REQUEST FOR BOARD ACTION

ITEM NO. 23.

DATE OF MEETING: December 9, 2013

REQUESTED BY: Kyle M. Breuer, Director, Planning & Community Development Department

SHORT TITLE: Public Hearing and Resolution Requesting Approval of a Special Use Permit for the Construction and Operation of a Sewage Treatment Facility (NAICS 221320).

BACKGROUND: Pluris Hampstead, LLC, applicant, on behalf of Pender 1164, owner, is requesting approval of a Special Use Permit for a Sewage Treatment Facility (NAICS 221320). The property is located approximately 1.3 miles west of US Highway 17 and approximately 1.0 miles northeast of the New Hanover County line and may be identified by Pender County PIN 3271-25-1909-0000. The property is zoned PD, Planned Development District and a Sewage Treatment Facility is permitted via Special Use Permit.

SPECIFIC ACTION REQUESTED: To hold a public hearing and consider the approval of a Special Use Permit for the construction and operation of a Sewage Treatment Facility.

RESOLUTION

NOW, THEREFORE, BE IT RESOLVED by the Pender County Board of Commissioners that:

on December 9, 2013 the Pender County Board of Commissioners (approved, modified, denied) a Special Use Permit (SUP) for a Sewage Treatment Facility (NAICS 221320) as described herein. The Chairman/County Manager is authorized to execute any documentation necessary to implement this resolution.

AMENDMENTS:

MOVED _____ SECONDED _____

APPROVED_____DENIED_____UNANIMOUS_____

YEA VOTES: Brown_____ McCoy_____ Tate_____ Ward _____ Williams_____

_____ 12/09/2013
George R. Brown, Chairman Date

_____ 12/09/2013 _____
ATTEST DATE

PLANNING STAFF REPORT
Special Use Permit

SUMMARY:

Hearing Date: December 9, 2013
Case Number: 11070 – Pluris
Applicant: Maurice Gallarda – Pluris Hampstead, LLC
Property Owner: Pender 1164, LLC

Land Use Proposed: The applicant is requesting the approval of a Special Use Permit (SUP) for the construction and operation of a Sewage Treatment Facility (NAICS 221320), as defined in the Pender County Unified Development Ordinance:

SEWAGE TREATMENT FACILITY: Any device or system used in the storage, treatment, disposal or reclamation of sewage and industrial wastes generated by more than two uses or dwellings.

Property Record Number and Location: The property is located approximately 1.3 miles west of US Hwy 17 and approximately 1.0 miles northeast of the New Hanover County line and may be identified as Pender County PIN 3271-25-1909-0000. There is one tract associated with this request totaling approximately 38.08 acres.

Zoning District of Property: The property is currently zoned PD, Planned Development, and Sewage Treatment Facilities are permitted via SUP in the PD zoning district.

PROJECT DESCRIPTION:

Pluris Hampstead, LLC, applicant, on behalf of Pender 1164, owner, is requesting approval of a Special Use Permit for a Sewage Treatment Facility (WWTF), classified by NAICS 221320, on approximately 38.08 acres. The WWTF is being proposed to be constructed in several separate phases and will collect, treat, and disperse effluent for the future development of the subject tract as well as for the immediate region surrounding the property, treating up to three (3) million gallons of effluent per day (mgd).

The WWTF is being proposed to be located along the northeastern boundary of the ±500 acre tract owned by Pender 1164, LLC. The tract will then be subdivided for the WWTF on approximately 38 acres. The 38 acres will contain the WWTF, associated equipment and groundwater impoundment basins for the treated effluent. It is being proposed that the project will be built in three (3) separate phases as demand increases for wastewater services. The first phase will include treatment capacity for up to 100,000 gallons per day (gpd). Based off of service demand, the second phase of the project will include another 100,000 gpd, following with future expansions up to three million mgd.

According to the applicant's submitted site plan and narrative, the project will be required to provide for at least a two hundred (200') foot buffer from all property lines. This buffer is required for the WWTF and all associated equipment utilized in the process. Within the 200' buffer, the project will also have to comply with Pender County's prescribed buffer and landscaping standards as outlined in the Unified Development Ordinance (UDO). The site plan depicts Buffer A and C types to satisfy this requirement.

As proposed, the WWTF will utilize membrane bioreactor (MBR) technology (see Exhibit 1-EPA Fact Sheet), which is a high level of treatment "tertiary". As stated in the submitted narrative, "tertiary treatment is considered an advanced treatment and is able to remove more than 99 percent of all the impurities from wastewater. This results in a water quality approaching that of drinking water standards". Furthermore, it is stated that "the process does not cause odor or noise issues to neighboring properties", this should be demonstrated by the applicant based off of proposed distance and buffer requirements as it is proposed that equipment in the form of sound dampening devices will be utilized for blowers and other normally loud equipment.

During the wastewater treatment process, the treated effluent will be disposed of on-site through high-rate infiltration basins. The basins will be surrounded by a subsurface ground water underdrain. The outfall of this underain will be directed to a ground water impoundment. It's stated that the impoundment will be used as a source of reuse water to serve the development and community with non-potable water for landscape irrigation and other uses. The applicant should demonstrate that the treated effluent does not have to be disposed of through landscape irrigation or other uses if the soils have been saturated due to heavy rain events and would not have to be hauled off of the treatment site to be disposed of at off-site locations.

Access to the site will be provided through "Hogan's Trail" which is an 18' wide gravel easement accessing Sidbury Road (SR 1572). It has been stated that this easement, upon future development of the overall 500 acres will be brought up to Pender County standards which will require design and construction to NCDOT secondary road standards. It is not anticipated that the WWTF will require frequent vehicular access; it will be limited to site contractors and the utility provider personnel for continuous monitoring activities.

According to the submitted site plan, the tract does contain Federal jurisdictional 404 wetlands. These areas are not proposed to be impacted by the WWTF or any of the equipment and effluent areas associated with the facility.

According to the 2007 Flood Insurance Rate Maps (FIRMs), there is no regulated Special Flood Hazard Areas (SFHA) located within the project area.

As a proposed public utility provider, the applicant will be governed by the North Carolina Utilities Commission (NCUC) who regulates the rates and services of all public utilities in North Carolina. On a case-by-case basis, the applicant plans on applying to the NCUC for new franchise or service areas in which to serve with waste water utilities. Each service area to be added to the applicant's responsibility must receive approval through the NCUC. In order to demonstrate appropriate land use patterns and growth associated with sewer service availability, a proposed condition has been drafted to allow for a consistency statement to be issued by the County prior to application to NCUC for

future service areas. This will assure that the proposed infrastructure extensions are consistent with the adopted Pender County Comprehensive Plan as well as any Planning Board recommended or approved projects and Board of County Commissioner approvals.

EVALUATION:

A) ***Public Notifications:*** Public Notice of the proposal for map change has been advertised in the Pender-Topsail Post and Voice. Adjacent property owners have been given written notice of the request, as well as a sign placed near the subject property.

B) ***Basis for Granting SUP:*** See Attachment A for approval procedures (§3.12.3 G of the Pender County Unified Development Ordinance) and revocation, expiration and revision procedures (§3.12.4.B, C, and H of the Pender County Unified Development Ordinance (UDO).

C) ***Unified Development Ordinance Compliance:*** The property is currently zoned PD, Planned Development District, and according to the Pender County Unified Development Ordinance, § 5.2.3, Table of Permitted Uses; Sewage Treatment Facilities (NAICS 221320) are permitted via Special Use Permit (SUP) in the RA District.

D) ***2010 Comprehensive Land Use Plan Compliance***: This property is located within the Coastal Pender Study Area and the 2010 Comprehensive Land Use Plan classifies the subject property as Mixed Use. The Mixed Use land use classification designates locations where a mixture of higher density/intensity uses is to be encouraged. The Coastal Pender area and designated land use classifications support the availability of public water and sewer services.

Water and sewer improvements are necessary for property to be developed to urban densities. Extensions of water and sewer lines significantly affect the timing and density of development and it is imperative that land use and utility extensions be coordinated in order to achieve the desired land use patterns identified in the Comprehensive Land Use Plan. Through utility planning, development required to use public water and sewer will occur in a more orderly pattern adjacent to existing developed areas.

a. Water and Sewer Goal 2A.1: Manage the timing, location and intensity of growth by locating water and sewer improvements in accordance with the Comprehensive Land Use Plan and Water and Wastewater Master Plans.

b. Policy 2A.1.2: Allow the use of package treatment plants only in areas where development is desirable but public sewer service is not feasible. If package treatment plants are used they should be designed to enable, at minimum public cost, the conversion of the system to public ownership, operation and maintenance in the future when public sewer service is viable, and cost effective.

E) ***Existing Land Use In Area:*** The project site is bounded to the north, northeast, south, and southeast by vacant timber/forestry tracts. The tract is bounded to the east by low density single family and a mix of non-residential uses with US 17 road frontage.

F) ***Site Access Conditions: Site Access Conditions:*** The property has access via an easement known as Hogan's Trail, an 18' wide gravel drive. Hogan's trail has direct access to Sidbury Road (SR 1572).

G) ***Conditions To Approval of Petition:***

1. County review of expanded service areas shall be required to demonstrate consistency with the goals and priorities of the comprehensive plan. A consistency determination should be issued by the Planning and Community Development Department prior to application being made to the State Utilities Commission. This may be in the form of staff approval of a specific project or Board (Planning Board/Board of County Commissioners) approval, dependent upon review criteria outlined in the Pender County Unified Development Ordinance (as amended).
2. The sewage treatment facility and associated infrastructure shall be built in accordance with all applicable local, state, and federal regulations. The treatment facility and associated infrastructure should be designed and constructed for the conversion of the system to public ownership, operation and maintenance should the system be accepted by the County.
3. Service areas requested by the applicant to the Public Utilities Commission should be non-exclusive service areas to allow for Pender County Utilities to provide service along the applicant's force main locations.
4. No junk, debris trash or inoperable vehicles, recycled or salvaged materials shall be stored on the site outside a completely enclosed building.
5. No project activity shall commence on the site including clearing and grading until a Final Zoning Permit has been issued.
6. No permanent personnel occupancy on-site will be allowed.
7. All operations must follow federal, state, and local standards, regulations, ordinances, permits, statutes, and/or laws.

Attachment A

3.12.1 Procedures for Reviewing Applications

G. The Board of Commissioners shall approve, modify, or deny the application for a Special Use Permit. In approving a Special Use Permit, the Board of Commissioners, with due regard to the nature and state of all adjacent structures and uses in the district within same is located, shall make written findings that the following are fulfilled:

1) The use requested is listed among the special uses in the district for which application is made, or is similar in character to those listed in that district;
2) The requested use will not impair the integrity or character of the surrounding or adjoining districts, nor adversely affect the safety, health, morals, or welfare of the community or of the immediate neighbors of the property;
3) The proposed use shall not constitute a nuisance or hazard;
4) The requested use will be in conformity with the Pender County Land Use Plan and other official plans or policies adopted by the Board of County Commissioners;
5) Adequate utilities, access roads, drainage, sanitation or other necessary facilities have been or are being provided;
6) That adequate measures have been or will be taken to provide ingress and egress so designed as to minimize the traffic congestion in the public roads;
7) That the special use shall, in all other respects, conform to the applicable regulations of the district in which it is located; and
8) The proposed use shall not adversely affect surrounding uses and shall be placed on a lot of sufficient size to satisfy the space requirements of said use.

3.12.4 General Provisions Concerning Special Use Permits

B. Revocation - In any case where the Special Use Permit or the conditions of a Special Use Permit have not been or are not being complied with, the Administrator may initiate a notice of violation for the provisions of this Ordinance and the conditions of the Special Use Permit not in compliance or the Administrator, may initiate notice of a public hearing to consider revocation of the permit by the Board of Commissioners or both actions may be initiated. Procedures for notice of such hearing shall be the same as procedures for consideration of an initial application for a Special Use Permit and the permittee shall be notified. After a public hearing has been held, the Board of Commissioners may revoke the Special Use Permit upon finding any of the following:

1) That the approval was obtained by fraud.
2) That the use for which such approval was granted is not being executed.
3) That the use for which such approval was granted has ceased to exist or has been suspended for one year.
4) That the permit granted is being, or recently has been exercised contrary to the terms or conditions of such approval.
5) That the permit granted is in violation of an Ordinance or Statute.

6) That the use for which the approval was granted was so exercised as to be detrimental to the public health or safety, or so as to constitute a nuisance.

C. Expiration - Unless a request for additional time is granted or approved otherwise as a condition of the permit, a Special Use Permit shall expire and become void if final Zoning Approval has not been issued for the project within 24 months after the Notice of Approval of the Special Use Permit has been served on the applicant. The Administrator may provide one extension of the expiration date by no more than 6 months, for complex projects requiring major state or federal permits, upon receipt of a written request for such extension by the applicant detailing the reasons for delay in completion of the requirements for the Zoning Approval.

H. Revisions - Major revisions to a Special Use Permit must be submitted to the Board of Commissioners. All legal notice and application fee requirements must be met for major revisions. Revisions that are considered minor revisions to an approved Special Use Permit may be reviewed and approved by the Administrator after basic submission requirements have been completed. All revisions approved by the Administrator must meet the original conditions of the permit as approved by the County Commissioners and current provisions of the Zoning Ordinance. The addition of an accessory structure less than 1000 sq. ft., addition of parking or other ancillary facilities or uses or the addition of similar product lines are examples of revisions that may be considered minor revisions.

Pender County
Planning and Community Development

Planning Division
805 S. Walker Street
PO Box 1519
Burgaw, NC 28425

Phone: 910-259-1202
Fax: 910-259-1295
www.pendercountync.gov

SPECIAL USE PERMIT APPLICATION

GENERAL

1. An applicant shall be required to schedule a pre-submittal meeting with the Administrator at least thirty (30) days prior to submission of an application.
2. Any information the applicant wishes to submit to assist in making the above findings may be included as part of the Project Narrative or as a supplement labeled "Support Information-Required Findings" (max. 1 page).
3. Where construction, location or relocation is proposed to be done upon a residence, place of business or place of public assembly, no permit required for electrical, plumbing, heating, air conditioning or other construction, *location or relocation activity under any provision of general or special law* shall be issued until an authorization for wastewater system construction has been issued under G.S. 130A-336 or authorization has been obtained under G.S. 130A-337(c).

APPROVAL STANDARDS

The Board of Commissioners shall approve, modify, or deny the application for a Special Use Permit. In approving a Special Use Permit, the Board of Commissioners, with due regard to the nature and state of all adjacent structures and uses in the district within same is located, shall make written findings that the following are fulfilled:

1. The use requested is listed among the special uses in the district for which application is made, or is similar in character to those listed in that district;
2. The requested use will not impair the integrity or character of the surrounding or adjoining districts, nor adversely affect the safety, health, morals, or welfare of the community or of the immediate neighbors of the property;
3. The proposed use shall not constitute a nuisance or hazard;
4. The requested use will be in conformity with the Pender County Land Use Plan and other official plans or policies adopted by the Board of County Commissioners;
5. Adequate utilities, access roads, drainage, sanitation or other necessary facilities have been or are being provided;
6. That adequate measures have been or will be taken to provide ingress and egress so designed as to minimize the traffic congestion in the public roads;
7. That the special use shall, in all other respects, conform to the applicable regulations of the district in which it is located; and
8. The proposed use shall not adversely affect surrounding uses and shall be placed on a lot of sufficient size to satisfy the space requirements of said use.

Conditions and Guarantees - Prior to the granting of any special use, the Board of Commissioners may stipulate such conditions and restrictions upon the establishment, location, or construction, maintenance, and operation of the special use as it deems necessary for the protection of the public and to secure compliance with the standards and requirements specified in this ordinance. In all cases in which special uses are granted, the Board of Commissioners shall require such evidence and guarantees as it may deem necessary to assure that conditions stipulated in connection therewith are being and will be complied with.

APPLICATION FOR SPECIAL USE PERMIT

THIS SECTION FOR OFFICE USE			
Application No.	SUP 11070	**Date**	10/18/2013
Application Fee	$ 638 10/100	**Receipt No.**	132342
Pre-Application Conference	5/8/2013	**Hearing Date**	12/9/2013

SECTION 1: APPLICANT INFORMATION

Applicant's Name:	Maurice Gallarda, Pluris Hampstead, LLC	**Owner's Name:**	Pender 1164, LLC2100 McKinney Ave
Applicant's Address:	2100 McKinney Ave.	**Owner's Address:**	1202 Eastwood Rd.
City, State, & Zip	Dallas, TX 75201	**City, State, & Zip**	Wilmington, NC 28403
Phone Number:	214-220-3412	**Phone Number:**	910-799-8755

Legal relationship of applicant to land owner:

SECTION 2: PROJECT INFORMATION

Property Identification Number (PIN):	3271-25-1909-0000	**Total property acreage:**	38.08
Zoning Classification:	PD	**Acreage to be disturbed:**	10.87
Project Address :	Island Creek Rd	**NAICS Code:**	221320
Description of Project Location:	500 AC PB 40/75 Jack Stocks Division Near the corner of Hwy 17 and Sidbury Rd. in Scotts Hill.		
Describe activities to be undertaken on project site:	Applicant proposes the construction of a wastewater treatment facility.		

SECTION 3: SIGNATURES

Applicant's Signature		**Date:**	10.11.13
Owner's Signature		**Date:**	10/15/13

NOTICE TO APPLICANT

1. Applicant must also submit the information described on the Special Use Checklist.
2. Applicant or agent authorized in writing must attend the public hearing.
3. Once the public hearing has been advertised, the case will be heard unless the applicant withdraws the application or unless the Board of Commissioners or other authorized person agrees to table or delay the hearing.
4. Applicant may wish to review the required findings for approval of a Special Use Permit found on page 1 of this application
5. **Permit will become void after 12 months if a final zoning permit is not obtained, unless specifically requested at the time of public hearing.**

Office Use Only

☑ **General/** Fees: $300 +$10 per acre over 5 acres, Max. of $5,000 ☐ **Tower over 75 Feet/** Fees $500 ☐ **Minor Revisions /**Fees $100 ☐ **Mining** Fees $750	**Total Fee Calculation: $** 630.10 **Application#:** 1108 **Date of Hearing:** 12/9/2013

Attachments Included with Application: (Please include # of copies)

CD /other digital version	☐ Y ☑ N	Plan Sets 20	# of large 2	# of 11X17 20	Other documents/Reports	☑ Y ☐ N	

Payment Method:	**Cash :** ☐ $_____	**Credit Card:** ☐ Master Card ☐ Visa	**Check:** ☑ Check # 1474

Application received by: [signature] Date: 10/18

Application completeness approved by: [signature] Date: 10/18

Special Use Permit Checklist

☐	Signed Application Form (Both Applicant and Owner)
☐	Application fee
☐	Legible list of all property owners adjacent to the property upon which the use is to be located. The list shall include the mailing address & physical address of these property owners (The application will not be advertised for public hearing until the list is accurate & complete
☐	One business size envelope legibly addressed with first class postage for each of the adjacent property owners on the above list.
☐	Project Narrative--Written description of the project (max of 3 pages) including the following: ☐ Location of the project and type of access to project site ☐ Detailed description of the activities to be undertaken on the site, including hrs. of operation, # of employees, etc. ☐ Description of all construction activities to be undertaken on the site ☐ Describe type of utilities that will serve project and status of approval from applicable providers ☐ List of all state and federal permits that will be required for the project ☐ Applicant must specifically address the 8 written findings for Special Use Permit approval which are identified on page 1 of this application and in the Pender County Unified Development Ordinance (Section 3.12.3.G.). Describe any potential impacts the project will have on the community or adjacent properties such as traffic, noise, etc. and explain efforts to mitigate these impacts. The applicant may also wish to describe any positive benefits the project will provide for the community and/or neighbors of the project.
☐	Project Map(s)--Map or maps of the special use project site with boundaries of the project if less than the parcel boundaries. This map or maps shall be drawn to a readable scale. The scale shall be not more than 200' to the inch. The map shall display an accurate bar graph scale, date prepared, north arrow and the author of the map. This map(s) shall show the following: ☐ Boundaries of the property upon which the special use will be located, the acreage in the property and project site, with a north arrow and bar graph. ☐ Access from the site and/or project boundaries to the nearest publicly maintained road. ☐ Location of any existing structures or uses on the property and within 50' of the property. ☐ Location of the project boundaries if they do not coincide with the property boundaries. ☐ Existing and proposed structures, other on-site improvements, and location of all activities associated with the use, location of well, septic tank, and/or other utilities. ☐ Boundary of all clearing, grading, and/or land disturbing activities on the site and the calculated acreage of all land disturbing activities on the site. ☐ Parking, loading areas, and access to the project (See Article 7, Pender County UDO) ☐ Landscaping and buffering (See Article 8, Pender County UDO) ☐ All signs to be located on the property (See Article 10, Pender County UDO) ☐ Pedestrian walks, area lighting and flood lighting. ☐ Existing natural features of the site including, wooded areas, tree lines, ponds, streams, other water bodies or ditches on or adjacent to the site, designated flood hazard areas & known or designated wetlands on the site. ☐ Drainage plan and/or direction of flow of runoff from the project and site. ☐ After review by the Planning and Community Development Department, additional information may be required to be submitted. ☐ Two full size and twenty reduced size (max. 11"x17") copies of this map(s) shall be submitted.

RETURN COMPLETED APPLICATION TO:
Pender County Planning & Community Development
P.O. Box 1519
Burgaw, NC 28425

Print Form

Michael C. Gallant PE, PA
Engineering / Consulting / Design

PLURIS HAMPSTEAD SPECIAL USE PERMIT NARRATIVE

Project Name
Pluris Hampstead, LLC WWTF

Applicant Information

Pluris Hampstead LLC
2100 McKinney Ave.
Suite 1550
Dallas, TX 75201

Location and Access

The project is located on a tract of land owned by Pender 1164, LLC. The tract is interior to the northwest of the intersection of Highway 17 and Sidbury Road in the Scotts Hill area of southeastern Pender County. The tract under consideration represents 38.08 acres of the 500+ acre project to be developed by the owner. The tract will be dedicated by the owner to Pluris Hampstead, LLC upon the approval of this Special Use Permit application.

The tract is presently accessed by Hogans Trail, a soil road that intersects with Sidbury Road. Hogans Trail will be improved in accordance with the Master Plan for the development. The tract can also be accessed by an easement from Highway 17.

Description of Onsite Activities

The applicant will construct and operate a waste water treatment facility ("WWTF") on the site. The facility will utilize membrane bioreactor ("MBR") technology to treat waste water. The resulting effluent will be disposed of on-site using high rate infiltration ("HRI") basins. The basins will be surrounded by a subsurface ground water underdrain. The outfall of this underdrain will be directed to a ground water impoundment. This impoundment will be used as a source of reuse water to serve the development and community with non-potable water for landscape irrigation and other uses. It is the intention of the applicant to furnish this resource to Scotts Hill and/or other local Sewer Districts in a bulk fashion to reduce and thus conserve the use of potable water for non-potable uses.

In order to meet the sanitary sewer demands of the surrounding community the applicant will design, construct and expand the MBR WWTF to keep pace with the demand. The initial plan illustrates a footprint for one 100,000 gallon per day system with room for a future 100,000 gallon per day train. The plan also designates areas for future infrastructure with the goal of accommodating between 2 and 3 million gallons per day of treatment and disposal on site. The plan calls for phases with the first two phases adding 100,000 gallons of treatment for each phase. Several additional phases will increase capacity up to 3 million gallons of treatment. The phased approach is welcomed by the North Carolina Utility Commission ("NCUC"), the state agency governing rates charged by utilities to customers. The phased approach is also accepted by the North Carolina Department of Environment and Natural Resources ("NCDENR"), the state agency governing the quality of water in treatment.

Pluris Hampstead, LLC will be required to make application to both of the aforementioned agencies and receive approvals from both before commencing construction of the MBR WWTF.

gallantmc@yahoo.com

tel 910.448.1046

P. O. Box 4039
Surf City, NC 28445

Michael C. Gallant PE, PA
Engineering / Consulting / Design

MBR treatment allows for a very high level of treatment ("tertiary") with a very small footprint. There are three levels of wastewater treatment and include in order - primary, secondary, and tertiary. Tertiary treatment is considered an advanced treatment and is able to remove more than 99 percent of all the impurities from wastewater. This results in a water quality approaching that of drinking water standards.The process does not cause odor or noise issues to neighboring properties. Unlike typical biological waste water treatment systems, the process is not prone to upsets and physically filters effluent so that pollutants are not allowed to enter the effluent stream. Pluris, LLC, an affiliate to the applicant designed built a 1 million gallon per day MBR WWTP facility in Sneads Ferry in 2011 and the plant is operating as designed.

Any and all residual bio-solids will be hauled off site for land application by a State of North Carolina licensed contract hauler. Unlike the Northside Plant in Wilmington, near the airport that is known for a distinct odor, bio-solids stored on site while waiting to be hauled will be processed in an aerobic digester. The Northside Plant in Wilmington utilizes anaerobic digestion which produces methane which is the source of the odor problems.

Noise from the plant will be controlled by the use of sound attenuating enclosures for blowers and other normally loud equipment.

Construction of the facility will involve grading of the basins and impoundments and construction of the plant infrastructure. Please note that the setback distance required by the NCDENR for all treatment units is 200 feet from any property line.

Compliance with Official Plans and Policies

In regards to the Pender County Comprehensive Land Use Plan, this special use permit is supported by Section 2, specifically Policies 2.A.1.3-4. These policies call for the limited construction of "package systems" by minimizing infrastructure duplication and encourage the development of utilities to serve currently underserved areas.

This application is compliance with and is supported by the Pender County Comprehensive Land Use Plan by encouraging smart growth, enabling environmentally responsible development of the area, and removing the need for future package system. In all probability, some development now served by package systems will inquire to connect to the proposed system.

This application is also supported by the Pender County Wastewater Master Plan. On page I-4 under the heading of treatment the plan calls for the construction of facilities on the "Sidbury" property in the Scotts Hill area. Specifically, the plan calls for several phases of expansion to eventually reach the 3 million gallons of treatment a day planned.

Required Permits and Approvals

The project will first have to be granted a special use permit by the Pender County Board of Commissioners. Following that approval, the applicant will proceed with design and permitting of the plant through the NCDENR. In addition the project will have to apply and receive storm water and erosion control permits through the NCDENR. No wetlands are to be impacted or disturbed for this project.

gallantmc@yahoo.com

tel 910.448.1046

P. O. Box 4039
Surf City, NC 28445

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Engineering / Consulting / Design

In addition to environmental requirements imposed by the NCDENR, Pluris Hampstead, LLC will be required to make an application before the NCUC in establishing any service area and to receive approval in order to charge customers for wastewater services.

Impact to the Community

Due to the remoteness and small footprint of an MBR WWTP facility, the impact on the immediate property adjacent to the project will be negligible. Due to the high level of treatment and production of reuse water for landscaping, the proposed system is a model of sustainable development. The goal of the applicant is to serve the sanitary wastewater needs of the community and produce a needed resource of reuse water, which conserves potable water at the same time.

The impact on the greater Hampstead area will allow for development of areas that were previously unsuitable for septic systems. The MBR WWTP facility will also allow customers who connect on to recapture land previously used for on-site treatment systems.

Unlike some private firms in the industry, Pluris Hampstead, LLC intends to own and operate the facilities after construction. Pluris Hampstead, LLC seeks to be a part of the community and provide an environmentally responsible method for treatment disposal and reuse of one of the region's most precious resources - water.

The economic impact from the availability of wastewater service in the region will allow for growth, bringing additional revenues to Pender County as well as needed jobs in the construction and service industries.

gallantmc@yahoo.com

tel 910.448.1046

P. O. Box 4039
Surf City, NC 28445

EPA
United States
Environmental Protection
Agency

Wastewater Management Fact Sheet
Membrane Bioreactors

INTRODUCTION

The technologies most commonly used for performing secondary treatment of municipal wastewater rely on microorganisms suspended in the wastewater to treat it. Although these technologies work well in many situations, they have several drawbacks, including the difficulty of growing the right types of microorganisms and the physical requirement of a large site. The use of microfiltration membrane bioreactors (MBRs), a technology that has become increasingly used in the past 10 years, overcomes many of the limitations of conventional systems. These systems have the advantage of combining a suspended growth biological reactor with solids removal via filtration. The membranes can be designed for and operated in small spaces and with high removal efficiency of contaminants such as nitrogen, phosphorus, bacteria, biochemical oxygen demand, and total suspended solids. The membrane filtration system in effect can replace the secondary clarifier and sand filters in a typical activated sludge treatment system. Membrane filtration allows a higher biomass concentration to be maintained, thereby allowing smaller bioreactors to be used.

APPLICABILITY

For new installations, the use of MBR systems allows for higher wastewater flow or improved treatment performance in a smaller space than a conventional design, i.e., a facility using secondary clarifiers and sand filters. Historically, membranes have been used for smaller-flow systems due to the high capital cost of the equipment and high operation and maintenance (O&M) costs. Today however, they are receiving increased use in larger systems. MBR systems are also well suited for some industrial and commercial applications. The high-quality effluent produced by MBRs makes them particularly applicable to reuse applications and for surface water discharge applications requiring extensive nutrient (nitrogen and phosphorus) removal.

ADVANTAGES AND DISADVANTAGES

The advantages of MBR systems over conventional biological systems include better effluent quality, smaller space requirements, and ease of automation. Specifically, MBRs operate at higher volumetric loading rates which result in lower hydraulic retention times. The low retention times mean that less space is required compared to a conventional system. MBRs have often been operated with longer solids residence times (SRTs), which results in lower sludge production; but this is not a requirement, and more conventional SRTs have been used (Crawford et al. 2000). The effluent from MBRs contains low concentrations of bacteria, total suspended solids (TSS), biochemical oxygen demand (BOD), and phosphorus. This facilitates high-level disinfection. Effluents are readily discharged to surface streams or can be sold for reuse, such as irrigtion.

The primary disadvantage of MBR systems is the typically higher capital and operating costs than conventional systems for the same throughput. O&M costs include membrane cleaning and fouling control, and eventual membrane replacement. Energy costs are also higher because of the need for air scouring to control bacterial growth on the membranes. In addition, the waste sludge from such a system might have a low settling rate, resulting in the need for chemicals to produce biosolids acceptable for disposal (Hermanowicz et al. 2006). Fleischer et al. 2005 have demonstrated that waste sludges from MBRs can be processed using standard technologies used for activated sludge processes.

MEMBRANE FILTRATION

Membrane filtration involves the flow of water-containing pollutants across a membrane. Water permeates through the membrane into a separate channel for recovery (Figure 1). Because of the cross-flow movement of water and the waste constituents, materials left behind do not accumulate at the membrane surface but are carried out of the system for later recovery or disposal. The water passing through the membrane is called the *permeate*, while the water with the more-concentrated materials is called the *concentrate* or *retentate*.

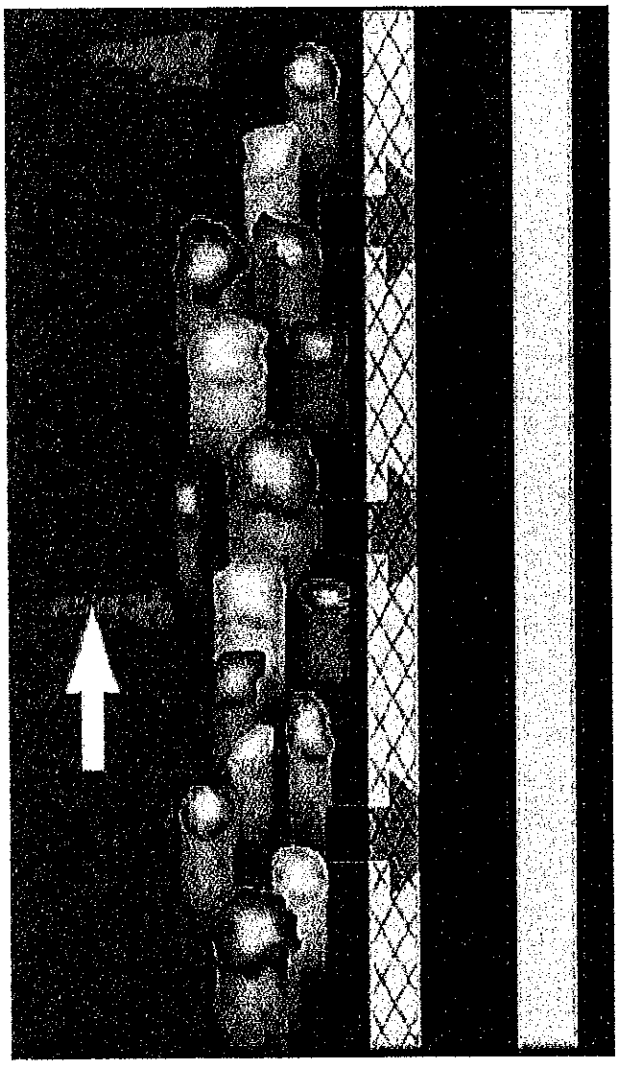

Figure 1. Membrane filtration process (Image from Siemens/U.S. Filter)

Membranes are constructed of cellulose or other polymer material, with a maximum pore size set during the manufacturing process. The requirement is that the membranes prevent passage of particles the size of microorganisms, or about 1 micron (0.001 millimeters), so that they remain in the system. This means that MBR systems are good for removing solid material, but the removal of dissolved wastewater components must be facilitated by using additional treatment steps.

Membranes can be configured in a number of ways. For MBR applications, the two configurations most often used are hollow fibers grouped in bundles, as shown in Figure 2, or as flat plates. The hollow fiber bundles are connected by manifolds in units that are designed for easy changing and servicing.

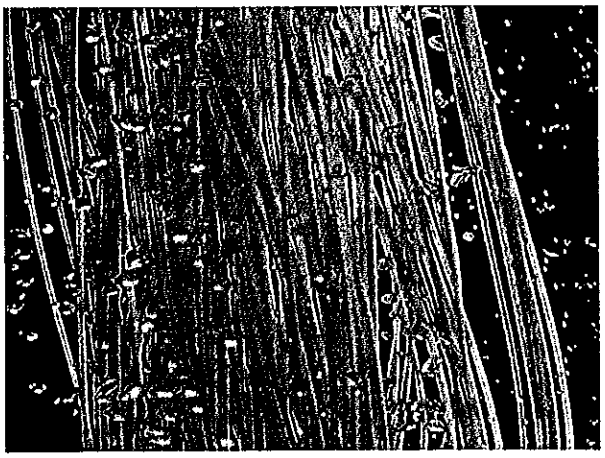

Figure 2. Hollow-fiber membranes (Image from GE/Zenon)

DESIGN CONSIDERATIONS

Designers of MBR systems require only basic information about the wastewater characteristics, (e.g., influent characteristics, effluent requirements, flow data) to design an MBR system. Depending on effluent requirements, certain supplementary options can be included with the MBR system. For example, chemical addition (at various places in the treatment chain, including: before the primary settling tank; before the secondary settling tank [clarifier]; and before the MBR or final filters) for phosphorus removal can be included in an MBR system if needed to achieve low phosphorus concentrations in the effluent.

MBR systems historically have been used for small-scale treatment applications when portions of the treatment system were shut down and the

wastewater routed around (or bypassed) during maintenance periods.

However, MBR systems are now often used in full-treatment applications. In these instances, it is recommended that the installation include one additional membrane tank/unit beyond what the design would nominally call for. This "N plus 1" concept is a blend between conventional activated sludge and membrane process design. It is especially important to consider both operations and maintenance requirements when selecting the number of units for MBRs. The inclusion of an extra unit gives operators flexibility and ensures that sufficient operating capacity will be available (Wallis-Lage et al. 2006). For example, bioreactor sizing is often limited by oxygen transfer, rather than the volume required to achieve the required SRT—a factor that significantly affects bioreactor numbers and sizing (Crawford et al. 2000).

Although MBR systems provide operational flexibility with respect to flow rates, as well as the ability to readily add or subtract units as conditions dictate, that flexibility has limits. Membranes typically require that the water surface be maintained above a minimum elevation so that the membranes remain wet during operation. Throughput limitations are dictated by the physical properties of the membrane, and the result is that peak design flows should be no more than 1.5 to 2 times the average design flow. If peak flows exceed that limit, either additional membranes are needed simply to process the peak flow, or equalization should be included in the overall design. The equalization is done by including a separate basin (external equalization) or by maintaining water in the aeration and membrane tanks at depths higher than those required and then removing that water to accommodate higher flows when necessary (internal equalization).

Design Features

Pretreatment

To reduce the chances of membrane damage, wastewater should undergo a high level of debris removal prior to the MBR. Primary treatment is often provided in larger installations, although not in most small to medium sized installations, and is not a requirement. In addition, all MBR systems require 1- to 3-mm-cutoff fine screens immediately before the membranes, depending on the MBR manufacturer. These screens require frequent cleaning. Alternatives for reducing the amount of material reaching the screens include using two stages of screening and locating the screens after primary settling.

Membrane Location

MBR systems are configured with the mem-

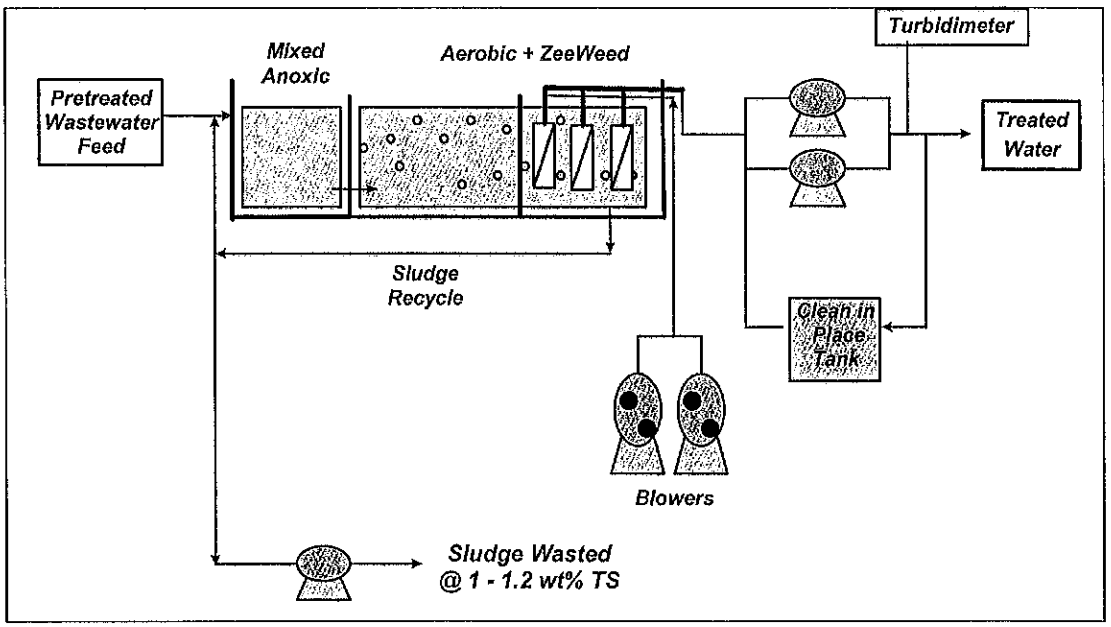

Figure 3. Immersed membrane system configuration (Image from GE/Zenon)

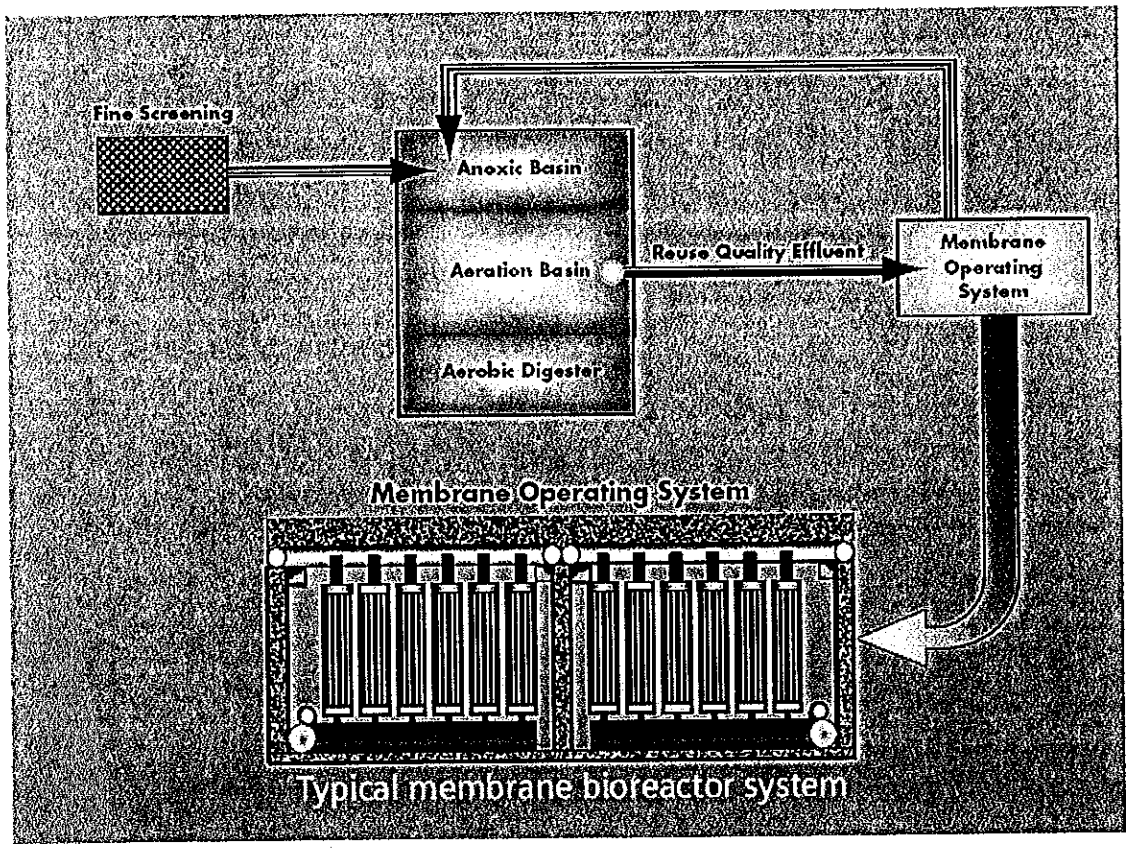

Figure 4. External membrane system configuration (Image from Siemens/U.S. Filter)

branes actually immersed in the biological reactor or, as an alternative, in a separate vessel through which mixed liquor from the biological reactor is circulated. The former configuration is shown in Figure 3; the latter, in Figure 4.

Membrane Configuration

MBR manufacturers employ membranes in two basic configurations: hollow fiber bundles and plate membranes. Siemens/U.S.Filter's Memjet and Memcor systems, GE/Zenon's ZeeWeed and ZenoGem systems, and GE/Ionics' system use hollow-fiber, tubular membranes configured in bundles. A number of bundles are connected by manifolds into units that can be readily changed for maintenance or replacement. The other configuration, such as those provided by Kubota/Enviroquip, employ membranes in a flat-plate configuration, again with manifolds to allow a number of membranes to be connected in readily changed units. Screening requirements for both systems differ: hollow-fiber membranes typically require 1- to 2-mm screening, while plate membranes require 2- to 3-mm screening (Wallis-Lage et al. 2006).

System Operation

All MBR systems require some degree of pumping to force the water flowing through the membrane. While other membrane systems use a pressurized system to push the water through the membranes, the major systems used in MBRs draw a vacuum through the membranes so that the water outside is at ambient pressure. The advantage of the vacuum is that it is gentler to the membranes; the advantage of the pressure is that throughput can be controlled. All systems also include techniques for continually cleaning the system to maintain membrane life and keep the system operational for as long as possible. All the principal membrane systems used in MBRs use an air scour technique to reduce buildup of material on the membranes. This is done by blowing air around the membranes out of the manifolds. The GE/Zenon systems use air scour, as well as a back-pulsing technique, in which permeate is occasionally pumped back

into the membranes to keep the pores cleared out. Back-pulsing is typically done on a timer, with the time of pulsing accounting for 1 to 5 percent of the total operating time.

Downstream Treatment

The permeate from an MBR has low levels of suspended solids, meaning the levels of bacteria, BOD, nitrogen, and phosphorus are also low. Disinfection is easy and might not be required, depending on permit requirements..

The solids retained by the membrane are recycled to the biological reactor and build up in the system. As in conventional biological systems, periodic sludge wasting eliminates sludge buildup and controls the SRT within the MBR system. The waste sludge from MBRs goes through standard solids-handling technologies for thickening, dewatering, and ultimate disposal. Hermanowicz et al. (2006) reported a decreased ability to settle in waste MBR sludges due to increased amounts of colloidal-size particles and filamentous bacteria. Chemical addition increased the ability of the sludges to settle. As more MBR facilities are built and operated, a more definitive understanding of the characteristics of the resulting biosolids will be achieved. However, experience to date indicates that conventional biosolids processing unit operations are also applicable to the waste sludge from MBRs.

Membrane Care

The key to the cost-effectiveness of an MBR system is membrane life. If membrane life is curtailed such that frequent replacement is required, costs will significantly increase. Membrane life can be increased in the following ways:

- Good screening of larger solids before the membranes to protect the membranes from physical damage.

- Throughput rates that are not excessive, i.e., that do not push the system to the limits of the design. Such rates reduce the amount of material that is forced into the membrane and thereby reduce the amount that has to be removed by cleaners or that will cause eventual membrane deterioration.

- Regular use of mild cleaners. Cleaning solutions most often used with MBRs include regular bleach (sodium) and citric acid. The cleaning should be in accord with manufacturer-recommended maintenance protocols.

Membrane Guarantees

The length of the guarantee provided by the membrane system provider is also important in determining the cost-effectiveness of the system. For municipal wastewater treatment, longer guarantees might be more readily available compared to those available for industrial systems. Zenon offers a 10-year guarantee; others range from 3 to 5 years. Some guarantees include cost prorating if replacement is needed after a certain service time. Guarantees are typically negotiated during the purchasing process. Some manufacturers' guarantees are tied directly to screen size: longer membrane warranties are granted when smaller screens are used (Wallis-Lage et al. 2006). Appropriate membrane life guarantees can be secured using appropriate membrane procurement strategies (Crawford et al. 2002).

System Performance

Siemens/U.S. Filter Systems

Siemens/U.S.Filter offers MBR systems under the Memcor and Memjet brands. Data provided by U.S. Filter for its Calls Creek (Georgia) facility are summarized below. The system, as Calls Creek retrofitted it, is shown in Figure 5. In essence, the membrane filters were used to replace secondary clarifiers downstream of an Orbal oxidation ditch. The system includes a fine screen (2-mm cutoff) for inert solids removal just before the membranes.

The facility has an average flow of 0.35 million gallons per day (mgd) and a design flow of 0.67 mgd. The system has 2 modules, each containing 400 units, and each unit consists of a cassette with manifold-connected membranes. As shown in Table 1, removal of BOD, TSS, and ammonia-nitrogen is excellent; BOD and TSS in the effluent are around the detection limit. Phosphorus is also removed well in the system, and the effluent

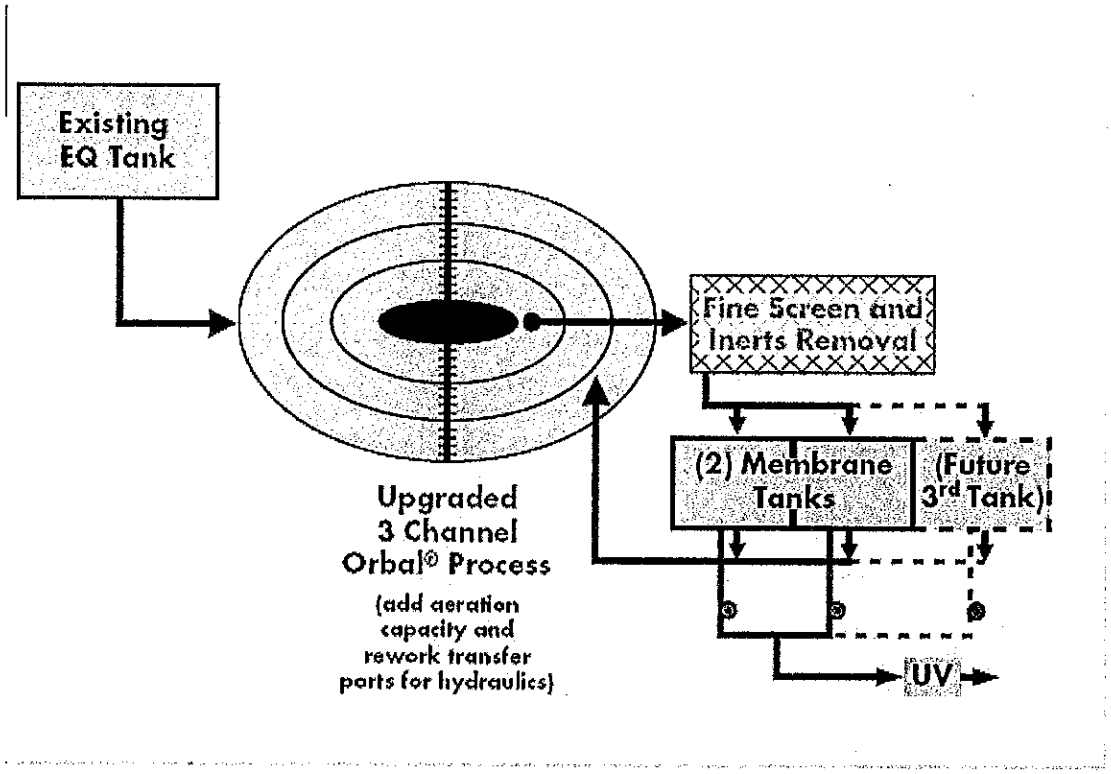

Figure 5. Calls Creek flow diagram (courtesy of Siemens/U.S. Filter)

Table 1.
Calls Creek results 2005

Parameter	Influent	Effluent		
	Average	Average	Max Month	Min Month
Flow (mgd)	0.35	--	0.44	0.26
BOD (mg/L)	145	1	1	1
TSS (mg/L)	248	1	1	1
Ammonia-N (mg/L)	14.8	0.21	0.72	0.10
P (mg/L)	0.88	0.28	0.55	0.12
Fecal coliforms (#/100 mL)	--	14.2	20	0
Turbidity (NTU)	--	0.30	1.31	0.01

has very low turbidity. The effluent has consistently met discharge limits.

Zenon Systems

General Electric/Zenon provides systems under the ZenoGem and ZeeWeed brands. The ZeeWeed brand refers to the membrane, while ZenoGem is the process that uses ZeeWeed.

Performance data for two installed systems are shown below.

Cauley Creek, Georgia. The Cauley Creek facility in Fulton County, Georgia, is a 5-mgd wastewater reclamation plant. The system includes biological phosphorus removal, mixed liquor surface wasting, and sludge thickening using a ZeeWeed system to minimize the required volume of the aerobic digester, according to information provided by GE. Ultraviolet disinfection is employed to meet regulatory limits. Table 2 shows that the removal for all parame-

Table 2.
Cauley Creek, Georgia, system performance

Parameter	Influent	Effluent		
	Average	Average	Max Month	Min Month
Flow (mgd)	4.27	--	4.66	3.72
BOD (mg/L)	182	2.0	2.0	2.0
COD (mg/L)	398	12	22	5
TSS (mg/L)	174	3.2	5	3
TKN (mg/L)	33.0	1.9	2.9	1.4
Ammonia-N (mg/L)	24.8	0.21	0.29	0.10
TP (mg/L)	5.0	0.1	0.13	0.06
Fecal coliforms (#/100 mL)	--	2	2	2
NO3-N (mg/L)	--	2.8		

ters is over 90 percent. The effluent meets all permit limits, and is reused for irrigation and lawn watering.

Traverse City, Michigan. The Traverse City Wastewater Treatment Plant (WWTP) went through an upgrade to increase plant capacity and produce a higher-quality effluent, all within the facility's existing plant footprint (Crawford et al. 2005). With the ZeeWeed system, the facility was able to achieve those goals. As of 2006, the plant is the largest-capacity MBR facility in North America. It has a design average annual flow of 7.1 mgd, maximum monthly flow of 8.5 mgd, and peak hourly flow of 17 mgd. The membrane system consists of a 450,000-gallon tank with eight compartments of equal size. Secondary sludge is distributed evenly to the compartments. Blowers for air scouring, as well as permeate and back-pulse pumps, are housed in a nearby building.

Table 3 presents a summary of plant results over a 12-month period. The facility provides excellent removal of BOD, TSS, ammonia-nitrogen, and phosphorus. Figure 6 shows the influent, effluent, and flow data for the year.

Operating data for the Traverse City WWTP were obtained for the same period. The mixed liquor suspended solids over the period January to August averaged 6,400 mg/L, while the mixed liquor volatile suspended solids averaged 4,400 mg/L. The energy use for the air-scouring blowers averaged 1,800 kW-hr/million gallons (MG) treated.

Costs

Capital Costs

Capital costs for MBR systems historically have tended to be higher than those for conventional systems with comparable throughput because of the initial costs of the membranes. In certain situations, however, including retrofits, MBR systems can have lower or competitive capital costs compared with alternatives because MBRs have lower land requirements and use smaller tanks, which can reduce the costs for concrete. U.S. Filter/Siemen's Memcor package plants have installed costs of $7–$20/gallon treated.

Fleischer et al. (2005) reported on a cost comparison of technologies for a 12-MGD design in Loudoun County, Virginia. Because of a chemical oxygen demand limit, activated carbon adsorption was included with the MBR system. It was found that the capital cost for MBR plus granular activated carbon at $12/gallon treated was on the same order of magnitude as alternative processes, including multiple-point alum addition, high lime treatment, and post-secondary membrane filtration.

Operating Costs

Operating costs for MBR systems are typically higher than those for comparable conventional systems. This is because of the higher energy

Table 3.
Summary of Traverse City, Michigan, Performance Results

Parameter	Influent	Effluent		
	Average	Average	Max Month	Min Month
Flow (mgd)	4.3	--	5.1	3.6
BOD (mg/L)	280	< 2	< 2	< 2
TSS (mg/L)	248	< 1	< 1	< 1
Ammonia-N (mg/L)	27.9	< 0.08	< 0.23	< 0.03
TP (mg/L)	6.9	0.7	0.95	0.41
Temperature (deg C)	17.2	--	23.5	11.5

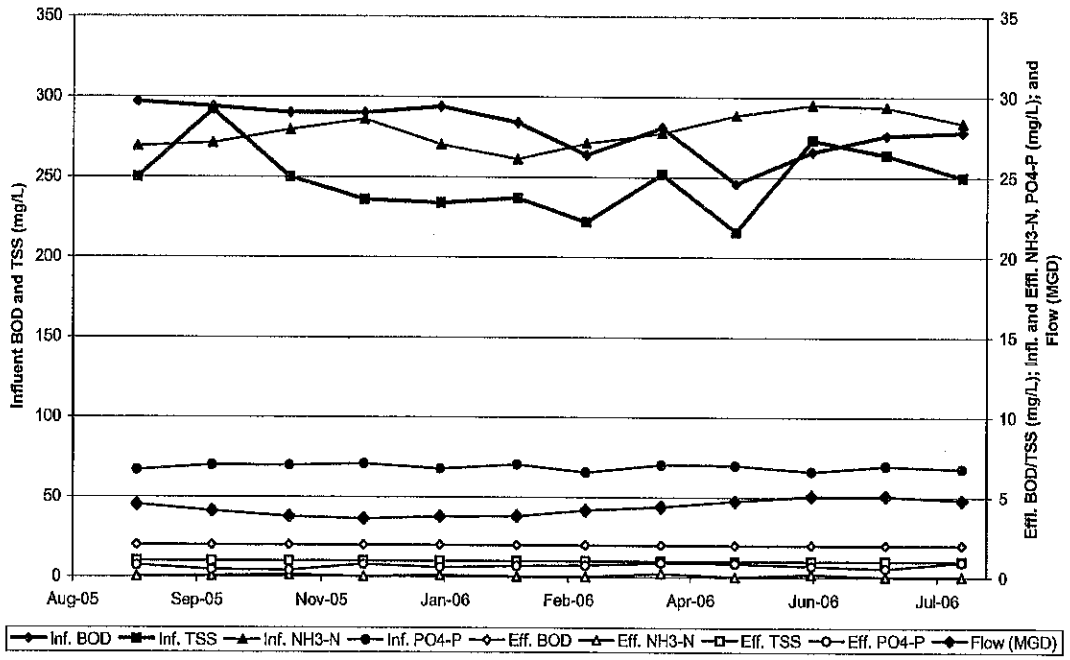

Figure 6. Performance of the Traverse City plant

costs if air scouring is used to reduce membrane fouling. The amount of air needed for the scouring has been reported to be twice that needed to maintain aeration in a conventional activated sludge system (Scott Blair, personal communication, 2006). These higher operating costs are often partially offset by the lower costs for sludge disposal associated with running at longer sludge residence times and with membrane thickening/dewatering of wasted sludge.

Fleischer et al. (2005) compared operating costs. They estimated the operating costs of an MBR system including activated carbon adsorption at $1.77 per 1,000 gallons treated. These costs were of the same order of magnitude as those of alternative processes, and they compared favorably to those of processes that are chemical-intensive, such as lime treatment.

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