What it takes to treat

Wastewater

Orange County Sanitation District

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Introduction

Treatment Plant No. 1 in Fountain Valley 1955.

Every day the average person in Orange County uses about 65-100 gallons of water. Some of it we drink, but most of it we do not. What happens to all the water that goes down the drain? The water we use to brush our teeth, wash our clothes, dishes, bathe, and flush the toilet.

We never really stop to think about where all that other water goes. We know it flows away from our homes. But where does it go? What happens to it along the way? What does it take to make it clean again? We also know that sewage does not flow into the street or out into the ocean. Although it may seem hard to imagine just 70 years ago, using an outhouse or having a septic tank was common in Orange County, and sewage flowed in the Santa Ana River. Something we could never accept today. That is why what we do at the Orange County Sanitation District (OCSD) is so important.

Treatment Plant No. 2 in Huntington Beach 2009.

Today, 2.6 million people live in our 480 square mile service area and generate about 207 million gallons a day (mgd) of wastewater. That is enough water to fill up Angel Stadium almost two and a half times each day. The good news is that when it is all said and done, about half of the water treated at OCSD is recycled and the other half is returned back into the ocean and the natural water cycle starts all over again. Knowing all the steps it takes to accomplish this, we are proud to say that it still costs less than a dollar a day per household to provide this service to you.

The annual single family user fee is $244; about $20 a month or less than a dollar a day per household.

Journey through the sewer from your home to the ocean

OCSD's 25-member Board of Directors meets monthly.

Here is some background information before we get started. In 1948, the Orange County Sanitation District was first formed under the County Sanitation District Act. It was created as a Special District to provide a regional wastewater treatment system serving central and northern Orange County. The current governance structure was established by the California State Legislature in 1998. The 25-member Board of Directors is comprised of one representative from each of the 21 cities and three special districts in the service area, and one from the County Board of Supervisors. The Board of Directors is ultimately responsible for governance including setting the levels of service and rate structure.

The day-to-day business of managing OCSD is the responsibility of the General Manager who reports to the Board of Directors and works closely with them to establish policies and procedures, as well as develop master and strategic plans that support OCSD's mission and vision. He is supported by an executive management team that run the departments of Operations and Maintenance, Engineering, Technical Services, and Administrative Services. All together there are a total of 641 full-time employees working to protect the public health and the environment every day.

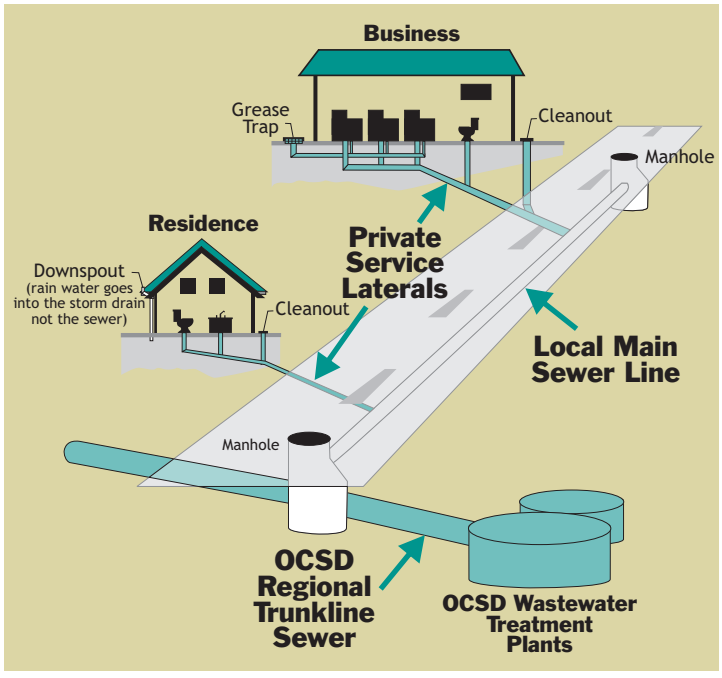


Diagram of the sewer collections system.

Treating wastewater is a 24 hour a day operation and the annual costs are estimated to be $134 million dollars for Fiscal Year 2010-2011.

Collections System

Collection crew cleaning a sewer line.

Most of the wastewater comes from within OCSD's service area. About 80 percent comes from residential sources and 20 percent is generated by commercial and industrial sources. All the wastewater flows away from your home through small lateral sewer pipes into larger city sewer lines that connect to regional trunklines which carry the wastewater to one of the two OCSD treatment plants: Reclamation Plant No. 1 in Fountain Valley, and Treatment Plant No. 2 in Huntington Beach.

In most cases, the wastewater flows by gravity alone. In some areas where the elevation is lower, a total of 15 off-site lift stations are needed to pump the wastewater to the treatment plants. There are 176 miles of local sewers (in the city of Tustin and unincorporated area around Tustin) and 403 miles of trunk sewers, for a total of 579 miles of sewer pipes that OCSD owns and operates. This network of pipes and pumps is called the collections system.

OCSD's collection facilities crews clean and maintain all of these assets. We provide routine inspections and maintenance of the sewer lines and easements; sewer spill response, notification assistance, and reporting; Underground Service Alert (Dig Alert); and coordinating street pavement overlay projects with various cities.

The key to meeting our federal, state and local regulations for water quality, biosolids reuse, and water reclamation requirements is preventing pollution from entering the waste stream in the first place. We accomplish this through source control. This program regulates and monitors industries to keep pollutants out of the sewage system. OCSD works proactively with businesses and industries advising them on best management practices, installing pretreatment systems, or using alternative chemicals. This relationship has helped our permittees reduce the amount of toxic pollutants discharged into the sewer system by more than 85 percent over the past 30 years. We also focus on our residential customers with "The Drain is Not a Dump" campaign that informs the public on how to properly disposal of fats, oils, and grease (FOG), pharmaceuticals, and other things that should not go down the drain.

Collection System costs over $25.8 million per year to operate and maintain. Over $6.5 million (32.5 percent) are chemical costs to control odor and corrosion.

Odor and Corrosion Control

Odor control systems deodorize foul smelling air collected in the treatment plants.

As a result of hydrogen sulfide forming in sewer pipes and processing units, wastewater collected and treated at our facilities has the potential to create nuisance odors. Typically characterized by a rotten egg smell, OCSD combats odors by sealing manhole covers, covering treatment areas, and treating foul and corrosive air.

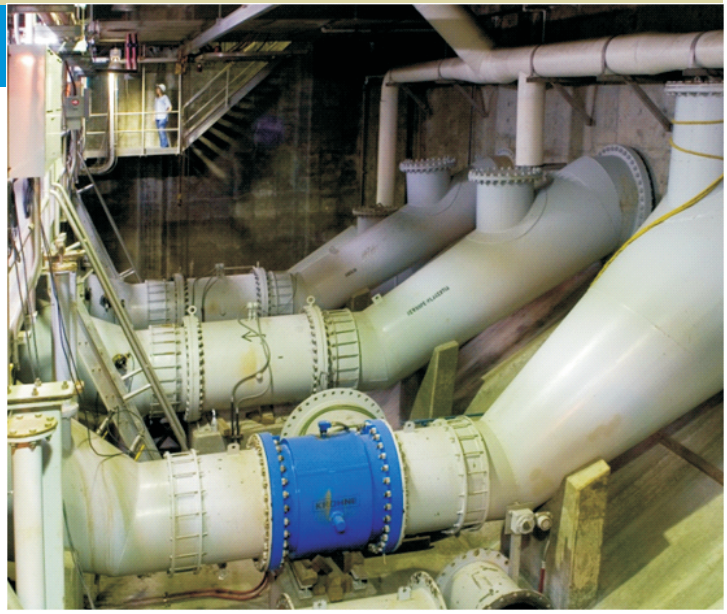
Hydrogen sulfide is one component of the odor spectrum and bacteria convert it to sulfuric acid that is very corrosive. To resolve these issues, OCSD has implemented an aggressive odor and corrosion control program. We work hard to reduce odors and corrosion in the collection system with our chemical dosing programs. Inside the treatment plants, we collect foul air and pump it through chemical and biological air scrubbers systems to deodorize the air. The chemical scrubbers use a solution of either caustic soda, hydrogen peroxide or bleach to strip hydrogen sulfide and other odorous gases from the air. The bioscubbers use microorganisms that live on a foam media inside the scrubber to eat hydrogen sulfide and remove odors.

New air scrubber complex at Plant No. 2 costs about $255 million.

OCSD continually conducts research studies of new odor technology to optimize odor control. Staff has also developed more accurate means to measure and identify odors both in the treatment plants and in the collection system. Our goal is to be a good neighbor in the community and reduce the amount of off-site odor complaints.

Odor control costs are estimated to be over $7.2 million per year.

Preliminary Treatment



Trunklines entering Plant No. 1 headworks.

Most of the wastewater collected in OCSD's trunklines enters the treatment plants through the plant headwork facilities designed to control and monitor wastewater flows. About 18.5 million gallons a year of waste from septic tanks and restaurants is deposited at a waste-hauler station located at Plant No. 1.

At Plant No. 1, six trunklines bring the wastewater into plant headworks, and at Plant No. 2 there are five trunklines coming into plant headworks. Diversion gates can be raised or lowered to move flows from one trunkline to another as needed. Plant No. 1 influent can also be diverted to Plant No. 2 through a 96-inch interplant pipeline. Meters connected to the pipes measure the flow, pH, and electroconductivity of the wastewater coming into the treatment plants. This information is monitored by our operations staff 24 hours a day.

A wastewater sample after preliminary treatment.

The first step of cleaning the water begins with preliminary treatment. The raw sewage flows though mechanical bar screens that collect and remove paper, rags, plastic, and chunks of grease before they damage or clog equipment in the treatment processes. Next, the water goes inside aerated grit chambers where sand, grit, egg shells, coffee grounds, and small rocks are settled out. The debris collected from both areas is removed and dumped into large trash bins and disposed in a landfill. The debris is trash and cannot be recycled.

In May 2013, the new Plant No. 2 headworks (Project P2-66) will be operational. It will replace the old headworks and increase the ability to manage flows. The new facility will also improve screening and grit removal and reduce overall maintenance costs on equipment and other plant processes.

Preliminary treatment costs are estimated to be over $7.6 million per year.

Chemically Enhanced Primary Treatment

Primary clarifiers at Plant No. 1 with recently replaced flat covers.

After the preliminary treatment process, the wastewater flows into large settling basins called clarifiers and begins the primary treatment process. In this phase we use gravity to remove the small particles of waste called suspended solids. Materials that are lighter or less dense than water float to the top. This scum layer (mostly grease) is skimmed from the top of the clarifiers and removed. Solids that are heavier sink to the bottom. All the collected primary sludge is removed and sent to digesters for solids processing.

A wastewater sample after chemically enhanced primary treatment.

Most influent flows receive chemically enhanced primary treatment which mixes anionic polymer and ferric chloride into the primary influent to help the suspended solids clump together and settle out much faster. Using chemicals has increased the efficiency of primary treatment by removing up to 75 percent of the solids.

At Plant No. 2, the addition of polymer has been temporarily discontinued because some disinfection bleach is added in the primary basins and interferes with the polymer.

Plant No. 1 primary clarifiers receive about 12 mgd of additional flows back from the Groundwater Replenishment System. This flow contains salts and solids removed by filtering secondary treated effluent sent to the Orange County Water District for reclamation.

Chemically enhanced primary treatment costs over $12.6 million per year to operate; over 40 percent of the costs are for chemicals.

Secondary Treatment

Trickling filters at Plant No. 1.

After chemically enhanced primary treatment, the water goes to secondary treatment. Secondary treatment is a biological process where aerobic microorganisms eat dissolved nutrients (biochemical oxygen demand) in the wastewater as food. We have two methods of secondary treatment. One method uses trickling filters where primary treated effluent is trickled over a zoogleal slime layer that lives on a plastic media. The other method is called activated sludge where the aerobic microorganisms are suspended in wastewater and additional air or oxygen is added. After the aerobic process is done, the water is sent to clarifier basins to settle out any remaining solids. In this case, the solids are mostly dead microorganisms that are removed and sent to digesters for solids processing.

A wastewater sample after secondary treatment.

Plant No. 1 uses two 15 mgd trickling filters and a 92 mgd air activated sludge plant for secondary treatment. At Plant No. 2, we use an oxygen activated sludge plant for secondary treatment. At both treatment plants, several million gallons per day of the secondary effluent stream are used by the plant water system for equipment cooling, belt filter press wash water, and general process cleanup eliminating the cost of purchasing potable water for these purposes.

At Plant No. 1, the activated sludge process requires about 45 percent of the total power usage and at Plant No. 2, the oxygen activated sludge process requires about 30 percent. Power requirements will increase as new secondary facilities at Plant No. 1 (Project P1-102 – Activated Sludge Plant) and Plant No. 2 (P2-90 – Trickling Filters with Solids Contacts Basins) begin operating in 2012.

Secondary treatment costs are estimated to be over $14.5 million; a large portion of this is due to the electrical power costs.

Bacterial Disinfection and Ocean Outfall

Disinfection with bleach removes bacteria.

Since 2002, OCSD has disinfected all treated wastewater released into the ocean to assure that no unsafe levels of bacteria are present. Sodium hypochlorite (bleach) is used for disinfection and sodium bisulfite for dechlorination of the treated wastewater effluent prior to release into the ocean. Although there are bleach stations at each plant, 90 percent of disinfection is done at Plant No. 2.

The effluent from Plant No. 1 and Plant No. 2 is blended, disinfected and dechlorinated and then pumped through a five-mile long, 10-foot diameter ocean outfall pipe built in 1971. The last mile of the pipe contains 503 holes through which the treated wastewater slowly diffuses the into the ocean. This occurs at a depth of 200 feet in an area called the zone of initial dilution (1:180). OCSD also maintains a 6.5-foot diameter outfall pipe built in 1952 for emergency use.

Before the treated wastewater can be recycled back into the ocean it must meet the National Pollutant Discharge Elimination System (NPDES) permit requirements for water quality. We must also meet effluent residual limits for chlorine because it could harm marine life. By the end of 2012, all effluent released into the ocean must meet full secondary effluent requirements. These specifications are 30 milligrams per liter each of biochemical oxygen demand (BOD) and total suspended solids (TSS).

The total effluent volume has decreased substantially due to providing about 104 mgd of secondary effluent from Plant No. 1 to the Orange County Water District for reclamation. Water conservation and drought have also decreased flows over the past several years.


Ocean outfall pipe at Plant No. 2.

Effluent disinfection costs are estimated to be over $10.2 million per year.
Effluent disposal costs through the ocean outfall are estimated to be $3.2 million.

Water Reclamation

The GWR System is a joint partnership between OCSD and OCWD.

OCSD supplies approximately 104 mgd of secondary treated specification water produced at Plant No. 1 to two reclamation systems at the Orange County Water District (OCWD): the Groundwater Replenishment System (GWRS), and the Green Acres Project (GAP). OCSD and OCWD have partnered on water reuse programs for over 35 years.

The GWRS began operation in January of 2008. It is a potable water reuse project designed to produce approximately 70 mgd of purified water for groundwater recharge. About 90 mgd of secondary effluent sent from OCSD's Plant No. 1 is treated by the GWRS using microfiltration, reverse osmosis, and advanced oxidation (ultra violet light with hydrogen peroxide). Half of the water is pumped to percolation ponds around Anaheim to recharge the aquifer providing a new reliable source of water for Orange County. The other half is used to expand to the seawater intrusion barrier that protects the fresh water aquifer.


People from all over the world come to see OCSD and OCWD.

The GAP has been in operation since 1992. It takes 14 mgd of secondary treated effluent from OCSD's Plant No. 1 and provides 10 mgd of reclaimed water for landscape irrigation at parks, schools, and golf courses, and for industrial uses such as carpet dying. OCSD is the largest industrial user of GAP water, averaging approximately 4.5 mgd a day.

A GWRS expansion project is in design. It will increase the production of 70 mgd purified water to 100 mgd and will increase OCSD's specification water requirements from 104 mgd to 130 mgd. In a new agreement, OCWD and OCSD will each pay for all treatment performed on their respective plant sites, and OCWD will provide 1,200 acre feet of recycled water annually to OCSD at no cost.

The Groundwater Replenishment System purifies up to 70 million gallons a day of clean water; enough water to meet the needs of 500,000 people per year.

Anaerobic Digestion and Solids Dewatering

Solids removed from both primary and secondary treatment are sent to digesters.

The scum and settled solids (sludge) removed from the primary and secondary treatment processes are sent to digesters for solids processing. They remain in the digester for an average of 20-25 days and are heated to a temperature of 98 degrees. Anaerobic bacteria are used to decompose the solids and reduce the amount of volatile organics and pathogens. One of the byproducts of solids digestion is digester gas.

In the future, primary solids will be thickened with centrifuges to save digester capacity, making room for increased sludge removed from new secondary facilities. There are ten operating and two holding digesters at Plant No. 1, and 15 operating and three holding digesters at Plant No. 2.

Excess water is removed before the biosolids are trucked away for reuse.

The anaerobically digested sludge is pumped from the holding digesters to the dewatering facility. A cationic polymer is added to help thicken it. As the sludge reaches the porous dewatering belts it is mostly water and only about 2-3 percent solids. The excess water seeps through the belts. At the end of the process, the solids are compressed between two belts to a consistent volume of 18-22 percent solids. There are eight belt presses at Plant No. 1 and 15 at Plant No. 2. The dewatered cake (biosolids) is transported by conveyor belt to the biosolids storage facility at each plant; from there it is loaded into trucks and transported off site for recycling. The treated solids are then considered biosolids, a recyclable organic material.

Anaerobic digestion costs are estimated to be over $9.1 million per year.
Solids dewatering costs are estimated to be over $4.5 million per year.

Biosolids Management

About 130,000 wet pounds of biosolids are produced each day.

Our wastewater operations produce about 650 wet tons (130,000 pounds) of treated biosolids every day. OCSD's 2003 Long-Range Biosolids Management Plan provided a strategy to develop a sustainable, reliable, and economical biosolids program. It recommended having multiple contractors, products and locations in order to increase our diversity in reuse markets in addition to farming with biosolids. As a result, nearly 80 percent of biosolids are currently sent to composting and green energy production facilities. The remaining 20 percent are used on farms for soil enrichment in California and Arizona.

Farming with biosolids continues to serve as an important cornerstone of our reuse program. It holds many advantages such as being scientifically sound and a proven technology. Biosolids enrich the soil with needed minerals and organics helping the farmer to increase crop yields. This is also our lowest-cost reuse alternative and saves our ratepayers a minimum of $1 million each year. It is also a good balance to higher-technology, higher cost disposal options in our biosolids management plan.

Biosolids are used to grown non-food crops like cotton.

OCSD's biosolids management plan meets stringent federal, state, and local regulatory requirements. We maintain certification through periodic third-party, independent audits of our contractors and management sites. Contracted biosolids hauling costs are by far the largest part of the total cost of biosolids management.

Solids management costs are estimated to be over $33.6 million per year.

Energy Recovery and Utilities

Central power generation system at Plant No. 2.

Solids processed in digesters produce a large amount of gas. About 60-65 percent of it is methane gas which can recycled. The methane is dried, cleaned, and compressed into a fuel that is used to power internal combustion engines in our central power generation systems. There are three, 2.5 megawatt engines at Plant No. 1 and five, 3.0 megawatt engines at Plant No. 2. Similar to a car engine, these engines also emit air emissions that are regulated by the South Coast Air Quality Management District (SCAQMD) new emission restrictions. The engines are currently limited to using only digester gas for normal operation and only natural gas for ignition. Upon completion of the emission controls system installation, we will be allowed to optimize power usage by either purchasing supplemental natural gas or electricity, whichever costs less. Currently, only purchased electrical power is the supplemental energy source. The combined power plants produce approximately 86 million kilowatt hours of electricity that is used to run the treatment plant processes. The purchase price of this power from a provider would be over $10 million, but by producing it on-site results we save about $5 million annually.

OCSD has an interplant gas line that can transport excess gas produced at Plant No. 1 to the larger central power generation system at Plant No. 2. This interplant gas line is currently out of service and repairs are scheduled to be completed in late 2012. Once completed, power production will increase and purchased power costs will decrease. The unused (about 15 percent) digester gas at Plant No. 1 is currently flared according to SCAQMD regulations.

Just like any business or household in our service area, OCSD must purchase utilities. OCSD must also operate and maintain utility distribution systems to run the treatment plants. The utilities purchased are electrical power, natural gas and water. Additional assets included in the overall utility costs are plant air, fire alarm, and tunnel systems. Operating and maintaining electrical distribution centers and power buildings account for most of the electrical utility costs. This is not considered part of the central power generation system.

Central power generation saves OCSD's rate payers about $5 million annually. Utility costs are estimated to be over $5.3 million per year.

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