February 8, 2018

Mr. Ewell Hopkins, Chairperson
Oak Bluffs Planning Board
56 School Street
Oak Bluffs, Massachusetts 02557

Re: Lagoon Ridge Development

Dear Mr. Hopkins and Planning Board Members:

I ask that you deny the special permit for the Lagoon Ridge Development.

You are well aware of the nitrogen issues so I will not repeat those concerns. But I do have some additional thoughts:

My concern is that should you vote to approve this development you will be allowing 2 "firsts" in the town of Oak Bluffs and I want to make sure that all potential issues have been addressed.

The first "first" is the use of the special flex housing bylaw which will permit the cluster housing layout as proposed. So my question is, "is this really the correct/proper use of land in this "rural" setting and location? You will be forever changing the flavor of the neighborhood.

The second "first" is the installation of a privately run; privately maintained; privately owned on-site sewage treatment facility: the Amphidrome system. While the MVC is requiring a "bond" to be provided that would cover the cost of repairs, my concerns are the effects on the ground water during any down time. Is there a back up system? Municipal treatments plants have a back up system should there be a failure! Will there be spare mechanical parts on site so if the system goes down; there is no time wasted on "finding the part"? If so how is this monitored? Will there be a repair person available on short notice to make repairs?

Additionally while the OB BOH signed off on this Amphidrome system, it is my understanding that the BOH agent did not. Maybe the agent was not required to? I do not know. Did anyone from the town compare this to other systems? With all due respect to the engineer who designed the system, should the town take his word and or should they get a second opinion?

Lastly, there have been comments made that the Amphidrome system reduces nitrogen by as much as 95%! Attached is a report on 7 Amphidrome systems on the Cape showing it does not meet expected nitrogen levels as proposed…and many times showing levels far above the state minimum!

My next question is "is this really the best technology available at this time"? I say no...there is a better system.. Called the SanToe® System…an overview is attached as is contact information for the engineer.

Should you decided you need to approve this development, I urge you to condition it upon using the "Best Available" technology for the sewer treatment plant.

Thank you.

D Reece

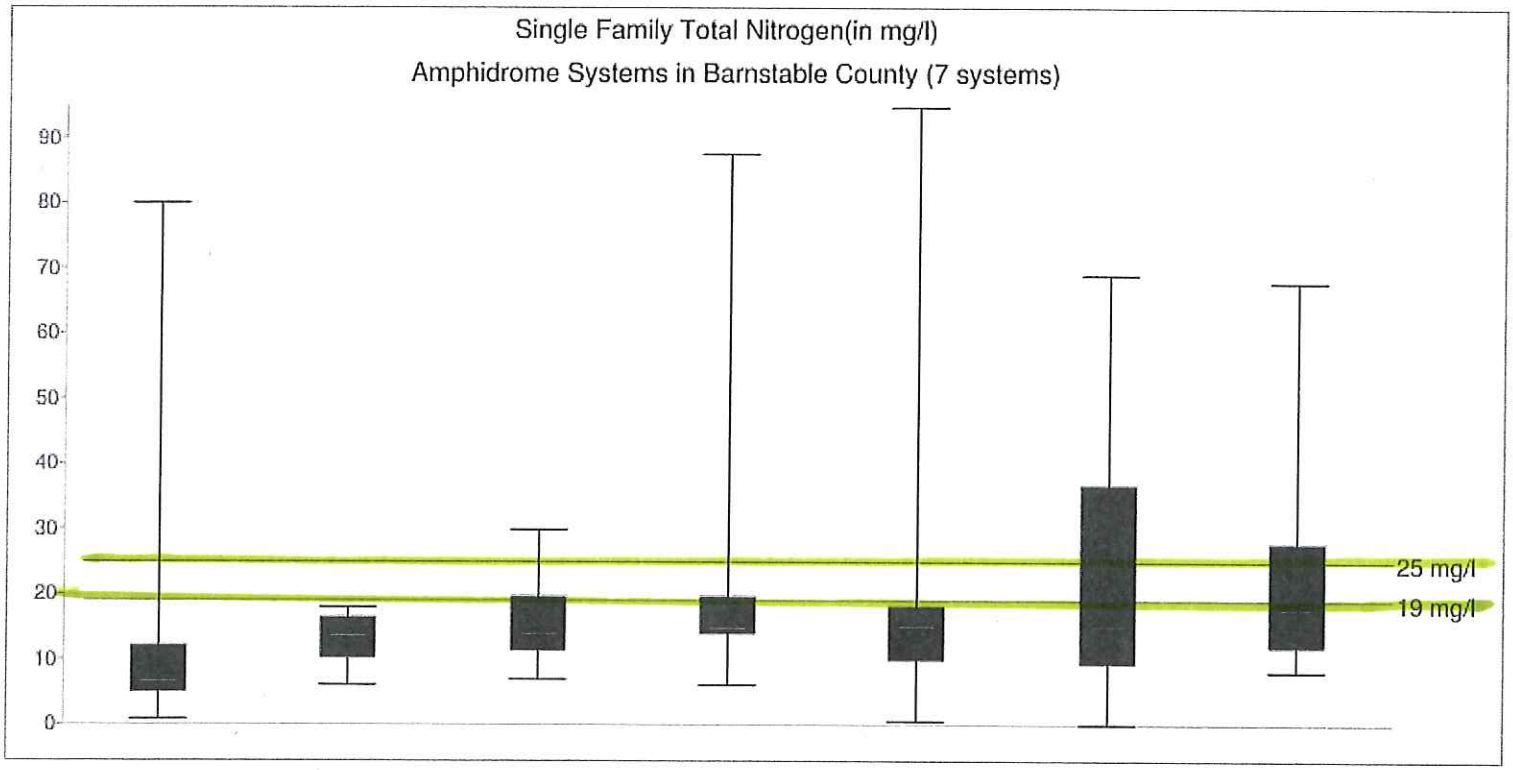
Doug Reece

Lagoon Pond Association

Amphidrome

Property Type

Single Family Residential



ID	Minimum	Upper Quartile	Lower Quartile	Maximum	Median
Amphidrome	1	12.23	4.8	80	6.65
Amphidrome	6.1	16.45	10.12	18	13.54
Amphidrome	7.1	19.6	11.2	29.75	13.8
Amphidrome	6.1	19.67	13.84	87.63	14.71

SanTOE™ System Overview

By

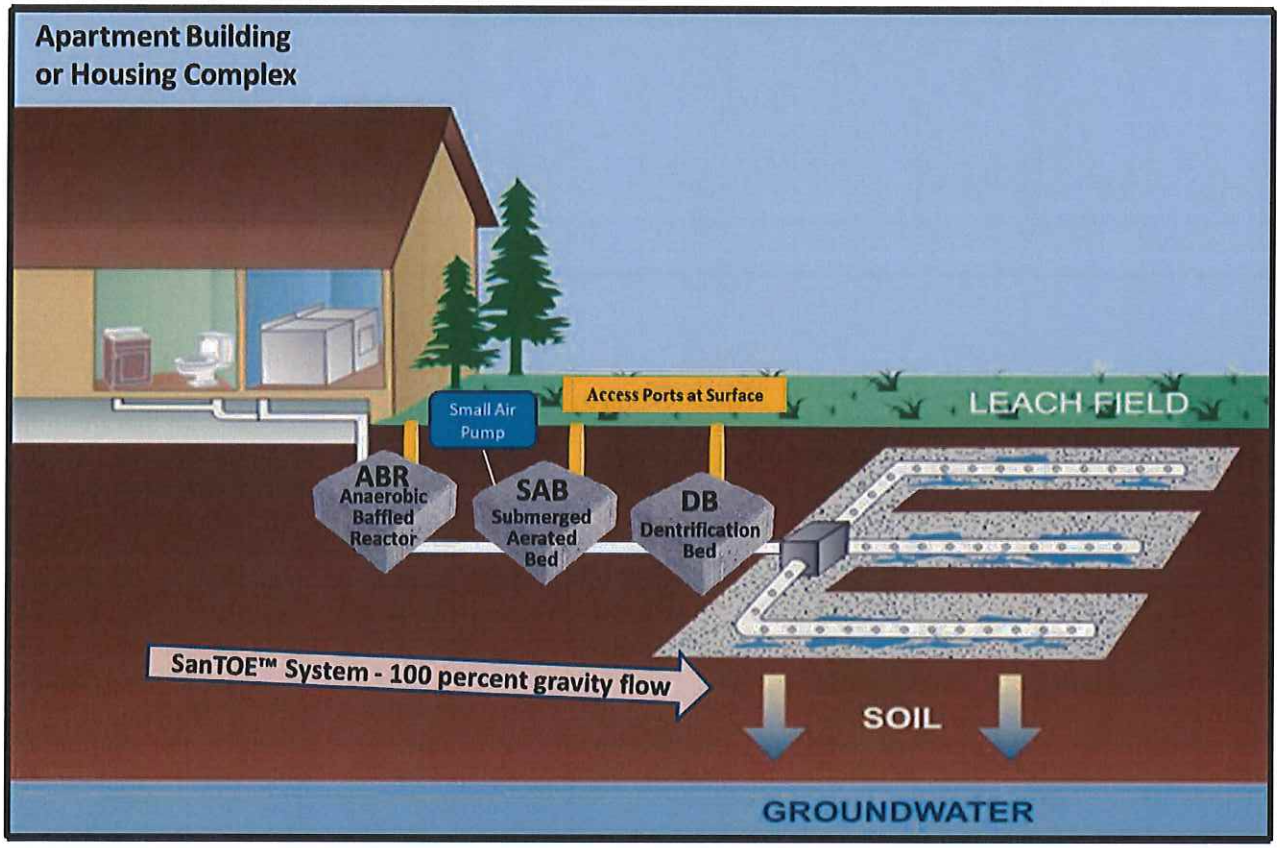
CES Clean Water LLC

Edgartown, MA

January 31, 2018

Figure 1 illustrates the SanTOE™ system concept for sanitary wastewater treatment for small communities, developments and building/apartment complexes. Here, wastewater gravity flows from the source into the three sequential treatment steps that comprise the SanTOE™ system.

Figure 1. SanTOE™ System Concept for Sanitary Wastewater Treatment



The three sequential treatment process steps are:

1. **Step 1 – Anaerobic Baffled Reactor (ABR) Tank.** This step is for initial settling of solids similar to that achieved in a conventional Title 5 septic tank. The one caveat is that in addition to solids settling, part of the ABR tank is baffled to also provide for additional solids settling and decomposition, along with biological degradation of organic compounds present in the wastewater. This ABR technology was developed by Dr. Perry McCarty and patented in 1992 by Stanford University. It is a proven and accepted technology that is widely used throughout the world for primary treatment of sanitary wastewaters.
2. **Step 2 – Submerged Aerated Bed (SAB) Tank.** This step is for the biological degradation of organic compounds to low mg/l levels, as well as the biologically mediated conversion of ammonia-nitrogen to nitrate-nitrogen. This is achieved by supplying supplemental air to a submerged media bed via a surface air pump. The specific power requirement of the air pump is dependent on the design flow, and the type and level of chemical constituents present in the

particular wastewater being treated. It is also noteworthy that the aeration pump is the only piece of mechanical equipment needed for the SanTOE™ system.

3. **Step 3 – Denitrification Bed (DB) Tank.** This step is for the biologically mediated conversion of nitrate-nitrogen to nitrogen gas. This is achieved by directing the wastewater flow through a bed of wood chips that serves to provide the supplemental organics needed by the bacteria responsible for catalyzing this nitrogen conversion. Once formed, the nitrogen gas passively exits the denitrification bed into the atmosphere. Noteworthy that nitrogen is a non-toxic inert gas with atmospheric air containing approximately 78% nitrogen.

Individually, each of these three different treatment steps are based on proven and accepted science and engineering design principles with the SanTOE™ system arranging them into an efficient and low-maintenance approach for sanitary wastewater treatment. Here, each different process step is configured in a manner that they complement each other to achieve a highly treated effluent containing low concentrations of organic chemicals, total nitrogen and total suspended solids.

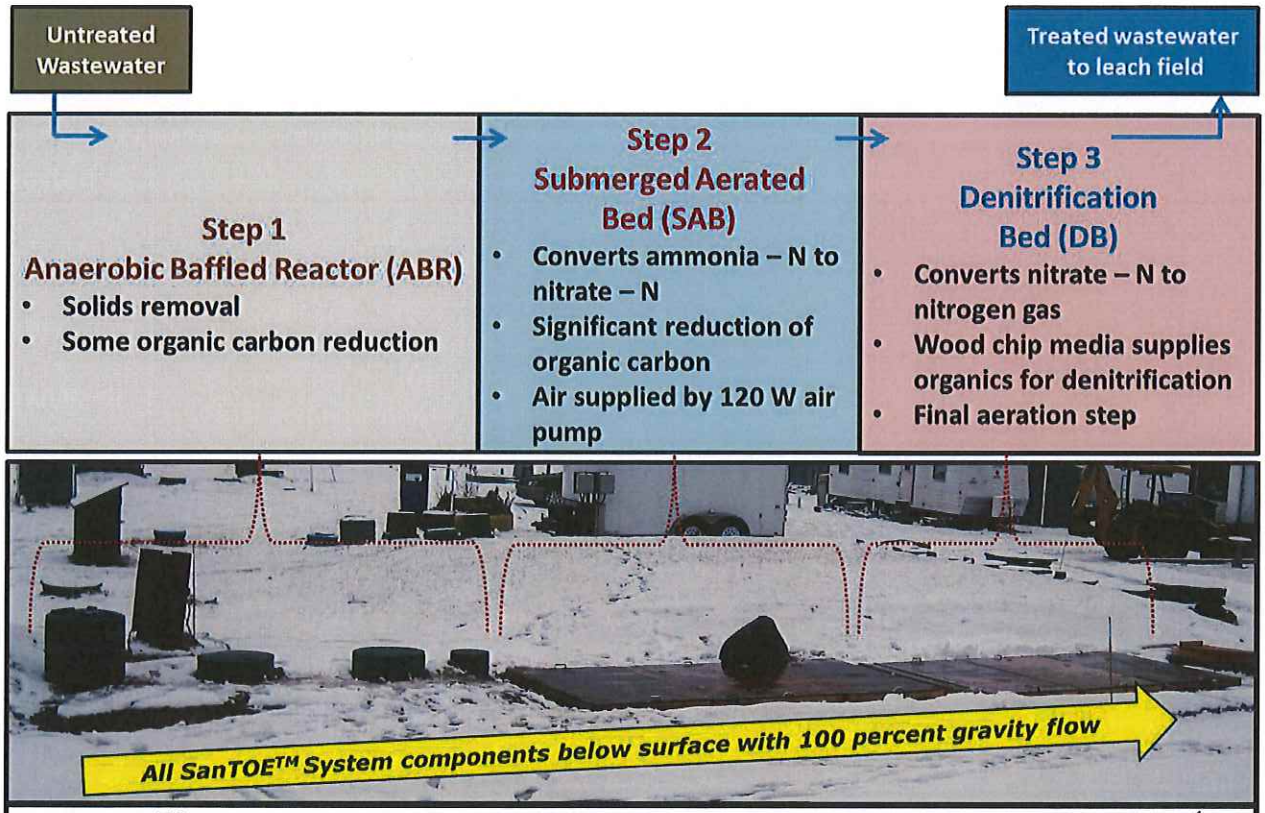
Referring back to Figure 1, each of the three SanTOE™ system treatment steps occurs in respective individual tanks. All tanks are situated at or below grade with access ports and/or pipes at or just below ground level for sampling and operational monitoring and maintenance purposes. Design is such that all flow is 100% gravity from Steps 1-3 and then finally to a Title 5 design leach field.

The SanTOE™ system can be designed to treat a wide range of wastewater flows beginning with a flow as low as 1,000 gallons per day (GPD) to as high as 1-2 million gallons per day (MGD). For construction, it uses the same materials and installation procedures as used for Title 5 septic systems. There is also flexibility in design so that a SanTOE™ system can be designed to fit into and be part of a particular landscape configuration.

Depending on design flow, the ABR, SAB and DB treatment process steps can be carried out in precast concrete or fabricated plastic tanks for lower design flows. For higher design flows, these same treatment steps can be carried out in poured-in-place concrete structures or in earthen type impoundments with impermeable liners. For the higher flow designs, it is also possible that the SAB can be landscaped such that wetland type vegetation can grow on the surface with the actual water surface at least 6 inches below grade. Here, the addition of adding vegetation can be done in a manner that serves to enhance the landscape esthetics of a particular site.

As depicted in Figure 2, a 1,200 GPD design flow demonstration unit was recently installed in December 2017 at the Massachusetts Alternative Septic System Test Center (MASSTC) in the town of Barnstable on Cape Cod. This demonstration unit is currently being operated to demonstrate that the SanTOE™ system can effectively treat sanitary wastewater with focus on significant reduction of organics, total suspended solids and total nitrogen.

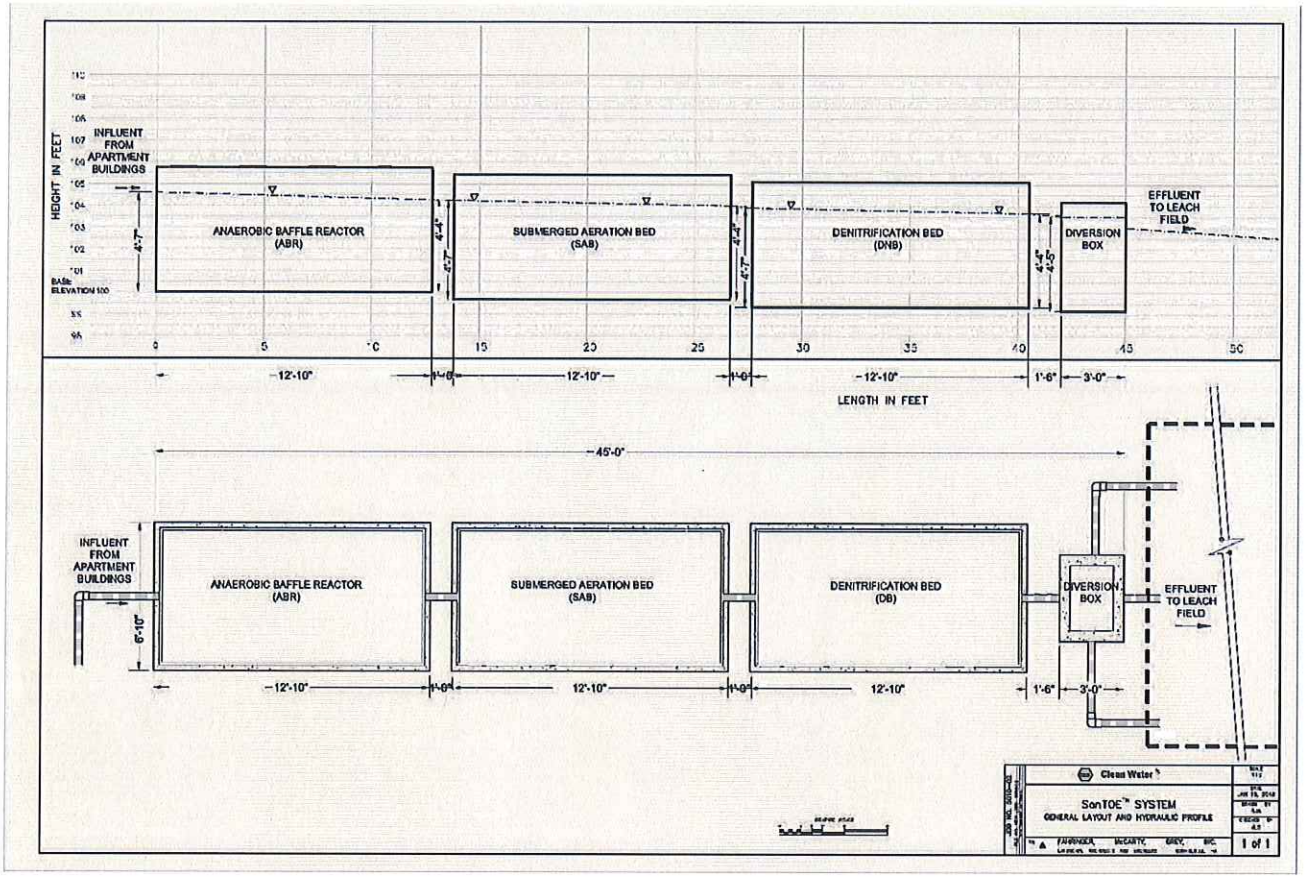
Figure 2. SanTOE™ System Process Steps Currently Being Demonstrated



SanTOE™ System Demonstration Unit at Massachusetts Alternative Septic System Test Center[1]

Regarding specific details related to tank sizing and construction of this demonstration unit , Figure 2 gives both the engineering profile and plan view details. As cited, the overall head loss across the SanTOE™ system will be ~9 inches. Each treatment step is done in 2,000-gallon precast H-10 concrete tanks. These tanks have internal elements assembled to maintain the specific conditions needed for each treatment process step to operate as required and to provide the overall SanTOE™ system treatment performance needed. The ABR tank has a concrete top with modified access holes. Both the SAB and DB tanks have removable covers for monitoring and maintenance access as needed. The top of the ABR tank can be covered with soil, and the tops of the SAB and DB tanks can be covered with mulch-type material for easier access.

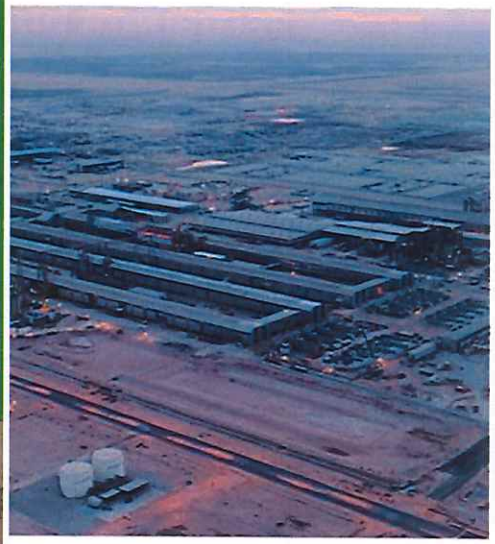
Figure 2. SanTOE System General Layout and Hydraulic Profile



From a much larger design flow perspective, CES Clean Water personnel were responsible for the design, construction management, start-up and operator training of a treatment system deployed in Saudi Arabia treating a design flow of 1.3 million gallons per day. This treatment system included the same basic treatment steps as the SanTOE™ system, albeit at a much larger scale than what is currently being demonstrated at MASSTC. Since its start-up in 2012, the system in Saudi Arabia has consistently achieved 98% ammonia-nitrogen reduction, while also maintaining nitrate-nitrogen in the 6-8 mg/l range in the final treated effluent. Here, it is noteworthy that due to its geographic location and larger flow, wood chips were not used to provide the supplemental organics needed for denitrification. Rather, acetic acid is the supplemental organic being metered in between the SAB and the DB treatment units to supply the right amount of organics needed for the conversion of nitrate-N to nitrogen gas. This treatment system approach resulted in meeting the Royal Commission discharge standard of 10 mg/l nitrate-N. Here it is noteworthy that system could also have been operated to achieve a lower total nitrogen limit if needed. In addition to this larger treatment system achieving significant total nitrogen reduction, it also achieved greater than 99% organic reduction, measured as biochemical oxygen demand.

For Further Information, please contact:

John R Smith, Ph.D., P.E.
CES Clean Water
72 Saddle Club Dr.
P.O. Box 1154
Edgartown, MA 02539
Cell – 412-719-5976
Island – 508-627-3072

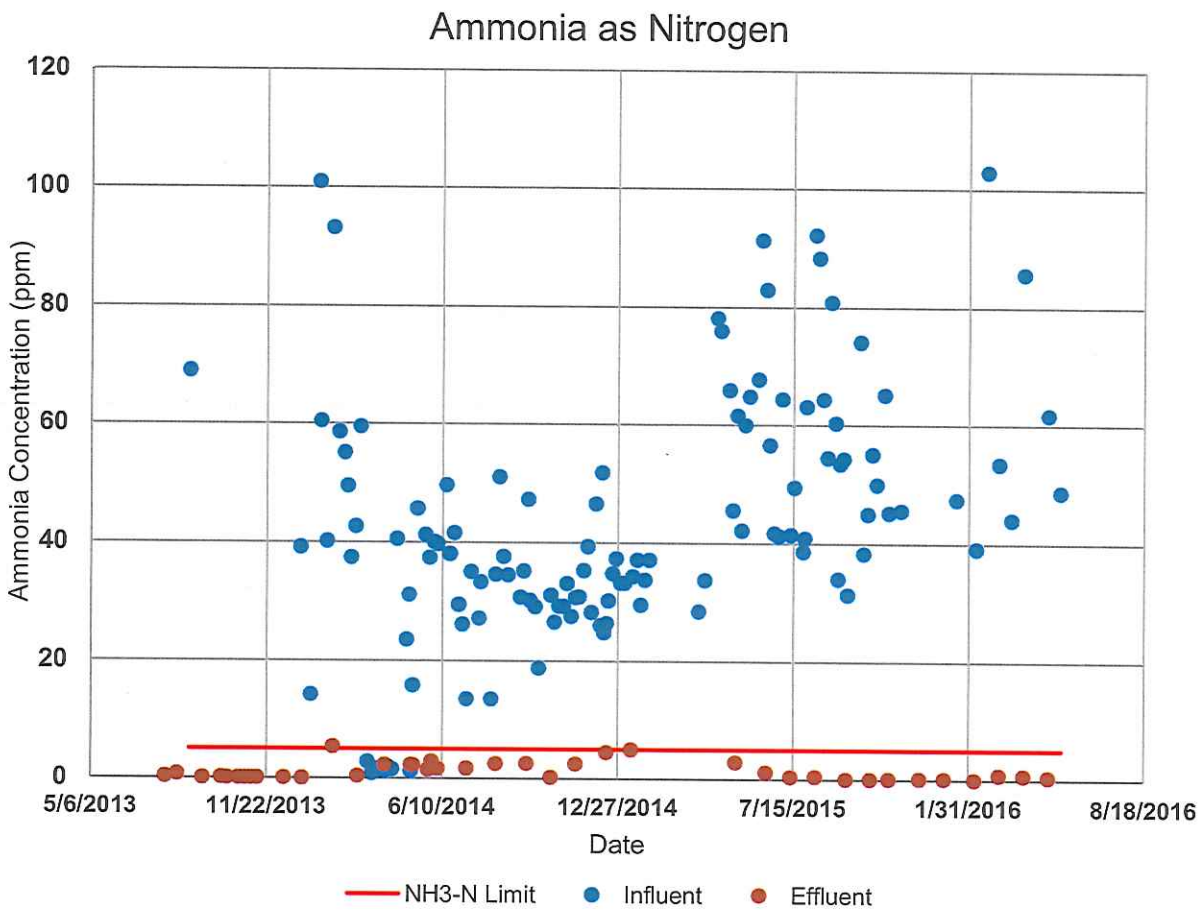


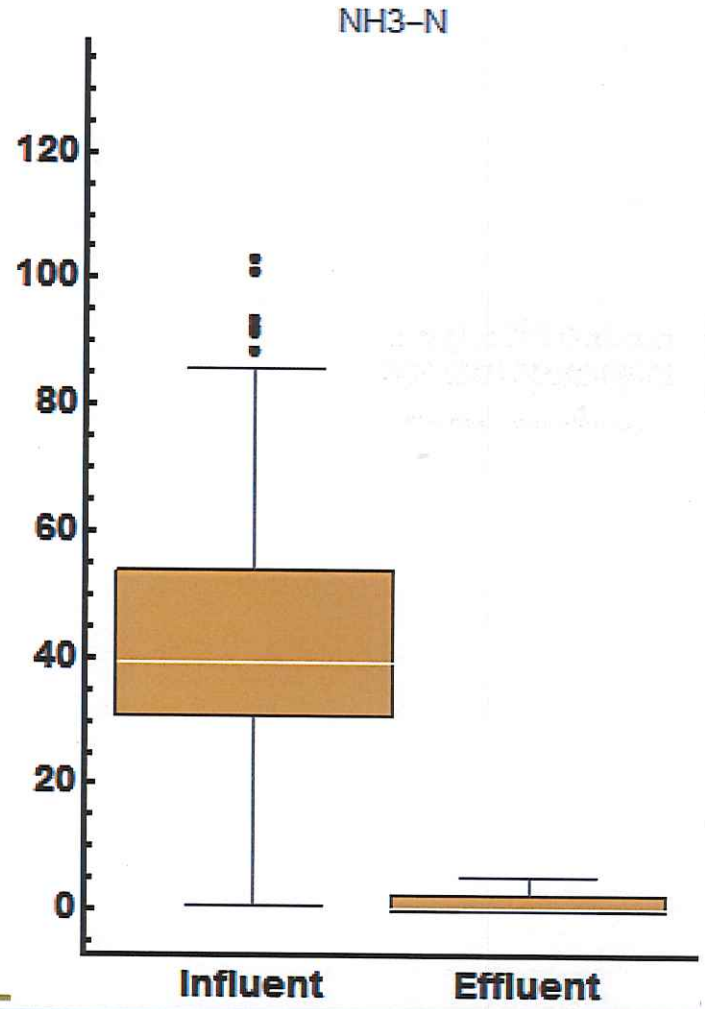
- **5,000 M^3 per day (1.3 million gallons) design flow of sanitary and industrial wastewaters**
- **Treated wastewater meets Royal Commission Irrigation Standards with 10 % reused for landscape irrigation and 90 % for process water make-up**

Source: Information provided by Ma'aden Site Environmental Manger

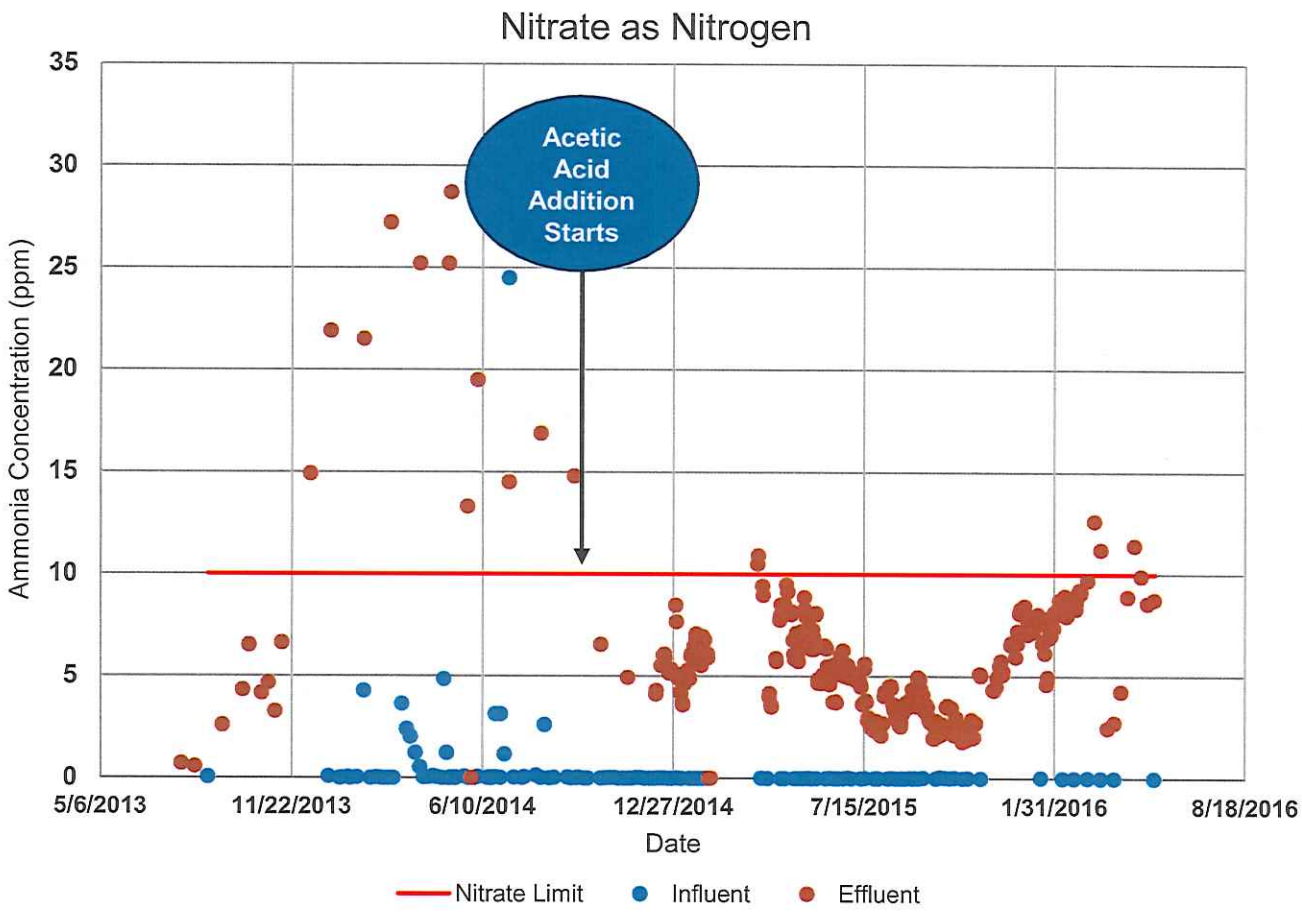
Photos of SAB

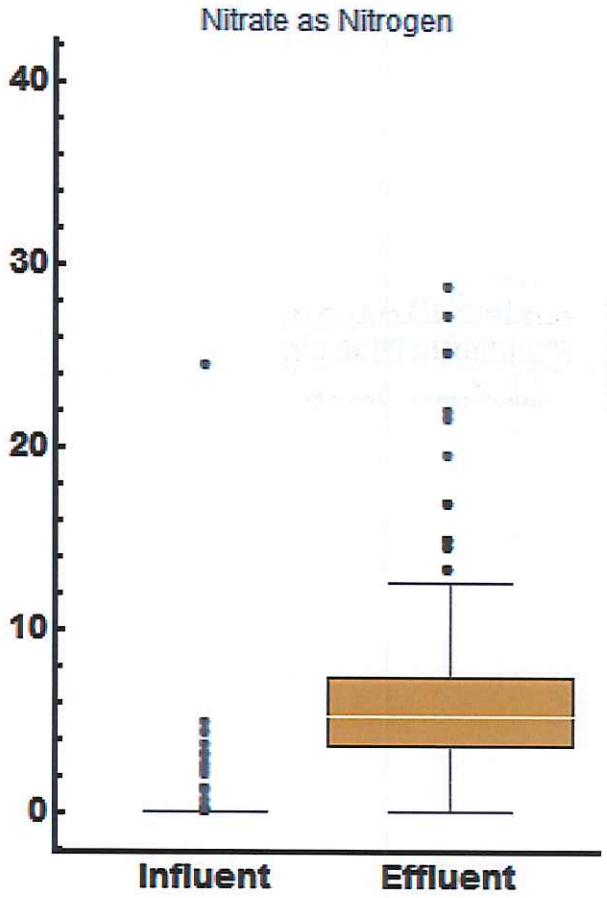
Ammonia


Ammonia as Nitrogen
Ammonia Concentration (ppm)
120
100
80
60
40
20
0
5/6/2013
11/22/2013
6/10/2014
12/27/2014
7/15/2015
1/31/2016
8/18/2016
Date
NH3-N Limit
Influent
Effluent

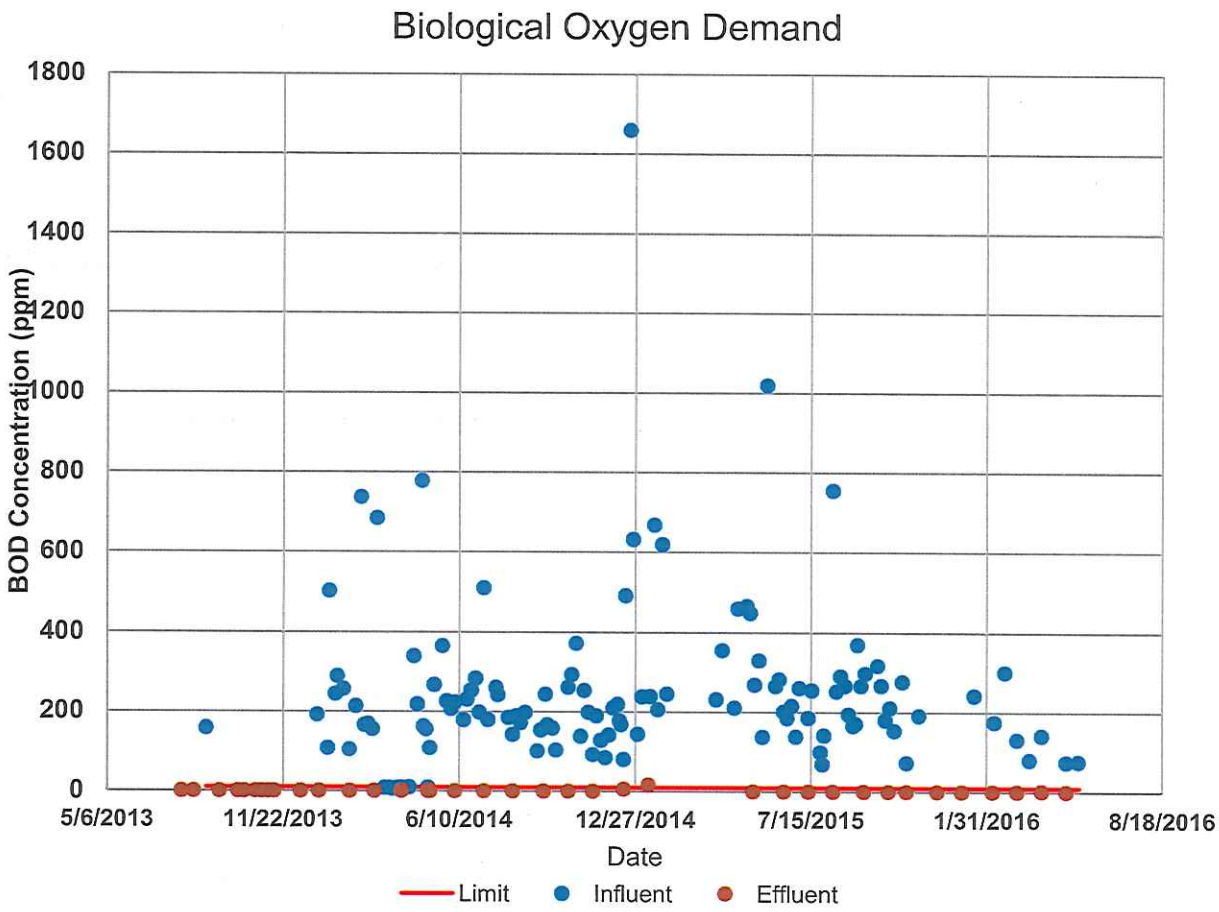

NH3–N
120
100
80
60
40
20
0
Influent
Effluent

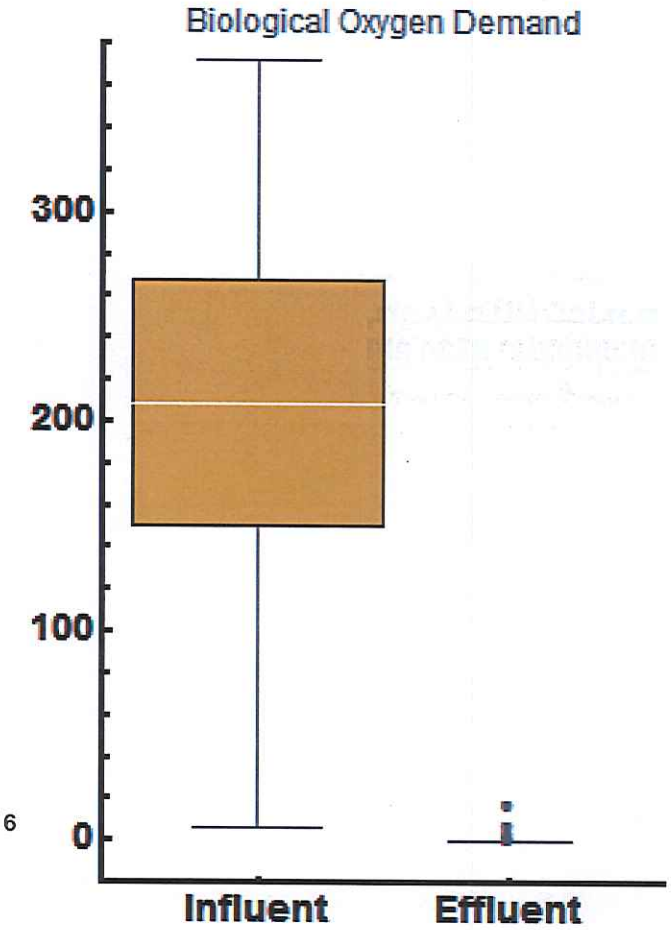
Nitrate


Nitrate as Nitrogen
Acetic Acid Addition Starts
Ammonia Concentration (ppm)
35
30
25
20
15
10
5
0
5/6/2013
11/22/2013
6/10/2014
12/27/2014
7/15/2015
1/31/2016
8/18/2016
Date
Nitrate Limit
Influent
Effluent

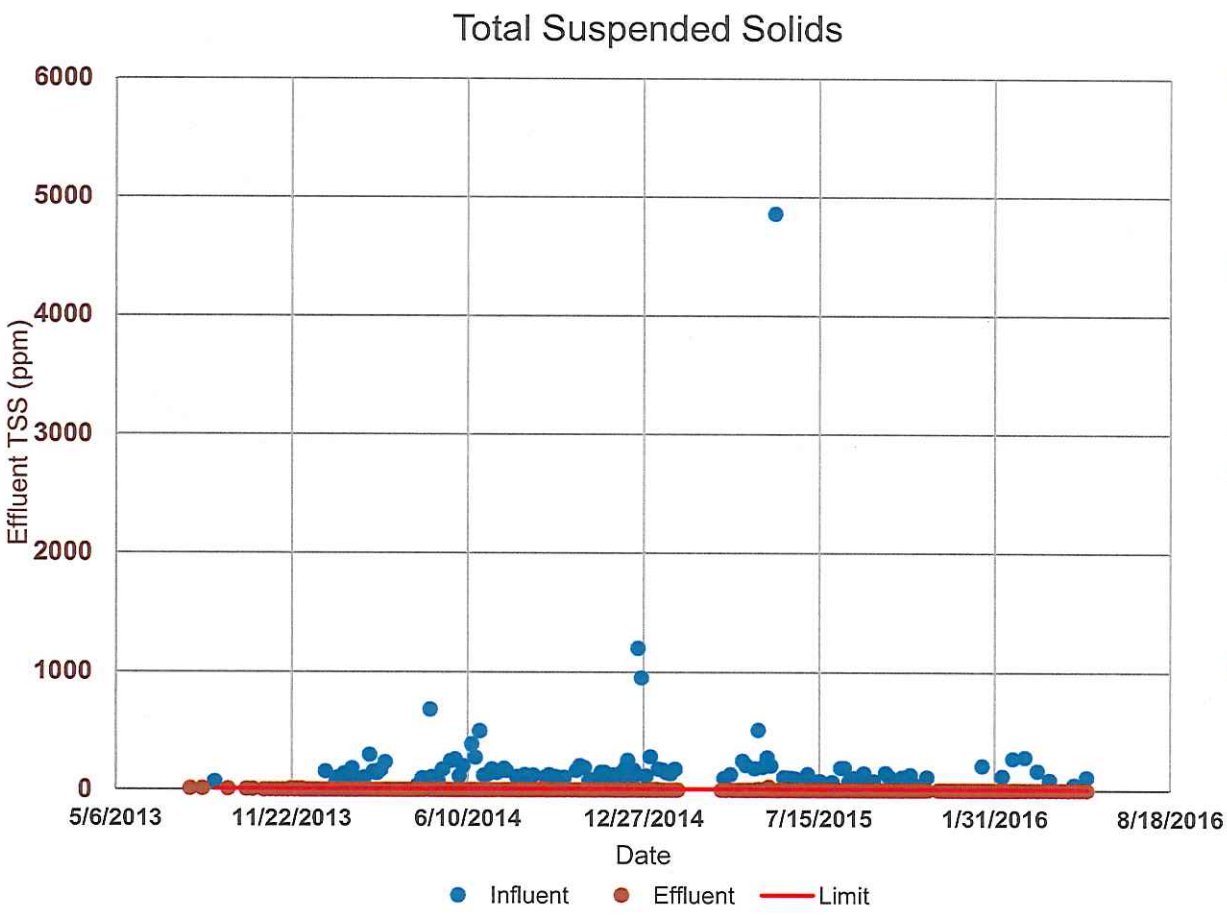

Nitrate as Nitrogen
40
30
20
10
0
Influent
Effluent

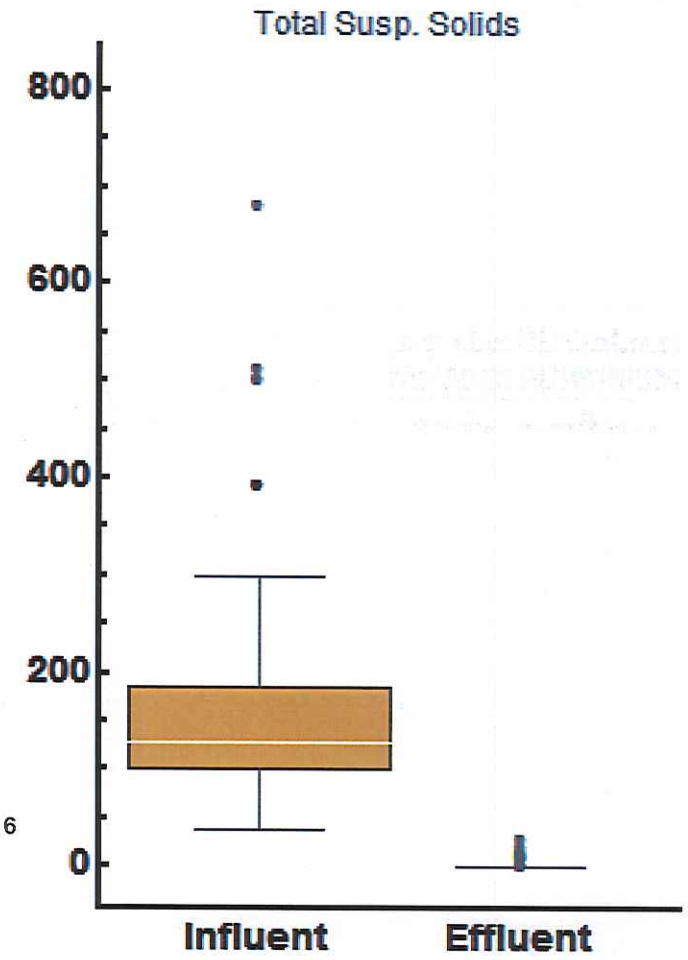
BOD


Biological Oxygen Demand
BOD Concentration (ppm)
1800
1600
1400
1200
1000
800
600
400
200
0
5/6/2013
11/22/2013
6/10/2014
12/27/2014
7/15/2015
1/31/2016
8/18/2016
Date
Limit
Influent
Effluent


Biological Oxygen Demand
300
200
100
0
Influent
Effluent

TSS


Total Suspended Solids
6000
5000
4000
3000
2000
1000
0
Effluent TSS (ppm)
5/6/2013
11/22/2013
6/10/2014
12/27/2014
7/15/2015
1/31/2016
8/18/2016
Date
Influent
Effluent
Limit


Total Susp. Solids
800
600
400
200
0
Influent
Effluent

Summary of Ma'aden's Performance

Since it's operation in 2012 till date, the System has produced high quality treated effluent meeting and exceeding regulatory standards

Permit Parameter	Units	Saudi Arabian RC Irrigation		Average Influent Water Quality	Average Effluent water quality	Percent Removal
		Maximum Allowable Limit	Monthly Average Limit			
Organics						
Biochmical Oxygen Demand	mg/L	10	-	220	<2	>99
Chemical Oxygen Demand	mg/L	50	-	387	22	94
Phenols (Total)	mg/L	0.002				
Nutrients						
Ammonia as N	mg/L	5	-	47	1	98
Nitrate as N	mg/L	10	-	1.3	6-8	NA
Total Kjeldahl Nitrogen	mg/L	60	35	59	2	97
Field Measurements						
pH	pH Units	6.0-8.4	-	5.5-7.8 (Avg=7)	7.2-8.9 (AVG=7.8)	NA
Dissolved Oxygen	mg/L	2.0(ming)	-	<1	6.3	NA
Microbiological Parameters						
Faecal Coliforms	MPN/100ml	1	-	>1800	<1	>99
Total Coliforms	MPN/100ml	23	2.2	>1800	<2	>99