

**NORTH CAROLINA DEPARTMENT  
OF ENVIRONMENT AND NATURAL RESOURCES  
DIVISION OF ENVIRONMENTAL HEALTH  
ON-SITE WATER PROTECTION SECTION**

**CONTROLLED DEMONSTRATION  
WASTEWATER SYSTEM APPROVAL**

**CONTROLLED DEMONSTRATION NO: CDWS 2007-02**

**ISSUED TO:** Keith Dobie, President  
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**FOR:** Amphidrome<sup>®</sup> Treatment Systems

**APPROVAL DATE:** August 23, 2007

In accordance with General Statute 130A-343, 15A NCAC 18A .1969 and .1970, a proposal by F. R. Mahony & Associates, Inc., for approval of subsurface wastewater systems utilizing the Amphidrome pretreatment systems has been reviewed, and found to meet the standards of a Controlled Demonstration system when all of the following conditions are met:

**A. GENERAL**

1. Scope of this Controlled Demonstration Approval includes:
  - a. Use, design and construction requirements for the specified models of Amphidrome pretreatment systems to meet TS-I and TS-II effluent quality standards pursuant to Rule 15A NCAC 18A .1970.
  - b. Special operation, maintenance and monitoring of the Amphidrome pretreatment systems and associated subsurface systems to ensure the treatment performance standards shall be met.
  - c. Proposal for evaluation of this Controlled Demonstration system.
2. This Controlled Demonstration Approval is applicable to domestic strength sewage systems (non-industrial wastewater) utilizing Amphidrome pretreatment systems that have a design flow not exceeding 3000 gallons per day.
3. Influent waste strength to the Amphidrome pretreatment system as permitted with this approval shall not exceed domestic septic tank quality effluent standards pursuant to Rule 15A NCAC 18A .1970(b).

4. This controlled demonstration is initially limited to 200 systems with design flows of up to 3,000 gallons per day. The intent of this Controlled Demonstration is to gain field experience sufficient to qualify this system for Innovative Approval, pursuant to Rule .1969(g).
5. Prior to the approval of any individual system under the controlled demonstration approval, the manufacturer of all proposed tanks must be identified and tank construction details must be State-approved, as typically required for generically approved Residential Wastewater Treatment Units (previously termed "ATUs").
6. Use of Amphidrome pretreatment systems that have a design flow exceeding 3000 gallons per day may be permitted after approval by the State on a case-by-case basis in accordance with the Large Systems State Review/Approval Process (Rule 15A NCAC 18A .1938).

#### **B. ADVANCED TREATMENT PERFORMANCE STANDARDS (TS-I and TS-II)**

The Amphidrome pretreatment systems are designed, installed, operated and maintained to meet TS-I and TS-II effluent standards in accordance with Rule .1970. Refer to Rule .1970(a) Table VII - Effluent Quality Standards for Advanced Pretreatment Systems for treatment performance levels.

#### **C. SITING CRITERIA**

Approved Controlled Demonstration systems may be installed on sites that are suitable for a conventional wastewater system and that have a repair area of sufficient size to allow installation of a conventional, modified, or alternative wastewater system, an approved Innovative wastewater system, or an accepted wastewater system if the Controlled Demonstration wastewater system fails to perform properly. Other sites may be used for the initial installation of a Controlled Demonstration system that meet the criteria for a modified, alternative, approved innovative or accepted wastewater system, when the Manufacturer agrees to provide such a system if the Controlled Demonstration system were to fail to perform properly. Exceptions to the repair area requirement are as set forth in Rule .1969(f)(3) and (4).

The Amphidrome pretreatment systems and associated drainfields shall be sited and sized in accordance with Rule .1970 for a TS-I or TS-II system.

Controlled Demonstration pretreatment systems may be used for new initial sites, with an approved Alternative, Innovative, or accepted pretreatment system for repair, and as a repair to an existing malfunctioning system when there are no other approved or accepted repair options.

#### **D. DESIGN CRITERIA**

1. The Amphidrome pretreatment systems and the corresponding soil absorption systems shall be designed and sited in compliance with Rule .1970.
2. The Amphidrome pretreatment system utilizes two tanks and one submerged attached growth bioreactor, the Amphidrome reactor. The system and tank sizing is specified in Table 1 below.

Table 1			
Design Flow (gallons per day)	Minimum Anoxic Tank Size (gallons)	Amphidrome Reactor Size (diameter (ft))	Clear Well Size (gallons)
≤ 480	2000	2.0	1000
720	2000	3.0	1500
960	2500	3.5	2000
1200 – 1440	3000	4.0	2000
1680 – 2400	4000	5.0	3000
2880 – 3000	5000	6.0	4000

3. All tanks shall be approved by the State and F. R. Mahony & Associates, Inc specifically for use with the Amphidrome pretreatment system. As part of this approval, the anoxic tank will have an inlet and outlet sanitary tee.
4. All blowers must be provided with a weatherproof enclosure. If any enclosure is not provided by F. R. Mahony & Associates, the following minimum standards must be met for the enclosure:
  - a. For reactors under 4-foot diameter, the enclosure must be a shed-type structure containing at least 10 square feet of unobstructed floor space and provide headroom adequate for the ORC to stand erect; or
  - b. For reactors greater than 4-foot diameter, the enclosure must contain at least 30 square feet of unobstructed floor space and provide adequate headroom for the ORC to stand erect.
5. The Amphidrome reactor consists of the following items, supplied by F. R. Mahony & Associates: underdrain, support gravel, and filter media. The underdrain, constructed of stainless steel is located at the bottom of the reactor. It provides support for the media and even distribution of air and water into the reactor. The underdrain has a manifold and laterals 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. On top of the underdrain is 18 inches (five layers) of four different sizes of gravel. Above the gravel is a deep bed of coarse, round silica sand media. The media must meet the following specifications (Layer 1 starts at the bottom of the reactor.):

Layer 1	1 ½" x ¾" gravel
Layer 2	¾" x ½" gravel
Layer 3	½" x ¼" gravel
Layer 4	¼" x 1/8" gravel
Layer 5	½" by ¼" gravel
Layer 6	sand to meet the specifications listed below

6. The sand layer shall meet the following specifications: the sand shall pass a 6 x 9 mesh; shall be well rounded, not flat or angular; and have a maximum uniformity coefficient of 1.35. The sand hardness shall be 6 to 7 on the MOH scale and the minimum specific gravity shall be 2.6. The hydrochloric acid solubility shall not exceed 0.3% when tested. The media shall have a sphericity of 0.75 to 0.85 as determined by methods described in Elements of Water Supply and Wastewater Disposal, second edition, 1971, pages 404-406, Fair, Geyer, and Okun, John Wiley & Sons, Inc.
7. Filtrate from the Amphidrome reactor flows by gravity into the clear well to be recirculated back through the system, or pumped through a UV system, when required, prior to discharge. The UV system shall be rated for the appropriate discharge rate from the Amphidrome unit.
8. The integral Amphidrome clear well and reactor is only for the 2-foot reactor size. The tanks will be joined on site with Sonolastic® Ultra Joint Sealant and a stainless steel ring. Buoyancy calculations shall be completed by a North Carolina Professional Engineer for the unit if it intersects the seasonal high water table.
9. For reactors that are three feet in diameter or smaller, the check valve will be located in the anoxic tank. For the reactors over three feet in diameter, the check valve will be located in the reactor. All confined space requirements will be followed as needed if the check valve is to be access in the reactors over three feet in diameter.
10. A PVC float tree will be provided for reactors three feet in diameter and smaller. A stainless steel float bracket will be used for reactors three feet in diameter or larger.
11. The UV disinfection system will be WEDECO DLR Series, or other UV system as approved by the State.
12. If the drainfield pump discharges more than the design daily flow to the drainfield in one day (24-hour period), the control panel will notify/send a message to the operator and the owner.

13. All access openings shall have cast-in-place manhole risers with ring and cover.
14. Buoyancy calculations shall be completed by a North Carolina Professional Engineer for the Amphidrome tankage and/or the UV basin if they intersect the seasonal high water table, and additional concrete ballast may be required.
15. Any tanks installed in paved areas must be traffic rated.
16. Control panels controlling drainfield dosing pumps shall have pump cycle and run timer recording capability and shall meet the requirements of .1952.
17. Timed dosing shall be provided to the disposal field.
18. Drip irrigation systems will have a separate pump tank from the clearwell tank.
19. Influent samples shall be taken from within the inlet tee of the anoxic tank. Effluent samples shall be taken from a spigot or sampling port that is placed on the force main from the final dosing tank.
20. The Amphidrome system is controlled by a programmable logic controller (PLC). F. R. Mahony & Associates will provide an automatic dialer capable of dialing three telephone numbers to report any system alarms.
21. The 7-day and 30-day readings will be stored in the Amphidrome Control Panel records. The ORC will be able to access this information when they are at the site. The Amphidrome Control Panel can be used for pressure manifold and LPP systems. F. R. Mahony & Associates will work with the individual local health departments on a case-by-case basis to ensure that they have access to the information stored in the Amphidrome Control Panel, independently of the ORC.
22. Amphidrome pretreatment systems shall be designed by a North Carolina Professional Engineer.

## **E. INSTALLATION AND TESTING PROCEDURES**

1. A preconstruction conference shall be required to be attended by the system designer, F. R. Mahony & Associates certified installer, and local health department (LHD), prior to beginning construction of the Amphidrome pretreatment system and associated ground absorption system.
2. The Amphidrome pretreatment system shall be located in compliance with the horizontal setback requirements of Rule .1950(a) and shall be located to prevent surface/subsurface water inflow/infiltration. The drainfield horizontal setback requirements are in accordance with Rule .1970 for a TS-I or TS-II system.

3. All Amphidrome pretreatment systems shall be installed according to directions provided by the manufacturer in the "Installation Manual" and instructions found on F. R. Mahony & Associates CAD drawings and specifications for each system. Additionally, all Amphidrome pretreatment systems and components used with, but not manufactured by F. R. Mahony & Associates, Inc., shall be installed in accordance with all applicable regulations and manufacturer instructions.
4. All individuals/companies installing Amphidrome pretreatment systems shall be in possession of all necessary permits and licenses before attempting any portion of an installation.
5. Watertightness of the tanks and any dosing tanks shall be demonstrated by a 24-hour leakage test conducted at the installation site. A water level change of 1/2 inch or more, within a 24" riser, over 24 hours, or visual observation of leakage shall be cause for failure of the watertightness test. Initial water level shall be to 2" above the riser/adapter seam.
6. The Amphidrome reactor and all connections shall be watertested prior to backfilling and again after backfilling around the reactor is completed.
7. An F. R. Mahony & Associates, Inc. certified system operator shall startup the Ampidrome unit for each installation and shall provide an acceptance letter to the LHD prior to issuance of the operation permit.
8. Specified site preparation steps and construction specifications for the ground absorption system shall be strictly adhered to, including specified depth of trenches in relation to site limiting conditions.
9. Prior to Operation Permit issuance, the final Health Department construction inspection shall include at least the following checks:
  - a. The health department shall observe the watertightness testing.
  - b. The health department staff shall press the "Push to Silence" button for 15 seconds to enable test mode. Then the health department shall test the pump float alarm.
  - c. Record the pump model.
  - d. Check to ensure vents are installed.
  - e. Check the hydraulics of the overall system.
  - f. Check that the riser hatches have tamperproof bolts and/or riser lock ring.
10. Each Amphidrome control panel shall have a label as shown in Attachment A.
11. Prior to the issuance of an Operation Permit, the manufacturer or manufacturer's representative shall provide an acceptance letter to the local health department verifying satisfactory installation and operation measures.

## **F. OPERATION, MAINTENANCE AND TESTING**

1. System classification, management and inspection shall be in accordance with Rules .1961 and .1970.
2. All F. R. Mahony & Associates Amphidrome Pretreatment Systems require an operation and maintenance agreement between the system owner and F. R. Mahony & Associates, Inc., or its authorized representative is required, as per Rule .1970. The system shall be inspected by a certified Subsurface Operator. The Certified Operator shall be either an employee of F. R. Mahony & Associates, Inc. or authorized in writing by F. R. Mahony & Associates, Inc. to operate and maintain the system. The operator must have proper equipment and training to access and program the control panels on site.
3. Amphidrome pretreatment systems shall be classified at a minimum as a Type Va system according to Table V(a) of Rule. 1961(b).
4. All Amphidrome pretreatment systems shall be operated and maintained according to the latest version of F. R. Mahony & Associates, Inc.'s O&M manual.
5. At each Amphidrome pretreatment system inspection the Operator in Responsible Charge (ORC) shall, at a minimum, observe, monitor, and record:
  - a. wastewater level in the tanks,
  - b. operation of the Amphidrome reactor, with emphasis on even air distribution during normal operation and during a backwash cycle,
  - c. watertightness of tanks, risers and pipe connections at tanks,
  - d. operation of pumps, floats, valves, electrical controls and alarms,
  - e. pumping frequency from pump impulse counters and elapsed run time meters,
  - f. the Amphidrome pretreatment system for any structural damage, accessibility, adequate ventilation, excess odors, ponding of effluent, insect infestations, vegetative growth over the drainfield, the drainfield area for surfacing of effluent, and a sample of Amphidrome pretreatment effluent collected from the sampling point to check for effluent clarity and odor, and
  - g. the pump cycle and run time meters and any water meter readings.
6. At least once per year the ORC shall, at a minimum, measure and report to the health department:
  - a. sludge and scum levels in the anoxic tank,
  - b. sludge level and grease presence in the clear well tank (if any),
  - c. drainfield pump delivery rate (drawdown test), and
  - d. drainfield dosing volume and measure or calculate average pump run time.

7. The ORC shall also conduct other additional observations, measurements, monitoring, and maintenance activities as specified in the Operation Permit and as recommended by the manufacturer.

8. Sampling and Testing

- a. All sampling shall be done in accordance with Rule .1970(n).
- b. All systems shall be tested for effluent CBOD<sub>5</sub>, TSS, NH<sub>4</sub>-N, and fecal coliforms. Influent shall be tested for BOD<sub>5</sub> and TKN. TS-II system effluent shall be additionally tested for TN.
- c. Influent samples shall be taken from the inlet end of the anoxic tank.
- d. Effluent samples for drip disposal systems or other pressurized dispersal systems shall be collected from a tap on the drainfield forcemain (prior to spin filters for drip systems). The preferred location of the tap is in the pump tank discharge assembly. The sample shall not commence until at least 30 seconds of continuous discharge through the sample tap has been completed.

9. Notification and Performance of Maintenance and Repairs

- a. The ORC shall alert F. R. Mahony & Associates and the system owner in a timely fashion of needed maintenance or repair activities including, but not limited to, landscaping, tank sealing, tank pumping, pipe or control system repairs, media replacement, and adjustments to any other system component.
- b. The septic tank will be pumped as needed upon recommendation of the ORC and in accordance with the Amphidrome Treatment System Operation & Maintenance Manual. However, at a minimum, the septic tank will be pumped whenever the solids level exceeds 25% of the tank's total liquid working capacity or the scum layer is more than 4 inches thick.
- c. The ORC shall notify the system owner, F. R. Mahony & Associates, and the local health department whenever the pump delivery rate efficiency or average pump run time are not within 25% of initial measurements conducted prior to system startup. System troubleshooting and needed maintenance shall be provided to maintain the pump delivery rate and average pump run time within 25% of initial measurements conducted during system startup.

10. Reporting

- a. The ORC shall provide a completed written report to F. R. Mahony & Associates, the system owner, and the local health department within 30 days after each required visit. At a minimum this report shall specify:
  - (1) the date and time of inspection,
  - (2) system operating conditions observed according to F.5, above,
  - (3) system operating conditions measured according to F.6 and F.7 above,
  - (4) results from any laboratory analysis of any effluent samples,



- (5) maintenance activities performed since the last inspection report,
  - (6) an assessment of overall system performance,
  - (7) a list of any improvements or maintenance needed; and,
  - (8) a determination of whether the system is malfunctioning, and the specific nature of the malfunction.
- b. Proposal for Evaluation and Reporting.
- (1) The manufacturer shall maintain a contract for evaluation of the performance of the controlled demonstration wastewater system with an independent third party laboratory, consultant, or other entity that has expertise in the evaluation of wastewater system and that is approved by the Department (Victor D'Amato with Arcadis Engineering and/or approved alternate). The third party shall review the site-specific sampling and flow-monitoring protocol, collect and analyze the ORC inspection reports, sampling and monitoring data, and prepare Semi-Annual Reports summarizing all data for all the sites. These reports are due by January 31 and July 31 of each year, and shall include all data gathered through December 31 and June 30 of the previous six-month period, respectively. These reports shall provide information to the Department based upon the monitoring data and observations made from the Controlled Demonstration systems installed pursuant to this Approval. This should include an assessment of system performance in relation to the established treatment performance standards; an assessment of physical and chemical properties of the materials used to construct the system, in terms of strength, durability, and chemical resistance to loads and conditions experienced; recommended areas of applicability for the system; and any conditions and limitations related to the use of the system.
  - (2) Upon completion of the research and testing protocol, and prior to completing any application by F. R. Mahony & Associates, to the State for reclassification of the Amphidrome Pretreatment System as an Innovative System, and within a maximum of five years of the effective date of the first Controlled Demonstration System Operation Permit (CDSOP) issued pursuant to this approval, the approved third party shall prepare a Final Report to the State that includes the results from all of the systems installed during the Controlled Demonstration, including sampling results, flow-monitoring information, ORC reports, etc., and provide recommendations on future use of the system. The Final Report shall be in electronic format and may be published on the On-Site Water Protection Section's website without confidentiality. The contents of the interim and final reports shall not be altered from the original document without approval from F. R. Mahony & Associates.
  - (3) The research and testing protocol that has been agreed to is as follows:
    - (a) All systems will be sampled quarterly.
    - (b) A minimum of 50 data points is required, including data from a minimum of 15 sites, with a minimum of two data sets per site collected over at least a 12-month period.
    - (c) For coastal resort communities, the two samples shall take place between June 1 and Labor Day weekend of each year. The samples must be taken at least

six weeks apart. Other seasonal homes shall be sampled during the times of greatest use.

- (d) A copy of the sample results will be provided to the On-Site Water Protection Section after the analyses directly from the laboratory.
- (e) The State of North Carolina and F. R. Mahony & Associates agree that any systems that are out of compliance due to owner intervention, i.e. excessive flows, chemical disposal, or high strength waste, etc., shall not be considered in the Controlled Demonstration approval and any test results from those systems shall not be held against F. R. Mahony & Associates.

11. Effluent Quality, System and Site Compliance. Compliance of each site and the system shall be in accordance with requirements set forth in Rule .1970. Consideration shall be given for the system to be reclassified as an approved Innovative system when the requirements of Rule .1969(g)(2) for "Fast Track" approval and system compliance requirements of Rule .1970(o)(2) have been met.

## **H. RESPONSIBILITIES AND PERMITTING PROCEDURES**

1. Prior to the installation of an Amphidrome pretreatment system at a site, the owner or owner's agent shall notify the local health department of their proposed use of such a system. The local health department shall issue an Improvement Permit or Authorization to Construct or amend a previously issued Improvement Permit or Authorization to Construct allowing for the use of up to 200 Amphidrome pretreatment systems statewide upon a finding that all provisions of this Approval and all other applicable rules are met. Use of the proposed Controlled Demonstration System and any conditions shall be described in the Improvement Permit and Authorization to Construct or amended Improvement Permit and Authorization to Construct, as well as described on the Operation Permit to be issued upon the acceptable completion of the system installation. **Notification of the issuance of all Operation Permits by the local health department pursuant to this Controlled Demonstration Approval shall be submitted to the On-Site Water Protection Section.**
2. Prior to the issuance of the Improvement Permit, the site shall be evaluated by a Licensed Soil Scientist and a written, sealed report provided to the local health department, as required pursuant to Rule .1970. The local health department may request the assistance of their Regional Soil Specialist in evaluating this report prior to Improvement Permit issuance.
3. When a special site evaluation is required pursuant to Rule .1970(p)(1), the report shall contain the information as specified in Rule .1970(p)(2).
4. Design responsibility: Prior to the issuance of an Authorization to Construct for a F. R. Mahony & Associates Amphidrome pretreatment system, a submission prepared by a North Carolina Professional Engineer and a Licensed Soil Scientist, as applicable, shall

be submitted for review and approval by the local health department. Approval shall be contingent upon the following:

- a. Site-specific design for the pretreatment system including the Amphidrome pretreatment system with approved tankage, and sampling point.
  - b. Site-specific soils report is provided as applicable.
  - c. The drainfield dosing tank and drainfield layout may be completed by either the local health department or the Certified Designer/Professional Engineer.
  - d. All design submittals shall be accompanied by a letter from F. R. Mahony & Associates or its North Carolina authorized representative.
5. It is recommended that local authorized environmental health practitioners attend a design training session offered by the manufacturer prior to permitting the system. Also, at the request of the local health department, your Regional Engineer will review the design.
6. The F. R. Mahony & Associates, authorized installer must certify in writing that the system was installed in accordance with the approved design prior to Operation Permit issuance. A professional engineer shall certify in writing that the system was installed in accordance with the approved plans and specifications prior to Operation Permit issuance. For sites required to be evaluated by a Licensed Soil Scientist or Professional Geologist (see Section H.2, above), the health department may specify as a condition on the Improvement Permit and Authorization to Construct that a Licensed Soil Scientist or Professional Geologist oversee critical phases of the drainfield installation and certify in writing that the installation was in accordance with their specified site/installation requirements prior to the Operation Permit issuance.
7. The operator shall be present during initial system commissioning. The ORC shall be certified both as a NC Subsurface Operator and an authorized F. R. Mahony & Associates Treatment System Operator.

## **I. REPAIR OF SYSTEMS**

The provisions of 15A NCAC 18A .1961 (c) shall govern the use of the Amphidrome Pretreatment System for repairs to existing malfunctioning wastewater systems.

Approved By: \_\_\_\_\_ Date: \_\_\_\_\_

**Attachment A**

Label is 4.75" long by 1.5" tall.

**NON-TYPICAL SEPTIC SYSTEM  
AMPHIDROME CONTROLLED  
DEMONSTRATION  
SUBSURFACE WW OPERATOR NAME  
AND CONTACT INFORMATION**