bay waters. The conditions that cause redistribution of contaminants include:

- Natural changes in erosion patterns causing sediment re-suspension and transport
- Dredging—to keep channels open for cargo ships, bottom sediments are dug up from the Bay floor and disposed of in other areas of the Estuary
- Washing of new amounts of pollutants into the Bay from upstream sources in the watershed
- Uptake into the food chain—bottom dwellers such as shrimp, clams, fish, and other aquatic organisms accumulate pollutants from the environment and, in so doing, redistribute them.

What does this mean for the future?

Because legacy pollutants in the Estuary are persistent, it may take decades for their levels to naturally decline. Because the significant mass of legacy pollutants already present in the sediments of the Estuary can be resuspended by the mechanisms discussed above, the levels of these pollutants in the water column are repeatedly influenced by outside forces. Limiting management solely to ongoing contributions or sources (such as air deposition, storm water runoff, and municipal industrial wastewater) may not be sufficient to achieve water quality standards. Nature will be a slow but large part of the solution, reducing contamination through natural degradation, burial in Bay sediments, and transport to the ocean and atmosphere.

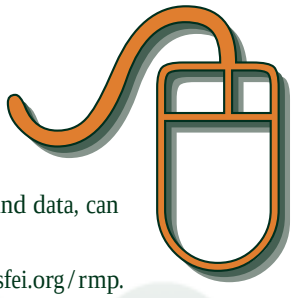
Collecting information and monitoring the inputs of pollutants from sediments and other sources is important to understanding pollutants in the Estuary and working to control them. Efforts to improve this understanding have been underway since 1993, when the Regional Monitoring Program (RMP) began collecting water, biota, and sediment samples. The pollution problems in the San Francisco Estuary are not discrete, and regional approaches focusing on the watershed as a whole are necessary to solve these difficult contamination issues.

Legacy Pollutants of Concern

SF Bay Contaminants from Draft 2002 State Water Resources Control Board listing

Mercury	PCBs
DDT	Dioxins *
Chlordane	Furans *
Dieldrin	

* Relative contributions of legacy versus contemporary sources are unresolved at this time.



More information on the RMP, including past reports and data, can be found at: http://www.sfei.org/rmp.

To learn more about the Clean Estuary Partnership, visit our website at http://www.cleanestuary.org.

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