Combined Sewer Overflows
V161 Research Paper
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The combined sewer started in Europe in the 1840’s. The cities of Hamburg and London started to put their wastewater into the closest body of water. The main reason for this was to get the smell out of cities and make the cities a more enjoyable and healthier place. They soon found out this wasn't the best way to handle the situation and didn't solve their problem. Between 1840 and 1880 the urban area populations rapidly grew from 11% to 28% with a shortage of supplies and an increase in congestion combined sewers started to become more popular in the united states (Combined Sewer Overflow, n.d.) The City of Jeffersonville (n.d.), Indiana states that the “combined sewage overflows still effects 772 cities in the United States along with 40 million people in 32 states.” A combined sewage system consists of one pipe to collect all types of water run off including everything from households and the environment. The majority of the time these pipes overflow during heavy times of waterfall while heading to a treatment plant. This causes unwanted runoff into lakes, rivers and ponds making them contaminated with unsanitary water.

The United States Environmental Agency (EPA) describes the combined sewage overflow as a violation of the clean water act because the sewage makes the water unusable for the areas around the cities. There are many pollutants that are included but not limited to that go into the water like, bacteria, viruses, trash and floatables. Bacteria’s are spread from the bathrooms runoff that is included in the pipe system.(CSO., 2014) .During high level of precipitation the contaminated water can carry items like, metals, oils, and other toxic pollutants into the bodies of water. The contaminated water leaves the water unusable for not only use humans but for the surrounding wildlife. It will kill the fish in the water and is dangerous for the animals that use the body of water for drinking. This affects the city by taking away the available food sources. This also affects cities with nearby bodies of water because some people will be
less likely to use these bodies of water, like the Ohio river for an example which runs along Jeffersonville, Indiana. The citizens are also affected by solutions that are being done with the combined sewers and their sewer bills be increased to help pay of the grant that the city has to pay back.

There are many different solutions to combined sewage overflow. The obvious solution to the problem would be to separate the pipe into different systems to eliminate the possibility of an overflow. A lot of these solutions have not been taken in place yet because a lot of times these solutions can be very costly and time consuming. They would also destroy the road systems, which would lead to congestion in the cities and higher taxes. Some solutions are not available everywhere, like rainwater gardens in dry areas, Massachusetts revamping old sewer lines (Parmelee, 1) or disinfecting sewage with UV rays (Shreible, Casey, Fordran, 1).

Every year in Seattle Washington rainfall washes millions of gallons of storm water and untreated sewage into bodies of water. This threatens human health, water health and our quality of life. On average more than three hundred sewage overflows happen in Seattle sending raw sewage and storm water into creeks, lakes, the Ship Canal, the Duwamish River, and Elliott Bay. (Seattle Overflow Prevention, 2014) The combined sewage system in Seattle helps create health and environmental risks.

Compared to Phoenix Arizona and Jeffersonville, the other cities that will be mentioned, Seattle Washington has a very unalike climate. Seattle, WA can be described as a city with chilly wet winters and dry summers. It averages only 71 clear days a year, meaning the sun is shining and these usually happen between the months of May and September. Between the months of October and May, the city is mainly cloudy almost every day but once a week. Seattle has a misleading reputation for rainfall only getting around 36 inches of rain per year and the
U.S. average is around 37 inches per year, seeing that though, Seattle is in the top 5 for the most precipitation days annually (Sperling’s, n.d.). Therefore, it rains often but when it does rain, it does not rain a lot. Even though this is the case, rainfall can be unpredictable and combined sewage overflows are still a problem in city of Seattle. On average, it rains 152 days out of the year. The annual average temperature is 51.95°F.

Seattle Public Utilities (SPU) is getting ready for a lengthy plan that will create a widespread strategy to protect their waterways. They have four big steps that are broken down. One-step being that they will identify areas of Seattle where combined sewage overflow projects are required. Second, where they evaluate different solutions for different areas of affected areas. Third, Select the preferred alternative. Lastly, figure out a schedule for designing and constructing projects. All these projects that Seattle have are planned to be built by 2025 (Sewer Overflow Prevention, n.d.). As it is described in the plan, over the next ten years SPU will build an underground storage for 9.4 million gallons of sewage and storm water to help prevent overflows.

Jeffersonville, IN is located on Ohio River, the ninth biggest river in the United States that also connects to the second biggest river, the Mississippi River (All Counties, n.d.). Jeffersonville has a wide variety of climate change with an average of 89°F during the summer and average of 27°F in the winter (Sperling’s, n.d.). The city also rains roughly 96 days out of the year and has around 45 inches of rainfall each year more than both Phoenix and Seattle. With Jeffersonville having this much rainfall it causes the combined sewers to overflow into the Ohio River and Cane Run. Even though Jeffersonville is a small city compared to Seattle and Phoenix it still has a big problem.
The EPA stepped in told Jeffersonville that they must fix the combined sewer costing $90 million to $120 million through 2020 to 2025 (City of Jeffersonville, n.d.). Jeffersonville has a plan to separate the pipes. The separation will also be designed to self clean itself with dry weather flows or by flushing the water such as cleaning velocities are achieved regularly. For flushing the sewer Flushing Gates will be installed and they are designed to help during wet weather events. The solids, floatables and finer rock materials that are in the sewer will be expected to settle within the box sewer, while larger rocks is likely to stay within the sewer. Another big problem with the CSO is the odor that it causes in and around the city. To help prevent the odor the city is designing more elements in this area. They are going to catch all basins connected directly to the CSO Interceptor will have traps to prevent air from the CSO Interceptor escaping to the atmosphere. Due to the high level of anticipated and size of the daily flow in the sewer, natural drifting will occur and draw air within the sewer to an odor-controlled facility (CSO Interceptor Workshop, 2014).

In comparison to Seattle and Jeffersonville, Phoenix has a very different climate. Arizona is very dry and hot climate with on average about a twenty degree increasing in temperature compared to the other cities. Phoenix sees the least amount of rain with an average of 30 days out of the entire year (currentresults.com). Half of this rainfall occurs during the monsoon season which is between June and September (arizonaexperience.org). During the monsoons the rain falls for a short amount of time but the rainfall is very heavy. As said above combined sewer overflow is caused during period of heavy rainfall or snowfall, so these monsoon seasons can be a huge problem for the city. Even though the monsoon lasts for four months the heavy rainfall can take all the pollutants in the streets and bring it down into the sewers within the few minutes
of rain. This provides a need for the city to change their sewer system or risk fines for the EPA for polluting the water.

Arizona does not have a combined sewer overflow problem because they do not have combined sewers. The have separate sewers one for storm water and the other for water from houses. The water from the houses goes to a water treatment plant while the storm water goes directly to the nearby water sources. With is just as bad as having combined sewers because whenever it rain the pollutants from the roads will immediately pollute the water sources. To fix this problem the Stormwater Management sector in Phoenix works with other sectors in the city to keep the roads clean and make sure the storm drains are kept clean. The city has permits for storm discharge that is given by the Arizona Pollution Discharge Elimination System under the Arizona Department of Environment Quality. These permits develop plans for the city to reduce or eliminate the pollution from stormwater (Phoenix.gov). To reduce the amount of pollution in the water Phoenix can reroute the storm water pipeline to a water treatment plant since the storm water pipe is what is polluting nearby water systems. Rerouting would cost the tax payers a lot of money to help fix the system resulting in unhappy citizens. This could be a reason why the city decided to keep this system.

Arizona can try many different solutions to stop the problem of combined sewer overflow but rainwater gardens is not one of them. Rainwater gardens are gardens planted to soak up water runoff after heavy rain (uri.edu). The gardens are made up of area of plants like grass, flowers, bushes, or trees all of which are not plants that survive without regular amounts of water. These gardens would need to be taken care of with a sprinkler system during the eight months without monsoons just to be useful during the monsoon season. Also the rain provided may be too much of these gardens to gather effectively.
The solution to the CSO is to make the waterways a more enjoyable place for the environment and the citizens in that area. Jeffersonville is on track to separate the two pipelines so there isn’t an overflow. When the pipes are separated the sewer lines will be directed to a sewer plant and discharged from there. Seattle has a different idea than Jeffersonville, that is to make a 9.4 million gallon tank that will be used to store water when there is an overflow before the water is treated. Both of the solutions to separate the combined are efficient and approved by the EPA. Phoenix on the other hand has separate sewer systems with one that has storm water leading directly to nearby water. Having two separate systems is not the only solution to stop pollution; both systems have to be led to water treatment plants to lower pollution.
Annotated Bibliography


This article by the EPA gives a great explanation about the combined sewers and why they are bad. It also explains in great detail about the harms to the environment and why they are doing something about it. We are using this article because it has great explanation on the combined sewer overflows.


This plan gives details on what is going to happen when the separation of the two pipes. It has the plans that are going to be done and why they are doing them. I got this information from the City of Jeffersonville.


This article gives a summary on why the combined sewers need to be separated and the reason for it. It gives great data because it was uploaded from the City of Jeffersonville itself. I found this article by going on Jeffersonville website and found where they talked the combined sewers.


The chart that they provide shows the climate in Jeffersonville, Indiana. It also gives great information on how many days a year it rains and is sunny, which is great information to have when talking about the overflow of combined sewers. I know this chart shows great information because I live in Jeffersonville and the information they provide is accurate. It not only does Jeffersonville, Indiana but almost all cities.


The chart that they provide shows all of the rivers in the U.S. and lists them by size. It also shows what each rivet connects too. This chart was very useful because it provided information on about the rivers. We use the information to explain why the EPA is making cities find solutions to combined sewer overflows.


The article by the EPA gives information on the history of combined sewer overflow. It also focuses on the consequences and the harms that the overflow has. It is great information because is from the EPA, which have done numerous studies on the harms that the overflow brings.


This gave us information based on Seattle, WA combined sewage system. This was full of information regarding their sewage problem and storm water runoff. It told us all the problems that was wrong with the system and what they plan on doing about it.

We looked at 3 different cities in our paper and his gave us information based on the climate in Seattle, WA. This helped us find the difference and similarities to each other.


This article describes a solutions brought up through an American Academy of Environmental Engineers competition in 2002. Different states give their solution to CSO that doesn’t include new sewer systems. A city in Washington had a treatment that resulted in 20,000 gpm reductions in water pollution that could have been done with 7 miles of pipelines.


This article gives in-depth look into what CSO are and the solutions to solve the problem. It goes through over many different solutions and a look into the pros and cons of these solutions. This article also talks about different cities actually using these solutions.


Research was done at San Francisco to see how CSO affected the bay. They did intensive research to see how the CSO affected the water, sediment, even the animals in the bay, etc. This article can helps us see how cities deal with CSO and how it affects their citizens.


King County is looking for a way to reduce combined sewer overflows. The county says that when there is an overflow 90% is rainwater the other 10% is sewage so they are looking for a way to reduce rainwater. They want to install roadside rain gardens to absorb the rain. They hope this rain will also replenish their groundwater.


This books shows a different solution on fighting CSO. Instead of separating the sewer system cities can use other techniques like ultraviolet rays. The rays disinfect certain pollutants like bacteria making the water more usable. This can be used in various cities to solve bacteria problems.

This article can be used to look up the climate of the three cities. We can compare the cities and see different solutions for different climates. No every city’s climate are the same and this website will make it easy to compare all three.


This website describes how the weather in Arizona is different from the three other cities. This website listed characteristics of Arizona’s monsoon season without this I wouldn’t know any extreme weather conditions Arizona has.


The website lists Arizona’s plans of stormwater. Beforehand I assumed Phoenix has a CSO like many other cities but this website shows that they actually have two separate system. This website also breakdown who authorizes the separation and the pollution produced from it. It is also shown that they have no further plans to change this system.


This website explains raingarden drains and how they can be used for soaking up storm water. This website shows that is can be a solution for other cities but may not work in all. The website also explains other benefits like visually appeal to having raingarden drains.