

Appendix K

Technical Memo –Water Reuse Systems

(May 26, 2016, Revised June 22, 2016)

Memorandum

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Subject **Town of Orleans, MA
Water Quality and Wastewater Planning
Task Number 1 - Facilities Engineering
Deliverable 1c.12 – Final Technical Memorandum on Water Reuse Systems**

Project Number 60476644

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Date 05/26/16 (Revised 06/22/16)

1. Background

The use of treated wastewater, also known as reclaimed water, recycled water, or effluent reuse water, is a supply of water for use in non-potable applications, including irrigation, industrial uses, toilet flushing, and aquifer recharge. The use of reclaimed water can satisfy many water demands but in many cases requires an enhanced or higher level of treatment where there is a greater chance of human exposure.

Reclaimed water can provide many advantages, particularly for proposed large-scale water use operations and to reduce impacts to environmentally sensitive areas. This includes locations where raw water supplies are limited, water infrastructure does not exist, and water quantity is not available. In addition, in many cases, cost effective water reuse systems allow business and industry to operate and expand at lower cost, and reduced water demand results in healthier rivers, streams, and lakes for recreation and wildlife.

An integral part of any Water Quality and Wastewater Planning program that includes the collection, treatment and disposal of wastewater effluent is the consideration of including effluent reuse. MassDEP requires that the effluent disposal system be capable of disposing of 100 percent of the wastewater effluent and therefore, reuse does not reduce the requirements for treated wastewater disposal at sites that have limited capacity. The reuse of treated wastewater requires a higher level of treatment but results in a reduced demand on municipal water supply systems and can enhance recycling of the nutrients remaining after treatment.

This Technical Memorandum discusses the current Massachusetts Department of Environmental Protection (MassDEP) Reuse Regulations; Advantages and Disadvantages of effluent reuse; Examples of Reclaimed Water in Massachusetts; Potential of Reclaimed Water Use in Orleans; and Conclusions and Recommendations.

2. Regulations

A. General

The Massachusetts Department of Environmental Protection (MassDEP) regulates the use of reclaimed water under 314 CMR 20.00: Reclaimed Water Permit Program and Standards. The regulations were established to regulate and permit reclaimed water systems including the requirements for the use, sale, distribution, and offering for use, sale, and distribution of reclaimed water. In general, the regulations allow for reclaimed water reuse for the following uses although other uses may be permissible:

- Irrigation as a source of water for recreational use;
- Industrial or commercial cooling, air conditioning, or boiler feed;
- Toilet and urinal flushing;
- Agricultural use;
- Creation of wetlands;
- Commercial (ie. laundries, carwashes, snowmaking);
- Miscellaneous (ie fire protection, dust control, soil compaction, street cleaning); and
- Aquifer recharge.

The regulations do not allow for reclaimed water to be used as follows:

- Used or distributed in a manner within the Zone I of a public water supply well, the Zone A of a surface water source for a public water system, or within 100 feet of a private water supply well.
- Used or distributed in a manner that will cause or contribute to violations of the Massachusetts Surface Water Quality Standards, or impair the use of the ground water as an actual or potential source of potable water.
- Used or distributed in a manner that causes the water quality of any public source of potable water or private source of water used for drinking, domestic or culinary purposes.

MassDEP regulations state that in order to meet the EPA Class I Reliability Standards (EPA-430-99-74-001 – Design Criteria for Mechanical, Electrical, and Fluid System and Component Reliability), the wastewater treatment facilities have to be designed to include the following components:

- Two independent and separate sources of power, with the backup source sufficient to operate all vital components during peak flow conditions, together with critical lighting and ventilation;
- Unit redundancy;
- Additional storage or bypass to a discharge site; and

- Sufficient inventory of spare equipment and parts to minimize the time period that treatment facility operations are off-line.

B. Classes

The regulations establish three classes of reclaimed water reuse identified as Class A, Class B and Class C.

1) Class A

- a) Uses** - Class A reclaimed water may be used for any activity for which Class B reclaimed water or Class C reclaimed water and for the following additional activities:
- Irrigation at locations where individual members of the public are likely to come into contact with the reclaimed water, including, without limitation:
 - Golf courses;
 - Parks and playgrounds;
 - Landscaping around schools, colleges, and universities;
 - Landscaping around residential and mixed-use developments;
 - Athletic fields;
 - Cemeteries;
 - Highway rest areas; and
 - Non-residential developments, such as office complexes, public buildings, hotels, motels, and commercial malls.
 - Cooling Water used for industrial or commercial cooling or air conditioning where aerosols or other mists are created, including, without limitation, cooling towers, evaporative condensers, or spray mechanisms. When a cooling system uses Class A reclaimed water in conjunction with an air conditioning facility that utilizes a cooling tower or otherwise creates a mist that may come into contact with employees or members of the public, the cooling system shall comply with the following:
 - Drift eliminator shall be used whenever the cooling system is in operation; and
 - Chlorine or other biocide shall be used to treat the cooling system recirculating water to minimize the growth of Legionella and other microorganisms.

- Toilet and Urinal Flushing used for toilet flushing in commercial, institutional, and industrial facilities and buildings, including hotels and motels. Class A reclaimed water may also be used for toilet and/or urinal flushing in barracks, jails, prisons, reformatories, and residential developments other than single family homes, town houses, and two- and three-family homes where the residents have access to the plumbing facilities for repairs or modification. All facilities using Class A reclaimed water for toilet and/or urinal flushing shall comply with the Massachusetts Uniform State Plumbing Code.
 - Agricultural Use used for food crop irrigation where there is contact between the reclaimed water and the edible portion of the crop.
 - Industrial Process Water used as industrial process water where inhalation or contact is possible.
 - Commercial Laundries and Carwashes.
 - Snowmaking.
 - Fire Protection.
 - Creation of Wetlands and Recreational Impoundments. Discharge of treated wastewater to an existing surface water or wetland requires a Surface Water Discharge Permit and does not involve the reuse of reclaimed water.
- b) Effluent Limits** - The following effluent limits apply to all Class A reclaimed water. The compliance point(s) are after the final treatment process and prior to the point of discharge:
- pH = 6.5-8.5;
 - BOD < 10 mg/l;
 - TSS < 5 mg/l;
 - Total Nitrogen < 10 mg/l;
 - Turbidity < average of 2 NTU within a 24-hour period, cannot exceed five NTU more than 5 percent of the time within a 24-hour period, and cannot exceed ten NTU at any time;
 - Median of no detectable fecal coliform/100 ml over continuous seven-day sampling periods, not to exceed 14/100 ml in any one sample; and
 - Other parameters as specified by MassDEP.

2) Class B

a) Uses - Class B reclaimed water may be used for any activity for which Class C reclaimed water and for the following additional activities:

- Irrigation used for at locations where individual members of the public are not likely to come into contact with the reclaimed water, including, without limitation, the following:
 - Ornamental nursery stock and sod farms where access by the general public is restricted; and
 - Landscaped areas associated with highways, other than highway rest areas, including, without limitation, median strips and shoulders.
- Cooling Water used for industrial or commercial cooling or air conditioning where aerosols or other mist are not created;
- Agricultural Use used to provide irrigation for the following agricultural uses:
 - Irrigation on land used as pasture for milking animals; and
 - Irrigation of unprocessed food crops where there is no contact between the reclaimed water and the edible portion of the crop.
- Dust Control;
- Soil Compaction;
- Mixing Concrete and Washing Aggregate; and
- Street Cleaning.

b) Effluent Limits - The following effluent limits apply to all Class B reclaimed water. The compliance point(s) shall be after the final treatment process and prior to the point of discharge:

- pH = 6.5-8.5;
- BOD < 30 mg/l;
- TSS < 10 mg/l;
- Total Nitrogen < 10 mg/l;
- Median of 14 detectable fecal coliform/100 ml over continuous 7-day sampling periods, not to exceed 100/100 ml in any one sample; and
- Other parameters as specified by MassDEP.

3) Class C

a) Uses - Class C reclaimed water may be used for the following activities:

- Agricultural used for orchard and vineyard irrigation where there is no contact between the reclaimed water and the edible portion of the crop, and for processed food crops that, prior to sale to the public or others, undergo chemical or physical commercial processing sufficient to kill pathogens;
- Industrial Process Water in a closed system where there is no worker contact;
- Industrial Boiler Feed; and
- Silviculture.

b) Effluent Limits - The following effluent limits apply to all Class C reclaimed water. The compliance point(s) are after the final treatment process and prior to the point of discharge.

- pH = 6.5-8.5;
- BOD < 30 mg/l;
- TSS < 30 mg/l;
- Total Nitrogen < 10 mg/l;
- Median of 200 detectable fecal coliform/100 ml; and
- Other parameters as specified by MassDEP.

3. Advantages and Disadvantages

The following summarizes some advantages and disadvantages of reclaimed water use.

A. Advantages

1. Reduces demand on the municipal water supply system;
2. Provides an increment of supply for growing communities in stressed basins;
3. Provides an option for wastewater disposal;
4. Provides a cost-effective supply for industrial users with large-scale demand for non-potable water, for industrial uses, cooling water, or toilet flushing;
5. Reduces the impact of large developments;
6. Decreases the diversion of freshwater from sensitive ecosystems;
7. Reduces or eliminates treated wastewater discharges into sensitive water bodies;
8. Creates or enhances wetlands and stream habitats; and

- 9. Reduces reliance on commercial fertilizers to the extent that nitrogen and phosphorus in the reclaimed water can offset current uses on irrigated surfaces.

It should be noted that Item 3, Item 7 and Item 9 are the most relevant to the Town of Orleans.

B. Disadvantages

- Increased public education required
- Increases capital costs including additional equipment (ie. pumps, tanks, analyzers, etc.) as well as distribution piping for the reuse system;
- Increases operation and maintenance costs including additional equipment (ie. pumps, tanks, analyzers, etc.) required to be operated and maintained;
- Increases monitoring costs including additional monitoring for reuse facilities above and beyond the normal WWTF monitoring and reporting process;
- Increases level of oversight to ensure that reclaimed water is not used for inappropriate purposes so that the reuse that is permitted for a specific purpose is not used for another purpose without an increase in treatment (ie Class C – Boiler Feed and then used for Class A Snowmaking).; and
- Adds legal and administrative costs related to customer agreements. and

4. Examples of Reclaimed Water in Massachusetts

A. Yarmouth-Dennis Septage Treatment Facility, Yarmouth, MA

The Yarmouth-Dennis Septage Treatment Facility provides septage treatment, effluent disposal at the Buck Island Road Spray Irrigation Site and reuse on Holes 2 through 8 at the Links at Bayberry Hills Golf Course. Both sites are only permitted to be used seasonally - April 1 through November 31 of each year.

- Service Date: 1992 and 2001 (Effluent Reuse).
- Wastewater Treatment Capacity: 110,000 gallons per day (ADF) with 10.5 million gallon effluent storage tank.
- Wastewater Treatment Process: Sequential Batch Reactors followed by Tertiary Treatment.
- Reclaimed Water Use: Golf Course Irrigation and Groundwater Recharge.

B. Wrentham Premium Outlet Mall, Wrentham, MA

Wrentham Premium Outlet Mall provides wastewater treatment and reuse for its outlet center, food court, mall management offices, and restaurants located in Wrentham, MA. The system reduces the strain on the Town's water supply system and provides a recycle water supply.

- Service Date: 1997.
- Wastewater Treatment Capacity: 100,000 gallons per day (ADF).

- Wastewater Treatment Process: Membrane Bioreactors with Ultraviolet Disinfection with blue dye added to enhance appearance.
- Reclaimed Water Use: Toilet-flushing (75 percent) and Groundwater Recharge (25 percent).

C. New Seabury Properties, LLC, Mashpee, MA

New Seabury Properties, LLC provides wastewater treatment and reuse to serve its resort community located in Mashpee, MA which reduces the strain on the Town's water supply system, and provides a recycled water supply.

- Service Date: 2001.
- Wastewater Treatment Capacity: 300,000 gpd (ADF).
- Wastewater Treatment Process: Rotating Biological Contactors followed by Denitrification Filters with Ultraviolet Disinfection.
- Reclaimed Water Use: Aquifer Recharge and Golf Course Irrigation.

D. EMC Corporation, Hopkinton, MA

EMC Corporation provides wastewater treatment and reuse for two large engineering facilities located at its Hopkinton, MA headquarters. The system reduces the strain on the Town's water supply system and provides a recycled water supply during the summer peak use periods.

- Service Date: 2000.
- Wastewater Treatment Capacity: 83,500 gallons per day (ADF) – 11,000 gpd used for reuse..
- Wastewater Treatment Process: Sequential Batch Reactors followed by Tertiary Treatment with Ultraviolet Disinfection.
- Reclaimed Water Use: Toilet-flushing (95 percent) and Industrial Cooling (5 percent).

E. Gillette Stadium, Foxborough, MA

The New England Patriots provides wastewater treatment and reuse at the Patriots' 68,000-seat Gillette Stadium located in Foxborough, MA. The system reduces the strain from the Town's water supply system and provides a recycled water supply for use during various events held at the stadium.

- Service Date: 2002.
- Wastewater Treatment Capacity: 250,000 gpd (ADF) and expandable to 1.1M gpd (ADF).
- Wastewater Treatment Process: Membrane Bioreactors with Ultraviolet Disinfection and ozonation, and 500,000 gallon Reuse Storage Tank.
- Reclaimed Water Use: Toilet-flushing.

F. Linden Ponds Retirement Community, Hingham, MA

Erickson Retirement Communities provides wastewater treatment and reuse for its Linden Ponds Retirement Community located in Hingham, MA. The system reduces the strain on the Town's water supply system and provides a recycle water supply.

- Service Date: 2004.
- Wastewater Treatment Capacity: 306,000 gallons per day (ADF).
- Wastewater Treatment Process: Sequential Batch Reactors followed by denitrification filters with Ultraviolet Disinfection.
- Reclaimed Water Use: Aquifer Recharge and Golf Course Irrigation.

5. Potential of Reclaimed Water Use in Orleans**A. General**

Previous reports have been developed for the Town and have indicated that the use of reclaimed water should be considered as a viable enhancement to the Town's Water Quality and Wastewater Program for various reasons including:

- Reduces demand on the municipal water supply system;
- Decreases the diversion of freshwater from sensitive ecosystems;
- Reduces or eliminates treated wastewater discharges into sensitive water bodies;
- Reduces reliance on commercial fertilizers to the extent that nitrogen and phosphorus in the reclaimed water can offset current uses on irrigated surfaces;
- Peak wastewater and septage flows occur during the summer months that corresponds to the peak irrigation demand of local agricultural and recreational facilities; and
- Recharges the Cape's sole source aquifer.

B. Locations¹

The most recent document indicates that the theoretical demand of reclaimed water for irrigation approaches 460,000 gpd (69 MG / 150 irrigation days). These potential irrigation sites included:

- Ocean Edge Golf Course – 15 MG annual demand;
- Captain Golf Courses (Port Course and Starboard Course) – 30 MG annual demand;
- Wequassett Resort and Golf Club - 15 MG annual demand;
- Orleans Cemetery - 3 MG annual demand;

¹ Conceptual Reclaim Water System Memorandum by Stantec dated October 17, 2014

- Orleans Athletic Fields on Eldredge Park Way – 3 MG annual demand; and
- Brewster Athletic Fields on Freemans Way (4 fields) – 3 MG annual demand.

The document indicated that a reclaimed water system would include a pumping system, storage tank and distribution network and has an “order of magnitude” cost of about \$12,000,000 as shown below.

Reclaim Water Pumping system	\$100,000
Reclaim Water Storage Tank	\$500,000
Reclaim Water Distribution Network (12 miles X 5,280 feet/mile = 64,000 lf at \$180/lf)	\$11,500,000

6. Conclusions and Recommendations

- Recent discussions with the Town of Brewster on March 24, 2016 indicated that the use of reclaimed water would be limited since the sites are located in nitrogen sensitive areas.
- The incorporation of a reclaimed water system increases the capital, operation and maintenance, replacement and monitoring costs of the proposed WWTF. While the costs within the limits of the proposed WWTF are modest, the cost of the distribution system necessary to bring the treated wastewater to the various points of use would be substantial, as indicated by the \$12 million estimate previously developed. AECOM has reviewed this estimate, and concurs that it is in the right order of magnitude.
- The incorporation of a reclaimed water system does not result in a reduction of effluent disposal capacity since the current state rules and regulations require that an effluent disposal system be incorporated into the project plan in case effluent quality degrades to a level that is not acceptable for reuse.
- Preliminary communications with the Town of Brewster and Brewster golf courses did not identify useful options, but that there are other private and public sites in Brewster that will be investigated during the next phase of planning/design, such as the Brewster Day Camp, Ocean Edge and Nickerson State Park, and the stone/concrete company.

In conclusion, the incorporation of a reclaimed water system at the proposed WWTF site would increase the capital, operation and maintenance, replacement and monitoring costs at the WWTF. Additionally, because there are no large scale users of irrigation water in immediate proximity to the proposed WWTF site, there is considerable capital expense associated with a distribution system to bring reclaimed water to potential points of use. Lastly, there is some uncertainty on whether or not some of the identified points of use would be viable due to watershed concerns and/or public perception issues. At a time when implementation of different elements of the Town’s Water Quality and Wastewater Program is subject to limited revenues, AECOM recommends that water reclamation not be included in the Program at this time. The currently recommended treatment process for the proposed Overland Way WWTF lends itself well to being modified for water reclamation in the future should water reclamation prove to be more viable at a later date, but items such as storage, color treatment, and most importantly a distribution system are not recommended at this time.