Groundwater Treatment Facility Operations
Martin State Airport
August 2018
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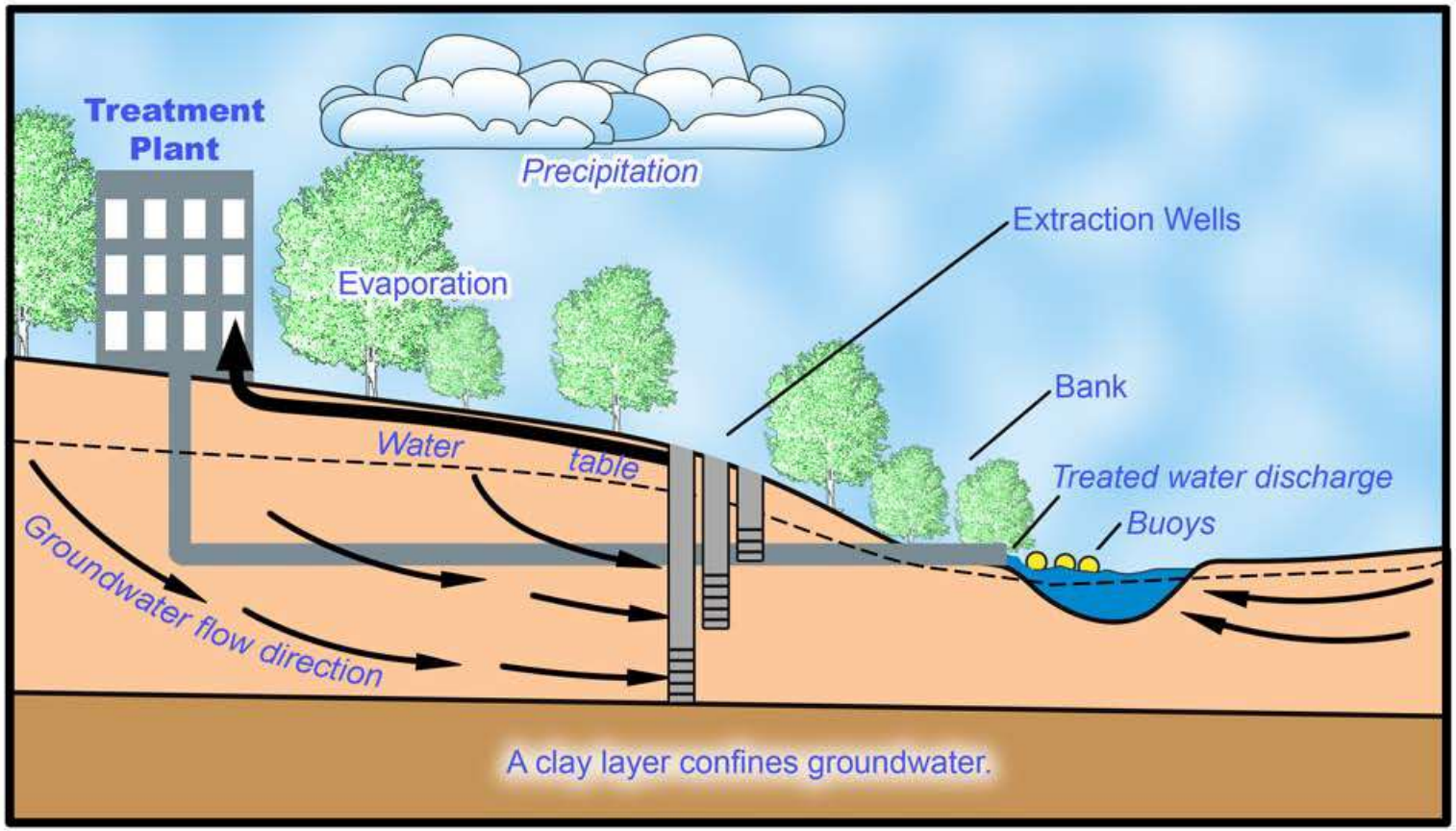
Martin State Airport Groundwater Treatment Plant

The recently completed 10,200 square foot building at Martin State Airport incorporates the latest in remediation engineering and technology. The plant intercepts contaminated groundwater before it reaches Frog Mortar Creek. The groundwater is treated to destroy and remove any contaminants and natural minerals, and then the treated water is discharged to Frog Mortar Creek. Work on the facility began in 2011 when elevated concentrations of volatile organic compounds (VOCs) were found in Frog Mortar Creek, leading the Maryland Department of the Environment (MDE) to issue a water contact advisory in 2012. Dissolved metals are removed to keep the equipment clean and meet discharge requirements.

Bioretention areas treat runoff with plantings and sand filtration. The treated storm water then enters the airport storm water swales. Four such areas were built to treat storm water off the building roof and paved areas around the plant. The bioretention areas are planted with native vegetation.

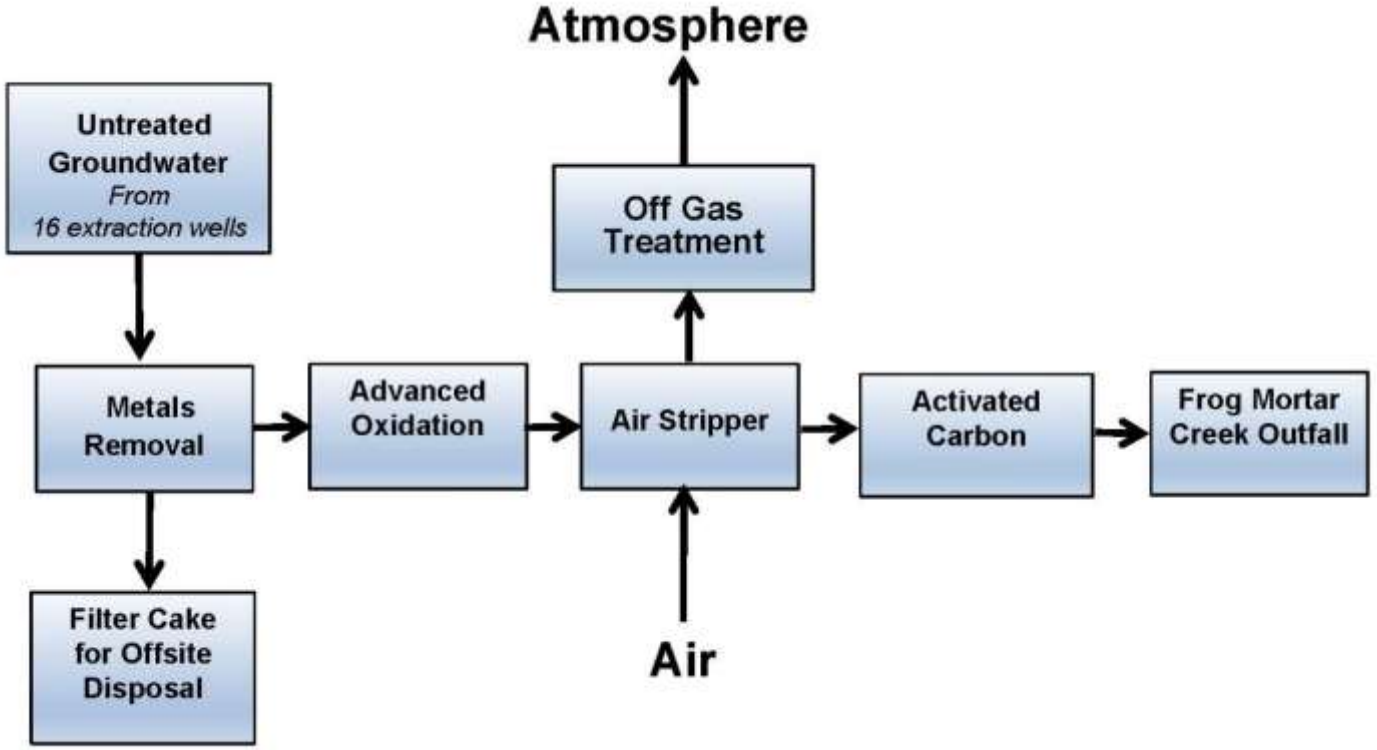
Groundwater Capture



The location and size of the groundwater plume was determined through site investigations and groundwater sampling. Sixteen extraction wells draw groundwater from three different depths, ranging from 30 to 90 feet below the ground surface. The wells are arranged roughly parallel to the shoreline, extending 1,000 feet north to south.

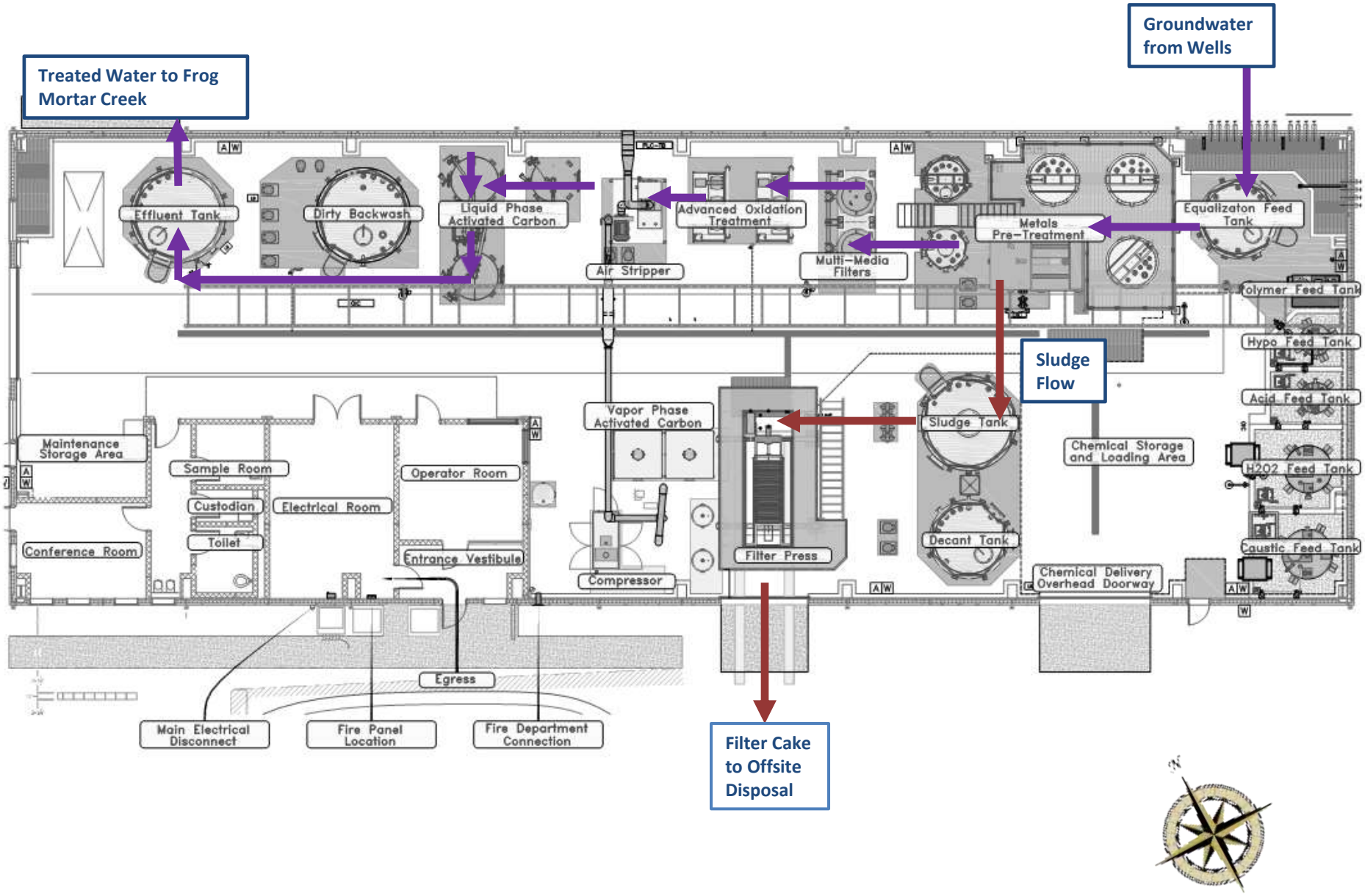

Taxiway T
Extraction Well (EW) Locations
North
Pond 1
Pond 2
Treatment Plant
(under construction)
EW 16
EW 13,14,15
EW 10,11,12
EW 7
EW 4, 5, 6
EW 8, 9
EW 1, 2, 3
Treated
Water
Outfall
Frog
Mortar
Creek
February 2017

Treatment Process Description



Metals are removed first when the groundwater enters the plant. The metals settle in tanks and are dried into a cake using a filter press. Disposal is at an off-site licensed facility. Most remaining contaminants are destroyed using ultraviolet light and hydrogen peroxide in an advanced oxidation process. What few contaminants remain are removed through an air stripper and activated carbon filters (similar to the carbon filters used in home systems). Air is bubbled through the water in the stripper and then treated with activated carbon before discharge to the atmosphere. The treated water is released into Frog Mortar Creek through a submerged pipe marked by yellow safety buoys.

Groundwater Treatment Plant Floor Plan



Situated inside a concrete vault, each of the 16 extraction wells has a control panel that provides power and a computerized system to control the flow rates of the groundwater into the treatment system to achieve the required groundwater capture.

Instruments inside the treatment plant display the flow of water from each well. The groundwater is sampled at this location to determine the concentration of the contaminants entering the treatment system. The water from each well is pumped into a large equalization tank before being pumped into the metals removal system.

Several chemicals are used in the groundwater treatment process. The metals removal step requires sodium hydroxide (caustic soda), sulfuric acid, and sodium hypochlorite (bleach). The advanced oxidation system uses hydrogen peroxide. For safety and containment in the event of a leak or tank failure, the chemical storage area has double-walled tanks and containment basins surrounding each tank. The Martin State Airport Fire Marshall inspected and approved the construction, and the area is checked regularly by the treatment plant operators.

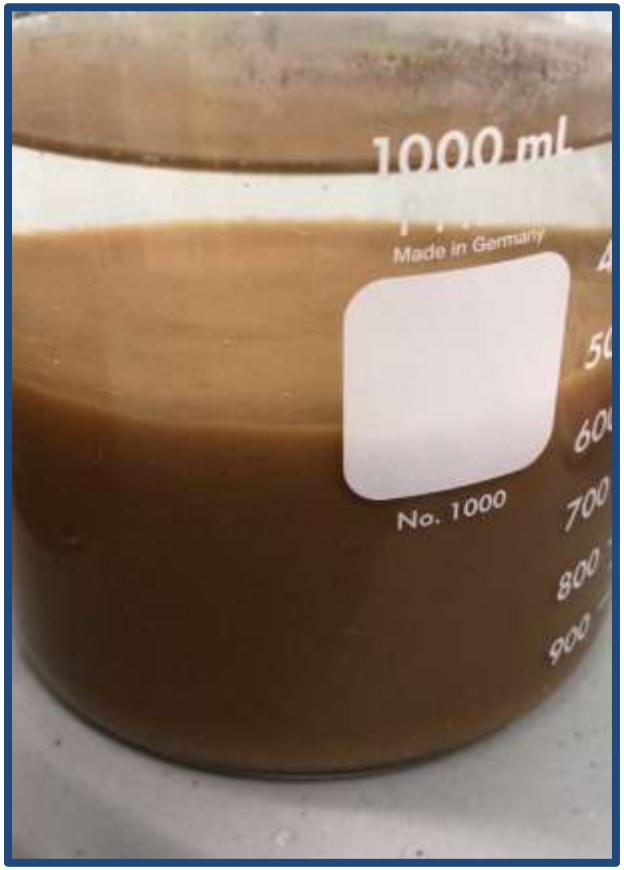
Metals are removed and settled out in these tanks. Chemicals are added in the round tanks, causing the dissolved metals in the groundwater to accumulate in the clarifier at lower right as a brown sludge.

Clarifier (Sludge Settling)

Chemical Addition Tanks

Clear water flows out of the top of the clarifier, while the brown sludge (mostly iron) settles at the bottom.

Clarifier clear water overflow



Sample of
settled sludge
from clarifier

From the clarifier, the sludge is pumped into a holding tank. When the tank is full, it is injected into a filter press. The filter press consists of filter plates that fill with sludge and are then squeezed together to press out the water, leaving behind a moist cake. The filter cake is taken to a licensed landfill for disposal as a non-hazardous waste. The remaining water is transferred to a decant tank and treated again through the plant.

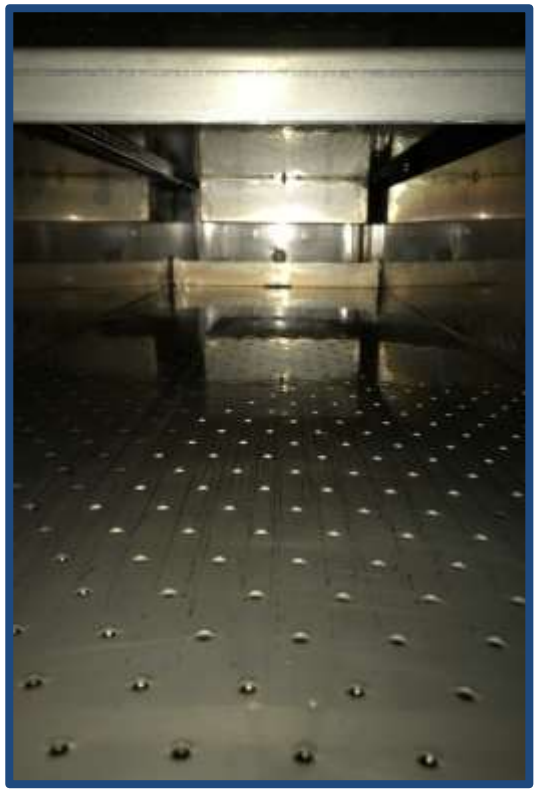
Filter press and plates

Filter cake in roll off awaiting disposal

The clear water leaving the clarifier is pumped through a multi-media (sand, gravel and garnet) filter to remove any remaining small particulates. There are two filters, and the operators alternate between the two. When one filter clogs with solids, the operators switch to the second filter, and the first filter is cleaned by backwashing with treated water. The solids and water that are washed out during the backwash are transferred to the dirty backwash tank before being re-treated through the system. The solids eventually end up in the sludge holding tank.

After the filtering process, the water is pumped through an advanced oxidation system. This treatment system consists of two identical units manufactured by the Calgon® Corporation. Each unit has three ultraviolet (UV) light lamps. The water passes through the two units in sequence. Hydrogen peroxide is injected into the untreated water before entering the first treatment unit. The combination of UV light and the hydrogen peroxide destroys (oxidizes) compounds such as trichloroethene, cis-1,2-dichoroethene, vinyl chloride, and 1,4-dioxane, which are the primary groundwater contaminants.

The advanced oxidation system destroys the primary contaminants. However, a few secondary chemicals remain untreated. Remaining compounds such as dichloroethane and methylene chloride are removed using an air stripper. The stripper consists of a stack of perforated "trays." Water flows down from the top of the stripper while a blower draws air up through the perforations, bubbling it through the water and transferring the contaminants from the water into the air stream. The air moves to the top of the stripper and passes through activated carbon filters before exiting through an exhaust out the roof of the plant. The treated water collects in the bottom of the stripper and is pumped to the last treatment step.



Perforated tray

Air bubbles during operation

After leaving the stripper, the air is treated through two 5,000 pound Calgon® vapor-phase carbon vessels. The treated air is sampled to ensure it meets the requirements of the MDE-issued air permit. Sampling results determine when the carbon filters are replaced. The treated air exits through an exhaust in the roof of the plant.

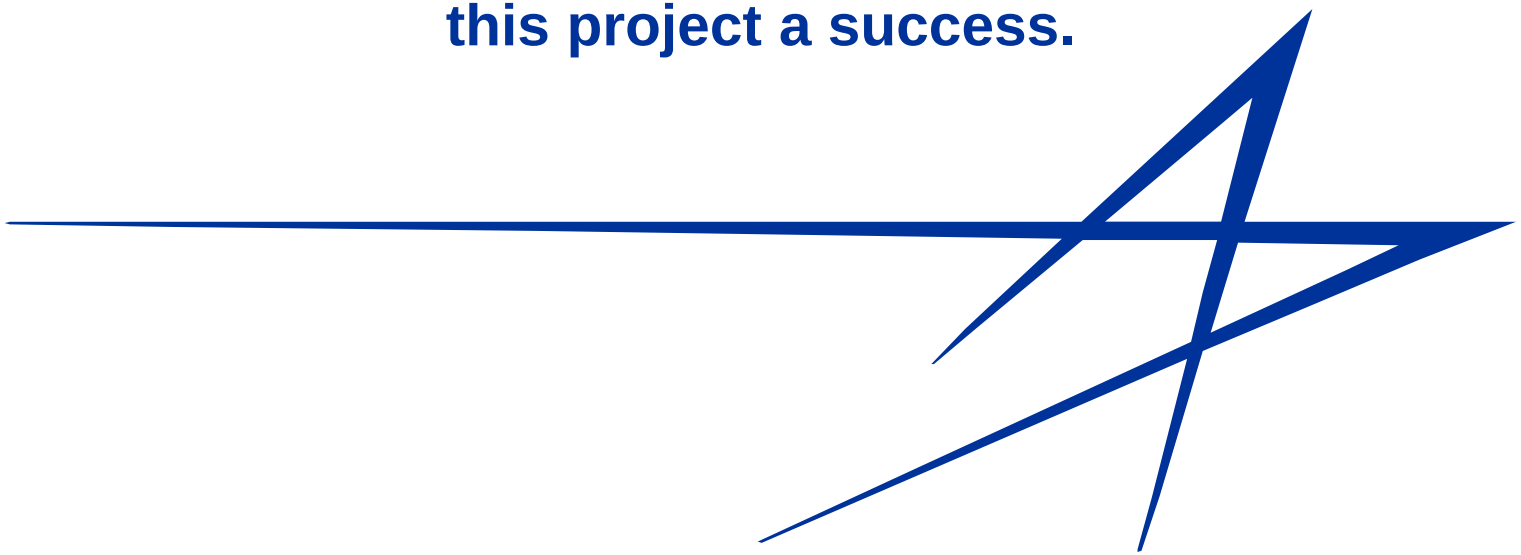
After the air stripper, remaining contaminants in the water are removed through three Calgon® vessels, each holding 6,000 pounds of activated carbon. This step mainly removes petroleum that was not treated in the advanced oxidation and air stripper systems and excess hydrogen peroxide that was not used during the advanced oxidation treatment. The carbon filters are replaced periodically as their ability to remove contaminants declines over time.

After passing through the three activated carbon vessels, the treated water is pumped to a discharge (effluent) tank before being released into Frog Mortar Creek. The photo also shows the Dirty Backwash Tank, where water is stored after the filters are backwashed. The contents of the Dirty Backwash Tank are periodically pumped back through the system for treatment.

The treated water is pumped to Frog Mortar Creek using an underwater discharge system. Since the water depth in this area of the creek is relatively shallow, yellow safety buoys have been used to discourage boaters from entering the area, which is located outside of the navigation channel. The outfall configuration was reviewed and approved by the Maryland Department of the Environment (MDE) and the U.S. Coast Guard. Water discharged from the plant is tested monthly and results are submitted to MDE.

As of June 30, 2018, over 9.7 million gallons of groundwater (enough to fill 14 Olympic-sized swimming pools) were treated and discharged at the plant, and all MDE permit conditions have been met.

Lockheed Martin thanks its contractors, the regulators and permitting authorities, and especially our community for their cooperation in helping make this project a success.



For questions, comments or concerns please contact: 800-449-4486.