6-2006

Water Reuse Feasibility Study

City of Portsmouth

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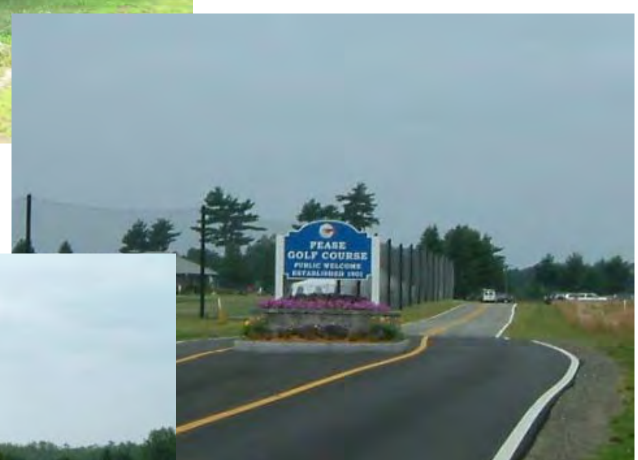
June 2006



Report

June 30, 2006

Mr. Peter H. Rice, P.E.
City Engineer, Water & Wastewater
Public Works Department
680 Peverly Hill Road
Portsmouth, New Hampshire 03801

Subject: Water Reuse Feasibility Study

Dear Mr. Rice:

Enclosed are six copies of the Final Water Reuse Feasibility Report. This report has incorporated your review comments on the Draft Report. This study outlines the steps required and infrastructure improvements needed to provide 300,000 gpd of reclaimed water to the Pease Golf Course. The report discusses the likely improvements necessary at both the golf course and Pease Wastewater Treatment to produce effluent of a suitable quality for reuse. The report also provides preliminary transmission piping layouts and an estimate in 2006 dollars of the project implementation cost.

Please call me at (603) 222-8300 with any questions or to set up a meeting to discuss the study contents.

Very truly yours,

Donald B. Freeman, P.E.
Associate
Camp Dresser & McKee Inc.

cc: W. Pauk, CDM
P. Cabral, CDM

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Background

The use of reclaimed water in the southern and western parts of the United States has been common practice for over 40 years. These water short areas have realized the value of utilizing highly treated wastewater (reclaimed water) and consider it a resource rather than a disposal problem. Growth impacts on drinking water supplies in New England, and specifically in Portsmouth, have now brought this concept to New Hampshire.

Currently the Pease Golf Course is using approximately 200,000 to 300,000 gallons per day (gpd) of potable water for irrigation in the summer months. The City of Portsmouth supplies this potable water from the municipal distribution system. This use is significant, and with projected growth development in the area, future potable water demands will continue to escalate making it prudent to investigate alternate water sources to supplement golf course irrigation water and other large scale non-potable uses.

The City of Portsmouth owns and operates the 1.2 million gallon per day (mgd) Pease Wastewater Treatment Facility (WWTF) which accepts wastewater flows from several businesses at the Pease International Tradeport. This facility currently discharges treated effluent to the Piscataqua River. This Reuse Feasibility Study evaluates the possibility of providing reclaimed water from the Pease WWTF to the Pease Golf Course for irrigation source water and to other potential users.

Use of reclaimed water provides several environmental benefits including preservation of valuable potable water, provides a means to recharge the groundwater table rather than simply discharging the treated effluent to the Piscataqua River, reduces the fertilizer (nitrogen) demand at the golf course, and will provide a net positive improvement to the estuarine water quality in the watershed by applying the nutrients in the effluent to the turf on the golf course instead of into the river.

Regulatory Requirements

There are currently no reclaimed water quality standards or guidelines adopted by the New Hampshire Department of Environmental Services (NHDES). Prior to implementation of a full-scale reuse project, the NHDES and the City of Portsmouth will have to agree on the quality standard for reclaimed water. For the purposes of this feasibility study, we assumed the following criteria will apply to all water pumped to the golf course site and reused for irrigation source water.

- Treatment processes must include secondary treatment, filtration, and high-level disinfection
- Total Suspended Solids (TSS) less than or equal to 5 mg/l

- Turbidity less than or equal to 2.0 NTUs
- The 7-day median fecal coliform count must be non-detectable with no single sample greater than 14 colonies/ 100 ml.
- Total nitrogen less than 10 mg/l.

The above criteria are conservative and were recently adopted by the Commonwealth of Massachusetts. A comparison of other state reclaimed water quality standards can be found in the EPA's *2004 Guidelines for Water Reuse* which provides guidance for those states without regulations or guidelines.

Infrastructure Requirements

There are several variations of process equipment possible to achieve the above criteria for reclaimed water. A separate facility plan for the Pease WWTF is planned for the Fall of 2006 and all feasible reuse treatment alternatives should be evaluated at that time.

For the purposes of this feasibility study, only one alternative was considered for the WWTF and that included installation of cloth disk filters, in-line ultraviolet (UV) disinfection and reclaimed water pumping. Additionally improvements would be required at the golf course to implement reuse. These would include:

- A new 12-inch reclaimed water main from the Pease WWTF to the intersection of Rye Street and International Drive;
- A new 8-inch reclaimed water main from this intersection to the existing 18-hole golf course irrigation pumping house located adjacent to the Smith Well;
- A new skid-mounted irrigation pumping system to supply the 18-hole golf course with reclaimed water;
- Approximately 1,000-ft of new 8-inch reclaimed water main to re-configure the existing irrigation system for reclaimed water;
- A reconfiguration of the back-up potable water supply; and
- Possibly a larger reclaimed water storage tank.

Construction of the above facilities could be done in phases to lessen the financial impact with the golf course included in Phase I and other users such as Lonza Biologics in Phase II. The estimated project cost for Phase I is between $3.1 million and $4.5 million depending on whether the City constructs a new 1.0 MG storage tank or elects to reuse the existing 0.25 MG storage tank. Phase II which expands the reuse water to Lonza Biologics will add an additional $1.1 million for a total project cost between $4.2 million and $5.6 million.

Project Considerations

Most proposed reuse projects implemented to date in New England have not been done so for purely cost-effective reasons. New England projects have been constructed because other influencing drivers make them attractive to municipalities and users. These drivers have included golf course water withdrawal restrictions imposed by regulators, municipal treatment plants looking for more effluent disposal capacity and hence another disposal source, and regulators looking to reuse as a means to recharge a stressed groundwater aquifer rather than continuing to allow discharge to a surface water.

Portsmouth's case is no different in the short term. Currently it is less costly to continue to provide potable water to the golf course than it will be to construct the infrastructure necessary to provide reclaimed water. In the long term, however, other environmental and institutional factors will likely make this project more attractive. Specific factors that should be considered when evaluating moving reuse forward include the following:

- Cost of development of a new water source is significant. Pursuing reuse may postpone or eliminate this need.
- Availability of reclaimed water could attract high-water use companies to the Tradeport thereby creating jobs and increasing the tax base.
- Applying reclaimed water to the golf course will reduce the need for nitrogen enriched fertilizers at the golf course. This reduces the nitrogen levels to the groundwater (and hence improves the water quality in the zone of influence to the Haven and Smith Wells).
- Applying reclaimed water to the golf course recharges the zone of influence to the Haven and Smith Wells rather than simply discharging the water to the river, which could potentially increase the capacity of these supply sources.
- Applying reclaimed water to the golf course reduces nitrogen loading to the Piscataqua River and the surrounding estuarine environment.

The above factors are difficult at this time to mathematically incorporate into a cost effective analysis, but need to be considered carefully when evaluating whether or not to pursue reuse at the Pease WWTF. The decision to move forward with reuse needs to be a joint policy decision by the City and the Pease Tradeport Authority with a focus on long-term goals and opportunities rather than only short-term costs.

Section 1
Introduction

1.1 Background and Purpose

The use of reclaimed water in the southern and western parts of the United States has been common practice for over 40 years. These water short areas have realized the value of utilizing highly treated wastewater (reclaimed water) and consider it a resource rather than a disposal problem. Growth impacts on drinking water supplies in New England, and specifically in Portsmouth, have now brought this concept to New Hampshire.

Currently the Pease Golf Course is using approximately 200,000 to 300,000 gallons per day (gpd) of potable water for irrigation in the summer months. The City of Portsmouth supplies this potable water from the distribution system. This use is significant, and with growing development in the area future potable water demands will continue to escalate making it prudent to investigate alternate water sources to supplement golf course irrigation water and other non-potable uses.

The City of Portsmouth owns and operates the 1.2 million gallon per day (mgd) Pease Wastewater Treatment Facility (WWTF) which accepts flows from several businesses at the Pease International Tradeport. This facility currently discharges treated effluent to the Piscataqua River. This Reuse Feasibility Study evaluates the possibility of providing reclaimed water from the Pease WWTF for use as irrigation source water by the Pease Golf Course.

Use of reclaimed water provides several environmental benefits including preservation of valuable potable water, provides a means to recharge the groundwater table rather than simply discharging the treated effluent to the Piscataqua River, reduces the fertilizer (nitrogen) demand at the golf course, and will provide a net positive improvement to the estuarine water quality in the watershed by applying the nutrients in the effluent to the turf on the golf course instead of into the river.

1.2 New Hampshire Estuaries Project Grant

The City of Portsmouth is funding a portion this study in part through a grant from the New Hampshire Department of Environmental Services (NHDES) Estuary Project. NHDES issued a Request for Proposals in July 2004 and Portsmouth responded with a scope of work to perform this feasibility study. The project was subsequently selected by a NHDES review team to receive grant funding. The NHDES approval letter is included in Appendix A.

1.3 New Hampshire Reuse Water Quality Standards

Currently in New Hampshire there are no large-scale reuse projects in operation and the NHDES has no established guidelines or regulations in place to govern the use of reclaimed water. There are three golf courses in New Hampshire that supplement irrigation water with treated wastewater, but in each case the irrigation water is diluted with either ground water or stormwater runoff. NHDES permitting and approval of each project was handled on an individual basis. The proposed project at the Pease WWTF and Pease Golf Course would break new ground in New Hampshire as reclaimed water would be used as the sole source of irrigation water with potable water used as a back up irrigation source.

Standards for reclaimed water quality vary by state and by type of reuse. The EPA's *2004 Guidelines for Water Reuse*, prepared by CDM, includes a summary of all current state requirements. New Hampshire currently has no established requirements but will need to adopt some criteria, or interim criteria before this project can be implemented. The EPA guidelines provide guidance for those states that have not adopted reclaimed water regulations.

The Commonwealth of Massachusetts recently went through a similar process and adopted the following effluent quality limits for reclaimed water used for golf course irrigation:

- Treatment processes must include secondary treatment, filtration, and high-level disinfection
- Total Suspended Solids (TSS) less than or equal to 5 mg/l
- Turbidity less than or equal to 2.0 NTUs
- The 7-day median fecal coliform count must be non-detectable with no single sample greater than 14 colonies/ 100 ml.

A decision on whether a total nitrogen standard is to be included in the permit will also need to be determined. Nitrogen in reclaimed water has been shown to reduce the overall need for commercial fertilizer applications at golf courses. However, it is often simpler to meet a permit standard prior to reclaimed water application on the golf course. Typically in Massachusetts, where the Department of Environmental Protection currently permits reclaimed water projects under the groundwater discharge permit program, a permit limit for total nitrogen of 10 mg/l is utilized. In addition, according to the EPA *2004 Guidelines for Water Reuse*, reclaimed water may be required to meet drinking water standards after percolating through the vadose zone. Since the Pease Golf Course is located above a productive aquifer, it can be assumed that any reclaimed water used for irrigation will need to meet a total nitrogen limit of 10 mg/l. There may be alternative ways to address these water quality criteria and the parties involved will all need to be part of the final decision process as the project develops further.

If New Hampshire were to adopt similar effluent quality criteria to those listed above, the Pease WWTF would need, at a minimum, filtration and disinfection upgrades to meet these proposed criteria.

1.4 Feasibility Study Outline

Section 2 of this feasibility study includes a brief discussion of the existing Pease WWTF and the improvements that would likely be needed to reliably meet anticipated reclaimed water quality criteria.

Section 3 of the study discusses the existing Pease Golf Course and describes infrastructure modifications that will be required there to accept reclaimed water as the irrigation water source. Additionally, Section 3 also identifies other potential users of reclaimed water in the Pease Tradeport area and what considerations must be addressed to distribute reclaimed water beyond just the golf course.

Section 4 identifies conveyance alternatives and the costs associated with transporting reclaimed water from the source at the Pease WWTF to the end user, the golf course.

Section 5 identifies possible permits and regulatory approvals that will likely be necessary before implementation of a reclaimed water project can be realized.

Finally, Section 6 provides a brief summary of the study and a project cost effective analysis.

Section 2
Pease Wastewater Treatment Facilities

2.1 General

The Pease WWTF was upgraded in the late 1980s to accommodate an average daily flow of 1.2 mgd with a peak flow of 4.0 mgd. Currently the average daily flow is approximately 0.75 mgd, but the flow is expected to increase as development in the Tradeport continues. The treatment processes include grinding and grit removal, primary clarification, secondary treatment using sequencing batch reactors (SBRs), disinfection in chlorine contact tanks using sodium hypochlorite, and dechlorination using sodium bisulfite. Ammonia is also currently being added to chloraminate the effluent to mitigate recent industrial waste that was interfering with the disinfection treatment process.

Effluent discharge permit limits for Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) include average-monthly limits of 30 milligrams per liter (mg/l) and maximum-day limits of 50 mg/l for both. Disinfection fecal coliform limits are 14 colonies per 100 milliliters (ml). Although the NHDES has no established effluent discharge limits for reclaimed water, based on CDM's experience in other states, discharge limits will need to be more stringent for any water that is to be reused for golf course irrigation.

2.2 Anticipated Permit Limits

As discussed in Section 1 there are currently no reclaimed water quality standards or guidelines adopted by NHDES. As part of this project, CDM met with officials of NHDES to brief them and get their feedback on likely effluent limits that might be acceptable. While NHDES was very receptive to the project, they were not in a position to commit to likely discharge limits at this time.

Prior to implementation of a full-scale reuse project, the NHDES and the City of Portsmouth will have to agree on the quality standard for the reclaimed water. It is likely that the final decision on these limits will take several months to establish requiring additional education and input from impacted stakeholders. Therefore, for the purposes of this feasibility study, we will assume the following criteria will apply to all water pumped to the golf course site and reused for irrigation water.

- Total Suspended Solids (TSS) less than or equal to 5 mg/l
- Turbidity less than or equal to 2.0 NTUs
- The 7-day median fecal coliform count must be non-detectable with no single sample greater than 14 colonies/ 100 ml.
- Total nitrogen less than 10 mg/l.

The above criteria are conservative and were recently adopted by the Commonwealth of Massachusetts. A comparison of other state reclaimed water quality standards can be found in the EPA's *2004 Guidelines for Water Reuse*.

2.3 UV Disinfection Pilot Study

An ultraviolet light (UV) Disinfection Pilot Study was conducted by Underwood Engineers and Dr. James P. Malley, Jr. in March 2006 at the Pease WWTF. The study was conducted in response to high fecal coliform discharges at times when chlorine residual concentrations were also high and adequate detention time was available. The thought was that chemical discharges from local industry may be interfering with the chlorine disinfection process and the City wanted to know if UV disinfection would be a more suitable alternative.

Data for the pilot study was compiled from August to October 2005. Table 2.1 is reproduced from the UV Pilot Study and includes facility flow, effluent BOD, effluent TSS and fecal coliform samples exceeding 14 colonies/100 ml.

Table 2.1
UV Pilot Study Average Results

Month 2005	Flow (mgd)	Effluent BOD(mg/l)	Effluent TSS (mg/l)	No. Samples Exceeding 14/100 ml
August	0.59	6.2	7.2	2
September	0.54	10.6	6.2	6
October	0.94	8.4	7.1	1

During the pilot study, influent turbidity varied from 0 to 8 NTUs and UV transmittance varied from 55 to 77 percent.

The pilot study concluded that UV disinfection was an appropriate method for disinfection. Dosage requirements need to be varied based on UV transmittance, degree of bulb fouling, and flow rate. The study was conducted based on meeting a maximum-day permit limit of 14 colonies/100 ml. The UV Pilot Study recommended a single channel design with three banks of UV lamps at a dose of 65 mWs/cm^2. These recommendations were based on disinfecting the entire facility peak flow of 4 mgd to achieve a fecal coliform limit of 14 colonies/100 ml over a 30-day geometric mean. The estimated cost for a UV disinfection system for the entire facility flow was $1.7 million.

Dosage requirements will likely need to be greater to meet the anticipated reclaimed water quality criteria, however flows will be considerably less for a disinfection system designed for reuse. The influent turbidity levels of 8 NTUs and UV transmittance of 55 percent will impact UV performance so it will be necessary to pilot test the proposed system during the design process to ensure adequate dosages are provided.

2.4 Process Improvements Necessary to Meet Reclaimed Water Quality Criteria

There are a number of process improvements and variations of equipment possible to achieve quality criteria suitable for reclaimed water. A separate facility plan for the Pease WWTF is planned for the Fall of 2006. If the City decides to pursue use of reclaimed water further, that facility plan should identify and evaluate all feasible treatment alternatives and make formal recommendations for process upgrades.

For the purposes of this feasibility study, only one feasible alternative was considered and costs estimated. This alternative is discussed below.

2.4.1 Separate Reclaimed Water Treatment

Current average day flow to the Pease WWTF is about 0.75 mgd. It is anticipated that golf course reuse will use a maximum of 300,000 gallons per day (gpd). Therefore, during the summer months the WWTF will still need to discharge more than half the daily flow to the Piscataqua River as is currently done. In the Winter months, the entire facility flow will still discharge to the Piscataqua River.

Because initial reclaimed water usage will typically be less than half of the current facility flow, it is likely that filtration and disinfection systems sized specifically for reuse would be more cost effective than sizing new filters and UV disinfection equipment to meet stringent reclaimed water quality criteria for the entire facility flow. Additionally, a separate reclaimed water treatment system would allow facility operators to quickly put equipment on and off line in response to actual irrigation needs, thereby minimizing operation costs.

2.4.2 Filtration

Effluent filtration will likely be required as part of any reclaimed water system. The filtration process is required for virus removal and to lower solids concentrations so that the disinfection process is not inhibited. Effluent TSS limits are anticipated to be 5 mg/l and achieving this performance should be easily accomplished with installation of filtration. For the purposes of this study we have assumed filtration is accomplished by installation of a packaged disk filtration system such as the one manufactured by Aqua Aerobics Inc. As part of this project, CDM approached Aqua Aerobics for a preliminary design and price quotation for their AquaDisk tertiary filtration system. This information is included in Appendix B.

The proposed package filtration system would include two filter disks rotating on a center shaft in a single tank. The system would come complete with automatic vacuum backwashing and solids removal from the tank hopper. The filters would have a surface area of about 107 square feet and the tank would measure approximately 10 feet by 12 feet. The proposed filtration unit could be easily expanded by adding 2 additional filter disks to the shaft and tank should the demand for reclaimed water increase in the future.

The filtration unit should be constructed inside a building to protect the equipment from the elements and to reduce algae growth caused from direct sunlight. A precast concrete building constructed on a slab could be an inexpensive way to house the filtration equipment. Size of the precast building would be about 16 feet by 20 feet.

Currently at the Pease WWTF, SBR discharge is piped to equalization tanks which have been converted from secondary clarifiers. These tanks are used to dampen the rate of discharge from the SBRs so that downstream equipment can be sized for lower flow rates. A submersible pump on guide rails is installed in each equalization tank and these pumps discharge to the existing chlorine contact tanks. For the reclaimed water system, the existing equalization tanks could be retained and a new 300 gpm submersible pump installed in one tank. This pump would simply feed the packaged filtration system while the existing pumps would continue to feed the chlorine contact tanks. This way, only water needed for reuse would be pumped to the filters while excess water continues treatment as is currently done and is discharged to the Piscataqua River.

Alternately, a submersible pump could be installed in the effluent end of the existing chlorine contact tanks to pump reclaimed water to the new disk filters. Since this water will already have been disinfected, this alternate may have the advantage of being able to down size the UV disinfection equipment. This alternative should be evaluated in detail during facility plan if reuse is pursued further.

2.4.3 UV Disinfection

High level disinfection will be required with effluent reuse. For the purposes of this study we have assumed disinfection is accomplished by installation of an in-line disinfection system such as the one manufactured by Sunlight Systems Inc. As part of this project, CDM approached Sunlight Systems, Inc. for a preliminary design and price quotation of their Sun Series disinfection system. This information is included in Appendix C.

Sunlight Systems and Aqua Aerobics have teamed up on several reclaimed water projects throughout the country supplying filtered and disinfected water for golf course irrigation. For this proposed system, effluent discharging the packaged filtration system would enter a 10 or 12-inch diameter pipe and one of two UV vessels. Each UV vessel would be 64-inches long with 4 UV lamps in each vessel. The UV disinfection system would be installed in the same precast concrete building as proposed for the packaged filtration system and could be easily expanded in the future by adding additional vessels should the demand for reclaimed water increase.

Please note that the Sunlight disinfection system included in Appendix C is sized based on an effluent water quality of 23 colonies/100 ml (7-day average). This is currently the Restricted Urban Reuse quality criteria for the states of Hawaii, Nevada, and Washington. The States of Arizona and Texas have Restricted Urban Reuse quality criteria of 200 colonies/100 ml. If the state of New Hampshire does adopt the bacteria criteria discussed in Section 2.2, the Sunlight disinfection system described in Appendix C would be upgraded accordingly.

2.4.4 Nitrogen Removal

As discussed in Section 1, it is likely that reclaimed water will be required to meet a total nitrogen effluent limit of 10 mg/l. A review of 2005 effluent data from the Pease WWTF indicates that effluent nitrite, nitrate, and TKN averaged 0.3, 4.0, and 5.8 mg/l, respectively; for a total nitrogen average discharge of 10.1 mg/l. From this data it appears that facility performance is already within the anticipated reclaimed water discharge limits for total nitrogen. It is also likely that further total nitrogen reduction could be achieved if necessary by altering the cycle time of the anoxic process in the SBRs.

2.4.5 Reclaimed Water Pumping

Unlike the current facility effluent which discharges by gravity to the Piscataqua River, reclaimed water used for irrigation will need to be pumped to storage facilities at the golf course (see Section 3). For the purposes of this study it is assumed that a simple submersible pumping station is installed at the treatment facility to provide the necessary transport.

A below ground pumping station could be installed downstream of the UV disinfection system. Two submersible pumps on rails could be installed in the precast station similar to the pump recommended for the equalization tank. One pump would be adequate for pumping the required flow, but a second pump should be provided as a spare. Discharge piping to the golf course could follow several different routes and this is discussed in more detail in Section 4.

2.5 Process Improvements Estimated Costs

Table 2-2 presents an estimate of project costs to implement the improvements discussed in this Section 2. Please note that the following conditions apply to this Table 2-2.

- All costs are in 2006 dollars without escalation (ENR=7691).
- Contractor overhead and profit assumed at 17 percent.
- Costs for storage upgrades and irrigation system modifications at the golf course are not included but are presented in Section 4.

- Costs for pipelines to transport reclaimed water to the golf course are not included but are included in Section 4.
- No back up power costs are included as it is assumed that backup power will not be required as reclaimed water is not the main source of disposal.
- Engineering and implementation (permitting) costs included at 20 percent for design and construction services.
- Contingency included at 25 percent given the initial planning stages of this project.

Costs presented Table 2-2 will be combined with pipeline, storage and irrigation system modification costs estimated in Section 4 to derive a project cost for this Reuse Feasibility Study.

Table 2-2
Process Improvements Estimated Costs

Process Improvement	Estimated Planning Level Costs
Equalization Tank Pump and Piping	$25,000
Precast Concrete Building	$200,000
Filtration System	$175,000
UV Disinfection	$75,000
Effluent Pumping Station	$175,000
Subtotal	**$650,000**
Contractor Profit and Overhead (17%)	$110,000
Subtotal	**$760,000**
Engineering, Implementation and Contingencies (45%)	$342,000
Total	**$1,100,000**

Section 3
Reclaimed Water Utilization

In order to estimate reclaimed water demand and conveyance costs, potential users were identified. According to our discussion with the City's Engineering Department, the primary reclaimed water user would be the Pease Golf Course. The City's Engineering Department also wanted to identify other potential reclaimed water users in the Pease International Tradeport. Figure 3-1 shows the location of other potential users as well as the Pease WWTF.

3.1 Pease Golf Course

Portsmouth is home to one of the seacoast's best public golf courses. The 27-hole Pease Golf Course could serve as prime location for applying reclaimed water for irrigation, while concurrently recharging the aquifer, reducing fertilizer requirements at the golf course, and reducing nutrient loads to the Piscataqua River.

The Pease Golf Course is located within the Pease International Tradeport next to the Pease Airport (see Figure 3-1). The Pease Golf Course includes the original 18-hole course and a new 9-hole course plus a practice facility. Currently, both courses are irrigated with municipal water (potable water) via an 8-inch water main from the groundwater supply wells and treatment facility. The golf course is allowed to use 15 million gallons (MG) of treated groundwater per year free of charge. Based on the meter records supplied by the water and sewer billing department, the golf course has used up to 25 MG of irrigation water in a single year, but typically uses less than 15 MG (see Table 3-1).

Table 3-1
Pease Golf Course Irrigation Water Use

Months	***2002 (gallons)***	***2003 (gallons)***	***2004 (gallons)***	***2005 (gallons)***
April	0	0	0	0
May	5,639,000	0	0	1,581,000
June	1,397,000	2,093,000	3,475,000	1,895,000
July	6,308,000	3,739,000	2,555,000	3,023,000
August	7,663,000	4,604,000	2,633,000	4,339,000
September	3,498,000	2,774,000	2,114,000	3,207,000
October	637,000	704,000	1,234,000	366,000
November	0	0	0	0
Total	**25,142,000**	**13,914,000**	**12,011,000**	**14,411,000**

The 18-hole golf course is currently irrigated from a pumping station located next to the Smith Well. Water is pumped from the City of Portsmouth water system to irrigate the 18-hole golf course. The pumping station includes one 400 gpm pump controlled by a variable frequency drive (VFD). The new 9-hole golf course is currently irrigated from a pumping station located next to the 250,000 gallon above ground storage tank. Water from the 250,000 gallon tank is used to irrigate the new 9-hole golf course and the storage tank is refilled during the day (typically from 10am to 4pm) from the City's water system. The pumping station includes one 400 gpm pump and one pressure maintenance pump. The 400 gpm irrigation pump is also controlled by a VFD.

Reclaimed water could be pumped from the Pease WWTF to either the existing 250,000 gallon storage tank or a new storage tank, which would then serve as the source of irrigation water for the golf course's existing irrigation system. Backflow preventers would be provided to prevent mixing the reclaimed water with potable water. According to our discussions with golf course staff, the average daily flow to the 18-hole golf course is between 150,000 to 175,000 gallons with a maximum of 200,000 gallons. The average daily flow to the new 9-hole golf course is between 70,000 to 85,000 gallons with a maximum of 100,000 gallons. Overall, the entire golf course uses an average of about 260,000 gpd during dry weather from June to August.

Since the average irrigation flow for both golf courses is about equal to the existing above ground storage tank volume, installation of a new 1 MG storage tank would provide more flexibility and about three days worth of irrigation water for the golf course. Without the larger storage tank, reclaimed water would need to be pumped to the existing storage tank continuously in order to maintain an adequate supply for the golf course irrigation system. This type of operation would require close coordination between the golf course staff and the Pease WWTF operations staff.

A larger storage tank would allow greater reclaimed water operation flexibility for the Pease WWTF. For example, the WWTF staff could choose to operate the reclaimed water treatment system only during the day. In addition, when the treated effluent does not meet reclaimed water quality standards and the operators stop supplying the golf course with reclaimed water, the golf course would not have to immediately switch the irrigation system over to potable water. The larger storage tank would give the golf course operators a couple days of storage while the WWTP staff resolves any treatment process issues.

At this time, CDM has assumed that the golf course reclaimed water system would be designed with a 1 MG storage tank to supply the golf course with up to 300,000 gpd of water at flow rate of up to 210 gpm (a storage pond could also be used for this purpose, but the adjacent airport is against open pond as they attract birds). This will be the flow rate at which the conveyance system will be evaluated in Section 4.

3.2 Potential Users – Pease International Tradeport

The Pease International Tradeport is a world class business and industrial park encompassing 3,000 acres and an airport with a 11,300 foot runway. The Tradeport caters to import and export businesses, as Pease offers access to the east coast and international trade corridors by land (via Route I-95), by air (via Pease Airport), or by sea (via the Port of New Hampshire). There is also a new international/ domestic passenger terminal with Federal Inspection Service including customs, agriculture and immigration. Also within the Tradeport, there are overnight accommodations, restaurants and banquet facilities, credit union and commercial banking, copy and printing services, and job training and continuing education facilities. With all these amenities and acres of available land, the Pease International Tradeport is a very attractive area for continuing growth, which could also benefit with the use of reclaimed water.

According to 2005 water billing records, the top ten water users in the Tradeport area are listed in Table 3-2 and shown on Figure 3-1.

Table 3-2
Pease International Tradeport Top Ten Water Users

Facility Name	*Location*	*Facility Type*	*2005 Water Usage (gallons)*
Lonza Biologics	101 International Dr.	Biotech/Biomedical Manufacturing	93,580,036
Redhook Brewery	35 Corporate Drive	Beer Brewery	45,016,884
Marriot Hotel	1 International Drive	Hotel	3,495,404
Air National Guard	302 New Market Dr.	General Office Use, Aircraft & Vehicle Maintenance	2,869,328
Department of State	31/32 Rochester Ave	General Office Use	2,627,724
222 International Dr.	222 International Dr.	Multi-tenant General Office Use with Light Assembly Area	1,926,848
Paddy's Restaurant	27 International Drive	Restaurant	1,581,272
One New Hampshire	One New Hampshire	Multi-tenant General Office Use	1,421,948
Computer Associates	100 Arboretum Drive	Multi-tenant General Office Use	1,740,596
119 International Dr.	119 International Dr.	Multi-tenant General Office Use	1,306,008

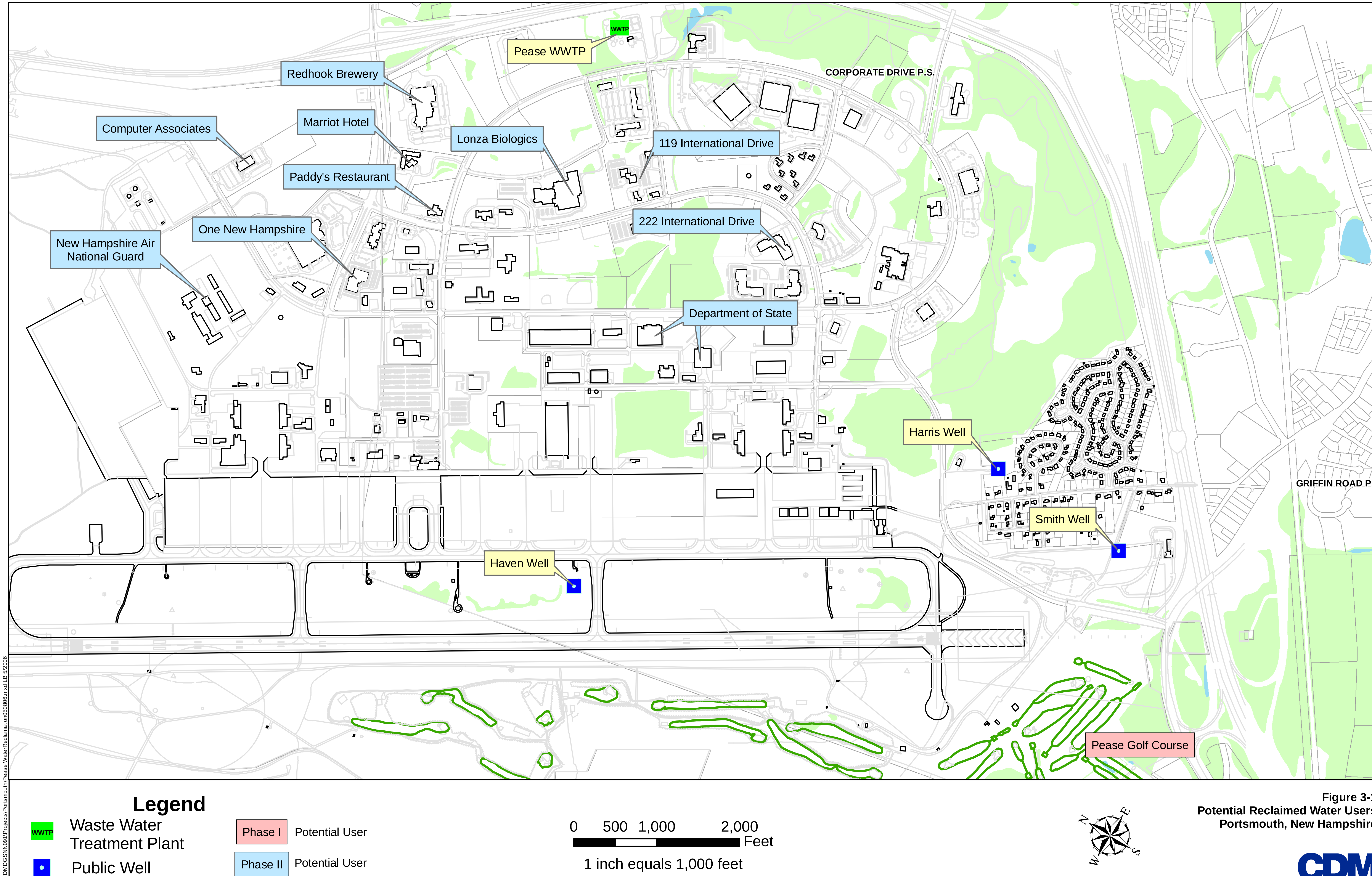


Figure 3-1
Potential Reclaimed Water Users
Portsmouth, New Hampshire

With the exception of Lonza Biologics and Redhook Brewery, the water currently used within the Pease International Tradeport is primarily domestic water use within office buildings, which will have a limited need for reclaimed water. The City could supply reclaimed water to these facilities for toilet flushing, but that would require very expensive plumbing retro fits for the buildings. The City could consider requiring new buildings in the Tradeport to be constructed to allow the use of reclaimed water for toilet flushing and outdoor irrigation. While the new office building would realize an extra cost for the additional plumbing, this cost would likely be offset by long-term savings associated with using reclaimed water rather than potable water for toilet flushing and outdoor irrigation.

Most of the water use at the Redhook Brewery is for their beer manufacturing process. Therefore, there is very limited need for reclaimed water at the Redhook Brewery. Similarly, most of the water use at Lonza Biologics is for the manufacturing of biomedical/pharmaceuticals products. However, according to Lonza Biologics, the facility is projected to be using 80,000 gallons per day of water for cooling towers in 2009, which is a significant amount of water that could be replaced with reclaimed water. If reclaimed water is supplied to Lonza Biologics, CDM assumes Lonza would be responsible for re-pumping and/or re-treating the reclaimed water for use as cooling water.

According to CDM's preliminary hydraulic calculations, it may be difficult to supply Lonza Biologics and any other industrial customers in the tradeport area with reclaimed water if the existing 250,000 gallon irrigation storage tank is reused. Based on the current overflow elevation of the tank, the static pressure at Lonza Biologics will be less than 20 psi even when the tank is full. One option is to build a larger and taller reclaimed water storage tank at the golf course.

As discussed in Section 3.1, installing a new 1 MG storage tank at the golf course allows for greater reclaimed water operation flexibility for the Pease WWTF and provides at least three days worth of irrigation water for the golf course or other users. This new reclaimed water storage tank could be built taller to maintain a minimum pressure of 35 psi at Lonza Biologics, but the new tank would have to be over 60-feet tall to maintain this pressure at Lonza Biologics. The height of this new tank could present a problem to the airport and the airport operation. The other option would be to build a separate booster station to maintain reclaimed water pressure within the tradeport area.

3.3 Reclaimed Water Implementation Plan

Based on the potential users identified above, CDM developed this implementation plan to provide the City with flexibility in order to maximize potential reclaimed water users. This mutli-phased reclaimed water implementation plan allows the City to begin by providing the Pease Golf Course with reclaimed water. Once the City is able to successfully provide the Pease Golf Course with reclaimed water, the City should consider expanding the reclaimed water system to include Lonza Biologics and any other future facility within the Pease International Tradeport. This multi-phased reclaimed water implementation plan would include the following:

- Phase I: Implement the treatment upgrades required at the Pease WWTF to produce the required reclaimed water quality, install a reclaimed water pumping system, install reclaimed water mains from the WWTF to the golf course, connect the reclaimed water mains to the existing 250,000 storage tank, and modify the irrigation pump and piping system at the golf course as needed to allow for pumping reclaimed water and potable water as a backup source.

  As a preferred alternative, construct a 1 MG reclaimed water storage tank near the existing irrigation tank if the WWTF is having trouble maintaining supply to the golf course. CDM recommends the construction of a glass-fused-to-steel bolted tanks, which could be raised as part of Phase II to increase the overflow height and provide better reclaimed water pressure to the Tradeport, if need be.

- Phase II – Expand the reclaimed water treatment system and reclaimed water pumping system capacity, install reclaimed water mains to Lonza Biologics and/or other potential users in the Tradeport and modify the reclaimed water tank as discussed above or construct a new booster station to maintain reclaimed water pressure within the tradeport area.

Overall this implementation plan allows for infrastructure construction flexibility in order to cost effectively maximize the use of reclaimed water.

3.4 Reclaimed Water System Operation

Traditionally, when a water system is constructed with a supply pumping station that feeds a storage tank, the system operation is configured on a "fill and draw" type sequence. In a "fill and draw" type sequence, the water level within the storage tank controls when the supply pumping station operates. In other words, once the water level within the storage tank drops to a preset level, the supply pumping station operates to refill the storage tank. Similarly, once the water level within the storage tank rises to another preset level, the supply pumping station shuts off.

As discussed in Section 3.1, the existing 0.25 MG storage tank may be unable to maintain sufficient pressure to both irrigation pumping systems when the reclaimed water pumping system at the WWTF is not operating. Therefore, the reclaimed water treatment train and pumping system would need to operate whenever the irrigation pumping systems are operating. This would require either greater operator oversight or the installation of additional telemetry equipment to connect the operation of the reclaimed water treatment train and pumping system with the golf course irrigation pumping systems.

One option to make the operation with the existing 0.25 MG storage tank less complicated is to simply operate the reclaimed water pumping system continuously, as long as the treated effluent meets reclaimed water quality. Reclaimed water would simply be allowed to overflow the existing 0.25 MG storage tank, which is piped to an existing leaching field (originally constructed as part of a groundwater treatment system for the airport) near the runway. This operation could continue even with the construction of the new 1 MG storage tank. Overall, this type of operation would have the added benefit of increasing the amount of aquifer recharge and the City should consider operation of this leaching field when applying for a groundwater discharge permit.

One other reclaimed water operational note for Phase I is that the reclaimed water delivery system should be shut-off during the winter months. This shut down would include draining the reclaimed water storage tank and the reclaimed water mains to prevent freezing of the reclaimed water in the storage tank. The Pease WWTF would also shut down the reclaimed water treatment system during winter to save money as the higher level of treatment would not be necessary.

However, if Phase II is implemented, the City and the Pease WWTF would need to decide whether to continue supplying reclaimed water to Lonza Biologics and other potential users in the Tradeport or switch them to potable water during the winter months. The low reclaimed water use during the winter months could lead to ice forming in the reclaimed water storage tank and tank overflow piping. In addition, it is currently unknown whether the existing 8-inch PVC water main located between the 18-hole golf course pumping house and the reclaimed water storage tank was installed to an appropriate depth to prevent freezing. This existing 8-inch PVC water main depth would need to be confirmed before the decision can be made to supply reclaimed water to Lonza Biologics and/or other potential users in the Tradeport during the winter months.

Section 4
Reclaimed Water Delivery Infrastructure

Based on the potential users identified in Section 3, a mutli-phased reclaimed water implementation plan in which the City begins by providing reclaimed water to the Pease Golf Course is preferred. Once the City is able to successfully provide the Pease Golf Course with reclaimed water, the City could then consider expanding the reclaimed water system to include Lonza Biologics and other potential users within the Pease International Tradeport.

This implementation plan allows for infrastructure construction flexibility to cost effectively maximize the use of reclaimed water. The infrastructure required to implement reclaimed water will mirror the mutli-phased approach recommended in Section 3.

4.1 Phase I – Pease Golf Course Reclaimed Water Supply

To supply the Pease Golf Course with reclaimed water, CDM recommends designing a system that can supply 300,000 gpd of reclaimed water at a flow rate of up to 210 gpm. The Phase I reclaimed water supply system would consist of the following infrastructure:

- ***New Reclaimed Water Treatment Train:*** As discussed in Section 2, the Pease WWTF needs to be upgraded in order to produce the necessary reclaimed water quality. The initial reclaimed water treatment train would be sized to meet the reclaimed water demands at the golf course but could be designed to be expandable to provide additional reclaimed water to other Tradeport areas under Phase II.

- ***New Reclaimed Water Pumping System***: Once the wastewater effluent is treated to reclaimed water quality standards, the reclaimed water will need to be pumped to either the existing 0.25 MG storage tank or a new 1.0 MG storage tank. The new pumping system at the treatment facility could be a submersible pumping system as discussed in Section 2. The reclaimed water pumping system will be sized to supply reclaimed water to the golf course only, but could be easily designed to increase supply of reclaimed water under Phase II .

- ***New Reclaimed Water Main***: Based on preliminary hydraulic calculations, installing a 12-inch reclaimed water main from the Pease WWTF to the intersection of Rye Street and International Drive and an 8-inch reclaimed water main from this intersection to the existing 18-hole golf course irrigation pumping house located adjacent to the Smith Well would be required. This configuration will facilitate the supply of reclaimed water to Lonza Biologics and any other facilities within the Tradeport under Phase II and is shown on Figure 4-1. Final water main size and material should be determined during the final design phase.

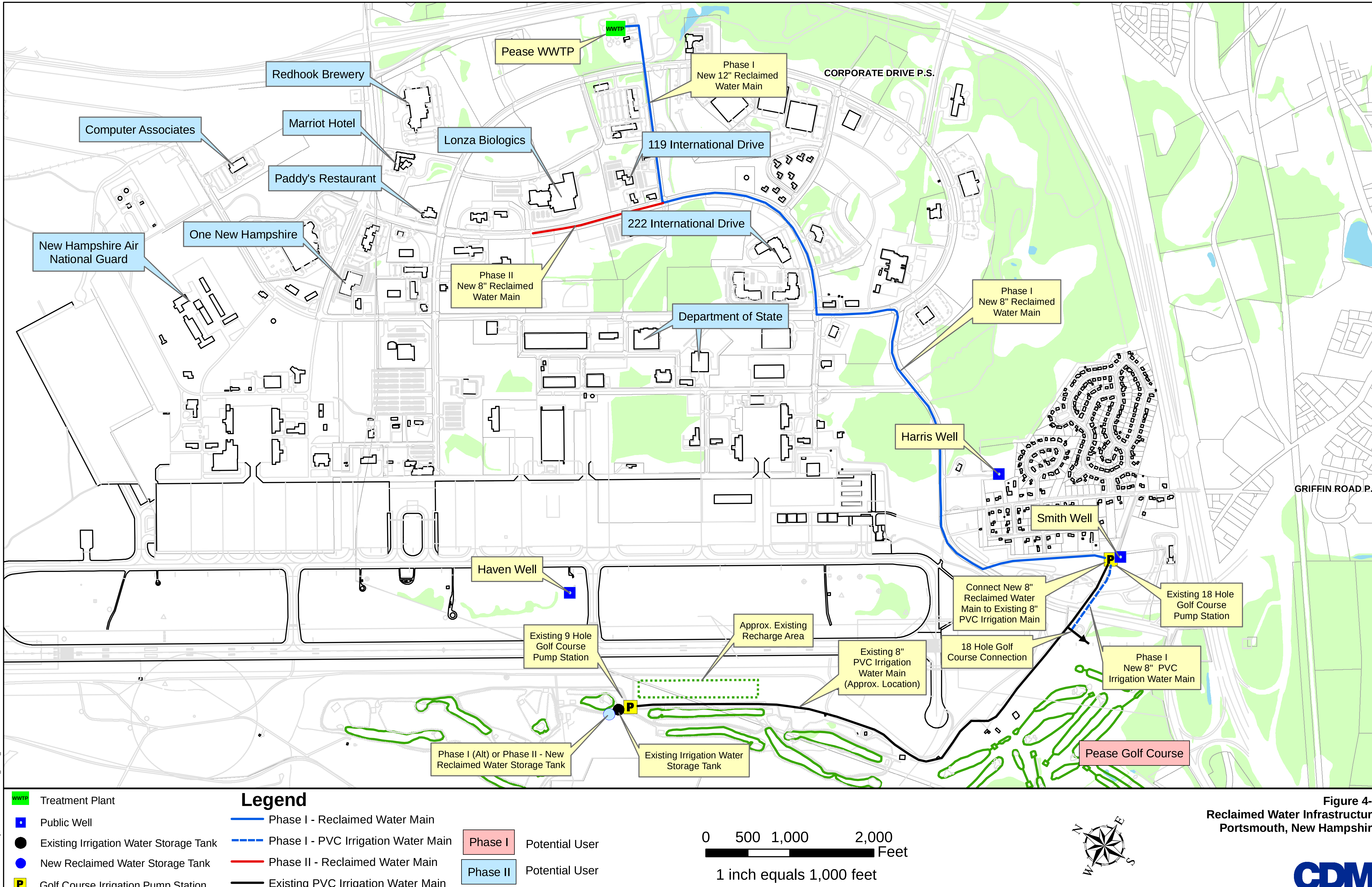


Figure 4-1
Reclaimed Water Infrastructure
Portsmouth, New Hampshire

- ***Irrigation Pumping System Modifications:*** A new skid-mounted irrigation pumping system will be required to supply the 18-hole golf course with reclaimed water from the storage tank. The current 18-hole golf course irrigation system pumps water from the City's potable water system. Once the golf course is connected to the reclaimed water system and storage tank, the pump suction side head will be much lower than current conditions so a new system will be required. The new 18-hole golf course irrigation system would include a pressure maintenance pump, a variable frequency drive (VFD) to control irrigation pump output pressure, and all pump controls and accessories. No modifications are required for the 9-hole golf course irrigation pumping system as the existing irrigation system is already designed to pump water from the existing irrigation storage tank.

- ***Irrigation Piping System Modifications:*** Approximately 1,000-ft of new 8-inch PVC irrigation water main is required in order to re-configure the irrigation system for reclaimed water. Currently, the existing 8-inch PVC irrigation water main is located between the 18-hole golf course irrigation pumping house and the existing 0.25 MG storage tank. When the 18-hole golf course irrigation pumps are operating, a valve located within the 9-hole golf course irrigation pumping house closes and isolates the storage tank and the 9-hole golf course irrigation system from the 8-inch water main and the 18-hole golf course irrigation system. This allows the 18-hole golf course irrigation system to pump water directly from the City's potable water system into the 8-inch water main and feed the 18-hole golf course irrigation system. This also allows the 9-hole golf course irrigation system to pump water from the storage tank.

  The proposed reclaimed water configuration is to convert the existing 8-inch PVC irrigation water main into a dedicated reclaimed water main that connects the new reclaimed water pumping system (at the Pease WWTF) and the storage tank. The valve within the 9-hole golf course irrigation pumping house (which currently closes during golf course irrigation) would remain open at all times. This will allow both golf course irrigation pumping systems to be supplied from the reclaimed water storage tank system and will allow the reclaimed water pumping station to continuously pump to the reclaimed water storage tank. In addition, this configuration will eliminate the need to "piggy-back" pump (i.e., pump from the Pease WWTF directly to the 18-hole golf course irrigation pumping system), which requires significant operator coordination and attention.

  It is also noted that the golf course club house is fed with a separate 4-inch ductile iron water line so no modifications will be required for this pipe.

- ***Back-up Potable Water Connection:*** As with any reclaimed water system used for irrigation and/or process water, a back-up potable water supply is needed when the treated effluent is not meeting reclaimed water quality standards. The back-up potable water connection could be located within the following areas:

- Pease WWTF
- Smith Well Station
- 18-hole Golf Course Irrigation Pumping House

It is important to note that the back-up potable water does not need to be pumped; therefore, the back-up potable water connection should be located at a convenient location for the Pease WWTF staff to operate and needs to be appropriately designed to prevent any backflow into the City's water system. The back-up potable water connection should also be designed with the appropriate safe guards, including backflow preventers, to prevent anyone other than the Pease WWTF staff from activating the connection and to protect the potable water supply. With this in mind, it may be most appropriate for the back-up potable water connection to be located at the Pease WWTF.

Regardless of the connection location, when the back-up potable water connection is active, the golf course irrigation system operation would need to revert back to the existing operating sequence in which the valve located within the 9-hole golf course irrigation pumping house closes as required to prevent the storage tank from overflowing.

- ***New Reclaimed Water Storage Tank (Alternative)***: As a project alternative, CDM recommends the construction of a larger and taller reclaimed water storage tank located near the existing irrigation tank. According to our preliminary hydraulic calculations, the existing reclaimed water storage tank may be unable to maintain sufficient pressure to both irrigation pumping systems when the reclaimed water pumping system is not operating. Therefore, the reclaimed water pumping system would need to operate at all times.

  The construction of a larger and taller storage tank would allow greater reclaimed water operation flexibility for the Pease WWTF staff. For example, the WWTF staff could choose to operate the reclaimed water treatment system only during the day. In addition, when the treated effluent does not meet reclaimed water quality standards and the operators stop supplying the golf course with reclaimed water, the operators do not have to immediately switch the irrigation system over to potable water. The larger storage tank would give the operators a couple of days to resolve any treatment process issues before having to switch the irrigation system over to potable water.

  Based on the irrigation water demand of 300,000 gpd for the entire golf course, CDM assumed the installation of a 1 MG reclaimed water storage tank. CDM recommends that the new tank be glass-fused-to-steel bolted type storage tank. The tank should also be pre-engineered for future vertical expansion, if required as part of Phase II to provide better reclaimed water system pressure to the tradeport area.

4.2 Phase II – Pease International Tradeport Reclaimed Water Supply

To supply Lonza Biologics and any other future facilities within the Pease International Tradeport with reclaimed water, the following infrastructure would be required to expand the Phase I reclaimed water system:

- ***Reclaimed Water Treatment Train Expansion:*** If the Phase II system were to expand beyond 300,000 gpd then additional infrastructure upgrades would be required at the Pease WWTF. These would include adding two additional disks to the filtration system and possibly adding another UV disinfection vessel. All improvements could easily be accomplished as long as this expansion is planned for in the original design. The need to upgrade the pumps would have to be evaluated at a later date once the extent of the upgrade is known and intermediate storage or pumping facilities are planned.

- ***New Reclaimed Water Mains***: New reclaimed water mains will be required to supply the Pease International Tradeport area with reclaimed water in Phase II. The extent of these water mains will depend on the facilities to be served and once the intermediate storage or pumping facilities are planned. CDM assumed the installation of a new 8-inch reclaimed water main from the intersection of Rye Street and International Drive to Lonza Biologics in Phase I, as was show in Figure 4-1.

- ***Reclaimed Water Storage Tank Modifications or New Reclaimed Water Booster Station***: Based on some preliminary hydraulic calculations, it may be difficult to supply Lonza Biologics and other industrial customers in the Tradeport with reclaimed water using the existing 250,000 gallon storage tank. Based on the tank's current overflow elevation, the static pressure at Lonza Biologics will be less than 20 psi even when the tank is full. Therefore, one option is to build a taller reclaimed water storage tank at the golf course.

  As discussed in Section 4.1 and as an alternative in Phase I, a new 1 MG storage tank at the golf course to allow greater reclaimed water operation flexibility and to provide at least three days worth of irrigation water for the golf course may be more appropriate. This new storage tank could be modified and expanded vertically in order to maintain a minimum pressure of 35 psi at Lonza Biologics. But the new height of the modified Phase II reclaimed water storage tank would be over 60-feet tall to maintain pressure at Lonza Biologics, which could present a problem to the airport and the airport operation.

  If the required height of the modified reclaimed water storage tank is unacceptable to the Pease Airport, the other option would be to build a separate booster station to maintain reclaimed water pressure within the Tradeport.

4.3 Planning Level Project Cost Estimate

The planning level project cost for the construction of the reclaimed water system infrastructure presented in this section also follows the mutli-phased project approach presented herein.

4.3.1 Cost Estimating Guidelines

Estimated planning level project costs are based on CDM's knowledge of typical construction costs in the area since no field work has been conducted as part of this feasibility study. Project cost of the reclaimed water system depends on several factors, such as pipe sizes and lengths, excavation constraints, paving requirements, permitting requirements, pump sizes, treatment system requirements, etc.

Similar to that discussed for the treatment facility upgrades in Section 2, construction costs for the reclaimed water lines were generated assuming a contractor overhead and profit of 17 percent and a 45 percent factor was applied to account for engineering services, related implementation costs (i.e. permitting) , and project contingency. The costs are in May 2006 dollars with an Engineering News Record (ENR) Construction Cost Index of 7691.

4.3.2 Treatment Facility Upgrades

As discussed in Section 2, the Pease WWTF needs to be upgraded in order to produce reclaimed water quality. CDM assumed that a new reclaimed water treatment train would be constructed and include disk filters, UV disinfection, and effluent pumping. For cost estimating purposes, CDM assumed the initial reclaimed water treatment train will be sized for 300,000 gpd for Phase I but expandable to 500,000 gpd for Phase II. As can be seen from Table 2-2, the estimated cost for treatment facility upgrades to produce an acceptable reclaimed water quality is $1.1 million for Phase I.

Costs for expanding the treatment train for Phase II will be minimal as both the filtration system and UV disinfection system will be sized to simply add additional disks and UV vessels, respectively. Additional cost will be approximately $75,000 to $100,000.

4.3.3 Reclaimed Water Mains

For cost estimating purposes, installation of reclaimed water mains is based on the conveyance route shown in Figure 4-1. Phase I includes 2,400-ft of 12-inch water main from the Pease WWTF to the intersection of Rye Street and International Drive and 8,600-ft of 8-inch water main from that intersection to the existing 18-hole golf course irrigation pumping house located by the Smith Well. Phase II only includes 1,600-ft of 8-inch water main from the intersection of Rye Street and International Drive to Lonza Biologics. CDM also assumed that the water mains would be purple PVC pipe – industry standard color for reclaimed water.

The unit costs used in developing the planning level cost estimate are shown in Table 4-1 and the construction costs of the water mains are summarized in Table 4-2. Final water main size and water main material will be confirmed during the final design phase.

Table 4-1
Unit Costs for Reclaimed Water Main Installation

Water Main Diameter (inch)	*Roadway Water Main ($ per linear ft)*	*Cross-country Water Main ($ per linear ft)*
8	$150	$125
12	$175	$150

Note: 1. Estimated unit costs include construction, engineering and contingency. All costs are in year 2006 dollars (ENR CCI May 2006 = 7691). No allowance for legal fees, land taking or easements.

4.3.4 Irrigation Pumping System Modification

Since the hydraulic conditions will change with the implementation of reclaimed water, CDM assumes a new irrigation pump skid system will be required to supply the 18-hole golf course with reclaimed water. For cost estimating purposes, CDM assumed the new 18-hole golf course irrigation pump skid system would also include a pressure maintenance pump, a variable frequency drive (VFD) to control irrigation pump output pressure, backflow preventers, and all pump controls and accessories. CDM also assumed no modifications are required for the 9-hole golf course irrigation pumping system as the existing irrigation is already designed to pump water from the existing irrigation storage tank. See Table 4.2 for the estimated project cost.

4.3.5 Irrigation Piping System Modification

As discussed in Section 4.1, installation of approximately 1,000-ft of new 8-inch PVC irrigation water main is required in order to re-configure the irrigation system for reclaimed water. The unit costs used in developing the planning level cost estimate was $125/lf and the estimated project cost is included in Table 4-2.

4.3.6 Back-up Potable Water Connection

A back-up potable water supply is needed to maintain supply to the golf course and/or other reclaimed water customers whenever the treated effluent is not meeting reclaimed water quality standards. CDM assumed the back-up potable water supply connection will be located at the Pease WWTF within the proposed precast concrete building. For cost estimating purposes, CDM assumed the back-up potable water supply connection will consist of a new water service line, new water meter, reduced pressure backflow preventer, and isolation gate valves. The estimated construction cost of this connection is included in Table 4-2.

4.3.7 New Reclaimed Water Storage Tank

As an alternative in Phase I, the City should consider the construction of a larger and taller reclaimed water storage tank located near the existing irrigation tank. CDM assumed the new reclaimed water storage tank would be a 1 MG glass-fused-to-steel bolted tank. CDM also assumed the tank would be pre-engineered for future vertical expansion, if required as part of Phase II. The estimated construction cost of this tank is included in Table 4-2.

4.3.8 Reclaimed Water Storage Tank Modifications or New Reclaimed Water Booster Station

For Phase II, CDM assumed that either the new reclaimed water storage tank installed in Phase I would need to be modifications or a new reclaimed water booster station would be constructed to supply Lonza Biologics and other industrial customers in the Tradeport. Since there is likely little cost difference, for estimating purposes, CDM assumed that the new reclaimed water storage tank could be modified and expanded vertically in order to maintain a minimum pressure of 35 psi at Lonza Biologics. The estimated construction cost of this tank expansion is included in Table 4-2.

Table 4-2
Reclaimed Water Infrastructure – Planning Level Cost Summary

	Estimated Planning Level Cost [1]
Phase I – Pease Golf Course Reclaimed Water Supply:	
Reclaimed Water Treatment Train	$1,100,000
Reclaimed Water Mains	$1,670,000
Irrigation Pumping System Modifications	$150,000
Irrigation Piping System Modifications	$130,000
Back-up Potable Water Connection	$50,000
Reclaimed Water Storage Tank (Optional Alternative)	$1,400,000
Total Phase I – Without Storage Tank	**$3,100,000**
Total Phase I – With Storage Tank	**$4,500,000**
Phase II –Expansion of Reclaimed Water Supply	
Reclaimed Water Treatment Train Expansion	$100,000
Reclaimed Water Mains	$240,000
Reclaimed Water Storage Tank (Expansion)	$750,000
Total Phase II – Reclaimed Water Implementation	$1,090,000
Total Reclaimed Water Implementation (rounded)	**$4,200,000 to $5,600,000**

Note: 1. The estimated planning level costs include construction, engineering and contingency. All costs are in year 2006 dollars (ENR CCI May 2006 = 7691). No allowance for legal fees, land taking or easements.

As can be seen from the above table, the estimated project cost for Phase I is between $3.1 million and $4.5 million depending on whether the City constructs a new 1.0 MG storage tank or elects to reuse the existing 0.25 MG storage tank. Phase II which expands the reuse water to Lonza will add an additional $1.1 million for a total project cost between $4.2 million and $5.6 million.

Section 6 examines these costs further as part of a project cost effective analysis.

Section 5
Possible Permits and Other Approvals

5.1 Overview

This section provides a preliminary overview of the permits that may be needed prior to implementation of the proposed reuse project. Permits covered in this section assume the following work is completed:

- Construction of a new filtration system, UV system, and pumping station at the existing WWTF;
- Pipelines extending from the existing WWTF to the existing Smith Well;
- Construction of a new irrigation pumping station for the 18-hole Pease Golf Course
- Installation of a new pipeline from the Smith Well to the existing 0.25 MG water storage tank;
- Modifications to the existing 9-hole irrigation pumping station for the Pease Golf Course;
- Construction of a new 1.0 MG storage tank

This memorandum describes the anticipated environmental permits and approvals, information needs/next steps, and schedule.

5.2 Description of Anticipated Permits and Approvals

5.2.1 US Army Corps of Engineers (Section 10 and/or Section 404)

Work in wetlands and waterways is regulated by the U.S. Army Corps of Engineers (the Corps) under the authority of Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. In New Hampshire, the Corps has developed the State of New Hampshire Programmatic General Permit (PGP) to expedite its evaluation of permit applications and streamline the permitting process. The purpose of the New Hampshire State PGP (NH SPGP) is to minimize duplication between the New Hampshire's Regulatory Program governing work within coastal waters and wetlands and the Corps regulatory program under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act.

There are three categories associated with the NH SPGP using the state defined criteria: non-reporting projects (minimum impact projects) and two types of projects that will be screened (minor and major impact projects). The Corps reviews projects according to the State of New Hampshire classification of minimum, minor, and major projects as per part WT 303, 400, 600. Projects with impacts up to 3 acres may be considered under the NH SPGP.

A Minimum Impact Project is non-reporting for projects that impact less than 3,000 square feet of inland wetlands or waterways and disturb less than 50 linear feet of a seasonal stream or dry river channel. Non-reporting minimum impact projects may proceed upon approval from the NH Wetlands Bureau without notification to the Corps provided all terms and conditions of the PGP are met.

Minor and Major Impact Project applications are reviewed by the Corps, New Hampshire and Federal resource agencies (U.S Fish and Wildlife, U.S Environmental Protection Agency, National Marine Fisheries Service) after approval from the NH Wetlands Bureau and a determination made that either: 1) the project meets the criteria of the PGP and can proceed with no changes and no additional Corps review is needed; 2) additional information is needed before making a permitting decision; or 3) the project does not meet the PGP criteria and an Individual Permit is required.

For state defined Minor Impact Projects, applicants may proceed after the 30-day review period. For state defined Major Impact Projects, the applicant must wait for written authorization from the Corps. A project is classified as a Minor Impact Project when there is 3,000 to 20,000 square feet of impacts to inland wetlands and waterways and disturbance of up to 200 linear feet of perennial stream of flowing river. Any project in or adjacent to prime wetlands, in tidal wetlands, tidal buffer zone, sand dunes, bogs, or in a wetland that is an exemplary natural community or supports endangered or threatened species is classified as a Major Impact Project, regardless of the amount of impact. If impacts to inland wetlands or waterways are greater than 20,000 square feet or disturb 200 or more linear feet of a stream or river, a project is classified as a Major Impact Project.

Any project impacting over 3 acres and that does not meet the terms and conditions of the NH SPGP will require an Individual Permit from the Corps of Engineers. In accordance with the NH SPGP, the Corps reserves the right to take discretionary authority on any project, regardless of impact category, which the Corps determines will have more than minimal environmental impact.

Applicability to Portsmouth Reuse Project

The proposed project will likely require construction near wetlands, but at this time no direct wetland impacts are anticipated. Therefore, this project is likely to qualify as a Minimum Impact Project which is non-reporting project because it will impact less than 3,000 square feet of inland wetlands or waterways. Non-reporting minimum impact projects may proceed upon approval from the NH Wetlands Bureau without notification to the Corps provided all terms and conditions of the PGP are met.

5.2.2 New Hampshire Department of Environmental Services Groundwater Discharge Permit

Any wastewater facility that proposes to discharge 20,000 gpd or greater to the groundwater or ground surface must obtain a groundwater discharge permit from the New Hampshire Department of Environmental Services (NHDES). Basic information that must be supplied as part of the application process is included in Section 3.0 of NHDES *Groundwater Discharge Permitting Guidance Document for Recharging Aquifers with Reclaimed Water* a copy of which is included in Appendix D.

5.2.3 EPA National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit

EPA currently regulates stormwater discharges from construction sites that are 1 acre or larger and notification to EPA via the Construction General Permit (construction GP) NPDES permit is required for these projects. In determining acreage, the cumulative area of disturbance should be used (plant site and all ancillary facilities). Compliance with the Construction GP involves preparing a Stormwater Pollution Prevention Plan and submitting a short form, Notice of Intent to Discharge, to EPA. This permit is commonly included in the General Contractor's scope of work during the construction phase.

In New Hampshire the EPA and NHDES have also developed a Construction Site Dewatering General Permit (Dewatering GP) for construction sites that disturb less than 1 acre of ground surface and that will require discharge of dewatering effluents to wetlands or waterways. Construction site dewatering activities can be included in the Construction GP if the SWPPP addresses the control of dewatering discharges.

5.2.4 New Hampshire Department of Environmental Services, Wetlands Bureau Permit

The NHDES Wetlands Bureau is responsible for enforcement and regulating activities within coastal and inland wetlands and waterways through the rules and regulations set forth in RSA 482-A. The majority of projects that impact wetlands will require the use of one of two applications, the Standard Dredge and Fill Application or the Minimum Impact Expedited Application. Based on the Federal NHSPGP and NHDES rules, each project that requires a wetlands permit is classified in one of three categories according to the potential impact of the project (minimum, minor, major). The classification scheme is briefly described above and in the NHDES Rules (Part Wt302). In addition, any project that proposes to impact an area in or adjacent to prime wetlands, in tidal wetlands, tidal buffer zone, sand dunes, bogs, or in a wetland that is an exemplary natural community or has endangered or threatened species, is classified as a major project regardless of the amount of impact requested. The Expedited Permit Process for Wetlands Minimum Impacts projects allows the Department of Environmental Services Wetlands Bureau staff to issue permits without the N.H Wetlands Board action within thirty days from receipt of a completed application for certain minimum impact projects. However, for NHDES to process a Minimum Impact Expedited application within thirty days, the signature by the local Conservation Commission is required.

Note, in the Standard Dredge and Fill Application, the applicant will need to explain why the proposal has less environmental impact on wetlands than other reasonable alternatives. The application will need to illustrate why the proposal is the least impacting alternative by showing a reason or need for the project and by showing that wetland impacts have been avoided or minimized wherever possible.

Applicability to Portsmouth's Reuse Project
The proposed project will likely require construction near wetlands, but at this time no direct impact is anticipated. Therefore, this project will likely require only a Minimum Impact Expedited Application. Agencies should be contacted at the beginning of the final design phase to determine if endangered or threatened species are present.

5.2.5 Communication with Federal and State Agencies

As part of the NH wetlands permitting process, communication will be required with the U.S. Fish & Wildlife Service; NH Fish & Game Department; NH Department of Resources and Economic Development – Natural Heritage Inventory and the State Historic Preservation Officer (SHPO) to assess potential project impacts on plants, fish, and wildlife that may be within the project corridor including: rare, special concern species; state and federally listed threatened and endangered species; migratory fish and wildlife, exemplary natural communities, and cultural resources (historic and archaeological sites).

Applicability to Portsmouth's Project
Correspondence including the project description, a USGS project location map and site photographs should be sent to the agencies listed above prior to submitting the Standard Dredge and Fill Application to NHDES (approximately one month) so that relevant correspondence from the agencies can be incorporated into the application.

5.2.6 Alteration of Terrain Permit (Site Specific)

NH DES Water Division issues these permits under NH Administrative Rules Env-Ws 415. Alteration-of-Terrain permits (a.k.a. Site Specific Permit-RSA 485-A:17) are designed to protect New Hampshire surface waters by minimizing soil erosion and controlling stormwater runoff. A permit will be obtained from the division prior to commencing any construction, earth moving or other significant alteration of the characteristics of the terrain when a contiguous area of 100,000 square feet or more will be disturbed. (Developments and earth removal operations, a contiguous earth disturbance of 100,000 square feet including building area, parking, driveways, roadways, utility construction, landscaping and borrow areas would require a Site Specific permit.)

5.2.7 Historical/Archaeological Preservation Review & Compliance

The Historic Preservation Act requires project areas be evaluated to determine the presence of cultural resources. All federally funded, licensed, or assisted projects in New Hampshire are subject to the review requirements of Section 106 of the National

Historic Preservation Act of 1966, as amended (16U.S.C. 470), implemented by the federal Advisory Council on Historic Preservation's procedures, Protection of Historic Properties (36 CFR Part 800). All NH state-licensed, assisted, or contracted projects, activities, and programs are subject to the review requirements of a similar state law, RSA 227-C:9, as implemented by state administrative rules. State agencies, departments, commissions, and institutions are required to submit such undertakings to the SHPO of the Division of Historical Resources for an initial determination of whether such proposed actions are located in or may affect cultural resources.

If a project is conducted entirely with local or donated funds, and no federal or state funds or programs are involved or no state permits are required, then review by the division of Historical Resources is usually not required because it is the federal or state funding or permitting which triggers the historic preservation review; if federal or state funds become involved later, or there is the need for federal or state permits the project should then be submitted to the Division of Historical Resources for review.

Applicability to Portsmouth's Reuse Project

The procurement of State Revolving Fund (SRF) funding as well as the need for a Wetland Bureau Permit would trigger the requirement for historical / archaeological preservation review and compliance. Construction of the proposed facilities will likely not require clearing of undeveloped areas; however, correspondence with the SHPO is still necessary. Correspondence should include such items as a narrative description of the proposed project, the project's area of potential effects (including secondary areas or impacts); the nature and extent of any past development or disturbance on the subject property (including the location of existing utilities, previous landscape alterations, and when these changes were made), a photocopy of the relevant portion of a soils map and/or soil boring log for ground-disturbing projects, a USGS project location map along with a site plan and photographs of the project site. To avoid delays in the project, a letter should be sent to the NH Division of Historical Resources during the planning phases to determine the presence of historic and/or archaeological resources on the site.

5.2.8 Portsmouth Conservation Commission

Continued **c**oordination with the Conservation Commission is suggested during the planning phases for the project. Approval from the Conservation Commission is received through the NH DES Standard Dredge and Fill Application process. The Conservation Commission will provide written correspondence to the NH DES with their approval or any issues they may want addressed through the permitting process. Projects need to be in compliance with local wetlands setback requirements.

Section 6
Summary and Cost-Effective Analysis

6.1 Study Summary

In order to implement a reclaimed water project at the Pease International Tradeport, the City of Portsmouth will be required to make improvements to the existing Pease WWTF and participate in improvements at the Pease golf course. Additionally, reclaimed water mains must be constructed to transport water to the Golf Course.

Improvements at the WWTF include effluent filtration, high level disinfection and reclaimed water pumping. Improvements at the golf course include a new pumping system for the 18-hole golf course, 1000 feet of additional water main and possibly a new storage tank.

The project could be constructed in phases such that 300,000 gpd of reclaimed water is provided to the golf course under Phase I and additional users are brought online in Phase II. At this time, Lonza Biologics is the only identified potential user for Phase II and they are predicted to want approximately 80,000 gpd for cooling water in 2009. It is very likely; however, that the demand for reclaimed water will increase over time should it be made available.

The estimated project cost for Phase I is between $3.1 million and $4.5 million depending on whether the City constructs a new 1.0 MG storage tank or elects to reuse the existing 0.25 MG storage tank. Phase II which expands the reuse water to Lonza will add an additional $1.1 million for a total project cost between $4.2 million and $5.6 million.

6.2 Reclaimed Water Implementation Cost Analysis

In order to compare the cost of implementing reclaimed water in the recommended phased approach, the amount of reclaimed water used in each phase needs to be considered. For Phase I, CDM assumed supplying 15 MG annually for the Pease Golf Course and for Phase II CDM assumed supplying an additional 29 MG annually (80,000 gallons per day) for Lonza Biologics. Assuming the capital costs of Phase I and Phase II will be paid back over a period of 20 years using a loan at 5 percent interest, the approximate annual debt service for the reclaimed water infrastructure can be calculated. By dividing the annual debt service by the amount of reclaimed water used, the average cost of reclaimed water for each phase can be estimated on a per 100 cubic foot (hcf) basis.

For Phase I, the cost for constructing the reclaimed water system to supply the Pease Golf Course with 15 MG of reclaimed water will range from $12.40/hcf to $18.00/hcf. For Phase II, the cost for constructing the reclaimed water system to supply the Lonza Biologics with 29 MG of reclaimed water will be an additional $2.26/hcf. Overall, the cost for constructing the reclaimed water system to supply the Pease Golf Course and Lonza Biologics with a total 44 MG annually of reclaimed water will range from about

$5.40/hcf to $7.50/hcf. If other users are identified these costs would decrease even further.

These values are essentially the price that the City would have to charge to recover only the capital cost of constructing the reclaimed water system (not including annual operation and maintenance). For comparison, the current water rate for the City is $1.67/hcf. Therefore, in 2006 dollars it is cheaper on a known cost basis for the City to continue to supply the Pease Golf Course and Lonza Biologics with potable water. If the City assumes that water rates escalate at 4 percent per year for 20 years, the City's current water rate will escalate to about $3.40 in the year 2026. If current rates increase faster, the cost effectiveness of reuse improves faster.

Because the City provides 15 MG annually to the golf course, this water is not available to other users. The above analysis does not take into account the cost that would be incurred if the City of Portsmouth had to develop a new water supply to support new or existing customers. If a new water supply was required, or will be required in the near future, the above analysis would need to include these supply development costs and it is then quite possible that use of reclaimed water could become the most cost effective approach.

6.3 Conclusions

As is typical for reuse projects in New England, reuse in Portsmouth is not cost-effective from a purely financial basis. If the City's water rates escalate at a pace higher than 4 percent per year assumed herein or if a new water supply becomes necessary to support the 15 MG annual golf course usage, then it is quite likely that the project would become financially sound.

An important item of consideration is that most proposed reuse projects in New England are also not cost-effective from a purely financial basis. There are always other drivers that make these projects attractive to both municipalities and the end users. These drivers have included golf course water withdrawal restrictions imposed by regulators, municipal treatment plants looking for more effluent disposal capacity and hence another disposal source, and regulators looking to reuse as a means to recharge a stressed groundwater aquifer rather than continuing to allow discharge to a surface water.

Reuse in Portsmouth may not on the surface appear feasible, but other environmental and institutional factors need to be considered. Specific factors to Portsmouth that should be considered when evaluating moving reuse forward include the following:

- Cost of development of a new water source is significant. Pursuing reuse may postpone or eliminate this need.

- Availability of reclaimed water could attract high-water use companies to the Tradeport thereby creating jobs and increasing the tax base.

- Applying reclaimed water to the golf course will reduce the need for nitrogen enriched fertilizers at the golf course. This reduces the nitrogen levels to the groundwater (and hence improves the water quality in the zone of influence to the Haven and Smith Wells).

- Applying reclaimed water to the golf course recharges the zone of influence to the Haven and Smith Wells rather than simply discharging the water to the river, which could potentially increase the capacity of these supply sources.

- Applying reclaimed water to the golf course reduces nitrogen loading to the Piscataqua River and the estuarine environment.

The above factors are difficult at this time to mathematically incorporate into a cost effective analysis, but need to be considered carefully when evaluating whether or not to pursue reuse at the Pease WWTF.

Appendix A

New Hampshire Estuaries Project Grant Approval Letter

The State of New Hampshire
Department of Environmental Services

NHDES

Michael P. Nolin
Commissioner

January 10, 2005

His Excellency, Governor John H. Lynch
and The Honorable Council
State House
Concord, NH 03301

APPROVED G & C
DATE
ITEM #

REQUESTED ACTION

Authorize the Department of Environmental Services to enter into an agreement with City of Portsmouth, Vendor Code #21283, Portsmouth, NH, in the amount of $10,000.00 for development of a water reuse feasibility study for the Pease wastewater treatment plant, effective upon approval of Governor and Council through December 31, 2005. 100% Federal Funds.

Funding is available for this agreement as follows,

010-044-3671-092	$10,000.00

EXPLANATION

On July 30, 2004, the New Hampshire Estuaries Project (NHEP) of the Department of Environmental Services issued a Request for Proposals (RFP) for projects that will result in achievement or significant progress toward achievement of one or more Action Plans described in the NHEP Management Plan. Nine proposals were received by the deadline of September 30, 2004. A Review Team consisting of members of the NHEP Management Committee ranked the proposals on October 26 and six were selected for funding. This project is one of those six approved for funding.

The purpose of this project is to assess the feasibility of using treated wastewater from the Pease wastewater treatment plant to irrigate portions of the Pease golf course. If feasible, this action would avoid the use of millions of gallons of drinking water and provide groundwater recharge for the Pease Aquifer.

The total project costs are budgeted at $20,000.00. DES will provide $10,000.00 (50%) of the project costs through a federal grant and the City of Portsmouth will provide the remaining costs through cash and in-kind services. A budget breakdown is provided in Attachment A. In the event that Federal funds become no longer available, General funds will not be requested to support this program.

P.O. Box 95, 29 Hazen Drive, Concord, New Hampshire 03302-0095
Telephone: (603) 271-3503 • Fax: (603) 271-2867 • TDD Access: Relay NH 1-800-735-2964
DES Web site: **www.des.nh.gov**

The agreement has been approved by the Office of the Attorney General as to form, execution, and content. We respectfully request your approval.

Michael P. Nolin, Commissioner

GRANT AGREEMENT

Subject: Pease Wastewater Treatment Plant Water Reuse Feasibility Study

The State of New Hampshire and the Contractor hereby mutually agree as follows:

GENERAL PROVISIONS

1. IDENTIFICATIONS AND DEFINITIONS

1.1 State Agency Name Department of Environmental Services		**1.2 State Agency Address** 6 Hazen Drive Concord, NH 03301	
1.3 Grantee Name City of Portsmouth, Public Works Department		**1.4 Grantee Address** 680 Peverly Hill Road. Portsmouth, NH 03801	
1.5 Effective Date Upon approval	**1.6 Completion Date** December 31, 2005	**1.7 Audit Date** N/A	**1.8 Grant Limitation** $10,000.00
1.9 Grant Officer for State Agency Dave Kellam, New Hampshire Estuaries Project		**1.10 State Agency Telephone Number** 603-599-0022	
1.11 Grantee Signature [signature]		**1.12 Name & Title of Grantee Signor** John P. Bohenko, City Manager	

1.13 Acknowledgment: State of New Hampshire, County of
On 12/21/04 before the undersigned officer, personally appeared the person identified in block 1.12., or satisfactorily proven to be the person whose name is signed in block 1.11., and acknowledged that s/he executed this document in the capacity indicated in block 1.12.

1.13.1 Signature of Notary Public ~~**or Justice of the Peace**~~ My commission expires: 9/4/07

(Seal) [signature: Raeline A. O'Neil]

1.13.2 Name & Title of Notary Public or Justice of the Peace

Raeline A. O'Neil (Notary Public)

1.14 State Agency Signature(s) [signature]

1.15 Name/Title of State Agency Signor(s)
Michael P. Nolin, Commissioner

1.16 Approval by Attorney General's Office (Form, Substance and Execution)

By: [signature] (K. Allen Brooks) **Attorney, On:** 1/13/2005

1.17 Approval by the Governor and Council

By: **On:** / /

2. **SCOPE OF WORK.** In exchange for grant funds provided by the state of New Hampshire, acting through the agency identified in block 1.1 (hereinafter referred to as "the State"), pursuant to RSA 21-O, the Grantee identified in block 1.3 (hereinafter referred to as "the Grantee"), shall perform that work identified and more particularly described in the scope of work attached hereto as EXHIBIT A (the scope of work being referred to as "the Project").

3. **AREA COVERED.** Except as otherwise specifically provided for herein, the Grantee shall perform the Project in, and with respect to, the state of New Hampshire.

4. **EFFECTIVE DATE; COMPLETION OF PROJECT.**

4.1 This Agreement, and all obligations of the parties hereunder, shall become effective on the date in block 1.5 or on the date of approval of this Agreement by the Governor and Council of the State of New Hampshire whichever is later (hereinafter referred to as "the Effective Date").

4.2 Except as otherwise specifically provided for herein, the Project, including all reports required by this Agreement, shall be completed in ITS entirety prior to the date in block 1.6 (hereinafter referred to as "the Completion Date").

5. **GRANT AMOUNT; LIMITATION ON AMOUNT; VOUCHERS; PAYMENT.**

5.1 The Grant Amount is identified and more particularly described in EXHIBIT B, attached hereto.

5.2 The manner of, and schedule of payment shall be as set forth in EXHIBIT B.

5.3 In accordance with the provisions set forth in EXHIBIT B, and in consideration of the satisfactory performance of the Project, as determined by the State, and as limited by subparagraph 5.5 of these general provisions, the State shall pay the Grantee the Grant Amount. The State shall withhold from the amount otherwise payable to the Grantee under this subparagraph 5.3 those sums required, or permitted, to be withheld pursuant to N.H. RSA 80:7 through 7-c.

5.4 The payment by the State of the Grant amount shall be the only, and the complete, compensation to the Grantee for all expenses, of whatever nature, incurred by the Grantee in the performance hereof, and shall be the only, and the complete, compensation to the Grantee for the Project. The State shall have no liabilities to the Grantee other than the Grant Amount.

5.5 Notwithstanding anything in this Agreement to the contrary, and notwithstanding unexpected circumstances, in no event shall the total of all payments authorized, or actually made, hereunder exceed the Grant limitation set forth in block 1.8 of these general provisions.

6. **COMPLIANCE BY GRANTEE WITH LAWS AND REGULATIONS.** In connection with the performance of the Project, the Grantee shall comply with all statutes, laws, regulations, and orders of federal, state, county, or municipal authorities which shall impose any obligations or duty upon the Grantee, including the acquisition of any and all necessary permits.

7. **RECORDS AND ACCOUNTS.**

7.1 Between the Effective Date and the date seven (7) years after the Completion Date the Grantee shall keep detailed accounts of all expenses incurred in connection with the Project, including, but not limited to, costs of administration, transportation, insurance, telephone calls, and clerical materials and services. Such accounts shall be supported by receipts, invoices, bills and other similar documents.

7.2 Between the Effective Date and the date seven (7) years after the Completion Date, at any time during the Grantee's normal business hours, and as often as the State shall demand, the Grantee shall make available to the State all records pertaining to matters covered by this Agreement. The Grantee shall permit the State to audit, examine, and reproduce such records, and to make audits of all contracts, invoices, materials, payrolls, records or personnel, data (as that term is hereinafter defined), and other information relating to all matters covered by this Agreement. As used in this paragraph, "Grantee" includes all persons, natural or fictional, affiliated with, controlled by, or under common ownership with, the entity identified as the Grantee in block 1.3 of these general provisions.

8. **PERSONNEL.**

8.1 The Grantee shall, at its own expense, provide all personnel necessary to perform the Project. The Grantee warrants that all personnel engaged in the Project shall be qualified to perform such Project, and shall be properly licensed and authorized to perform such Project under all applicable laws.

8.2 The Grantee shall not hire, and it shall not permit any subcontractor, subgrantee, or other person, firm or corporation with whom it is engaged in a combined effort to perform such Project, to hire any person who has a contractual relationship with the State, or who is a State officer or employee, elected or appointed.

8.3 The Grant officer shall be the representative of the State hereunder. In the event of any dispute hereunder, the interpretation of this Agreement by the Grant Officer, and his/her decision on any dispute, shall be final.

9. **DATA; RETENTION OF DATA; ACCESS.**

9.1 As used in this Agreement, the word "data" shall mean all information and things developed or obtained during the performance of, or acquired or developed or obtained during the performance of, or acquired or developed by reason of, this Agreement, including, but not limited to, all studies, reports, files, formulae, surveys, maps, charts, sound recordings, video recordings, pictorial reproductions, drawings, analyses, graphic representations, computer programs, computer printouts, notes, letters, memoranda, papers, and documents, all whether finished or unfinished.

9.2 Between the Effective Date and the Completion Date the Grantee shall grant to the State, or any person designated by it, unrestricted access to all data for examination, duplication, publication, translation, sale, disposal, or for any other purpose whatsoever.

9.3 No data shall be subject to copyright in the United States or any other country by anyone other than the State.

9.4 On and after the Effective Date all data, and any property which has been received from the State or purchased with funds provided for that purpose under this Agreement, shall be the property of the State, and shall be returned to the State upon demand or upon termination of this Agreement for any reason, whichever shall first occur.

9.5 The State, and anyone it shall designate, shall have unrestricted authority to publish, disclose, distribute and otherwise use, in whole or in part, all data.

10. **CONDITIONAL NATURE OR AGREEMENT.** Notwithstanding anything in this Agreement to the contrary, all obligations of the State hereunder, including without limitation, the continuance of payments hereunder, are contingent upon the availability or continued appropriation of funds, and in no event shall the State be liable for any payments hereunder in excess of such available or appropriated funds. In the event of a reduction or termination of those funds, the State shall have the right to withhold payment until such funds become available, if ever, and shall have the right to terminate this Agreement immediately upon giving the Grantee notice of such termination.

11. **EVENT OF DEFAULT; REMEDIES.**

11.1 Any one or more of the following acts or omissions of the Grantee shall constitute an event of default hereunder (hereinafter referred to as "Events of Default"):

11.1.1 failure to perform the Project satisfactorily or on schedule; or

11.1.2 failure to submit any report required hereunder; or

11.1.3 failure to maintain, or permit access to, the records required hereunder; or

11.1.4 failure to perform any of the other covenants and conditions of this Agreement.

11.2 Upon the occurrence of any Event of Default, the State may take any one, or more, or all, of the following actions:

11.2.1 give the Grantee a written notice specifying the Event of Default and requiring it to be remedied within, in the absence of a greater or lesser specification of time, thirty (30) days from the date of the notice; and if the Event of Default is not timely remedied, terminate this Agreement, effective two (2) days after giving the Grantee notice of termination; and

11.2.2 give the Grantee a written notice specifying the Event of Default and suspending all payments to be made under this Agreement

and ordering that the portion of the Grant Amount which would otherwise accrue to the grantee during the period from the date of such notice until such time as the State determines that the Grantee has cured the Event of Default shall never be paid to the Grantee; and
11.2.3 set off against any other obligation the State may owe to the Grantee any damages the State suffers by reason of any Event of Default; and
11.2.4 treat the agreement as breached and pursue any of its remedies at law or in equity, or both.

12. **TERMINATION.**
12.1 In the event of any early termination of this Agreement for any reason other than the completion of the Project, the Grantee shall deliver to the Grant Officer, not later than fifteen (15) days after the date of termination, a report (hereinafter referred to as the "Termination Report") describing in detail all Project Work performed, and the Grant Amount earned, to and including the date of termination.
12.2 In the event of Termination under paragraphs 10 or 12.4 of these general provisions, the approval of such a Termination Report by the State shall entitle the Grantee to receive that portion of the Grant amount earned to and including the date of termination.
12.3 In the event of Termination under paragraphs 10 or 12.4 of these general provisions, the approval of such a Termination Report by the State shall in no event relieve the Grantee from any and all liability for damages sustained or incurred by the State as a result of the Grantee's breach of its obligations hereunder.
12.4 Notwithstanding anything in this Agreement to the contrary, either the State or except where notice default has been given to the Grantee hereunder, the Grantee, may terminate this Agreement without cause upon thirty (30) days written notice.

13. **CONFLICT OF INTEREST.** No officer, member or employee of the Grantee and no representative, officer of employee of the State of New Hampshire or of the governing body of the locality or localities in which the Project is to be performed, who exercises any functions or responsibilities in the review or approval of the undertaking or carrying out of such Project, shall participate in any decision relating to this Agreement which affects his or her personal interests or the interest of any corporation, partnership, or association in which he or she is directly or indirectly interested, nor shall he or she have any personal or pecuniary interest, direct or indirect, in this Agreement or the proceeds thereof.

14. **GRANTEE'S RELATION TO THE STATE.** In the performance of this Agreement, the Grantee, its employees, and any subcontractor or subgrantee of the Grantee are in all respects independent contractors, and are neither agents nor employees of the State. Neither the Grantee nor any of its officers, employees, agents, members, subcontractors or subgrantees, shall have authority to bind the State nor are they entitled to any of the benefits, workmen's compensation or emoluments provided by the State to its employees.

15. **ASSIGNMENT AND SUBCONTRACTS.** The Grantee shall not assign, or otherwise transfer any interest in this Agreement without the prior written consent of the State. None of the Project Work shall be subcontracted or subgranteed by the Grantee other than as set forth in Exhibit A without the prior written consent of the State.

16. **INDEMNIFICATION.** The Grantee shall defend, indemnify and hold harmless the State, its officers and employees, from and against any and all losses suffered by the State, its officers and employees, and any and all claims, liabilities or penalties asserted against the State, its officers and employees, by or on behalf of any person, on account of, based on, resulting from, arising out of (or which may be claimed to arise out of) the acts or admissions of the Grantee of Subcontractor, or subgrantee or other agent of the Grantee. Notwithstanding the foregoing, nothing herein contained shall be deemed to constitute a waiver of the sovereign immunity of the State, which immunity is hereby reserved to the State. This covenant shall survive the termination of this agreement.

17. **INSURANCE AND BOND.**
17.1 The Grantee shall, at its sole expense, obtain and maintain in force, or shall require any subcontractor, subgrantee or assignee performing Project work to obtain and maintain in force, both for the benefit of the State, the following insurance:
17.1.1 statutory workmen's compensation and employees liability insurance for all employees engaged in the performance of the Project, and
17.1.2 comprehensive public liability insurance against all claims of bodily injuries, death or property damage, in amounts not less than $2,000,000 for bodily injury or death any one incident, and $500,000 for property damage in any one incident; and
17.2 The policies described in subparagraph 18.1 of this paragraph shall be the standard form employed in the State of New Hampshire, issued by underwriters acceptable to the State, and authorized to do business in the State of New Hampshire. Each policy shall contain a clause prohibiting cancellation of modification of the policy earlier than ten (10) days after written notice has been received by the State.

18. **WAIVER OF BREACH.** No failure by the State to enforce any provisions hereof after any Event of Default shall be deemed a waiver of its rights with regard to that Event, or any subsequent Event. No express waiver of any Event of Default shall be deemed a waiver of any provisions hereof. No such failure or waiver shall be deemed a waiver of the right of the State to enforce each and all of the provisions hereof upon any further or other default on the part of the Grantee.

19. **NOTICE.** Any notice by a party hereto the other party shall be deemed to have been duly delivered or given at the time of mailing by certified mail, postage prepaid, in a United States Post Office addressed to the parties at the addresses first above given.

20. **AMENDMENT.** This agreement may be amended, waived or discharged only by an instrument in writing signed by the parties hereto and only after approval of such amendment, waiver or discharge by the Governor and Council of the State of New Hampshire.

21. **CONSTRUCTION OF AGREEMENT AND TERMS.** This Agreement shall be construed in accordance with the law of the State of New Hampshire, and is binding upon and inures to the benefit of the parties and their respective successors and assignees. The captions and contents of the "subject" blank are used only as a matter of convenience, and are not to be considered a part of this Agreement or to be used in determining the intent of the parties hereto.

22. **THIRD PARTIES.** The parties hereto do not intend to benefit any
third parties and this Agreement shall not be construed to confer any such benefit.

23. **ENTIRE AGREEMENT.** This Agreement, which may be executed in a number of counterparts, each of which shall be deemed an original, constitutes the entire agreement and understanding between the parties, and supersedes all prior agreements and understandings relating hereto.

Exhibit A
Scope of Services

The City of Portsmouth shall perform the following tasks as described in the detailed proposal titled *City of Portsmouth Pease Wastewater Treatment Plant Water Reuse Feasibility Study*, submitted by the City of Portsmouth, dated September 30, 2004:

1. Project Management: The City of Portsmouth will coordinate activities and schedules of all parties involved in the project. City of Portsmouth will provide Interim Reports and a Final Report to the NHEP.

2. Hire Contractor: The City of Portsmouth will hire a contractor using the City's Purchasing Guidelines for securing services through a competitive bid process. The City will enter into a contract with a firm that will conduct the study and produce materials described in the project proposal's scope of work.

3. Consider Nutrient Impacts to Surface Waters: The City of Portsmouth will direct the contractor to consider the impacts of increased nutrients to surface waters as part of the list of potential concerns or issues described in section "e3" of the project proposal.

4. Communicate with Media: City of Portsmouth will send at least one press release to the Portsmouth Herald and Foster's Daily Democrat highlighting the project. The press release must include a sentence noting that the project was funded by the NHEP. A copy of the press release and press clippings (if applicable) will be included in the Final Report.

All materials produced for public distribution shall be reviewed and approved by NH DES prior to distribution and shall include a citation that funding was provided by DES along with the DES logo.

Exhibit B
Contract Price and Method of Payment

All services shall be performed to the satisfaction of DES before payment is made. All payments shall be made upon receipt and approval of stated outputs and upon receipt of an associated invoice. Documentation of match costs (including the value of volunteer labor) shall be provided with each payment request. The final invoice shall include total match cost documentation of $10,000.00. Payment shall be made in accordance with the following schedule based upon completion of specific tasks described in Exhibit A:

Upon receipt and approval of a Payment Request Form, match documentation equal to or exceeding reimbursement amount, and Interim Report #1 (due June 30, 2005).	$3,000
Upon receipt and approval of a Payment Request Form, match documentation equal to or exceeding reimbursement amount, and Interim Report #2 (due September 31, 2005).	$3,000
Upon receipt and approval of a Payment Request Form, match documentation equal to or exceeding reimbursement amount, and Final Report (due December 31, 2005).	$4,000
Total	**$10,000**

Exhibit C
Special Provisions

Subparagraph 1.7 and paragraph 17 of the General Provisions shall not apply to this Agreement. There are no construction activities related to this Grant Agreement.

CERTIFICATE OF AUTHORITY

I, Kelli Barnaby, City Clerk for the City of Portsmouth, New Hampshire do hereby certify that:

(1) The City Council voted to accept funds and enter into a contract with the New Hampshire Department of Environmental Services;

(2) The City Council further authorized the City Manager to execute any documents which may be necessary for this contract;

(3) This authorization has not been revoked, annulled, or amended in any manner whatsoever, and remains in full force and effect as of the date hereof; and

(4) the following now occupies the office indicated above:

John P. Bohenko

IN WITNESS WHEREOF, I have hereunto set my hand as the City Clerk of Portsmouth, New Hampshire this 21 day of December, 2004.

Kelli Barnaby, City Clerk

STATE OF NEW HAMPSHIRE
COUNTY OF ROCKINGHAM

On this the 21 day of December, 2004, before me name of notary public/JOP, the undersigned officer, personally appeared Kelli Barnaby, City Clerk, who acknowledged herself/himself to be the City Clerk for the City of Portsmouth, being authorized to do so, executed the foregoing instrument for the purpose therein contained.

IN WITNESS WHEREOF, I hereunto set my hand and official seal.

(Seal)

~~Justice of the Peace~~/Notary Public
Commission Expiration Date: 9/11/07

Attachment A
Budget Estimate

Budget Item	State Funding	Match	Total
Salaries & Wages		$1,603.00	$1,603.00
Employee Fringe Benefits			$0.00
Travel			$0.00
Supplies & Services	$10,000.00	$8,397.00	$18,397.00
Equipment			$0.00
Facilities & Administrative Costs			$0.00
Subtotals	**$10,000.00**	**$10,000.00**	**$20,000.00**
Total Project Cost			**$20,000.00**

Appendix B

AquaDisk Filtration System

Aqua-Aerobic Systems, Inc.

6306 North Alpine Road * P.O. Box 2026 / Rockford, IL 61130 * Ph#:815/654-2501 * Fx#:815/654-2508

Project E-Mail

Correspondence ID#: AAE-50988

Attention: Mike Caso
Company: Technology Sales Associates
E-Mail: Casotsai@Aol.Com
From: Brandon Thomas
Project: PEASE INTL TRADEPORT, NH Filter Upgrade

Date: March 14, 2006
Ph#: 978/562-1500 (Tsa Office)
Total Pages (including this one): 1

Preliminary Design

Mike,

Please find attached the preliminary design for the above referenced project. Also attached a typical pdf disk filter drawing for 2 - 6 disk filter.

AASI design # 27628 is for one (1) - 2 disk package AquaDisk filter with a painted steel tank.

Preliminary budget pricing including freight and start-up services is $145,400

Please forward this to the engineer after your review.

If you have any questions or require additional information, please do not hesitate to call me.

Regards,

Brandon Thomas
Project Applications Engineer
BThomas@aqua-aerobic.com

CC: Aqua-Aerobic Systems, Inc.
Bernie Eiswert

PROCESS DESIGN REPORT

PEASE INTL TRADEPORT, NH Filter Upgrade

Design#: 27628

Option: Preliminary Design

Designed by Tamera Knapp on Tuesday, March 14, 2006

The enclosed information is based on preliminary data which we have received from you. There may be factors unknown to us which would alter the enclosed recommendation. These recommendations are based on models and assumptions widely used in the industry. While we attempt to keep these current, Aqua-Aerobic Systems, Inc. assumes no responsibility for their validity or any risks associated with their use. Also, because of the various factors stated above, Aqua-Aerobic Systems, Inc. assumes no responsibility for any liability resulting from any use made by you of the enclosed recommendations.

Design Notes

Filtration

- The filter recommendation following the SBR is predicated on an equalization basin preceding the filter.

- The anticipated effluent quality is based upon filterable influent solids defined as having a nominal diameter of 10 microns or larger.

- Aqua-Aerobic Systems recommends covering filters in areas where bright sunlight is expected to cause excessive algae growth.

- For this application, pile filter cloth is recommended, which has a nominal pore size of 10 microns.

Pricing

- Pricing includes freight, installation supervision and start-up services.

- Pricing is based upon Aqua Aerobic Systems standard materials of construction and electrical components.

AquaDISK Tertiary Filtration - Design Summary

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment: SBR

Avg. Design Flow	= 0.432 MG/day	= 300 gpm	= (1633 m^3/day)
Max. Design Flow	= 0.864 MG/day	= 600 gpm	= (3265.9 m^3/day)

DESIGN PARAMETERS	Influent	mg/l	Effluent Required	<= mg/l	Effluent Anticipated	<= mg/l
Avg. Total Suspended Solids:	TSSa	10	TSSa	5	TSSa	5
Max. Total Suspended Solids:	TSSm	20	--	--	--	--

AquaDISK FILTER SIZING CRITERIA

Filter Type:

Vertically Mounted Cloth Media Disks featuring automatically operated vacuum backwash . Tank shall include a hopper-bottom and solids removal manifold system.

Average Flow Conditions:

Average Hydraulic Loading = 3.25 gpm per square foot of filter area at Avg. Flow.
= (2.21 L/s per square meter of filter area at Avg. Flow.)

Filter Area Required = Avg. Design Flow (gpm) / Avg. Hydraulic Loading (gpm/ft^2) = 92.3 ft^2 = (8.58 m^2)

Maximum Flow Conditions:

Maximum Hydraulic Loading = 6.5 gpm per square foot of filter area at Max. Flow.
= (4.42 L/s per square meter of filter area at Max. Flow.)

Filter Area Required = Max. Design Flow (gpm) / Max. Hydraulic Loading (gpm/ft^2) = 92.3 ft^2 = (8.58 m^2)

Solids Loading:

Solids Loading Rate = 3.25 lbs TSS per square foot of filter area per day.
= (15.87 kg TSS per square meter of filter area per day.)

Filter Area Required = (lbs TSS/day) / Solids Loading Rate (lbs TSS/ft^2/day) = 44.3 ft^2 = (4.12 m^2)

AquaDISK FILTER RECOMMENDATION

Qty Of Filter Units Recommended	= 1
Number Of Disks Per Unit	= 2
Total Number Of Disks Recommended	= 2
Total Filter Area Provided	= 107.6 ft^2 = (10 m^2)
Filter Model Recommended	= AquaDisk Package Model 54: 2 Disk Unit

Equipment Summary

Cloth Media Filters

AquaDisk Tanks/Basins

1 Aquadisk model # ADFP-54x2E-PC package filter painted steel tank(s) consisting of:

- 2 disk tank(s) will be painted steel, estimated dry weight is 8,400 lbs., and estimated operating weight is 37,300 lbs..
The tank finish will be:
Interior: near white sandblast (SSPC-SP10), painted with Tnemec 66 polyamide epoxy (color "safety blue") 2 coats 4-6 mils each for 8-12 mils DFT.
Exterior: commercial sandblast (SSPC-SP6), painted with Tnemec 66 polyamide epoxy (color "safety blue") 2 coats 3-4 mils each, 1 coat Tnemec 175 endurashield 2-3 mils for 8-11 mils DFT.
- Effluent seal plate weldment.
- 3" ball valve(s).

AquaDisk Centertube Assemblies

1 Centertube Assembly(ies) consisting of:

- Centertube.
- Centertube carrier assembly.
- Centertube position maintainer.
- Centertube end support bearing kit(s).
- Effluent centertube lip seal.
- Centertube drive sprocket(s).
- 5/8" diameter 316 stainless steel media support rods.
- Neoprene media sealing gaskets.
- Pile cloth media and non-corrosive support frame assemblies.

AquaDisk Drive Assemblies

1 Drive System Assembly(ies) consisting of:

- Gear reducer and drive motor.
- Drive chain(s) with pins.
- Chain guard weldment(s).
- Warning label(s).
- Adjustable drive bracket weldment.
- Stationary drive bracket weldment.
- Drive spocket(s).

AquaDisk Backwash/Sludge Assemblies

1 External Piping Assembly(ies) consisting of:

- 2" wire reinforced flexible hose.

1 Backwash Hose Assembly(ies) consisting of:

- 3.75" O.D. high pressure hose.
- Pressure gauge(s).

1 Backwash Support Assembly(ies) consisting of:

- Backwash support weldment(s).

1 Backwash System Assembly(ies) consisting of:

- Backwash collection nozzle.
- 304 stainless steel backwash collection manifold(s).
- 304 stainless steel threaded union(s).
- Sludge manifold(s).
- Combination nipple(s) for hose to pipe connection(s).
- Stainless steel backwash nozzle springs.

- 1 1/2" PVC flexible hose.
- 2" wire reinforced flexible hose.
- Stainless steel hose clamps.

1 Backwash Pump installation(s) consisting of:

- Backwash and sludge pump(s).
- Backwash pump throttling gate valve(s).
- 2" bronze 3 way ball valve(s).

<u>AquaDisk Instumentation</u>

1 Pressure Transducer Assembly(ies) consisting of:

- Level sensing pressure transducer(s).
- Schedule 80 PVC stilling tube(s).
- Float Switch(es).

<u>AquaDisk Valves</u>

1 Influent Valve(s) consisting of:

- 8" manual butterfly valve(s).

1 Set(s) of Backwash Valve(s) consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be manufactured by TCI / Nibco or equal.

1 Sludge Valve(s) consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be manufactured by TCI / Nibco or equal.

<u>AquaDisk Controls w/Starters</u>

1 Controls Package(s) will be provided as follows:

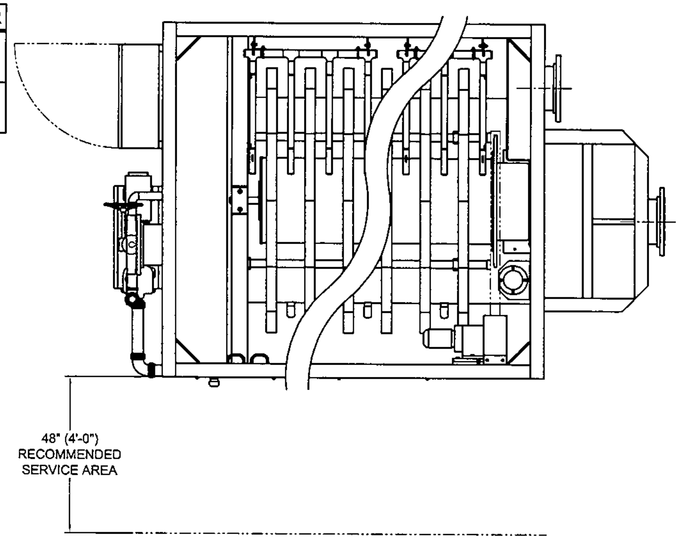
- NEMA 4X fiberglass enclosure(s).
- Starter 18 AMP 3-Pole.
- Allen Bradley Panelview 550 touch screen display(s).
- Panelview 550 operational cable.
- Allen Bradley SLC 5/04 integral programmable controller.
- Analog input card(s).

	2 DISK FILTER	4 DISK FILTER	6 DISK FILTER
FLOW RATE @ 3.25 GPM / ft^2	0.5 MGD	1.0 MGD	1.5 MGD
FLOW RATE @ 6.50 GPM / ft^2	1.0 MGD	2.0 MGD	3.0 MGD

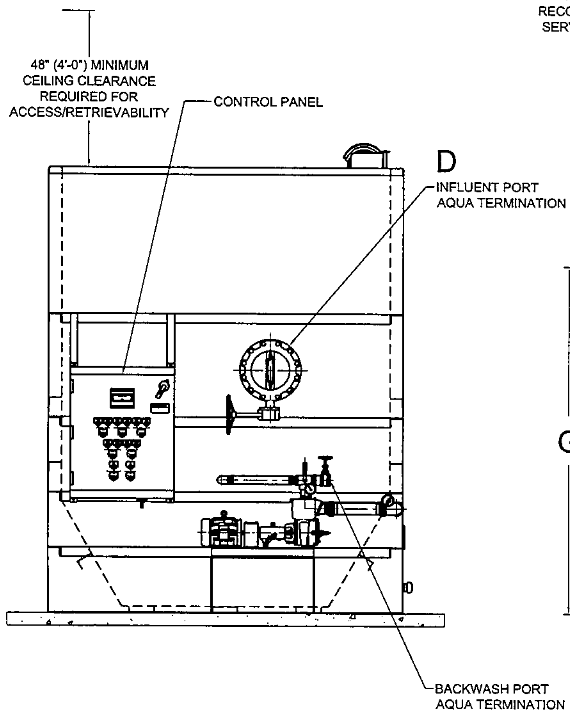
WEIR LENGTHS	
INFLUENT	102" (8'-6")
EFFLUENT	48" (4'-0")
OVERFLOW	45 5/8" (3'-9 5/8")

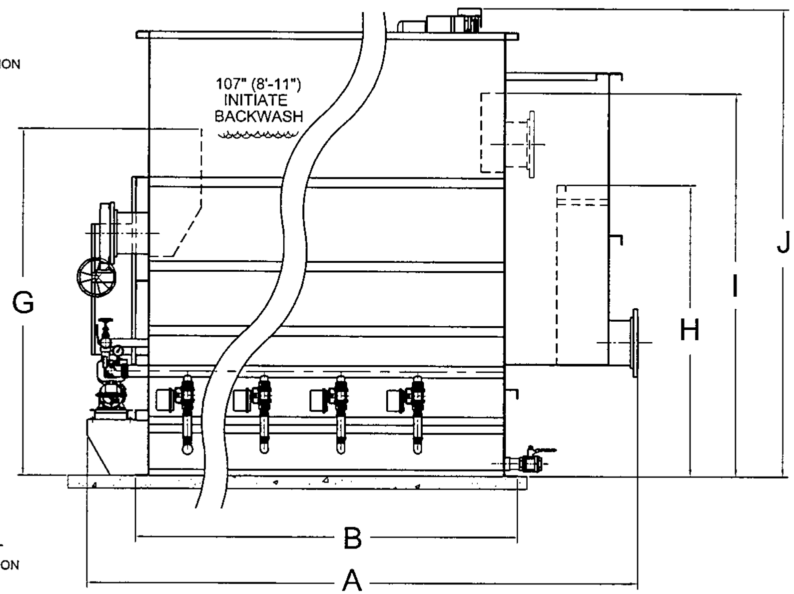
FREEZE NOTE

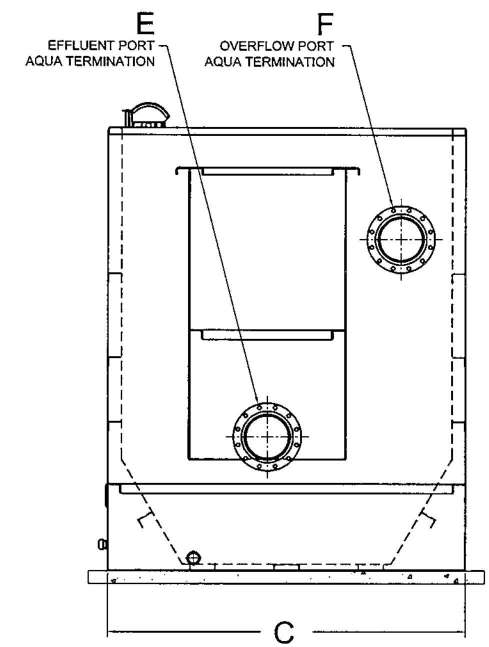
IF FREEZING IS A CONCERN, AQUA-AEROBIC SYSTEM RECOMMENDS THE FILTERS BE PLACED IN A HEATED BUILDING.



	2 DISK FILTER	4 DISK FILTER	6 DISK FILTER
A	127" (10'-7")	151" (12'-7")	172" (14'-4")
B	71 1/2" (5'-11 1/2")	95 1/2" (7'-11 1/2")	119 1/2" (9'-11 1/2")
C	110 1/2" (9'-2 1/2")	110 1/2" (9'-2 1/2")	110 1/2" (9'-2 1/2")
D	8"	10"	12"
E	8"	10"	14"
F	8"	10"	14"
G	107 1/2" (8'-11 1/2")	107 1/2" (8'-11 1/2")	107 1/2" (8'-11 1/2")
H	90 3/8" (7'-6 3/8")	90 3/8" (7'-6 3/8")	90 3/8" (7'-6 3/8")
I	119 1/16" (9'-11 1/16")	119 1/16" (9'-11 1/16")	119 1/16" (9'-11 1/16")
J	145 1/2" (12'-1 1/2")	145 1/2" (12'-1 1/2")	145 1/2" (12'-1 1/2")
K	8,400 lb.	10,750 lb.	13,000 lb.
L	37,300 lb.	49,350 lb.	64,100 lb.







DIMENSIONS ARE: INCHES (FEET-INCHES)

FILTER IS SHOWN IN RIGHT HAND CONFIGURATION.
LEFT HAND FILTER IS A MIRROR IMAGE.

DRY WT (LBS)	OPER. WT. (LBS)
K	L

JOB NAME:	DO NOT SCALE DRAWING	AQUA-AEROBIC SYSTEMS, INC
JOB LOCATION:	DRN BY: DAL; DATE: 05-13-03	
ENGINEERS:	CKD BY:; ACT WT:	
REF / ECO / DATE / BY / REVISION	SCALE:	NAME: AQUA-DISK FILTER MODEL ADFP-54 2 DISK, 4 DISK, 6 DISK
	SIMILAR:	
	REF: 2801620	
	HP/SIZE:	SHEET 1 OF 1
	TYPE:	DWG. NO.: 2801661

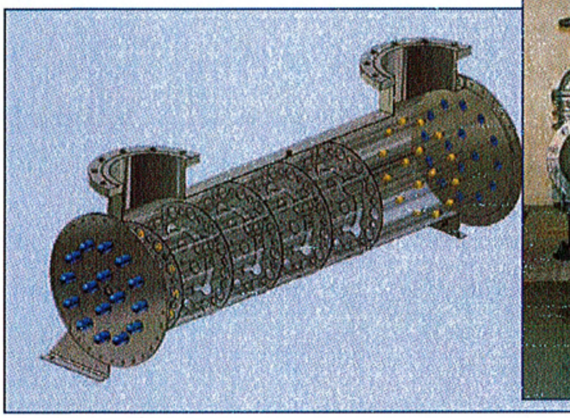
Appendix C

Sunlight UV Disinfection System

ULTRAVIOLET WASTEWATER DISINFECTION

Chambered Treatment Systems
1 to Millions of Gallons Per Day

SUN SERIES



APPLICATIONS

The SUN Series of chambered ultraviolet disinfection systems is designed to treat unlimited flows. The most significant features are its chambered design, small footprint and ease of operation.

The systems come standard with horizontally oriented stainless steel chambers, remote NEMA 4x power control centers, automatic air-driven cleaning systems and PLC controls.

PRODUCT HIGHLIGHTS

- Lamp replacement without draining vessel
- Automatic quick-stroke quartz cleaning
- Flexible inlet and outlet sizes and locations
- Low maintenance

TYPICAL INSTALLATIONS

- Towns, cities and municipalities
- Private developments
- Schools and institutions
- Camp grounds and trailer parks
- Highway rest stops
- Business parks
- Industrial wastewater plants
- Parks and recreational areas

STANDARD FEATURES

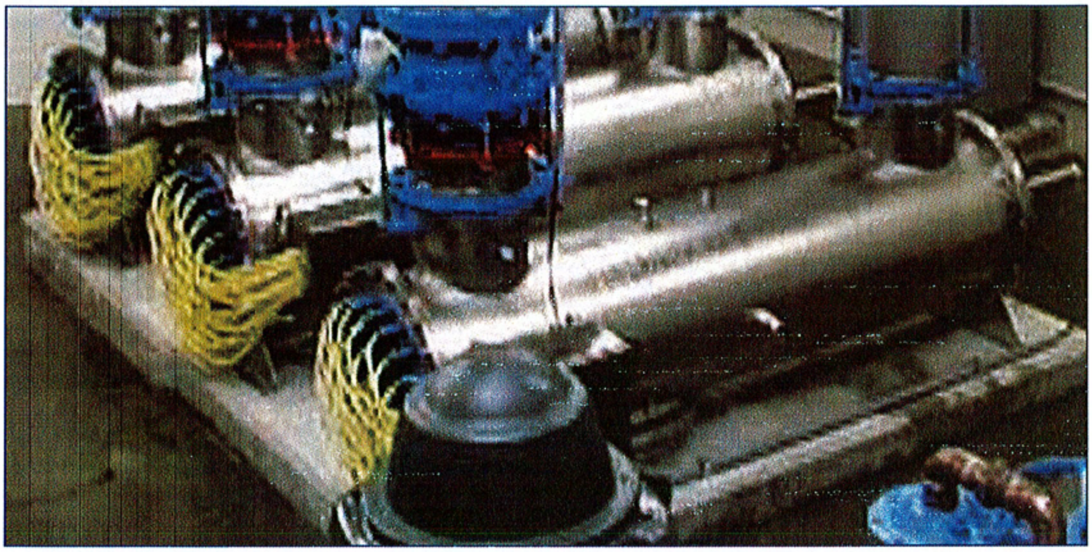
- Stainless steel electropolished vessels
- Local window kits displaying lamp status, elapsed run time and UV output
- Low pressure standard, high output (HO) or amalgam lamp technology with 12,000 hour lamp life
- Medium pressure lamp technology with variable output lamp power
- Energy efficient electronic ballasts
- High-heat protection

OPTIONAL FEATURES

- PLC control
- 4-20 mA output or dry contact alarming
- HOA switches
- Supplemental chemical cleaning systems
- On-line UV transmission monitoring

SUNLIGHT SYSTEMS

4 D Pearl Court, Allendale, NJ 07401 · phone: 201-934-7772 fax:201-934-6886 · info@sunlightsystems.com
www.sunlightsystems.com



DESIGN CONSIDERATIONS

When designing a chambered wastewater UV system into the overall wastewater treatment plant (WWTP), you will need to determine how the system will be connected.

The piping must be designed to allow the chamber to remain flooded at all times including no flow situations.

The inlet and outlet sizes and location are customizable. Based on existing or new piping, the engineer can design a UV system that fits into the overall plant design.

INFORMATION REQUIRED FOR SYSTEM DESIGN

- Discharge permit
- Peak instantaneous flow rate
- Average flow rate
- No flow situations
- UV transmission % at 254 nm
- Total suspended solids (TSS)
- Biological oxygen demand (BOD)
- Installation location (indoor or outdoor)
- Pre-process description
- Access to maintenance personnel

OPERATION AND MAINTENANCE

In order to meet the discharge permit, the system will require maintenance. Lamps will need to be replaced every 12,000 hours. Due to the heat of the lamps and the harsh nature of wastewater, the quartz sleeves (the protective material over the lamps) will need to be cleaned. The cleaning regimen will be directly related to the pre-treatment, the makeup of the wastewater and access to personnel. Fouled quartz sleeves will prevent the UV from penetrating and thus reduce system efficiency. The choices for cleaning are as follows:

Manual

Operator can use a portable chemical tank to re-circulate a citric acid through the vessel.

Automatic

An air compressor will drive a wiper across the sleeves and help remove build up. Based on a field adjustable timer or PLC, operators can adjust frequency and duration of cleaning cycles. This is highly recommended for all installations.

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www.sunlightsystems.com

SUNLIGHTSYSTEMS

PROPOSAL Ultraviolet "UV" Disinfection	March 10, 2006 Proposal # SQ003590

PROJECT NAME: CDM STUDY POST AQUA DISK

SUPPLIED SYSTEM: SUN-4L-AM-450-AW x 2

LAMP TECHNOLOGY: Low-pressure high intensity "AMALGAM"

AUTHORIZED REPRESENTATIVE:

Mike Caso
Technology Sales Associates Inc.
Building 2
Suite 201
Hudson, MA 01749
978-562-1500

DELIVERABLES:

SUN-4L-AM-450 x 2 Units

OPTIONS WHICH HAVE BEEN INCLUDED
Automatic cleaning systems
PLC monitoring and lamp dimming
UV Monitor
High heat shutoff
Spare parts
Shipping
Start up

BUDGETARY: $45,000.00

ADDER TO GO UP IN SIZE: $5,000.00

All pricing is in US Dollars. Sunlight Systems' standard terms and conditions apply.

Please see attached scope of supply for details.

By:

Adam Donnellan

Sunlight Systems

SUNLIGHTSYSTEMS

SCOPE OF SUPPLY Ultraviolet "UV" Disinfection	March 10, 2006 Proposal # SQ003590

PROJECT NAME: CDM STUDY POST AQUA DISK

SUPPLIED SYSTEM: SUN-4L-AM-450-AW x 2

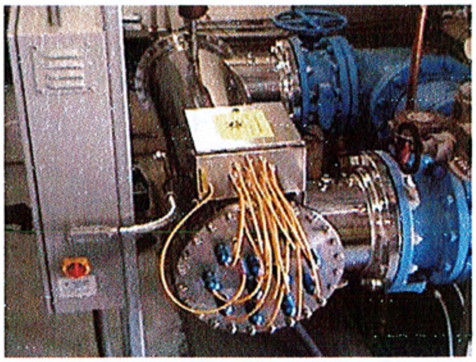
LAMP TECHNOLOGY: Low-pressure high intensity "AMALGAM"

AUTHORIZED REPRESENTATIVE:

Mike Caso
Technology Sales Associates Inc.
Building 2
Suite 201
Hudson, MA 01749
978-562-1500

DESIGN OVERVIEW:

This scope assumes achieving a 200 MPN/100 ml. If lower counts are required (for re-use), we would recommend the next sized vessel (SUN-6L-AM450), this would provide a higher dosage for a 23/100 ml discharge.



Water type	Wastewater
Flow rate (peak)	432,000 US GPD = 300 US GPM
Flow rate (average)	
Flow rate (minimum)	
Transmission @ 254 nm	65% to 75% based on Aqua Disk
Total suspended solids TSS	<5 mg/liter
Biological oxygen demand	<5 mg/liter
Temperature	5/30 C
Influent (per 100 ml sample)	
Discharge permit	200 MPN /100 ml
UV Dosage[1]	>38,000 @ 70% UVT

System type	Chambered
UV monitoring system	Yes
Lamp type	High intensity
Vessel material	316 L stainless
Operating pressure	150 PSI
Electrical enclosure	Remote NEMA 4x modified stainless with window kit
Running time meter	Yes
PLC to dim lamps	Yes
Temperature shut-off	Yes
Connections (FLANGE)	3" or other
Quartz cleaning system	Automatic

[1] As calculated by Point Source Summation Method at end of lamp life. Expressed in uWs/cm2 (microwatts).

This UV disinfection system is designed to provide maximum dosage using low-pressure high intensity "AMALGAM" output technology at peak flow at end of lamp life. System has been designed based on calculations as outlined in the EPA design manual.

The system will provide > 38,000 uWs/cm2 at end of lamp life. This insures that the system will be capable of meeting and exceeding dosage requirements.

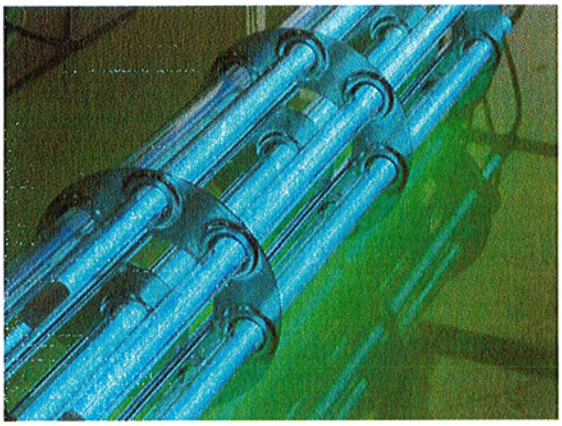
System is an enclosed chamber. The chambered design allows operators to change lamps without system shutdown. Configuration allows system to be piped using a variety of client defined sizes.

HIGHLIGHTED SYSTEM FEATURES

Automatic Cleaning

The closed vessel provides user safety as well as features like the automatic quartz cleaning. This insures that the protective quartz sleeves will be cleaned without having to breakdown the system.

Since the quartz sleeves (the glass like tubes which hold the lamps) can become fouled, Sunlight Systems integrates an automatic air driven cleaning system. A piston drives a stainless steel wiper mechanism across the sleeves with a quick stroke. The mechanism houses free floating flexible UV resistant wiper rings, which wick off and prevents build up.



Air by Sunlight Systems will be used to drive the wiper.

UV Monitoring

A sensor monitors the output of the UV lamps and provides a relative output reading from 0 to 100%. This allows the operators to track system performance. A low reading may indicate that the lamps are nearing the end of life, that the quartz sleeves are fouled or that there is some other problem. Monitors will provide a 4-20 mA output for system alarming.

High Heat Shut-Off

In the event of a prolonged no flow event, a temperature probe will shut the system down at a pre-determined set point (usually 115 F). This will protect the system and prevent the wastewater's impurities from baking on to the quartz sleeves.

Programmable Logic Controls (PLC) - OPTIONAL

An Allen Bradley Micrologix 1200 PLC with Panelview 300 OUI will be included to provide status, alarms and dimming of lamps based on flow signal by others.

SCOPE OF SUPPLY

Standard

SYSTEM	SUN-4L-AM450-AW
NUMBER CHAMBERS	2
LAMPS PER CHAMBER	4
TOTAL LAMPS	8
ELECTRICAL ENCLOSURE	REMOTE STAINLESS STEEL WITH WINDOW KIT

Options Included

UV MONITOR	Yes
AUTOMATIC CLEANING	Yes
HIGH HEAT SHUT OFF	Yes
SPARE PARTS	Yes
PLC	Yes
HAND OFF AUTO	Yes

CHAMBER

Chamber material	316L SS
Chamber treatment	Electropolished
Chamber length	64"
Chamber diameter	10"
Pressure rating	150 PSI
Pressure loss	0.1
Inlet and outlet	3" or other 150# Flange
Removable heads	2
Monitoring port	1 (custom)
Sample ports	2 (1/4" FNPT)
Cleaning ports	2 (3/4" FNPT)
Drain ports	1 (2" FNPT)
Mounting legs	2
Skid	No

ELECTRICAL PER VESSEL

Enclosure material	304L SS
Type	Modified Remote NEMA 4x
Size (WxHxD)	16" x 16" x 8" on each end
Window kit	Yes
Fan cooled	Yes
Mounting legs	Yes
Power required	230 V single 50/60 Hz 2 KVA
Amp draw	10
Lamp indicators	4 LEDS
Running time	Digital non resettable
Hand Off Auto	Yes

SYSTEM CONTROLS AND DISPLAYS

UV Monitors	1
High Heat Shut-off	1
PLC	Micrologix 1100
Hand Off Auto	Yes
Transformer	0

UV LAMPS PER VESSEL

Lamp type	High intensity amalgam
Quantity	4
Lamp watts	450
UVC output	140
Lamp life	12,000 Hrs
Lamp wavelength	254 nm
Lamp treatment	Internally coated

QUARTZ SLEEVES

Material	Pure fused quartz
Type	GE Type 214
Transmission rating	94%
Style	Open on each end
Seals	Viton

WARRANTY

All metal components will be guaranteed for a period of five (5) years. All electrical components will be guaranteed for a period of one (1) year. Lamps have a pro-rated warranty of one (1) year.

SPARE PARTS

Two (2)	Lamps
Two (2)	Sleeves
One (1)	Ballast
Two (2)	Oring Seals
Two (2)	Wiper rings
Two (2)	Stainless steel washers

Based upon present conditions, it is estimated shipment of the system can be made within six (6) weeks after receipt of approved drawings.

Sunlight Systems, LLC

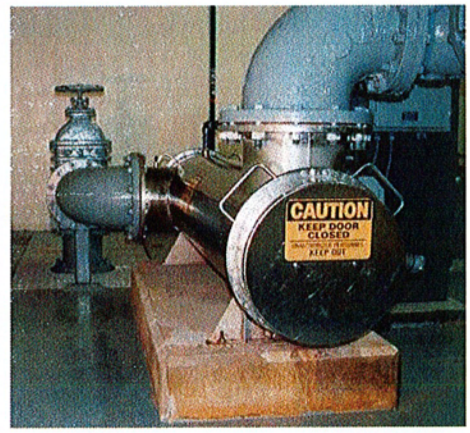
By: *Adam Donnellan*

Adam Donnellan

SUNLIGHTSYSTEMS

WASTEWATER CHAMBERED

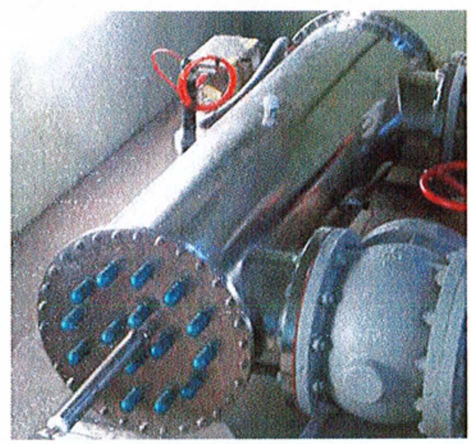
Wanaque Regional Sewage Authority



Gregory White
Facilities Manager
101 Highland Avenue
Wanaque, NJ 07465
973-831-6658

Design flow rate: 4.0 US MGD
Installation: June 2001

Silt Colorado

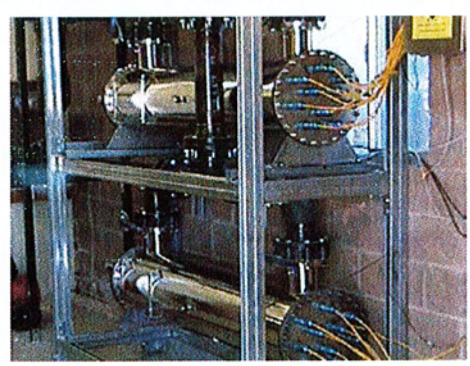


Wastewater Treatment Plant
600 West Frontage Road
Silt, CO 81652

Design flow rate: 3.0 US MGD
Installation: December 2003

The plant operates with two (2) low-pressure high intensity amalgam vessel systems with automatic cleaning.

Rancho Viejo, NM



Flow rate: 500,000 US GPD – Re-use
Installation: November 2004
Quantity: Two – 10 lamp systems

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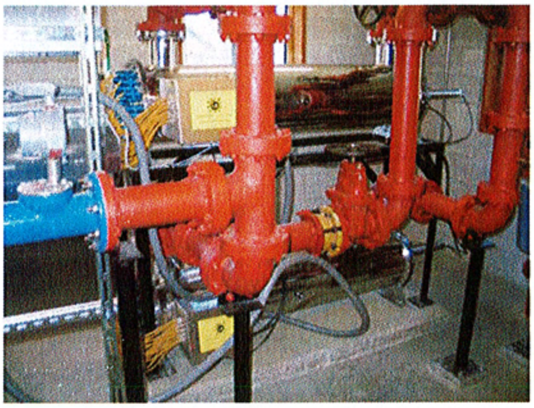
Selected chambered systems

RAE Wastewater Treatment, MT



Dave King
Plant Operator
10 Rae Water Lane
Bosman, MT 59710
406-586-3930

Design flow rate:	1.0 US MGD
Installation:	June 2003
Quantity:	Two – 20 lamp systems

Four Corners WRF, NM

104 South Riverside Drive
Espanola, NM 87532

Design flow rate:	250,000 US GPD
Installation:	February 2004
Quantity:	Two – 8 lamp systems

Rainsville WWTP, AL

609 Horton Road
Rainsville, AL 35986

Design flow rate:	3.75 US MGD
Installation:	August 2005
Quantity:	Three – 16 lamp systems

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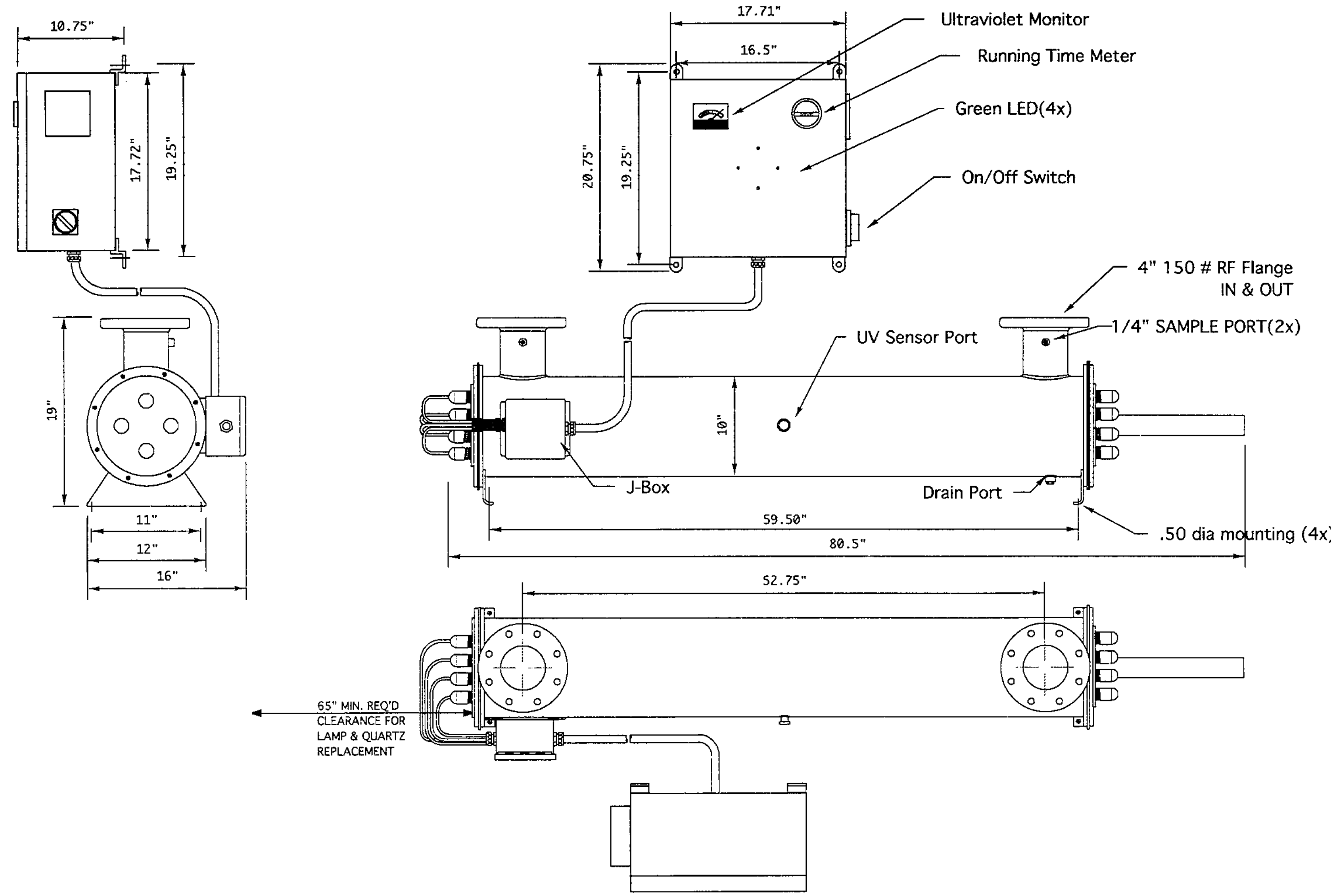
Other Chambered Installations

Precision, AZ
Flow rate: 1.0 US MGD
Installation: October 2002
Quantity: One – 16 lamp system

Leesburg, AL
Flow rate: 500,000 US GPD
Installation: August 2003
Quantity: One – 12 lamp system



Sunlight Systems
4D PEARL COURT ALLENDALE NJ 07401
PH 201-934-7772 FAX 201-934-6886
www.sunlightsystems.com

MODEL		
SUN-4L-AM-450		
JOB REFENCE#	DATE 5/12/04	SHEET 1 OF 1

Appendix D

NHDES Groundwater Discharge Permitting Guidance

New Hampshire Department of Environmental Services

Groundwater Discharge Permitting Guidance Document for Recharging Aquifers with Reclaimed Wastewater
WD-05-31

February 2006

Water Supply Engineering Bureau
Groundwater and Drinking Water Source Protection Program

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Table of Contents

1.0 INTRODUCTION

The New Hampshire Department of Environmental Services (DES) has developed this guidance document to describe how the use of reclaimed water from wastewater treatment plants is regulated in New Hampshire. For this document, the use of reclaimed wastewater has been limited to discharges to the land surface to: 1) recharge aquifers; or 2) irrigate turf at golf courses. Specifically, this document provides guidance for developing new groundwater discharges associated with the following forms of wastewater land treatment and/or disposal methods:

1) Rapid Infiltration (RI) systems.

2) Slow Rate infiltration (SR) systems.

3) Spray irrigation of turf at golf courses.

Rapid infiltration achieves treatment and disposal by rapid infiltration of primary or secondary effluent into alternately dosed shallow basins over highly permeable soil. (Primary effluent quality is attainable by primary treatment or simple settling. Secondary effluent quality is attainable by secondary treatment, which follows primary treatment and contains a biological treatment component.) Slow rate infiltration systems achieve treatment and disposal by slow rate application of primary or secondary effluent (i.e., typically spray irrigation) onto moderately permeable cultivated or forested land. Similarly, spray irrigation at golf courses achieves treatment and disposal by applying treated wastewater as spray irrigation to turf where the wastewater is evaporated, transpired, or recharged into aquifers.

A groundwater discharge permit issued by DES is the primary mechanism regulating wastewater reclamation activities in New Hampshire. It is DES' intent that this guidance be used to achieve compliance with the requirements contained in Env-Ws 1500 to obtain a groundwater discharge permit, although the applicant should be aware that additional laws and regulations apply. In addition to this guidance document, other documents are available and can be used as resources for developing a wastewater reclamation project. These documents include:

TR-16: Guides for the Design of Wastewater Treatment Works – 1998 Edition. New England Interstate Water Pollution Control Commission.

Process Design Manual: Land Treatment of Municipal Wastewater. United States Environmental Protection Agency (EPA 625/1-81-013).

Process Design Manual: Land Treatment of Municipal Wastewater – Supplement on Rapid Infiltration and Overland Flow. United States Environmental Protection Agency (EPA 625/1-81-013a).

Guidelines for Water Reuse – 2004. United States Environmental Protection Agency (EPA EPA/625/R-04/108) www.epa.gov/ORD/NRMRL/pubs/625r04108/625r04108.pdf.

2.0 LAWS AND REGULATIONS

There are several laws and regulations implemented by federal, state and local governmental agencies that pertain to developing sites to receive reclaimed wastewater. This section summarizes the major regulatory programs with jurisdiction over the types of wastewater reclamation projects described in this document. Copies of the laws and regulations referenced below may be obtained as follows:

(1) State Laws and Regulations - Visit DES' website at www.des.state.nh.us or telephone (603) 271-2975 or 8876.

(2) Local Bylaws, Ordinances and Regulations - Contact the town clerk at the town hall for the municipality in which the facility is to be located.

(3) Federal Laws and Regulations - Visit the Federal Bookstore website at http://bookstore.gpo.gov or telephone (866) 512-1800.

2.1 State

The primary statutory authority for regulation of wastewater treatment and disposal facilities is contained in the New Hampshire State Law – RSA 485-A: Water Pollution and Waste Disposal. This law requires DES to develop regulations pertaining to the siting and operation of wastewater treatment and disposal facilities. This law also requires DES to maintain regulations for discharging wastewater to the groundwater to ensure any disposal activity does not make groundwater undrinkable beyond a designated "groundwater discharge zone." (A groundwater discharge zone is defined as the subsurface volume in which groundwater contamination associated with the discharge of domestic wastewater is contained.)

DES has adopted regulations to implement the requirements of RSA 485-A. The regulations and their purpose are described below.

Env-Ws 700 - Standards of Design and Construction for Sewerage and Wastewater Treatment Facilities

DES' Wastewater Engineering Bureau (WWEB), Design Review Section, has the responsibility of reviewing plans and specifications for all public and private wastewater collection systems and domestic sewage treatment systems. The WWEB also reviews and issues permits for major new users of municipal treatment plants, assists small communities with wastewater treatment needs and prepares environmental assessments for projects that are funded by the State Revolving Loan Fund. Additional functions of the Design Review Section include reviewing wastewater planning studies, municipal sewer use ordinances, user charge systems and inter-municipal agreements. In accordance with state law, the WWEB has developed regulations (Env-Ws 700) that pertain to the location, design, construction, and maintenance of new wastewater facilities.

Env-Ws 901 - Certification of Wastewater Treatment Plant Operators

The WWEB maintains a certification program for wastewater treatment plant operators. Operators of wastewater treatment plants must have the proper level of certification for a given type of treatment process. The WWEB has developed regulations (Env-Ws 901) that specify the certification requirements for operating wastewater treatment plants.

Env-Ws 1500 - Groundwater Discharge Permit and Registration

DES' Water Supply Engineering Bureau (WSEB) maintains a groundwater discharge permit program that specifies procedures applicable to the management and disposal of pollutants. DES has adopted regulations (Env-Ws 1500) that identify requirements for obtaining a groundwater discharge permit including: 1) minimum water quality applicable to the various waters of the state; 2) mechanisms to establish and manage discharges within designated groundwater discharge zones; and 3) requirements for dischargers to establish groundwater and surface water monitoring, sampling, record keeping and reporting procedures.

Each groundwater discharge permit also contains monitoring and reporting requirements to verify compliance with permit limitations and conditions. Detailed plans for a groundwater monitoring well network must be submitted to DES as part of a complete permit application. The plans must specify the type of wells, their locations, depth, screen selection and method of construction, development and sampling. The applicant must also submit, for review and approval by the program, detailed plans and specifications for all new collection, treatment, and disposal facilities.

An applicant must submit sufficient engineering and hydrogeologic information to explain the potential public health and environmental impacts of the proposed project to DES. The information must demonstrate that all groundwater contamination associated with a groundwater discharge is contained within a "groundwater discharge zone" that is owned or legally controlled by the applicant. After receiving sufficient information, DES will either: 1) issue a groundwater discharge permit possibly with conditions; 2) deny the discharge permit application; or 3) request additional information.

Env-Ws 1600 Septage Management

DES' Residuals Management Section (RMS) maintains a permit system that specifies procedures applicable to the management and disposal of septage. DES has established regulations (Env-Ws 1600) that identify requirements for obtaining a permit to allow either land application (Site Permit), or processing/disposal (Facility Permit) at a location other than a municipal treatment plant operating under a National Pollution Discharge Elimination System (NPDES) permit.

Depending on the specific design of a facility, conditions may warrant incorporation of groundwater discharge monitoring within the terms and conditions of the Facility Permit. Though a separate application for a groundwater discharge permit is not required when applying for a Facility Permit, the same data required of an applicant for a groundwater discharge permit will be required of a Facility Permit applicant.

2.2 Local

DES has primary regulatory authority for developing new wastewater treatment and disposal facilities. However, local ordinances and zoning may restrict the type of activities allowed at a private wastewater treatment and disposal facility.

Municipalities must be notified when a complete application for a groundwater discharge permit has been submitted to DES. Notification requirements shall be met by providing a copy of a completed permit application to the town/city clerk of the municipality in which the facility is to be located.

2.3 Federal

The Underground Water Source Protection Program, also known as the Underground Injection Control (UIC) Program, is a federal program designed to protect underground sources of drinking water from pollution. The United States Environmental Protection Agency (EPA) pursuant to the Federal Safe Drinking Water Act, 42 U.S.C.A §§300f to 300j-26, administers this program. The EPA divides injection practices into five classes. Class I includes deep disposal wells for industrial and municipal waste. Class II covers all injection wells related to oil and gas production including wells used to store hydrocarbons, which are liquid at standard temperature and pressure. Class III includes wells, which inject liquids for the in situ extraction of minerals or energy. Class IV includes the injection of hazardous and high level radioactive wastes into and above usable groundwater. Class V covers all other injection wells including those used to discharge treated sewage.

In New Hampshire, the EPA has delegated the UIC Program to DES. DES has developed regulations (Env-Ws 384) to implement the state's UIC Program in accordance with federal requirements. For purposes of the UIC Program, a well is defined as a "bored, drilled, or driven shaft, a dug hole, or seepage pit whose depth is greater than the largest surface dimension; or, an improved sinkhole; or, a soil absorption system."

3.0 FILING FOR A GROUNDWATER DISCHARGE PERMIT

Any wastewater facility that discharges 20,000 gallons per day or greater to groundwater and/or the ground surface must possess a valid groundwater discharge permit issued by DES in accordance with Env-Ws 1500. Once issued, permits are valid for a period of up to five years, unless modified or revoked by DES. An application for a permit renewal must be submitted 90 days prior to the expiration date of the permit. Additionally, new or modified wastewater treatment facilities must obtain separate approval from DES and comply with the requirements of Env-Ws 700. Information on compliance with the requirements of Env-Ws 700 can be found at www.des.state.nh.us/wwe/.

Groundwater discharge permit applications must include hydrogeologic studies of the proposed disposal site, its surroundings, and a surface water and groundwater monitoring plan. Applications are reviewed by DES to verify compliance with the requirements of Env-Ws 1500. DES' review consists of two parts. First, an administrative review will be completed to insure proper rules have been followed and the permit fee paid (when applicable). Then technical reviews will be completed to evaluate the technical submittals (plans and specifications, hydrogeologic studies, surface water and groundwater water monitoring plans, ownership documentation, if required). If, during either review, deficiencies are noted in the application, DES will send written notice to the applicant defining such deficiencies. If compliance with Env-Ws 1500 is demonstrated, a permit will be issued within 90 days. Issued discharge permits will contain effluent discharge limitations, surface water and groundwater monitoring requirements and operational conditions. Permits also contain requirements for the regular monitoring of groundwater quality up gradient and down gradient of the proposed discharge in approved monitoring wells.

Applicants proposing to apply reclaimed wastewater to the land surface to recharge aquifers or to golf course turf must submit the basic information described below as part of the groundwater discharge permit application. In addition to the information required below, the applicant must demonstrate compliance with the criteria stated in Section 4.0 for the specific discharge method.

Although DES only requires that an application for a groundwater discharge permit be submitted in accordance with the requirements of Sections 3.0 and 4.0 of this document and Env-Ws 1500, it strongly recommends that applicants submit a proposed scope of work for review and approval prior to initiating work on the application and completing field testing. This will allow all parties to more clearly identify data needs on a site-by-site basis upfront, before work initiates, which may make the permitting process more time and cost efficient.

3.1 Basic Information

Each groundwater discharge permit application for discharging reclaimed wastewater must contain the following basic information:

(1) The facility name, address, property deed reference by county, book and page, property tax map and lot number.

(2) The facility owner's name, mailing address, and telephone number.

(3) The property owner's name, if different then facility owner, mailing address, and telephone number.

(4) The facility operator's name, if different then facility owner, mailing address, and telephone number.

(5) The contact person's name, mailing address, and telephone number.

(6) An original or color photocopy of a United States Geological Survey (USGS) map, 7-1/2 minute series, which clearly identifies the facility location.

(7) Written verification from the Department of Resource and Economic Development that threatened or endangered species do not exist on the site.

(8) A copy of the permit, or application if permit not yet issued, for DES approval of a site specific permit under RSA 485-A:17 if applicable, for drainage and erosion control measures.

(9) A copy of the permit, or application if a permit has not yet been issued, for the septage or sludge management permit pursuant to Env-Ws 800 or Env-Ws 1600, if applicable.

(10) A copy or status of DES' dam permit, if applicable, for bermed or dammed structures.

(11) A copy or status of DES' wastewater treatment plant operator permit, as required under Env-Ws 901, if applicable.

(12) An estimate of the construction time and the projected start-up date.

(13) All pertinent data concerning relevant local, state and federal permits, approvals, orders of conditions and variances.

(14) A list of reports on land use history, activities, water quality, and hydrogeology associated with the property on which the facility is located.

3.2 Inventory of Abutters and Potential Receptors

Each groundwater discharge permit application utilizing reclaimed wastewater must describe the abutters and potential receptors in the vicinity of the proposed facility. This information should be provided both on maps with an appropriate scale and in a written and/or tabular format. Specifically, the following information must be provided:

(1) Any streets within 1,000 feet of the proposed groundwater discharge zone.

(2) Any properties, including tax map and lot number, ownership and land use information, within 1,000 feet of the proposed groundwater discharge zone.

(3) Any surface waters or flood zones within 1,000 feet of the proposed groundwater discharge zone including their designated river classification, in accordance with RSA 483, New Hampshire Rivers Management and Protection Program, if applicable.

(4) Any private or public water supply sources, including type of use, within one half mile of the proposed groundwater discharge zone.

(5) Any wastewater disposal systems, which are within one half mile of the proposed groundwater discharge zone.

(6) Any public utilities which are within one half mile of the proposed groundwater discharge zone.

(7) Any source water protection areas (or wellhead protection areas) for any community, transient, or noncommunity, non-transient public water supply as defined by RSA 485:1-Aa, within one half mile of the groundwater discharge zone.

(8) Residences or developed areas within one half mile of wastewater storage and disposal areas.

(9) Land uses and vegetative coverages within one half mile of the wastewater storage and disposal areas.

3.3 Hydrologic Study

Each groundwater discharge permit application must contain the following information based on a hydrologic study:

(1) A description and map of existing and proposed site topography, existing and proposed site drainage, and proposed retention/recapture zones.

(2) A site geologic description including a description of surficial geologic materials, estimates of hydraulic conductivity, hydraulic gradients, and seepage velocity using published surficial geology maps, published soil survey maps, or maps prepared by a Certified Soil Scientist or Professional Geologist.

(3) The location of bedrock known to be at or near the ground surface within 1,000 feet of the groundwater discharge zone.

(4) Boring log data including:

a. Soil sample descriptions according either the document titled, "Standard Classification of Soils for Engineering Purposes, Unified Soil Classification System," American Society for Testing and Materials, Designation: D2487, approved June 29, 1990, and published August 1990, updated 1993; or "Standard Practice for Description and Identification of Soils, Visual Manual Procedure," American Society for Testing and Materials Designation: D2488, approved June 29, 1990, and published August 1990, updated 1993.

b. Drilling methods.

c. "N-values" according to "Penetration Test and Split Barrel Sampling of Soil," American Society for Testing and Materials Designation: D1586, approved October 15, 1992.

(5) Well construction details of existing and proposed groundwater monitoring wells including the elevation of the top of well casings, soil boring information, Standard Penetration Test results and measured depth to the water table from the top of casing. Monitoring wells must be installed and maintained in accordance with the New Hampshire Water Well Board Administrative Rules We 602.13. It is recommended that monitoring wells be constructed with 15-foot screens installed approximately 5 feet above and 10 feet below the adjusted high groundwater level. Well construction may be modified based upon specific site conditions such as suspected seasonal high

water level fluctuations. Wells must be able to be secured and constructed so as not to allow infiltration of surface water.

(6) Soil horizon and soil profile data obtained by test pits excavated throughout the proposed disposal area. One test pit must be excavated per each 500 square feet of disposal area, with a minimum of two per proposed contiguous disposal area. Test pits shall be excavated at the furthest boundaries of the proposed disposal area. If the soil profile is consistent across the proposed disposal area, then the number of test pits may be reduced to one per 1,000 square feet, with a minimum of four test pits. The following test pit data must be provided:

a. Verify depth, type, and texture of soil based on field observations recorded in test pit logs. If bedrock rock is encountered, field personnel shall describe observations to characterize the bedrock surface such as but not limited to the degree of weathering, fracturing, and type of rock. Field personnel shall note if redoxymorphic (mottling) features (evidence of seasonal water table or seasonal saturation) or water appear to be at or near this surface at the time of observation.

b. Identify distinct soil layers.

c. Identify grain size.

d. Determine field-based soil permeability results.

e. Determine chemical soil properties such as pH, nutrient levels, and cation exchange capacity.

f. Determine root zone storage capacity.

(7) A groundwater conditions evaluation, which must include the following:

a. Depth to groundwater confirmed by field investigations (i.e., piezometers or backhoe test pits) for various seasons, including data from the period of March through May.

b. Location of perched water tables.

c. Groundwater contours.

d. Direction of groundwater movement and flow.

e. Location of groundwater seeps or discharges.

(8) An estimation of hydraulic conductivity and infiltration rate for the site. Basin loading tests, double ring infiltrometer tests, and permeameter tests may be conducted, as applicable, in accordance with certified testing methods. Basin loading tests shall be required where rapid infiltration is the proposed disposal method.

(9) An estimation of the seasonal high groundwater table utilizing redoxymorphic features when applicable, or published observation or monitoring well data according to the methodology set forth in the following publications: Frimpter, M.H. 1981, Probable High Ground-Water Levels in Massachusetts: U.S. Geological Survey Water Resources Investigations Open File Report 80-1205. Frimpter, M.H. and Fisher, M.N, 1983, Estimating Highest Ground-Water Levels for Construction and Land Use Planning – A Cape Cod Massachusetts Example: U.S. Geological Survey Water Resources Investigation Report 83-4112.

(10) A table summarizing all groundwater and surface water monitoring results to date.

(11) Nitrate, phosphorous or contaminant movement study (if applicable). No discharge may cause nitrate in a public water supply well to exceed 5 mg/l, or result in a surface water quality violation in accordance with Env-Ws 1700.

(12) Ambient water quality of the site (groundwater and if present, nearby surface water). Sampling points for monitoring ambient water quality must be provided.

(13) A consideration of the added effects of natural precipitation as it relates to soil saturation, and seasonal changes affecting both soil and groundwater characteristics. This analysis must include, at a minimum:

a. Evaluate yearly rainfall, seasonal rainfall variations, and total precipitation for each month (use the wettest year in the past ten).

b. Determine the mean number of days per year with temperatures less than or equal to 32°F (O°C).

c. Determine mean wind velocities and prevailing direction.

d. Determine potential water loss through evapotranspiration.

e. Evaluate plant growing seasons and periods of highest nutrient/water uptake.

(14) An analysis of the ability of the site to accept and disperse flow at the proposed maximum monthly flow rate for 90 days.

(15) An evaluation of the potential for groundwater mounding, the presence of confining layers, and unsaturated receiving material thickness and estimated aerial extent. Mounding calculations or modeling must be evaluated for maximum monthly flow for a period of 90 days. The evaluation must include (if applicable) the effect of impermeable or semi-permeable barriers within the potential groundwater mound. These would include but not be limited to foundations and retaining walls. Characterization of difference between the mounding material and the native material must be done to account for difference in infiltration rate and preferential flow direction.

(16) A proposal for an appropriate groundwater monitoring well network based upon known or inferred groundwater flow direction under various seasonal conditions and geology (must include both up gradient, cross gradient, and down gradient locations). The exact number of monitoring points should be based upon site complexity, proximity to sensitive areas, or design of the system.

(17) A proposal for a water level and water quality monitoring program. The program must include a sampling plan for both wastewater and monitoring wells installed within the groundwater discharge zone. The sampling plan must also include any nearby surface water bodies. The purpose of the sampling plan is to ensure that the discharge of wastewater will not cause water quality standards to be violated outside of the groundwater discharge zone immediately, or over time. A water level monitoring plan must be maintained to: 1) Ensure the land application of wastewater does not exceed design standards specified in Section 4.0; and 2) Verify the extent of mounding and the direction of seasonal groundwater flow and velocity under discharging conditions.

(18) An evaluation of likely impacts on current and potential down gradient and cross gradient receptors as identified in Section 3.2.

(19) If within a source water protection area (or wellhead protection area), an evaluation of the time of travel from discharge to the source of supply. Recharged wastewater must have a travel time of two

years or more to any public water supply well or intake, unless enhanced treatment process or controls combined with other natural hydrologic influences justify an allowance of a shorter travel time.

(20) Delineation of a groundwater discharge zone in which all contamination associated with the discharge will be contained.

(21) Demonstration with the facility design and siting parameters described in Section 4.0.

a. For rapid infiltration, demonstration with the design parameters specified in Section 4.1.

b. For slow rate application, demonstration with the design parameters specified in Section 4.2.

c. For spray irrigation of golf course turf, demonstration with the design parameters specified in Section 4.3.

3.4 Final Hydrologic Design and Operational Parameters

Each groundwater discharge permit application utilizing reclaimed wastewater must contain the following information describing operational parameters of the proposed facility:

(1) A complete description of the facility, its intended capacity, and type of wastewater that will be discharged. Supporting information describing the process involved in the pretreatment, treatment, storage, or disposal of wastes should be included in the description.

(2) A detailed description of the wastewater to be discharged, including:

a. Discharge characteristics, including calculations and analytical results if available.

b. Volume of discharge.

c. Hydraulic loading rates (including seasonal, peak, and monthly averages).

(3) Proposed discharge schedule.

(4) Location and number of discharge points.

(5) A detailed proposal for a groundwater and surface water quality monitoring program, including proposed monitoring schedule, parameters to be analyzed, and monitoring locations with supporting information justifying the locations, frequency, and parameters selected.

(6) Status of DES' approval of design plans and operations and maintenance manuals for the wastewater treatment system in accordance with Env-Ws 700.

3.5 Standard Site Control Measures

Each groundwater discharge permit application utilizing reclaimed wastewater must contain the following information demonstrating that adequate site control measures are in place:

(1) A groundwater discharge zone map, using a tax map as a base, which identifies and locates, to the extent ascertainable, the following:

a. A groundwater discharge zone boundary.

b. Any deeded easements, which restrict the use of the groundwater within the zone.

(2) Proof of ownership of the groundwater discharge zone including documentation filed in the registry of deeds, which acknowledges that easement ownership rights have been obtained to restrict the use of water wells within the groundwater discharge zone.

3.6 Facility Plan

Each groundwater discharge permit application utilizing reclaimed wastewater must contain a facility plan prepared in accordance with the following:

(1) The plan shall include a title, a legend, and a true north arrow.

(2) The plan shall be drawn to scale and the scale shall be noted on the plan and include a graphic scale bar.

(3) The base plan sources from which the facility plan was derived shall be noted on the plan.

(4) The location, elevation, and datum of a bench mark shall be included, but if a bench mark referenced to National Geodetic Vertical Datum (NGVD) is within 1,000 feet of the facility, elevation shall be recorded using NGVD and the source of the NGVD bench mark information shall be noted on the plan.

(5) The plan shall identify and locate, to the extent ascertainable, the following:

a. Existing and proposed groundwater monitoring wells that will be monitored.

b. Surface water sampling points.

c. Groundwater contours which show groundwater flow direction within 100 feet of the groundwater discharge zone.

d. Surface waters within 1,000 feet of the groundwater discharge zone.

e. Areas where deeded easements restrict the use of groundwater.

f. A groundwater discharge zone boundary.

g. Land surface contours within 100 feet of the groundwater discharge zone.

h. Piezometers used to develop groundwater contours and/or monitor groundwater mounding.

i. Table of water level measurements and elevations found in piezometers and monitoring wells used to develop the groundwater contours.

j. Soil borings and test pits within 1,000 feet of the groundwater discharge zone.

k. Physical structures and buildings associated with facility.

l. Surface and underground storage tanks associated with the facility.

m. Underground utilities at the facility.

n. Subsurface drains at the facility.

4.0 DESIGN CRITERIA FOR WASTEWATER LAND TREATMENT AND/OR DISPOSAL METHODS

Final effluent disposal to the land or subsurface must be by means of properly designed facilities. This section provides general guidelines for developing land treatment facilities that use the following disposal methods for treated wastewater:

1) Rapid Infiltration (RI) systems.

2) Slow Rate infiltration (SR) systems.

3) Spray irrigation of turf at golf courses.

Other methods of discharge may be allowed on a case-by-case basis provided adequate documentation is presented to DES, which demonstrates the estimated impact on the environment and hazard to public health resulting from such alternate system. This documentation shall include either results of a properly monitored pilot test performed with Departmental approval at the proposed discharge site or the results of tests and/or actual experience at other similar locations. It may be necessary to develop a reserve area to dispose of wastewater in the event the facility main disposal area cannot be operated.

Below, some basic facility siting and design guidelines are provide for various wastewater land treatment and disposal methods. Note that these guidelines supplement the standard information required for all new groundwater discharge permit applications associated with wastewater land treatment and disposal that are listed in Section 3.0 of this document.

4.1. Rapid Infiltration (RI) Systems

RI systems achieve treatment and disposal by rapid infiltration of primary or secondary effluent into alternately dosed shallow basins over highly permeable soil. RI systems provide treatment as wastewater percolates through the soil. RI systems require a minimum of primary treatment although secondary treatment has often been provided at existing facilities. When RI basins follow aerated lagoons, filtration for algae control is sometimes necessary to prevent surface clogging. Soil permeability is most often the factor limiting the application rate but a particular constituent in the wastewater may also limit the application rate. Very little of the applied wastewater will be lost to evaporation. RI systems typically achieve a high level of treatment.

Hydraulic Loading Rate

The design average annual hydraulic loading rate for rapid infiltration should be calculated as follows:

$$L_w = I \times (24 \text{ hr/day}) \times N \times f$$

Where:

- L_w = annual design loading rate, in inches per year
- I = measured infiltration rate, in inches per hour
- N = number of operating days per year, in days per year
- f = design application factor expressed as a decimal that ranges from 2 to 15 percent of the measured infiltration rate depending on type of infiltration test conducted

Drying periods are required for RI systems to allow the soil to aerate and recover between application periods. Because wastewater application is not continuous, the actual wastewater application rate is greater than the annual design loading rate. The actual application rate is calculated according to the following formula:

$$RA = \frac{Lw \text{ x operating cycle in days}}{365 \text{ x application period in days}}$$

Where:

- RA = actual application rate in inches per day
- Lw = average annual design loading rate, in inches per year

Typical RI system design loading rates vary from 50 to 400 feet per year. Basin bottom area requirements for rapid infiltration are calculated from the following formula:

$$A = \frac{Q \text{ (gal/day) x 365 day/yr}}{(0.083 \text{ ft/in.) x Lw (in./yr) x 7.48 gal/ft}^3\text{) x 43,560 ft}^2\text{/acre}}$$

Where:

- A = basin bottom area in acres
- Q = wastewater flow in gallons per day
- Lw = average annual design loading rate in inches per year

This formula is applicable if flow equalization or storage is available. When equalization is not available, the daily wastewater flow should be adjusted to provide for the highest flow rate anticipated on a weekly, monthly, or seasonal basis. Additional basins may be provided to accommodate periods of high flow. RI basins can operate on a year-round basis therefore storage may not be necessary. However, it has been found useful to dose the basins with a large flow from storage, particularly when daily flows are small. Small continuous flows are more susceptible to freezing than a large dose of warmer wastewater. For winter operation, the formation of an ice cover is encouraged, as each dose of wastewater should float the ice to allow infiltration to occur under the ice surface. Storage may also be needed if soil permeability is relatively low and the water drains so slowly that freezing occurs.

Site Investigation

Special emphasis should be placed on site geology and field verification of soil characteristics when developing RI basins. RI basins generally require deep, permeable soils with percolation rates of one inch per hour or more. A complete hydrogeologic evaluation must be completed to predict the range of the effluent plume and the point of breakout. Site investigations must include depth of soil to groundwater or bedrock, topography, and groundwater movement. Depth to groundwater and bedrock at several locations during the field investigation must be determined. Test pits and permeability tests must determine the location and infiltration rate of the most restrictive soil layer in the basin. Adequate test pits and monitoring wells must be constructed to define the movement of groundwater. Soil conditions beyond the RI basin site must be verified to ensure that percolate will flow away from the site.

Measurements of infiltration rates using flooding basin tests should be conducted whenever possible, and must be conducted when rapid infiltration is the only method for disposing of wastewater. Alternative methods of measuring can overestimate the infiltration rate. Depending on the soil type, application rates may vary from 4 to 120 inches per week. The minimum distance from the application surface to groundwater or an impervious layer should be 10 feet prior to application. A groundwater mounding analysis should be performed to estimate the vertical and horizontal extent of the effluent plume. After application, mounding should be no closer than 2 feet to the basin bottom. The design should include multiple dosing basins to avoid overdosing individual basins. Allow sufficient drying time between doses on individual basins. At the very least, the surface of the basin should be dry prior to the next dosing. Chemical analysis of the soil is recommended to determine if the accumulation of phosphorus or nitrogen in the soil may limit design. A complete background sampling and analysis of groundwater is also recommended. Site management should ensure long-term treatment by controlling the hydraulic and nitrogen loading rates.

Treatment Performance

RI systems can remove relatively high levels of BOD (biochemical oxygen demand) and TSS (total suspended solids) through filtration, soil adsorption, and bacterial decomposition. Nitrogen removal does not always occur, but removals from 40 to 90 percent have been reported at some sites. Nitrogen removal is a function of biological denitrification and occurs through modified operating procedures that ensure an anoxic period. Denitrification is affected by the BOD-to-nitrogen ratio (optimally 3:1), hydraulic loading rate, and the ratio of flooding time to resting time (basin rest periods may range from 5 to 20 days). Phosphorus removal occurs from soil adsorption and chemical precipitation. Detention time in the percolate zone in relation to the proximity of monitoring wells must be estimated. Short-circuits may occur, yielding false high phosphorus content in the groundwater. Nitrogen and phosphorus may be limiting factors at a given RI site, particularly if the existing groundwater aquifer approaches or exceeds state drinking water limits.

Maintenance Requirements

Periodic cutting should be conducted to control vegetation on basin slopes and bottom areas. Cuttings should be removed. Exterior basin slopes and surrounding grounds should be cut regularly to discourage burrowing animals and tree roots from penetrating the basin embankments.

4.2 Slow Rate (SR) Systems

Slow rate systems achieve treatment and disposal by slow rate application of primary or secondary effluent (i.e., typically spray irrigation) onto moderately permeable cultivated or forested land. Special emphasis should be placed on field verification of soil characteristics when designing SR systems. A certified soil scientist should conduct a high-intensity soil survey when a detailed soil survey is not available. Even when published data are available, field confirmation and refinement of soil properties in the areas to be used is necessary. A hydrogeologic evaluation must be performed to quantify site hydrogeologic capacity based on the soil and groundwater information required by Section 3.0 of this document.

Hydraulic Loading Rate

Soil permeability should be mid-range for spray irrigation. When soils are rapidly permeable, rapid infiltration basins are generally a better treatment choice. Typical soil permeabilities for spray irrigation as a means of effluent disposal are in the range of 0.2 to 2.0 inches per hour and are normally associated with loamy soils. Soil permeability is typically a limiting factor in the design of SR systems. Depending on the soil type, slope, depth to groundwater, and depth to an impermeable layer, application rates may vary from 0.5 to 4.0 inches per week (including precipitation). Vegetation selection directly affects the level of pre-application treatment, type of distribution system, and hydraulic loading rate. The type of vegetative cover will determine the period of expected transpiration and the duration of the application season. Wastewater should not be disposed of using the SR method when:

- More than 0.5 inch of rain fell in previous eight-hour period.
- Frost is in the ground.
- More than one inch of snow is on the ground.
- Cannot land apply on snow if the ground is frozen and a hard crust is on the snow.
- High groundwater limits infiltration of effluent.

Surface runoff from spray sites is not allowed; and wastewater application at spray sites must cease during storm conditions. The wastewater field application area can be calculated using the formula below:

$$A = \frac{Q \text{ x } (\text{ft}^3/7.48 \text{ gal}) + dV}{Lw \text{ x } (\text{ft.}/12 \text{ in.}) \text{ x } (43{,}560 \text{ ft}^2/\text{acre})}$$

Where:

- A = field area, in acres
- Q = wastewater flow, in gallons per day
- dV = net loss or gain in stored water volume because of precipitation and/or evaporation, in cubic feet per day
- Lw = design hydraulic loading rate, in inches per day

Hydraulic loading rate must be calculated on a site-specific basis using the water balance equation:

$$Lw = ET - P + Wp$$

Where:

- Lw = wastewater hydraulic loading rate based on soil permeability, in depth per time
- ET = design evapotranspiration rate based on the estimated average evapotranspiration of the crop, in depth per time
- P = design precipitation rate based on total precipitation for the wettest year in a 10 year period, in depth per time
- Wp = design percolation rate as measured in the field, in depth per time

In this formula, the precipitation rate should be the wettest year in the past 10 years. The percolation rate should be based on field measurements. If permeability varies across the site, conservatively determine the average value of permeability based on different soil types. The design percolation rate should not exceed 4 to 10 percent of the minimum soil permeability. Use the lower percentage for poorly defined soil conditions. A water balance should be calculated using the equation above for each of the 12 months of the year to determine the annual loading rate. Consideration must be given to the agronomic rate for the selected vegetative cover at the application site. Typical spray irrigation systems in New England use sprinklers for wastewater application and apply 3.5 to 6.5 feet per year.

Nitrogen may be a limiting factor at a given SR site. If this is the case, percolate nitrogen should be limited to a maximum of 10 mg/L total nitrogen.

<u>Site Investigation</u>

Chemical analysis of the soil is recommended to determine if the accumulation of nitrogen may limit system design. In general, minimum depth to an impervious layer prior to application ranges from one to five feet. The minimum vertical separation from the ground surface to the actual water table during the period of spray application ranges from one to three feet.

<u>Treatment Performance</u>

Slow rate systems can achieve greater than 90 percent BOD^5 (5-day biochemical oxygen demand test) removal from primary effluent, up to 90 percent BOD^5 removal from secondary effluent, nearly complete pathogen reduction, and significant nitrogen and phosphorus reduction. BOD^5 removal is achieved by filtration, soil adsorption, and bacterial oxidation. Phosphorus is removed by soil adsorption and chemical precipitation. Nitrogen is removed through plant uptake, nitrification/denitrification, and storage in the soil. Pathogens are similarly removed in addition to other reductions by radiation and exposure to adverse environmental conditions. Effluent disinfection immediately prior to SR application will ensure pathogen reduction and is required when the potential for human contact exists. Pathogens, particularly viruses, are adsorbed to soil particles in the first 20 inches (0.5 m) under the infiltrative surface. In cool, moist conditions they can remain viable for more than a year, and may desorb under saturated conditions. Therefore seasonal high groundwater cannot inundate the treatment zone even if effluent application is not occurring at the time. High groundwater may not be an issue if the effluent to be applied is pretreated to at least secondary levels and is disinfected immediately prior to application.

4.3 Water Reuse as Irrigation for Golf Courses or Other Landscaping Applications

Proposals to use reclaimed wastewater on golf courses or other landscaping applications are based on a SR system design, however, these proposals must satisfactorily address public health related issues and demonstrate that the permitted treatment plant can successfully achieve and maintain the water quality described in the ambient groundwater quality standards (AGQS). (AGQS as defined in RSA 485-C:2, I, namely "maximum concentration levels for regulated contaminants in groundwater which result from human operations or activities, as delineated in RSA 485-C:6."). A best management practices (BMP) plan must be submitted that demonstrates how operation of the treatment and disposal systems and the facility or land use itself will be managed to minimize exposure to humans and prevent direct contact with reclaimed water. The applicant must also submit a plan to monitor the impacts that the project has on ground and surface water quality and the performance of the land use components that are considered part of the treatment system. For example, if turf on a golf course is meant to remove nitrogen from treated wastewater, the performance of the turf must be demonstrated through sample acquisition below the root layer.

Best Management Practices (BMP)

The implementation of golf course management protocols is an integral part of the goal of minimizing health risks through minimizing exposure to humans. There are a multitude of construction, and operation and maintenance practices that can be employed at golf courses to minimize human exposure. BMPs are considered a “working” part of the overall system approval, as important to minimizing risk through exposures as generating an acceptable effluent and insuring proper treatment train performance. As part of the groundwater discharge permit application process, DES must review and approve a facility management plan that describes in detail the types of BMPs that will be employed at the spray irrigation facility. Depending upon the type of land use, the geologic setting, the sensitivity of local water resource areas and the risk of human exposure, many or all of the following practices/protocols must be employed where spray irrigating reclaimed wastewater:

- Spray irrigating during non-use hours utilizing low trajectory sprayers.
- Public awareness signs indicating use of reclaimed water.
- Nutrient management plan reflecting fertilizer application and nutrients in sprayed wastewater.
- Storage ponds designed for maximizing water quality.
- Provide appropriate cross-connection/backflow preventing devices and the color coding of potable vs. non-potable piping and fixtures.
- Emergency contingency plans and contracts with a spray irrigating system vendor.
- Procedure for immediate switch-over to a non-growing season disposal system.
- No ponding of sprayed water may result.
- Outside plumbing fixtures must have locking caps and be labeled as non-potable water.
- Wind speed measurements must be correlated to spraying practices.
- Appropriate buffers to spray irrigated water must be imposed.

- Education of facility personnel responsible for irrigation practices.

Buffers and Barriers

To reduce the risk of human exposure, the establishment of natural barriers and buffers to eliminate aerosol drift must be undertaken by facilities spray irrigating reclaimed wastewater:

- Areas of the facility receiving sprayed treated effluent must be a minimum of 400 feet from buildings, drinking water wells, Class A surface water bodies and surface water intakes.
- Areas of the facility being sprayed with potable water need not employ barriers or setbacks.
- To further reduce the risk of human exposure, spray irrigation of treated effluent must take place during nonoperational hours.
- There can be no spray irrigation of reclaimed water within 100 feet of any property line, wetland or surface water body.
- Irrigation systems must be designed to avoid any surface ponding, the spraying of paved or impermeable areas or the creation of any surface runoff.
- Irrigation systems should be designed to avoid spraying building and dwellings, decks, garages, driveways and roads.

In some instances, hedges or trees may be used to create barriers and reduce setback requirements. This will be considered on a case-by-case basis.

Treatment

Wastewater reused for irrigation at golf courses must meet more stringent reclaimed water quality standards and collect sample wastewater effluent water quality more frequently because of the potential of human contact with the disposal areas. Effluent used at golf courses must receive secondary treatment, be filtered and be disinfected. Except for certain nutrients discussed below, effluent sprayed onto golf courses must meet ambient groundwater quality standards. Permits that do not impose a drinking water standard for nitrogen, nitrate or phosphorous may be issued to enhance fertilization practices. In order for permits to reflect the allowance of a different nutrient limit for reclaimed water, golf course fertilization practices must include a reduction in artificially applied fertilizer. For example, a golf course that receives reclaimed water with a nitrogen concentration of 30 mg/l from a nearby treatment plant must demonstrate that the number of pounds of nitrogen dissolved in the reclaimed water is taken into account when fertilization plans for the course are considered. There should effectively be a weight for weight reduction in artificially applied fertilizers. This issue must be addressed in the BMP plan.

Storage Ponds

Man-made irrigation ponds designed to store reclaimed water must be designed to minimize biological influences that would adversely affect the quality of the stored water. These design factors include, but are not limited to:

- Lining the pond.

- Pond aeration.

- Promoting pond circulation by properly locating inlet and outlet structures.

- The pond should be sized to allow for frequent recycling of pond water. One pond volume equivalent should be pumped frequently allowing for the addition of fresh reclaimed water and the evacuation of old water.

- Runoff from fertilized areas must be directed away from ponds.

Man-made storage and/or irrigation ponds should be located so that they do not present a physical hazard to the public. Appropriate warning signs should be placed around the pond(s) indicating that direct contact with water and/or sediment could pose a health risk. The perimeter of the pond(s) should be landscaped to impede direct access to the water by exploratory children and youth.

5.0 ADDITIONAL INFORMATION

Contact Mitch Locker at 271-xxxx or mlocker@des.state.nh.us or Stephen Roy at 271-3918 or sroy@des.state.nh.us for additional information regarding the use of wastewater to recharge aquifers.