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July 10, 2015

Grey Water Initiative

Water treatment serves to remove impurities from sewage before it reaches natural bodies of water, including lakes, rivers, and oceans. Impurities in water always exists in nature and the difference between "polluted" water and clean water depends on its intended use. Polluted water is water with impurities that make it unfit for particular uses such as drinking, fishing, or swimming. Even though natural conditions may pollute water, polluted water is often associated with humans as the source of contamination.

Sewage is classified into three different categories: domestic sewage, industrial sewage, and storm sewage. Domestic sewage is the waste from homes and apartments and is 99.9 percent pure water. However, it is the most likely to contain disease-causing microbes. Industrial waste is the water-bound byproduct from chemical and manufacturing processes. Storm sewage is the runoff from precipitation and can contain organic substances, various solids, and other material along the way.

The main pollutants in sewage are organic material, suspended solids, plant nutrients, and microbes. Organic material in sewage is measured by the biochemical oxygen demand (BOD). BOD is the amount of oxygen required for microorganisms to decompose the organic material. The lower the amount of organic material, the lower the BOD is. Oxygen levels in the water is also an important factor. Generally, high quality water has a high concentration of dissolved oxygen. When oxygen levels get too low, fish and other organisms can perish. In water treatment plants, suspended solids become sludge. Often, industrial and storm sewage have a higher concentration of suspended solids than domestic sewage. The rate at which a treatment plant removed suspended solids determines the plant's efficiency. Domestic sewage often contains high amounts of plant nutrients such as nitrogen and phosphorus. These plant nutrients often used in fertilizers contribute to algae blooms in bodies of water. Additionally, domestic sewage contains a high amount of microorganisms. Coliform bacteria (from the intestinal tract of humans) present in sewage is a sign of sewage pollution.

A Brief History

Sewer systems trace its history back to the drainage systems of ancient Rome. In these early times, drainage systems were used to carry rainwater away from roofs and roads. Many channels connected to a main channel called the Cloaca Maxima, or Great Sewer, which connected to the nearby Tiber River. The Cloaca Maxima is considered one of the greatest feats in Roman engineering. During the Middle Ages, little progress was achieved in cities' sewer systems. Most waste was dumped into gutters and streets to be washed away during rains. Toilets, which were commonly installed into houses during the 19th century, were connected to cesspools (underground storage tanks for human waste and sewage). The cesspools often overflowed and conditions in cities became intolerable. Human waste often contaminated well-water supplies, and in England, outbreaks of cholera were linked to the insanitary conditions.

During the late 19th century and early 20th century, countries such as the United States and the United Kingdom started building centralized sewage treatment p lants. The saying “the solution to pollution is dilution” was no longer relevant. Earth’s natural bodies of water were not large enough to handle the amount of sewage from cities without serious consequences. The new sewage plants used a combination of physical, biological, and chemical processes to remove the contaminants in the sewage. In the 1900s, stormwater and wastewater were separated so, so plants did not become overloaded during precipitation.

During the 1950s, public concern about the environment increased, which lead to more stringent regulation of water treatment plants. Wastewater was treated to prevent toxic chemicals from interfering with biological processes. During the oil crisis of 1970, there was an increased awareness for energy conservation at the plants. Another concern is the disposal of sewage wastes.

The Drought

California is situated in the western part of the United States, an area that has historically had many megadroughts. Megadroughts are extreme dry spells that can span for over a decade. California is no stranger to droughts; droughts have been a factor in California for thousands of years. The difference is that now, there is 70 million people to support and according to bioclimatology Park Williams, the current drought is the worst one to strike California in the past 850 years. According to the U.S. Drought Monitor, 100% of California is considered in a drought, with 58% in an “exceptional” drought. With the reservoirs down to 59% of its average and a projected agricultural loss of $2.2 billion, Governor Jerry Brown declared a statewide drought emergency. Restrictions on outdoor water usage, such as watering lawns, using hoses to clean, and washing cars, are in place.

The California State Water Project

Before the first gold rush of 1848, California had a series of uncontrolled streams and wetlands. Recognizing the water needs of the increasing population, President Ulysses S. Grant sent a series of engineers and surveyors to investigate the land. In 1919, Lt. Robert B. Marshall of the U.S. Geological Survey proposed California's first state water project: transporting water from the Sacramento River, through the San Joaquin Valley, over the Tehachapi Mountains, and finally to Southern California. The California Aqueduct spans 400 miles and is the world's largest water conveyance system, consisting of 20 pumping stations, 130 hydroelectric plants, and more than 100 dams. It connects northern California, where most of the rain and snow is, to central and southern California, where most of the demand is. Now, state officials are planning to reverse the flow of the aqueduct - make it flow upstream. The plan, costing $10 million, would use diesel generators to pump emergency supplies of water to underground reservoirs in Kern County. Farmers could then pump the water to their fields. Engineer for the Department of Water Resources Geoff Shaw said "there is no place on planet Earth where an aqueduct is designed to go backwards."

Greywater

When treating clean water and converting it to greywater both physical and chemical processes are taking into account to clean the water. These processes are what allow us to send our “dirty” water back into the ocean and to irrigate our animals’ food. But why stop there? Why not irrigate our yards too with this water? Why not have greywater in our toilets? Doing this would not only be beneficial economically but also be beneficial environmentally.

Water treatment in general is composed of five steps. The first step is the separation of pollutants using physical barriers. These barriers remove the large sized components from water simply by obstructing their passage. This step is called screening and the waste obtained is transferred to landfills. Next step is transferring the water to settlement tanks. As it can be also be understood from their name, these large tanks help the particles in the water to settle themselves down. This may be considered as the easiest part of the process for no intrusion is made. Afterwards the supernatant (the liquid left above the precipitated particles) is either sent to a percolating filter or an aeration tank. The percolating filter forces water through a porous surface which gets rid of even smaller particles and the aeration tank vaporizes water for the same purpose. The very last step left to take before sending the water back to nature is disinfecting it with chemicals (chlorine is commonly used).

Although this is generally the path water takes during a treatment process there may be other methods used depending on the desired cleanness of water. Some of these methods are cited below:

1)Carbon treatment: Initially this was only used to get rid of the unpleasant smell and taste of treated water but then it was discovered to be beneficial in terms of filtrating too. (oxidizing carbon results in small pores on the surface.)

2) Coagulation: Particles that can not be seen by naked eye are assembled by adding certain chemicals.These chemicals usually contain ions which neutralize charged particles and avert repulsion. At the end of this process water is usually taken to sedimentation tanks.

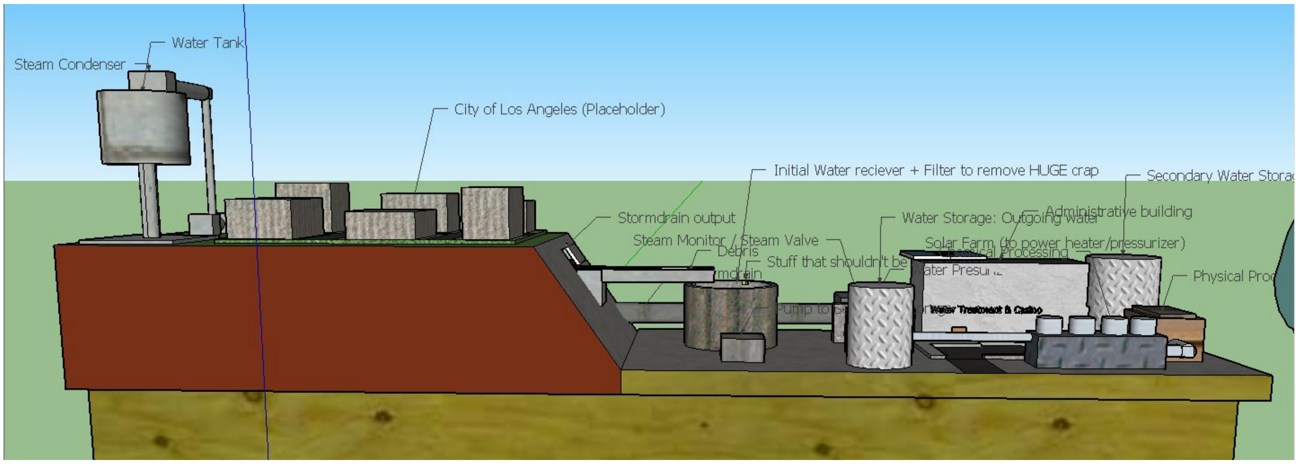
Important note: Sedimentation tanks and settlement tanks serve the same cause.

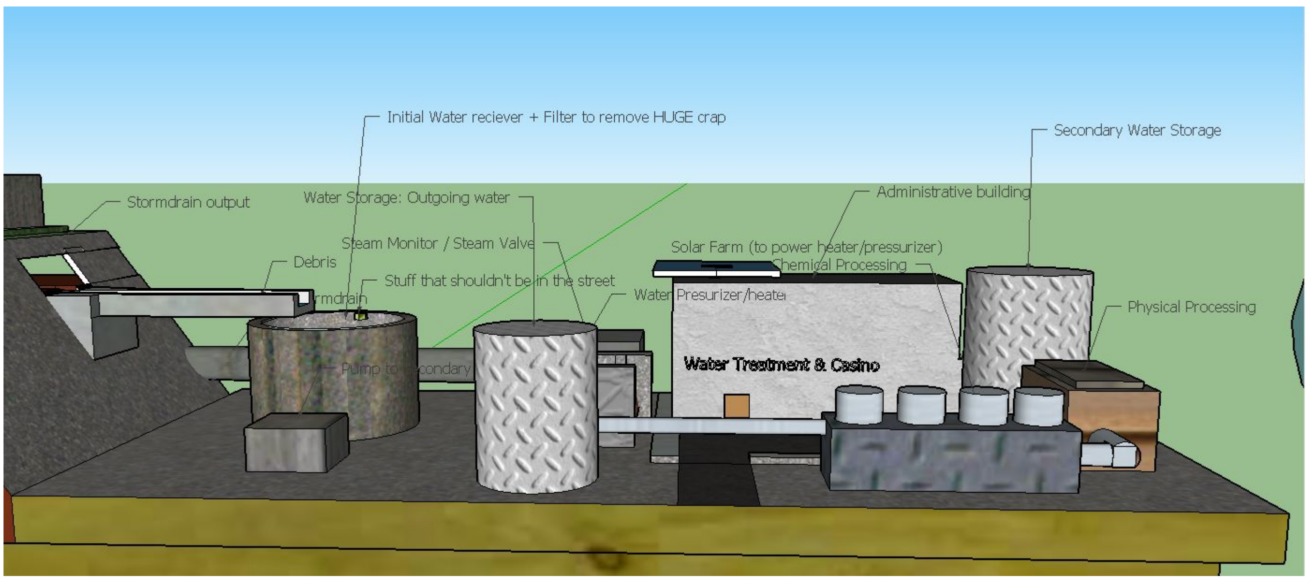
3)Flocculation: This could be seen as a different version of coagulation. Just like coagulation it's primary objective is to create large particle groups (colloids) but instead of introducing ions for neutralization, materials that have high-molecular-weights are used.

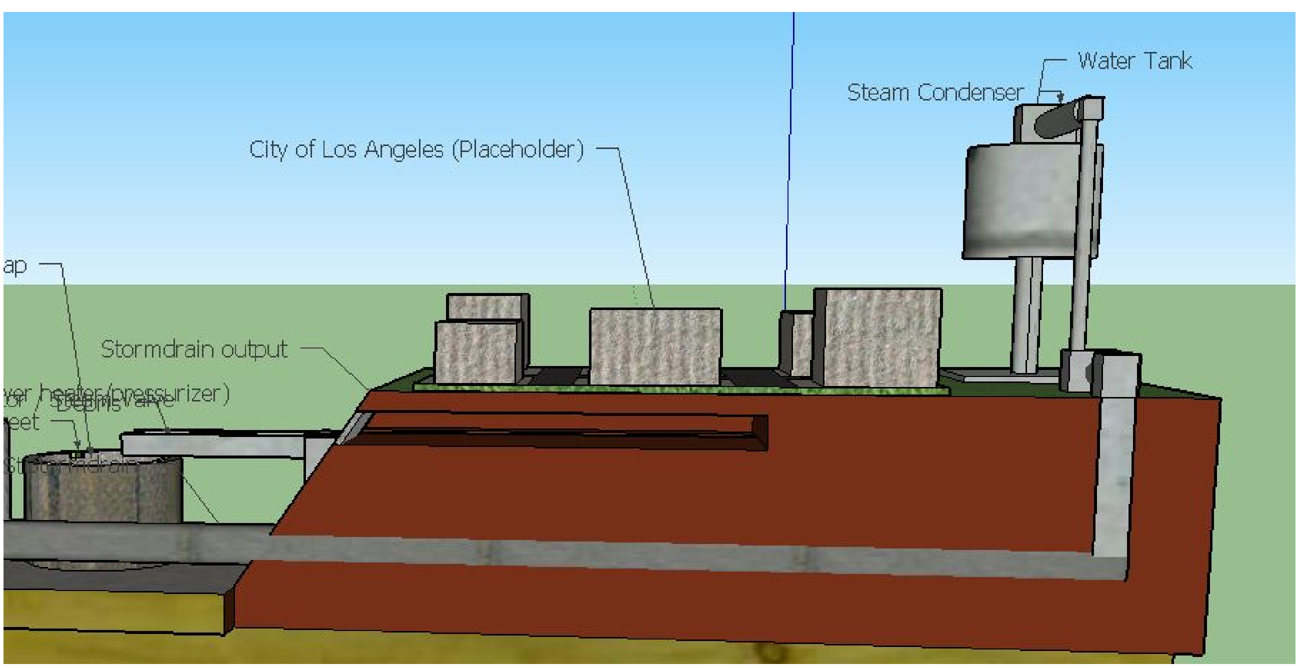
The plan we've made for our treatment plant includes most of these methods and let me tell you how. The journey of water starts off on the streets. As you all know especially during rain most of the trash is dragged by the flow of water to sewage holes. This mixture of dirt and water is then brought to water treatment plants to be cleaned and returned to nature. Our treatment plant like every other begins by detecting the big solid wastes and removing them from this mixture with the help of filters and this application is followed by another intense set of physical processes. (various different filters are used to purge water from particles that can be seen by the naked eye) Chemical processes start right after this (coagulation and flocculation methods are used one after the other, charcoal method is not necessary because we don't need the water to be potable). Aeration is the last step and the energy necessary for vaporization is obtained by solar panels and the methane emission of the solid wastes. Finally the gas is transferred by pipes to a water tank located near a row of mountains (it condenses) and is then distributed.

You may be asking yourself “How are we going to transport all this greywater?” Well, the answer is simple. Water will be traveling to the plant downhill, so no energy is needed to move it seeing as gravity will guide it. On the other hand, when travelling uphill back to the customer, greywater will be submitted into high pressure pipes at high temperatures. The water will then turn into vapor and travel up the pipelines to a chamber near the given area where it will then condense back into water. By using this method of transporting greywater, energy is going to be saved and may be used for other vital problems.

Greywater has many purposes in society. Having a separate greywater line into homes can be used to water lawns or use in toilets. Not only is this water harmless for these purposes but also has potential savings for the consumer. According to the US EPA, about 30% of fresh water is used to water lawns and other outdoor uses. Reusing greywater aid California’s historic drought, provide the consumer with savings, and reduce the amount of energy required to purify water.


Water Tank
Steam Condenser
City of Los Angeles (Placeholder)
Initial Water reciever + Filter to remove HUGE crap
Stormdrain output
Administrative building
Steam Monitor / Steam Valve
Solar Farm (to power heater/pressurizer)
Water Treatment & Casino


Initial Water reciever + Filter to remove HUGE crap
Secondary Water Storage
Stormdrain output
Water Storage: Outgoing water
Administrative building
Steam Monitor / Steam Valve
Debris
Solar Farm (to power heater/pressurizer)
Chemical Processing
Stuff that shouldn't be in the street
Physical Processing
Water Treatment & Casino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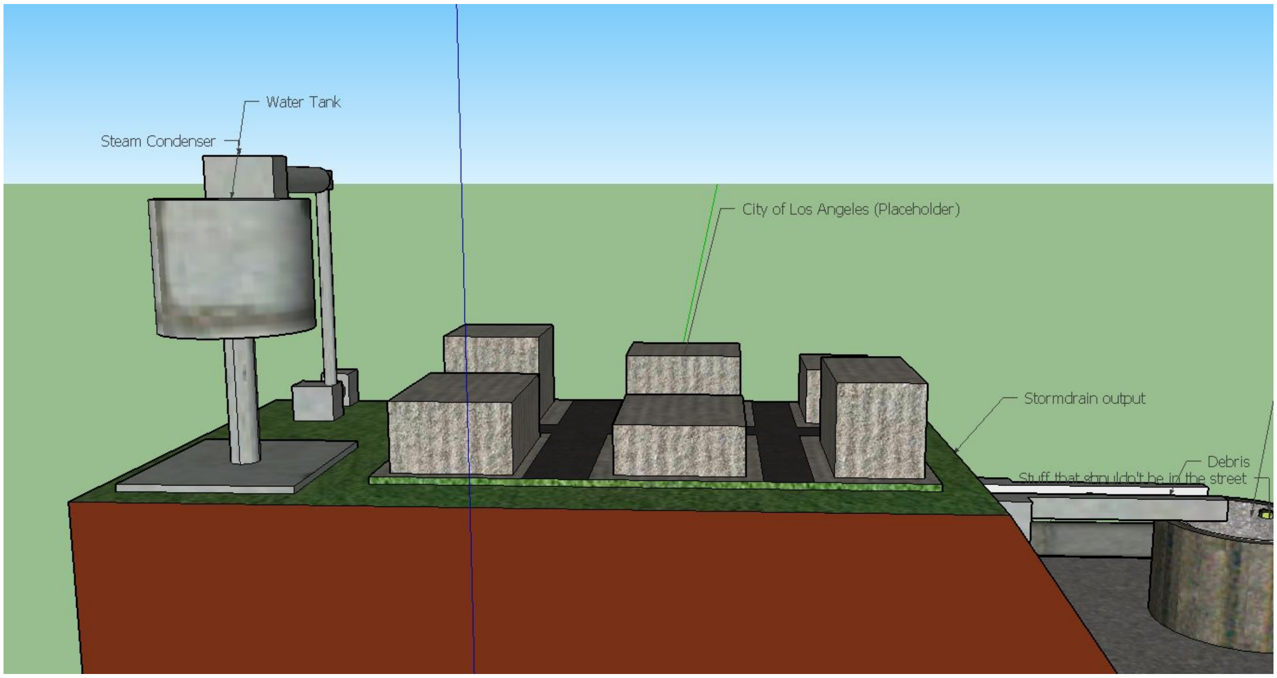
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Debris
Stuff that shouldn't be in the street

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