The system has attained an effluent of <2 mg/L TN since it was put into operation by WhiteWater Inc. in the fall of 2015.

The control system is PLC based with a user friendly touch screen interface that allows real time control and observation of the system via the internet.

Remote access to system, trending data, alarm history etc. provides valuable insight on system operation and any adjustments that may need to be made to optimize performance. These adjustments can be made remotely in real time.

Mashpee, Massachusetts

Stantec Engineers was challenged by the Massachusetts Cape Cod Commission to design a nitrogen reducing system with stringent limits for Epoch Assisted Living in Mashpee, MA.

After discussion with the CCC, an effluent limit of ≤5 TN was determined to be required. Stantec set a design target of ≤3 TN.

An Amphidrome® system was chosen as the best technical solution.

The process is a biologically active filter (BAF) and provides up to 15,000 mg/l of active volatile solids (VS) in a small footprint.

The media also provides physical filtration and therefore the need for solids separation after the biological treatment process is eliminated.

The 8,500 gpd system incorporates an 8 ft. dia. Amphidrome® reactor, a 3 ft. dia. Plus™ denitrifying filter and a 2.5 ft. dia. polishing filter.

2017 Operational Data

<table>
<thead>
<tr>
<th>Month</th>
<th>Influent TKN</th>
<th>Effluent TKN</th>
<th>Effluent TN</th>
<th>Effluent BOD</th>
<th>Effluent TSS</th>
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<td>&lt;3</td>
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</table>

Manufactured under license from De Nora Water Technologies

09/17
Chatham Bars Inn

Project Description

Location
Chatham, Massachusetts

Services
Engineering Design Plans
Construction Documents
Construction Administration
Daily Operations and Maintenance
Compliance and Well Sampling
Emergency Response Coverage

Project Duration
2005 – Present

Point of Contact
Robert Berke
Director of Property Operations
Chatham Bars Inn
297 Shore Road
Chatham, MA
(508) 945-6800

System Specifications
Built in 1998
35,000 Gallons Per Day
Expanded in 2011 to 60,850 Gallons Per Day
Quad Train Amphidrome® Plus
Odor Control
Ultraviolet Disinfection

- CBI is a resort property consisting of numerous buildings on several lots including guest rooms, restaurants, tavern, swimming pool, office space and spa facility. The property was originally developed in the early 1900’s with the construction of the Main Inn building and some of the surrounding cottages. Other buildings have been constructed over time and parcels added or sold off.

- The existing WWTF was designed and permitted by under DEP’s Groundwater Discharge Permit process in March 19, 1998.

- Portions of the property were being serviced by multiple individual and some failing Title 5 septic systems. This was a nitrogen loading issue in general and also a magnified concern in that the facility is on the shoreline proximate to the Tern Island Sanctuary within Little Pleasant Bay in Chatham harbor.

- A study of the aggregate wastewater flow from all buildings resulted in the need to accommodate the additional flow from the other portions of the resort. The upgrades consisted of adding two additional trains to the existing Amphidrome® system with upgrades to the control building for air and chemical feeds and odor control systems. It is the only quad-train Amphidrome® system ever designed, permitted and constructed.

- Coler & Colantonio, Inc. Operations has been operating the WWTF since 2005.
Greenfield, NH

The Crotched Mountain Foundation and Rehabilitation Center recently completed the installation of a 100,000 gallon per day, Amphidrome® on-site wastewater treatment system utilizing a blend of advanced wastewater treatment processes.

Crotched Mountain Foundation is a nonprofit charitable organization serving children and adults with disabilities and their families from across the Northeast since 1953. The facility is located on a 1,400-acre campus that includes a residential school for children with special needs, a hospital that focuses on rehabilitation following brain injuries and other neurological conditions, an outpatient clinic and residential services for adults.

The existing wastewater collection and treatment system has suffered from the ravages of time and was undersized for future growth.

The gravity collection system which covers the campus grounds experienced a great deal of (I/I) Inflow and Infiltration. CMRC commissioned Underwood Engineers, Inc., Portsmouth, NH to provide a complete study of the system in 2005. Sewer improvements were completed in 2007.

The existing on-site septic system and leaching trenches also suffered from aging and over loading from the inflow and infiltration.

Locating a new site for wastewater discharge presented additional challenges. Due to the large design flow, mountainous terrain, shallow depth to groundwater and soil conditions a fairly large area was required. The available land was also adjacent to sensitive environments thus dictating the need for a high level of wastewater treatment.

Unique solutions required

A combination of solutions was found to fit this site. Discharge of treated effluent was handled with a blend of conventional sub-surface trenches and a relatively new process using a sub-surface drip dispersal system. The drip dispersal system sometimes used as an irrigation device works with pressure regulated emitters and provides even distribution of effluent. This provides greater flexibility to permit the use on sloping land.

Advanced treatment required. (See page 2)

Project Scope

Contract #1

This contract included the main treatment plant site with a base bid for the 85,000 gpd plant with an alternate to increase the plant to 100,000 gpd.

The contract was awarded to Weston & Sampson, CMR.

Contract #2

This contract included the on-site disposal system and other site improvements to the campus. The contract was awarded to S.U.R. Construction West.

These contractors teamed to provide services to each other under both contracts. The treatment plant went on line July 30, 2009. The drip dispersal and trench system followed on September 1, 2009.
Advanced Treatment Required (from page 1)

The sub-surface solutions selected still required a great deal of land area. The utilization of an advanced treatment system was found to provide the benefits of higher quality effluent thus permitting a 50% reduction in the sub-surface systems.

CMRC and Underwood Engineers, inc. selected the Amphidrome Treatment Process to protect the environment and to reduce the size of the leaching system. FRMA was also selected due to their experience, performance history and capabilities to treat the large wastewater flows from this facility. The system was sized to treat and discharge flows up to 100,000 gpd with potential build out.

On July 25th 2008 CMRC solicited bids for construction of this $3.024M project which was funded through a bond issue, grants from CDBG and USEPA, and a loan from the NH SRF program.

The treatment system is now meeting discharge permit limits within the first month of operation.

The Amphidrome System

The Amphidrome system utilizes two tanks and one submerged attached growth bioreactor, subsequently called Amphidrome reactor.

The first tank, the anoxic/equalization tank, is where the raw wastewater enters the system. The tank has an equalization section, a settling zone, and a sludge storage section. It serves as a primary clarifier before the Amphidrome reactor.

This Amphidrome reactor consists of the following four items: underdrain, support gravel, filter media, and backwash trough. The underdrain, constructed of stainless steel, or HDPE encased concrete block, is located at the bottom of the reactor. The underdrain provides support for the media and even distribution of air and water into the reactor.

Air laterals are provided to distribute the air evenly over the entire filter bottom. The design allows for both the air and water to be delivered simultaneously, or separately via individual pathways to the bottom of the reactor.

The system utilizes an automated PLC control system with touch screen interface to provide the operator easy access to process controls.

This system is in use throughout the United States and Poland and has been in use since 1996.

The Amphidrome® system provides the highest level of treatment attainable with the lowest site impact.
The Amphidrome Process

The Amphidrome system is a submerged attached growth bioreactor process (SAGB). It is a deep-bed sand filter designed for the simultaneous removal of soluble organic matter, nitrogen and suspended solids within a single reactor.

However, if stringent total nitrogen limits, (i.e. less than 10 mg/l), are required, a second smaller polishing reactor is required. Since the process removes nitrogen, it is also classified as a biological nutrient removal (BNR) process.

To achieve simultaneous oxidation of soluble material, and to provide nitrification and denitrification in a single reactor, the process must provide aerobic and anoxic environments for the two different populations of microorganisms.

The Amphidrome process can be used as a stand-alone treatment process or can be used with other processes to provide further treatment. Depending on the discharge permit requirements these systems can include micro-filtration, Chemical coagulation processes and ultraviolet disinfection.

As the air flows up through the media, the bubbles are sheared by the sand--producing finer bubbles as they rise through the filter. On top of the under-drain is 18”, (five layers), of four different sizes of gravel. Above the gravel is a deep bed of coarse, round, silica sand media. The media functions as a filter, significantly reducing suspended solids, and provides the surface area for which an attached growth biomass can be maintained.

To achieve the two different environments required for the simultaneous removal of soluble organics and nitrogen, aeration of the reactor is intermittent, rather than continuous.

Depending on the strength and the volume of the wastewater, a typical aeration scheme may be three to five minutes of air and ten to fifteen minutes without air. Concurrently, return cycles are scheduled every hour, regardless of the aeration sequence.

During a return, water from the clear well is pumped back up through the filter and overflows into the trough. The trough is set at a fixed height above both the media and the influent line; and the flow is by gravity back to the front of the anoxic/equalization tank.

The cyclical forward and reverse flow of the waste stream and the intermittent aeration of the filter achieve the required hydraulic retention time and create the necessary aerobic and anoxic conditions to maintain the required level of treatment.

Applications

The Amphidrome process is used in applications from single family homes to very large flows in excess of 200,000 gpd.

Applications can include new home construction, remedial applications to fit in reduced space limitations, commercial and residential development and community wastewater treatment solutions.

Effluent quality provides advanced treatment to enable a vast range of discharge solutions from direct soil absorption systems to end of pipe water re-use systems.

More information may be found at:

www.frmahony.com

Vital Statistics

NH DES Discharge Limits

- Flow 85,000 gpd
- BOD, TSS <30 mg/l
- TN <20 mg/l, <10 mg/l at monitoring wells

Treatment Plant

Dual Train Amphidrome ®

- (2) sets of Anoxic tanks in series @ 50,000 per train
- (2) 9.5 by 15 ft. Amphidrome Reactors.
- (2) 35,000 gallon clear wells
- (1) Plus Reactor Pump chamber 10 by 52 ft.
- (1) 8ft. Diameter Plus® Reactor
- (1) 10ft. Diameter Final discharge Pump chamber.

Structures include

- (1) Headworks Facility
- (1) Control Building

SSDS

Drip system 48,000 gpd

- (6) Zones @ 67,000 ft.
- (1) Control Building

Trench System 38,400 gpd

- (4) Zones @ 1200 ft.

Collection System

>10,850 feet of gravity sewer with a mix of 6, 8 and 10 pipe consisting of PVC, AC and Concrete pipe.

In 2007 50% of this system has undergone rehabilitation including slip lining, pipeline replacement and manhole rehabilitation.
WASTEWATER
We specialize in process solutions for the collection and purification of wastewater from single family homes to large municipal systems.

WATER
We will assist you in the application of state of the art processes for the clarification, treatment and disinfection for drinking water.

ON SITE TREATMENT
Our Amphidrome® system provides the highest level of treatment attainable with the lowest site impact
Providing SBR, MBR, and RBC technologies to fit the right solution for you.

SEWER SYSTEMS
Our applications group will assist you with the application of Pressure Sewer System technology and custom designed pump stations for your project.

SAGB® SYSTEMS
Process solutions for the nitrogen reduction in recycle streams.

About Crotched Mountain
Crotched Mountain is a charitable organization whose mission is to serve individuals with disabilities and their families, embracing personal choice and development, and building communities of mutual support.

Crotched Mountain has a long history of serving people with disabilities and their families since 1936. We invite you to learn more about the evolution of our programs and services and the remarkable people and places associated with our history.

Crotched Mountain provides specialized education, rehabilitation, community, and residential support services for more than 2,000 consumers, including individuals with disabilities and the elderly, living in New England and New York.

For more information about Crotched Mountain, please visit www.crotchedmountain.org.
Nags Head, NC
Originally built in 1939, Jen-
nette’s is the oldest fishing pier
on the Outer Banks.

North Carolina’s Outer Banks
has long been known for its
spectacular fishing. Red drum,
bluefish, striped bass, flounder
and king mackerel are just
some of the prized fishes
sought by anglers young and
old.

Fishing on the banks was for-
ever changed when the first
fishing pier—Jennette’s Pier—
was opened in Nags Head
back in 1939.

Battered by storms and rebuilt
many times throughout its
seventy-year life, Jennette’s
was knocked down by Hurri-
cane Isabel in 2003, just after
the pier and its five-acre tract
were purchased by the NC
Aquarium Society.

Now, after years of planning
and twenty-four months of
construction, Jennette’s will
reemerge in 2011 as a one
-of-
kind educational ocean pier.
The Aquarium-operated com-
plex will feature educational
classrooms and programs,
alternative energy demonstra-
tions, live animal exhibits,
meeting facilities, a snack bar
and tackle shop, and a host of
other displays and features for
good family fun….with great
fishing too!

Check this website frequently
for updates on grand opening
events, fees and hours, activity
calendars, facility rental op-
portunities, and other pier news.

www.jennettespier.net

Unique solutions required
Anticipating that this location
will once again draw large
crowds, a responsible
wastewater solution had to be
found to protect this valuable
resource.

See More on the Amphidrome®
Wastewater Solution.
Advanced Treatment Required (from page 1)

The Wastewater Treatment system at Jennette’s Pier provides full wastewater treatment to remove BOD, TSS, nitrogen and phosphorus and turbidity.

The Amphidrome Plus treatment process removes organic and solid wastes and provides a very high removal of nitrogen.

The membrane filtration system further removes phosphorus and turbidity. Final (UV) Ultraviolet disinfection follows these treatment steps to provide a very high quality re-use water.

This advanced treatment system allows for above ground discharge to an infiltration pond and provides full re-use water for toilet flushing making this a truly “green” solution to wastewater disposal.

Amphidrome System—For Re-Use

The Amphidrome system utilizes two tanks and one submerged attached growth bioreactor, subsequently called Amphidrome reactor.

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Effluent quality provides advanced treatment to enable a vast range of discharge solutions from direct soil absorption systems to end of pipe water re-use systems.

More information may be found at:
www.frmahony.com

Vital Statistics for Jennette’s Pier Amphidrome

<table>
<thead>
<tr>
<th>NC Discharge Limits</th>
<th>Monthly Average</th>
<th>Daily Maximum</th>
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<tbody>
<tr>
<td>Flow 15,000 gpd</td>
<td>Nitrate &lt;= 10 mg/l</td>
<td>TN &lt;= 7 mg/l</td>
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<tr>
<td>Monthly Average - Daily Limits</td>
<td>TP &lt;= 3 mg/l</td>
<td>Turbidity 10 NTU</td>
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<tr>
<td>BOD &lt;= 10 mg/l - 15</td>
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<td>Ammonia &lt;= 4 mg/l - 6</td>
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<td>TSS &lt;= 5 mg/l - 10</td>
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<tr>
<td>Fecal 14/100 ml - 25/100</td>
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</table>

- (2) Anoxic/Equalization Tanks @ 14,000 per train
- (2) 9.5 by 10.5 ft Amphidrome Reactors.
- (2) 12,000 gallon clear wells/Plus Reactor Dosing Tanks
- (1) Plus Reactor Pump chamber 4 ft dia..
- (1) 3,000 gallon Membrane Filtration feed tank.
- (1) PALL Processing Aria AP-1 Package Filtration Unit.
- UV In vessel Disinfection Unit
- (1) 500 cfm Tub Scrubber with Mist Eliminator

Collection System

- Pumping Station Feed
WASTEWATER
We specialize in process solutions for the collection and purification of wastewater from single family homes to large municipal systems.

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We will assist you in the application of state of the art processes for the clarification, treatment and disinfection for drinking water.

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SAGB® SYSTEMS
Process solutions for the nitrogen reduction in recycle streams.

water supply and pollution control equipment

About Jennette’s Pier
You can become part of history and help rebuild Jennette’s Pier. Over 1,000 of the new pier’s deck boards are available for sponsorship through our Own A Plank! campaign.

Your tax-deductible contribution of $200 will be used to support the many programs and exhibits featured at this new coastal landmark. Sponsors’ names will be engraved in personalized fish tiles prominently embedded in deck boards along the pier. Pier benches are also available for sponsorship.

For more information, please visit www.jennettespier.net.