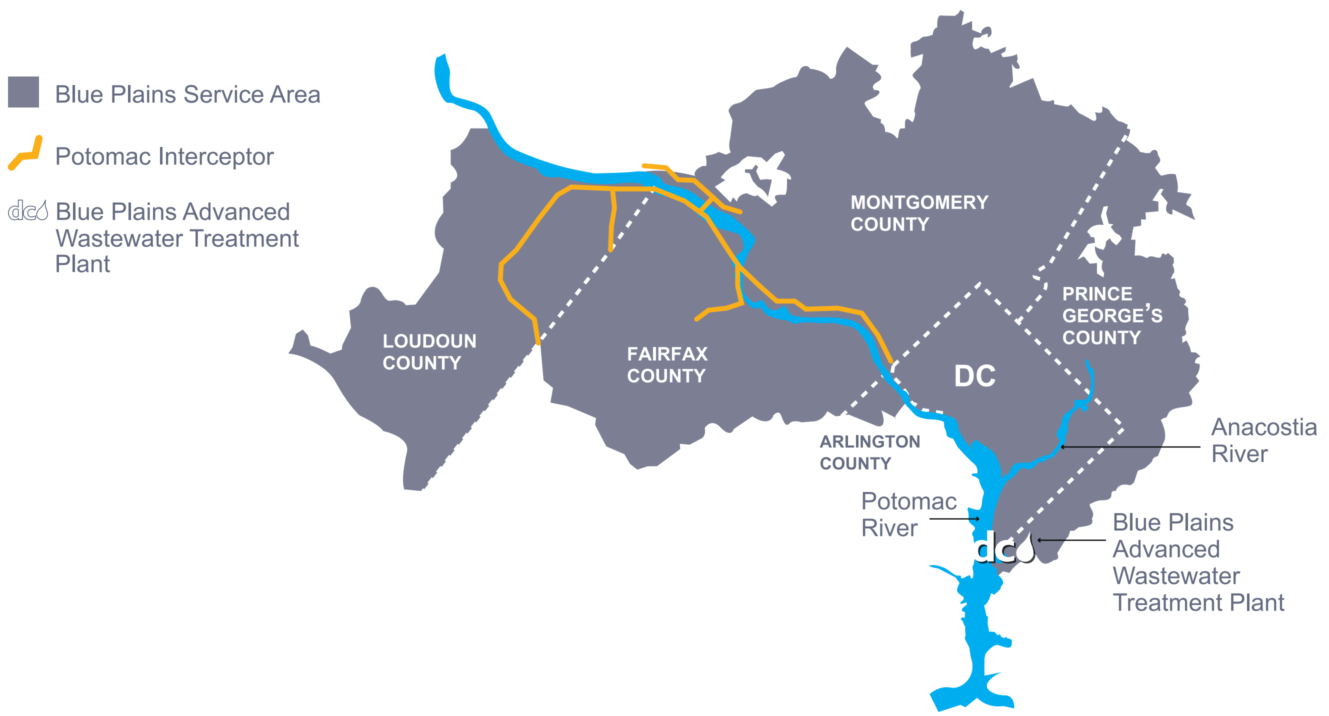
dc water is life®

BLUE PLAINS ADVANCED WASTEWATER TREATMENT PLANT

A resource recovery facility. Transforming wastewater into clean water and energy.

dcwater.com

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



WELCOME

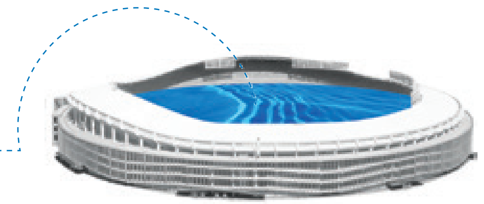
dc water is life®

INSIDE:

Facts at a Glance: Blue Plains Advanced Wastewater Treatment Plant

DC Water's Blue Plains Advanced Wastewater Treatment Plant is the largest plant of its kind in the world, averaging 384 million treated gallons per day and over one billion gallons per day at peak flow.

384 million gallons. Enough to fill RFK Stadium daily.



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

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.

Facts:

- Service area covers more than 725 square miles.
- Treats used water for the entire District of Columbia. In addition, provides treatment for more than 1.6 million people in Montgomery and Prince George's counties in Maryland and Loudoun and Fairfax counties in Virginia.
- Capacity to treat an average of 384 million gallons per day (mgd).
- Peak wet weather capacity to treat more than one billion gallons per day.
- 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.
- 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.

Evolution of Wastewater Treatment

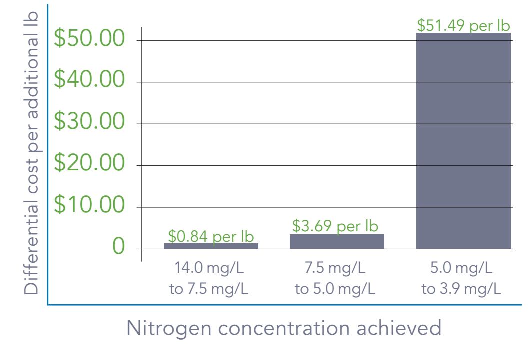
Before 1937, wastewater flowed through the District in open sewers and discharged untreated to the nearest waterway. Before sewers, disposal methods were even more primitive, contributing to epidemics of cholera and dysentery that caused a high death rate. Sewage conveyance and treatment, and the sanitation 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.

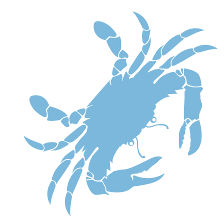
Local waterways suffered from the population growth of the District and upstream suburbs. Urban and suburban runoff, agricultural runoff and wastewater degraded the health of the Potomac and Anacostia rivers, Rock Creek and the Chesapeake Bay. The Blue Plains Advanced Wastewater Treatment Plant remains 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. We are committed to improving the health of local waterways and generating sustainable energy from the wastewater treatment process.

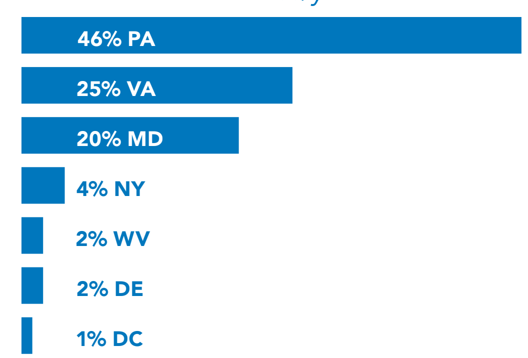
The Cost of Environmental Stewardship

DIFFERENTIAL COST PER POUND OF TOTAL NITROGEN REMOVED

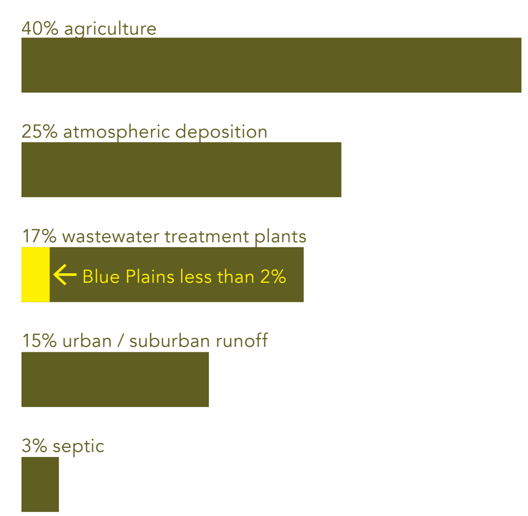




2011 NITROGEN LOADS TO THE BAY BY JURISDICTION *mil lbs/yr*



2011 NITROGEN LOADS TO THE BAY BY SOURCE *mil lbs/yr*



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.

DC Water joined the Chesapeake Bay Agreement and was the first in the watershed to meet its voluntary program goals for nutrient 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 single point-source discharger of nitrogen, the vast majority of the nitrogen in the Bay is 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.

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. This FOG is sent to landfills, while the solids are treated for reuse.

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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 pumping air into the tanks with bubble diffusers. The wastewater contains the food (organic matter, or carbon). The microbes consume this food and grow more microbes. The added oxygen causes the wastewater in secondary reactors to have a bubbling, active appearance and the microbes cause a reddish-brown color.

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

Many wastewater treatment plants stop 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 in the nitrification reactors with a large amount of air.

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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 step does not add oxygen, which causes the microbes to consume the oxygen in nitrates. The process is achieved in the same type of tanks as nitrification, but the nitrification section is aerated (aerobic), while the denitrification section is not aerated (anoxic). 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.

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Solids thickening, dewatering

In the treatment processes, solids are removed from process 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.

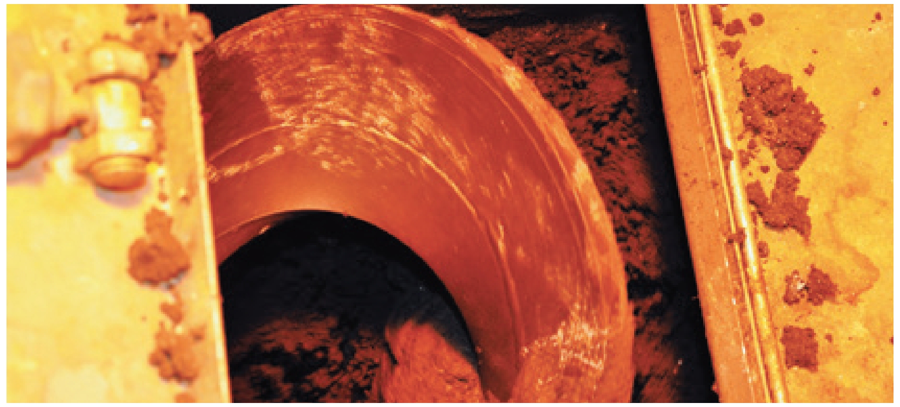
This secondary solids are skimmed off the surface and combined with the gravity thickened solids in a blend tank. Blended solids are screened, dewatered to 18 percent solids, and sent through a thermal hydrolysis process. Thermal hydrolysis uses high heat and pressure to (1) eliminate pathogens and (2) prepare the "food" for hungry archaea and bacteria microbes in the digesters.

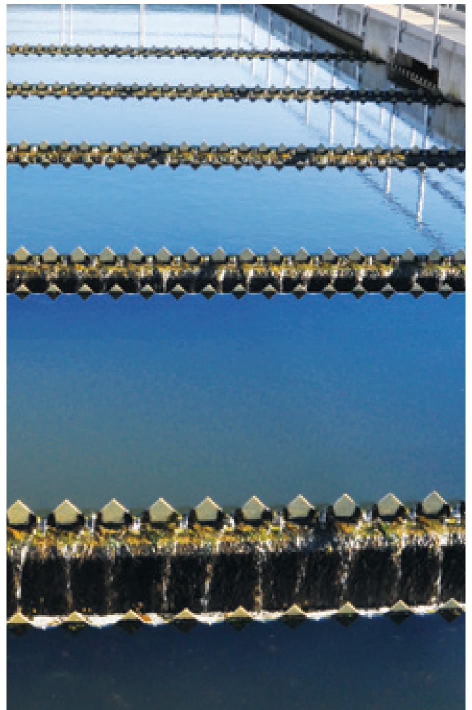
The digesters produce methane and Class A biosolids. The biosolids are then further dewatered through a belt filter press.

Biosolids end use

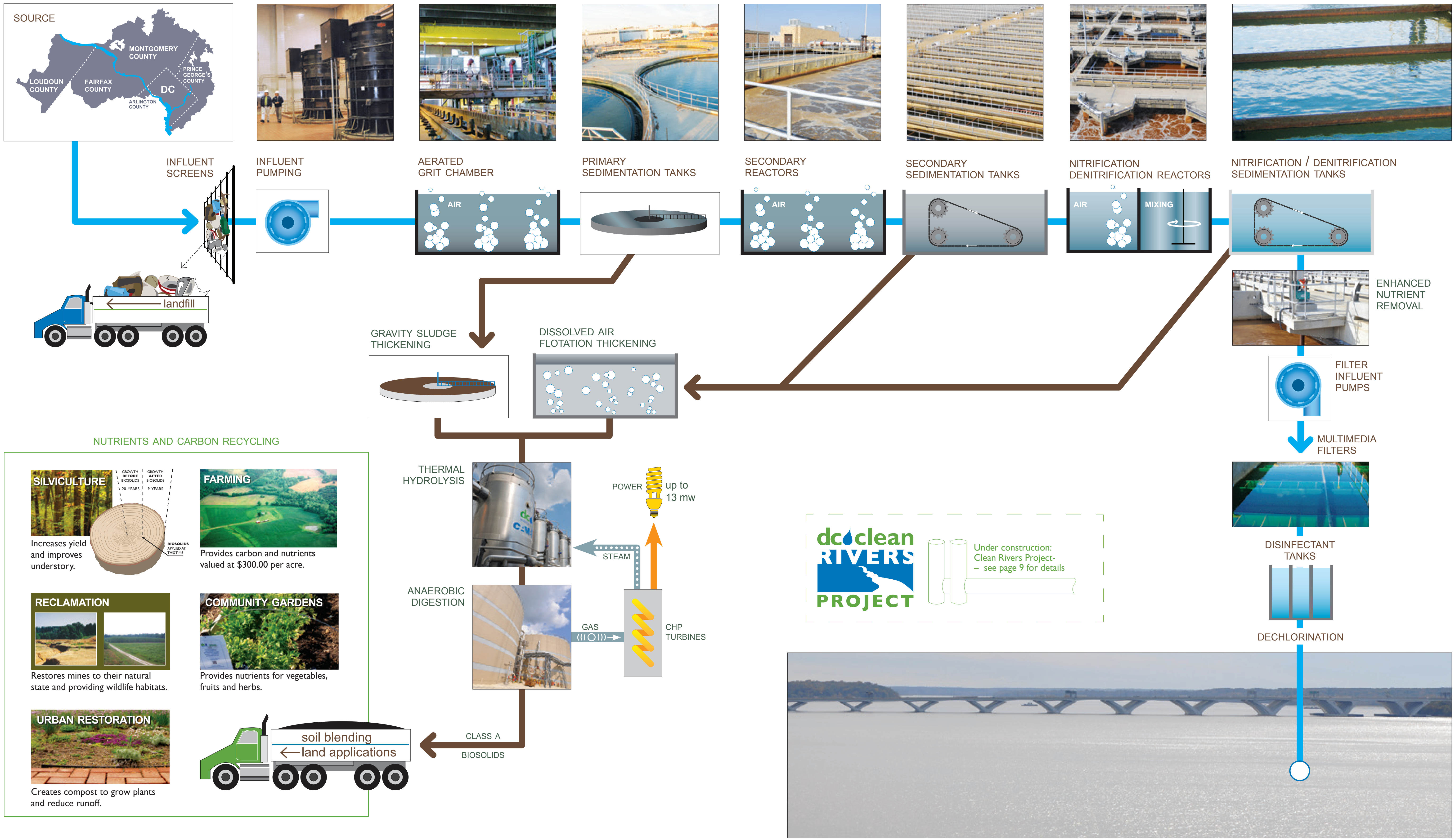
The biosolids at DC Water generate combined heat and power. The digesters capture methane and burn it in a turbine, providing net 10 Megawatts (MW) of electricity and steam to heat the process.

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. –o





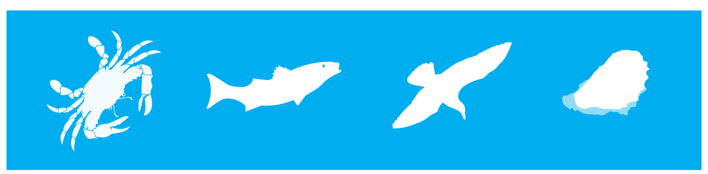
The Wastewater Treatment Process



Enhanced Nutrient Removal

The enhanced nutrient removal project reduced the level of nitrogen from the cleansed wastewater 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 and alternative carbon sources.



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. Industry leaders across the continent eagerly await the results for the potential of using this technology.

The process pressure-cooks the solids left over after wastewater treatment to produce combined heat and power—generating a net 10 MW of electricity. DC Water is the largest single source consumer of electricity in the District, and the digesters cut consumption up to a third. The process also creates 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.

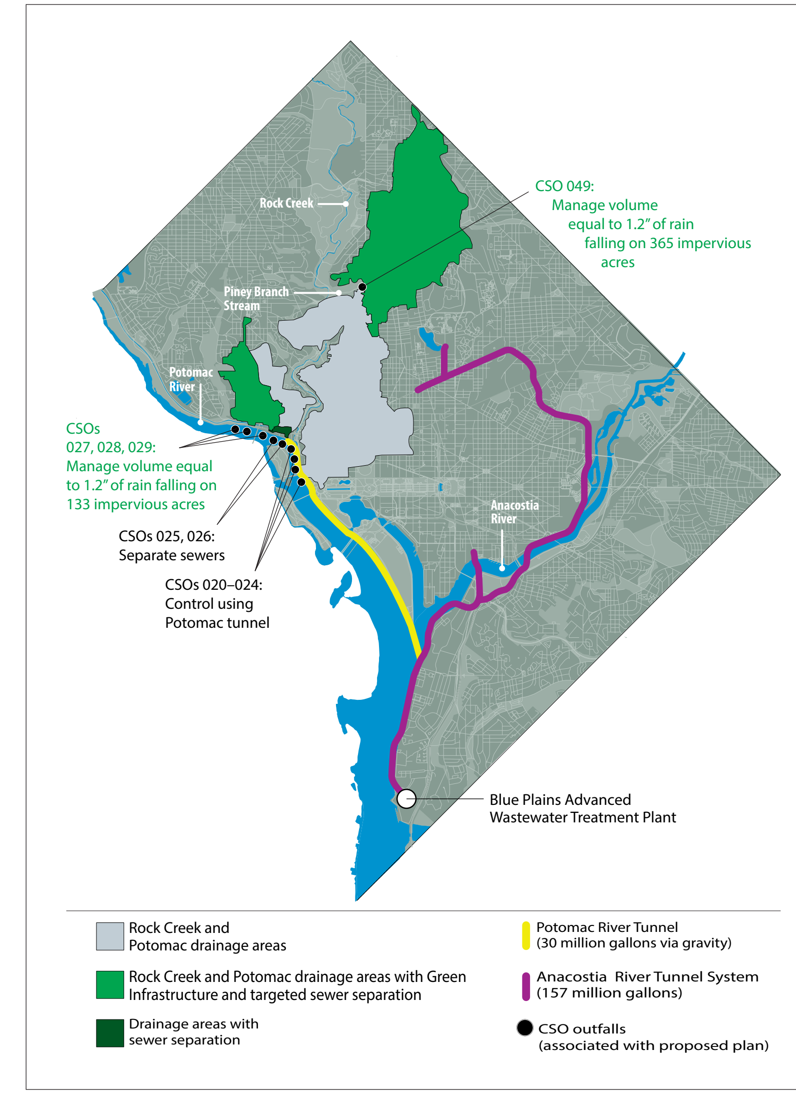
As in many older cities, about one-third of the District has a combined sewer system, meaning one pipe carries both wastewater and storm runoff. A combined-sewer overflow (CSO) occurs during heavy rain when the mixture of sewage and stormwater cannot fit in the sewer pipes and overflows to the nearest water body. CSOs direct about two billion gallons of combined sewage into the Anacostia and Potomac rivers and Rock Creek in an average year. CSOs contain bacteria and trash that can be harmful to the environment.

DC Water has already reduced CSOs to the Anacostia River by 40 percent with improvements to the existing sewer system. To achieve a 98 percent reduction, the Clean Rivers Project will create massive underground tunnels to store the combined sewage during rain events, releasing it to Blue Plains after the storms subside.

The first and largest tunnel system will serve the Anacostia River. This tunnel will be 23 feet in diameter and will run more than 100 feet deep, along the Potomac and under the Anacostia.

The tunnel segments south of RFK Stadium, together with their surface hydraulic facilities and a tunnel dewatering pump station, are scheduled to begin operating in 2018, providing relief to the Anacostia River first.

For the Potomac River and Rock Creek, DC Water is incorporating green infrastructure (GI) —trees, tree boxes, rain barrels, porous pavers, rain gardens, etc.— to control enough runoff that one previously planned tunnel was eliminated and the other reduced in size. A GI solution provides the District with green jobs, enhanced natural habitats, higher property values, reduced heat island effect and cleaner waterways.



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