

The City’s Combined Sewer System

Under most of the City’s streets there are two sewers; one for carrying stormwater to streams and rivers and one for carrying sanitary sewage from homes and businesses to the wastewater treatment plant (Figure 1). In a small area of the City in and around Old Town the City maintains and operates a Combined Sewer System (CSS). A CSS is a sewer system in which there is one pipe that conveys both sanitary sewage and stormwater to a local wastewater treatment plant (Figure 2). Under dry conditions all flow is conveyed to the treatment plant where it is treated, but during rain events the amount of stormwater entering the sewers can overwhelm the system and the combined sewage overflows into the local receiving waters (e.g., Hunting Creek) out of permitted Combined Sewer Overflows (CSOs). Along with stormwater discharges, these overflows impact local water quality. CSS systems are common in older cities throughout the US.

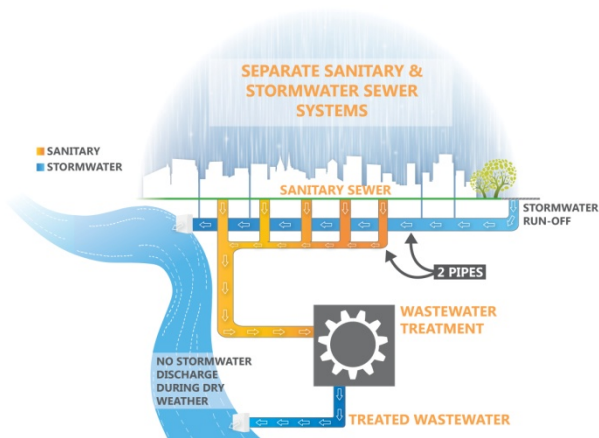


Figure 1: Separate Sewer System

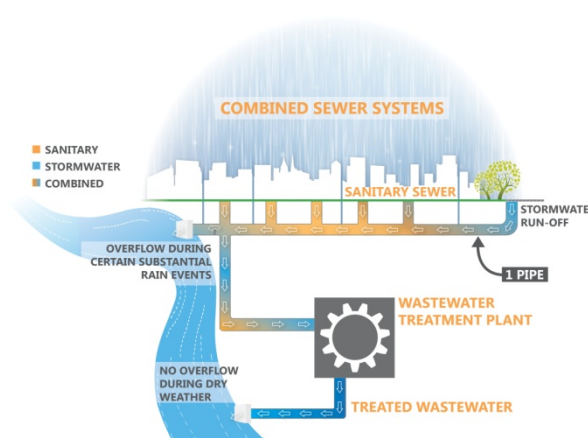


Figure 2: Combined Sewer System

What is a Long Term Control Plan?

The City of Alexandria’s Long Term Control Plan is a plan to control and reduce pollution from combined sewage overflows within the City through proper operation and maintenance. The City’s initial Long Term Control Plan was approved by the Virginia Department of Environmental Quality in 1999 and incorporated into the City’s discharge permit. Consistent with other combined sewer communities, the City’s current Long Term Control is built around combined sewer overflow control guidance provided by the Environmental Protection Agency.

Water Quality and New Regulations

The water quality in and around Alexandria has been monitored by the City for many years. The Virginia Department of Environmental Quality determined that Hunting Creek exceeded water quality standards for bacteria and established a Total Maximum Daily Load (TMDL) for bacteria. The TMDL is the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards and calls for reductions in the bacteria discharged from combined sewers. The City was issued a new combined sewer system discharge permit in 2013 that requires the City to update its Long Term Control Plan by August 2016. The Long Term Control Plan Update will be a strategic plan that will provide a path for the City to meet the Hunting Creek TMDL for bacteria. This plan update will focus on decreasing the amount of bacteria discharged into the receiving waters and gradually reducing impacts from the combined sewer system.



City's Evaluation Criteria

The City of Alexandria has developed a draft list of criteria to assist in evaluating the CSO Control Strategies for incorporating into the Long Term Control Plan Update. Public feedback will inform the City on how to weight the various criteria through the evaluation process.

- a) **Capital Cost.** The capital cost category of the evaluation criteria measures the relative cost of each CSO control strategy.
- b) **Combined Sewer Overflow Reduction (Volume).** One of the most effective ways to reduce the bacteria load to the receiving waters is to limit the volume of combined sewer overflow. In some instances there may be a reduction in the bacteria load (e.g., disinfection) without a reduction in CSO volume.
- c) **Effectiveness.** The effectiveness criterion is a rating of how well a control strategy meets the Hunting Creek TMDL requirements. The reduction in bacteria will be determined for each control strategy.
- d) **Implementation Effort.** The implementation criterion is the feasibility with which all the projects in a CSO control strategy can be successfully completed. Implementation considerations include, but are not limited to:
 - Complexity of the construction project(s)
 - Experience with the selected technologies
 - The implementation timeline and ability to meet regulatory deadlines
 - Availability of land for the proposed project(s)
 - Ability to acquire the land for the proposed project(s)
 - Availability of resources, labor and expertise to complete the project(s)
- e) **Impact to the Community.** The CSO control strategies will result in capital projects that will impact the businesses and citizens of the City of Alexandria during implementation (i.e., construction). Alternatives that result in improved quality of life for residents and business and with minimal negative impact during implementation will receive more favorable ratings. The strategies that could have disruptive impacts to the community and business operations during implementation will receive less favorable ratings.
- f) **Expandability.** The expandability criterion describes how well a strategy will adapt to future updates and expansion to the sewer and stormwater infrastructure in the City of Alexandria.
- g) **Net Environmental Benefit.** The net environmental benefit criteria observes how the potential negative environmental impacts of constructing the projects compares to the overall environmental benefits the projects provide in the long-term
- h) **Credit Trading between the Combined Sewer and the Storm Sewer Systems.** It may be possible to implement combined sewer controls that will capture both sanitary flow and storm flow to be treated at the AlexRenew Water Resources Reclamation Facility (i.e., the wastewater treatment plant). Due to the high level of treatment at the wastewater plant, the pollutant reduction associated with the treatment of stormwater could potentially be applied to the City's stormwater program.
- i) **Required Operation and Maintenance.** This criterion is a rating of the predicted operation and maintenance a completed project will need over its lifetime.



CSO Control Strategies

Storage Tunnels

During a rain event, underground tunnels will capture and store the combined sewer overflow in the tunnel. After the rain event, the stored volume will be sent to the wastewater treatment plant for a high level of treatment.

Underground tunnels are a common and accepted technology for conveyance and storage of combined sewage overflows. Across the Potomac River, DC Water is currently constructing a series of underground tunnels to mitigate their combined sewer overflows. Many other communities have installed tunnels to address their combined sewer systems, including Atlanta, Boston, and Richmond.

Advantages:	Disadvantages:
<ul style="list-style-type: none"> • Captures and stores the combined sewer overflow and then sends it to the wastewater treatment plant for a high level of treatment • Minimal aesthetic impact and spatial requirements, as the facilities are largely underground • Generates credits for stormwater 	<ul style="list-style-type: none"> • Complex construction project • Siting and easement challenges (private property, Federal park land, historic considerations, etc.) • Construction impacts at tunnel access shafts

Storage Tanks

During a rain event, the combined sewer overflow will be diverted to storage tanks. The storage tanks can either be constructed above ground or below ground. The storage tank(s) will be in the vicinity of the existing outfalls. After the rain event, the stored volume will be sent to the wastewater treatment plant for a high level of treatment. Storage tanks are a common and accepted technology for storage of combined sewage overflows. Although not specific to combined sewers, underground storage tanks have been installed in the City at the Four Mile Run Pump Station located at the north end of Commonwealth Avenue. Arlington County utilized above ground storage tanks at their wastewater treatment plant (intersection of Route 1 and S. Glebe Road).

Advantages:	Disadvantages:
<ul style="list-style-type: none"> • Captures and stores the combined sewer overflow and then sends it to the wastewater treatment plant for a high level of treatment • Anticipated to be one of the less costly infrastructure control strategies • Generates credits for stormwater 	<ul style="list-style-type: none"> • Space required for storage tanks is at a premium in an urban environment such as Alexandria • Siting and easement challenges (private property, Federal park land, historic considerations, etc.) • May be impractical to site due to space limitations

Sewer Separation

Separation will create two separate systems: a stormwater system utilizing the current combined sewer pipes and a new sanitary system. Full separation will require digging up the infrastructure in Old Town and would lead to years of disruption. The City already has a separation plan, which is known as the Area Reduction Plan. Over the last 10 years the City has separated more than 13 acres from the combined sewer system. The Area Reduction Plan is tied to redevelopment projects within the combined sewer area. In order to meet the regulatory timeline, separation would be independent of redevelopment.

Advantages:	Disadvantages:
<ul style="list-style-type: none"> • Over time will eliminate the combined sewer system (separate storm and sanitary sewers) • New sanitary sewer infrastructure constructed 	<ul style="list-style-type: none"> • Design complexity – significant conflicts with existing utilities • Anticipated to be the most costly control strategy. • Anticipated to be the most disruptive to the local residents and businesses as construction will be throughout entire Old Town Area • Will take longer to implement • Additional stormwater discharges to be regulated



Green Infrastructure

Green infrastructure can be used as a method to reduce stormwater runoff and the volume of combined sewer overflows in the City of Alexandria. The combined sewer system is in a densely populated area, with a large portion of the land covered with impervious surfaces (pavement, sidewalks, and buildings). These impervious surfaces prevent much of the rainfall from being absorbed into the ground and diverts the rainfall into the combined sewer system, where it may eventually overflow. Green infrastructure captures rainfall, removes pollutants, and lengthens the amount of time it takes for the rainfall to make it into the sewers. By lengthening the amount of time it takes to reach the sewer it may be possible to reduce the amount of overflow volume and frequency. Green infrastructure technology examples include rain gardens, bioswales, and permeable pavement. Other communities have begun to incorporate green infrastructure into their combined sewer mitigation efforts, including Washington, New York City, and Philadelphia.

Advantages:	Disadvantages
<ul style="list-style-type: none"> Reduces the stormwater entering the combined sewers. Provides ancillary environmental and community benefits. 	<ul style="list-style-type: none"> May not achieve bacteria reduction requirements as a stand-alone strategy Highly site specific – existing soils, utilities, and community needs will dictate effectiveness. Disruptive to local residents and businesses as multiple projects will be required over a long implementation timeline

Disinfection

During a rain event the combined sewer overflow will be diverted a new disinfection facility. The disinfectant is added or applied to kill the bacteria before it discharges into Hunting Creek. Disinfection technologies include sodium hypochlorite (chlorine) and ultra-violet (UV) radiation disinfection. The disinfection facilities would be in the vicinity of the existing outfalls. Other communities have installed disinfection facilities to address their combined sewer systems, including Indianapolis and Detroit.

Advantages:	Disadvantages
<ul style="list-style-type: none"> Disinfects (i.e. kills) the bacteria associated with the combined sewer overflow Smaller footprint than storage tanks 	<ul style="list-style-type: none"> May be impractical to site due to space limitations. Requires storage of chemicals in an urban/residential area (chlorine) Requires significant electrical infrastructure (UV) Does not reduce volume of combined sewer overflows Does not treat other pollutants and nutrients

Outfall Relocation

The City’s outfalls 002, 003, and 004 ultimately discharge into Hunting Creek. Hunting Creek has been identified as impaired for bacteria by the Virginia Department of Environmental Quality. The outfalls could be consolidated and moved to the Potomac River and out of the Hunting Creek embayment. The Potomac River has a higher capacity to assimilate (absorb the impact of) the bacteria. The infrastructure necessary to convey the combined sewer overflow would be significant, resulting in a high volume of storage and treatment, similar to the tunnel control strategy. Only combined sewer overflows that could not be stored would overflow into the Potomac River.

Advantages:	Disadvantages
<ul style="list-style-type: none"> Captures and stores some of the combined sewer overflow and then sends it to the wastewater treatment plant Removes all overflows from the Hunting Creek embayment Minimal aesthetic impact and spatial requirements, as the facilities are largely underground Generates credits for stormwater 	<ul style="list-style-type: none"> Complex construction project Requires a significantly longer tunnel and construction of a new outfall on the Potomac Regulatory and permitting challenges. Siting and easement challenges (private property, Federal park land, historic considerations, etc.) Construction impacts at tunnel access shafts