Treatment Of Effluent By Septic Tanks Versus FAST Units

Questions submitted by Granville Hogg; Answers to questions 1 and 2 provided by Joe Turner of Hurt & Proffitt; Answers to question 3 provided by Bob Panek

1. How is the effluent being injected into the ground treated any differently that my individual septic tank effluent? Ozone, Chlorine, UV lighting?

The major difference is that effluent will be treated to a much higher degree using a Fixed-film Activated Treatment (FAST) unit. The FAST unit incorporates a greater amount of oxygen into the treatment system through aeration and mixing of the wastewater. Media cartridges inside the treatment units, with a "fixed-film" of microorganisms, digest the waste components through aerobic and anaerobic means. As the concentration of wastewater increases, the film grows to increase digestion. When the wastewater concentration decreases, the excess microorganisms sluff off. Additionally, treatment of the wastewater is achieved through recycling a portion of the effluent through the system.

UV lighting and other tertiary treatment methods will be considered to achieve additional disinfection of effluent. Chlorine and ozone are both operationally and maintenance intensive options when compared to UV light. Both chlorine and ozone can present safety and health hazards as well. UV light can achieve up to 99% elimination of fecal coliform and other pathogens.

Effluent characteristics from septic tank units can vary due to the types of wastes input into the system. Some general effluent characteristics for septic tank and aerobic treatment units:

	Septic Tank (mg/l)	Aerobic Treatment (mg/l)
BOD_5	160-190	10-50
TSS	75-85	15-60
TN	60-80	17-40

Note: BOD_5=Biological Oxygen Demand; TSS= Total Suspended Solids; TN= Total Nitrogen

The FAST system that we are considering would present even better TN removal (<20mg/l).

2. What type treatment, at what site will be used to significantly reduce the Nitrogen and Fecal Coliforms?

Treatment plants are being considered at either Exmore, Nassawaddox or both towns. The bulk of the nitrogen removed during treatment will come from the FAST units. An additional amount (10%) will be removed through plant/grass uptake in the drainfields. The required total nitrogen (TN) level is 5 mg/l at the project boundary. The treatment train design will target the lowest possible TN concentration upon discharge from the FAST units.

3. What, if any, are the discharge limitations from the Cape Charles Plant? to Baycreek, to Chesapeake Bay?

Attached are two documents that provide information concerning discharge limitations that will apply to the new Cape Charles WWTP.

The first, from our VPDES permit, addresses discharge to the bay. The most challenging parameter is 4 mg/L for nitrogen. Our plant will have the capacity to treat up to 250,000 GPD at this nitrogen concentration. However, MBR plants have demonstrated the ability to achieve 3 mg/L nitrogen. We should be able to get some additional capacity (around 310,000 GPD) if we are able to achieve that performance.

The second, from our Water Reuse Preliminary Engineering Report, addresses discharge for golf course irrigation. The limitations are from the state regulations addressing Level 1 water reuse (includes golf course irrigation). Our plant should have no difficulty meeting these requirements.

I have also attached a document providing information concerning the performance of our GE membrane system.

PART I

A. FINAL LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning with the issuance of a CTO for the upgraded plant and lasting until the permit's expiration, the permittee is authorized to discharge from outfall(s): 001 (WWTP).

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
Type	Monthly Average	Weekly Average	Minimum	Maximum	Frequency	Sample
Flow (MGD) [2]	NL	NA	NA	NL	Continuous	Totalizing, Indicating & Recording Equipment
pH (S.U.)	NA	NA	6.0	9.0	1/Day	Grab
$CBOD_5$ (mg/l; kg/d) [a]	10 9.5	15 14	NA	NA	3D/Week	8-Hr. comp
Total Suspended Solids (mg/l; kg/d) [a]	10 9.5	15 14	NA	NA	3D/Week	8-Hr. comp
Dissolved Oxygen (mg/l)	NA	NA	5.0	NA	1/Day	Grab
Fecal Coliform (N/CML)	200	NA	NA	NA	3D/Week (Between 10 am & 4 PM)	Grab
Enterococci (N/100ml)	35	NA	NA	NA	3D/Week (between 10am and 4 pm)	Grab
Ammonia Nitrogen (NH_3-N) (mg/l) [a]	2.4	2.4	NA	NA	1/Month	8-Hr. comp
Total Nitrogen (mg/l) [a]	NL	NA	NA	NA	1/Month	8-Hr. comp
Total Nitrogen Year-to-Date (mg/l) [b]	NL	NA	NA	NA	1/Month	Calculated
Total Nitrogen - Calendar Year (mg/l) [b] [c]	4.0	NA	NA	NA	1/Year	Calculated
Total Phosphorus (mg/l) [a]	NL	NA	NA	NA	1/Month	8-Hr. comp
Total Phosphorus Year-to-Date (mg/l) [b]	NL	NA	NA	NA	1/Month	Calculated
Total Phosphorus- Calendar Year (mg/l) [b] [c]	0.30	NA	NA	NA	1/Year	Calculated

PMT Member Questions; August 31, 2010

PART I

A. LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 001 (Continued)

NA = Not Applicable.
NL = No limitation, however, reporting is required.

Upon issuance of the permit, Discharge Monitoring Reports (DMRs) shall be submitted to the regional office at the frequency required by the permit regardless of whether an actual discharge occurs. In the event that there is no discharge for the monitoring period, then "no discharge" shall be reported on the DMR.

[a] See Parts I.B.8 and I.B.9. for quantification levels and reporting requirements, respectively.
[b] See Part I.B.12 for additional instructions regarding total nitrogen and total phosphorus.
[c] Annual average limitation, based on a calculation of all samples collected during the calendar year.

2. The design flow of this treatment facility is 0.25 MGD.
3. There shall be no discharge of floating solids or visible foam in other than trace amounts.
4. At least 85% removal for BOD and TSS must be attained for this effluent.

In addition to any Total Nitrogen or Total Phosphorus concentration limits listed above, this facility has Total Nitrogen and Total Phosphorus calendar year load limits associated with this outfall included in the current Registration List under registration number VAN05001, enforceable under the General VPDES Watershed Permit Regulation for Total Nitrogen and Total Phosphorus Discharges and Nutrient Trading in the Chesapeake Watershed in Virginia.

7. WATER REUSE REGULATIONS

The Cape Charles WWTP water reuse system will be designed in compliance with the Water Reclamation and Reuse Regulation (9VAC25-740-60 et seq.), with any clarifications, interpretations and exceptions noted below.

Reclaimed Water Standards, Monitoring Requirements and Reuses (9VAC25-740-70 to 90)

Water used for irrigation of golf courses is classified as "Urban – Unrestricted Access" reuse, which requires treatment to Level 1 quality standards. Effluent from the Cape Charles WWTP is expected to meet Level 1 standards for reclaimed water, as detailed in Table 7-1. Effluent quality would be tested during plant startup to verify compliance with Level 1 quality standards.

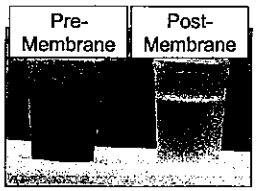
Table 7-1: Reuse Water Quality Standards

PARAMETER	REQUIRED FOR LEVEL 1 QUALITY	ANTICIPATED FOR CAPE CHARLES WWTP	NOTES
General	Secondary treatment with filtration and higher-level disinfection	Tertiary treatment with membrane filtration and UV disinfection	Membrane filtration performance greatly exceeds that of typical filtration processes
Bacteria	Less than 14 colonies per 100 mL	UV disinfection system was designed for less than 200 colonies per 100 mL per SCAT Regulations; however, membrane filtration has been proven to remove bacteria that would otherwise escape typical filtration processes, and so bacteria counts are expected to meet Level 1 standards	The UV disinfection system can be expanded if necessary to meet water reuse requirements without structural modifications
Total Residual Chlorine	Less than 1 mg/L	No residual	WWTP does not use chlorine
pH	6.0-9.0	6.0-7.0	No adverse impact on pH anticipated, sufficient alkalinity is present for biological treatment
BOD	BOD_5 monthly average less than 10 mg/L	BOD_5 of 3 mg/L	Specified effluent quality from membrane filtration is 3 mg/L
Turbidity	Daily average less than 2 NTU	0.5 NTU	Specified effluent quality from membrane filtration is 0.5 NTU

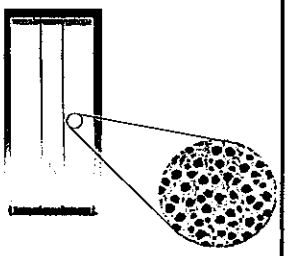
Reuse water would be sampled downstream of all treatment processes and upstream of discharge to the water reuse distribution system, with the exception of turbidity which would be continuously monitored by the membrane filtration system upstream of the UV disinfection system. Water which does not meet Level 1 quality standards would be diverted to the plant outfall (or to a future reuse water reject storage facility) by manually raising the flow control weir gate between the plant water well and the water reuse system. This gate would not be automated; however, the turbidity monitoring system would be connected to the WWTP auto-dialer system and the plant operators would divert the non-compliant water within one hour of an alarm condition, as required by the regulations. Parameters other than turbidity would measured

What Are Membranes?

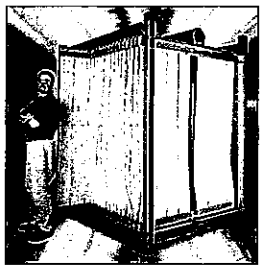
- Membranes are used for solids separation



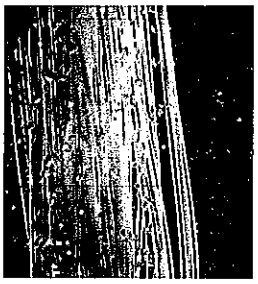
- Water that passes through the membrane is called permeate
- There are different types of membrane systems. Cape Charles will use hollow fibers



- Membrane fibers are hung in frames called "cassettes"



- Cape Charles will use ultrafiltration, with membrane pore size of about 0.04 microns (25,400 microns = 1 inch)
- Ultrafiltration removes microscopic solids from the wastewater, including bacteria, cryptosporidium, and red blood cells
- Membrane cassettes are immersed in wastewater and permeate is pulled through the fibers



- The membrane system uses air bubbles to knock solids off the outside of the hollow fibers
- Permeate can be pumped back through the hollow fibers into the membrane tank to clean the membranes during a process called "backpulsing"
- Membrane tanks will be covered by grating, with header pipes to carry permeate and air to and from each cassette.