AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

AquaPrime® Cloth Media Filter
PROJECT CASE STUDY

Project Name and Location
Four Rivers Sanitation Authority, Rockford, IL

Aqua-Aerobic Solution
AquaPrime® Cloth Media Filter – Primary Treatment

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Introduction

Energy efficiency and sustainability have long been at the forefront of Four Rivers Sanitation Authority's (FRSA) mission, guiding its pursuit of advanced technologies over the past few decades. A pivotal step toward these goals was establishing a formal partnership in 2011 with Aqua-Aerobic Systems, Inc. (AASI) to conduct onsite research and development of innovative wastewater treatment solutions. This collaboration was mutually beneficial: FRSA could reduce technology assessment costs, while AASI gained a valuable testing environment to evaluate the performance of its systems under real-world conditions.

FRSA, located in Rockford, IL, serves a vast area of approximately 110 square miles, supporting over 277,000 residents across 77,000 active user accounts. Operating since 1932, the facility is rated for an average flow of 40 million gallons per day (MGD), with a maximum daily flow of 80 MGD and a peak flow capacity of 130 MGD. In 2018, FRSA embarked on a new facility planning initiative, setting ambitious goals around nutrient removal, scalable capacity, resource recovery, and modernization of aging infrastructure. As FRSA transitioned to the implementation phase, insights from its robust research efforts enabled strategic investment in key areas, including the decision to adopt AquaPrime cloth media primary filtration. This choice allowed FRSA to enhance primary clarifier capacity without increasing the process footprint, aligning with their sustainability and efficiency targets.

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Drawing on FRSA's extensive experience collaborating with AASI, the Authority proceeded with site-specific demonstration testing to refine design parameters and predict performance outcomes. In 2016, AASI conducted a feasibility study to compare the AquaPrime filters against the existing primary clarifiers. The evaluation assessed operational costs, footprint efficiency, and additional biogas production potential. The study concluded that replacing traditional primary clarifiers with AquaPrime filters would yield significant energy savings, driven by increased methane production and reduced aeration energy demands. This solution not only enhanced operational efficiency but also supported FRSA's broader sustainability objectives.

AquaPrime® Cloth Media Filter Process

The AquaPrime® filter features a disk configuration and an outside-in flow path which allows for three zones of solids removal that are shown in Figure 1. These zones are especially critical in wet weather applications due to the high solids typically associated with the first flush after wet weather events. The top zone is the "floatable zone" where surface materials such as fats, oils and grease are allowed to collect on the water surface. Solids are removed from this zone by allowing floating material to overflow a scum weir several times each day.

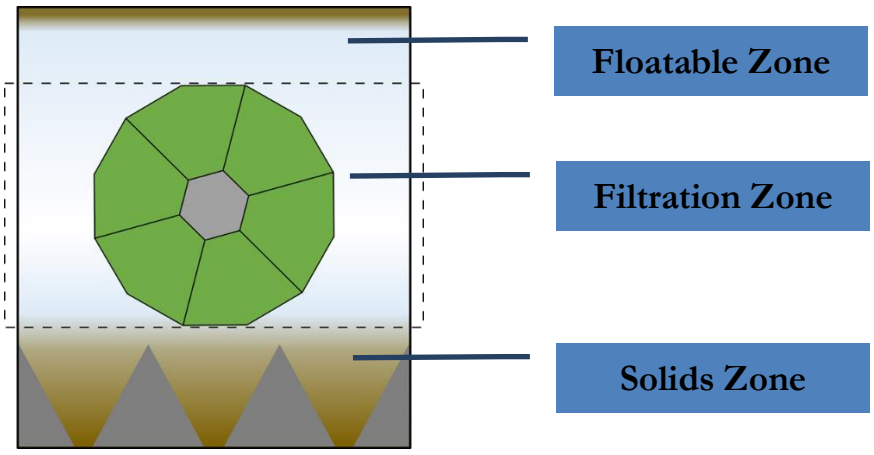

Figure 1: AquaPrime® Filter - Solids Removal Illustration

The middle zone is the "filtration zone" where solids are removed through filtration. Here, solids deposit on the outside of the cloth media forming a mat as filtrate flows through the media. This buildup of solids on the media creates hydraulic resistance to flow through the media and causes the water level in the tank to rise. Once a predetermined liquid level or time setting is attained, the disks begin to rotate and the backwash pump starts, which draws filtered water from the inside of the disk through the media and removes solids from the filter media's surface. This process fluidizes fibers to provide an efficient release of stored solids deep within the fiber. An illustration of the backwash mechanism is shown as Figure 2.

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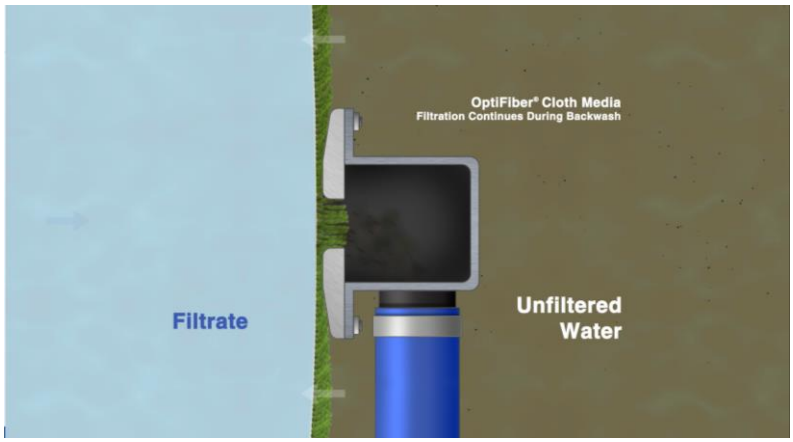

Figure 2: AquaPrime® Filter - Backwash Illustration

The bottom or "solids zone" permits heavier solids to settle to the bottom of the tank for intermittent removal. The solids are evacuated from the hopper through collection laterals using the backwash pump.

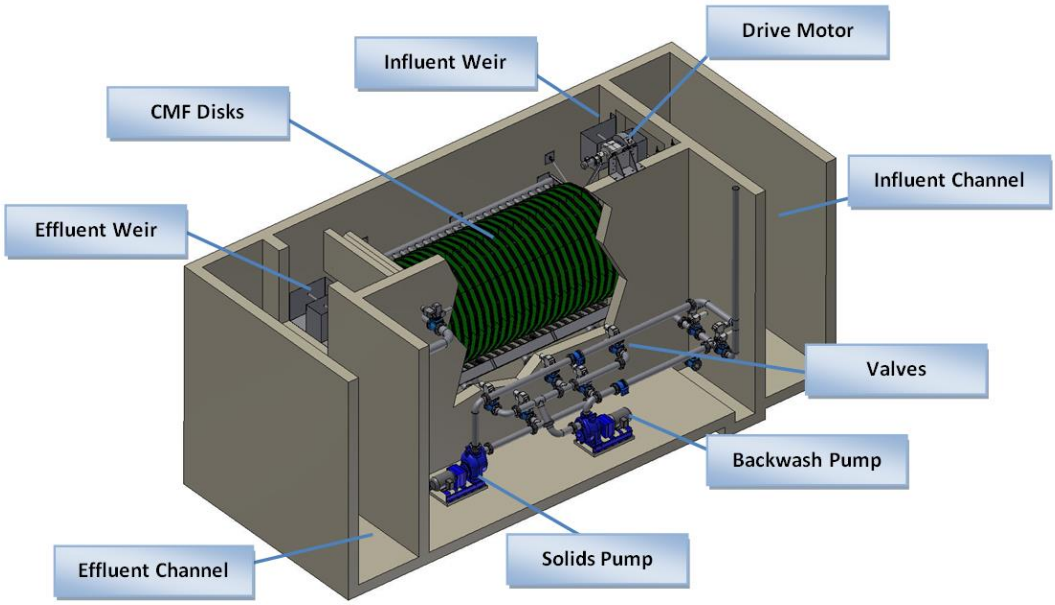

Figure 3: AquaPrime® Filter Arrangement

Pilot Study

An Aqua MiniDisk® cloth media filter (CMF) system was installed for pilot testing at the Four Rivers Sanitation Authority in April of 2014 for a 3-month study. The pilot unit was located adjacent to the influent to the existing primary clarifiers in order to facilitate side-by-side comparative testing.

The Aqua MiniDisk pilot unit and pilot setup shown in Figure 4 was used for the pilot study.

Figure 4: Pilot Unit and Setup.

Pilot Study Results

The pilot unit was operated at a hydraulic loading rate (HLR) of 3.25 to 4.0 gpm/ft2 (7.9 to 10.7 m3/m2/hour) and a corresponding solid loading rate (SLR) of 9 to 10 lbs. TSS/ft2-day (1,830 to 2,030 g/m2-hr).

Influent and effluent discrete samples collected for the pilot testing were analyzed for BOD_5 concentration, TSS concentration, turbidity, ultraviolet (UV) light transmittance, TKN concentration, and Fats-Oils & Grease (FOG). A summary of the collected average pilot test data is as follows in Table 1:

Table 1: Pilot Summary Results.

Parameters	Average Influent	Average Effluent	Average Removal %
BOD (mg/L)	169	59	64.2 %
COD (mg/L)	417	147	62.8%
TSS (mg/L)	221	26	87.5%
Turbidity (NTU)	143	37	73.5%
UVT (%)	28	44	59.9%
FOG (mg/L)	14	10	28.6%
TKN (mg/L)	39	36	7.7%

Design Summary

Design of the AquaPrime system was initiated in 2019 for an average flow of 15 MGD and maximum flow rate of 30 MGD. The design includes two (2) 24-disk units with each disk being 9.8 feet (3 m) in diameter. Each disk has an effective area of 107.6 ft^2 with a total filter area of 5164.8 ft^2 (479.8 m^2). The plant flow diagram for the project is shown below in Figure 5.

In this configuration, the primary influent is split between the existing primary clarifiers and the AquaPrime filters. Effluent from the AquaPrime filters is then merged with the effluent from the primary clarifiers before entering the biological treatment train. The backwash water and settled solids waste generated by the AquaPrime filters are routed to a dedicated gravity thickener, where solids are concentrated before being transferred to the anaerobic digesters. The supernatant from the thickener is subsequently directed to the biological treatment process.

The new filtration systems were strategically designed to be installed within the footprint of the aging primary clarifiers at the wastewater treatment plant (WWTP). The internal walls of the existing clarifiers were demolished, leaving the clarifier floors intact to serve as a foundation for constructing the AquaPrime units. Due to the hydraulic conditions at the facility, the design incorporates low lift pumps to transfer influent from an influent wet well to the AquaPrime filter's influent channel.

The flow scheme for the AquaPrime Filter system is depicted below:

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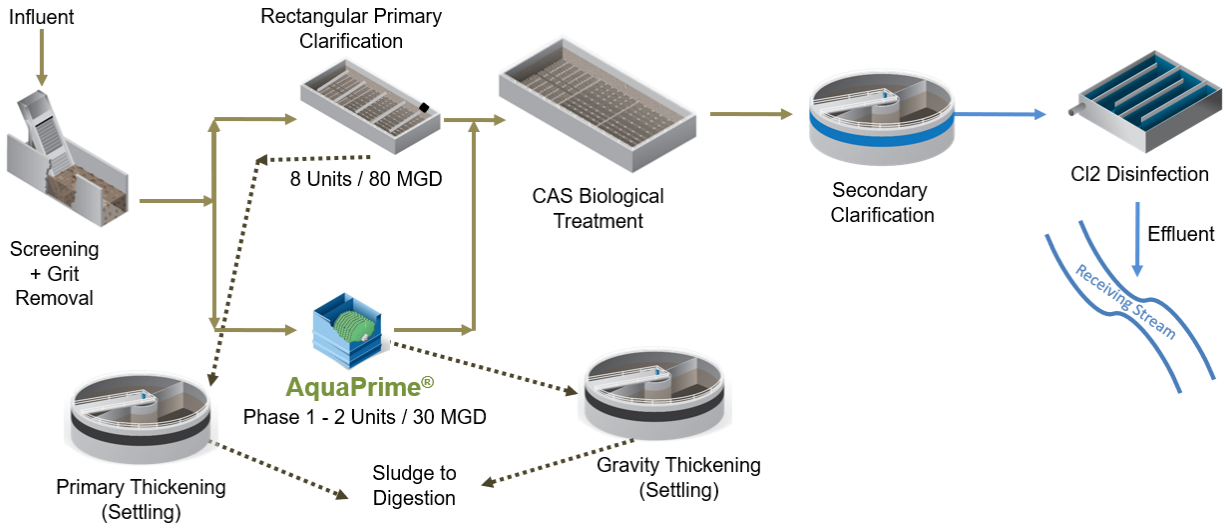

Figure 5: Plant flow scheme.

Status and Performance

Design for the project was completed in 2021 and a contract for construction was awarded in Feb 2022. The filter portion of the installation was substantially complete in June 2024. Below in Table 4 is a summary of the performance of the AquaPrime filters. Figure 6 and 7 shows the performance of the AquaPrime filters in comparison to the existing primary clarifiers. Notably, the AquaPrime filters demonstrate a 20% higher removal efficiency for TSS and BOD compared to the existing primary clarifiers. This enhanced performance results in increased biogas production and reduced aeration requirements in the biological treatment process, delivering significant operational benefits.

Table 4: Summary of AquaPrime Cloth Media Filter Performance

Primary Filtration Performance					
Constituent	**Primary Filter Influent mg/L**		**Primary Filter Effluent mg/L**		**Average Removal Efficiency**
	Range	**Average**	**Range**	**Average**	**Percent**
TSS	120-416	166	12-58	24	84%
BOD	99-294	168	43-127	81	52%

Notably, the removal efficiencies for TSS and BOD in the full-scale installation closely mirror those observed during the pilot study, demonstrating the robustness and consistency of the AquaPrime system's performance across different scales.

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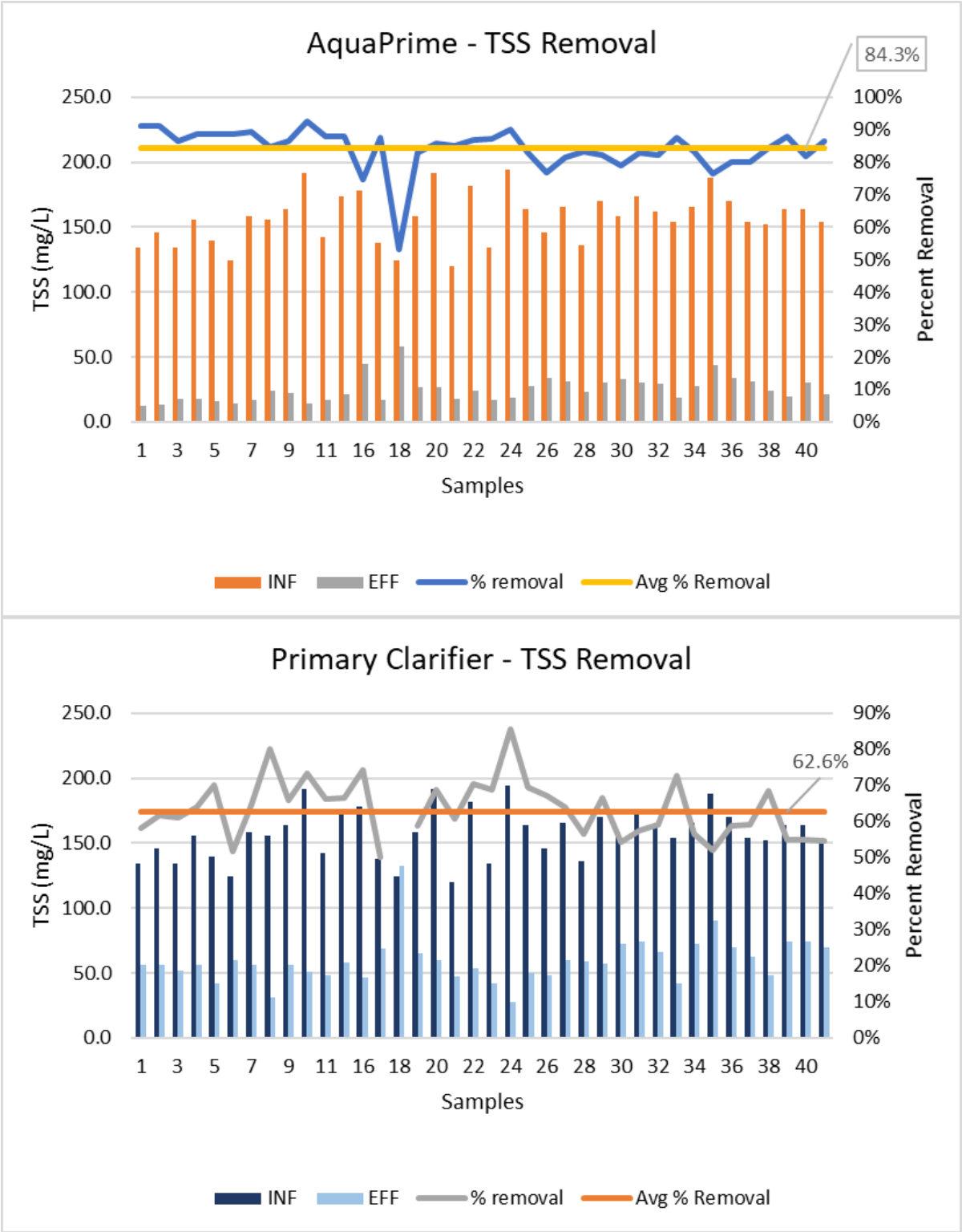

Figure 6: TSS Removal with AquaPrime in comparison to Primary Clarifiers

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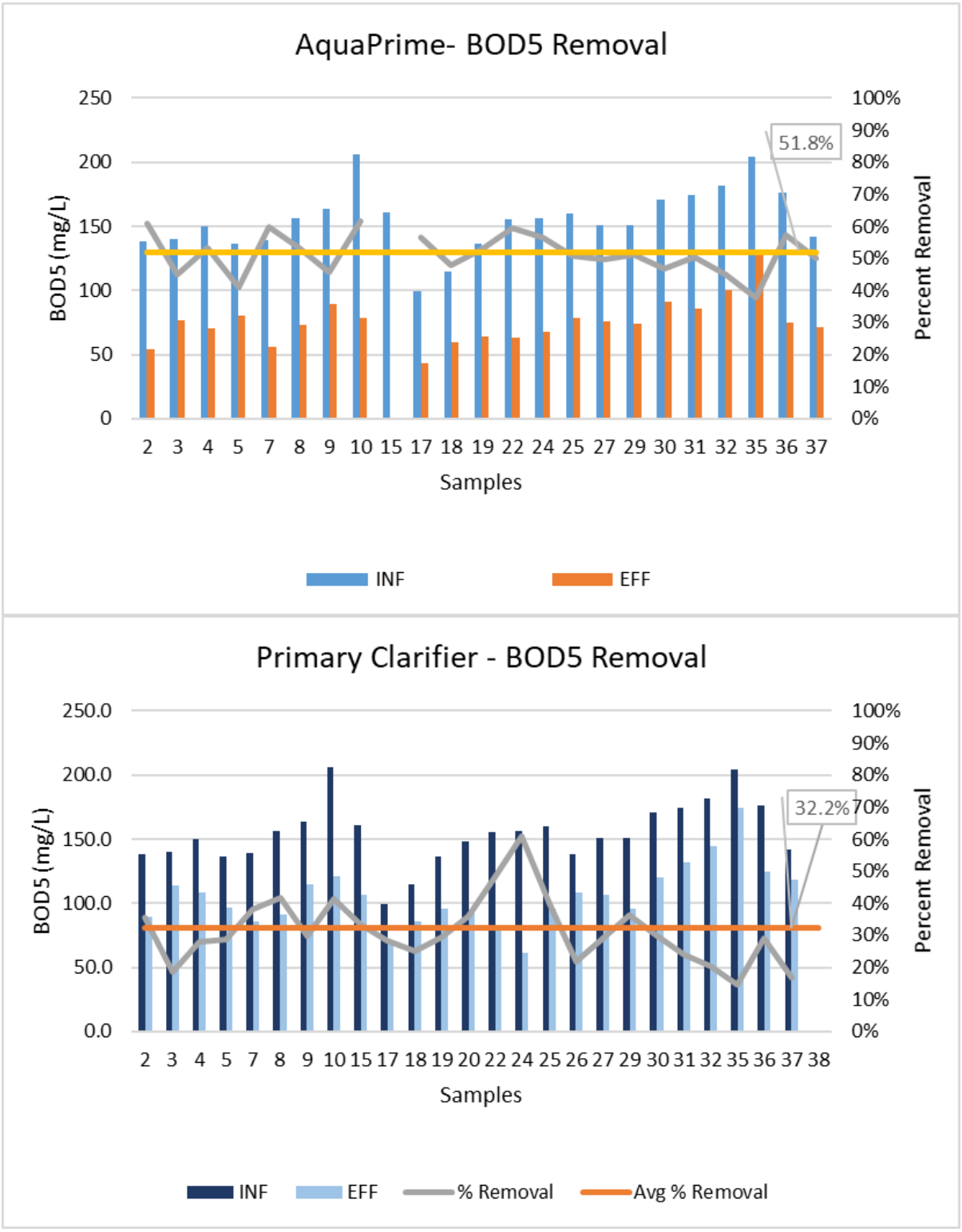

Figure 7: BOD Removal with AquaPrime in comparison to Primary Clarifiers

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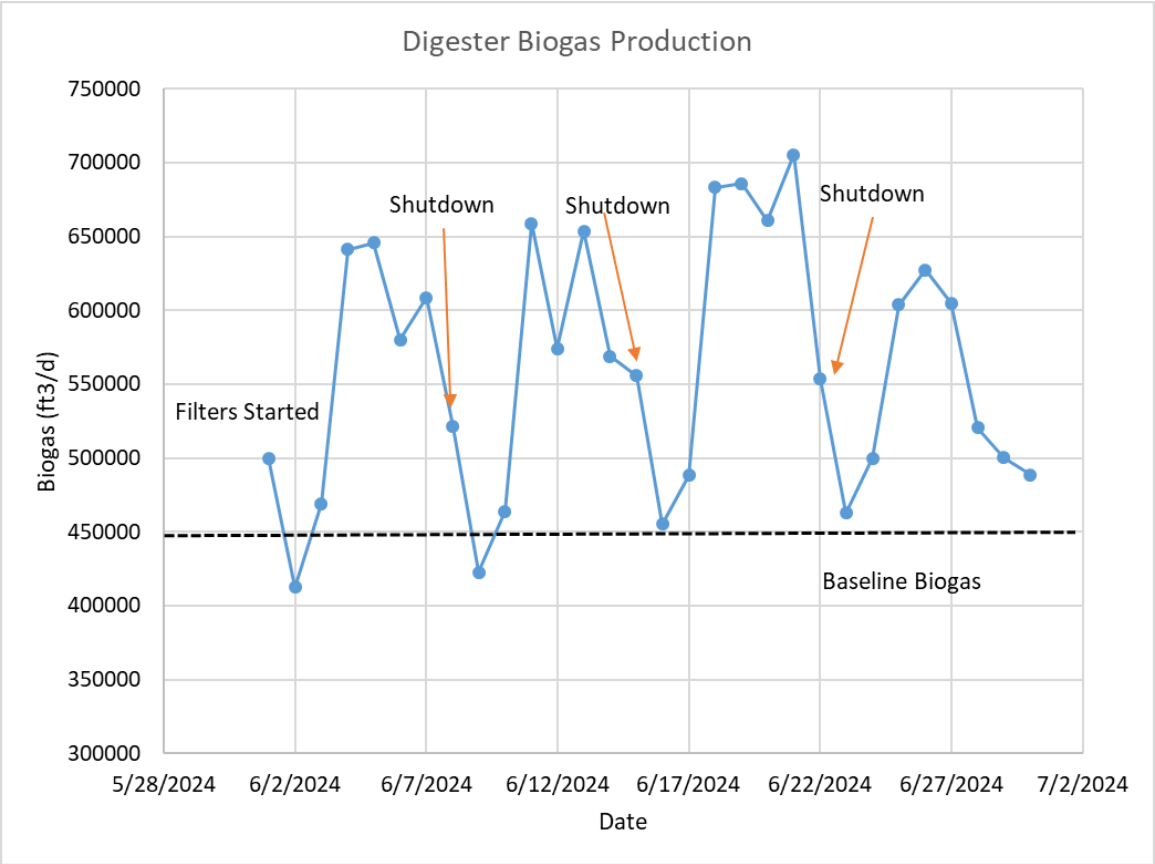

Figure 8: Digester Biogas Production after AquaPrime filters startup

AquaPrime Cloth Media Filter Advantages for Advanced Primary Treatment

- Utilizes engineered OptiFiber® PF-14 pile cloth filtration media specifically designed for advanced primary treatment
- Produces extremely consistent, high quality effluent
- Designed to handle extreme variation in TSS loadings
- Reduces energy costs associated with secondary treatment by reducing the aeration requirements
- Removes more solids for increased biogas production in anaerobic digestion
- Eliminates the need for chemical addition, in many applications
- Low waste volumes and gravity thickening of BW & SSW to over 5% concentration by weight
- Simple to operate and maintain
- Vertical oriented disks reduce the footprint; resulting in small overall site requirement
- Outside-in flow pattern allows heavier solids to settle to the bottom of the filter tank.

Below are several images of the Four Rivers Sanitation Authority in Rockford, IL. These include a drone view of the primary filtration facility, along with detailed shots of the filter complex.

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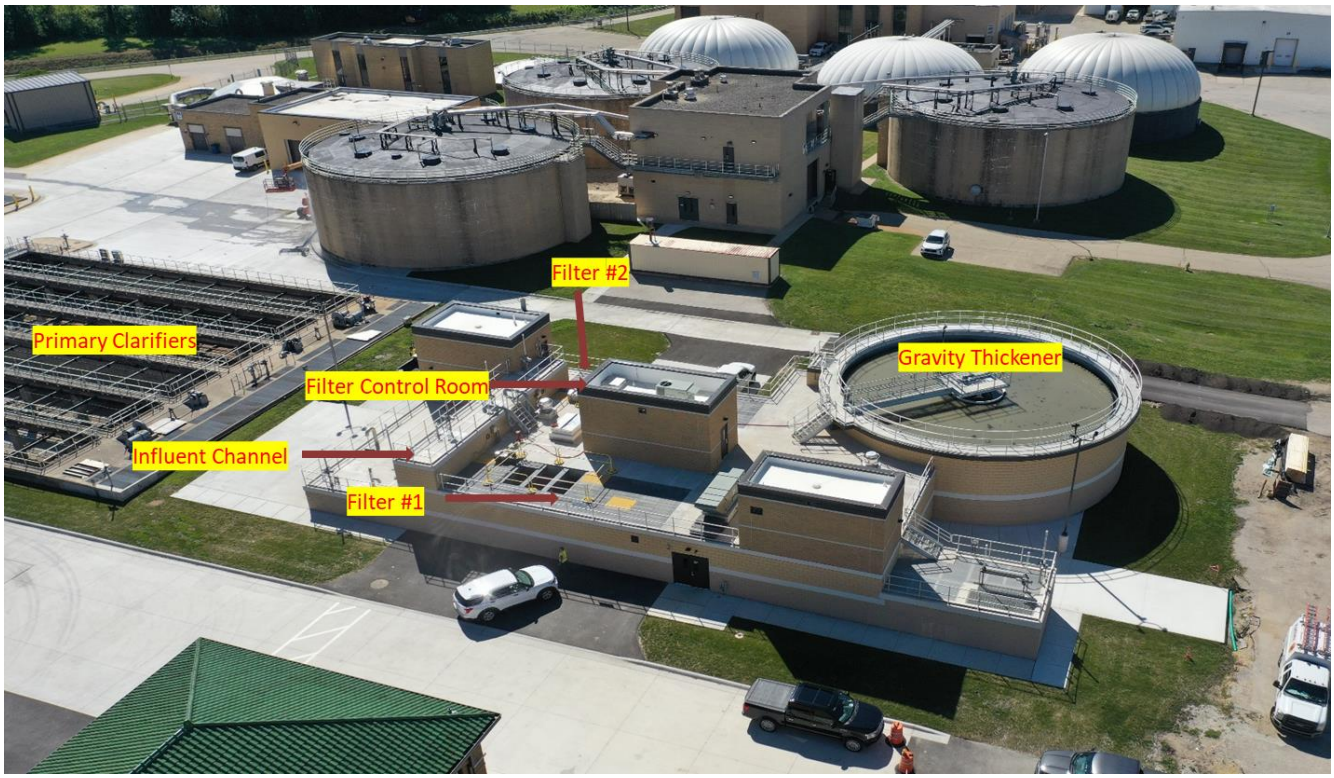

Figure 9: Four Rivers Sanitation Authority AquaPrime Filtration Building

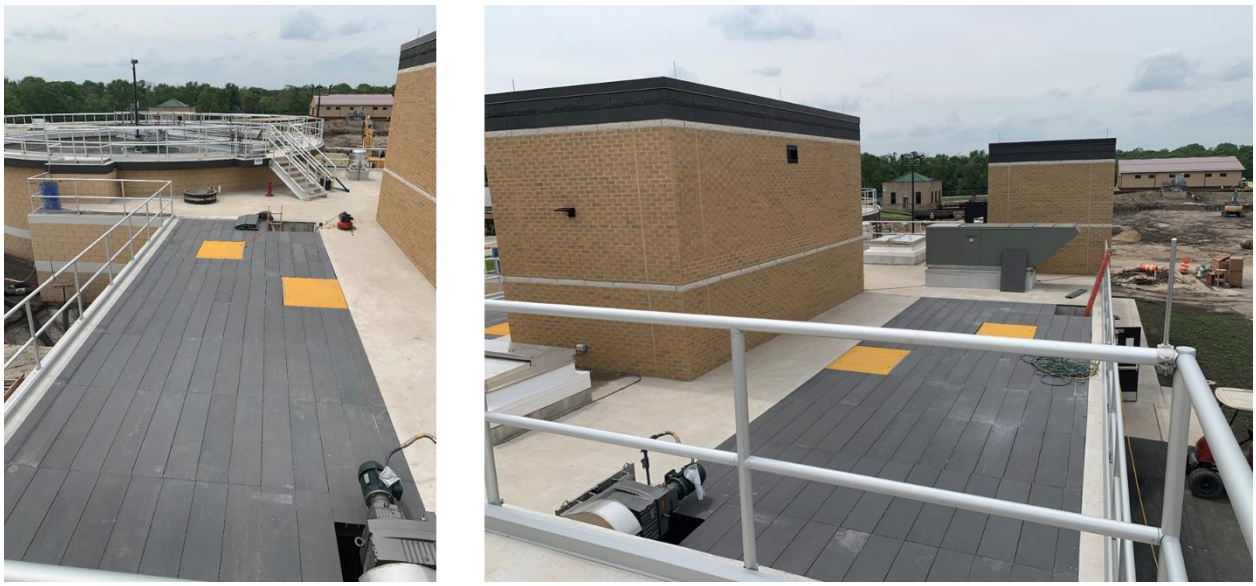

Figure 10: AquaPrime filters with removable fiberglass covers

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Figure 11: Inside view of the AquaPrime Filter unit showing influent weir

Figure 12: Views of the Filter Gallery

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