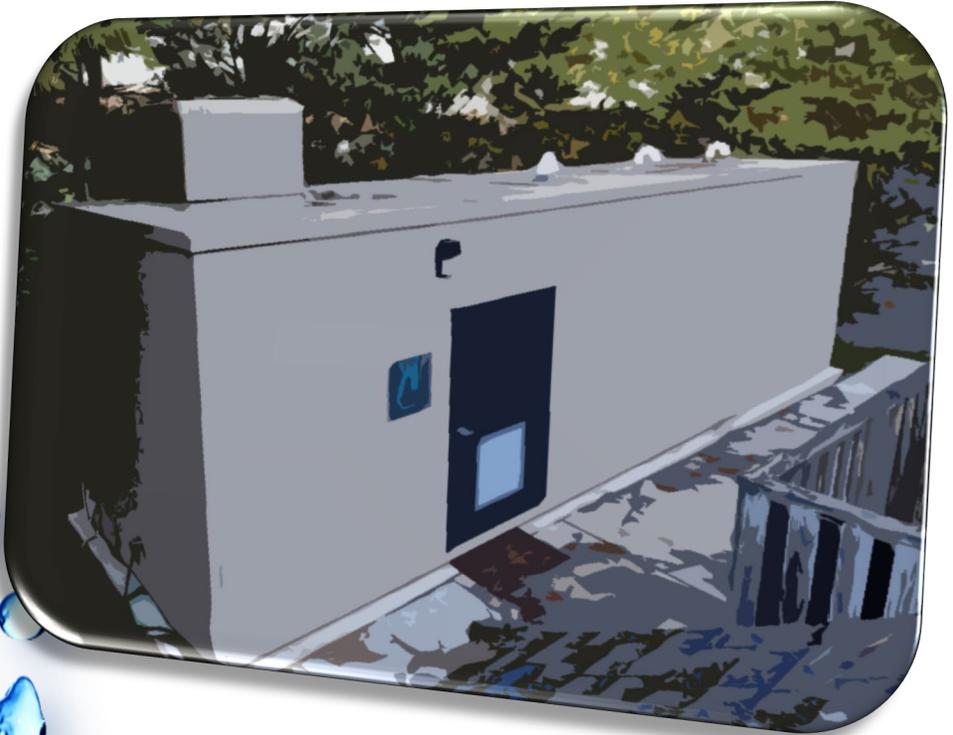


# miniMBR<sup>®</sup> Package Plant

UF Membrane Bio-Reactor System



Case Study: 15024

## Gerstell Academy WWTP

Carroll County, MD

December 6, 2018

**Innovative Treatment Products, LLC**

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## Overview

Project	Gerstell Academy
Location	Finksburg, Maryland, USA
Plant Type	Sanitary Wastewater – BNR
Technology	miniMBR® by ITP
Operational	Spring 2017



Gerstell Academy in Carroll County, MD - 2017

## Design Challenge

Gerstell Academy is an independent, co-educational pre-K to 12<sup>th</sup> grade school that was established in 1996 by Dr. Frederick G. Smith. The school, pictured above, was founded in Carroll County, Maryland in a small home on the School’s campus and was initially permitted to discharge wastewater through a standard home use septic system.

In 2002, higher admittance numbers and the prospect of future growth encouraged the school to expand with the design and construction of the Robert E. Smith Hall. In order to treat the projected wastewater flows, a 9,800-GPD *Sequencing Batch Reactor (SBR)* was also designed for phased installation. Extreme variations in the diurnal and seasonal flow cycles proved to be too difficult of a challenge for the *SBR* to treat wastewater to local *Biological Nutrient Removal (BNR)* discharge levels and the School was unable to commission the first phase of equipment for use.




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*“The plant was never brought into compliance because of the lack of flow so we have been pumping and hauling since 2002.”*  
– John Scholz, Facilities Director, 2015

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With further success in student attendance and application, Gerstell Academy applied for a building permit to construct their Alumni House. The permit stipulated a minor increase in presence of school personnel, families and students. The new facility would house a conference room, administrative offices, supplies storage and lavatories for the occasional private or scholastic event. The State approved the application with a requirement to upgrade the wastewater facility to handle on-site wastewater treatment.

In 2015, Dr. Smith and his team reached out through local engineering firms to discuss the possibility of upgrading their existing plant. ITP was approached to propose an equipment package to upgrade the failed *SBR* with the added challenge to utilize and re-purpose as much of the existing equipment as possible, fit in the same footprint and achieve a high level of *BNR* at a location where it had never been achieved.

In 2016, construction for the new treatment plant began and in Spring of 2017, ITP delivered the miniMBR® Advanced Membrane Bio-Reactor Package Plant with BNR and Water Reuse Capability.



## Facility

The miniMBR® Package Plant was set in place pre-wired, pre-piped and pre-tested for final connections on a single day. Within two weeks of delivery, the complete system was operational and commissioned for startup.

The entire facility was built into a vacuum infused, close-molded monolithic *Fiberglass Reinforced Plastic (FRP)* structure, measures 10' wide x 13' tall x 36' long and weighs approximately 30,000 lbs (dry weight). The Package Plant includes a process control room, two anoxic zones and one aerobic zone. The *process control room* includes the membrane skid, controls and *all* mechanical equipment, desk space with storage, a slop sink with floor drains, lighting and HVAC for an all-weather insulated operations laboratory. The *pre & post anoxic reactors* are integrated into the enclosure and include coarse bubble air diffusers for mixing. Also, integrally molded into the FRP structure, the *aerobic reactor* includes fine bubble diffusers for mixing and oxygen transfer. Each diffuser assembly is accessible and retrievable from atop the tank.



## Process

Sanitary wastewater is collected in underground infrastructure (septic and equalization tanks), then screened and processed by the miniMBR® Package Plant. The design criteria for the miniMBR® process is based upon influent containing up to the flows and pollutant loads stated in Table – 1 below.

Table - 1				
Parameter	Concentration or Rate	Load/Design Flow (lb/d)	Limitation (lb/d)	Actual Op. Data (lb/d)
Flow	11,000 GPD Design	15,000 GPD Peak	-	-
BOD	500 mg/L	45.87	0.46	0.03
TSS	800 mg/L	45.87	0.46	0.01
TKN	200 mg/L	73.39	0.55	0.01
NH <sub>3</sub> N	175 mg/L	18.35	0.05	0.01
NO <sub>2</sub> N + NO <sub>3</sub> N	0 mg/L	16.05	0.14	0.07
TN	Not Given in Design Criteria		0.55	0.08
pH	7.0 - 8.5 SU		-	-
Temp.	Influent 10-25C and 30C maximum in-basin		-	-

Process set points were determined to allow the plant to automatically increase effluent production during periods of higher flow and decrease to best utilize and reserve the molecular biology associated with the nitrification/denitrification process. ITP's miniMBR® has been designed specifically to handle the large flow fluctuations while maintaining a high level of *biological nutrient removal*. The process effluent, noted as Actual Operational Data in Table – 1 above, reflects continuous compliance with discharge criteria.

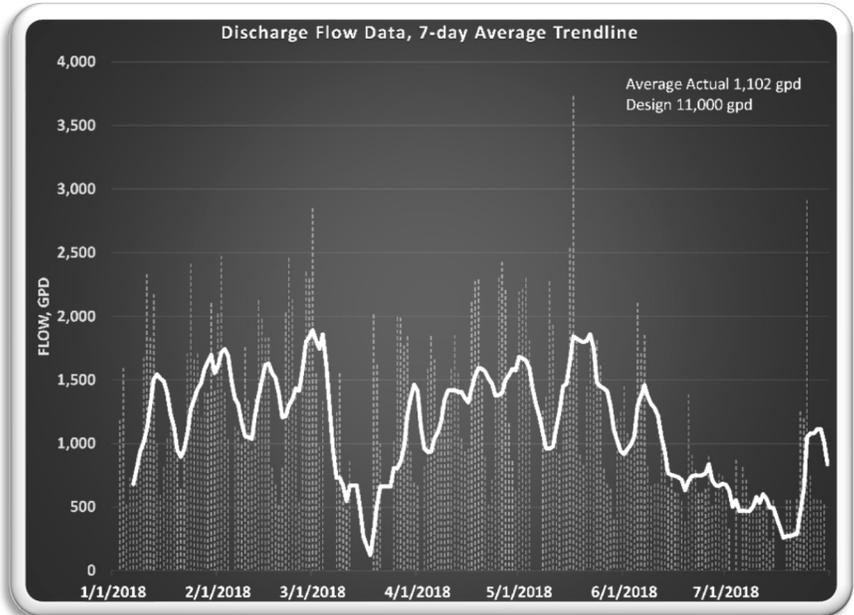


## Achievements

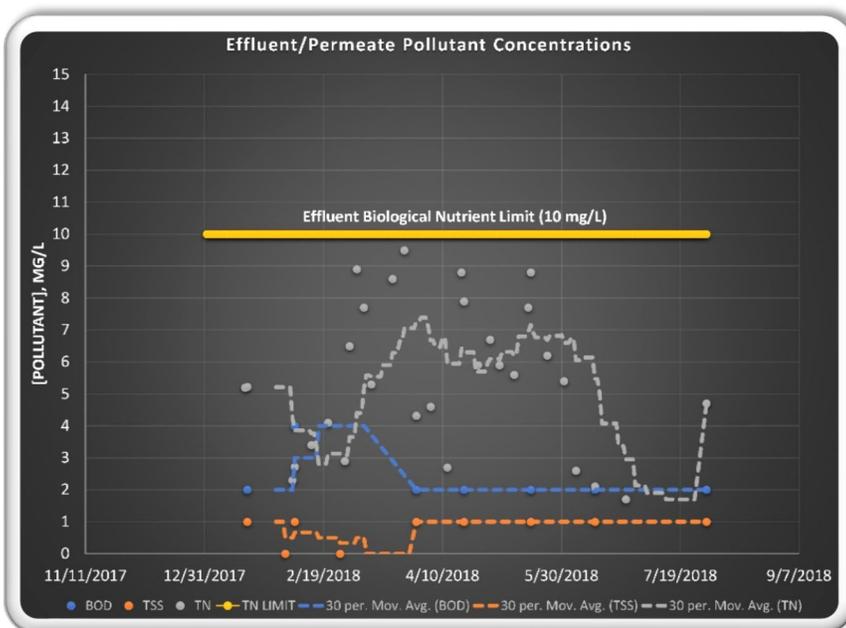
The facility is a school, and as such, wastewater generation is sporadic and seasonal, indicated by extreme flow fluctuations in Table - 2 below. All the while, the miniMBR® process has provided effluent continuously below pollutant load and concentration limits. The line represents the average flow through the plant on any given day from January 1<sup>st</sup>, 2018 through August 1<sup>st</sup>, 2018.

The challenge of performance in an *BNR* process is in the control of the biology. In particular, nitrogen removal requires stable environments for both nitrification and denitrification to occur. The large fluctuations of influent volumes due to the daily variations in flow and load result in a continuous cycle of nutrient surplus and shortage for existing biology of the plant to consume. This stresses the biology and makes it difficult, if not impossible, for operators to achieve regulatory discharge compliance.

This is where the *SBR* Process struggled. The sequential process design of the *SBR* restricts clean wastewater processing to batches, i.e. one tank settles while the other aerates and fills. Operators must rely on time, gravity and chemical supplement to achieve compliance. The large fluctuations in flow found at Gerstell doesn't allow for enough time to batch produce *BNR* quality



permeate with high rates of solids removal. Smaller wastewater treatment systems often have difficulty meeting permit conditions with extreme flow and load fluctuation. Typically, liquids handling equipment is not designed with large turndown capacity, and operations staff do not always have full-time purview over operating setpoints. This is not the case for ITP's miniMBR®. As you can see in Table – 3 to the left, the miniMBR® has been continuously achieving *BNR* compliance despite the varying influent at Gerstell Academy's WWTP. The gray line represents *Total Nitrogen (TN)*, the blue line is *Biological Oxygen Demand (BOD)*, and the orange line is *Total Suspended Solids (TSS)*. ITP's miniMBR® is well below the *Nutrient Pollutant Limit* of 10 mg/l.





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