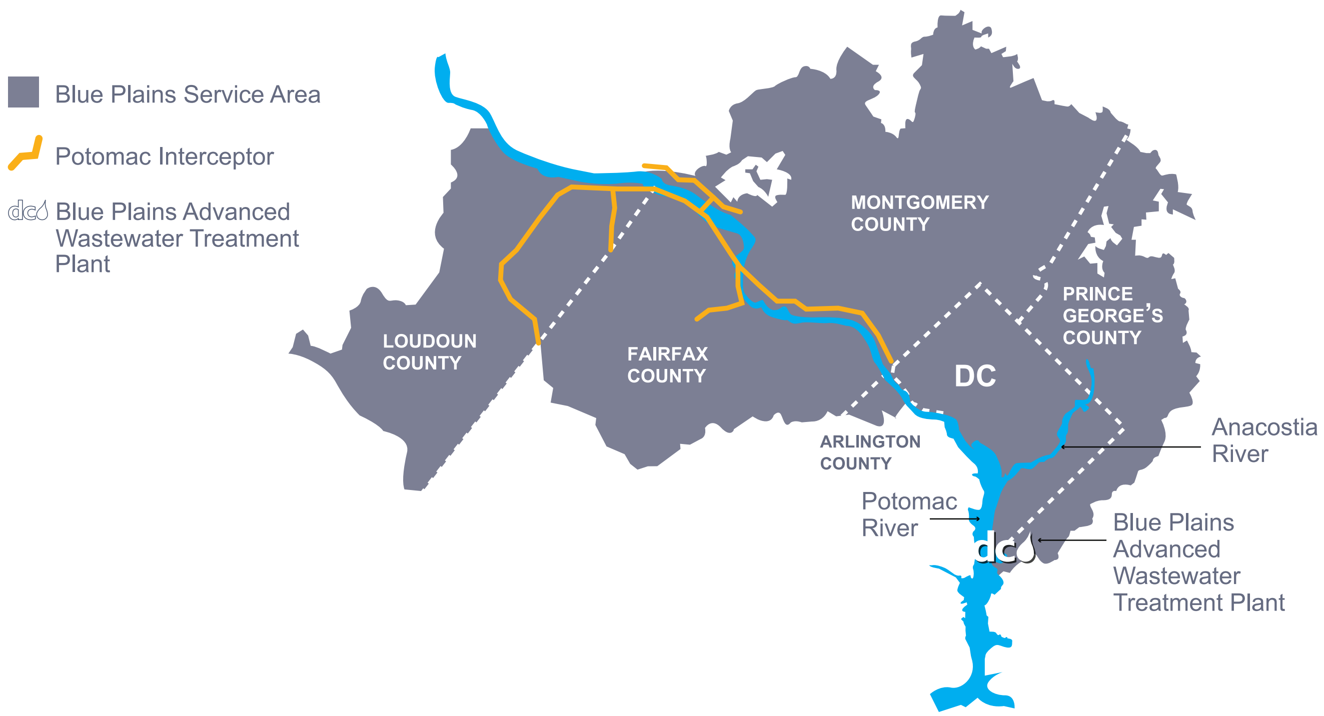
BLUE PLAINS ADVANCED WASTEWATER TREATMENT PLANT

A resource recovery facility. Transforming wastewater into clean water, green energy, and renewable soil amendments.

Advanced Wastewater Treatment

FACILITIES MANAGED BY, AND SERVICE AREAS SERVED BY, DC WATER



WELCOME

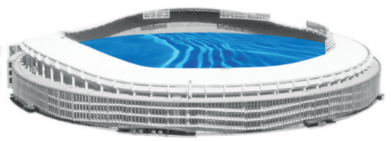
water is life®

INSIDE:

Facts at a Glance: Blue Plains Advanced Wastewater Treatment Plant

1. DC Water's Blue Plains Advanced Wastewater Treatment Plant is the largest plant of its kind in the world. It has a design average treatment capacity of 384 million gallons per day (MGD), a peak four-hour capacity of 555 MGD, and an additional wet weather treatment capacity of 225 MGD.

2. The average treatment capacity of 384 MGD is enough to fill RFK stadium daily.



3. The plant opened as a primary treatment facility in 1937 and added processes, technology and capacity in subsequent years. The facility continues to expand with new environmental and sustainable energy projects, using all of its 153 acre footprint.

4. While larger plants employ primary and secondary treatment, and stop there, Blue Plains provides advanced treatment – nitrification and denitrification, multimedia filtration and chlorination/dechlorination.

5. In 2015, DC Water started anaerobic digestion, converting over half the organic matter from the water treatment process to methane to generate electricity to help power operations at Blue Plains. The remaining half of the solids are processed into Class A biosolids. DC Water's Class A biosolids can be applied to gardens and farms as a soil amendment.

6. Blue Plains treats used water for the entire District of Columbia and more than 1.6 million people in Montgomery and Prince George's counties in Maryland and Loudoun and Fairfax counties in Virginia, for a total service area of more than 725 square miles.

7. The pretreatment program manages industrial dischargers from all four counties in the service area and the District of Columbia including temporary construction discharges, dental dischargers, and hauled waste. Blue Plains receives over 30 million gallons of hauled waste a year from within the local service area.

8. DC Water uses both contracted and on-site laboratories to analyze samples to ensure it is meeting federal, state and local regulatory requirements. The in-house lab conducts more than 100,000 tests a year.

9. Blue Plains captures over 99% of the stormwater runoff within its 153 acre footprint and treats it in the process.

10. The Blue Plains operations team covers the 24/7 operations rotating through four crews, each with one General Foremen, three Area Foremen, and roughly 15 Operators.

11. The Blue Plains maintenance team performs corrective, preventative and predictive work on over 5,000 rotating machines with 11 maintenance foremen and nearly 90 trades peoples.

12. Our employees continually improve and enhance our wastewater treatment processes to better serve the community, protect the environment and ensure the safety and reliability of our wastewater treatment. Blue Plains is run by a team of nearly 230 employees, including skilled maintenance trades, administrators, engineers, lab technicians and wastewater operators licensed at the highest level of certification for their position.

Evolution of Wastewater Treatment

Before 1937, wastewater flowed through the District in open sewers and discharged untreated to the nearest waterway. Before sewers, disposal methods were even more primitive, contributing to epidemics of cholera and dysentery that caused a high death rate. Sewage conveyance and treatment, and the sanitation they brought to the District, were heralded for public health, quality of life and economic benefits. Blue Plains' treatment provided the first barrier to protect the environment from wastewater generated by those living or working in the region.

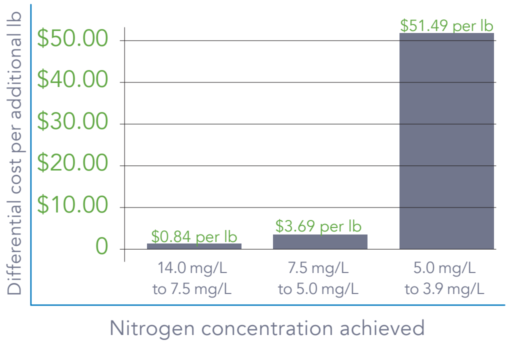
Local waterways suffered from the population growth of the District and upstream suburbs. Urban and suburban runoff, agricultural runoff and wastewater degraded the health of the Potomac and Anacostia rivers, Rock Creek and the Chesapeake Bay. The Blue Plains Advanced Wastewater Treatment Plant remains the best protection for our waterways, as it cleanses the wastewater generated by more than two million people, every minute of every day. The plant serves as a barrier to the receiving waters, minimizing the environmental impact of the things we do in our daily lives—not only using the toilet, but washing our clothes, cars, dishes, food, bodies and teeth. It is an essential service for the region.

Environmental protection is an ongoing commitment. The engineers at DC Water continually examine wastewater technology and facilities to remain on the cutting edge and to implement innovative solutions. DC Water has massive environmental wastewater programs underway, totaling nearly $4 billion. DC Water is committed to improving the health of local waterways, producing exceptional Class A biosolids and generating sustainable energy from the wastewater treatment process.

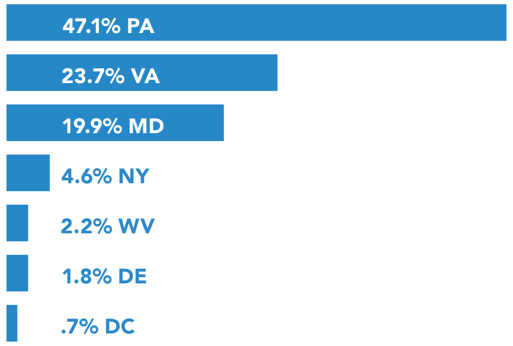
The Cost of Environmental Stewardship

The cost of innovation and stewardship is significant. For example, the Blue Plains discharge permit issued by the United States Environmental Protection Agency (U.S. EPA) has three times required the Authority to dramatically reduce the level of nitrogen in its treated water. This has been achieved through technological and engineering projects. As the nitrogen limits are further reduced, the price increases exponentially. The recently completed enhanced nitrogen removal project cost close to $1 billion and is at the limit of technology.

DIFFERENTIAL COST PER POUND OF TOTAL NITROGEN REMOVED



2017 NITROGEN LOADS TO THE BAY BY JURISDICTION



CHESAPEAKE BAY WATERSHED

DC Water joined the Chesapeake Bay Agreement and was the first in the watershed to meet its voluntary program goals for nitrogen removal of 40 percent of the 1985 levels, or 7.5 milligrams per liter (mg/L), two years ahead of schedule. With the recent completion of enhanced nutrient removal facilities, the plant meets its nitrogen goals under the Chesapeake 2000 Agreement. The plant already meets its phosphorus goals, as phosphorus is captured in primary and secondary treatment and stored in biosolids which are land applied, recycling this valuable nutrient back to the land. DC Water continues to meet or exceed performance levels set by the U.S. EPA.

Customers bear the bulk of the costs of these environmental protections. DC Water has received limited federal funding for environmental projects under construction at Blue Plains, but their ultimate cost is nearly $4 billion.

It is important to note that even if nitrogen levels at Blue Plains were reduced to zero, local waterways and the Chesapeake Bay would still be impaired by other sources of nitrogen. Blue Plains contributes less than two percent of the estimated nitrogen load to the Chesapeake Bay. Although Blue Plains is the largest point-source discharger of nitrogen, the nitrogen in the Bay is largely from non-point sources like agriculture.

It is imperative that other sources of nitrogen, including agricultural, and urban and suburban runoff, are addressed to improve the health of local waters. States in the Chesapeake Bay watershed are formulating watershed implementation plans to do just that, but many are finding the solutions to be cost-prohibitive.

State-of-the-Art Technology and Innovative Research

As part of the nearly $1 billion plant-wide upgrades in the 2000s, the Authority streamlined operations by automating many processes and built a state-of-the-art operations center, where performance of the entire plant can be monitored.

Blue Plains is world-renowned for its research programs that analyze technologies years before they are put into practice. DC Water's engineering team is recognized for innovation, exploring technologies that have not been adopted in the United States. In fact, delegations of international wastewater engineers visit Blue Plains regularly to learn more about DC Water's management, engineering, finance, research and technology.

While the plant provides advanced wastewater treatment, the maintenance of our equipment also uses advanced techniques to determine the health of equipment including laser alignment, oil analysis, ultrasound lubrication, infrared thermography, and vibration analysis.

The Wastewater Treatment Process

Screening and grit removal
Wastewater comes to Blue Plains through 1,800 miles of sewers from around the District and from the Potomac Interceptor, a large sewer that begins at Dulles Airport, bringing with it wastewater from the Maryland and Virginia suburbs along the way.

The sewage is pumped up from below ground for treatment at the plant. A series of screens removes objects and large particles. The grit chamber removes rocks and other non-degradable particles. These are loaded into trucks and taken to a landfill. The wastewater then flows to the next stage of treatment.

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Primary clarifiers
Primary treatment is a physical process that takes place in a cone-shaped tank. Solid particles settle out and fall to the bottom, while the wastewater flows outward, over a set of weirs. An arm skims the fats, oils and grease (FOG) off the top while the solids settle to the bottom. The FOG and solids are directed to Solids thickening.

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Secondary reactors and sedimentation
Secondary treatment is a biological process that uses microbes to treat organic material (fats, sugars, short-chain carbon molecules). At Blue Plains, activated sludge is the process used to achieve secondary treatment.

For the process to be most effective, the microbes need both oxygen and food. Blue Plains supplies the oxygen by blowing air into the tanks through bubble diffusers. The wastewater contains the food (organic matter, or carbon). The microbes consume this food and grow more microbes. The bubbling oxygen also mixes the wastewater and the microbes give the flow a reddish-brown color.

It is a delicate environment that requires diligent monitoring to ensure the health of the microbial ecology. Once the bugs have done their duty, they are settled out from the wastewater in secondary sedimentation tanks. A portion of the settled microbes are then returned to secondary reactors to sustain the process, with the remainder recycled with the biosolids.

Many wastewater treatment plants stop nutrient treatment here. But Blue Plains discharges to the Potomac, a tributary to the Chesapeake Bay, and nitrogen must be further removed to protect the watershed.

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Nitrification, denitrification, filtration and disinfection establish Blue Plains as an advanced wastewater treatment facility.

Nitrification
The first step of advanced treatment is oxidizing the nitrogen from ammonia to nitrate. This is achieved through another biological process using microbes supplied with a large amount of air in the nitrification reactors.

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Denitrification
The second step to nitrogen removal requires converting the nitrate to nitrogen gas, which releases the nitrogen safely into the atmosphere. This process is achieved in the denitrification reactors. No oxygen is added here, which forces microbes to consume the oxygen in nitrates instead. The microbes require a carbon source as food. Methanol is added in this process as the carbon source.

Multimedia filtration and disinfection
The treated plant flow is filtered through sand and anthracite in the world's largest wastewater filtration facility. The flow is disinfected with sodium hypochlorite-based chlorination at the filter influent, and the residual chlorine is removed before discharge with sodium bisulfite. The final plant effluent after processing looks the same as drinking water.

Solids thickening, dewatering
In the treatment processes, solids are removed from settling tanks. In the primary clarifiers, these solids are sent to screening and grit removal, and then sent to gravity thickeners for thickening. Secondary or final effluent is used for dilution water for the gravity thickening process.

Solids that come from the secondary and nitrification processes are sent to dissolved air flotation tanks where a process using supersaturated air is able to float the solids to the surface.

The gravity thickened solids and the dissolved air flotation solids are combined and homogenized in a blend tank. Blended solids are screened, dewatered to 16-18 percent solids, and sent through a thermal hydrolysis process.

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Thermal Hydrolysis and Anaerobic Digestion
Thermal hydrolysis uses high heat and pressure to eliminate pathogens and prepare the "food" for hungry archaea and bacteria microbes in the digesters.

The digesters produce methane and Class A biosolids. The biosolids are then further dewatered through a belt filter press. The liquid removed from the biosolids, called filtrate, has significantly higher ammonia content than regular wastewater and is treated separately.

The captured methane is used as fuel in turbines providing net 10 megawatts of electricity and steam to heat the thermal hydrolysis process.

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Biosolids end use
The Class A biosolids product is loaded onto trucks and hauled to farmlands, forests and reclamation projects as well as to local soil blenders. The biosolids are land-applied, recycling the carbon and nutrients—nitrogen and phosphorus—back to the soil. Because the biosolids meet Class A standards, they can be used in both rural and urban settings.

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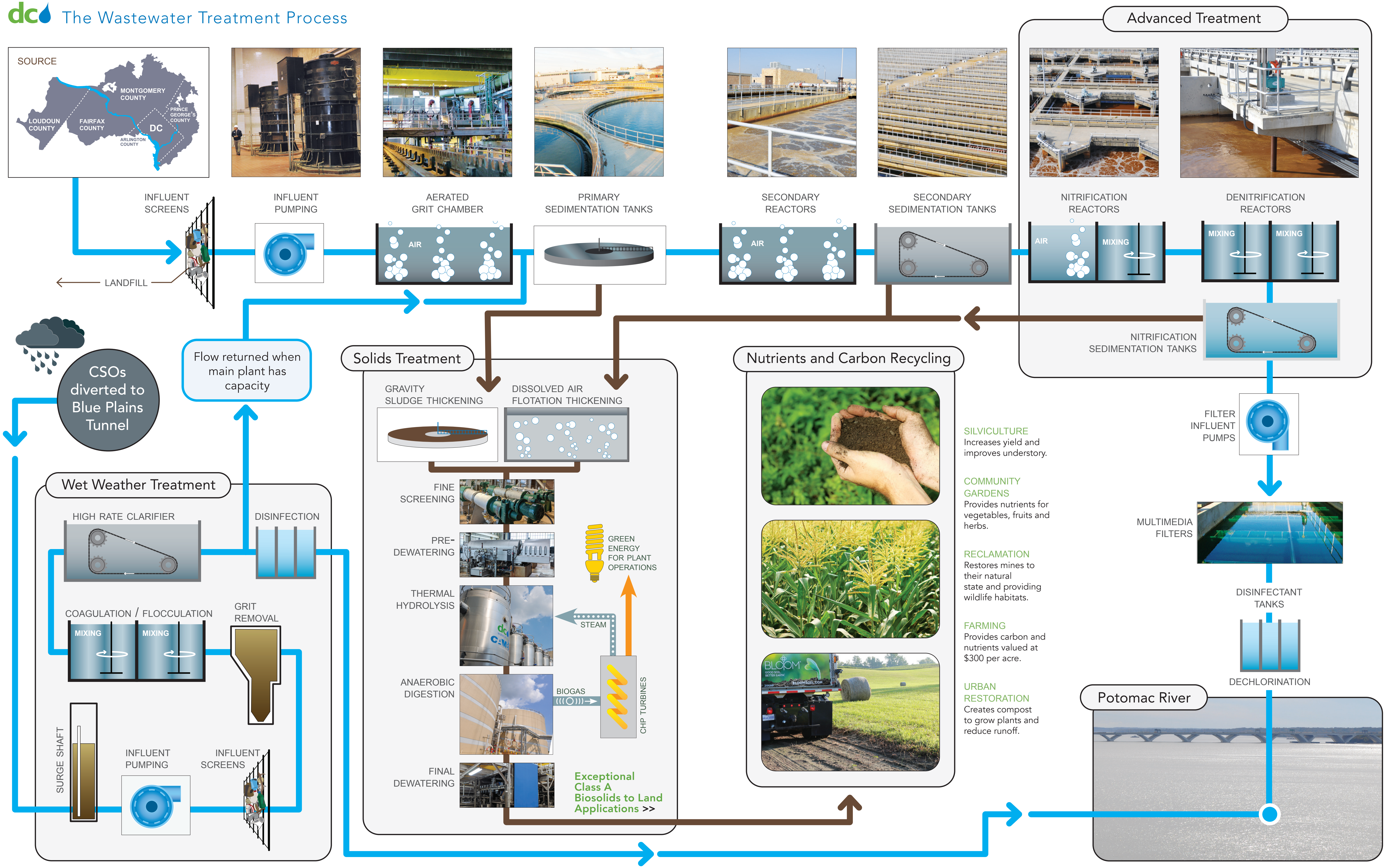
Filtrate Treatment Facility
The Filtrate Treatment Facility operates the DEMON process, which uses a special group of bacteria called anammox to remove nitrogen without the use of methanol, reducing chemical costs.

The Wastewater Treatment Process



Enhanced Nutrient Removal

The enhanced nutrient removal project reduced the level of nitrogen from the final effluent that DC Water discharges to the Potomac River. Nitrogen can act as a fertilizer in the Potomac River and Chesapeake Bay, creating unruly grasses that deplete oxygen needed by marine life to live and thrive.

With the $950 million project complete, Blue Plains will produce effluent with some of the lowest levels of nitrogen in the country. At 4 mg/L, it is extremely low, and is considered near the limit of conventional treatment technology. The facilities include more than 40 million gallons of additional anoxic reactor capacity for nitrogen removal, new post-aeration facilities, an 890 mgd lift station, new channels and conveyance structures, and new facilities to store and feed methanol.

Filtrate Treatment Facility

The Filtrate Treatment Facility was commissioned in 2018 to remove ammonia nitrogen from the filtrate stream that is generated from dewatering of the digested biosolids. The DEMON process uses a special group of bacteria called anammox to efficiently remove nitrogen without the use of an organic carbon source such as methanol. This helps minimize the volume of methanol used in the main plant Enhanced Nitrogen Removal Facility and reduces chemical costs.

Thermal Hydrolysis and Anaerobic Digestion

DC Water was the first utility in North America to use thermal hydrolysis for wastewater treatment. It is the largest thermal hydrolysis plant in the world. Though thermal hydrolysis has been employed in Europe, the water sector in North America has been slow to adopt this technology.

The thermal hydrolysis process (THP) eliminates pathogens and allows the digesters to be half the size otherwise needed. In the digesters, microbial methanogens converts solids into biogas. The biogas is cleaned for its methane, which is then used in the combined heat and power (CHP) system to generate 10 MW of electricity for Blue Plains and steam to operate THP.

DC Water is the largest single source consumer of electricity in the District, and CHP cuts consumption up to a third. The final product is a Class A biosolids that has many more reuse options as a soil amendment than the former Class B product. The solids product is a smaller volume, and even when land-applied, will reduce hauling and emissions, further reducing the plant's carbon footprint.

How much energy is 10 MW?
That's enough to power 8,000 homes.

dc clean RIVERS PROJECT

As in many older cities, the District has a combined sewer system, which carries both wastewater and stormwater in a single pipe serving about a third of the District's area. A combined sewer overflow (CSO) occurs during heavy rain when the mixture of sewage and stormwater exceeds the capacity of the system and overflows to the nearest water body to prevent upstream flooding. Prior to the start of the Clean Rivers Project, the CSO over flow volume was about three billion gallons into the Anacostia and Potomac Rivers and Rock Creek in an average year of rainfall.

DC Water's Clean River Project is a massive infrastructure program to reduce CSOs into the District's waterways. It includes green infrastructure and more than 18 miles of tunnels. With the Clean Rivers Project, DC Water will improve our waterways by reducing CSO volume systemwide by 96% in the average year and by 98% to the Anacostia River alone. The Clean Rivers Project will also provide flood relief to neighborhoods in the Northeast Boundary section of the city, such as Bloomingdale, LeDroit Park, Trinidad, and Ivy City.

The Anacostia River tunnel system from Blue Plains to RFK Stadium began operation in March 2018. As of September 2020, it has captured almost 9 billion gallons of combined sewage and over 4,300 tons of trash, solids, and debris that otherwise would have been discharged to the river. Instead, these flows were diverted to Blue Plains for treatment.

The Northeast Boundary Tunnel (NEBT) is the final 5-mile segment of the CSO controls serving the Anacostia River, which will add 90 million gallons of storage capacity and provide flood relief for neighborhoods in Northwest and Northeast DC. Construction of the NEBT will be completed in 2023. The Potomac River Tunnel, currently in design, will control CSOs to the Potomac River between the Lincoln Memorial and Georgetown. It will be placed into operation in March 2030.

The Clean Rivers Project includes green infrastructure – bioretention (rain gardens) in planter strips and curb extensions, permeable pavement in streets and alleys, parks, streetscapes, and a downspout disconnection and rain barrels program – to manage CSOs Potomac River and Rock Creek. Green infrastructure practices manage stormwater by taking advantage of the earth's natural processes that allow water to infiltrate into the soil, evaporate into the air, or for plants to use the water and transpire it as vapor. These practices can slow down, clean, and, in some cases, reduce stormwater runoff prior to it entering the combined sewer system. In addition to managing stormwater and promoting cleaner waterways, green infrastructure enhances natural habitats and contributes to beautifying the streetscape and making it more welcoming for pedestrians, bicyclists and drivers while also providing the District with green jobs.

dc water is life®

dcwater.com

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