

More About Water:

WHERE IT COMES FROM



WHERE IT GOES



WHERE IT COMES FROM

Most of the water used by EBMUD customers begins as snow on California's highest mountain range, the Sierra Nevada. Winter storms over the Sierra result in a snowpack that usually reaches depths of six to ten feet. The Sierra snowpack, which flows into creeks and rivers as the weather warms up, is the main source of water for most of California.

EBMUD water comes from the melted snows of Alpine, Amador and Calaveras counties, which contain the 575-square-mile natural watershed of the Mokelumne River. The watershed (a land region that drains snow and rain runoff into a river system or other body of water) is on the western slope of the Sierra Nevada. EBMUD holds rights to up to 325 million gallons a day of Mokelumne River water.

The Water System In 1929, East Bay MUD completed building Pardee Dam and Reservoir 38 miles northeast of Stockton on the Mokelumne River to collect its pure mountain water for the cities and

Sierra snowmelt feeds the Mokelumne River (cover photo). EBMUD catches the water from the river in the Pardee Dam and Reservoir



communities on the east side of San Francisco Bay. The dam is in a narrow rock canyon and is 345 feet high. The reservoir can hold 68 billion gallons of water, about a 10-month supply for the East Bay.

East Bay MUD has a powerhouse at the base of Pardee Dam. The Pardee Powerhouse generates about 110 million kilowatt-hours of electricity each year, usually during the winter and spring when the river is at its fullest. That's enough power to meet the needs of 28,650 people. The electrical power is sold as a way of providing energy to Californians and bringing income to EBMUD, which helps keep water prices low for its customers.

Water from Pardee Reservoir travels about 90 miles to the East Bay through three huge steel pipes called the Mokelumne Aqueducts. They range in size from five and one-half feet to more than seven feet in diameter—large enough for an adult to walk in—and can carry from 202 million gallons per day (MGD) without pumping, to 325 MGD with pumping. Water from Pardee flowing through the Mokelumne Aqueducts by gravity (no pumping) takes 30 to 45 hours to reach the East Bay.

Water Storage After the mountain water arrives in the East Bay, it is either treated immediately in water treatment plants or stored until needed in one of the five large reservoirs in the East Bay hills. Called terminal reservoirs, they also collect local rainwater, but most of the water they store is from the Mokelumne River. East Bay MUD uses no groundwater (water from underground aquifers and springs).

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San Pablo is the northernmost of the five reservoirs and holds 12.5 billion gallons of water. East of San Pablo is Briones, EBMUD's newest and largest local reservoir, which holds 19 billion gallons. Lafayette Reservoir, in the City of Lafayette, holds one billion gallons. To the south are Upper San Leandro Reservoir, which holds 14 billion gallons, and Chabot Reservoir, which holds 3 billion gallons. All five reservoirs combined hold about a six-month supply of water at today's water-use rates of about 155 million gallons per day.

The terminal reservoirs are surrounded by 25,300 acres of land owned and managed by EBMUD to protect the water that runs off this watershed into the reservoirs.

Watershed Land EBMUD owns 54,605 acres of land in the East Bay and in the Mokelumne River Basin, including 12,765 surface acres of water in the reservoirs. The land is managed and cared for by EBMUD's Ranger-Naturalists.

Environmentally sound management of this land assures water of high quality and increases water production. Use of pesticides and other chemicals on the watersheds is minimized, controlled burning and goat grazing are used to clear vegetation that can fuel fires, and erosion is carefully monitored and controlled to minimize silt entering the reservoirs.

EBMUD policies allow use of the lands, including some public recreational opportunities,

Ranger-Naturalists carefully manage the watershed lands around EBMUD's reservoirs. Goats are used to control brush and other harmful vegetation which could serve as fuel in a fire.



Mokelumne Aqueduct No. 3 is 7 feet 3 inches in diameter. An adult can easily stand up inside a replacement pipe for the aqueduct. Wooden braces keep the heavy pipe round.

compatible with primary watershed purposes of protecting the water supply, with emphasis on preserving open space. The EBMUD mission statement adopted by the Board of Directors in 1992 guides watershed management and District operations. The mission of the East Bay Municipal Utility District is: *To manage the natural resources with which the District is entrusted, to provide reliable, high-quality water and wastewater services at fair and reasonable rates to the people of the East Bay, and to preserve and protect the environment for future generations.*



Water Treatment EBMUD provides high-quality water from a protected, unpolluted source. However, some impurities must be removed to make sure the drinking water is safe for people.

EBMUD has six water treatment plants that treat and filter every drop of water before it

reaches customers. The water treatment plants are Upper San Leandro in East Oakland, which treats water from Upper San Leandro Reservoir; San Pablo in Kensington, and Sobrante in El Sobrante, which both treat water from San Pablo Reservoir; and the Orinda, Lafayette and Walnut

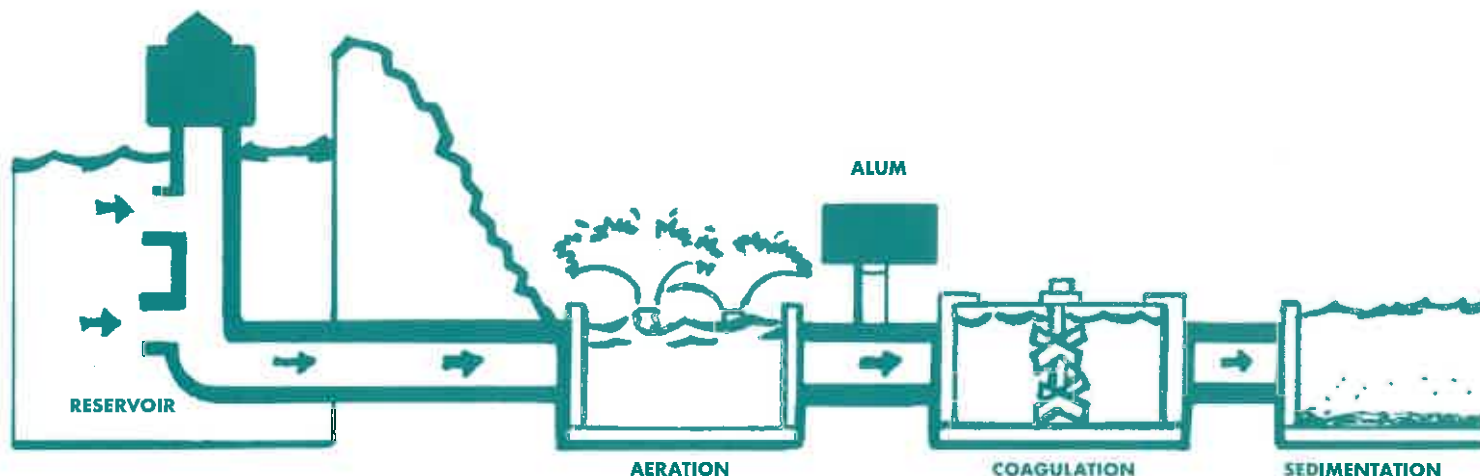
Creek water treatment plants, which treat water that comes directly from the Mokelumne Aqueducts. The Orinda Water Treatment Plant has the largest output, with a capacity of 175 MGD. This plant supplies water to Alameda, Albany, Berkeley, El Cerrito, Emeryville, Moraga, Oakland, Orinda, Piedmont, Richmond and San Leandro. The other plants supply water to the rest of EBMUD's service area, which receives varied blends of water from the Orinda plant.

Water is treated to remove dirt particles, algae and bacteria that could cause illness. These are removed by EBMUD in six steps at the Upper San Leandro, San Pablo, and Sobrante water treatment plants. These treatment steps are: aeration, coagulation, sedimentation, ozonation, filtration, and disinfection. The Orinda, Lafayette, and Walnut Creek water treatment plants do not use aeration, sedimentation, and ozonation, because the water treated in them comes directly from the Mokelumne Aqueducts and needs only three basic treatment steps. The six treatment stages described below are used by EBMUD for specific purposes:



EBMUD Ranger-Naturalists perform a controlled burn to remove grass that has grown too high in the watershed. Removal and reduction of these grasses reduce the risk of wildfires.

WATER TREATMENT



- **Aeration** - Water entering the treatment plant is sprayed into the air through many nozzles. Breaking the water into tiny drops of spray releases gases that can cause unpleasant tastes and odors.



Aeration, shown at the Sobrante water treatment plant, consists of spraying water to allow it to release gases. This process improves the taste and odor of the water.

- **Coagulation** - The next three treatment steps remove dirt and other tiny particles. Coagulation (which means “thickening”) is achieved by adding a chemical called aluminum sulfate, or alum. The alum dissolves and forms tiny, sticky particles that catch dirt floating in the water. The combined dirt and alum particles become heavy enough to sink.



Sedimentation basins (the one shown is part of the San Pablo water treatment plant) allow heavy clumps of alum combined with dirt to settle to the bottom.

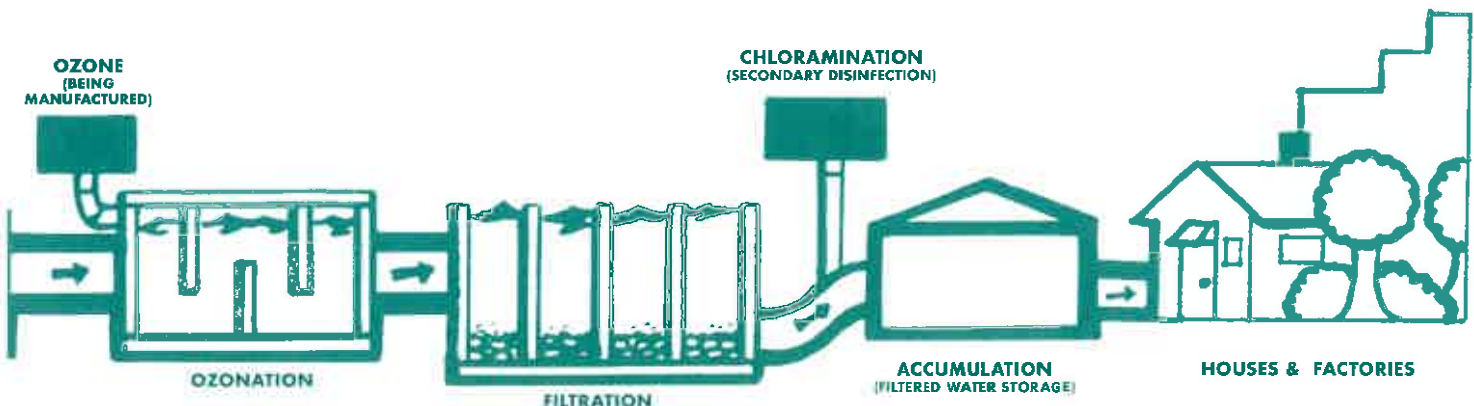
- **Sedimentation** - After the alum and dirt have been mixed for about 15 minutes, the water flows into large, quiet pools called sedimentation basins. The water moves slowly through the basins to allow the heavy alum and dirt particles to settle on the bottom.

- **Ozonation** - Ozone is used for primary water disinfection at the Sobrante and Upper San Leandro water treatment plants. Ozone improves water taste and odor, and it reduces trihalomethanes (THMs) and other disinfection by-products that can result from the interaction of chlorine with natural organic matter in water.

- **Filtration** - Most particles suspended in the water are removed by coagulation and sedimentation. Any remaining particles are trapped and removed by filtration. The almost-clear water from the sedimentation basins flows into deep, concrete-walled boxes, which have filter beds made of layers of coal, sand, gravel and rocks at the bottom. Impure particles are trapped in the coal and sand as the now-clean water flows down through the rest of the bed to a collecting system. Granular activated carbon is also used at the Sobrante and Upper San Leandro water treatment plants for taste and odor control.

- **Disinfection** - Chloramine (chlorine and ammonia) is added to kill any bacteria or viruses or other microscopic pathogens that may still be in the water.

EBMUD adds fluoride to the water to benefit the dental health of its customers and adds calcium hydroxide (lime) or sodium hydroxide to the water at the source or at a water treatment plant to make it less corrosive.



Lime reduces the acid content in water, creating a good chemical balance (pH level) that prevents damage to EBMUD's pipes and to customers' plumbing.

Water Quality EBMUD's goal is to provide the highest-quality water it possibly can to all of its customers at the lowest possible cost. The water is regularly sampled and tested throughout the water distribution system, and chemical and physical tests are performed every two hours at the water treatment plants. This ensures that EBMUD drinking water meets all of the health and safety standards established by the U.S. Environmental Protection Agency and by the California Department of Health Services. Test results and analyses consistently show that EBMUD drinking water meets or surpasses all government requirements.

Water Distribution Sending treated water to customers is a large, complex job for a regional water agency such as EBMUD.

Some customers use water at sea level along the San Francisco

Bay shore; others use water high in the hills, at elevations of up to 1,500 feet. Some customers use millions of gallons a day, while others use only a few gallons. Some customers live or work near a water treatment plant, but most are miles away.

Water is sent to customers through 4,000 miles of pipe, 140 pumping plants and 175 distribution tanks and reservoirs. People use water at all times of the day or night, so the water system works around the clock. The water treatment plants constantly treat water, pumps fill tanks day or night as needed, and water flows through thousands of miles of pipes all the time. Nearly 60 percent of the water treated by EBMUD is distributed to customers by gravity, with no pumping required.



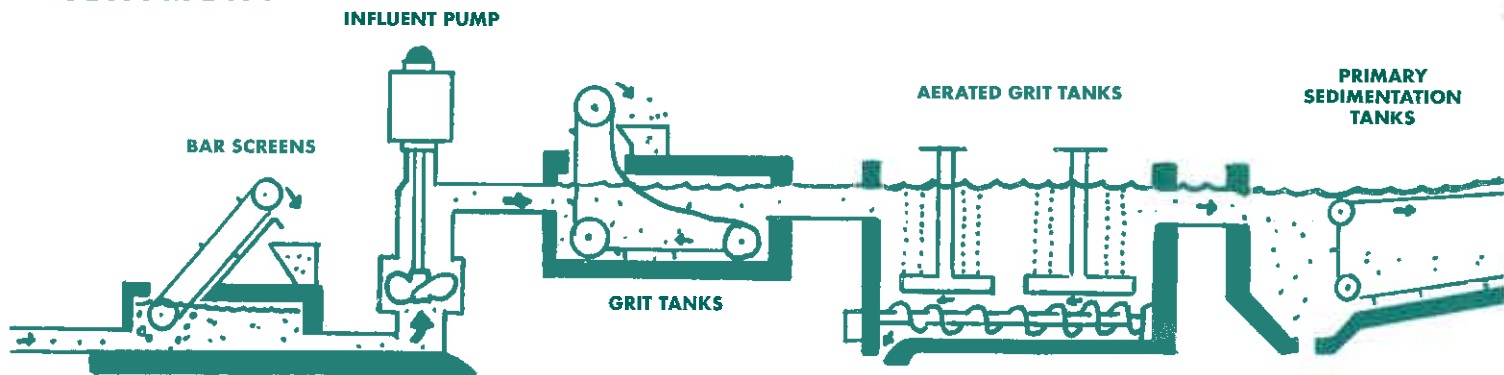
WHERE IT GOES

Almost two-thirds of the water distributed by East Bay MUD goes to homes. About half the water is used outdoors. Most people use only a few gallons a day for drinking and food preparation, but dishwashers and clothes washers can use a lot of water, as can dripping faucets and leaky pipes. Repairs can save 140 gallons a month. Running dishwashers and clothes washers only with full loads can save about 800 gallons of water a month, and also saves energy. Taking five-minute showers while using a low-flow showerhead can reduce home water use by 600 gallons a month. Watering the lawn only when needed saves about 1,500 gallons of water per month.

East Bay MUD's largest customers are industries, such as oil refineries and food processors, that need water to cool factories, equipment and products, or as an ingredient in products, to process products, or to wash away wastes. Many business and industrial establishments practice conservation by recycling—using the same water several times for different purposes.

Nearly two-thirds of the water distributed by East Bay MUD is sent into homes. This high-quality water is healthful for all important uses.

WASTEWATER TREATMENT



Restaurants need water for cooking and cleaning; office buildings and schools need it for lavatories, drinking fountains and gardening. Water is used in several ways for the public good—for example, in water fountains, firefighting, irrigating plants in parks and other community locations, and filling public swimming pools.

THE WASTEWATER SYSTEM

EBMUD treats wastewater from residences, businesses, and industry in the cities of Alameda, Albany, Berkeley, Emeryville, Oakland, and Piedmont, as well as the Stege Sanitary District, which includes El Cerrito, Kensington, and part of Richmond. Each of these communities operates sewer collection systems that discharge into one of EBMUD's five interceptor sewers.

The interceptor sewers consist of 29 miles of concrete pipes, which vary from 12 inches to 9 feet in diameter. They collect wastewater from about 1,400 miles of sewers owned and operated by the communities. Fourteen pumping stations, which can carry from 1.5 million to 60 million gallons per

day (MGD), lift the wastewater through the interceptors as it flows to EBMUD's main wastewater treatment plant.

Wastewater Treatment

Wastewater flows from the five interceptor sewers into the wastewater treatment plant in Oakland, near the entrance to the San Francisco-Oakland Bay Bridge. The plant provides primary treatment for up to a peak of 415 MGD (the average annual flow is about 80 MGD), and secondary treatment for a maximum flow of 168 MGD.

Primary treatment removes floating material, oils and greases, sand and silt, and organic solids heavy enough to settle in water.

Secondary treatment biologically removes most of the organic and chemical impurities that are suspended or dissolved in the wastewater. These are impurities that would rob life-giving oxygen from the waters of San Francisco Bay if allowed to decompose naturally. The secondary treatment process protects the Bay, where EBMUD and other wastewater agencies must discharge wastewater from the communities they serve.

Wastewater treatment steps are prechlorination (for odor control); screening (to remove large objects);



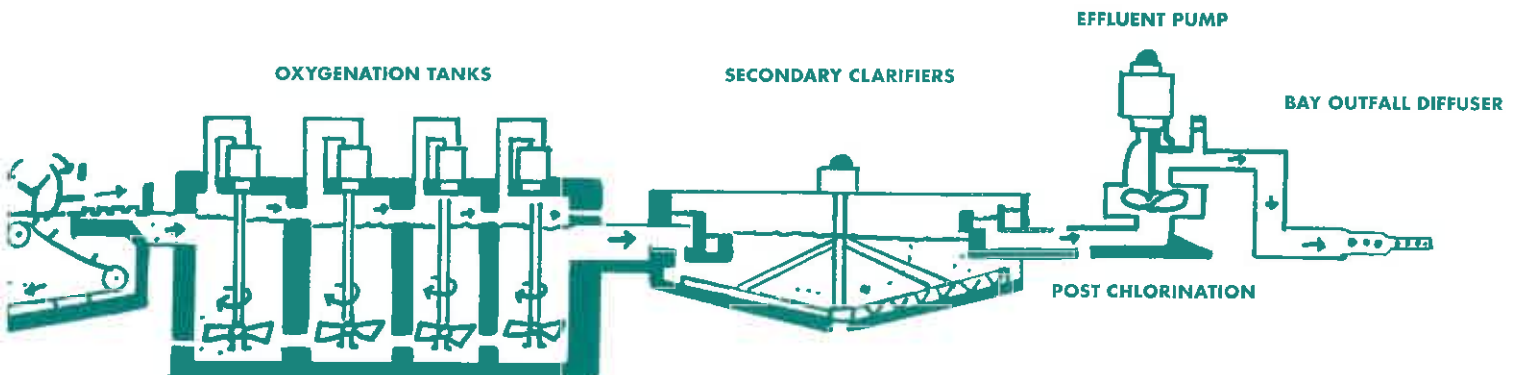
EBMUD Wastewater Control Inspectors routinely test industrial wastewater streams to make sure toxic substances are not discharged into San Francisco Bay.

grit removal; primary sedimentation; and secondary treatment using high-purity oxygen-activated sludge, final clarification, sludge digestion, dewatering and composting. The remaining treated wastewater, or effluent, is disinfected with chlorine. Then the chlorine is removed, because it could damage marine life, and the water is discharged one mile off the East Bay shore through a deepwater outfall pipe into San Francisco Bay.

Protecting San Francisco Bay

Wastewater Source Control —

In 1972, EBMUD began a local source control program requiring pretreatment of wastes by certain categories of industrial customers



A CLASSROOM ACTIVITY

before the wastes were discharged to the sewers. The EBMUD wastewater service area includes more than 20,000 commercial and industrial customers. Source control has reduced the amount of heavy metals discharged by 91 percent. EBMUD's treatment plant reduces the remaining heavy metals another 75 percent. Together, these two steps have cut by 98 percent the quantity of heavy metals (copper,



Before releasing treated wastewater, EBMUD tests the water to ensure the health of marine life in San Francisco Bay is preserved.

lead, nickel, chromium and zinc) discharged to the Bay since 1972.

In 1984, local pretreatment programs were delegated control authority under the federal Clean Water Act, and EBMUD began enforcing federal standards along with its own local ordinance.

In 1989, 1993 and 1997, EBMUD received the National Pretreatment Excellence Award for large

EBMUD's Power Generation Station helps conserve energy.

Statistically speaking: Recycled water use in California

Use the following information to answer the questions.

FACTS

1987 — 266,559 acre-feet (AF) of water were recycled in California.

1993 — 383,752 acre-feet (AF) of water were recycled in California.

programs from the U.S. Environmental Protection Agency. Besides being the first agency to win the award, EBMUD is the only agency to receive the award three times.

Conservation of Natural Resources

Biosolids Management — The solid, stabilized organic materials removed from wastewater are called biosolids. In the 1980s, EBMUD's award-winning compost program recycled about 20 percent of the biosolids generated during wastewater treatment.

In 1994, EBMUD began applying biosolids to agricultural lands.

The percentage of recycled water use throughout the state, by region, was as follows:

Region	1993 AF	Percentage (%)
North Coast	14,192	_____
San Francisco Bay Area	21,752	_____
Central Coast	12,415	_____
Central Valley	66,735	_____
Lahontan*	4,000	_____
Metropolitan Water District of Southern California (MWD)**	261,410	_____
Colorado River Basin	3,248	_____
Total	383,752	100%

*Lahontan: A prehistoric lake that once covered much of Nevada and Eastern California.

**The Metropolitan Water District service area includes the Los Angeles, Santa Ana, and San Diego water recycling districts.

Recycled water use, by category, in 1993:

Plant and lawn irrigation in public areas — recycled water use for golf courses, cemeteries, etc., totalled 47,112 foot-acres per year (FAY).

Industries — recycled water use in manufacturing and other industrial uses totalled 6,557 FAY.



Composting was discontinued in 1995, because land application was more cost effective. Now, 100 percent of the biosolids produced go to beneficial uses, and none goes to landfill.

Energy Recovery — Another wastewater treatment by-product is methane gas produced by the sludge digestion process. EBMUD's 6.3-megawatt power generation station, a cogeneration facility, recovers about 85 per cent of the available energy from methane gas. The power generation station also produces between 2.1 and 3.2 megawatts of electricity,

Agriculture — recycled water use for crop irrigation totalled 79,591 AFY.

Groundwater replenishment — recycled water use for replenishing underground aquifers totalled 185,057 AFY.

Prevention of marine water intrusion — recycled water use for preventing the intrusion of sea water, which contaminates fresh water in overpumped aquifers along the coast, totalled 7,000 AFY.

Environmental improvements — recycled water use in parks and wetlands totalled 29,164 AFY.

Other uses — recycled water use for toilet flushing, snowmaking and fire prevention totalled 29,271 AFY.

QUESTIONS

1. How many more acre-feet of water were reclaimed in 1993 than in 1987?
2. What was the percentage of increase in the use of recycled water?
3. Calculate the total percentage of recycled water use in each region.
4. Why do you think that the largest amount of recycled water is used in the MWD service area?
5. Why is the Central Valley in second place for recycled water use?
6. Make a pie chart showing the percentage of recycled water use in each category.

which provides a significant amount of the electrical power needed for wastewater treatment.

Water Recycling — Wise water use includes using the right type of water for specific purposes. Drinking water is not needed to irrigate parks, cemeteries, ball fields and golf courses, for industrial processes, toilet flushing in highrise buildings or equipment washdown. By using recycled water for these purposes, the drinking-water supply is stretched for all of us to have more available in droughts. At the same time, customers for recycled water get a drought-proof supply, our economy benefits from improved water supply reliability, and the environment benefits as well.

Less treated waste water is released into San Francisco Bay, and more water remains in streams for fish and other natural resources. East Bay MUD supplies



Regions on the Map

NC	North Coast
CV	Central Valley
SF	San Francisco Bay Area
CC	Central Coast
L	Lahontan
M	MWD Service Area
CR	Colorado River Basin



The center of operations of EBMUD's Wastewater Treatment plant is located in Oakland, at the foot of the Bay Bridge.

more than 9 million gallons a day of nonpotable water and highly treated wastewater for purposes not requiring high-quality drinking water. By 2040, EBMUD plans to recycle an additional 11 MGD, for a total of 7.3 billion gallons a year. New or expanded water recycling projects are proposed throughout EBMUD's service area. The program includes: East Bayshore Recycled Water Project to serve portions of Alameda, Albany, Berkeley, Emeryville and Oakland with up to 2.2 MGD of recycled

Answers:
 1. 177,193 foot-acres. 2. About 44%.
 3. The percentages, by region, are: NC — 14%; SF — 6%; CC — 3%; CV — 17%; L — 1%; M — 68%; and CR — 1%.
 4. It is a mainly urban area with a limited water supply and a population of almost 10 million inhabitants.
 5. The Central Valley is mostly agricultural. The use of recycled water is an economically and environmentally sound decision.

Statistically Speaking was adapted with permission from the Metropolitan Water District of Southern California.

water for landscape irrigation, industrial processes, wash-down water, flushing toilets in new commercial buildings (the first of these is the \$100-million Shorestein Building at 555 City Center in Oakland), and wetlands restoration.

San Ramon Valley Recycled Water Project, a joint project with EBMUD and the Dublin-San Ramon Services District that will provide up to 2.4 MGD in EBMUD's service



EBMUD tests drinking water at regular intervals in its laboratories and water treatment plants to ensure that it is healthful. Treated wastewater and samples of water taken from the Bay are also analyzed regularly, to protect the marine ecology of the Bay.

area for landscape irrigation in portions of Danville and San Ramon.

Lamorinda Recycled Water Project, which could supply 1 to 2 MGD to portions of Lafayette, Moraga, Orinda, Pleasant Hill and Walnut Creek for landscape irrigation.

Laboratory Services

EBMUD's Environmental Laboratory operates 10 hours a day, 365 days a year to keep constant tabs on water quality for the drinking-water and wastewater systems. The 30,000

square-foot, up-to-date laboratory is certified by the California Department of Health Services Environmental Laboratory Accreditation Program for water, wastewater and hazardous waste analysis to use U. S. Environmental Protection Agency-approved standard methods for analyzing air, water, wastewater, soils, sludge, receiving water, sediments, biosolids and materials.

The laboratory performs organic, inorganic and microbiological analyses to help ensure that EBMUD's drinking water always meets or surpasses federal, state and local health requirements, and that treated wastewater meets all regulatory requirements.

Biological testing, using such marine life as fish, sea urchins, plankton and water fleas, shows whether the wastewater discharge is poisonous. Combined chemical and biological testing continually confirms that treated wastewater discharged by EBMUD to the Bay does not lower water quality.

WATER CAREERS

EBMUD people design, install, operate and maintain the water system and the wastewater system so that water and wastewater treatment are there when needed 24 hours a day.

To do all this, EBMUD employs engineers, drafters, treatment plant operators, pipeline construction and maintenance crews (which include heavy-equipment operators, water distribution plumbers, truck drivers, and more), mechanics, carpenters, hydrologists, surveyors, computer systems analysts and programmers, chemists and microbiologists, customer service representatives, radio and telephone operators,



meter readers, administrative assistants, construction inspectors, source control representatives, public information and community affairs representatives, water conservation staff that includes landscape designers and experts, secretaries, planners, health and safety officers, water system inspectors, lawyers, management analysts, accountants, human resources analysts, wastewater control representatives, ranger-naturalists, fishery biologists and more.



WATER CONSERVATION

Water is a resource often taken for granted. We assume water will be there whenever we turn on the faucet. Nature's sporadic droughts remind us that water is a limited resource, and no living creature can survive without it.

During dry periods, most people gladly cooperate when asked to cut down their daily water use through careful conservation measures. In normal weather years, when water seems plentiful, wise use of water is still a good idea. Water conservation, along with EBMUD's water recycling projects, helps assure adequate drinking water for the future by stretching current supplies as much as possible.

EBMUD manages one of the largest water conservation programs in California, and in 1994 was one of the first water utilities in the nation to develop a master plan for water conservation. The plan is designed to reach a water savings goal of 34 million gallons a day by 2040. In California, wise water use must be a way of life.

***Remember: Water is life...
Save it for what you love.***



Pipeline Construction and Mainline Maintenance crews ensure continuous operation of the water distribution system. They install new pipes, replace old pipes, and repair breaks or leaks in water mains.

EBMUD hydrographers summarize historical rainfall, flow, and water level data to determine annual water supply needs.

calculate how much water will be required through the new century, what cutbacks will be needed during droughts, and whether new water mains, distribution reservoirs and treatment plants might be needed to deliver water reliably to customers. EBMUD is engaged in an ongoing effort to define the needs within its service area and the ways to meet them in the distant future.

The water industry offers opportunities in many fields. Some require college and higher levels of education and some require specialized or technical training. Virtually all careers at EBMUD require training and experience beyond a high school diploma. For many careers and job classifications in the water world, a good grounding in math and science in high school is the best preparation. Communications skills developed in language arts, writing and speech classes are also necessary in most fields.

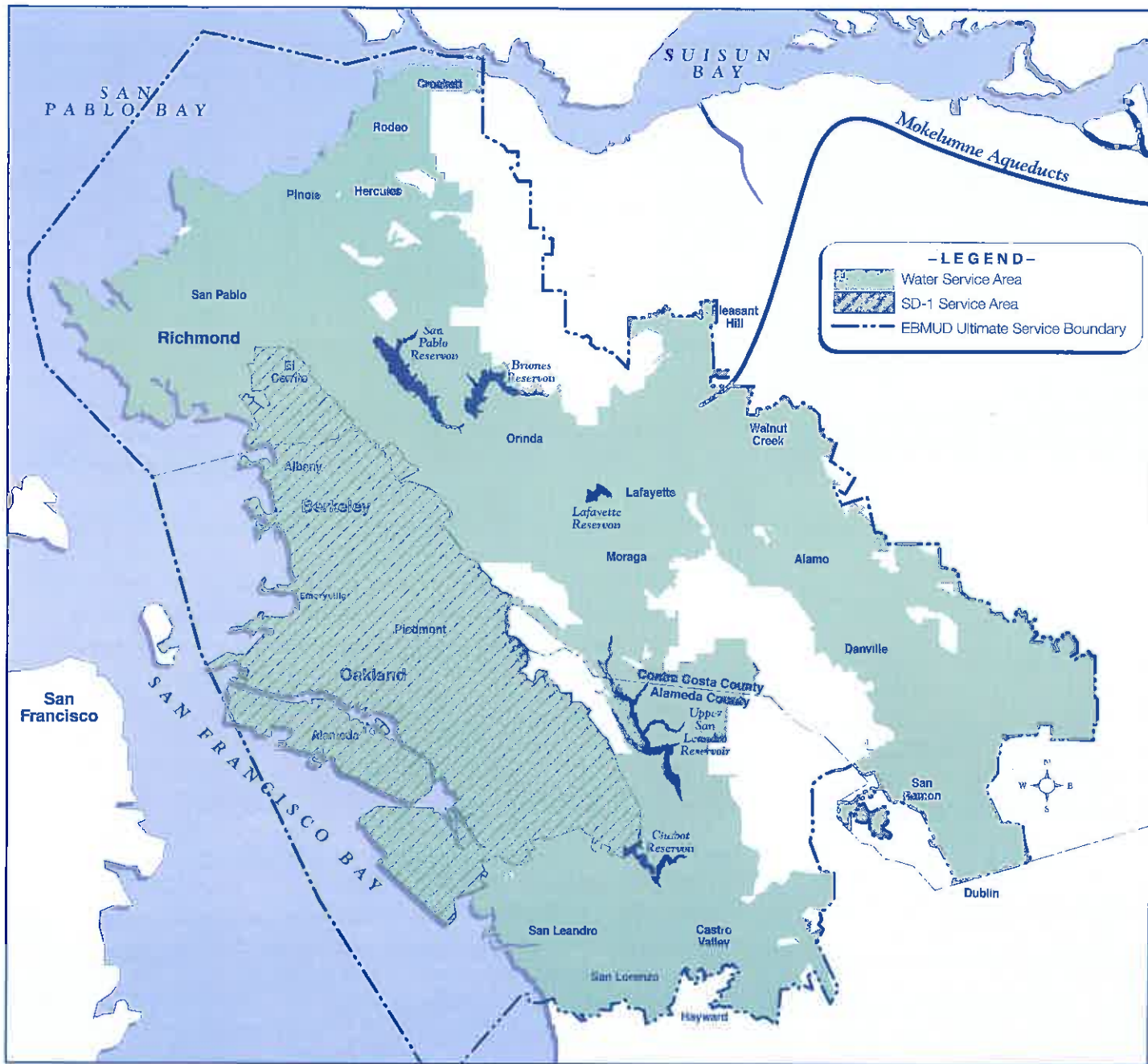
Professional, technical, administrative and skilled trades careers in the water and wastewater industry offer opportunities to experience the challenges and satisfaction of providing people and communities with essential public services. A career in EBMUD's can-do, teamwork environment might be right for you. An award-winning EBMUD video, "Water Work," is available in your school, your local public library and from EBMUD. This 19-minute program surveys water and wastewater careers and tells you how to prepare for a career with the East Bay Municipal Utility District. Look into it.

In all, about 2000 people work in some 300 different job classifications to assure that enough of EBMUD's high-quality water is always available and no toxins are released to San Francisco Bay.

Looking beyond tomorrow is a way of life for a well-managed water agency. EBMUD hydrographers measure the winter snowpack and study the information to determine how much water will be available during the coming year. Other people plan for the future by projecting population growth to

Data management is one of the responsibilities of the wastewater treatment plant operators, shown here at a computer work station.





East Bay Municipal Utility District