WASTEWATER FACILITIES PLAN
for the
TOWN OF EXETER, NEW HAMPSHIRE

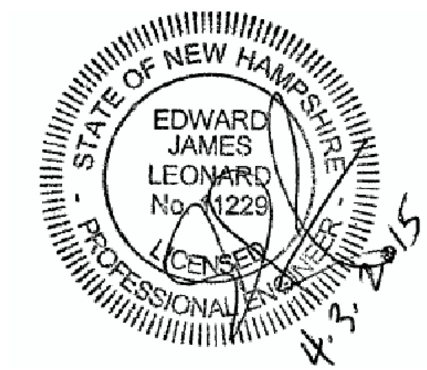
March 2015

WRIGHT-PIERCE
Engineering a Better Environment

TOWN OF EXETER, NEW HAMPSHIRE

WASTEWATER FACILITIES PLAN

MARCH 2015



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TOWN OF EXETER, NEW HAMPSHIRE

WASTEWATER FACILITIES PLAN

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B	TECHNICAL DATA AND MEMORANDA
C	SUPPORTING INFORMATION FOR PLANNING-LEVEL COST ESTIMATE

SECTION 1

EXECUTIVE SUMMARY

1.1 INTRODUCTION

The Town of Exeter owns and operates a wastewater collection, treatment and disposal system which serves the Town of Exeter as well as small portions of the Towns of Stratham and Hampton. The collection system includes 9 pumping stations and approximately 51 miles of sewers. There are approximately 3,600 wastewater accounts.

The wastewater treatment facility (WWTF) is an aerated lagoon facility with disinfection that was constructed in 1964 and comprehensively upgraded in 1988. The WWTF discharges effluent into a tidally-influence segment of the Squamscott River (Class B), upstream of the Great Bay. The WWTF outfall has a dilution factor of 25:1. The effluent must meet standards set forth in state and federal water quality legislation, including the Clean Water Act. The WWTF effluent quality requirements are contained in a National Pollutant Discharge Elimination System (NPDES) permit which is issued by the US Environmental Protection Agency (EPA).

EPA issued a new NPDES permit to the Town in December 2012, which included requirements that the existing WWTF is not able to accomplish. EPA then issued an Administrative Order on Consent (AOC) to the Town in June 2013. The AOC provides a framework and schedule for the Town to achieve compliance with the NPDES permit requirements.

1.2 PURPOSE AND ORGANIZATION OF REPORT

The purpose of this report is to provide a technical basis upon which to make wastewater management decisions necessary to comply with the AOC and NPDES permit. This report is divided into the following sections: 1) Executive Summary; 2) Wastewater Flows, Loads and Effluent Standards; 3) Evaluation of Existing Facilities; 4) Town-Wide Nitrogen Management; 5) Evaluation of Alternatives; 6) Recommended Plan ; and 7) Project Costs and Financing. A list of commonly used acronyms and abbreviations is provided in **Table 1-1**.

TABLE 1-1
LIST OF COMMONLY USED ACRONYMS AND ABBREVIATIONS

AO	Administrative Order
AOC	Administrative Order on Consent
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BOS	Board of Selectmen
CAPE	Climate Adaption Plan for Exeter
CMOM	Capacity, Management, Operations and Maintenance (for sewer collection system)
COD	Chemical Oxygen Demand
CSO	Combined Sewer Overflow
Current	Covering the dates 2011 to 2013, applied to population, wastewater flow or nitrogen load conditions
DO	Dissolved Oxygen
Future	Referring to population, wastewater flows or nitrogen loads, expected at Planning Horizon (2040)
GIS	Geographic Information System
gpd	Gallons Per Day
gpd/sf	Gallons Per Day Per Square Foot
IDDE	Illicit Discharge Detection and Elimination
I/I	Infiltration and Inflow
lb/day, lb/yr	Pounds Per Day, Pounds Per Year
mgd	Million Gallons Per Day
mg/l	Milligrams Per Liter
MS4	Municipal Separate Storm Sewer System
NHDES	New Hampshire Department of Environmental Services
NPDES	National Pollutant Discharge Elimination System
NPS	Non-Point Source
PH	Planning Horizon
ppm	Parts Per Million
PREP	Piscataqua Region Estuaries Partnership
SRF	State Revolving Fund (administered by New Hampshire Department of Environmental Services)
SSO	Sanitary Sewer Overflow
TBA	Total Buildable Area
TBO	Theoretical Build-Out
TDN	Total Dissolved Nitrogen
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorous
USEPA	U.S. Environmental Protection Agency
USGS	United States Geologic Survey
WISE	Water Integration for Squamscott-Exeter
WWFP	Wastewater Facilities Plan
WSAC	Water & Sewer Advisory Commission

1.3 CONCLUSIONS

Based on the work completed as a part of this project, the following conclusions are provided:

1. The WWTF has provided reliable service since the late 1980s; however, many of the equipment and building systems are reaching the end of their useful life and will require comprehensive upgrades in order to provide continued reliable service for the planning period. In addition, the WWTF will require significant modifications in order to meet the AOC requirements (i.e., less than 8 mg/l effluent total nitrogen) and/or the NPDES permit requirements (i.e., less than 3 mg/l effluent total nitrogen). Refer to **Section 3** for additional information.

2. Estimates of future wastewater flows were prepared based on input from the Public Works Department and Planning Department and are consistent with the Town Master Plan. Future flows are projected to be less than the NPDES permit flow limit (3.0-mgd) at the "Planning Horizon" (i.e., 2040) and at "Build-Out" (i.e., 2040 and beyond) for the Town of Exeter alone. Future flows are projected to be less than the NPDES permit flow limit at the "Planning Horizon" but slightly greater than the NPDES permit flow limit at "Build-Out" if the Stratham and Newfields were connected to the Exeter WWTF. The current NPDES permit capacity limit of 3.0-mgd can be maintained if the Towns commit to removing infiltration/inflow as the 3.0-mgd limit is approached. Refer to **Section 2** for additional information.

3. The AOC requires that the Town upgrade the WWTF to achieve 8-mg/l effluent total nitrogen or better. Based on the Town's evaluative criteria, the recommended approach is to upgrade the existing facility to achieve 5 mg/l effluent total nitrogen. In the future, if required by EPA, this system can be upgraded to achieve 3 mg/l effluent total nitrogen. The Town will utilize either On-Site Alternative No. 2 (Bardenpho) or On-Site Alternative No. 3 (SBR). The Town will evaluate the specific advantages/disadvantages of these alternatives early in the preliminary design phase. The Town will also evaluate phasing alternatives in detail early in the preliminary design phase. Refer to **Section 4** and **Section 5** for additional information.

4. The AOC requires significant efforts by the Town to track and account for increases and decreases in point source and non-point sources loadings of total nitrogen from the Town to the Exeter/Squamscott River and Great Bay. Non-point sources include storm drainage, fertilizer, septic systems, animal wastes and atmospheric deposition. This effort is expected to require collaboration between the Public Works, Planning and Building Departments. Refer to **Section 4** for additional information.

5. Per the AOC, the Town needs to fund and develop a town-wide Nitrogen Control Plan by September 2018. This Nitrogen Control Plan should be an "integrated plan" (i.e., meaning that the NPDES, AOC and MS4 requirements are addressed in concert with each other). This will allow the Town to address the nitrogen management problem holistically and over the longest potential compliance timeframe. The WISE report will address this topic in greater detail.

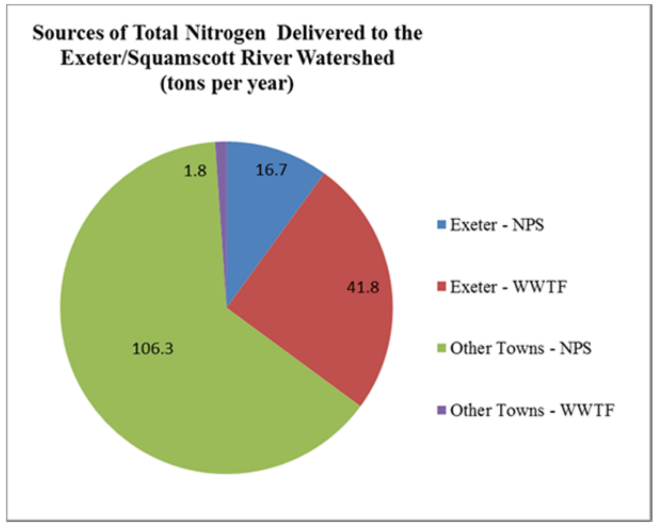
6. The amount of nitrogen reduction required is very dependent on the regulatory threshold (i.e., the allowable nitrogen load to the river/bay) and there is uncertainty associated with the current threshold criteria established by NHDES. The ultimate determination as to the appropriate threshold will take many years to play out and will have significant cost implications.

7. It is critical for the Town to establish a river monitoring program, in collaboration with other towns and NHDES, in order to establish baseline water quality information and to allow refinement of allowable threshold nitrogen loadings. While there is a relatively long-term record of data in Great Bay, such data does not exist for the Squamscott River or the Exeter WWTF. The upcoming Great Dam removal and WWTF upgrade will introduce major changes in the data record for the river. The Town should establish a robust monitoring program, based on sound science, as well as a calibrated water quality model, in order for the Town, NHDES and EPA to properly assess the environmental benefits resulting from these significant capital expenditures. Refer to **Section 4** for additional information.

8. Based on the NHDES Great Bay Nitrogen Non-Point Source Study (June 2014, Appendix H), the nitrogen from septic systems which are located greater than 200 meters from a 5^{th} order river receives *significant natural attenuation* whereas septic systems which are located closer than 200 meters to a 5^{th} Order River receive little to no natural attenuation. Existing parcels

which are located closer than 200 meters should be considered for potential sewer extensions or for private nitrogen removing septic systems. Moving forward, new development within 200 meters of a 5th order river should not be allowed to use a conventional septic system. Refer to **Section 2** and **Section 4** for additional information.

9. The AOC and NPDES permit requires the Town to remove significant amounts of nitrogen from the Exeter River/Squamscott River watershed. Under current conditions, Exeter represents approximately 35% of the total nitrogen load to the Exeter River/Squamscott River watershed. The Town should aggressively pursue a watershed funding source for additional point source and non-point source nitrogen controls. The Town should consider partnering with other "point source communities" through the Great Bay Municipal Coalition and/or the Southeast Watershed Alliance to foster a watershed-based regional revenue generation approach. Refer to **Section 4** for additional information.



Total Delivered Load – 167 tons/year

Source: NHDES-GBNNPS, June 2014

To put this in perspective:

- ***Exeter's contributes 8.4 lbs/capita/year to the Exeter/Squamscott River watershed as compared to the 7.4 lbs/capita/year from the other 15 communities in the watershed.***
- ***The "upper threshold value" (based on river dissolved oxygen) is equivalent to 6.2 lbs/capita/year across the watershed.***
- ***Once the WWTF upgrade is completed in 2018, Exeter's contribution will be reduced to 4.4 lbs/capita/year – substantially less than the other watershed communities.***

10. The loadings described above represent current conditions; development within the watershed will increase these loadings. Whereas most of Exeter's development potential is within the sewered area, Exeter's future development should have a lower nitrogen footprint due to the fact that sewage will be treated at a new WWTF. That said, other non-point source nitrogen

reduction strategies will be advisable to prevent making the nitrogen challenge larger and more costly. This is especially true for the other watershed communities that do not have a WWTF and that have the significant potential to dramatically increase future nitrogen loadings to Great Bay under a "business as usual" approach to managing development. The importance of engaging the other watershed communities on the topic of regulating nitrogen from new development cannot be overstated.

11. There are two on-going planning projects which will provide information, analysis and conclusions that are essential to the Town's decision making process with regard to the WWTF and its regional upgrade options. These projects – the WISE project and the Portsmouth Pease Regional WWTF Alternative – are expected to be completed in March/April 2015 and April/May 2015, respectively. Refer to **Sections 4 and 5** for additional information.

12. There is a clear downward trend in peak system flows based on the infiltration/inflow reduction efforts initiated in the late 1990's and continued to present. There is also a downward trend in average system flows. This is a result of the Town's considerable infiltration/inflow removal efforts. This trend should be re-assessed in Spring 2015 to incorporate the results of the on-going and recently completed efforts with private inflow removal from Phillips Exeter Academy and the Jady Hill neighborhood. Refer to **Section 2** for additional information.

13. The Town's WWTF influent sampling program indicates that there is a relatively small data set with relatively large variability. The detailed supplemental sampling program should be continued until there is a sufficient body of data on which to base the design of its upgraded wastewater treatment facilities. In addition, the Town should investigate the impacts of the Exeter Water Treatment Plant discharge as well as potential impacts of industrial user discharges to the variability of the influent concentrations. This topic represents significant uncertainty in terms of the cost of the recommended plan. Refer to **Section 2** for additional information.

1.4 PROJECT COSTS AND FINANCING

The recommended plan, and its estimated cost, is described in detail in **Section 6**. The funding and financing implications are described in detail in **Section 7**. The recommended facilities are estimated to cost approximately $51,870,000 to design/construct and $1,150,000 annually to operate (upon start-up in 2018), both expressed in 2014 dollars. The estimated annual Sewer Fund revenue requirements from the Town of Exeter, including the debt and O&M for the new facility, are $5,889,000. These cost estimates are for the recommended facilities as identified in **Section 6** (i.e., WWTF upgrade for a 3.0-mgd facility design to achieve 5-mg/l, Main Pump Station Upgrade, Main Pump Station forcemain upgrade, watermain to the DPW complex and lagoon decommissioning activities). It is important to note that these costs do not include the following:

- Cost saving opportunities identified in **Section 6**. These opportunities to reduce or defer project costs should be explored as an early task in preliminary design.
- Additional costs associated with the non-point source nitrogen reductions or other AOC related compliance items described in **Section 4**.

These project costs are significant and will have a significant impact on the average sewer user rate. Based on the funding assumptions described in **Section 7**, the total annual Sewer Enterprise Fund would increase to approximately $5,889,000 (*with no State Aid Grant but with 15% SRF principal forgiveness*). This results in a 140% increase in the Sewer Enterprise Fund annual budget. If the State of New Hampshire re-establishes the State Aid Grant program, the total annual Sewer Enterprise Fund would increase to approximately $5,039,000 and would result in a 105% increase in the existing Sewer Enterprise Fund annual budget.

In order to mitigate these impacts to the sewer user rates, the following grant funding sources should be aggressively pursued: NHDES State Aid Grant (SAG) and SAG Plus grants; US Economic Development Administration grants; and Unitil grants. The Town should also review and revise, as appropriate, all of its other sewer-related fees.

It is important to note that DES has issued a moratorium on new SAG and SAG Plus grant applications as of July 1, 2013. To this end, we recommend that the Town:

- Get involved with the New Hampshire Municipal Association's on-going effort to maintain this important grant program.
- Get involved with efforts to create a State Water Trust Fund, which was recommended by the SB60 Joint Legislative Study Commission created to study water infrastructure sustainability funding.
- Begin contacting grant agencies and assembling grant application materials.
- Lobby NHDES for a significant principal forgiveness allocation for this project.

1.5 PROJECT IMPLEMENTATION

The Administrative Order on Consent (AOC Docket No. 13-010) puts forth a specific implementation schedule, as described in greater detail in **Section 4**. The October 2014 preliminary draft of this report has been on the Town's website since November 2014. In addition, the preliminary draft report was presented to a joint meeting of the Water and Sewer Advisory Committee and Board of Selectmen in December 2014 (televised meeting). Accordingly, the following key implementation steps are recommended:

1. Submit this report to NHDES and EPA.
2. Review the WISE report, CAPE report and Pease Regional Evaluation report when they are issued. Determine whether they modify any conclusions identified herein.
3. Engage NHDES, EPA and neighboring communities regarding watershed-wide reductions in non-point source nitrogen loadings, allocation of nitrogen removal responsibilities and watershed-wide revenue sources.
4. Initiate efforts to review the Town's ordinances as well as the Southeast Watershed Alliances' model stormwater ordinance. This review should identify ordinance updates and revisions that will minimize the increase of future nitrogen from current and future development.
5. Engage the Southeast Watershed Alliance and watershed communities on establishing lawn chemical fertilizer and agricultural best management practice measures that can produce low

cost nitrogen reductions as well as establishing development standards that can ensure future development has the lowest practicable nitrogen footprint.

6. Engage NHDES and WISE to further study the anticipated future reductions in atmospheric deposition sources of nitrogen. Near-field (e.g., automobiles) and far-field (e.g., power plants) of nitrogen have/will continue to decline due to EPA air pollution control regulations.
7. Engage Stratham and Newfields regarding the inter-municipal contractual details if the Exeter intends to serve as a regional host facility for wastewater treatment.
8. Engage grant funding agencies including NHDES, EDA and Unitil. Complete grant funding applications for portion(s) of the project which are eligible and supported.
9. Consider phasing and other cost saving and affordability strategies.
10. Review sewer user fees, as well as all other fees, and determine whether revisions are appropriate.
11. Formalize rate increases based on the final project financing scenario.
12. Implement the recommended upgrades in accordance with the approved project schedule.
13. Continue with monitoring, study, planning and implementation of non-point source nitrogen management to comply with the AOC (refer to **Section 4** of this report).

A preliminary implementation schedule for the recommended plan is presented in **Table 1-2**.

TABLE 1-2
IMPLEMENTATION SCHEDULE

Item	**Milestone Dates**
Planning	
Submit Report to NHDES and EPA	March 2015
Review WISE, CAPE and Portsmouth Reports, when available	March to May 2015
Finalize Decision regarding On-Site or Off-Site Treatment	May to July 2015
Develop and Submit Grant Applications	April to October 2015
Design, Bidding & Award	
Design	April 2015 to June 2016
Bidding & Award	June to September 2016
Town Meeting Funding Authorizations	
Design Funding	Completed (March 2014)
Construction Funding	March 2016
Construction	
Initiate Construction (AOC)	June 30, 2016 (1,2)
Substantially Complete Construction (AOC)	June 30, 2018 (1,2)
Meet Interim TN NPDES Permit (AOC)	June 30, 2019 (1)
Other	
TN Annual Reports (on-going)	2015 to 2018
Squamscott River Monitoring (on-going)	2015 to 2018
Review regulations, ordinances and bylaws (e.g., stormwater, fertilizer control, nitrogen management, etc.)	2015 to 2016
Total Nitrogen Control Plan (AOC)	September 30, 2018 (1)
Nitrogen Reduction Projects	To be determined
Nitrogen Engineering Evaluation (AOC)	December 31, 2023 (1)

Notes:

1) AOC specified deadline
2) The Town will likely require an AOC schedule extension; however, additional evaluations will occur during the preliminary design phase in order to determine how the AOC dates could be achieved. The Town continues to consider the Pease Regional WWTF option on a “dual-track” with preliminary design of the on-site WWTF option.

SECTION 2

WASTEWATER FLOWS, LOADS AND EFFLUENT LIMITS

2.1 INTRODUCTION

This report summarizes current land use, population trends and wastewater flows and loadings for the Exeter Wastewater Treatment Facility (WWTF). Daily data has been collected and analyzed from the past seven years of plant operations. This data will be used as the baseline for the projected future flows and loadings. A summary of the current permit requirements as well as potential future permit requirements are also presented in this section.

2.2 LAND USE AND POPULATION DATA

Land use and zoning information presented herein is based on information contained in the Town Master Plan (2002, with selected updates) and the 2013 GIS database information supplied by the Town. The Town has 19 different zoning districts. **Figure 2-1** depicts a simplified zoning map where all similar zoning districts have been consolidated (e.g., R-1, R-2, R-3, etc., consolidated to Residential). **Table 2-1** summarizes the total land area and remaining developable land area, as presented in the Town Master Plan.

The Town Master Plan indicates several key items related to potential future development:

- There is relatively limited buildable acreage in the Industrial, Office and Commercial Districts (page LU-6)
- there is a fair amount of buildable acreage in Residential Districts (page H-34)
- The Town does not plan to extend the sewer service area (page LU-30) and future residential development outside the sewered area will rely on septic systems (page LU-12)

Since the development of the Town Master Plan, there have been discussions with Stratham regarding potentially extending sewer service into Stratham to a designated area along Route 108 and there has been some consideration of potentially extending sewer service to the High School in the future if septic system maintenance and replacement becomes problematic.

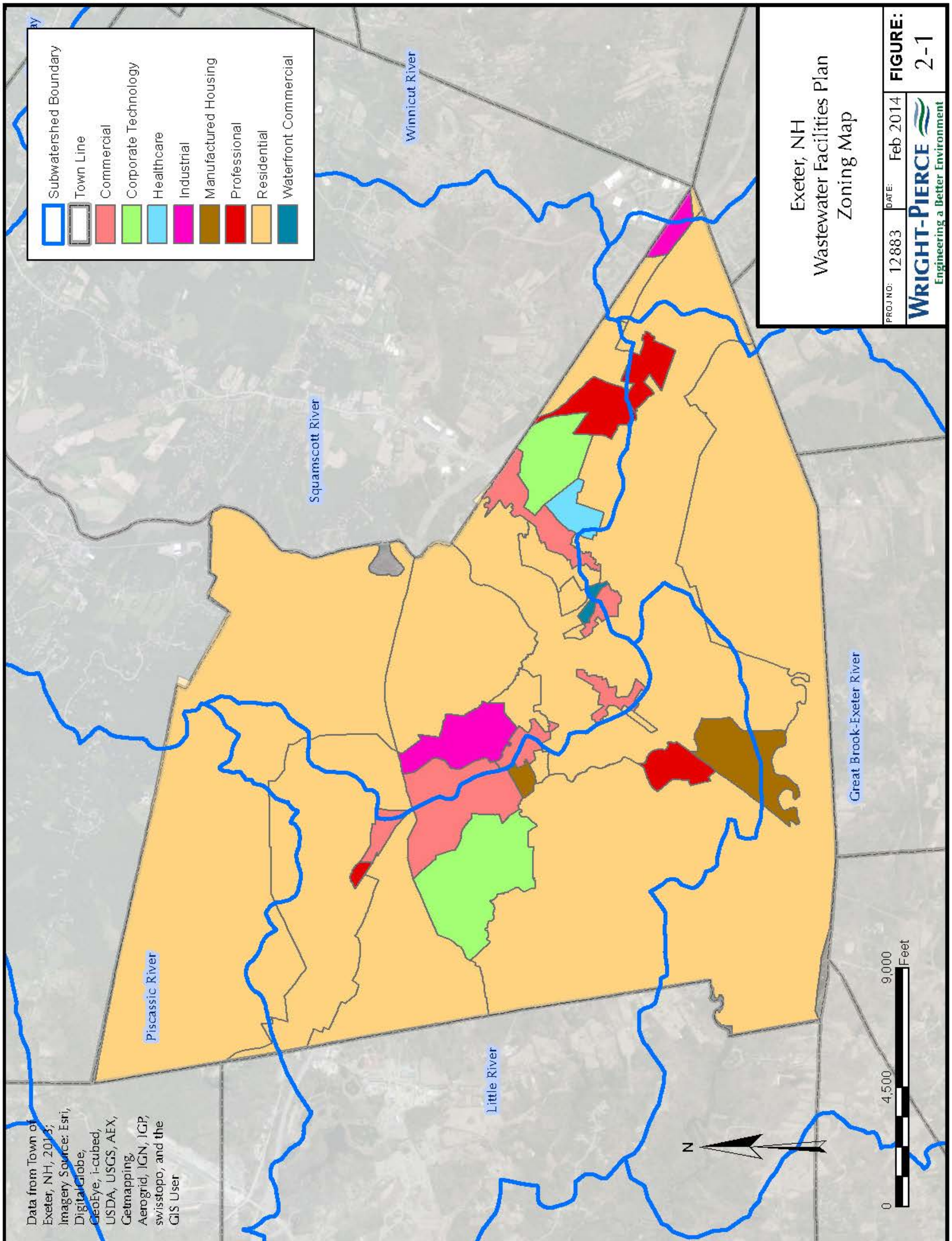

Subwatershed Boundary
Town Line
Commercial
Corporate Technology
Healthcare
Industrial
Manufactured Housing
Professional
Residential
Waterfront Commercial
Winnicut River
Squamscott River
Piscassic River
Little River
Great Brook-Exeter River
Exeter, NH
Wastewater Facilities Plan
Zoning Map
PROJ NO: 12883
DATE: Feb 2014
FIGURE: 2-1
WRIGHT-PIERCE
Engineering a Better Environment
Data from Town of Exeter, NH, 2013; Imagery Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User
0
4,500
9,000
Feet
N

TABLE 2-1
SUMMARY OF LAND USE AND BUILDABLE ACRES

Development Zone	Total Land Area (acres)	% of Total Land Area	Total Land Area Remaining as Developable[1] (acres)	% of Total Land Area Remaining as Developable [1]
C-1 Central Area Commercial	65.0	0.5%	0.0	0.0%
C-2 Highway Commercial	173.6	1.4%	46.5	26.8%
C-3 Epping Road Hwy Comm.	269.0	2.1%	112.7	41.9%
NP Neighborhood Professional	136.7	1.1%	16.9	12.4%
WC Waterfront Commercial	9.4	0.1%	0.0	0.0%
CT Corp Technology Park	145.0	1.1%	61.9	42.7%
CT-1 Corp Technology Park 1	333.7	2.6%	80.6	24.1%
PP Professional Tech Park	98.4	0.8%	28.4	28.8%
I Industrial	488.9	3.9%	135.6	27.7%
H Healthcare	44.6	0.4%	2.2	5.0%
RU Rural	2,836.3	22.4%	952.6	33.6%
R-1 Single Family	5,388.4	42.6%	1,544.1	28.7%
R-2 Single Family	2,150.2	17.0%	270.6	12.6%
R-3 Single Family	70.1	0.6%	2.3	3.3%
R-4 Multi-Family	157.0	1.2%	25.1	16.0%
R-5 Multi-Family/ Elderly	33.7	0.3%	1.3	3.8%
R-6 Retirement Community	45.2	0.4%	32.4	71.5%
M Mobile Home Park	180.5	1.4%	1.8	1.0%
MS Mobile Home Subdivision	19.7	0.2%	0.2	1.1%
TOTAL	**12,646**	**100%**	**3,315**	**26%**

Source:
1) *Town Master Plan (2002, 2010), Table H-11 – Land Area and Developable Land by Zone*.

According to the 2010 US Census, Exeter had a population of approximately 14,306 residents. Population growth in Town was significant from the 1970s to 2000; however, population growth has slowed considerably since 2000. Two previous population projections were developed for the Seacoast region – one by the New Hampshire Office of Energy and Planning (NHOEP) and the other by a consultant which incorporated input from NHOEP and Rockingham Planning Commission. A summary of past and projected future population is presented in **Table 2-2**.

TABLE 2-2
SUMMARY OF PAST AND PROJECTED FUTURE POPULATION

Date	US Census	Projected by NH OEP[1]	Projected in Seacoast Study[2]
1970	8,892	-	-
1980	11,024	-	-
1990	12,654	-	-
2000	14,098	-	14,098
2010	14,306	-	-
2020	-	14,187	-
2025	-	14,499	17,280
2040	-	14,851	-
2055	-	-	20,161

Source:
1) *New Hampshire Population Forecast by Municipality:2013.* NH Office of Energy and Planning (2013).
2) *New Hampshire Seacoast Region Wastewater Management Feasibility Study*. AECOM (2005).

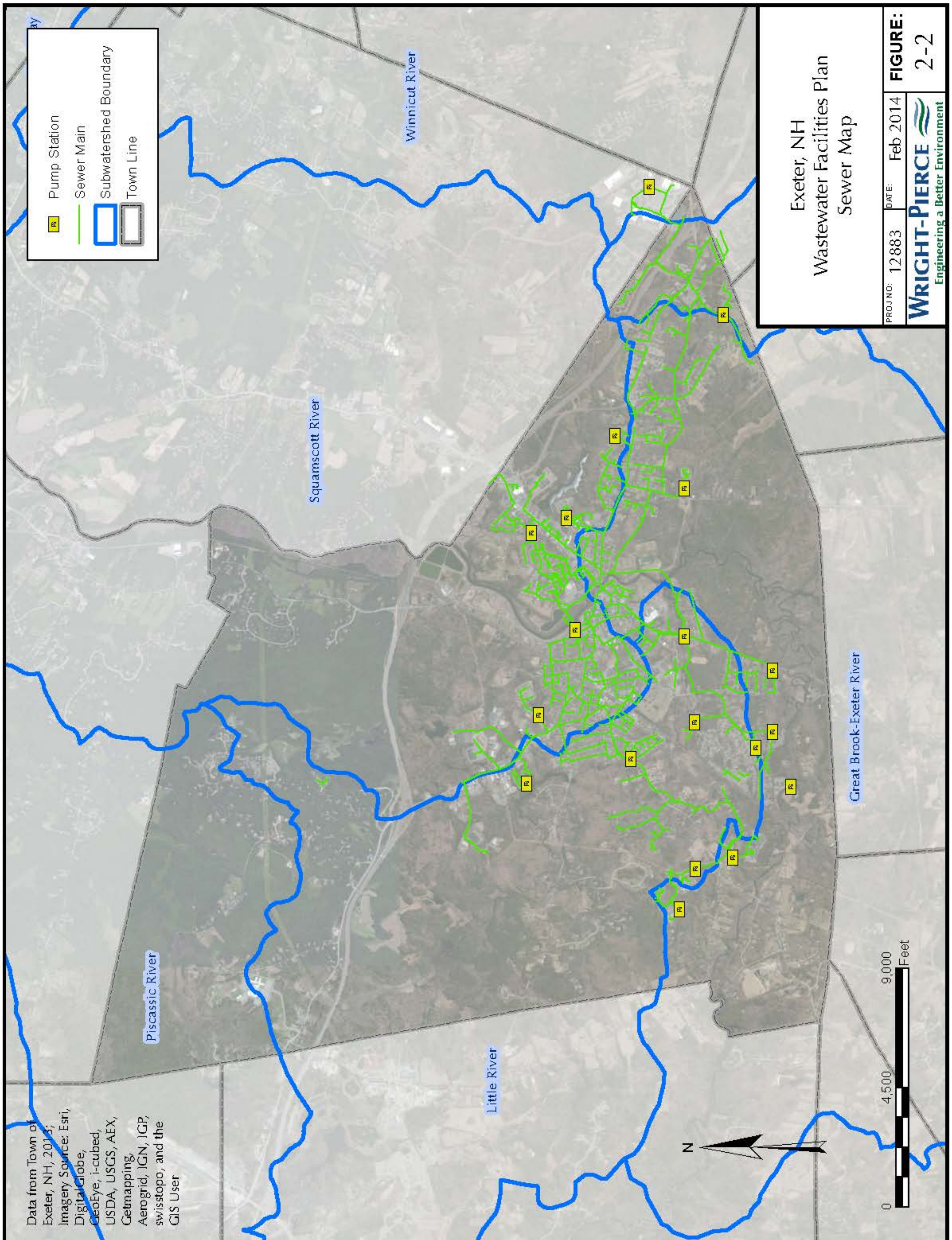
2.3 SEWER SERVICE AREA

The existing sewer service area is presented on **Figure 2-2**. Based on information contained in the Town Master Plan as well as water and sewer account information provided by the Town, approximately 85% of the housing units are served by public sewer. Additional information is summarized in **Table 2-3**.

TABLE 2-3
ESTIMATE OF SEWERED VERSUS NON-SEWERED POPULATION

	Town Master Plan (1990 Census)	Current Estimate
Total Population	12,654	14,306*
Total Housing Units	5,346	6,422*
Persons per Household	2.3	2.2*
Wastewater Accounts	Unknown	3,600 **
Housing Units Served by Public Sewer	4,522	5,000 **
% of Total Housing Units	85%	78%
Estimated Population Served by Public Sewer	10,400	11,000 **
% of Total Population	82%	77%

Note: "*" indicates 2010 Census data; "**" indicates estimated based on Town data



Pump Station
Sewer Main
Subwatershed Boundary
Town Line
Exeter, NH
Wastewater Facilities Plan
Sewer Map
PROJ NO: 12883
DATE: Feb 2014
FIGURE: 2-2
WRIGHT-PIERCE
Engineering a Better Environment
Winnicut River
Squamscott River
Great Brook-Exeter River
Piscassic River
Little River
N
0
4,500
9,000
Feet
Data from Town of Exeter, NH, 2013; Imagery Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User

2.4 CURRENT WASTEWATER FLOWS AND LOADINGS

Exeter's wastewater is generated from two general sources: *sewage flow* from residential, commercial, and industrial sources; and *infiltration and inflow (I/I)*, which is water from extraneous sources such as storm drains, cellar drains and roof leaders and is generally associated with rainfall or ground water. The Town does not currently accept *septage*, which is highly concentrated sludge from septic tanks or boat pump-outs. The current treatment process does not have any recurring *recycle* flows or loads.

Influent flow data is measured by a magnetic flow meter installed on the influent forcemain (from the Main Pump Station) in August 2010. Prior to that time, influent flow data was measured by an area-velocity insert-type flow meter in the 24-inch influent pipe in the Grit Building. Influent samples are collected just downstream of the manual bar rack by a composite sampler that was permanently installed in January 2014 (time-based composite samples). Prior to that time, influent data is based on grab samples collected from influent channel just upstream of the manual bar rack.

Effluent flow data is measured by a Parshall flume with ultrasonic flow element. Effluent samples are collected upstream of the Parshall flume just before the ultrasonic level by a composite sampler that was permanently installed in July 2013 (time-based composite samples). Prior to that time, effluent data is based on grab samples collected from the same location.

2.4.1 Data Analysis

The key flow and load conditions that have been utilized as the basis of the evaluation for unit processes are identified and defined as follows:

- <u>Annual Average</u>: This is the average of daily data for the study period. The average flows and loadings are important benchmarks, but capacity is typically controlled by other design criteria.
- <u>Maximum Month</u>: This is the maximum 30-day running average for the study period which is calculated for each parameter independently (i.e. the maximum TSS loading condition may not have occurred at the same time as the maximum month BOD loading

condition). The maximum month conditions are an important measure of sustained capacity. Note that this data is not available for nitrogen and phosphorus loadings as samples are only taken quarterly.

- Maximum Day: This is the maximum single day that occurs for each parameter during the period and, similarly to the maximum month condition, each parameter is calculated independently. The single maximum day values for the data set are reported along with the 98th percentile values. Typically, unit processes are designed to handle the peak recorded flow rate (i.e. 100th percentile) and the 98th percentile loading rates. This is done to eliminate any outliers in the data set.
- Peak Hour: This is the peak instantaneous recorded value during any one day and is only determined (and available) for flow. The peak hour flow is an important hydraulic consideration for the design of unit processes. Sufficient hydraulic capacity is typically provided for the peak recorded flow rate to prevent overtopping of channels and structures. However, individual unit processes would typically be sized for the 98th percentile flow rate.
- Minimum Day: This is the minimum recorded value during any one day and is only determined for flow. The minimum hour flow is an important hydraulic consideration for the design of unit processes to ensure that velocities are adequate to prevent solids deposition and that the unit processes are not oversized.

A review of current flows and loadings for the WWTF was conducted by analyzing data from Monthly Operation Reports (MOR) from 2007 through 2014. Flow and loadings information is presented below, summarized in **Table 2-4,** and depicted on **Figures 2-3 through 2-7**. Additional nutrient-related data was obtained from supplemental sampling conducted by WWTF as well as by third party groups (e.g., PREP). Additional “Influent Characterization” sampling was completed in 2010 and in 2014 and is presented in **Section 2.4.5**.

TABLE 2-4

SUMMARY OF WWTF INFLUENT FLOWS AND LOADS (2007 to 2014)

Parameter	Flow[1]		Influent TSS		Influent BOD	
	MGD	P.F.	mg/L	lb/day	mg/L	lb/day
Average for Individual Years						
2007	1.88	-	138	2,116	168	2,574
2008	2.34	-	127	2,407	148	2,806
2009	2.13	-	142	2,483	233	4,009
2010	2.13	-	186	3,037	164	2,809
2011	1.93	-	175	2,706	139	2,127
2012	1.58	-	185	2,423	174	2,259
2013	1.63	-	183	2,460	156	2,018
2014	1.61	-	249	3,347	186	2,449
Summary for 2007 to 2014						
Average	1.90	-	172	2,624	174	2,715
Minimum Month	1.09	0.4	87	1,215	58	890
Maximum Month	4.08	2.2	855	6,477	367	5,907
Maximum Day[3,4]	4.40	2.3	432	6,649	411	7,212
Peak Hour[5]	6.46	3.4	-	-	-	-
No. Data Points	2,922	-	388	-	388	-
Summary for 2011 to 2014						
Average	1.69	-	198	2,757	167	2,237
Minimum Month	1.16	0.7	88	1,215	75	890
Maximum Month	2.81	1.7	855	9,989	393	4,655
Maximum Day[3,4]	3.90	2.3	1,020	14,713	540	6,309
Peak Hour[5]	5.75	3.4	-	-	-	-
No. Data Points	1,461	-	181	-	100	-

Notes:

1. Flows are recorded by area-velocity insert flow meter from 2007 to August 2010.
2. Flows are recorded by magnetic flow meter on influent forcemain from August 2010 to present.
3. Maximum Day values for BOD and TSS are based on 98th percentile of collected data
4. Maximum Day Flow is based on 99th percentile of collected data.
5. Peak hour flow is not recorded. Peak hour flow is estimated by a TR-16 peaking factor of 3.4.
6. All data is based on Grab samples.

FIGURE 2-3
WWTF INFLUENT FLOWS (MGD)

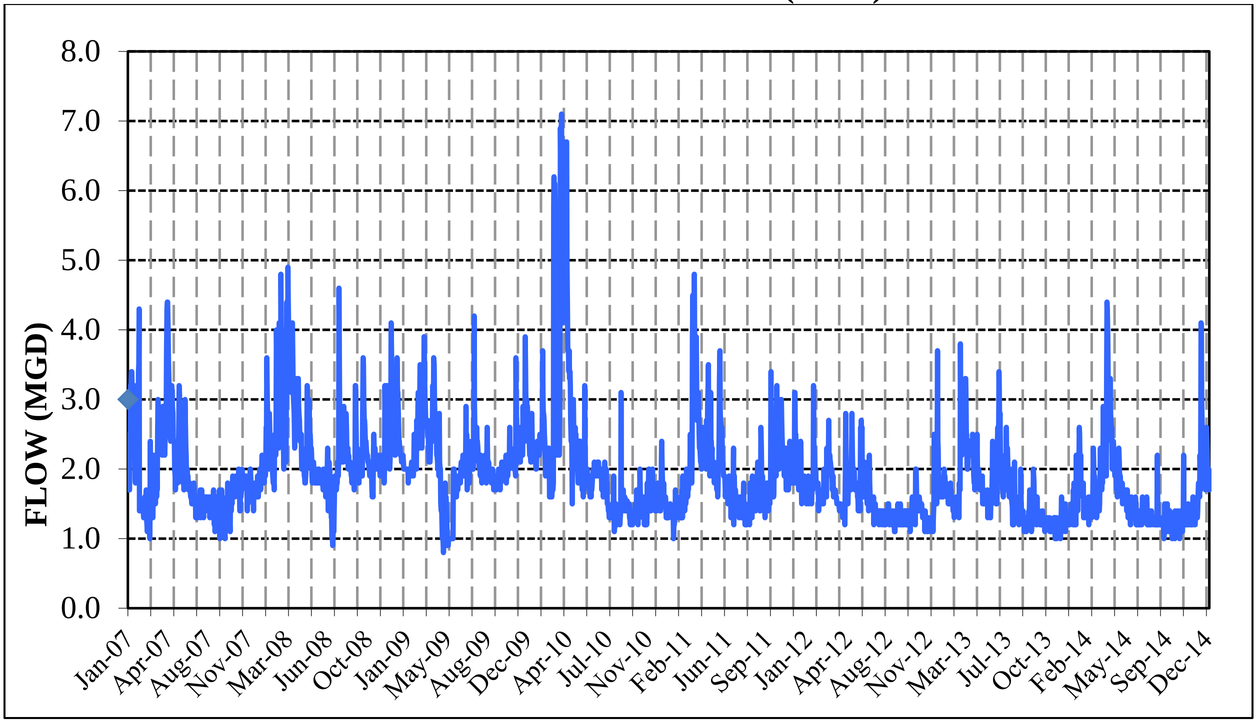


FIGURE 2-4
INFLUENT FLOW – EVENT FREQUENCY

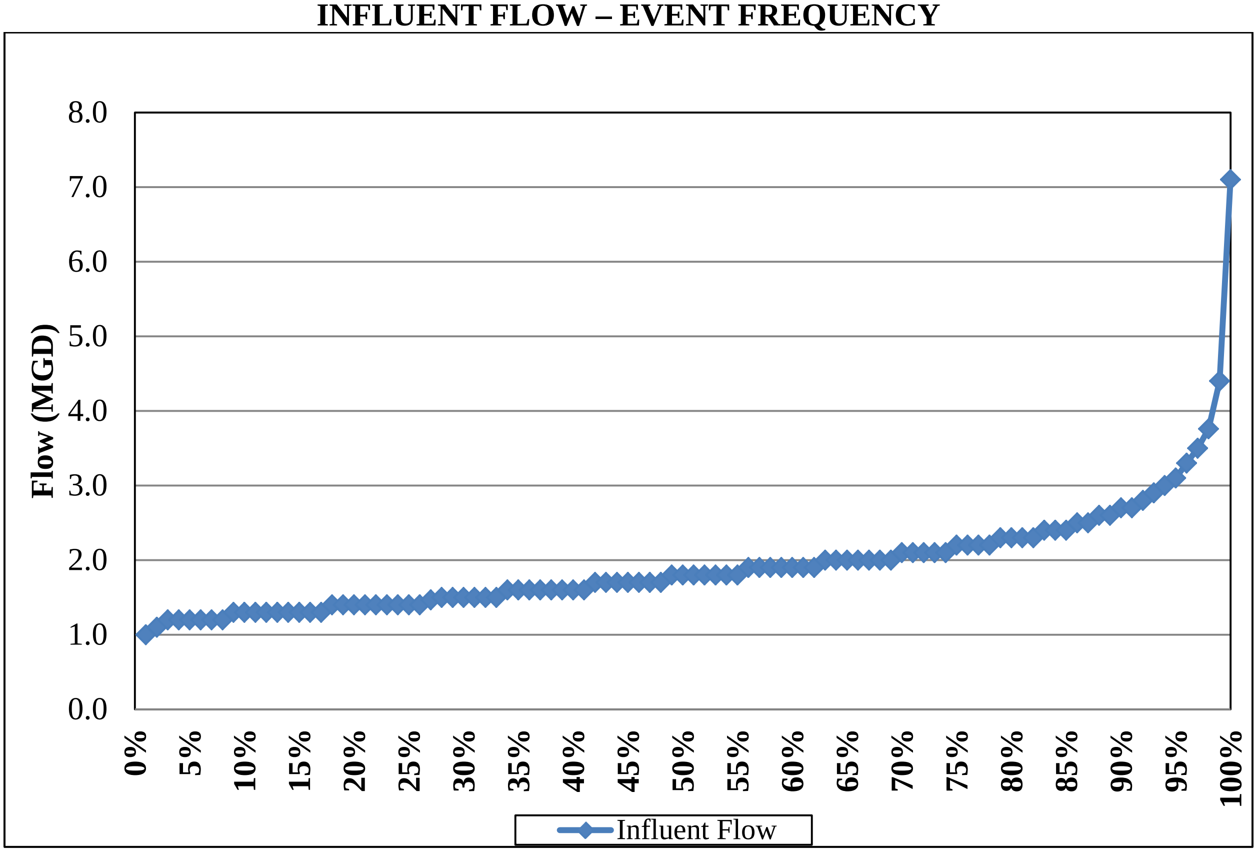


FIGURE 2-5
INFLUENT BOD & TSS MASS LOADINGS

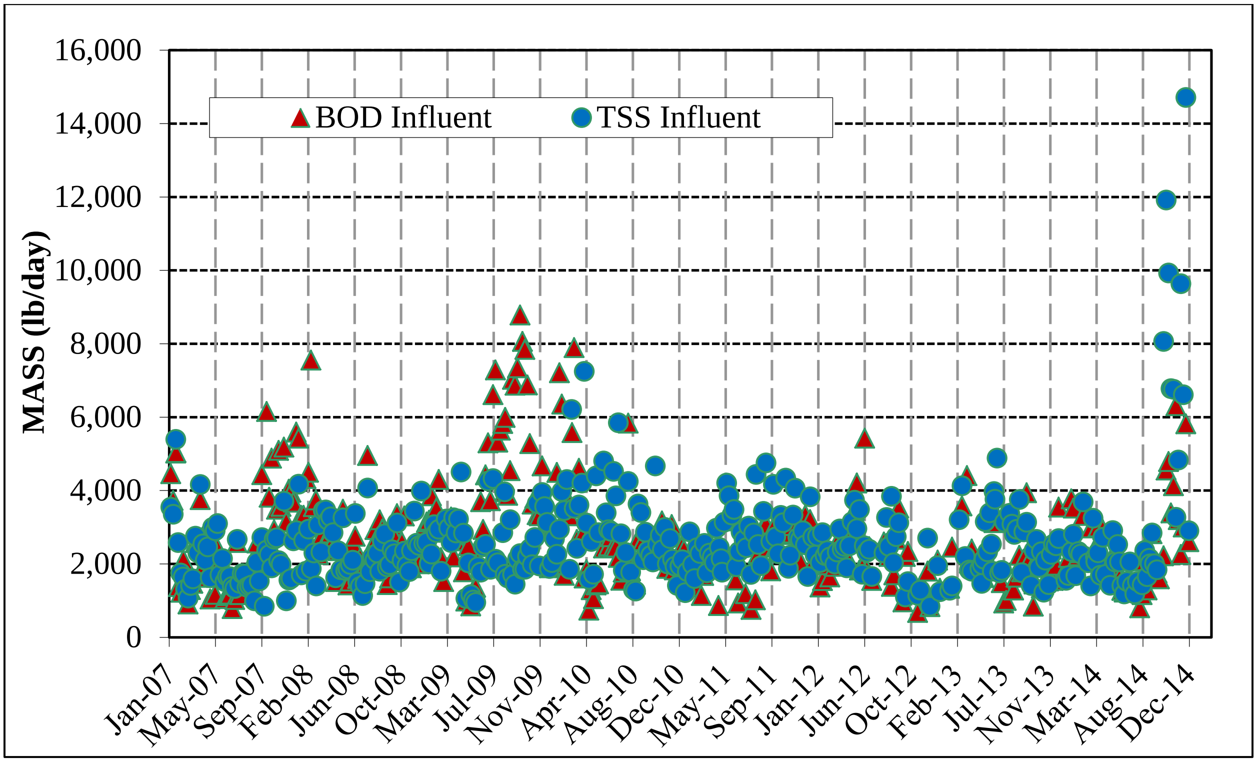


FIGURE 2-6
INFLUENT BOD & TSS MASS LOADINGS – EVENT FREQUENCY

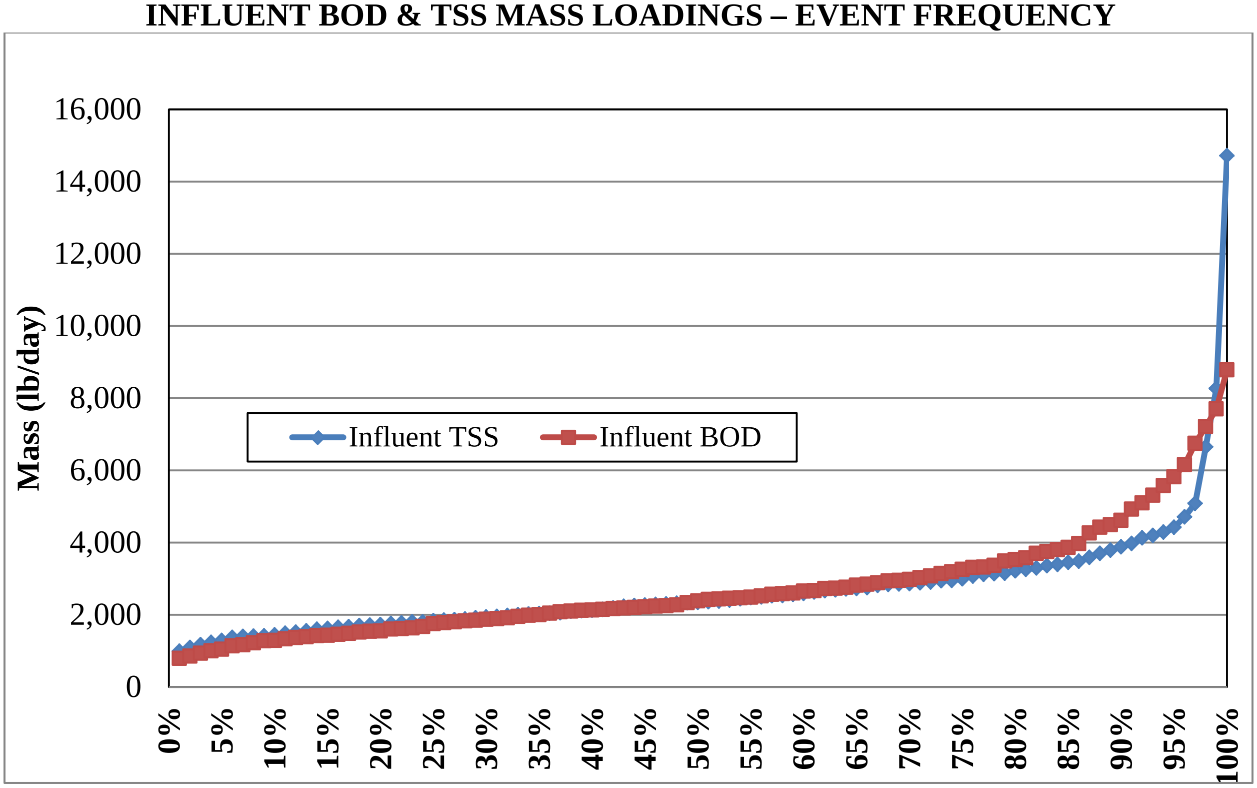
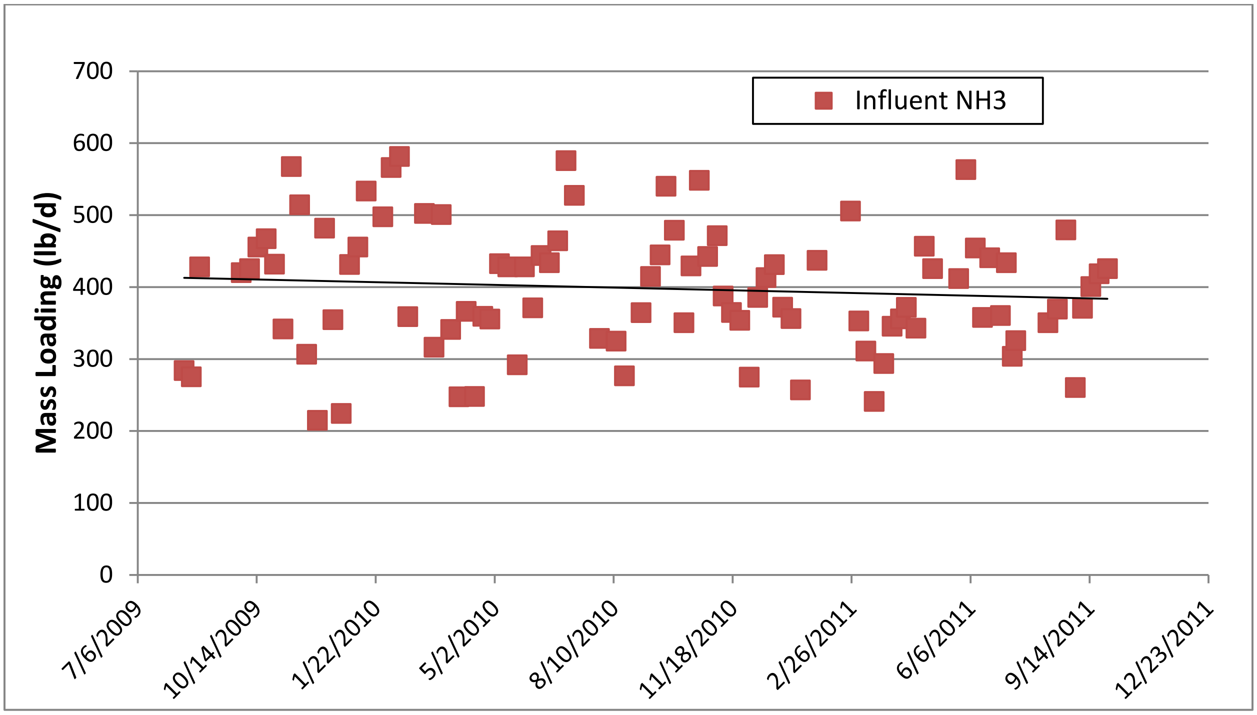


FIGURE 2-7
INFLUENT AMMONIA MASS LOADINGS



2.4.2 Industrial Users and Industrial Pretreatment Program

The Town's Sewer Use Regulations define industrial waste as "any process waste which is distinct from sanitary waste". Major industrial users are required to obtain an Industrial Discharge Permit (IDP) through the Town's Industrial Pretreatment Program (IPP). The definition of a major industrial user is discussed in the Sewer Regulations, but generally includes facilities with design flows over 10,000 gpd or with the requirement to install pretreatment in accordance with Federal standards. A summary of the industries which currently have an IDP is presented in **Table 2-5**. A summary of typical IPP permit limits is included in **Table 2-6.**

The Town has implemented a wastewater reduction project at the Water Treatment Plant located at the Exeter Reservoir. The project involved modifications to the "water treatment wastewater" pumping system (to reduce the peak pumping rate) and to increase on-site storage and recycling. This project is expected to significantly reduce average daily flow and peak flow rates.

TABLE 2-5
SUMMARY OF MAJOR INDUSTRIAL USERS

Name	Permitted Annual Average Flow Rate (gpd)
Exeter Hospital	48,500
Phillips Exeter Academy	7,055
Lindt	6,000
Chemtan	1,770
Cobham Defense	12,477
OSRAM	5,685
Total	81,487

Note: The Town is currently in negotiations with Lindt regarding increasing its permit from 6,000 to 30,000 gpd.

TABLE 2-6
TYPICAL INDUSTRIAL DISCHARGE PERMIT LIMITS

Parameter	Typical Limit
Annual Average/Daily Maximum Flow (gpd)	Based on Expected Flow
BOD (mg/l)	276
TSS (mg/l)	306
Oil/Grease (mg/l)	100SL/350L
pH	5.5-11.5
Temperature (°F)	150
Chromium (mg/l)	1.7
Cyanide (mg/l)	0.08
Ammonia N (mg/l)	20
Total Kjeldahl Nitrogen (mg/l)	Monitor only
Chloride (mg/l)	1500
Sulfate (mg/l)	150, 1500
Sulfide (mg/l)	1
Arsenic (mg/l)	0.004
Cadmium (mg/l)	0.001
Copper (mg/l)	0.12
Lead (mg/l)	0.013
Mercury (mg/l)	0.00004
Nickel (mg/l)	0.02
Selenium (mg/l)	0.003
Silver (mg/l)	0.038
Zinc (mg/l)	0.42

2.4.3 Inflow/Infiltration

The Town has completed numerous infiltration/inflow (I/I) studies in the past to address significant I/I flows in the system. The most recent study encompassed approximately 75% of the collection system and determined that in some areas, infiltration accounted for 20-70% of total dry weather flows and over 90% of peak wet weather flows (Underwood Engineering, 2013). The 2013 report estimated that peak I/I accounted for 63% of total system flows. I/I flows tend to be highest when the groundwater is high (spring) which can be observed in **Figure 2-3** and **Figure 2-4.** The Town has recently completed projects focused on reducing I/I, including private inflow and groundwater infiltration. A listing of I/I projects completed by the Town from 2011 to 2014 is provided below.

- Jady Hill Utility Replacement Project Phase I and Phase II (Oct 2011 to Aug 2013)
  - 8-inch diameter sewer: 5,500 lf
  - 4-inch diameter sewer services: 5,150 lf
  - 15-inch diameter storm drain: 3,540 lf
  - 18-inch diameter storm drain: 460 lf
  - 24-inch diameter storm drain: 1,065 lf
  - 4-inch diameter storm drain services: 5,280 lf

- Water Street Sewer Interceptor Improvement Project (Nov 2011 to Nov 2012)
  - 24-inch diameter sewer: 204 lf
  - 30-inch diameter sewer: 63 lf
  - 36-inch diameter sewer: 43 lf
  - New CSO Structure installed
  - Disconnected storm drain system from CSO structure
  - Re-lined 300 lf of 18-inch diameter sewer

- Water Street / Main Pump Station Sewer Manhole Rehabilitation (Nov 2012)
  - Chemically sealed and grouted SMH-902, SMH-937 and SMH-938

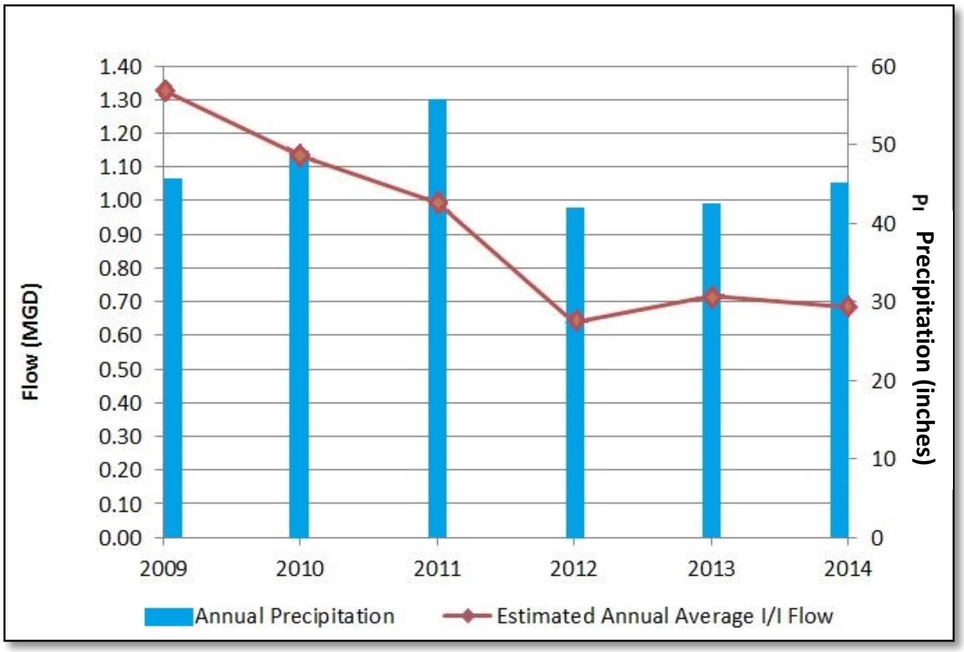
- Phillips-Exeter Academy and Spring Street I/I Removal (Aug 2013)
    - Removed Langdon Merrill Dining Hall sump pump and roof leaders from sewer
    - Removed two catch basins from sewer

- Portsmouth Avenue Water and Sewer Improvement Project (Nov 2013 to June 2014)
    - 8-inch diameter sewer: 2,550 lf
    - 10-inch diameter sewer: 250 lf
    - 6-inch diameter sewer service: 1,350lf

- Miscellaneous I/I Reduction Efforts (2014)
    - A catch basin was discovered to be tied into the sewer collection system, which was immediately disconnected. It was estimated that this connection contributed 4 to 6 million gallons per year and 2 million gallons per day peak hour flow during intense rainfall events.
    - A drain pipe that discharged to the tidal portion of the Squamscott River was found to be connected to the sewer collection system. It was estimated that 3 to 4 million gallons a day peak flow rate into the sewer during extreme high tide events from this connection. The connection was immediately disconnected from the sewer system.
    - 17 sump pumps and 2 yard drains were discovered to be discharging directly into the sewer collection system from the Phillips Exeter Academy campus. These items are in the process of being redirected to the stormwater collection system and follow up inspections are required to verify disconnection.

Figure 2-8 shows the estimated I/I flows based on a review water use records and estimated sanitary flows. In 2009, I/I represented approximately 60% of influent flows to the WWTF; whereas by 2013, I/I represented approximately 35% of the influent flows to the WWTF. **Figure 2-8** also shows annual precipitation values (National Weather Service Epping weather station). Interestingly, the strongly decreasing trend is I/I flow occurred during a period with a modest increasing trend in precipitation. The Town continues to make improvements to reduce I/I flows through regular O&M and sewer main repair/replacement projects.

FIGURE 2-8
ESTIMATED INFILTRATION AND INFLOW TRENDS



2.4.4 Septage

The Exeter WWTF does not currently accept septage flows. It is estimated that the non-sewered buildings in Exeter generate approximately 650,000 gallons per year of septage; which is currently disposed of at the Hampton WWTF (Seacoast Region Wastewater Management Study, 2005).

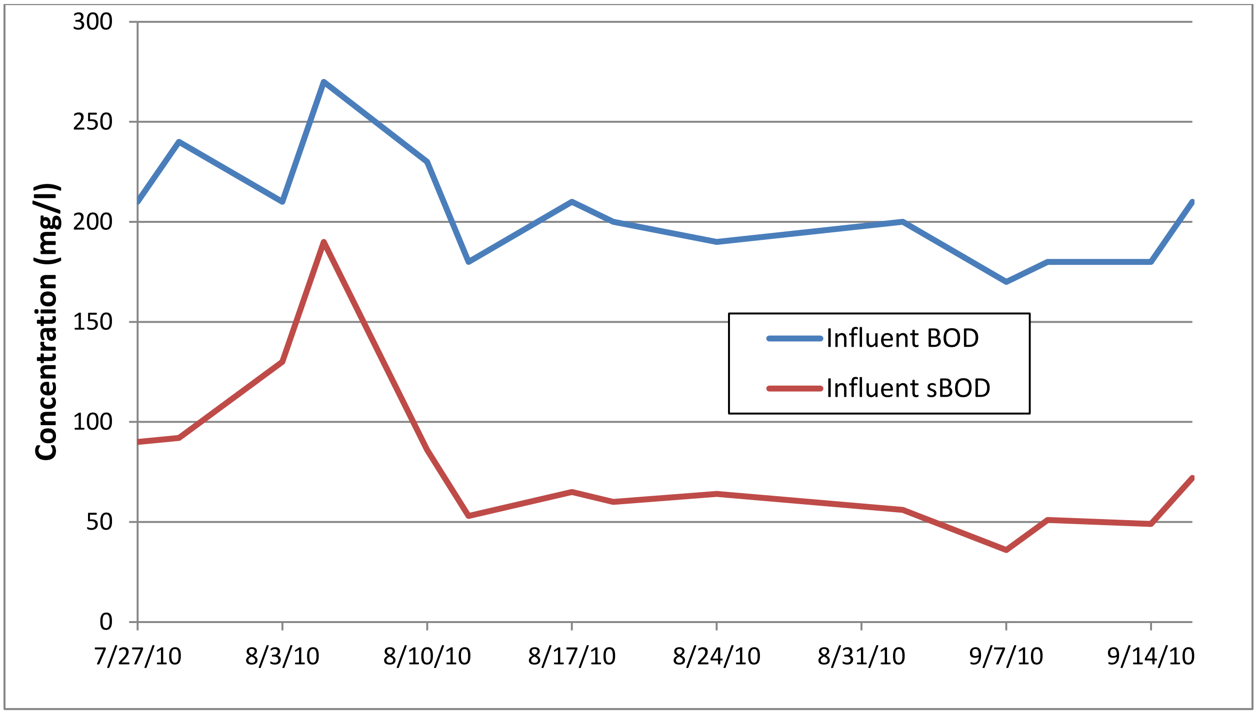
2.4.5 Supplemental Sampling Program

To gather sufficient data for a wastewater facility plan for a WWTF facing nutrient limits, a supplemental influent wastewater characterization program was implemented between July 2010 and January 2011. This data and is summarized in **Table 2-7** and was used to populate **Figures 2-9, 2-10**, **2-11** and **2-12.** The samples were time-based composites collected at the influent sampler from the influent channel. The supplemental sampling program provided composite samples necessary to determine typical influent characteristics.

TABLE 2-7
INFLUENT COMPOSITE SAMPLING DATA

Compound	Average (mg/l)	Maximum (mg/l)	Minimum (mg/l)	No. of Data Points
July 2010 to January 2011				
Total Kjeldahl Nitrogen	28	37	16	43
Ammonia Nitrogen	22	26	13	43
Organic Nitrogen	6	13	1	43
Total Suspended Solids	217	256	174	13
Volatile Suspended Solids	161	234	62	13
Biochemical Oxygen Demand (BOD)	201	263	110	18
BOD, Soluble	78	174	36	14
Chemical Oxygen Demand (COD)	226	302	150	45
COD, Soluble	150	211	86	45
Total Phosphorus	3.9	5.3	2.0	11
Ortho Phosphorus	1.9	2.6	1.1	11
BOD:TKN Ratio	7.0	9.1	5.0	14
BOD:TP Ratio	47.8	79.9	34.0	8
BOD:SBOD Ratio	3.0	4.7	1.4	14
VSS:TSS	0.74	0.95	0.27	13
January 2014 to June 2014				
Total Kjeldahl Nitrogen	24	38	13	29
Ammonia Nitrogen	21	33	12	29
Organic Nitrogen	5	13	0	22
Total Suspended Solids	311	880	120	24
Volatile Suspended Solids	280	840	116	24
Biochemical Oxygen Demand (BOD)	237	390	120	29
BOD, Soluble	58	110	36	29
Chemical Oxygen Demand (COD)	379	720	140	29
COD, Soluble	139	260	27	29
Total Phosphorus	3.7	6.9	2.3	29
Ortho Phosphorus	2.1	4.4	1.0	29
BOD:TKN Ratio	10.1	17.5	5.8	29
BOD:TP Ratio	67.9	134.5	37.5	29
BOD:SBOD Ratio	4.1	6.1	1.9	29
VSS:TSS	0.90	0.99	0.54	24
Alkalinity as CaCO3	152	220	55	28

FIGURE 2-9
INFLUENT BOD AND SBOD CONCENTRATIONS



Note: Influent BOD and sBOD samples were only taken from 7/27/2010 to 9/14/2010

FIGURE 2-10
INFLUENT COD AND SCOD CONCENTRATIONS

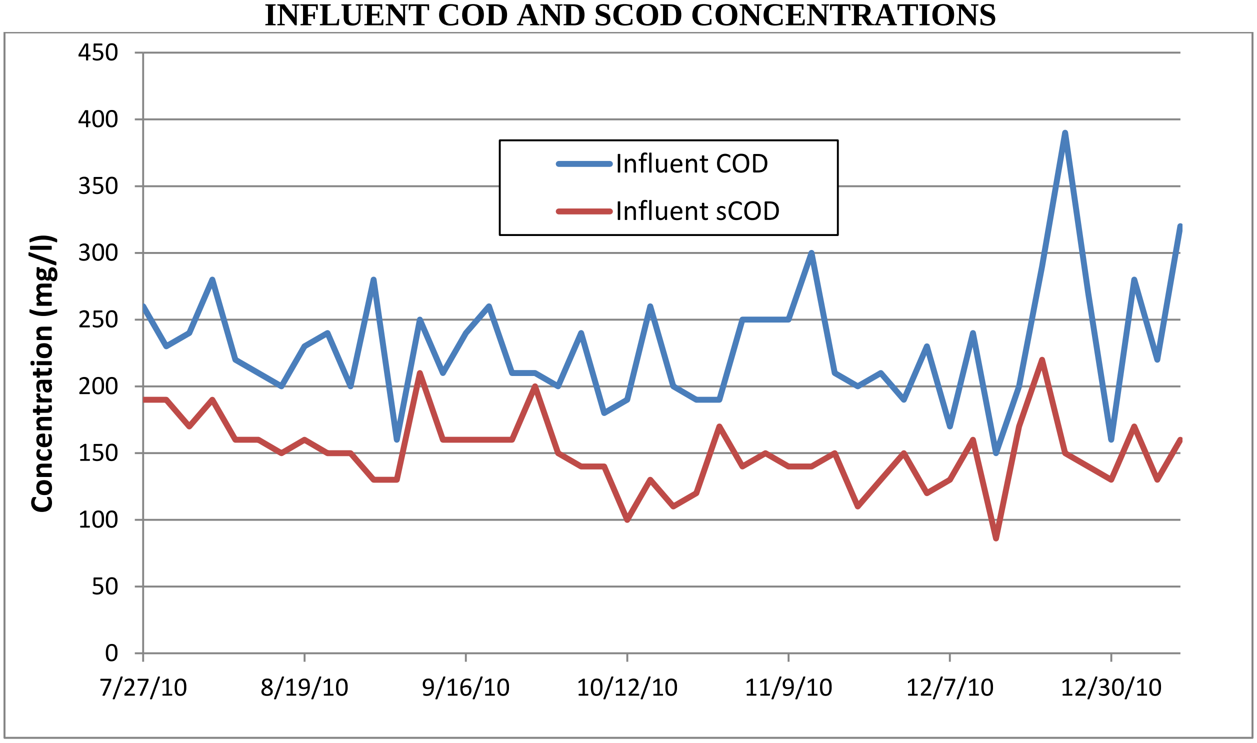
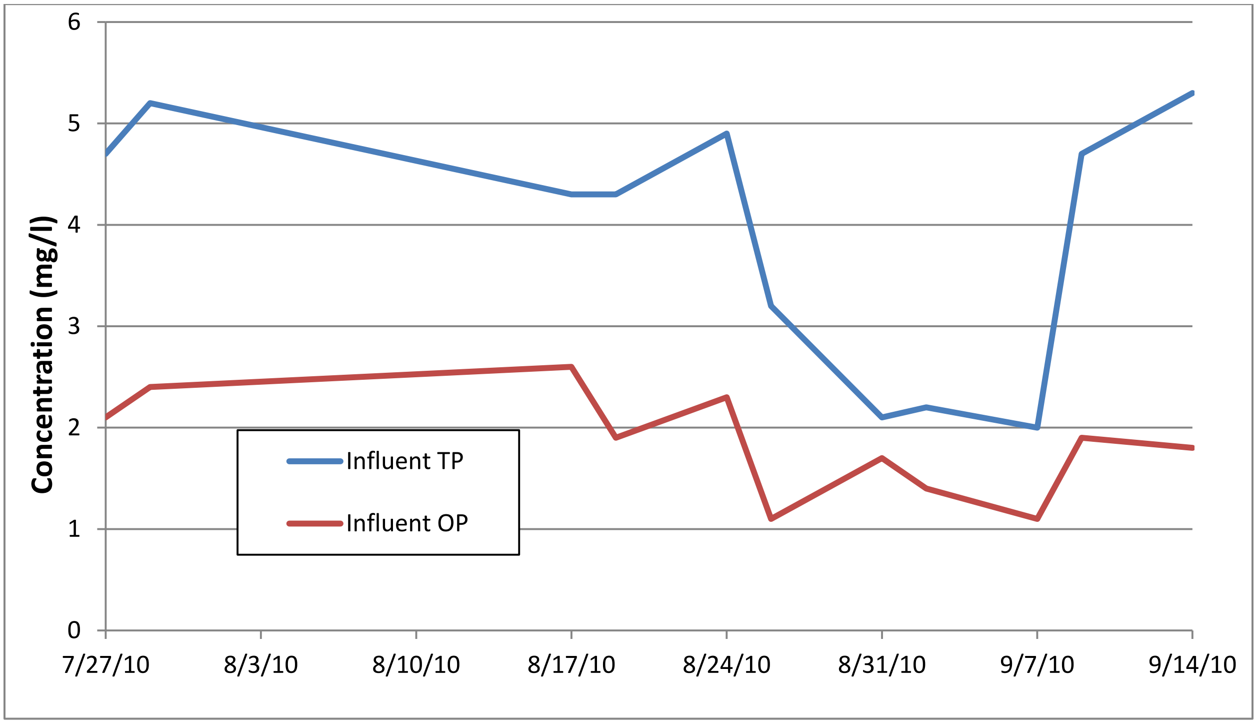
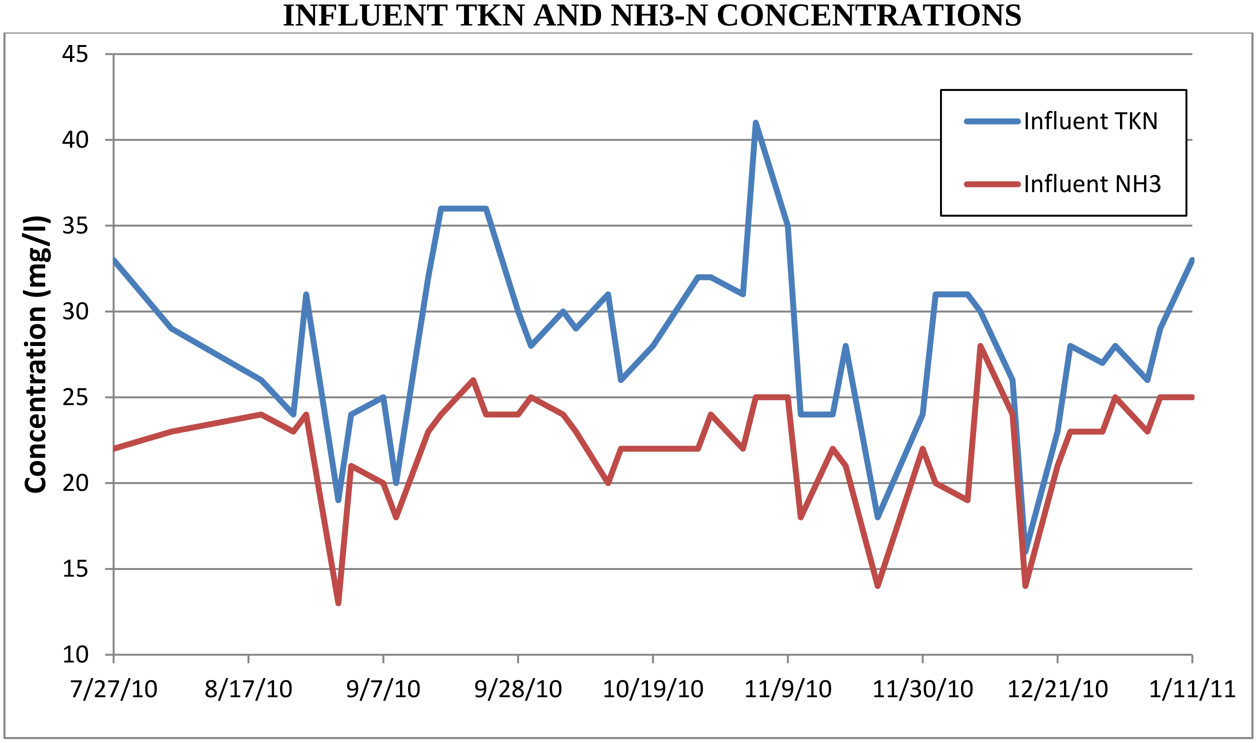


FIGURE 2-11
INFLUENT TP & OP CONCENTRATIONS



Note: Influent TP and OP samples were only taken from 7/27/2010 to 9/14/2010

FIGURE 2-12
INFLUENT TKN AND NH3-N CONCENTRATIONS



2.4.6 Combined Sewer and Sanitary Sewer Overflows

The Town has approximately 49 miles of separated gravity sewer lines, portions of which were originally constructed as combined sewers. The system still contains two diversion structures and one licensed CSO discharge (Outfall #003, located at Clemson Pond and controlled by an outlet weir and tide gates). A summary of CSO events is shown in **Table 2-7**. **Figure 2-13** depicts WWTF flows, CSO flows and CSO volumes from 2007 through 2013. The graph also portrays the "theoretical peak system flow" if all flow were captured and directed to the WWTF. In 2007, the theoretical peak daily system flow was approximately 13.0 mgd; however, the theoretical peak daily system flow has been less than 10.0 mgd since that time. Clearly, the I/I removal work completed by the Town over the past 5 years has significantly decreased rates and volumes of CSOs in the system.

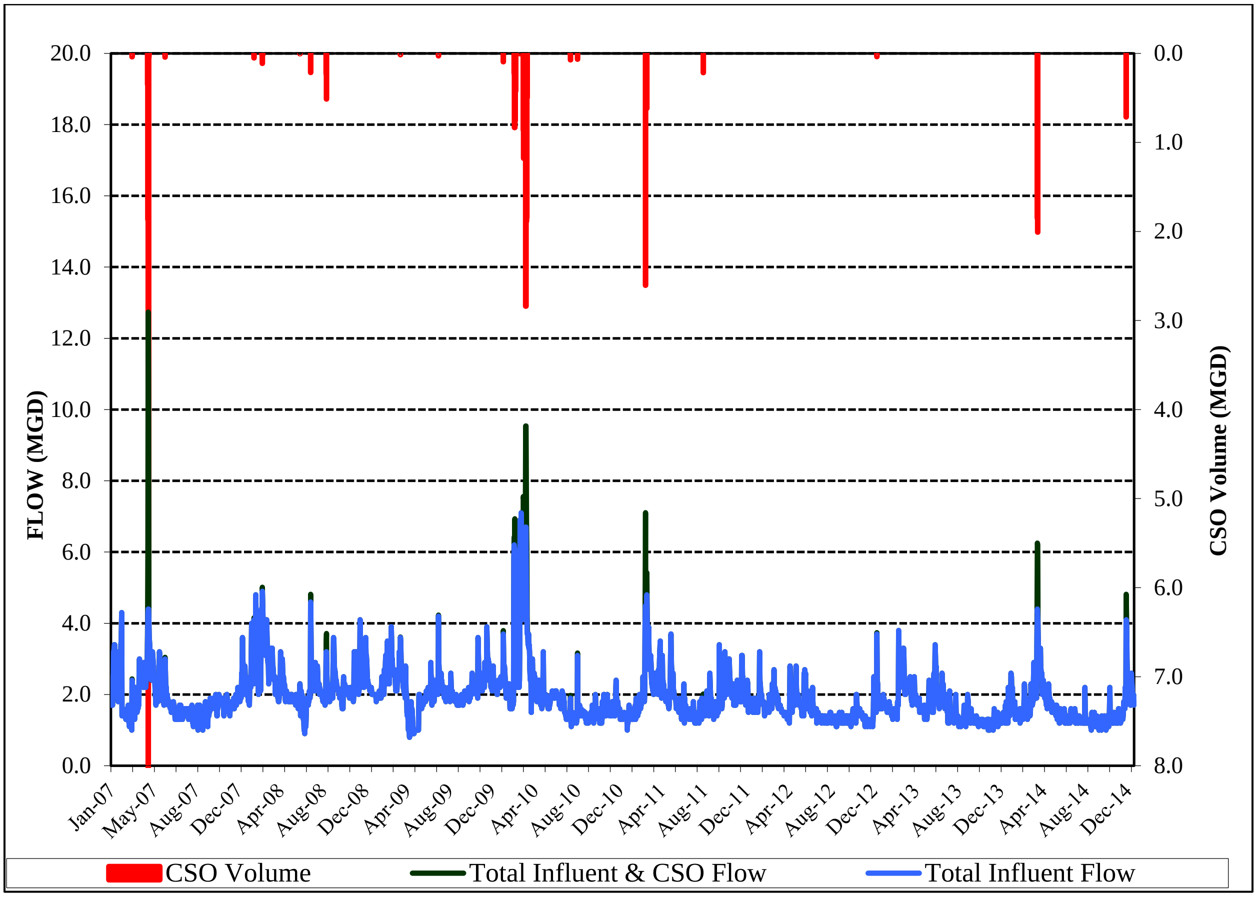
Sanitary sewer overflows (SSO) occur when wastewater exits the collection system at an unlicensed location (e.g., manhole). SSOs often occur due to undersized piping, excessive I/I, lack of O&M and lack of standby power. In Exeter's case, the most common reason for a reported SSO was a surcharged line and pipe blockages. SSO record keeping is essential to making adjustments to the Town's collection system operational procedures. **Table 2-8** summarizes the SSOs that have occurred since 2007. **Figure 2-14** depicts the location of the SSOs and frequency of occurrence.

TABLE 2-8
SUMMARY OF CSO AND SSO EVENTS

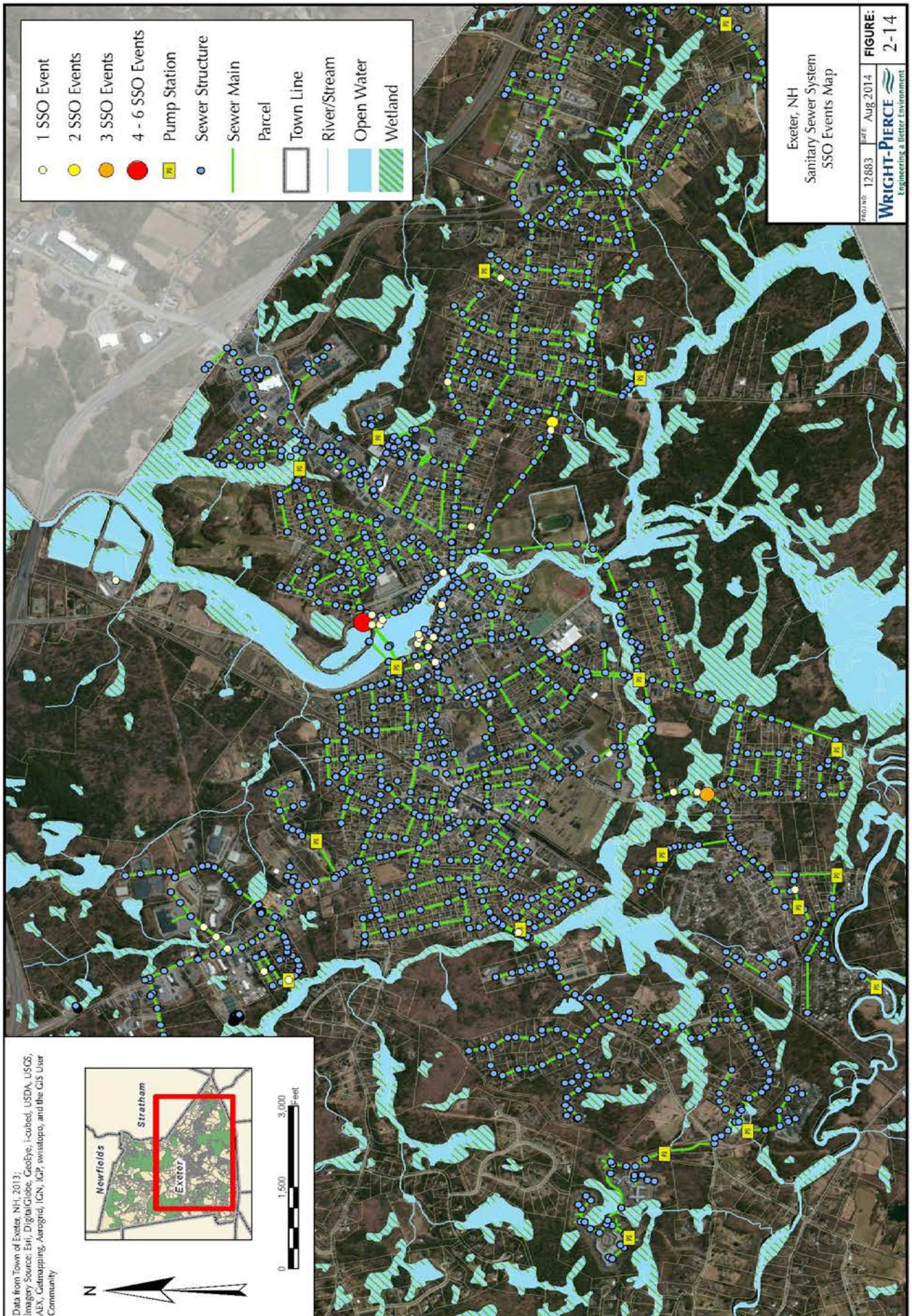
Year	Annual Precip (inches)	Annual CSO Events	Annual CSO Volume (MG)	Annual WWTF Volume (MG)	Annual Wastewater Volume (MG)	% of Annual Wastewater Volume as CSO	Total SSO Events	Dry Weather SSO Events
2007	39.0	8	17.2	693.5	710.7	2.4%	3	3
2008	50.8	8	1.1	839.5	840.6	0.1%	3	3
2009	45.4	2	0.05	766.5	766.5	<0.1%	6	6
2010	49.6	23	17.0	777.5	794.5	2.1%	11	0
2011	55.6	3	3.4	693.5	696.9	0.5%	2	2
2012	41.2	1	0.04	576.7	576.7	<0.1%	4	4
2013	42.5	0	0	595.0	595.0	0%	5	5
2014	45.2	6	4.6	587.7	592.3	0.8%	0	0

Notes: 1. WWTF, CSO, SSO and precipitation data provided by the Town of Exeter.

FIGURE 2-13
WWTF INFLUENT AND CSO FLOWS



While there is a direct linkage between precipitation and inflow, the linkage with infiltration is indirect. The amount of CSO flow can also vary dramatically with a given precipitation event depending the time of year (e.g., snow covered ground, dry summer conditions) and precipitation intensity (e.g., all day rain versus thunder showers). In general, there is a clear downward trend in peak system flows based on the infiltration/inflow reduction efforts initiated in the late 1990's and continued to present. There is also a downward trend in average system flows. This is a result of the Town's considerable infiltration/inflow removal efforts. This trend should be re-assessed in Spring/Summer 2015 to incorporate the results of the on-going and recently efforts with private inflow removal from Phillips Exeter Academy and the Jady Hill neighborhood.


1 SSO Event
2 SSO Events
3 SSO Events
4 - 6 SSO Events
Pump Station
Sewer Structure
Sewer Main
Parcel
Town Line
River/Stream
Open Water
Wetland
Exeter, NH
Sanitary Sewer System
SSO Events Map
PROJ NO. 12883
DATE Aug 2014
FIGURE: 2-14
WRIGHT-PIERCE
Engineering a Better Environment
Data from Town of Exeter, NH, 2013;
Imagery Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Newfields
Stratham
Exeter
0
1,500
3,000
Feet
N

2.4.7 Groundwater Discharge Flows

The existing WWTF treatment lagoons are un-lined; therefore, there is a potential for seepage from the lagoons into the groundwater. There are three monitoring wells located down gradient and one up gradient of the lagoons for groundwater sampling and monitoring. See **Section 2.5.4** for a summary of the Groundwater Discharge Permit monitoring requirements.

2.4.8 Summary of Current Flows and Loadings

The majority of the influent sampling record is from grab sample results. While this method is consistent with the NPDES permit requirements and is acceptable for a lagoon plant, it is not sufficient for a non-lagoon plant. Starting in January 2014, the Town began collecting composite influent sampling. Starting in June 2014, the Town converted to *flow-proportional* composite samples. The table below summarizes the differences between the composite sampling data and the grab sampling data for various time periods.

Dates	Sample Type	Avg Flow (mgd)	Avg BOD (mg/l)	Avg TSS (mg/l)	Avg BOD (lb/d)	Avg TSS (lb/d)	No. of Samples for BOD
2010/ July to Dec	Composite	1.52	201	217	2,550	2,750	18
2010/ July to Dec	Grab	1.52	185	204	2,350	2,590	21
2011/ July to Dec	Grab	1.83	152	197	2,320	3,010	26
2012/ July to Dec	Grab	1.39	176	200	2,040	2,320	13
2013/ July to Dec	Grab	1.38	164	215	1,890	2,480	22
2014/ Jan to Aug	Grab	1.67	155	145	2,160	2,020	32
2014/ Jan to Aug	Composite	1.67	237	311	3,300	4,330	29

From this data, the following conclusions can be reached:

- The 2010 data set compares reasonably well (i.e., grab to composite, ±5% to 10%); however, the 2014 data set does not compare well (i.e., grab to composite, ±35% to 55%). Initial investigations by Town staff indicate that the Water Treatment Plant discharges to the sewer on the composite sampling day. The Town should review whether there have been any operational changes at the Water Treatment Plan in 2014 which may be causing this. The Town should also investigate whether there are any industrial users which may be contributing to this differential.

- In general, the grab sampling results appear to be lower than the composite sampling results. Composite sampling results are more representative than grab sampling; therefore, the composite sampling results should be given more weight.

- There is a relatively small data set of composite sampling results; therefore, there is some uncertainty related to the appropriate concentrations to utilize as the design basis. The Town should continue its detailed supplemental sampling program until there is a sufficient body of data on which to base the design of its upgraded wastewater treatment facilities.

2.4.9 Summary of Baseline Effluent Nitrogen Loadings

Since the early 2000s, there has been increased interest and attention in total nitrogen in the Great Bay estuary environment. Various groups have collected WWTF effluent samples for nitrogen analysis over the years, including the Piscataqua Region (PREP), HydroQual and the Town. Most of the earlier sampling efforts were grab samples collected monthly; while the more recent sampling efforts have been weekly time-based composite samples. A summary of the annual total nitrogen concentrations and loads is presented in **Table 2-9. Figure 2-15** through **Figure 2-18** depict the effluent total nitrogen concentrations and loads, from the various sampling efforts. These data show that the nitrogen concentration and load discharged from the WWTF is highly variable. The effluent TN load discharged does not appear to be positively or negatively impacted by the reduction in infiltration/inflow in the collection system. One item worth noting is that, as of mid-2013, the Town is now directly measuring effluent TN via composite sampling techniques. This method will result in more representative data moving forward.

TABLE 2-9
EFFLUENT TN VALUES TO SQUAMSCOTT RIVER

Period	Annual Average NH3-N Concentration (mg/l)	Annual Average Total Nitrogen Concentration (mg/l)	Estimate of Annual Total Nitrogen Load (tons/yr)	Total Nitrogen Concentration in Squamscott River (mg/l)	Notes
2008	11.7	14.4	42.7	0.77	1
2011	14.8	14.7	49.1	0.71	2
2012	16.0	19.0	43.1	0.83	3
2013	21.5	22.9	55.5	0.82	4
2014	n/a	20.6	48.2	Not available	5

Notes:

1. For 2008, the Town collected 54 grab samples for NH3-N and PREP collected 10 grab samples for TN. Annual load estimated by PREP (2008).
2. For 2011, the Town collected 51 grab samples for NH3-N and Hydroqual collected 2 grab samples for TN.
3. For 2012, the Town collected 50 grab samples for NH3-N and 6 grab samples for TN.
4. For 2013, the Town collected 10 grab samples for NH3-N and 12 grab and 27 composite samples for TN.
5. For 2014, the Town collected 0 samples for NH3-N and 51 composite samples for TN.
6. The estimate of annual TN was generated by multiplying the annual average nitrogen load/day by 365 days/year.
7. The TN Annual loads for 2012 and 2013 were based on estimates for months with no available data.
8. Total nitrogen concentration in the Squamscott River is collected at Station GRBCL by UNH Jackson Estuarine Laboratory Tidal Water Quality Monitoring Program.

FIGURE 2-15
EFFLUENT TN CONCENTRATIONS FROM EXETER WWTF

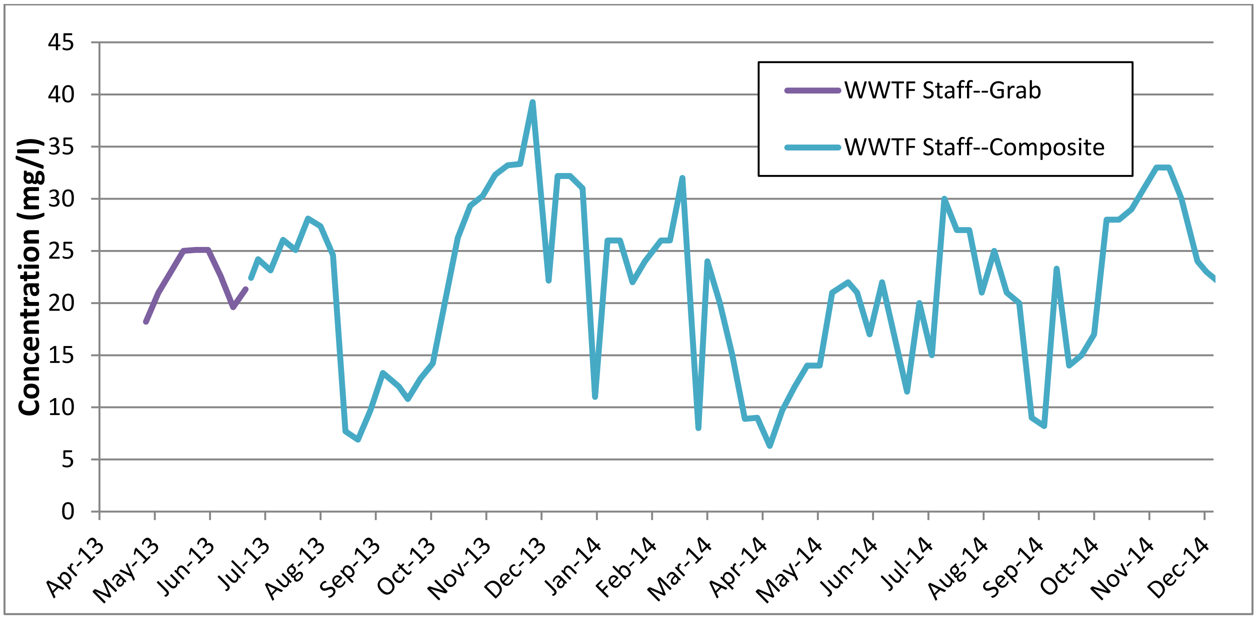


FIGURE 2-16
EFFLUENT TN MASS LOADINGS FROM EXETER WWTF

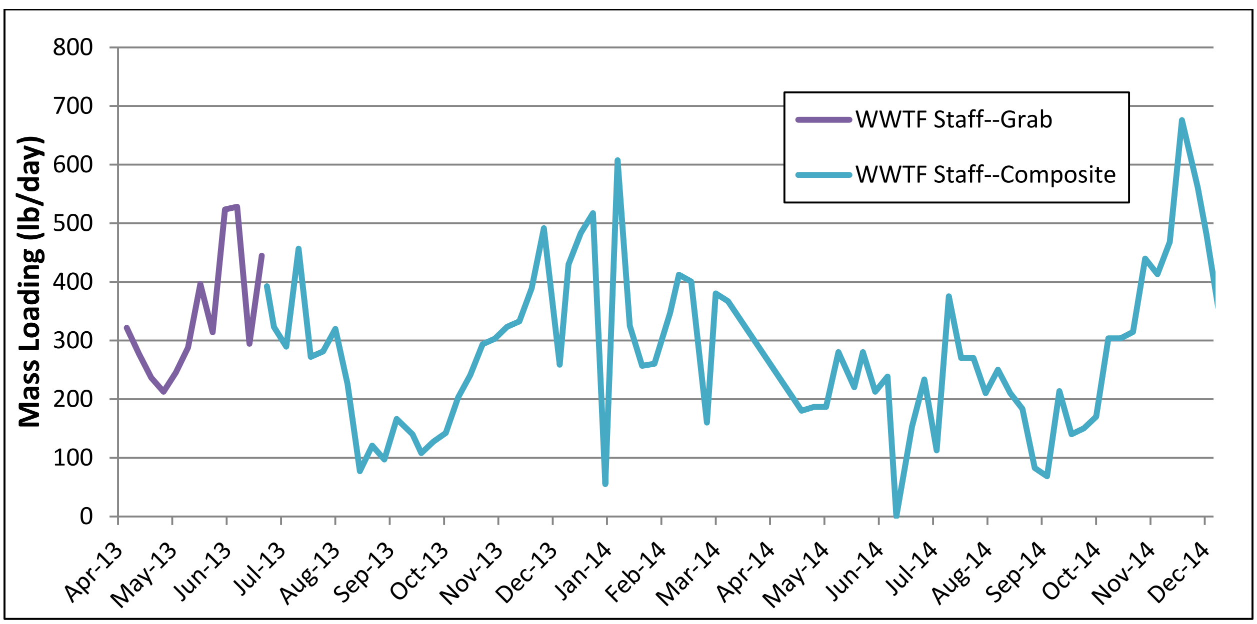


FIGURE 2-17
EFFLUENT TN CONCENTRATIONS FROM VARIOUS DATA SOURCES

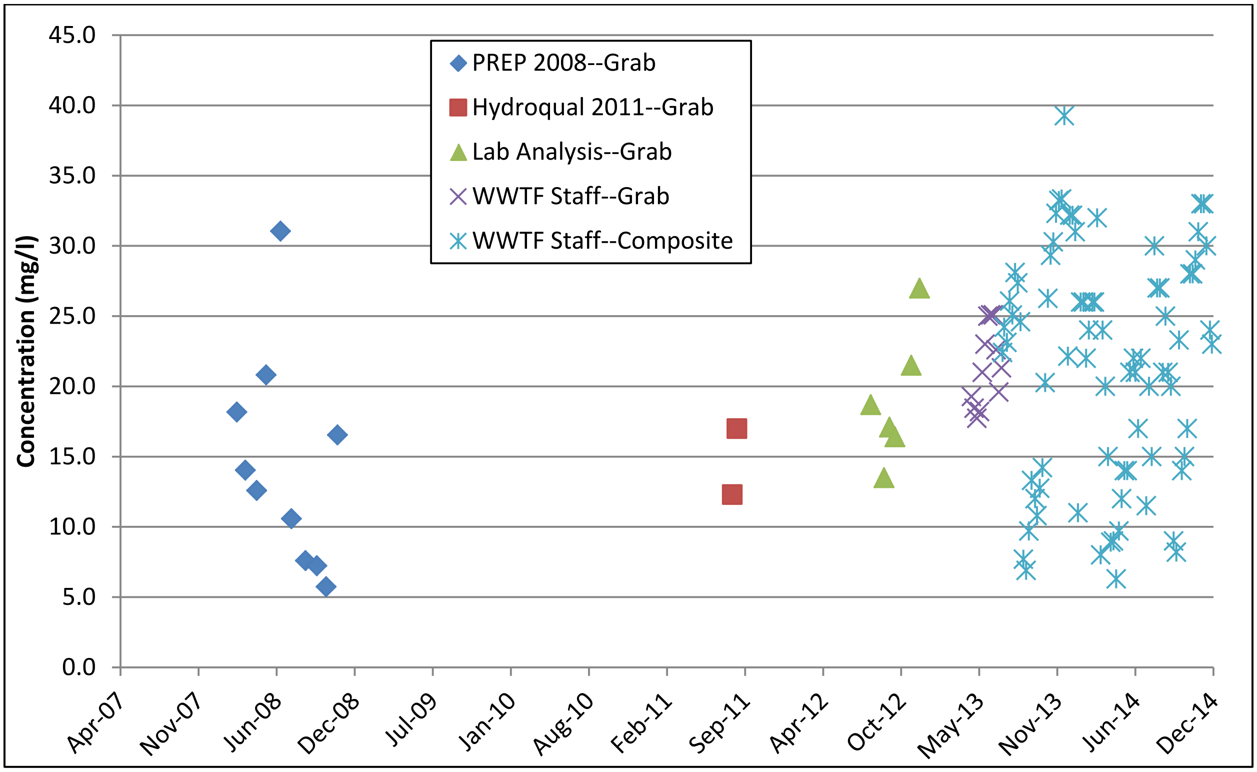
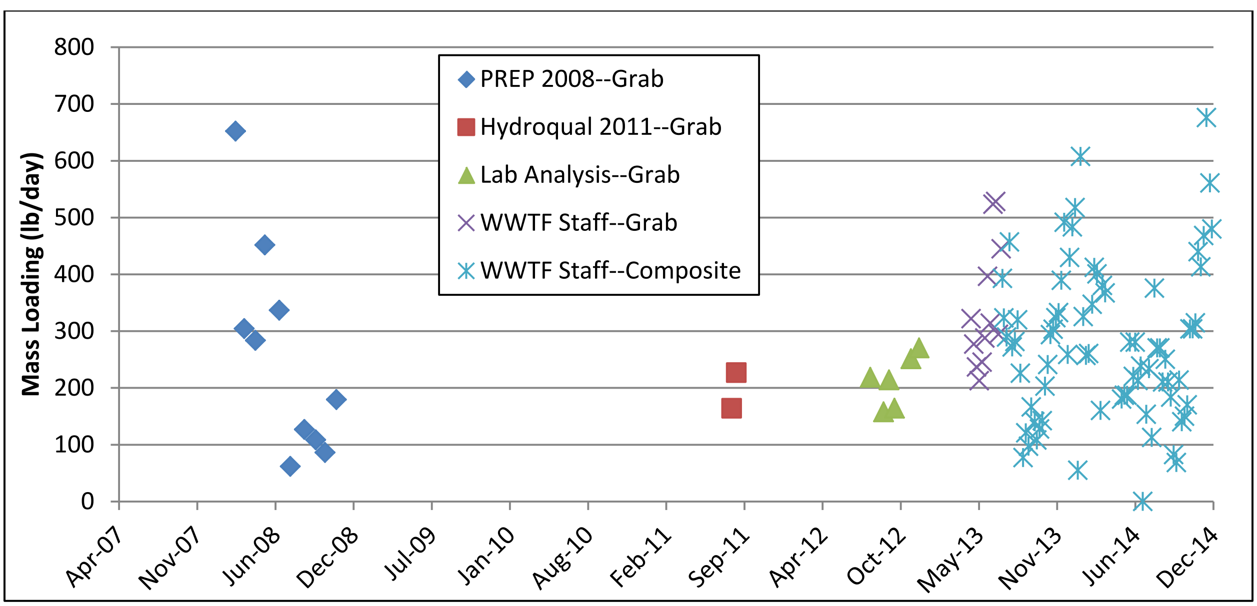


FIGURE 2-18
EFFLUENT TN LOADS FROM VARIOUS DATA SOURCES



2.5 FUTURE WASTEWATER FLOWS AND LOADS

Water resource management planning must consider both the current and future needs which will occur within the planning horizon. Future flows and loadings are a function of residential, commercial and industrial development within the existing sewered area, sewer extensions to existing or future development, redevelopment of existing properties and septage quantities to the WWTF. For the purposes of this study, wastewater volumes have been used as the "measure" of future growth. The estimates of town-wide wastewater flows are presented as annual average daily volumes.

2.5.1 Definition of Terms

"Future" conditions are defined as the conditions that will exist once additional development occurs. For the future conditions, the following terms apply to this discussion:

- *Planning Horizon:* A future population, level of development and an associated wastewater flow that will be the basis for analyzing and designing wastewater infrastructure. The design life of the mechanical components of wastewater facilities is typically 20 years; therefore, including time for planning and construction of recommended measures, a planning horizon should be 25 to 30 years into the future. The planning horizon for this study is 2040.

- *Theoretical Build-Out:* The population and commercial activity associated with the ultimate development to the fullest extent possible under current zoning and other regulation, regardless of economic issues.

- *Total Buildable Area:* The area of a parcel which excludes 100% of all water bodies, 75% of all wetlands and 10% of the total parcel area to account for roads and parking.

2.5.2 Methodology for Development of Future Growth Projections

The methodology that was used to develop future growth projections is as follows:

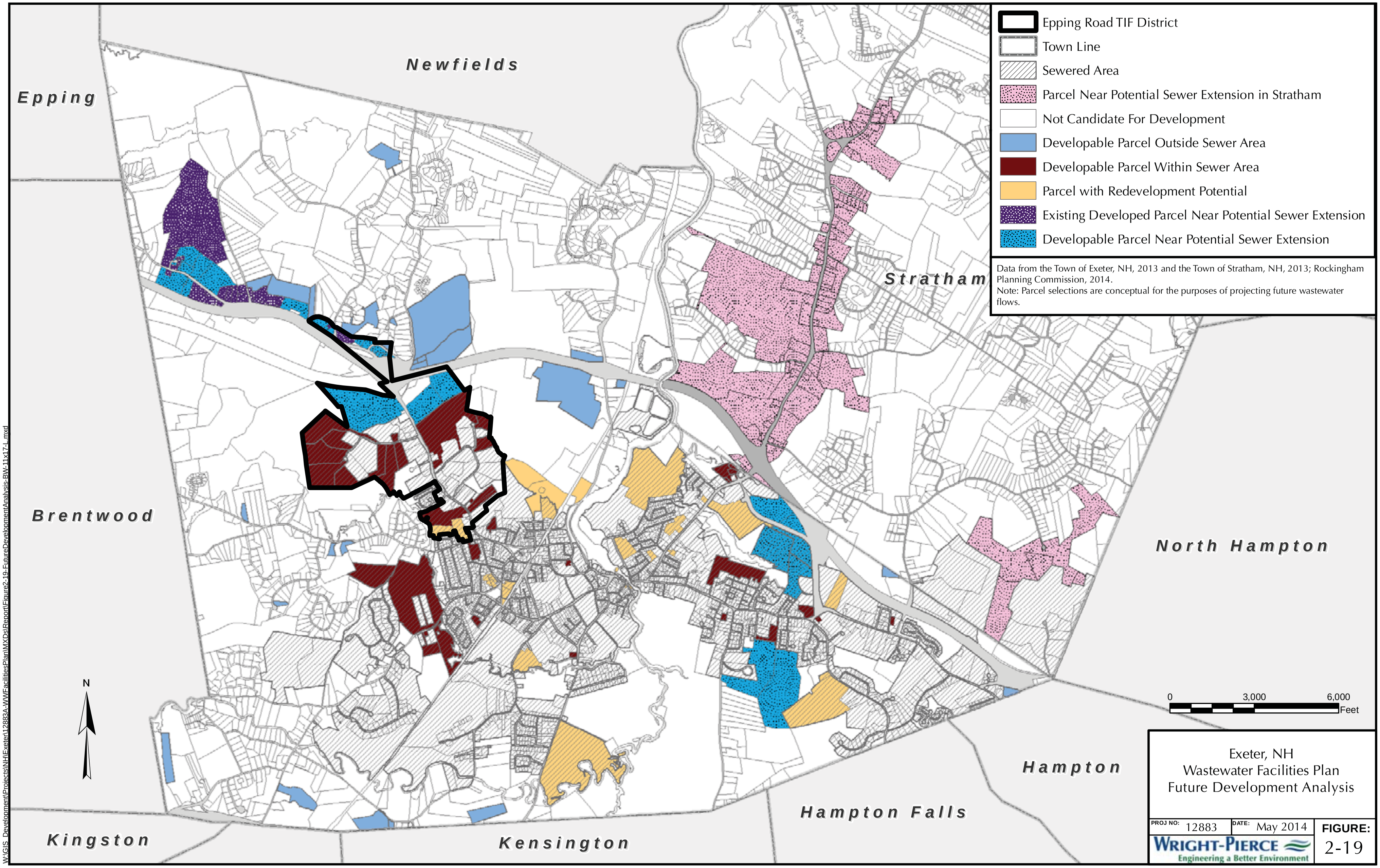
- The Town of Exeter Master Plan (2002 – 2010) was reviewed and analyzed for Town wide trends of development in the residential, commercial and industrial zoning districts.

- A meeting held on February 13, 2014 between Town staff (Jennifer Perry, Michael Jeffers, Matt Berube, Sylvia von Aulock, Doug Eastman) and Wright-Pierce (Ed Leonard, Andy Morrill) to discuss potential development scenarios within the existing sewer area, potential redevelopment scenarios within the existing sewer area as well as possible sewer extensions to serve existing and potential future development. A figure was developed to document the identified parcels. A follow-up meeting held on March 6th, 2014 between Town staff (Sylvia von Aulock, Kristen Murphy) and Wright-Pierce (Ed Leonard, Andy Morrill) to review and adjust the figure. **Figure 2-19** represents a summary of the discussions held during these two meetings.

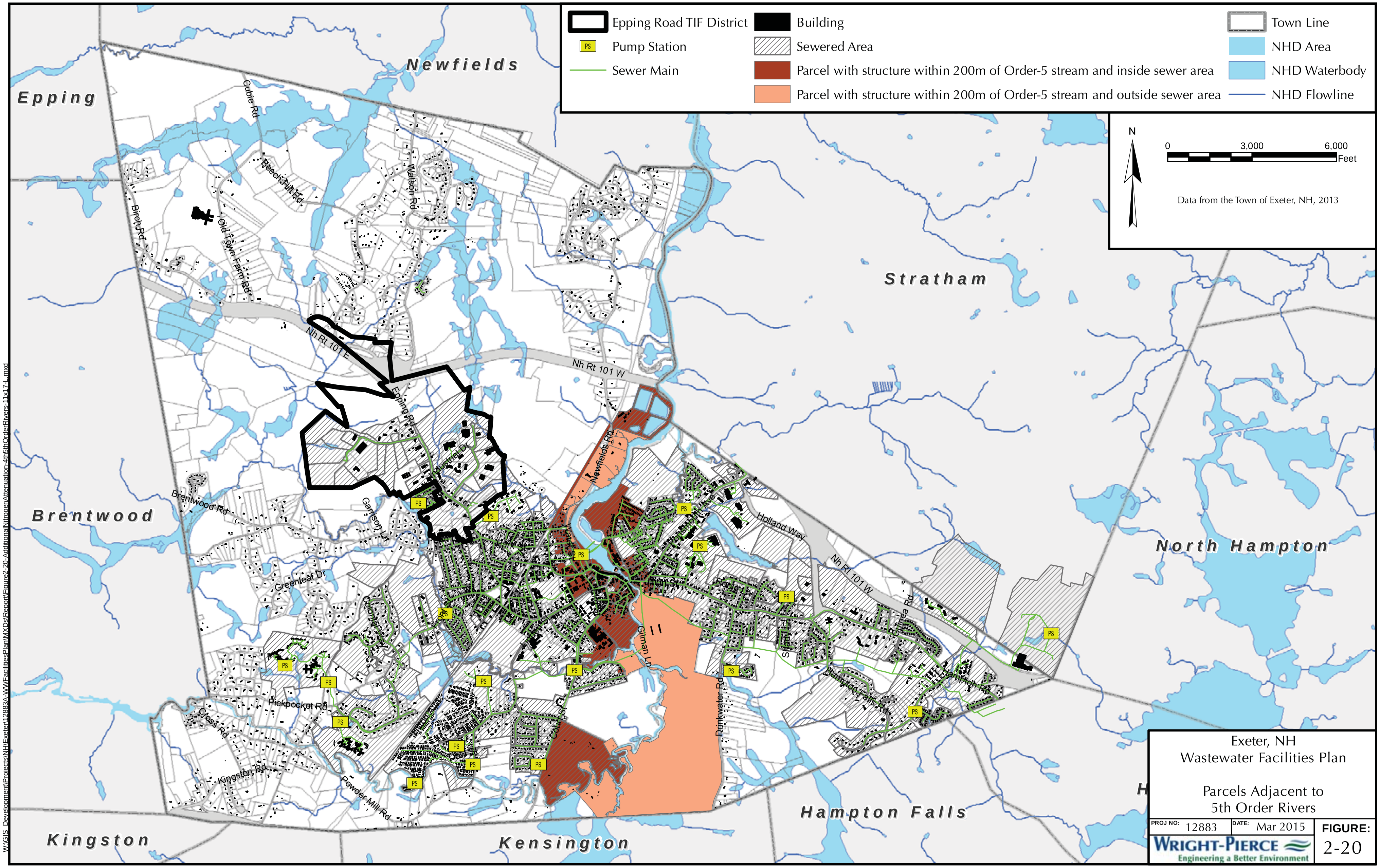
- The amount of buildable land area was estimated based on a visual review of the identified parcels on the Town of Exeter MapsOnline interactive website tool and the calculation basis described in **Section 2.5.1**.

- The wastewater generated from the estimated buildable area was estimated by zoning district. This spreadsheet tabulated the identified parcels which had the potential for development or redevelopment in five categories (Developable Parcel within Sewer Area, Parcel with Redevelopment Potential, Existing Developed Parcel near Potential Sewer Extension, Developable Parcel near Potential Sewer Extension and Developable Parcel Outside Sewer Area) and broken out per zoning districts. This information is summarized in **Appendix B**.

- Developed parcels within 200 meters of 5th order rivers were identified by NHDES as not receiving natural attenuation of nitrogen loading from septic systems (Great Bay Nitrogen Non-Point Source Study, 2014). These parcels are identified on **Figure 2-20**. Refer to **Section 4** for additional information on this topic.



Epping Road TIF District
Town Line
Sewered Area
Parcel Near Potential Sewer Extension in Stratham
Not Candidate For Development
Developable Parcel Outside Sewer Area
Developable Parcel Within Sewer Area
Parcel with Redevelopment Potential
Existing Developed Parcel Near Potential Sewer Extension
Developable Parcel Near Potential Sewer Extension
Data from the Town of Exeter, NH, 2013 and the Town of Stratham, NH, 2013; Rockingham Planning Commission, 2014.
Note: Parcel selections are conceptual for the purposes of projecting future wastewater flows.
Epping
Newfields
Stratham
Brentwood
North Hampton
Hampton
Hampton Falls
Kensington
Kingston
N
0
3,000
6,000
Feet
Exeter, NH
Wastewater Facilities Plan
Future Development Analysis
PROJ NO: 12883
DATE: May 2014
FIGURE: 2-19
WRIGHT-PIERCE
Engineering a Better Environment
W:\GIS_Development\Projects\NH\Exeter\12883A-WWFacilitiesPlan\MXDs\Report\Figure2-19-FutureDevelopmentAnalysis-BW-11x17-L.mxd



Exeter, NH
Wastewater Facilities Plan

Parcels Adjacent to
5th Order Rivers

PROJ NO: 12883 DATE: Mar 2015 FIGURE: 2-20

WRIGHT-PIERCE
Engineering a Better Environment

W:\GIS_Development\Projects\NH\Exeter\12883A-WWFacilitiesPlan\MXDs\Report\Figure2-20-AdditionalNitrogenAttenuation-4th5thOrderRivers-11x17-L.mxd

Development potential and wastewater flow potential were assessed for each zoning category under the following criteria: developable parcels within the existing sewered area; redevelopment of existing developed parcels with the sewered area; developable parcels near a potential sewer extension; existing developed parcels near a potential sewer extension; and developable parcels beyond the current and future sewered area. Refer to **Appendix B** for additional information.

2.5.3 Residential

The theoretical build-out for residential zones was calculated by dividing the total residential buildable area by the minimum lot size. A wastewater flow allowance of 140 gallons per day per lot was utilized, based on water use data provided by the Town. The planning horizon estimated flow was calculated by multiplying the build-out estimated flow by the probability of occurrence within the planning horizon (set at 50% probability). **Table 2-10** summarizes the potential residential development. The development will result in an additional 1,126 people on sewer and an additional 145 people off-sewer. Note, that one of the existing developed parcels in the residential zone is the high school (assumed at 30,000 gpd).

TABLE 2-10
POTENTIAL RESIDENTIAL DEVELOPMENT

	Build-out New Lots	**Build-out Estimated Sewer Flow (gpd)**	**Planning Horizon New Lots**	**Planning Horizon Estimated Sewer Flow (gpd)**
Sewered Area – Developable	717	41,900	360	21,000
Sewer Extension – Developed	0	33,200	0	33,200
Sewer Extension – Developable	302	42,300	152	21,100
Sewer Extension – Developed/TN Mgmt	0	2,200	0	2,200
Subtotal – Sewered and Potential Sewered	1,019	119,600	512	77,500
Subtotal – Unsewered	132	0	66	**0**
Total	1,151		578	

2.5.4 Commercial and Industrial

The theoretical build-out for commercial and industrial zones was calculated by dividing the total commercial and industrial buildable area by the minimum lot size. A wastewater flow allowance of 1,500 gallons per day per buildable acre for commercial parcels and 2,000 gallons per day per buildable acre for industrial parcels was provided. The planning horizon estimated flow was calculated by multiplying the theoretical build-out estimated flow by the probability of occurrence within the planning horizon (set at 50% probability). **Table 2-11** summarizes the potential commercial and industrial development.

TABLE 2-11
POTENTIAL COMMERICAL AND INDUSTRIAL DEVELOPMENT

	Total Buildable Area (acres)	Build-out Estimated Sewer Flow (gpd)	Planning Horizon Estimated Sewer Flow (gpd)
Sewered Area – Developable	324.4	452,500	226,300
Sewer Extension – Developed	0	1,000	1,000
Sewer Extension – Developable	122.1	190,600	95,300
Sewer Extension – Developed/TN Mgmt	0	0	0
Subtotal – Sewered and Potential Sewered	446.5	644,100	322,600
Subtotal – Unsewered	1.8	2,600	1,300
Total	448.5	646,700	323,900

A vast majority of the commercial development could occur in commercial zoning districts C-3 (Epping Road Highway–Commercial) and CT-1 (Corporate/Technology Park – 1) which are located on both sides of Route 27/Epping Road just before Exit 9 directly off of Route 101. The industrial zoning district is located east of Route 27/Epping Road on both sides of Industrial Drive. The Epping Road TIF District passed at the March 2015 Annual Town Meeting.

2.5.5 Redevelopment of Existing Structures or Parcels

In contrast to development of vacant lots, additional wastewater flows could be generated by the redevelopment of existing structures or parcels to a more intense use. A number of redevelopment possibilities were conceptualized with Town staff; however, none of these are firm development plans. Accordingly, a redevelopment allowance of 20% of existing sanitary flows was used as a placeholder (i.e., 200,000 gpd).

2.5.6 Potential Sewer Extensions in Exeter

The Town recently passed the Epping Road TIF District, which could result in a sewer extension to serve this area. A portion of the TIF District is currently served by by sewer and has an estimated wastewater flow of 34,000 gpd. At the planning horizon the wastewater flow form the TIF District is estimated at 295,000 gpd. These flows are accounted for in Tables 2-10, 2-11 and 2-12.

While the Town does not have any other plans to extend the sewer area; it could extend the sewer out to the High School in the future if that septic system were to fail. This would result in some existing developed and potentially developed parcels being served by public sewer. Estimates of these potential flows were developed using the methodologies described herein.

2.5.7 Inflow/Infiltration

The Town has invested considerable effort and funding aimed at reducing inflow/infiltration. The Town has implemented inflow/infiltration removal projects including investigations, sewer and manhole rehabilitation, sewer replacement, sewer service work and storm drain service work, where applicable. Based on observations of the Exeter WWTF dry weather flows, we estimate the inflow/infiltration to be approximately 700,000 gallons per day. For the purposes of this report, future inflow/infiltration is assumed to be held constant through the planning horizon, based on continued investment in the collection system over time.

2.5.8 Septage

As noted previously, Exeter currently generates an estimated 650,000 gallons of septage per year which is generally disposed of at the Hampton WWTF. Based on potential residential development outside of the anticipated sewered area, an estimated 66 to 132 new residential lots would be served by septic systems at the planning horizon and theoretical build-out, respectively. This growth would generate approximately an additional 22,000 to 44,000 gallons of septage per year at the planning horizon and theoretical build-out, respectively. An estimated 670,000 to 700,000 gallons per year could be received at the WWTF in the future (say 3,000 gallons per day based on receiving 240 days per year).

2.5.9 Stratham

The Town of Stratham has expressed interest in constructing a sewer extension to serve the Route 108 area and connecting that sewer extension to the Town of Exeter wastewater infrastructure. The two Towns have engaged in numerous workshops and an engineering study in an effort to determine if this inter-municipal connection is viable. Stratham was initially considering a wastewater flow allocation of 555,000 gpd and 660,000 gpd at the planning horizon and at theoretical build-out, respectively ("Exeter/Stratham Inter-municipal Water and Wastewater Systems Evaluation Study", Kleinfelder, July 2012, Table 3-6). In February 2015, Stratham reduced its requested wastewater flow allocation to a total of 250,000 gpd at the planning horizon. For the purposes of this study, we will utilize 100,000 gpd for "Phase 1" flows, an additional 150,000 gpd for "Phase 2 flows (at planning horizon) and a total of 660,000 gpd at build-out.

2.5.10 Newfields

The Town of Newfields currently operates a WWTF with an annual average flow of approximately 50,000 gallons per day and is permitted for a flow of 117,000 gallons per day. At this time, the Town of Newfields has not requested service from the Town of Exeter; however, for the purposes of this study, we have included the Newfields' flows in the future flow projections.

2.5.11 Future Wastewater Flow and Loading Projections

Future wastewater flow projections were developed by multiplying future development projections by current water use rates (for each user category – residential, commercial and industrial/institutional). Future annual average wastewater flow projections are summarized in **Table 2-12.**

It is important to note that the build-out flows exceed Exeter's 3.0-mgd NPDES permit value. If Stratham and Newfields are connected, and if all three towns reach the projected wastewater flows identified herein, then additional I/I flows will need to "mined out" to create the capacity. There appears to be ample time to plan for this; therefore, the existing 3.0-mgd permitted flow will be retained.

Future maximum month and maximum day flows were developed by multiplying future annual average flows and current "peaking factors" based on the 2011 to 2014 influent flow data set. Future annual average wastewater loads were developed by multiplying future wastewater flow projections by current average day wastewater concentrations obtained from the 2010 and 2014 influent characterization programs. Future maximum month and maximum day wastewater loads were calculated by multiplying future annual average loads and current "peaking factors" based on the 2010 and 2014 influent characterization programs. Future wastewater flows and loadings are summarized in **Table 2-13.**

TABLE 2-12
FUTURE WASTEWATER FLOW PROJECTIONS

Category	**Current 2014 (gpd)**	**Future Planning Horizon 2014 to 2040 (gpd)**	**Future Theoretical Build-out 2040+ (gpd)**
Existing Flows			
Residential	490,000	-	-
Institutional	100,000	-	-
Commercial/Industrial	330,000	-	-
Sewer Only	80,000	-	-
Inflow/Infiltration	700,000	-	-
Septage	0	-	-
Total – Existing Flows	**1,700,000**	**1,700,000**	**1,700,000**
Sewered Area - Redevelopment	-	200,000	200,000
Sewered Area – Developable Parcels	-	247,300	494,400
Sewer Extension – Existing Parcels	-	34,200	34,200
Sewer Extension – Developable Parcels	-	116,400	232,900
Sewer Extension – Developed/ TN Mgmt	-	2,200	2,200
Septage	-	3,000	3,000
Total – Exeter	1,700,000	**2,303,100**	**2,666,700**
New Flows – Other Towns	-	300,000	777,000
Future I/I to be Removed	-	-	(443,700)
Total – with Regional	1,700,000	**2,603,100**	**3,000,000**
% of Total Flow from Other Towns	-	*12%*	*26%*

TABLE 2-13
EXISTING AND PROJECTED WASTEWATER FLOWS AND LOADS

	Existing No Septage (Current)	Projected Without Septage (2040)	Projected With Septage (2040)
Flows (MGD)			
Annual Average (Note 3)	1.71*	3.00	3.00
Minimum Month	1.18*	1.60	1.60
Maximum Month	2.88*	5.10	5.10
Maximum Two-Week	3.09*	5.40	5.40
Maximum Day (99.5th Percentile)	3.75*	6.60	6.60
Instantaneous Peak Flow (100th Percentile)	5.65*	9.75	9.75
Biochemical Oxygen Demand (lbs/day)			
Annual Average	2,138*	5,400	5,600
Maximum Month	3,484*	6,800	7,100
Maximum Day	4,210*	7,900	8,200
Total Suspended Solids (lbs/day)			
Annual Average	2,544*	6,000	6,400
Maximum Month	3,632*	10,500	11,200
Maximum Day	4,376*	12,600	13,400
Ammonia-Nitrogen (lbs/day)			
Annual Average	265**	550	570
Maximum Month	320**	660	680
Maximum Day	360**	750	780
Total Kjeldahl Nitrogen (lbs/day)			
Annual Average	306**	690	710
Maximum Month	320**	910	940
Maximum Day	480**	1090	1120
Total Phosphorus (lbs/day)			
Annual Average	45**	110	120
Maximum Month	57**	140	150
Maximum Day	77**	190	210

Notes:
1) "*" denotes measured data for 2011 to 2013.
2) "**" denotes measured data for 2010 and 2014 only, limited data set.
3) Existing and projected conditions exclude on-site recycle flows & loads
4) Existing permitted flow and design flow is 3.0-mgd.
5) Future peak flows to WWTF will be increased in order to reduce or eliminate CSO activity in the collection system.

2.6 EFFLUENT STANDARDS

2.6.1 NPDES Permit and Administrative Order on Consent

The effluent discharge must meet standards set forth in state and federal water quality legislation. These standards establish minimum effluent discharge requirements which must be satisfied at all times. In accordance with Section 402 of the Clean Water Act, the plant's effluent quality requirements are contained in a National Pollutant Discharge Elimination System (NPDES) permit which is issued to the Town by the Environmental Protection Agency (EPA). A copy of the current NPDES permit (Permit No. NH0100871, issued December 2012) and related correspondence is contained in **Appendix A**.

The existing WWTF was not designed to remove nitrogen from wastewater and, therefore, cannot meet the NPDES permit requirements. Accordingly, EPA issued Administrative Order on Consent (AOC) Docket No. 13-010. A copy of the AOC is also included in **Appendix A.** The AOC provides the Town with an interim effluent Total Nitrogen limit of 8.0 mg/l and provides a compliance schedule to achieve numerous specific tasks, as summarized below:

- <u>June 30, 2016</u>: Initiate construction of the WWTF upgrade.
- <u>June 30, 2018</u>: Achieve substantial completion of the WWTF upgrade.
- <u>June 30, 2019</u>: Meet the interim WWTF effluent limit of 8 mg/l Total Nitrogen.
- <u>September 30, 2018:</u> Submit a "Nitrogen Control Plan" for implementing specific control measures for non-point source (NPS) and stormwater nitrogen loadings to the Great Bay Estuary (including Squamscott River) within the Town. The plan shall include a 5 year schedule for implementing the control measures.
- <u>December 31, 2023:</u> Submit an engineering evaluation with recommendations to achieve the NPDES TN discharge requirement of 3 mg/l or a justification for leaving the interim limit of 8 mg/l.
- <u>Annually (beginning January 2014):</u> Submit Total Nitrogen Control Plan Progress Reports to EPA and NHDES. The reports must include the following descriptions with sufficient information such that changes to Nitrogen loads within the watershed can be associated with individual sources of nitrogen. The required descriptions include: the pounds of Total

Nitrogen (TN) discharged from the WWTF during the previous calendar year; a description of the WWTF operational changes that were implemented during the previous calendar year; the status of the development of a TN NPS and stormwater point source accounting system; the status of the development of the NPS and stormwater point source Nitrogen Control Plan; a description and accounting of the activities conducted by the Town as part of its Nitrogen Control Plan; a description of all activities within the Town during the previous year that affect nitrogen loading to the Great Bay Estuary.

- On-going: Take action to reduce NPS and stormwater sources of total nitrogen to the Great Bay, including:
    - Track all activities within the Town that affect TN including new/modified septic systems, decentralized WWTFs, changes to impervious cover, and any new or modified BMPs.
    - Coordinate with NHDES to develop and utilize a comprehensive subwatershed-based tracking/accounting system for quantifying the TN loading changes associated with Town activities.
    - Coordinate with NHDES to develop a subwatershed community-based TN allocation.

2.6.2 Receiving Water Quality

The WWTF discharges into the Squamscott River, upstream of the Great Bay estuary. The Squamscott River is a Class B waterway, as designated by the New Hampshire Department of Environmental Services (NHDES). The NPDES permit provides for a dilution factor of 25.2:1 for the WWTF effluent discharge to the Squamscott River.

2.6.3 Current NPDES Effluent Limitations

The NPDES permit limits for the WWTF effluent (Outfall #001 to the Squamscott River) are summarized in **Table 2-14**. The mass limits for the WWTF are based on a design flow of 3.0-mgd. The NPDES permit limits for the permitted CSO (Outfall #003 to Clemson Pond) are summarized in **Table 2-15.**

TABLE 2-14
NPDES EFFLUENT LIMITS FOR WWTF

Parameter	Monthly Average	Weekly Average	Daily Maximum
Flow, mgd	Report	—	Report
BOD_5, mg/l	30	45	50
TSS, mg/l	30	45	50
pH, Std. Units	6.0-9.0	6.0-9.0	6.0-9.0
Fecal Coliform, #/100 mL	14	—	Report
Fecal Coliform, %	—	—	Report
Enterococci, #/100Ml	Report	—	Report
Total Residual Chorine, mg/L	0.19	—	0.33
Total Nitrogen, mg/l November 1 to March 31	Report	—	—
Total Nitrogen, mg/l (lb/d) April 1 to October 31, seasonal rolling average	3.0 (75)	—	—
Whole Effluent Toxicity - LC50; % effluent	—	—	100
Total Recoverable Metals, mg/L Aluminum, Cadmium, Chromium, Copper Nickel, Lead, Zinc	Report	Report	Report
Ammonia Nitrogen as N, mg/L	Report	Report	Report

Note:
1) The AOC requirement is for 8.0 mg/l effluent total nitrogen, from April 1 to October 31, seasonal rolling average.
2) The AOC states that supplemental carbon is not required at any time during the year.

TABLE 2-15
NPDES EFFLUENT LIMITS FOR CSO #003

Parameter	Each CSO Event
Volume	Report
Escherichia Coli, #/100 mL	1,000
Duration	Report
1-hr and 24-hr rain gauge data (in.)	Report

2.6.4 Groundwater Discharge Permit

The existing WWTF lagoons do not have impermeable liners. The NHDES recently issued the Town a Groundwater Discharge Permit to monitor the groundwater quality proximate to the lagoons (Permit No. GWP-198401079-E-001, issued January 2012). A copy of the Groundwater Discharge Permit is included in **Appendix A**. The sampling and monitoring requirements contained in the permit are summarized in **Table 2-16**.

TABLE 2-16
GROUNDWATER DISCHARGE PERMIT MONITORING REQUIREMENTS

Parameter	Sampling/Monitoring Frequency
WWTF Effluent Flow, mgd	Weekly
pH, Std. Units*	May and November, each year
Escherichia Coli, #/100 mL	May and November, each year
Arsenic, Boron, Chloride, Nitrate, Total Kjeldahl Nitrogen, Total Phosphorus	May and November, each year
Static Water Level (ft)	May and November, each year
Water Temperature	May and November, each year
Drinking Water Metals and VOCs by EPA 8260B (including 1,4-Dioxane)	November 2014, May 2017

2.6.5 Anticipated Future Effluent Limitations

The current NPDES permit and AOC are focused primarily on addressing concerns related to effluent total nitrogen. Over time, the Town may face more stringent effluent limits for other parameters. Each of these potential areas are described below.

2.6.6 Phosphorus

The WWTF discharges into a tidally-influenced and brackish section (<10 ppt, HydroQual, August 2011 data) of the Squamscott River. Given the location of the discharge (i.e., upgradient of an estuary), it is unlikely that phosphorus limits would be imposed on the WWTF in the near-term. However, it is appropriate to consider the implications of possible future phosphorus removal requirements as a part of this planning effort. In the unlikely event a phosphorus limit were imposed, it would most likely be at a level where simple chemical addition (e.g., ferric or alum) to the secondary clarifiers would be the most economical strategy. Other strategies exist, such as biological phosphorus removal, but these other processes would cost more than simple chemical addition. In some fresh water situations, advanced solids removal processes are also needed to reach very low phosphorus limits but this is not likely in Exeter's situation (e.g. filtration, ballasted flocculation).

2.6.7 Ammonia and Metals

The WWTF has a dilution factor of 25.2:1. This is a modest dilution factor which could result in future metals limits being imposed if a major industrial source of metals were introduced in the Exeter system. The metals criteria already exist and Exeter is in compliance with these standards. Relocating the WWTF outfall in 2002 was done to gain more dilution was in part motivated by the need to comply with metal and ammonia standards. Ammonia limits would not likely result in any modifications to the process due to the very low total nitrogen levels currently being required. If metal criteria were to become a problem in the future, the most common strategy for compliance would be industrial pretreatment standards, Note that the chemical addition strategy used for a possible future phosphorus standards, discussed above, would also reduce metal levels. Additionally, portions of the existing lagoons could be used to avoid discharge during slack tides.

2.6.8 Compounds of Emerging Concern

Compounds of emerging concern (CECs) encompass a wide variety of compounds including endocrine disrupting compounds, pharmaceuticals, flame retardants, hormones, industrial solvents and surfactants, metals, pesticides, and personal care products. CECs have been found in wastewater for decades; however, they have recently reached the forefront of regulatory and public concern, and there is currently a great deal of research on CECs. One of the difficulties associated with addressing this topic is the large number and wide array of substances that can be classified as CECs. EPA and NHDES have not established effluent standards for CECs to date, and have not indicated any intention to regulate CECs in the near term.

Processes utilized at typical secondary wastewater treatment facilities provide for some CEC removal based on sorption and biodegradation. The technologies more frequently referenced for potential supplemental removal of CECs include coagulation/flocculation, adsorption (e.g., granular activated carbon, ion exchange), advanced oxidation processes (e.g., ultraviolet/peroxide; ozone); and. reverse osmosis. Which technology might be required would depend on the magnitude and nature of CECs in the effluent and nature of possible future standards.

2.6.9 Staffing/License Classifications

The NPDES permit requires that the existing WWTF be operated by a Grade II operation, minimum. The WWTF is currently staffed by one Grade II operator, one Grade III operator and one full-time equivalent maintenance technician. Depending on the processes selected, the future WWTF may require a higher operator grade and may require additional staff.

SECTION 3

EVALUATION OF EXISTING PROCESS SYSTEMS

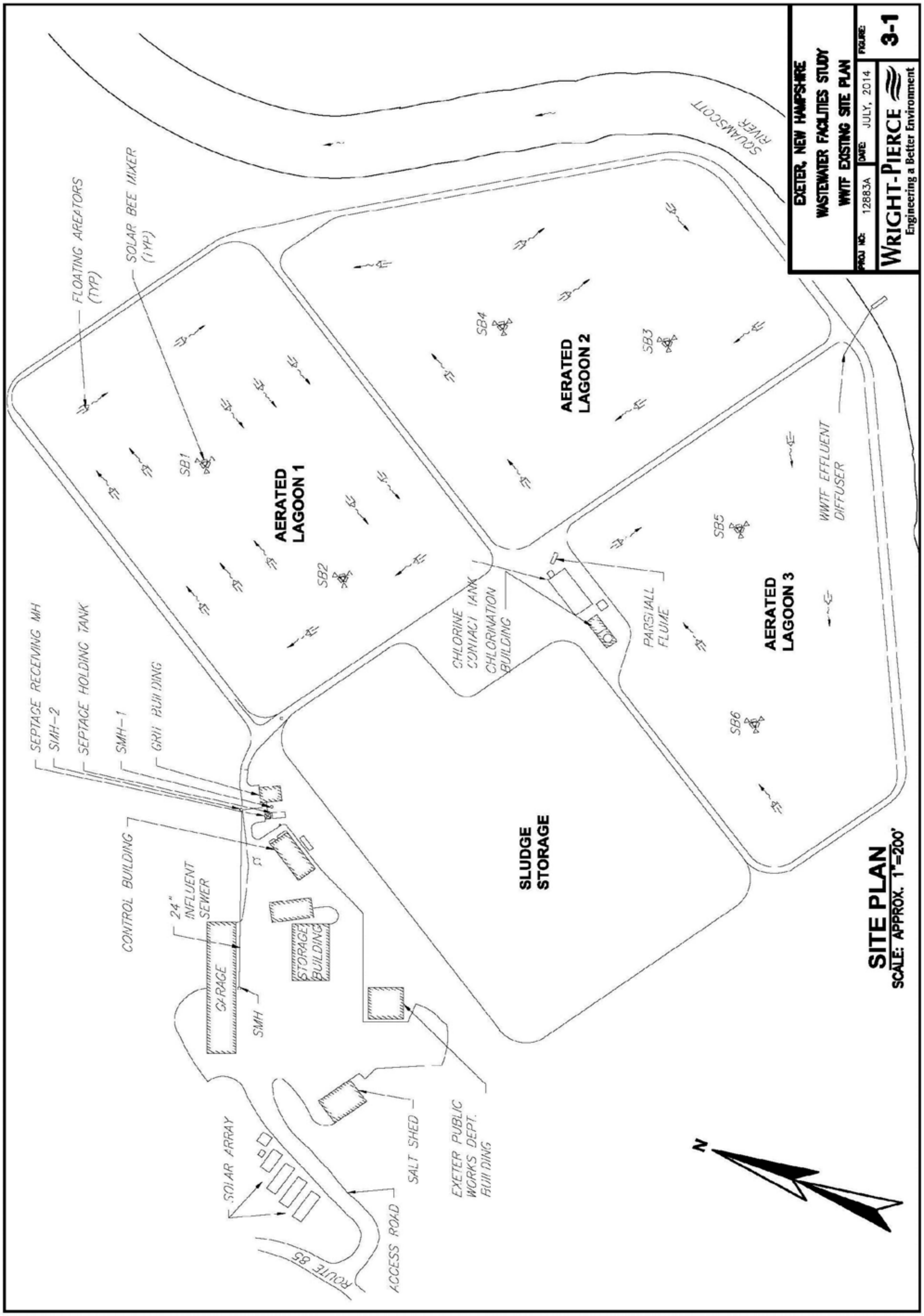
3.1 BACKGROUND

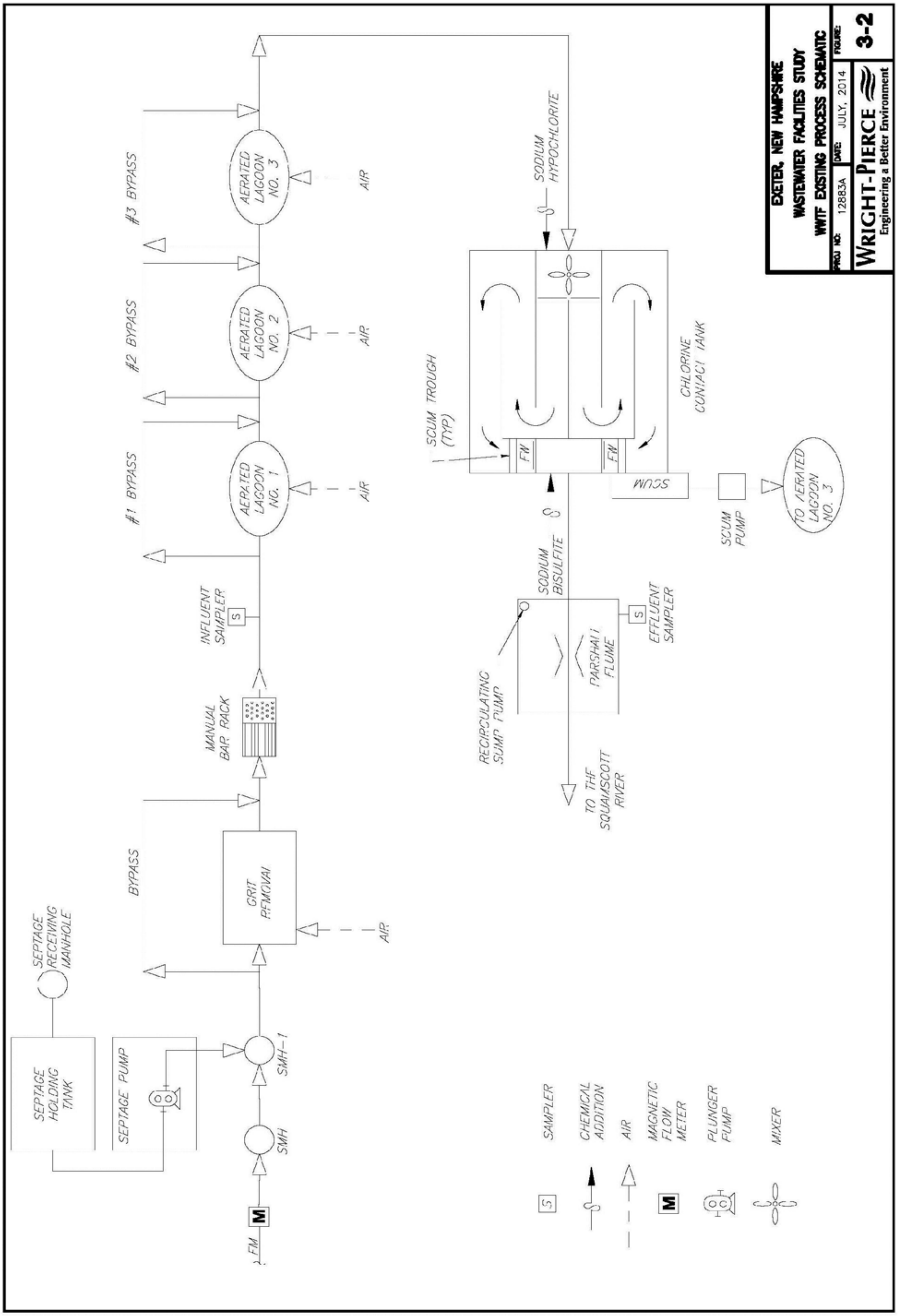
The purpose of this section of the report is to present background information on each unit process at the wastewater treatment facility (WWTF) and recommended improvements to individual unit processes. Each of these unit processes is discussed in greater detail below. The WWTF existing site plan is shown in **Figure 3-1**. The existing site process schematic is shown in **Figure 3-2.**

The Exeter WWTF consists of the following treatment processes:

- Main Pump Station and Forcemain
- Influent Flow Metering
- Septage Receiving
- Preliminary Treatment
- Secondary Treatment
- Disinfection
- Effluent Outfall
- Plant Wide Support Systems
- Biosolids Handling

In some cases, the recommended improvements presented herein are independent of the improvements which will be needed for advanced nutrient removal at the facility. Alternatives for WWTF upgrades are presented in **Section 5**.


EXETER, NEW HAMPSHIRE
WASTEWATER FACILITIES STUDY
WWTF EXISTING SITE PLAN
PROJ NO: 12883A
DATE: JULY, 2014
FIGURE: 3-1
WRIGHT-PIERCE
Engineering a Better Environment
SITE PLAN
SCALE: APPROX. 1"=200'
SQUAMSCOTT RIVER
FLOATING AREATORS (TYP)
SOLAR BEE MIXER (TYP)
AERATED LAGOON 1
AERATED LAGOON 2
AERATED LAGOON 3
SLUDGE STORAGE
SB1
SB2
SB3
SB4
SB5
SB6
SEPTAGE RECEIVING MH
SMH-2
SEPTAGE HOLDING TANK
SMH-1
GRIT BUILDING
CONTROL BUILDING
24" INFLUENT SEWER
GARAGE
SMH
STORAGE BUILDING
CHLORINE CONTACT TANK
CHLORINATION BUILDING
PARSHALL FLUME
WWTF EFFLUENT DIFFUSER
SOLAR ARRAY
SALT SHED
EXETER PUBLIC WORKS DEPT. BUILDING
ACCESS ROAD
ROUTE 85
N


EXETER, NEW HAMPSHIRE
WASTEWATER FACILITIES STUDY
WWTF EXISTING PROCESS SCHEMATIC
PROJ NO: 12883A
DATE: JULY, 2014
FIGURE: 3-2
WRIGHT-PIERCE
Engineering a Better Environment
FM
SMH
SMH-1
SEPTAGE HOLDING TANK
SEPTAGE PUMP
SEPTAGE RECEIVING MANHOLE
BYPASS
GRIT REMOVAL
AIR
MANUAL BAR RACK
INFLUENT SAMPLER
#1 BYPASS
AERATED LAGOON NO. 1
#2 BYPASS
AERATED LAGOON NO. 2
#3 BYPASS
AERATED LAGOON NO. 3
SODIUM HYPOCHLORITE
SCUM TROUGH (TYP)
FW
CHLORINE CONTACT TANK
SCUM
SCUM PUMP
TO AERATED LAGOON NO. 3
SODIUM BISULFITE
EFFLUENT SAMPLER
PARSHALL FLUME
RECIRCULATING SUMP PUMP
TO THE SQUAMSCOTT RIVER
SAMPLER
CHEMICAL ADDITION
MAGNETIC FLOW METER
PLUNGER PUMP
MIXER

3.2 MAIN PUMP STATION AND FORCEMAIN

The Main Pump Station and forcemain were constructed in 1964 and are located just off Swasey Parkway in downtown Exeter. The forcemain conveys all of Exeter's wastewater flow from the Main Pump Station to the Exeter Wastewater Treatment Facility (WWTF) on Newfields Road.

3.2.1 Main Pump Station

The Main Pump Station was originally constructed in 1964 as a drywell/wetwell configuration with three vertical, close coupled sewage pumps. The pump station was originally constructed with a sewage grinder (comminutor) and grit removal system (which consisted of a grit collection sump, grit pump and classifier); however, due to regular clogging of the classifier it was removed in the mid-1980s. The Main Pump Station was upgraded in 1995 to include three drypit submersible pumps (each with variable frequency drives). The design capacity of the pump station is 5,500 gpm at 72 feet total dynamic head. The pumps are operated in a lead-lag-standby configuration and each pump is alternated on a weekly basis. The pump station still has sewage grinding (two new channel grinders) but no grit removal system. Grit is manually removed from the grit sump on a monthly basis. Wetwell level is monitored and controlled by an ultrasonic level sensor and has a float system as backup. Each pump discharge has a strap-on type flow meter. A 200-kilowatt emergency generator serves the entire Main Pump Station and was installed in March 1999.

The mechanical, instrumentation and electrical components in the Main Pump Station have reached the end of their useful life and should be overhauled with any future upgrades to the facility. The pump station currently has reduced peak capacity due to pump wear and an upgrade is warranted in the near-term. The Main Pump Station pumping capacity should be comprehensively upgraded to convey the peak flows so that CSO events can be avoided. The generator should be maintained for continued use.

3.2.2 Forcemain

The Main Pump Station forcemain is a 16-inch diameter cement-lined cast iron forcemain that is approximately 4,900 linear feet long. A portion of the forcemain was inspected by Wright-Pierce in August 2010, in the vicinity of the new flow meter and the forcemain invert was found to show considerable wear of the cement lining as well as the invert of the cast iron pipe (approximately 78% remaining). Forcemain velocities should be maintained at or above 2.0 ft/sec to ensure that solids do not collect in the forcemain, which would decrease the pumping capacities. During normal flow conditions, the velocity in the forcemain is approximately 3.4 ft/sec; during high flow conditions, the velocity in the forcemain is approximately 7.5 ft/sec. Due to the critical nature of this forcemain, it is recommended that the forcemain be rehabilitated or replaced within 5 to 10 years. Several options are listed below:

1. *Sliplining* the existing forcemain is a trenchless technology with minimal excavation, but would not allow for increasing the forcemain diameter/capacity and would require bypass pumping.
2. *Pipe bursting* the existing forcemain is another trenchless technology with minimal excavation that would allow for a modest upsizing of the forcemain for increased capacity and would require bypass pumping.
3. *Open cut replacement* of the existing forcemain would allow for upsizing the forcemain for additional capacity but would require bypass pumping and excavation along the entire route.
4. *Open cut construction of a seasonal parallel forcemain* would allow for upsizing the forcemain for additional capacity and would dramatically reduce the time bypass pumping would be needed but would require excavation along the entire route and may require modifications to existing easements if the forcemain crosses private property.

A combination of Option 1 and Option 4 is recommended.

The WWTF is not currently served by public water. A new 8-inch or 12-inch diameter ductile iron water main should be installed from the intersection of Water Street/Summer Street (approx. 5,000 feet) to provide potable water and fire protection to the WWTF and the Public Works Complex.

3.3 INFLUENT FLOW METERING

The influent flow meter vault was installed in August 2010 just off Newfields Road to the left of the entrance driveway to the Public Works Complex. It consists of an 8-foot diameter precast structure where a 16-inch diameter magnetic flow meter is housed. The influent flow meter isolation gate valves are located a few feet outside of the structure to provide upstream and downstream isolation. An offset 12-inch diameter bypass line was also installed and consists of two 12-inch diameter live-tapping tees and a 12-inch diameter forcemain with isolation valves. The influent flow meter is calibrated annually by A&D Instruments. In June 2014, the influent flow meter radio telemetry was upgraded by A&D Instruments and provides accurate influent flow data to SCADA. From August 2010 to June 2014, the WWTF operator needed to manually record the totalizer reading from the local panel because the value sent to SCADA was not accurate. No additional modifications are anticipated.

3.4 SEPTAGE RECEIVING

The Septage Receiving Facility was constructed during the 1988 upgrade and is located between the Control Building and Grit Building. Septage is discharged from the truck into the septage dumping manhole where it flows by gravity into the Septage Holding Tank (approximately 10,500 gallon capacity). Septage is then conveyed through an inline commuter and one of two 7.5-hp plunger pumps, located in the basement of the Control Building, before being discharged in to SMH-1. Flow is measured through the use of a cycle counter on each pump, where each piston cycle is counted and then multiplied by the volume of the cylinder to calculate total flow.

The Exeter WWTF has never received septage since the administrative protocol to do so was never developed. Septage represents a source of revenue and should be considered in the WWTF upgrade plans. If septage will be received, the existing system should be upgraded including the addition of mechanical fine screening and flow metering. The existing septage holding tanks should receive concrete repairs.

3.5 PRELIMINARY TREATMENT

The Grit Building houses the preliminary treatment equipment which was constructed during the 1988 upgrade and is located northeast of the Septage Receiving Facility. Flow enters the Grit Building from SMH-1 on the east side of the building via a 24-inch diameter ductile iron sewer pipe. Flow is then conveyed through the manual bar rack and aerated grit chamber before exiting the building on the northeast corner via a 24-inch diameter ductile iron pipe.

3.5.1 Screening/Manual Bar Rack

Influent screening is achieved by the one coarse manual bar rack (1-inch spacing). Screenings are periodically manually raked by an operator and then placed in a five gallon bucket which is transferred into a hopper that is dumped into the storage container located east of the storage lagoon. The storage container holds all of the screenings, grit, spoils from cleaning pump station wet wells and sewer main construction debris. The contents of this container are periodically disposed of offsite. In 2012 and 2013, 12.5 tons and 16.5 tons of material, respectively, were disposed of at the Turnkey Landfill in Rochester, NH. The influent screenings should be upgraded with the addition of a new mechanical fine screen (1/4-inch to 3/8-inch spacing) with a screenings wash press and the coarse manual bar rack (1-inch spacing) should be replaced.

3.5.2 Grit Removal

After exiting the bar rack, wastewater flows to the aerated grit chamber, which is approximately 15.2-feet wide by 15.0-feet long by 13.1-feet deep and a volume of approximately 22,200 gallons. Per NHDES regulations and TR-16, ideal aerated grit chamber geometry has a length to width ratio of 3:1 to 8:1 and a width to depth ratio of 0.89:1. The existing aerated grit chamber has a length to width ratio of 1:1 and a width to depth ratio of 1.15:1. At the peak hourly flow rate, the detention time through the grit chamber is approximately 5.3-minutes, which is just outside the design standard of 2 to 5 minutes of detention time. The grit chamber is aerated by a series of coarse bubble diffusers, replaced in 2012, which are served from a 4-inch diameter air header. The air header is fed from two 5-hp positive displacement lobe blowers that are located in the basement of the Control Building. The aeration in the chamber creates a spiral roll pattern which promotes the grit to separate from organic matter and settle out at the bottom of the tank. A 12-inch diameter 15-foot long screw conveyor then collects the settled grit and conveys it to the grit sump where it is picked up by the elevator chain and bucket system. The buckets discharge the grit into the dewatering screw where the separated grit is deposited into a roll-off container for disposal and the organics are drained back into the grit chamber.

The existing aerated grit chamber does not conform to current design standards and all of the grit removal system equipment has reached the end of its' useful life. If the WWTF upgrades allow for the same hydraulic gradeline, the grit removal system could be upgraded to minimize cost. However, the grit removal efficiency could be improved with an upgraded configuration.

3.5.3 Influent Sampling

The influent composite sampler was recently installed in January 2014. It is located on the east side of the Grit Building in a prefabricated enclosure. The influent samples are taken from the effluent channel of the Grit Building just downstream of the manual bar rack. As of June 2014, the influent samples are flow paced composite samples. The influent sampler should be maintained for continued use.

3.6 SECONDARY TREATMENT

Secondary treatment is accomplished through the aerated lagoon system. Specific details concerning each component are presented below.

3.6.1 Aerated Lagoons

Three aerated lagoons are located behind the Control and Grit Buildings and were re-graded and re-configured during the 1988 upgrade. **Table 3-1** above summarizes key dimensional data associated with the aerated lagoons.

TABLE 3-1
AERATED LAGOON DATA

Dimensions		Lagoon No.1	Lagoon No.2	Lagoon No.3
Volume at Average Design Flow (MG)		26.0	27.0	23.4
Water Surface Area (acres)		9.01	9.30	8.22
Water Surface Elevation (ft)	Average Design Flow	25.40	16.27	15.28
	Peak Design Flow	25.60	16.50	15.72
Maximum Depth (ft)[1]		9.6	10.5	9.7
Bottom Elevation (ft)		16.0	6.0	6.0
Freeboard (ft)		2.4	1.5	2.3

Note: 1. Maximum depth calculated at Peak Design Flow.

All lagoon piping consists of 24-inch diameter ductile iron pipe, except for the outlet piping for Lagoon No. 3 which consists of 30-inch diameter ductile iron pipe. During normal flow conditions, flow goes from Lagoon No. 1, through Lagoon No. 2, through Lagoon No. 3 and then to disinfection. During high flow conditions Lagoon No. 1 and No. 2 have a bypass outlet structure to avoid overtopping of the embankments. Lagoon No. 1 utilizes fourteen 15-hp floating aerators, Lagoon No. 2 utilizes eight 10-hp floating aerators and Lagoon No. 3 utilizes five 7.5-hp floating aerators. The floating aerators in Lagoon No. 1 and No. 2 were replaced in 1995, while the floating aerators in Lagoon No. 3 are original. Each lagoon is also equipped with two solar powered 0.5-hp SolarBee circulators (six total) which were installed in 2000. Although the lagoons have never been drained, dewatering sumps exist to gravity drain the lagoons for routine maintenance. Lagoon No. 2 dewatering sump is presently inoperable due to the riser section having tipped over during a winter freeze and thaw cycle.

Algae blooms typically occur in both the spring and fall in Lagoons No. 2 and No. 3 but rarely in Lagoon No. 1. The Exeter WWTF has had six violations for TSS due to algae since 1989. When NHDES was consulted for solutions to the TSS violations due to algae, they suggested introducing daphnia into the lagoons. Since the NHDES recommendation has been implemented, there has been a noticeable decrease in algae and TSS violations.

The existing lagoons cannot be configured to reliably achieve the nitrogen removal requirements identified in the NPDES permit or the AOC (due to lower levels and specific calendar year time frames). The lagoons will need to be replaced by an activated sludge treatment system to meet these specified limits and timeframes.

3.7 DISINFECTION

Disinfection is the final treatment process and provides the means for removal of pathogens prior to discharge to the Squamscott River. Disinfection is accomplished in the Chlorine Contact Tanks which are located at the northwest corner of Lagoon No. 3 and were constructed during the 1988 upgrade.

3.7.1 Chlorine Contact Tank

The Chlorine Contact Tank is a "three-pass" serpentine channel configuration. Under normal flow conditions chlorinated wastewater is conveyed to one of two "three-pass" serpentine channels after passing through its respective slide gate. During peak flow conditions both "three-pass" serpentine channels are placed into service and are able to properly disinfect with no known issues. Each serpentine channel is approximately 233.5-feet long, 5.0-feet wide, with a maximum water depth of approximately 9.4-feet and has a volume of approximately 82,000 gallons (164,000 gallons total). Each chlorine contact train is equipped with a gutter drain that leads to a sump to facilitate draining the tanks for maintenance; however this drain system is not currently operational. Each Chlorine Contact Tank can be pumped down to Lagoon No. 3 for maintenance using a pump powered from the closest aerator in Lagoon 3 which is controlled through SCADA. There is a scum trough at the end of the last pass channel. The Chlorine Contact Tank has numerous cracks located throughout the tanks and should be inspected for structural damage.

Wastewater enters the Chlorine Contact Tank via a 4,000 gallon± mixing chamber where sodium hypochlorite is mixed using a 5-hp single speed mixer. The mixer operates continuously and the motor and gears have been replaced. As chlorinated wastewater passes over the effluent weir it enters a 3,000 gallon± mixing chamber; however, the Town removed the dechlorination mixer at some point in the past. Sodium bisulfite is now mixed via turbulence in the mixing chamber and a sump pump in the entrance of the effluent Parshall Flume.

At the design peak hourly flow rate, the contact time is approximately 26 minutes, which meets the NHDES design standard of 15 minutes at peak flow. Since there has been a good compliance record associated with disinfection, the Chlorine Contact Tank could be repaired and maintained for continued use.

3.7.2 Chlorination System

Sodium hypochlorite is added to the mixing tank through a 1.5-inch diameter CPVC pipe that is fed by three metering pumps located in the Chlorination Building. Process water can be added as carrier water if needed. The three sodium hypochlorite metering pumps are paced off influent flow through SCADA. Since the chlorine residual samples are taken from the end of the "second-pass" serpentine channel, the chlorine residual results are not used to trim the pacing of the sodium hypochlorite metering pumps. Seasonally the sodium hypochlorite metering pumps' strokes are adjusted by the operators based on operational experience. The sodium hypochlorite metering pumps are fed from a pumped loop system which is supplied from one of two 1/2-hp sodium hypochlorite recirculation pumps that take suction from and discharge back to a 1,000 gallon day tank located in the Control Building. Weekly the operators alternate the sodium hypochlorite recirculation pumps and cleanout the offline Y-strainer. The sodium hypochlorite pumped loop system has had two leaks since coming online in 1988 with the last incidence occurring in January 2014 just behind the Control Building. The day tank is filled by two sodium hypochlorite 1-hp transfer pumps which take suction from one of two 2,000 gallon bulk storage tanks. During normal operation, approximately 100 gallons of sodium hypochlorite (12.5% concentration) and 500 gallons of process water are used to fill the 1,000 gallon day tank (2.0% concentration) each week. However, during times of partial nitrification sodium hypochlorite use can be upwards of 400 gallons per day at which time Lagoon No. 3 is taken offline and the discharge from Lagoon No. 2 is directed to the Chlorine Contact Tank. The 1,000 gallon day tank was installed during 1988 upgrade, the 2,000 gallon bulk storage tank No. 1 was replaced in 2013 and the 2,000 gallon bulk storage tank No. 2 was replaced in approximately 2002. Each sodium hypochlorite tank is equipped with an ultrasonic level probe which is connected to SCADA and provides a low and high level alarm. The sodium hypochlorite feed pumps, 1,000 gallon day tank, transfer pumps, and both 2,000 gallon bulk storage tanks are all located in the Control Building.

All components of the chlorination system have reached the end of their useful life and should be replaced with any future upgrades to the facility.

3.7.3 Dechlorination System

Sodium bisulfite is added to the mixing tank through a 1.5-inch diameter CPVC pipe that is fed by two sodium bisulfite metering pumps located in the Chlorination Building. Process water can be added as carrier water if needed. Mixing in the sodium bisulfite mixing tank is accomplished through a submerged sump pump that locally recirculates the wastewater. The two sodium bisulfite metering pumps are paced off influent flow through SCADA and trimmed using the chlorine residual analyzer results. The chlorine residual samples are taken from the "second-pass" of the serpentine channel. Seasonally the sodium bisulfite metering pumps' strokes are adjusted by the operators based on operational experience. The sodium bisulfite metering pumps are fed from a pumped loop system which is supplied from one of two 1/2-hp sodium bisulfite recirculation pumps that take suction from and discharge back to a 1,000 gallon day tank. Weekly the operators alternate the sodium bisulfite recirculation pumps and cleanout the offline Y-strainer. The sodium bisulfite loop system has never had a leak since coming online in 1988. The day tank is filled by a 1-hp sodium bisulfite transfer pump that takes suction from the 4,000 gallon sodium bisulfite bulk storage tank. During normal operation, approximately 42 gallons of sodium bisulfite (38% concentration) and 600 gallons of process water are used to fill the 1,000 gallon day tank (2.5% concentration) each week. The 1,000 gallon day tank was installed during 1988 upgrade and the 4,000 gallon bulk storage tank was replaced in approximately 2006. The 1,000 gallon day tank and 4,000 gallon bulk storage tank is equipped with an ultrasonic level probe which is connected to SCADA and provides a low and high level alarm. The room which stores both sodium bisulfite tanks has a low room temperature alarm which is connected to SCADA. During normal operation in the winter months the chlorine residual is between 0.6 and 0.8 mg/L while in the summer months the chlorine residual is between 1.0 and 1.5 mg/L. The sodium bisulfite feed pumps, day tank, transfer pump, 1,000 gallon day tank and 4,000 gallon bulk storage tank are all located in the Control Building.

All components of the dechlorination system have reached the end of their useful life and will need to be replaced with any future upgrades to the facility.

3.7.4 Effluent Flow Measurement

Effluent flow measurement is accomplished through the 18-inch wide Parshall Flume located northeast of the Chlorine Contact Tank and was constructed as part of the 1988 upgrade. After wastewater flow leaves the dechlorination mixing tank via a 30-inch diameter ductile iron pipe it is conveyed in to the Parshall Flume. The depth of wastewater over the flume is measured by an ultrasonic sensor and then the depth measurement is converted into a corresponding flow rate. The ultrasonic sensor was replaced in approximately 2009.

The Parshall Flume insert has been compromised due to water infiltration between the fiberglass flume insert and the concrete that houses it. Due to freeze and thaw action, the throat of the flume has been restricted at the entrance to 17.25 inches wide and 16.75 inches wide at the exit. As a cross-check, the depth at the ultrasonic level sensor was measured at 1.05 feet which correspond to a flow of 4.18 MGD on the 18-inch Parshall Flume discharge table. The corresponding flow reading was recorded at 4.10 MGD, which is a difference of 0.08 MGD or approximately 1.9% difference. The Chief Operator indicated that Environmental Instrument Services (EIS) or A&D Instruments had adjusted the effluent flow signal to account for the restriction. However, when EIS and A&D Instruments were contacted in April 2014, they had no record or recollection of making any adjustments.

The 18-inch wide Parshall Flume is appropriately sized for the design flow rate of the WWTF; however, due to the damage to the throat of the Parshall Flume and possibility of further damage over time it is recommended to replace the 18-inch wide Parshall Flume fiberglass insert and grout fillet at a minimum with any future upgrades to the facility.

3.7.5 Effluent Sampling

The effluent sampler was installed in 2009 and is located on the north side of the Parshall Flume in a prefabricated enclosure. Effluent composite samples are automatically collected in the Parshall Flume before the ultrasonic sensor. The samples are time-paced, 24-hour composite samples. The effluent sampler is in good condition and should be calibrated and maintained for continued use. The sampler should be converted to flow-paced composite sampling as a part of any future upgrade.

3.8 EFFLUENT OUTFALL

The extended effluent outfall was constructed during the 2002 upgrade and is located in the Squamscott River, east of Lagoon No. 2 and just downstream of the confluence of Wheelwright Creek. After treated wastewater leaves the Parshall Flume it is conveyed to the effluent outfall via a 30-inch diameter ductile iron pipe which transitions to a 32-inch diameter HPDE SDR-17 pipe. The effluent outfall consists of eight 9.0-inch diameter diffusers which are spaced at 5.7-feet on center. The effluent outfall is inspected by divers every 2 years and dredged if the average depth to the bottom is less than 16.5-inches. The effluent outfall is in good condition and has no known issues and therefore should be maintained for continued use.

3.9 PLANT HYDRAULICS

The operation staff indicated that, prior to the 2002 Outfall Upgrade project, the Parshall Flume experienced a tail water condition during extreme high tides. The operations staff indicated that there no known hydraulic problems at the WWTF at this time. The NPDES permit requires periodic visual inspection of the outfall.

The 100-year flood elevation as defined by the FEMA Flood Insurance Rate Maps (Map No. 33015C0402E, May 2005) at Elevation 8.0 (NGVD 1929 datum). The 100-year flood elevation as defined by the *Preliminary* FEMA Flood Insurance Rate Maps (Map No. 33015C0402F, April 2014) at Elevation 7.0 (NAVD 1988 datum). The current and preliminary proposed flood elevation are essentially identical when expressed on the same datum. The current and preliminary FEMA flood elevations is lower than the aerated lagoon berms as well as the lowest hydraulic control point at the WWTF (i.e., the effluent parshall flume, invert Elevation 10, NGVD 1929).

The Town is currently participating in the Climate Adaptation Plan for Exeter (CAPE) project. The purpose of the CAPE project is to facilitate long-term adaptation planning as it pertains to existing zoning as well as existing stormwater infrastructure (and to a lesser extent wastewater infrastructure). As a part of the project, the CAPE project team developed a computer model to assess flood elevations under a series of existing and future conditions. In August 2014, CAPE team members provided preliminary model output which indicated that flood elevations in the vicinity of the WWTF would increase to Elevation 11 to 13 (NAVD 1988 datum) for the 100-year flood combined with the 100-year storm surge in the year 2070.This projected future flood elevation is below the existing aerated lagoon berms but is well above the lowest hydraulic control point at the WWTF. The impact of these higher future flood elevations should be considered in the preliminary design phase of the project as it may impact the elevation of the new WWTF unit processes. It may also be appropriate to provide space on-site for a potential future effluent pump station. Additional information from the CAPE project team should be evaluated when it becomes available.

3.10 PLANT WIDE SUPPORT SYSTEMS

The ancillary plant wide support systems are described below.

3.10.1 Process Water System

The process water system was installed during the 1988 upgrade and is fed from the "second-pass" of both Chlorine Contact Tanks via an 8-inch diameter ductile iron pipe. The system capacity was identified as 200 gpm at 80 psi. The process water feed is pumped by one of two 10-hp process water pumps, located in the Chlorination Building, via a 4-inch diameter ductile iron forcemain to a 1,000 gallon hydro-pneumatic storage tank located in the Control Building. The process pumps were rebuilt in approximately 2011. The hydro-pneumatic storage tank is pressurized by a 3-hp air compressor also located in the Control Building which was replaced in approximately 2002 and had the motor replaced in approximately 2009. The process pump running status is sent to SCADA and alarms if the pump fails, but there are no controls associated with the pumps. Process water is supplied to the Septage Holding Tank, Grit Building, yard hydrants and as carrier water for the sodium hypochlorite and sodium bisulfite chemical systems. The operators indicated that the system capacity is sufficient for current demands. The process water system has reached the end of its useful life and should be replaced with any future upgrades to the facility.

3.10.2 Scum Removal

Scum removal is only accomplished at the end of the Chlorine Contact Tank. Scum is collected at the end of each serpentine channel via an 8-inch diameter scum trough and then conveyed through an 8-inch diameter ductile iron pipe into the approximately 180 gallons Scum Well. The scum is pumped from the Scum Well via a 1/2-hp scum pump via a 2-inch diameter PVC pipe which discharges into Lagoon No. 3. The scum pump operates by floats and is not configured to SCADA. Both of the scum troughs worm gears are difficult to operate and leak. The scum removal system has reached the end of its useful life and should be replaced with any future upgrades to the facility.

3.11 BIOSOLIDS PROCESSING

3.11.1 Aerated Lagoons No. 1, 2, and 3

Waste biosolids settle out from the wastewater and accumulate in the bottom of each aerated lagoon. The amount of biosolid accumulation decreases as the wastewater moves from Lagoon No. 1 to No. 2 and No. 3, therefore Lagoon No. 1 has the most accumulated biosolids and Lagoon No. 3 has the least amount of biosolids. The estimated waste biosolids volume is approximately 8.0 MG, based on the SolarBee data report dated October 26, 2013. These biosolids will need to be removed if the lagoons are to be decommissioned.

3.11.2 Sludge Storage Lagoon

The Sludge Storage Lagoon has never been used for its intended purpose of storing sludge from Lagoons No. 1, No. 2 and No. 3. Prior to becoming the Sludge Storage Lagoon, it was Lagoon No. 1 and a Stormwater Holding Pond. Presently the Sludge Storage Lagoon has two ponds located in it that drain via two 8-inch diameter culverts under the access road to Aerated Lagoon No. 3.

3.12 BUILDING SYSTEMS

A site evaluation was conducted on July 15, 2014 by Wright-Pierce architectural and electrical engineers. A summary of their findings is presented below.

3.12.1 Architectural

Wastewater Treatment Facility Buildings

The buildings at the WWTF were constructed in 1988 and have not been significantly upgraded. The buildings consist of a Control Building, a Grit Building and a Chlorination Building. All three buildings are of similar construction type: single story split faced masonry exterior walls with wood framed shingle roofs. Any of the existing buildings that will be retained for continued use should have the following repairs and improvements:

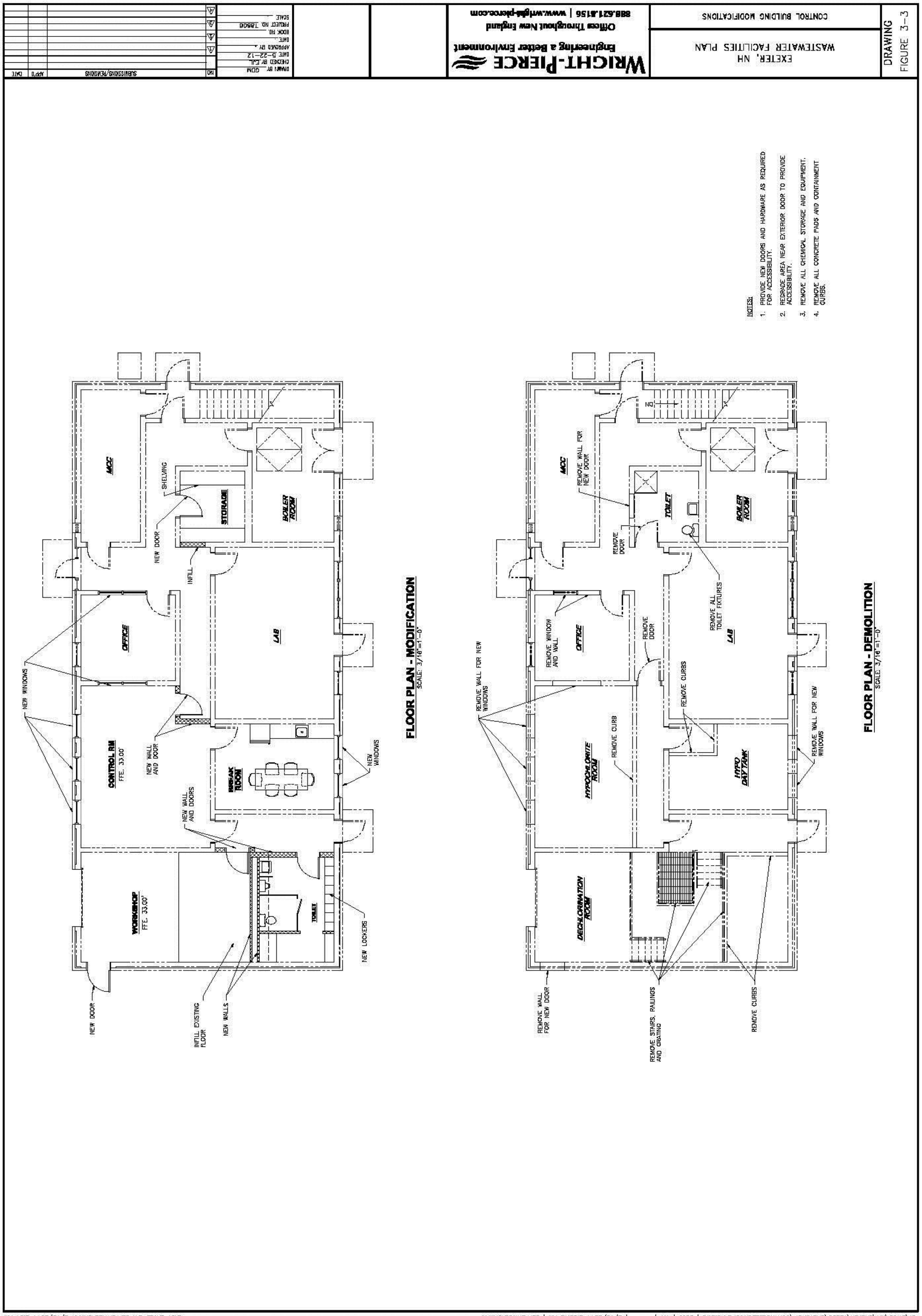
- Repair the minor cracks in the exterior masonry walls.
- Clean the moss and organic growth at the base of the walls in various locations.
- Install new sealants at the control joints and around the perimeter of all wall penetrations.
- Replace the shingle roofing and eave flashing.
- Replace vinyl siding at gable ends.
- Replace deteriorated doors.
- Replace the wood trim at the overhead door in the Control Building, if it is to remain.
- Replace the existing windows.
- Repaint the interior spaces.
- Replace other interior finishes such as flooring and acoustical ceilings.
- Provide separation of electrical gear from process spaces in Chlorination Building.

- Maintain separation between “classified” Pump Room and “unclassified” upper floor in Control Building (NFPA 820).

If a major upgrade is implemented at this facility, additional buildings would be constructed to meet the new treatment requirements. This would allow the chemical systems to be relocated out of the existing Control Building and would allow for the current chemical rooms to be converted to occupied functions (e.g., Meeting/Break Room, Control Room, Storage, Workshop and a handicapped accessible restroom) to better accommodate the needs of the current staff of four. Improvement required to implement these changes would include:

- Raising the depressed floor areas in the chemical rooms.
- New windows in the occupied spaces.
- Demolition of existing walls and construction of new walls
- New accessible rest room.
- New accessible door hardware.
- New interior finishes including paint, acoustical ceilings and flooring.
- New lighting.
- New HVAC systems.
- Re-grading at the building entry to make it accessible.
- Accessible parking.
- Add a small ramp or re-grade as required to provide a second accessible means of egress.
- Provide accessible signage.

A preliminary layout of the Control Building, indicating alternative space arrangements to address the identified space needs, is presented as **Figure 3-3**. This preliminary layout will need to be reviewed with the WWTF staff as well as the Code Enforcement Officer in greater detail in the preliminary design phase.



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WASTEWATER FACILITIES PLAN
CONTROL BUILDING MODIFICATIONS
DRAWING
FIGURE 3-3
NOTES:
1. PROVIDE NEW DOORS AND HARDWARE AS REQUIRED FOR ACCESSIBILITY.
2. REGRADE AREA NEAR EXTERIOR DOOR TO PROVIDE ACCESSIBILITY.
3. REMOVE ALL CHEMICAL STORAGE AND EQUIPMENT.
4. REMOVE ALL CONCRETE PADS AND CONTAINMENT CURBS.
FLOOR PLAN - MODIFICATION
SCALE: 3/16"=1'-0"
FLOOR PLAN - DEMOLITION
SCALE: 3/16"=1'-0"
MCC
STORAGE
BOILER ROOM
OFFICE
LAB
CONTROL RM
BREAK ROOM
WORKSHOP
TOILET
HYPOCHLORITE ROOM
HYPO DAY TANK
DECHLORINATION ROOM

Main Pump Station Building

The Main Pump Station was constructed in 1964 and was upgraded in 1996. The building consists of single story building with a below-grade pump room and wetwell. The materials of construction are precast concrete tilt-up panels framed by aluminum “W” shapes installed vertically with base support plates to retain each panel. The aluminum frame is installed at the face of the slab with the wall cantilevered off the structure. The general condition of the building is fair to good, but there is evidence of movement of the building components. A gap is evident between the loading dock and the wall panels and several of the base plated supporting the wall panels are deformed. Recommended improvements and repairs at this building should include:

- Repair the damaged base plates supporting the wall.
- Investigate further the cause of the gap between the wall panels and loading dock. This may be as result of simple settlement of the loading dock, but it should be further investigated.
- Replace the exterior doors.
- Provide separation between the “classified” and the “unclassified” spaces (NFPA 820).
- Replace the damaged stair nosings at the exterior stairs.
- The roofing system likely needs to be replaced.

Note that this building should be surveyed for lead and asbestos unless that has already been done as part of the previous upgrade.

3.12.2 Electrical

Wastewater Treatment Facility

The WWTF was constructed in its present form in 1988, and most of the electrical equipment dating from the initial construction is still in service. Electric service to the facility is provided by overhead utility primary conductors to riser pole #3736. From this pole, primary conductors feed an adjacent 500 kVA pad-mounted three-phase utility transformer located in front of the Control Building. Secondary conductors from the transformer supply electric service to the Control Building Main Circuit Breaker (Electrical Room) at 480 volts, three-phase, three-wire ungrounded, 800 amps. The aforementioned riser pole also supplies telephone and communications services to the Control Building. Also located adjacent to the riser pole and transformer is a diesel standby generator, built by Superior and rated 60 kW, located inside a walk-in enclosure which appears to be non-sound-attenuated. General observations are summarized below:

- The electric service disconnecting means (Main Circuit Breaker) is located inside the Control Building Electrical Room just off the building front entrance. The three-wire service appears to be ungrounded with no evidence of ground detection equipment. From the main circuit breaker switchboard, power is split with one branch feeding MCC#1 Normal Power Section (Aerators) and one branch feeding the Automatic Transfer Switch and MCC#1 Emergency Power Section. From MCC#1 Emergency Power Section, power is fed underground to the Grit Building (MCC#2) and the Chlorination (Lagoon) Building (MCC#3). The major electrical gear all appears to date from the original facility construction.
- Electrical components associated with a photovoltaic (PV) system are located outside the Control Building and are connected to a Photovoltaic Array located along the entrance to the site. This equipment is connected into the Control Building electrical service although the specific location could not be determined visually. The PV equipment is rated 50kW, 208 volts, 141 amps, with a 75 kVA dry-type transformer which appears to be provided for the purpose of stepping up the voltage from 208 volts to 480 volts. This equipment does not date from the original facility construction, but is of undetermined age.
- Power capacitors are located adjacent to, and connected to, MCC#1 Normal Power Section. These were reportedly provided to attempt to rectify some utility power problems and are not original to the facility construction.
- Standby power is supplied from the 60kW generator to all facility loads except for the Lagoon Aerators, which will not operate during an interruption of utility power to the facility. The Aerators are each fed by underground conductors from MCC#1 Normal Power section, to receptacle connection points located on the banks of the lagoons. Power is then carried aerially to each Aerator by power cables suspended on messenger cables.
- Lighting and single phase power in each of the buildings is provided from lighting panels and/or subpanels, with power to these panelboards being supplied from dry-type transformers.

- Interior lighting fixtures are either fluorescent or incandescent, depending on the location. Fixtures in the Control and Chlorination Buildings are enclosed and gasketed fluorescent with T8 lamps. Fixtures in the Grit Building are incandescent hazardous-location fixtures appropriate for that space. Exterior lighting fixtures are building-mounted HID wallpack fixtures. The fixtures are mostly functional, and appear to date from the original facility construction. No emergency battery lighting was observed in the facility, and exit lighting appeared to be inadequate in some areas.
- The facility presently has a SCADA system in place, with radio telemetry being received at the Control Building and signals being transmitted to the SCADA Panel MPU located in the Electrical Room. These controls are more recent than the original construction.
- The facility Fire Alarm System, GE ESL 1500 Series, appears original to the facility construction, and is reportedly functional and tested annually. The system covers the Control Building, Grit Building, and Chlorination (Lagoon) Building. It includes pull stations, smoke or heat detectors, notification appliances, and outdoor items at the Control Building (Gamewell box, red strobe, remote annunciator, and Suprasafe key box).
- Electrical equipment and systems in the facility are generally functional and in conditions consistent with their age and various locations. As expected, equipment in the Grit Building and nearest the different chemical systems is showing the greatest degree of corrosion.

Given the age and obsolescence of much of the electrical equipment and systems in the facility, it should be considered for replacement. Ultimately, however, it will depend on the final process configuration of the facility whether the electrical systems are completely or only partially replaced. If the present facility is replaced with a new activated-sludge treatment facility, then there would be a completely new electrical service with new standby generator, and new distribution equipment throughout the facility. Existing buildings would be upgraded with new electrical equipment and wiring to meet the new space requirements. If the present facility is to remain as it exists today as a lagoon plant, then more targeted electrical upgrades would be provided. The intent would be to replace degraded or obsolete equipment and wiring as necessary, and leave some newer functional equipment in place.

Main Pump Station

The Main Pump Station was constructed in 1964, and most electrical equipment in the station dating from the initial construction is still in service. Since that time, variable frequency drives have been provided for the present-day pumps, which were upgraded in 1996. Also, the original indoor standby generator was removed and replaced with a new outdoor, 200 kW Caterpillar diesel generator, installed in a sound-attenuated walk-in enclosure. This generator, installed within the past 12 to 15 years, has its fuel supplied from a dual-wall, sub-base tank located under the generator inside the enclosure. General observations are summarized below:

- Electric service to the station is provided by a pole-mounted three-phase utility transformer located adjacent to the station. Main service and distribution equipment consists of the original Clark Control motor control center, with transfer to standby power through the ASCO automatic transfer switch located in the Clark MCC. The main circuit breaker in the Clark MCC is not readily accessible from the station entry door, necessitating travel through the main floor of the station in order to shut off utility power to the station.
- The variable frequency drives provided as part of the 1996 pump upgrade are Cutler-Hammer SV9000 drives. The drives are located on the main floor level. There are no local safety disconnect switches on the lower level where the pumps are located.
- Interior and exterior lighting fixtures are a mix of incandescent (lower level and outdoors) and fluorescent (main floor level). The fixtures are mostly functional, and have likely been upgraded since the original construction.
- Telephone service exists in the station, but there is no fire alarm system present in the station.
- Pump controls have been upgraded since the original construction, with SCADA system panel RTU-800 providing control and data transmission to the Wastewater Treatment Facility Control Building via radio telemetry.

Given the age and obsolescence of much of the pump station electrical equipment, it is recommended that the station electrical equipment and systems be completely replaced, with the exception of the outdoor standby generator, which can remain in service. This will also provide an opportunity to bring the pump station into compliance with present National Electrical Code requirements regarding location of power disconnecting means, as well as other pertinent requirements.

3.12.3 Energy Efficiency/ Green Design

New buildings, as well as upgrades to existing buildings, will need to consider current building codes, energy efficiency guidelines and requirements and "green design" elements (where cost effective). Items that are typically considered for WWTF upgrades include the following:

- Natural and high efficiency lighting (with motion sensors in some locations);
- Solar walls;
- Effluent heat exchanger (to capture heat from WWTF effluent) and air-to-air heat exchangers and/or energy recovery ventilators (to capture heat from heated spaces);
- Building envelope improvements such as insulated walls, windows and roofs;
- White EPDM roofing for reduced solar gain; and
- Minimizing impervious surfaces and point source runoff.

SECTION 4

TOWN-WIDE NITROGEN MANAGEMENT

4.1 INTRODUCTION

NHDES has been studying the Great Bay Estuary system for many years. A listing of the most relevant work prepared by NHDES is provided below.

- Numeric Nutrient Criteria for the Great Bay Estuary (June 2009)
- Preliminary Watershed Nitrogen Loading Thresholds for the Watersheds Draining to the Great Bay Estuary (October 2009)
- Review of Numeric Nutrient Criteria for the Great Bay Estuary (EPA funded review, Howarth, June 2010)
- Analysis of Nitrogen Loading Reductions for Wastewater Treatment Facilities and Non-Point Sources in the Great Bay Watershed (Draft, December 2010)
- Assessments of Aquatic Life Use Support in the Great Bay Estuary for Chlorophyll-a, Dissolved Oxygen, Water Clarity, Eelgrass Habitat, and Nitrogen (April 2012)
- Great Bay Nitrogen Non-Point Source Study (Draft, May 2013)
- Joint Report of Peer Review Panel for Numeric Nutrient Criteria for the Great Bay Estuary (Coalition funded review, Bierman, Diaz, Kenworthy, Reckhow, February 2014)
- Great Bay Nitrogen Non-Point Source Study (Final, June 2014)

Based on their studies, NHDES has determined that the nitrogen sources of concern are largely "man-made" (or anthropogenic) sources which come from "point sources" (e.g., WWTF) and from "non-point sources" (e.g., atmospheric deposition, stormwater drainage systems, fertilizer use, animal wastes, and septic systems). Further, NHDES has concluded that reductions in nitrogen are required from all communities within the Great Bay Estuary watershed in order to achieve the desired level of water quality improvements. On this basis, EPA issued the Town a NPDES permit and an Administrative Order on Consent (AOC). The AOC requires that the Town have a serious and long-standing commitment to monitoring, tracking, accounting and implementation for nitrogen management. The AOC is included in **Appendix A** of this report.

Key implementation elements of the AOC are summarized below.

- *"…the Town shall begin tracking all activities [that the Town should reasonably be aware of, e.g., activities that involve a Town review/approval process or otherwise require a notification to the Town] within the Town that affect the total nitrogen load to Great Bay Estuary. This includes, but is not limited to, new/modified septic systems, decentralized wastewater treatment facilities, changes to the amount of effective impervious cover, changes to the amount of disconnected impervious cover [including pavement and buildings], conversion of existing landscape to lawn/turf and any new or modified Best Management Practices." [Article D.1]*

- *"…the Town shall begin coordination with the NHDES, other Great Bay communities, and watershed organizations in NHDES's efforts to develop and utilize a comprehensive subwatershed-based tracking/accounting system for quantifying the total nitrogen loading changes associated with all activities within the Town that affect the total nitrogen load to the Great Bay Estuary." [Article D.2]*

- *"…the Town shall begin coordination with the NHDES to develop a subwatershed community-based total nitrogen allocation." [Article D.3]*

- *"By September 30, 2018, [the Town shall] submit to EPA and the NHDES a total nitrogen non-point source and point source stormwater control plan ("Nitrogen Control Plan"), including a schedule of at least five years for implementing specific control measures as allowed by state law to address identified non-point source and stormwater Nitrogen loadings in the Town of Exeter that contribute total nitrogen to the Great Bay Estuary, including the Squamscott River. … The Nitrogen Control Plan shall be implemented in accordance with the schedules contained therein."[Article D.4]*

- *"By December 31, 2023, the Town shall submit an engineering evaluation that includes recommendations for the implementation of any additional measures necessary to achieve compliance with the NPDES Permit, or a justification for leaving the interim discharge limit set forth in Attachment 1.a in place (or lower the interim limit to a level below 8.0 mg/l but still above 3.0 mg/l) beyond that date." [Article E.2]*

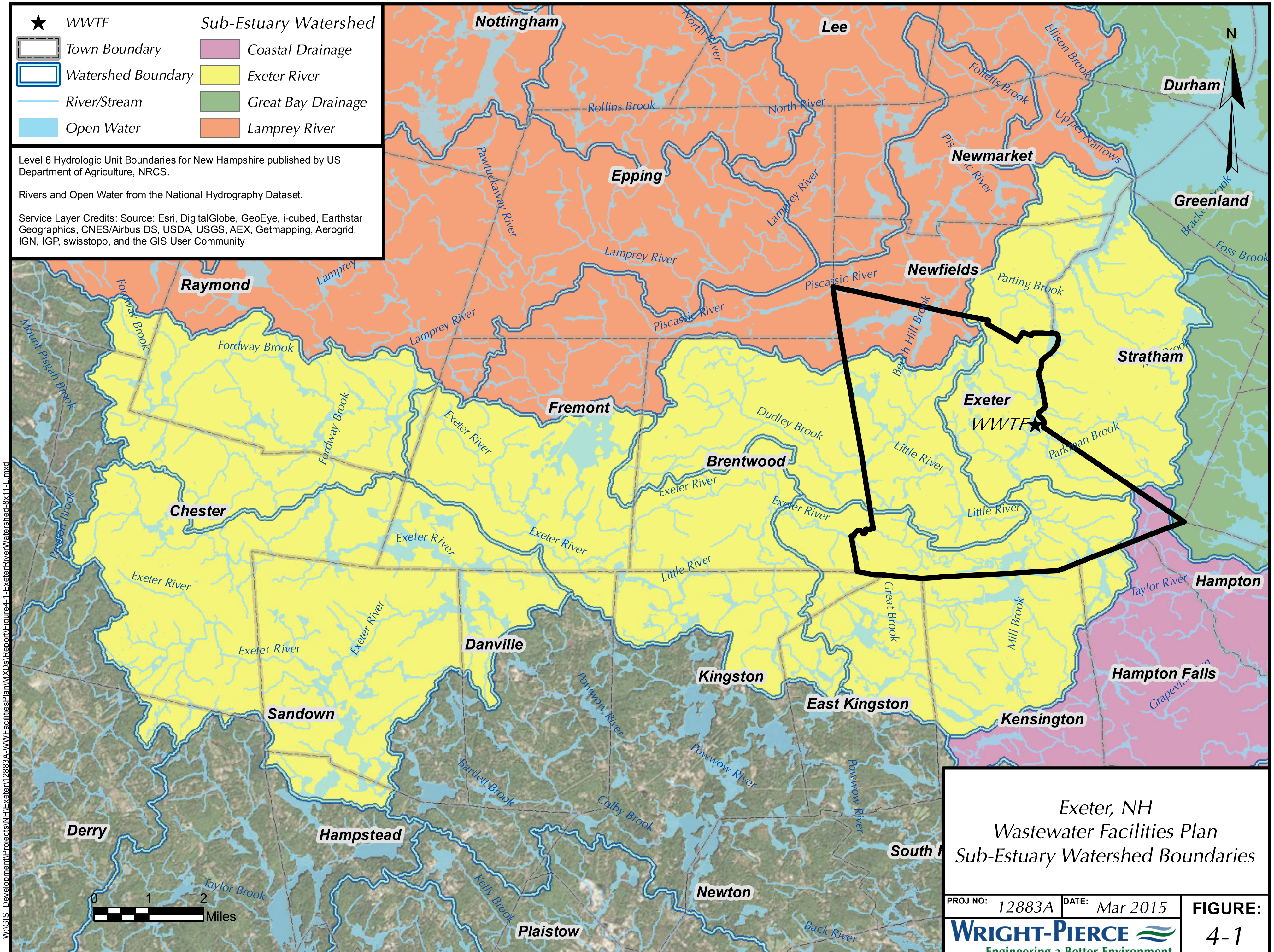
In addition to the above items, the AOC also requires the submittal of annual progress reports [Article E.1] on the status of the development of the nitrogen tracking/accounting system, status of the development of the Nitrogen Control Plan and a description of any activities that changed nitrogen loading.

4.2 BASELINE LOADINGS FROM EXETER TO GREAT BAY

In order to determine the source of nitrogen loadings to the Great Bay, NHDES has developed numerous technical reports over the past five years, including reports which estimate the amount of point source and non-point source nitrogen generated by each municipality. The most recent and comprehensive effort is the 2014 Final Great Bay Nitrogen Non-Point Source Study. This study provides a breakdown of non-point source loadings resulting from atmospheric deposition, chemical fertilizers, animal wastes, and human wastes (septic systems).

The Great Bay Nitrogen Non-Point Source Study describes the distinction between the "input load" to the watershed (i.e., the actual load generated by a particular source such as a roof, field, forest, parking lot, etc.) and the "delivered load" to the watershed (i.e., the load which ultimately reaches the receptor surface water after undergoing natural treatment processes along the transport pathway such as bacterial action, vegetative uptake, etc.). The delivered load is the most important parameter in terms of achieving the water quality goals.

The municipal boundaries of the Town of Exeter encompass four sub-estuary watersheds: Exeter/Squamscott River watershed; Lamprey River watershed; Winnicut River watershed; and Hampton Harbor watershed (refer to **Figure 4-1**). **Table 4-1** summarizes the demographics and delivered nitrogen loadings from Exeter to each of these sub-estuary watersheds. For example, Exeter has 30% of the total population that lives within the Exeter/Squamscott River sub-estuary watershed but has 10% of the total land area that falls within that watershed. **Table 4-2** summarizes Exeter's delivered nitrogen loadings to all four sub-watersheds by source type. **Table 4-3** summarizes the delivered nitrogen loadings to the Exeter/Squamscott River watershed by source type and by source town. Figure 4-2 summarizes the factors involved in input load and delivered load. Figure 4-3 depicts the delivered nitrogen loadings to the Exeter/Squamscott River watershed by source type and by source town.



Exeter, NH
Wastewater Facilities Plan
Sub-Estuary Watershed Boundaries

PROJ NO: 12883A DATE: Mar 2015

FIGURE: 4-1

WRIGHT-PIERCE
Engineering a Better Environment

W:\GIS_Development\Projects\NH\Exeter\12883A-WWFacilitiesPlan\MXDs\Report\Figure4-1-ExeterRiverWatershed-8x11-L.mxd

TABLE 4-1
DELIVERED TN LOAD FROM EXETER – BY SUB-ESTUARY WATERSHED

Category	% of Category Resulting From Exeter			
	Exeter/ Squamscott River	Lamprey River	Winnicut River	Hampton Harbor
Population	30%	1.0%	0.4%	1.7%
Land Area	10%	1.1%	0.2%	6.7%
No. of Septic Systems	8%	1.3%	0.2%	2.4%
Point Source Nitrogen	96%	0%	0%	0%
Non-Point Source Nitrogen	14%	0.7%	0.5%	0.6%
Total Nitrogen	35%	0.5%	0.5%	0.6%

Source: Great Bay Nitrogen Non-Point Source Study (2014), WWTF effluent data (2009-2012).
Additional point source nitrogen loads from lagoon leakage, CSOs and SSOs are not quantified.

TABLE 4-2
DELIVERED TN LOAD FROM EXETER – BY SOURCE TYPE

Source Type	Nitrogen Load (tons/year)	% of Total	Rank
NPS-Atmospheric Deposition (incl. stormwater)	7.22	12%	2
NPS-Chemical Fertilizers	4.37	7%	3
NPS-Animal Waste	2.87	5%	5
NPS-Human Waste (septic systems)	4.17	6%	4
PS-WWTF	42.69	70%	1
Total	61.33	100%	

Source: Great Bay Nitrogen Non-Point Source Study (2014), WWTF effluent data (2009-2012).
Additional point source nitrogen loads from lagoon leakage, CSOs and SSOs are not quantified.

TABLE 4-3
DELIVERED TN LOAD TO EXETER RIVER WATERSHED
BY SOURCE TYPE & TOWN

Source Type	Nitrogen Load From Exeter (tons/year)	Nitrogen Load Total (tons/year)	% of Total from Exeter
NPS-Atmospheric Deposition (incl. stormwater)	6.38	41.36	15%
NPS-Chemical Fertilizers	4.00	19.43	21%
NPS-Animal Waste	2.77	16.82	16%
NPS-Human Waste (septic systems)	3.53	45.40	8%
PS-WWTF	42.69	44.27	96%
Total	59.37	167.28	35%

Source: Great Bay Nitrogen Non-Point Source Study (2014), WWTF effluent data (2009-2012).
Additional point source nitrogen loads from lagoon leakage, CSOs and SSOs are not quantified.

FIGURE 4-2
NITROGEN SOURCES AND DELIVERY METHODS

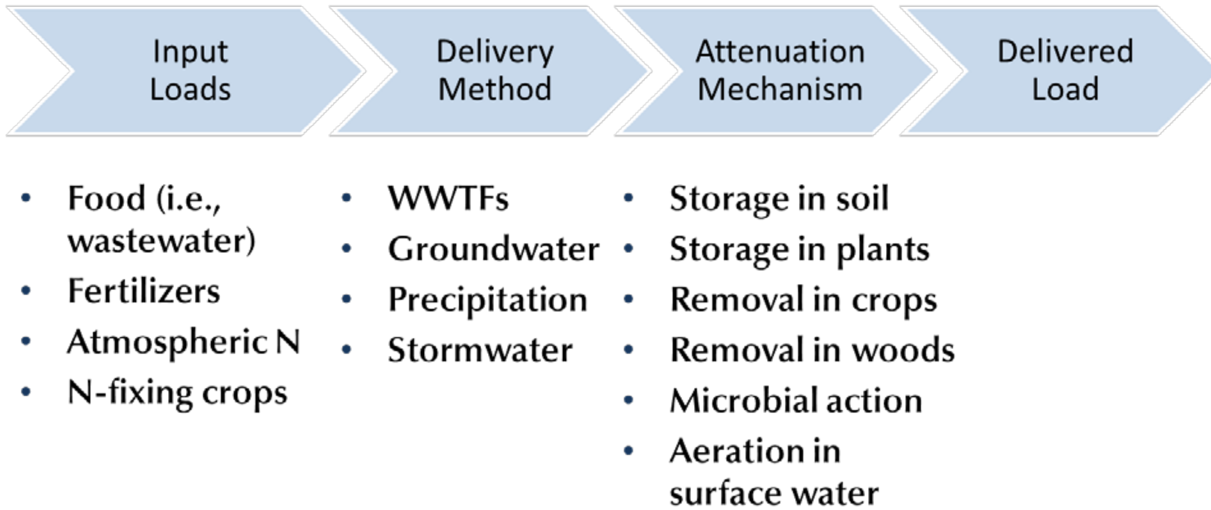
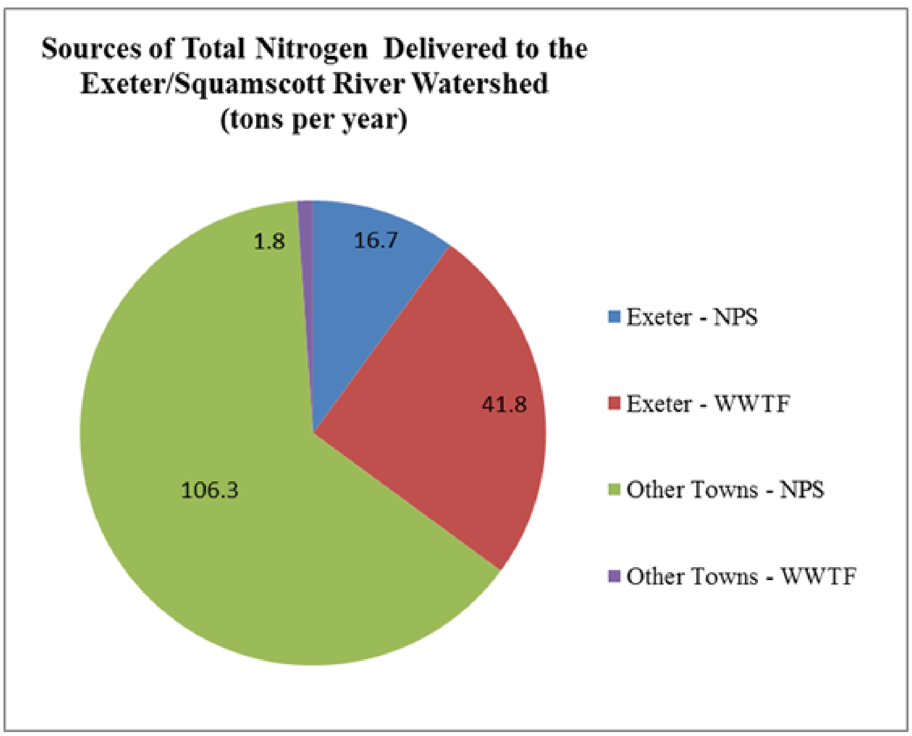


FIGURE 4-3



Total Delivered Load – 167 tons/year

Source: NHDES-GBNNPS, June 2014

Key conclusions from these tables and figures include:

- The total land area in the Exeter/Squamscott River watershed is approximately 115,545 acres (source: data files from GBNNPS Study); 90% of this land area is outside of Exeter.

- The total population in the Exeter/Squamscott River watershed is approximately 44,900 people (source: data files from GBNNPS Study); 70% of this population is outside of Exeter. The "per capita delivered nitrogen loading" for the whole watershed is 7.4 pounds/capita/year; whereas, Exeter generates approximately 8.4 pounds/capita/year under current conditions. Exeter's number will decrease substantially after the Exeter WWTF is upgraded and will be well below the watershed average.

- The significant majority of Exeter's nitrogen loads are to the Exeter/Squamscott River watershed; whereas, the loadings to the Lamprey River, Winnicut River, and Hampton Harbor watersheds are relatively insignificant.

- Approximately 65% of the nitrogen load to the Exeter/Squamscott River watershed comes from other towns. This percentage will increase after the Exeter WWTF is upgraded.

- Approximately 74% of the nitrogen load to the Exeter/Squamscott River watershed comes from non-point sources. This percentage will increase after the Exeter WWTF is upgraded.

- All of these loadings represent current conditions. Development within the watershed will increase these loadings. Whereas most of Exeter's development potential is within the sewered area, Exeter's future development should have a lower nitrogen footprint due to the fact that sewage will be treated at a new WWTF. That said, other non-point source nitrogen reduction strategies will be advisable to prevent making the nitrogen challenge larger and more costly. This is especially true for the other watershed communities that do not have a WWFT and that have the significant potential to dramatically increase future nitrogen loadings to Great Bay under a "business as usual" approach to managing development. The importance of engaging the other watershed communities on the topic of regulating nitrogen from new development cannot be overstated.

4.3 ESTABLISHMENT OF NITROGEN THRESHOLDS

A "threshold load" is the load below which water quality goals are presumed or expected to be met. Typically, a threshold load would be established by a Total Maximum Daily Load (TMDL) Study. To date, a TMDL Study has not been completed and is not being contemplated in the near term. Instead, the 2010 Analysis of Nitrogen Loading Reductions is the only document prepared by NHDES to date which identifies a threshold load. These threshold loads are based on the 2009 Numeric Nutrient Criteria document. The 2009 Numeric Nutrient Criteria document established 0.3-mg/l as the water column nitrogen concentration necessary to prevent loss of eelgrass habitat and 0.45-mg/l as the water column nitrogen concentration necessary to prevent occurrences of low dissolved oxygen. NHDES identified a threshold load for the Great Bay as well as each sub-estuary. The 2010 Analysis of Nitrogen Loading Reductions identifies the threshold loads for the Exeter/Squamscott River sub-estuary watershed as:

- 140.3 tons of nitrogen per year to prevent low dissolved oxygen conditions in the river (*equivalent to 6.2 pounds of delivered nitrogen/capita/year at current population*);
- 87.8 tons of nitrogen per year to protect eelgrass in the sub-estuary (*equivalent to 3.9 pounds of delivered nitrogen/capita/year at current population*); and
- 161.7 tons of nitrogen per year to protect eelgrass in the downstream subestuaries (*equivalent to 7.2 pounds of delivered nitrogen/capita/year at current population*).

NHDES has indicated that there is no known eelgrass habitat within the Exeter/Squamscott River sub-estuary "upper assessment unit" (P. Trowbridge, NHDES, January 2014); however, NHDES has indicated that there was or may have been historic eelgrass habitat in the "lower assessment unit" (T.Diers, NHDES, February 2015). Per **Table 4-3**, the current delivered load is 167.3 tons/year; therefore, approximately 16% (approximately 27 tons of nitrogen per year) of the current delivered load needs to be removed to meet the DO threshold and 48% (approximately 80 tons of nitrogen per year) of the current delivered load needs to be removed to meet the sub-estuary eelgrass threshold. <u>In addition to the above noted reductions, future growth must be fully offset by additional reductions in order to maintain nitrogen loads below the threshold load (i.e., no net nitrogen increase resulting from growth). For this reason, it is important to implement "near-nitrogen-neutral" development standards for new development and re-development.</u>

These values will be used for planning purposes in this report. However, it is essential to note that the 2009 Numeric Nutrient Criteria document underwent a peer review by collaborative agreement between NHDES and the Cities of Dover, Rochester and Portsmouth. The results of the peer review are documented in a report entitled "*Joint Report of Peer Review Panel for Numeric Nutrient Criteria for the Great Bay Estuary, New Hampshire Department of Environmental Service, June 2009*". On the basis of this peer review, NHDES and the Cities of Dover, Rochester and Portsmouth agreed that the NHDES will no longer use the numeric nutrient criteria in its Section 305(b) and 303(d) water quality assessment for the Great Bay Estuary (Settlement Agreement, Docket 2013-0119). Accordingly, the threshold values noted above and used herein should be considered the best available guidance at this time and that they may change in the future.

As will be shown later in this report, the threshold nitrogen has a very significant impact on the magnitude and cost of nitrogen management required. The Town should actively (and financially) participate in a regionally-funded water quality monitoring program designed to measure the various factors in meeting water quality criteria (e.g., dissolved oxygen, chlorophyll-a, transparency, salinity, suspended solids, etc.) in order to refine the threshold values. The removal of Great Dam and the upgrade of the Exeter WWTF will make significant improvements in water quality which should also be assessed.

4.4 PRELIMINARY STRATEGY FOR NITROGEN MANAGEMENT

In general, there are two approaches to nitrogen management – reduce inputs of nitrogen to the watershed and/or increase nitrogen removals from the watershed. The AOC requires that Exeter address point and non-point source of nitrogen. Point source reduction strategies are addressed in **Section 5** of this report and consist of upgrading the WWTF. Non-point source reduction strategies could consist of a host of options to manage the loads coming from the various categories included in the NHDES model. A general description of each category is provided below.

- Atmospheric Deposition - There is a growing body of data which indicates that atmospheric nitrogen deposition has been decreasing since the late 1990s (a result of the Clean Air Act and Clean Air Act Amendments). These trends in atmospheric deposition warrant inclusion in nitrogen management strategies. It is worth noting that the Long Island Sound TMDL Report (CTDEP, 2000) included an 18% reduction in atmospheric nitrogen deposition as a part of the required reductions. The CTDEP Long Island Sound Study Work Group is currently re-evaluating the TMDL and expects that atmospheric nitrogen deposition has been reduced more than the 18% value. In Appendix A of the DES Great Bay Non-Point Source Study, referencing EPA estimates, NHDES cites that by 2020 nitrogen deposition could decrease by as much as 33% from the 2009 rates included in the NHDES report. In addition, the atmospheric deposition category includes non-point source loadings from stormwater. Best professional judgment suggests that a 30% reduction in atmospheric nitrogen inputs is likely for the planning period (through 2040).

- Stormwater Best Management Practices - Stormwater carries pollutants to surface waters, including oils, fuels, sand, road salt and nutrients. Stormwater Best Management Practices (BMPs) are designed to minimize the transfer of these pollutants to surface waters. BMPs fall into several categories such as planning/design (e.g., minimizing impervious area, maximizing setbacks from wetlands, stormwater treatment, etc.), construction (e.g., sedimentation and erosion controls) and on-going maintenance (e.g., treatment unit inspection/maintenance, street sweeping, catch basin cleaning, etc.). Stormwater BMPs will be required by the new MS4 permit (impending) in order to reduce the delivered nitrogen load. This item will be covered in detail in the WISE report.

- Chemical Fertilizers - Chemical fertilizers are used for lawns and for agricultural operations. Lawns represent one of the "low hanging fruit" opportunities for nitrogen management. Homeowners have come to expect green lawns and many apply lawn fertilizers (typically 4 to 6 pounds of nitrogen/year/thousand square feet of lawn). The controllable source of nitrogen load can be reduced in numerous ways including: educating the public regarding the environmental and cost implications of lawn fertilizers; educating the public regarding best management practices; modifying the perception of what constitutes attractive landscaping; use of animal manures or composts generated from within the Great Bay watershed (versus animal manures/composts/chemical fertilizers imported into the watershed); and even planting slow-grow grass species which need much less nitrogen (typically 0 to 2 pounds of nitrogen/year/thousand square feet of lawn). These approaches can be applied to agricultural operations as well. It is also important to note that these same approaches will minimize phosphorus transport as well. We suggest targeting a 20% reduction in chemical fertilizer load through a rigorous public education program and perhaps some regulation.

- Animal Wastes - Animal wastes can result in bacterial, viral and nutrient pollution to groundwater and surface water. Nitrogen load resulting from animal wastes could be reduced by public education and community outreach. We suggest targeting a 10% reduction in animal waste load through a rigorous public education program and perhaps some regulation.

- Human Wastes (Septic Systems) - Human wastes from septic systems contain bacterial, viral, “contaminants of emerging concern” (e.g., pharmaceuticals, personal care products, etc.) and nutrient pollution to groundwater and surface water. Most of the nitrogen in this wastewater category comes from the food we consume. The two most common approaches to address the nitrogen load from septic systems are: 1) to construct public sewers which discharge to nitrogen-removing WWTFs; and 2) to convert the on-site septic systems to denitrifying septic systems. Several less common and non-traditional approaches to address the nitrogen load from septic systems are: 1) to install composting toilets; 2) to install urine diverting toilets; and 3) to modify of diet. These non-traditional approaches have been used around the world and sporadically in the United States. Broad-based public acceptance of these non-traditional approaches does not appear to be imminent but may change over time. We suggest setting a target value of “no net increase” in the current nitrogen loadings for this category given that planned growth outside the sewered area is relatively small.

As described earlier in this section, the impact of natural attenuation is an important consideration with regard to nitrogen removal and cost-effectiveness. A typical septic system will remove approximately 40% of the nitrogen which is generated by a typical residential home. According to the NHDES GBNNPSS Study, a septic system located greater than 200 meters from a 5th order river will receive additional natural attenuation before reaching the river or the bay (i.e., increasing the effective removal rate to 74% of the input) whereas a septic system located less than 200 meters from a 5th order river will receive little to no natural attenuation (i.e., remaining at the 40% removal rate). Table 4-4 presents the effective nitrogen removal rates for various traditional approaches to addressing the non-point source human waste/septic system category. An important conclusion which can be drawn from this table is that the delivered load from a typical residential home with a standard septic system located greater than 200 meters from a 5th order river is approximately the same as a typical residential home which is sewered and connected to an advanced WWTF designed to produce effluent total nitrogen of 8 mg/l.

TABLE 4-4
NITROGEN REMOVAL RATES FROM VARIOUS TREATMENT APPROACHES

Wastewater Management Approach	Assumed Input Load lbs/day	Resultant Delivered Load lbs/day	Effective Removal
Secondary WWTF	1	0.67	33%
Standard Septic System, <200m	1	0.60	40%
Denitrifying System, <200m	1	0.30	70%
WWTF with TN Removal to 8 mg/l	1	0.27	73%
Standard Septic System, >200m	1	0.26	74%
WWTF with TN Removal to 5 mg/l	1	0.17	83%
Denitrifying System, >200m	1	0.13	87%
WWTF with TN Removal to 3 mg/l	1	0.10	90%

Notes:
1. Delivery factors for standard septic systems are from NHDES GBNNPS Study (June 2014).
2. Delivery factors for denitrifying systems were adjusted by Wright-Pierce to account for improved TN removal by the on-site system.
3. WWTF TN removals were based on the typical Exeter influent TKN value of 30 mg/l.

As noted previously, Exeter’s nitrogen management strategy will address point source and non-point nitrogen management. From a water quality perspective, it does not matter which is reduced – so more point source reductions would result less required non-point source reductions and vice versa. **Table 4-5** presents the required watershed-wide non-point source nitrogen reductions for a given WWTF effluent concentration under current and future WWTF flow conditions to meet the dissolved oxygen threshold. This table accounts for sewered growth in Exeter, but does not account for non-sewered growth in Exeter or the remainder of the watershed. As noted elsewhere in this report, future development should be managed to a “near-nitrogen-neutral” condition.

TABLE 4-5
REQUIRED WATERSHED-WIDE NPS NITROGEN REDUCTIONS
AT DIFFERENT WWTF CRITERIA

WWTF Effluent TN Concentration	Current Conditions (2018)	Planning Horizon (2040)
8-mg/l	3% reduction required	16% reduction required
5-mg/l	3% below threshold	5% reduction required
3-mg/l	8% below threshold	3% below threshold
<1-mg/l (Pease WWTF)	12% below threshold	10% below threshold

Table 4-6 provides a preliminary analysis of readily achievable NPS nitrogen reductions possible in order to compare it to the required NPS nitrogen reductions. The fraction of the NPS load is based on the NHDES GBNNPS Study (2014). The estimated reductions are estimates based on the descriptions above. The possible net reduction is the product of the fraction of NPS load and the estimated reductions. Based on this analysis, a 15% reduction in NPS nitrogen should be possible at very low cost. Note that Stormwater BMPs are not included in the table below as they will be included in the WISE report. These measures will further improve the NPS reductions possible.

TABLE 4-6
POSSIBLE NPS NITROGEN REDUCTIONS

Category	Fraction of NPS Nitrogen Load	Estimated Reductions	Net Possible Reduction
Septic	24%	0%	0%
Animal/Agricultural	17%	10%	1.7%
Chemical Fertilizer	24%	20%	4.8%
Atmospheric Deposition	35%	30%	10.5%
Total Net Reduction			17% **Use 15%**

Figure 4-4 provides a comparison of existing conditions (i.e., existing flows and existing effluent nitrogen concentrations) versus several nitrogen management scenarios, as briefly described below:

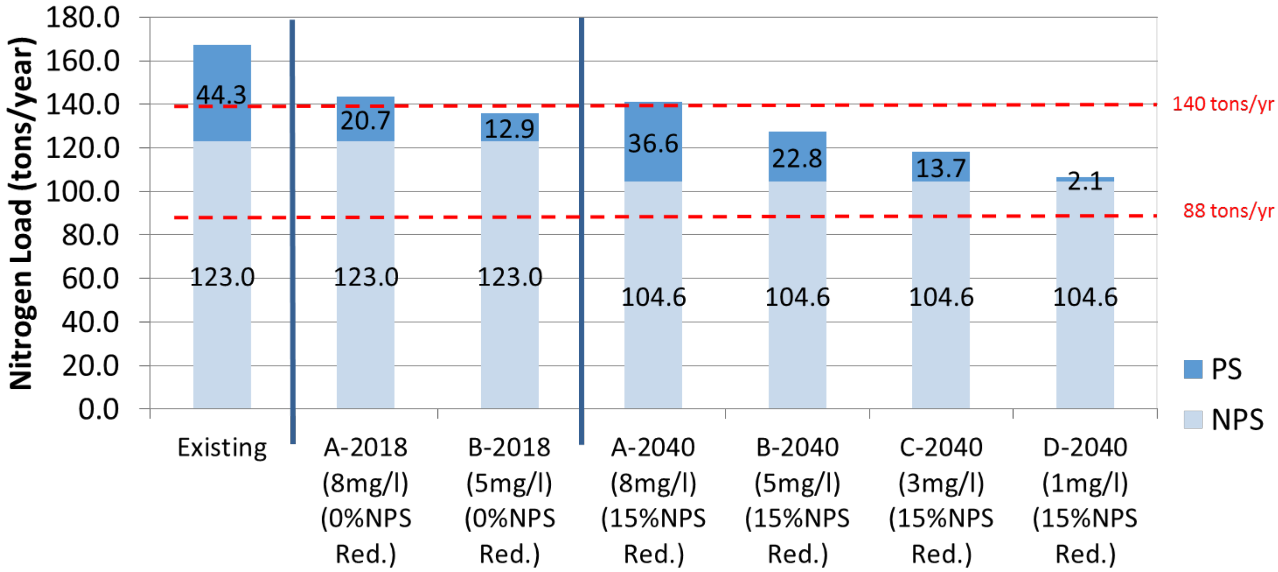
- Scenario A – Upgrade the WWTF to 3.0-mgd flow at **8-mg/l** effluent total nitrogen;
- Scenario B – Upgrade the WWTF to 3.0-mgd flow at **5-mg/l** effluent total nitrogen;

- Scenario C – Upgrade the WWTF to 3.0-mgd flow at **3-mg/l** effluent total nitrogen; and
- Scenario D – Connect to Pease Regional WWTF at Pease (i.e., **<1-mg/l** TN to Great Bay).

It is also important to consider how the nitrogen management strategies might play out over time. As noted in previous sections of this report, the existing annual average flow from the WWTF is considerably less than the permitted 3.0-mgd. Also, the WWTF upgrade and the non-point source management measures will take time to implement and for the benefits to be measureable.

Scenarios A and B are presented in both "post-WWTF upgrade conditions" (i.e., 2018, 1.8-mgd WWTF flow) and at the planning horizon (i.e., 2040, 3.0-mgd WWTF flow); whereas, Scenarios C and D are presented only at the planning horizon. **Figure 4-4** illustrates a broad range of point source and non-point source nitrogen reduction strategies that the Town may consider.

FIGURE 4-4
COMPARISON OF NITROGEN MANAGEMENT STRATEGIES FOR EXETER/SQUAMSCOTT RIVER WATERSHED LOADS



This analysis includes "sewered growth" in Exeter but does not include non-sewered growth that will occur in the watershed. This analysis indicates that attainment of the river dissolved oxygen threshold is achievable. It will be much more challenging to achieve the river eelgrass threshold, if required, and will require larger NPS reductions than indicated in **Table 4-6**.

As shown in **Table 4-3**, it important to note that Exeter produces only 16.7 tons/year of the 123.0 tons per year of non-point source nitrogen in the Exeter/Squamscott River watershed. Accordingly, cooperation from the other watershed communities will be essential to achieving the water quality goals.

4.5 COST-EFFECTIVENESS OF NITROGEN REMOVAL METHODS

In order to assess which nitrogen reduction methods to implement first, it is important to consider the cost-effectiveness of the various methods on a "cost per pound of nitrogen removed" basis. One key element to consider is the dramatic impact of *natural attenuation* (refer to Section 4.2) has on the cost-effectiveness of the various methods. **Table 4-7** summarizes the cost effectiveness of various nitrogen removal methods in terms of "capital cost per pound of delivered total nitrogen removed per year".

It is important to understand that these numbers are based on Exeter's situation and are based on numerous stated assumptions, including the high-level assumptions built into the NHDES Great Bay Nitrogen Non-Point Source Study regarding attenuation. That said, changes in the various assumptions will not change the fact that there are order of magnitude cost differences between these approaches.

- The least cost approaches involve managing the inputs – atmospheric deposition, lawn care, chemical fertilizer application, animal wastes and agricultural BMPs.
- The next lowest cost approach involves upgrading the existing WWTF to remove nitrogen.
- The highest cost approaches involve converting existing septic systems to denitrifying septic systems or constructing sewer extensions for nitrogen reduction only (i.e., there may be other reasons that make a sewer extension appropriate). In this third category, the initial focus should be on parcels that have septic systems within 200 meters of a 5^{th} order river.

TABLE 4-7
RANGE OF CAPITAL COSTS FOR NITROGEN REMOVAL METHODS

	Capital Cost per Pound of Delivered TN Removed per Year	Notes
Atmospheric Deposition Reductions	$0	1
Chemical Fertilizer Management	$60	2
Agricultural BMPs	$180	3
Exeter WWTF	$290 to $330	4
On-Site Denitrification System <200 meters from 5th Order River	$3,300	6
Sewer Extension <200 meters from 5th Order River	$4,000	5
On-Site Denitrification System >200 meters from 5th Order River	$7,700	6
Sewer Extension >200 meters from 5th Order River	$18,100	5

Notes:

1) Atmospheric deposition reductions are occurring with no incremental cost.
2) Chemical fertilizer management is assumed to be a staff position to promote, monitor and enforce chemical fertilizer reductions. Assumes staff position and expense budget of $100,000 per year and a 20% reduction in Exeter only loads from Table 4-3.
3) Agricultural BMPs is also assumed to be a staff position to promote, monitor and enforce chemical fertilizer reductions. Assumes staff position and expense budget of $100,000 per year and a 10% reduction in Exeter only loads from Table 4-3.
4) Exeter WWTF TN removals are based on 3.0-mgd at 20-mg/l (current concentration) to 3.0-mgd at 8/5/3-mg/l (future); this equates to 110,000 to 155,000 pounds of delivered TN removed per year. This excludes the cost of the collection system, since it already exists.
5) A typical residential home produces approximately 25 pounds per year of TN (2.5 people at 10 pounds per capita). Based on Table 4-4, a typical septic system will remove approximately 40% of the load. So, if that typical home is less than 200 meters from a 5th order river, the delivered load from the septic system is assumed to be 15 lbs/year; whereas if that that typical home is greater than 200 meters from a 5th order river, the delivered load from the septic system is 6.5 lbs/year (with natural attenuation). The TN removed by a sewer extension is 10.75 lbs/years and 2.25 lbs/year for systems located less than 200 meters and greater than 200 meters, respectively. The metric is based on an assumed sewer extensions cost of $40,000 per home connected to the sewer.
6) Similar to Note 5, for a denitrifying septic system less than 200 meters from a 5th order river, the delivered load is 7.5 lbs/year; whereas, a denitrifying septic system greater than 200 meters from a 5th order river, the delivered load is 3.25 lbs/year (with natural attenuation). The TN removed by conversion from a standard septic system to a denitrifying septic system is 7.5 lbs/year and 3.25 lbs/year for systems located less than 200 meters and greater than 200 meters, respectively. The metric is based on an assumed denitrifying septic system cost of $25,000 per home converted.

4.6 IDENTIFICATION OF RELEVANT WATERSHED STUDIES

Squamscott River August-September 2011 Field Studies

A field study of the Squamscott River was conducted in the August and September 2011. This work was documented in a technical memorandum prepared by HydroQual dated March 20, 2012. The study included two “spatial surveys” to collect representative samples for laboratory analysis of a suite of parameters along the river section between Great Dam in Exeter and Railroad Bridge in Stratham/Newfields. The study also included two datasondes deployed in the Squamscott River for approximately 45 days to provide continuous data for dissolved oxygen, chlorophyll-a, temperature and salinity. The technical memorandum indicates that the existing Exeter WWTF is a dominant factor is the dissolved oxygen levels in the river, in part because the WWTF is a source of nutrient as well as a direct source of chlorophyll-a to the river. The technical memorandum concludes that upgrade of the WWTF to an activated sludge-type treatment system, suitable to achieve 8-mg/l effluent total nitrogen, will result in substantial reduction in chlorophyll-a, and increase in dissolved oxygen. In addition, the technical memorandum concludes that decisions on further upgrades to the WWTF should be made based on a calibrated water quality model with data collected after the first upgrade.

Water Integration for the Squamscott-Exeter (“WISE”)

The WISE project is funded by a grant from the National Estuarine Research Reserve System (NERRS). The purpose of the project is to establish a framework for inter-municipal collaboration for the Exeter/Squamscott River watershed and to provide certain tools for use by the towns. The project began in late 2013 and is on-going. Primary outputs from the project include items identified below:

- Analysis of a broad range of scenarios for non-point source nitrogen management such as green infrastructure, stormwater BMPs, fertilizer controls, low impact design zoning, “business as usual” zoning, etc.).
- Framework for the tracking and accounting system required by the AOC for use in the Nitrogen Control Plan.

- Input and technical assistance to evaluate and recommend the river monitoring locations and protocols for long-term AOC and MS4 (Municipal Separate Storm Sewer System) permit compliance.
- Macroalgae monitoring in the Squamscott River in 2014.
- Technical tools and guidance for stormwater BMPs, "illicit discharge detection and elimination" (IDDE) program, Water Quality Response Plan, mapping, etc.

Exeter River Great Dam Removal Project

The Town of Exeter has been studying the advantages, disadvantages and costs associated with removing Great Dam located on the Exeter River. Removal of the dam will likely improve water quality upstream and downstream of the dam. It is important to note that the Exeter WWTF is located downstream of the dam where river flow and depth characteristics are not expected to change. The Exeter River Great Dam Removal Feasibility and Impact Study (Vanasse Hangen Brustlin, Inc., 2013) indicates that removal of the dam would reduce thermal gain (smaller surface area for thermal absorption) and result in improved dissolved oxygen concentrations. Downstream water quality impacts/improvements will require additional data collection and analysis subsequent to the dam removal.

4.7 DEMONSTRATION OF FUTURE COMPLIANCE

EPA and NHDES have not specified a "conventional" or "traditional" path to demonstrate future compliance, but rather, have stated that they expect that information gathered and prepared by Exeter and other regulated communities (e.g., Newmarket, Durham, Dover, Rochester, Portsmouth) over the next five to ten years (through the AOC and other public studies) will inform this determination. Ultimately, EPA and NHDES will be looking for the Great Bay and its sub-estuaries to have an ecological and biological response that meets the water quality standards. This response may occur at nitrogen levels that are above or below the threshold criteria concentrations developed by NHDES. If an adequate response occurs with nitrogen levels higher than the threshold criteria, this would be justification to suspend implementation activities. Alternatively, if the response has not occurred and nitrogen levels are lower than the threshold criteria, additional efforts will likely be required.

Accordingly, the following specific items should be considered over the upcoming years:

- EPA and NHDES have indicated that groundwater travel time ("on the order of decades") and natural and seasonal variations will need to be taken into account in the demonstration of compliance over the long-term. This will place additional emphasis on the river monitoring program and on the ability of the tracking and accounting tools to project future conditions (i.e., when does the load arrive in the river or the bay).

- NHDES will review trends in the nitrogen concentrations in the Squamscott River, above and below the WWTF, and in Great Bay. Establishing a long-term data record for in-stream nitrogen concentration is critically important.

- Exeter should maintain a lead role in advocating that NHDES establish a method to allocate responsibility for nitrogen management. The methodology for allocation of responsibility for nitrogen loads is extremely important as it will determine how the cost burden is shared between sewered and non-sewered communities.

- In conjunction with other communities, and perhaps the Southeast Watershed Alliance, Exeter should consider developing "near-nitrogen-neutral" strategies for new development and re-development.

- Exeter nitrogen management program should provide for an adaptive and phased approach to implementation of both point source and non-point source management efforts. Efforts should be focused on measures that have the least natural attenuation as well as the shortest travel time to the Squamscott River and Great Bay.

- Exeter should strongly consider WWTF upgrade approaches that have the "lowest cost per pound of nitrogen removed" (versus just "lowest cost"), especially for approaches that provide additional nitrogen removal and minimal or modest incremental cost.

- Exeter should continue to monitor the progress of, and to collaborate with, the other regulated "point source" Great Bay communities. For example, significant point source load reductions will be implemented over the next four years. Specifically, upgrades to the five largest WWTFs are anticipated to occur as follows: Rochester (2015); Dover (2015); Durham (2015); Portsmouth Peirce Island (2017); Newmarket (2017); and Exeter (2018).

4.8 NON-STRUCTURAL AND NON-TRADITIONAL MEASURES

Nitrogen management can be accomplished through so-called structural, non-structural and non-traditional measures. Structural measures include "grey infrastructure" (e.g., sewers, treatment plants, etc.) and "green infrastructure" (e.g., source control through private I/I reduction, engineered wetlands for stormwater treatment, pervious pavement, rain gardens, etc.). Non-structural and non-traditional measures which could be used for nitrogen management include:

Non-Structural	Non-Traditional
Density controls	Permeable reactive treatment barriers
Fertilizer management	Aquaculture
Stormwater best management practices	Dredging and flushing enhancements
Public awareness campaigns	Alternative toilet systems
Septic system nutrient management	Integrated "grey" and "green" approaches

It is also essential to ensure that all Great Bay watershed communities participate and address their share of the delivered load (i.e., the load that reaches the estuary). This will require that NHDES refine its point source and non-point source models to "allocate" responsibility among the Great Bay watershed communities. Implementation under this model could be accomplished through techniques such as cost sharing arrangements (e.g., Maryland's "Flush Tax") or watershed-based permitting and nutrient trading (e.g., Connecticut's Long Island Sound Program).

4.9 ADAPTIVE MANAGEMENT

In dealing with complex environmental problems, precisely determining the optimum solution can take many years and require very extensive study. At some point, sufficient information is available to embark on a solution, even though all aspects of the best solution have not yet been determined. Adaptive management is the formulation and implementation of a plan that begins to solve the problem while further information is gained to guide later phases toward the best overall solution. The basic elements of a successful adaptive management plan are:

- A solution that can be implemented in phases over time;
- Acquisition of data to show the effectiveness of the early phases of the solution; and
- A mechanism to re-assess the plan and adjust it to reflect the information gathered.

The data acquisition program must be directed at answering the question: "***What information is needed to determine the impacts of early phases of the project so that later phases can be modified if necessary?***" The data evaluation and "program re-assessment" must be well planned and must provide results that are approvable by the regulatory agencies.

Exeter's Adaptive Management Plan should address the following uncertainties:

1. How does the reduction in watershed nitrogen loading actually improve the water column nitrogen concentration in the impacted embayment? Is the water column concentration more or less sensitive to watershed load than predicted by the NHDES models?

2. How does the eelgrass or benthic community respond to the reduction in water column nitrogen concentration? Are the eelgrass and/or benthic communities more or less sensitive to water column nitrogen concentration than predicted in the NHDES models?

3. Has progress in other watershed communities occurred on schedule and, if not, how does that impact the decision making framework for Exeter?

4. Has growth followed the progression expected or is capacity needed sooner (or later) than planned?

5. Have any municipalities expressed interest in regional solutions?

6. Are the non-structural and non-traditional components of the plan more, or less, effective than assumed?

7. Have any pilot programs for non-traditional and/or non-structural measures conducted in the Great Bay watershed produced results which should be applied full-scale in Exeter? Have pilot programs for non-traditional and/or non-structural measures conducted in other areas of the United States produced results which could be applied in Exeter?

8. Have advanced on-site denitrifying treatment systems become available and should they be applied in less densely developed neighborhoods in lieu of sewer extensions? Should a nitrogen management ordinance be enacted within 200 meters of surface waters?

A data acquisition program should be developed such that these questions can be analyzed on an annual basis throughout the project. This review could be documented in an annual report which could be distributed to regulators, representatives of neighboring towns and interested watershed associations. A core group of these parties could meet annually to review the annual report and to provide input on possible modifications to the program.

SECTION 5

EVALUATION OF ALTERNATIVES

5.1 INTRODUCTION

This section of the report presents the identification and evaluation of several wastewater treatment alternatives to address specific facility needs identified in **Sections 2 and 3** while acknowledging the town-wide nitrogen management considerations identified in **Section 4**.

5.1.1 Purpose of the Alternatives Analyses

In order to progress through a facilities planning process, numerous decisions must be made. The purpose of these alternatives analyses is to provide technical and cost information on which to base these decisions. Each of these decisions will serve as a "building block" towards the development of the recommended plan. We have made every effort to develop each analysis is such a way as to compare alternatives on an "apples to apples" basis. However, it is important to recognize that items which are "equivalent between alternatives" may not be included. It is also important to recognize that there will likely be cost saving opportunities as well as phasing opportunities, which will be explored in **Section 6**.

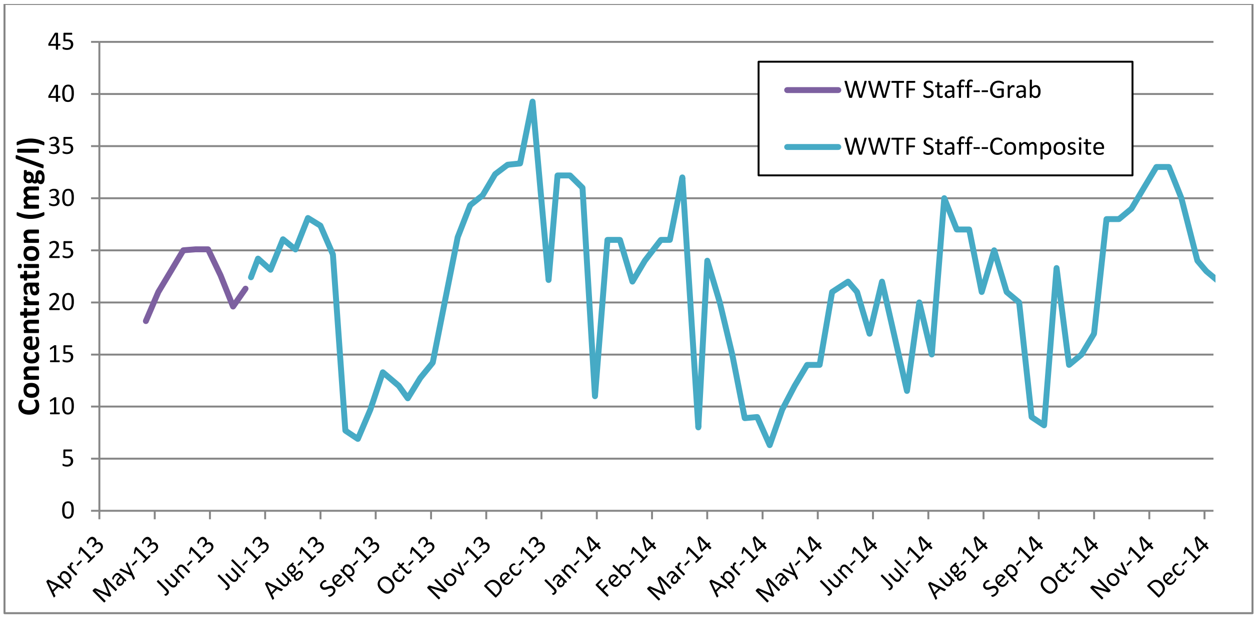
5.1.2 NPDES Permit and AOC Requirements

As described in Section 2, the NPDES permit provides the WWTF with a limit of 3.0 mg/l effluent total nitrogen based on a 214 day, seasonal rolling average from April 1 to October 31. The facility must "optimize the operation" of the facility for total nitrogen removal from November 1 to March 31, however, there is no effluent limit and no supplemental carbon is required in this non-summer period. The AOC provides the WWTF with an interim limit of 8.0 mg/l effluent total nitrogen based on a 214-day seasonal rolling average from April 1 to October 31. The facility must "optimize the operation" of the facility for total nitrogen removal from November 1 to March 31; however, there is no effluent limit during this non-summer period. In addition, the AOC states that no supplemental carbon is required at any time during the year.

5.1.3 Mechanisms of Nitrogen Removal at WWTFs

For *aerated lagoon* WWTFs, like that in Exeter, there are several mechanisms for nitrogen removal, including algal uptake, solids settling (sludge deposition), adsorption by bottom sediments and to lesser extents nitrification, denitrification and volatilization. Total nitrogen removal at aerated lagoon WWTFs is seasonal, limited in effectiveness and typically occurs between June and October when conditions are favorable (i.e., not able to be positively controlled to a specific timeframe). The effluent concentrations from Exeter's WWTF, as shown in **Figure 5-1**, are typical of a lagoon facility and are significantly higher than the levels required by the AOC and the NPDES permit.

FIGURE 5-1
EFFLUENT TN CONCENTRATIONS FROM EXETER WWTF



For *nitrogen removal WWTFs*, total nitrogen removal is accomplished through the use of two primary biological processes: nitrification and denitrification. When coupled together, influent nitrogen is reduced through either converting the influent nitrogen to nitrogen gas or converting and capturing it as a biological solid and "wasting" it out of the system. Total nitrogen removal at conventional WWTFs can be designed to work on a year round basis.

As noted above, biological nitrogen removal is a two-step process: nitrification followed by denitrification. The conversion of ammonia to nitrate is referred to as nitrification. This first step requires oxygen and alkalinity and, depending on wastewater temperatures and treatment process configuration, can convert most of the ammonia to nitrate. The conversion of nitrate to nitrogen gas is referred to as denitrification. This second step requires a carbon source in order for the bacteria to convert nitrate to nitrogen gas. Typically, this carbon source comes from the sewage itself; however, depending on influent characteristics and treatment process configuration, supplemental carbon (e.g., methanol) is sometimes necessary.

Denitrification processes can be grouped into two general categories – *exogenous* and *endogenous*. *Exogenous* denitrification processes utilize either the soluble carbon in the influent sewage or an external carbon source (e.g., methanol). *Endogenous* denitrification processes utilize the carbon released from the normal cell decay of the activated sludge biomass. Individually, exogenous or endogenous denitrification processes can achieve effluent total nitrogen levels in the range of 6.5 to 8 mg/l. When combined, exogenous and endogenous denitrification processes can achieve effluent total nitrogen levels in the range of 3.5 mg/l to 4 mg/l. The application of exogenous and endogenous are determined through aeration tank sizing and configuration.

For effluent total nitrogen limits of 5 mg/l and below, the *non-biodegradable* nitrogen fraction becomes very important. The non-biodegradable nitrogen fraction is a characteristic of the influent wastewater. Total nitrogen is the sum of multiple nitrogen components including ammonia, organic nitrogen, nitrate and nitrite. The dissolved organic nitrogen (DON) fraction is of particular concern. Effluent DON is primarily due to recalcitrant or hard-to-degrade forms of the influent nitrogen which can pass through the treatment plant unchanged. Typical municipal recalcitrant DON (rDON) levels range from 0.5 - 2.0 mg/l.

The effluent rDON value is a function of the influent wastewater characteristics, not the specific process employed at the facility to remove nitrogen. The remaining nitrogen components of the effluent total nitrogen are ammonia and nitrate/nitrite. The levels of these components are directly affected by the operation of the biological process. Advanced *non-biological* processes (e.g., carbon adsorption) may be required to remove the non-biodegradable organic nitrogen portion if effluent TN levels of 3.0 mg/l or less are required.

5.1.4 Basis for Cost Estimates

Regardless of which alternatives are implemented, the Town will be faced with costs in two categories. The first category is "capital cost", which include the cost to design and construct the needed facilities, including technical, legal and administrative costs. The second category is "operation and maintenance costs" (O&M costs), which include the on-going annual expenses to run the facilities.

For the ***regional WWTF alternatives analysis*** presented in **Section 5.2** below, capital and O&M were develop using standard cost estimating procedures consistent with industry standards for conceptual estimates. Costs for conveyance piping are based on conceptual layouts and unit cost information. Costs for the treatment plants and pump stations are based on the identified flow rate and planning-level cost curves. Unit costs for treatment facilities were taken from the Barnstable County Cost Report ("*Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod*", April 2010). Once basic construction costs were estimated, allowances were added for contingencies and technical services, legal and administrative services (40%). Land acquisition costs were not evaluated at this time. Annual O&M costs were developed for each plan for the purposes of comparison among the plans. These planning-level costs were developed using the anticipated wastewater flow rates for each plan based on the O&M costs from the Barnstable County Cost Report (April 2010). All cost information presented herein is in current dollars. These estimates have been developed primarily for determining whether a regional solution is advantageous to Exeter. Conceptual cost estimates are based on limited technical information and have a broad range of accuracy (+40% to -25%).

For the ***on-site regional WWTF alternatives analysis*** presented in **Section 5.3** below, capital and O&M costs were developed using standard cost estimating procedures consistent with industry standards for planning-level estimates. Costs were developed by utilizing concept site-specific tank and building layouts and unit cost information. Once basic construction costs were estimated, allowances were added for contingencies and technical services, legal and administrative services (40%). Land acquisition costs were not evaluated because the WWTF in on Town land. Annual O&M costs were developed for each plan for the purposes of comparison among the plans. All cost information is presented in current dollars. These estimates have been developed primarily for evaluating alternative solutions and are generally reliable for determining the relative costs of various options. Planning-level costs are based on a greater level of technical information and have a more narrow range of accuracy (+30% to -10%).

5.1.5 Evaluative Criteria

Alternatives were evaluated based on the following cost and non-cost criteria:

- Reliability – The selected alternative must be able to reliably and consistently achieve the effluent limits and seasonal time frames. Reliability is the primary selection criteria.
- Flexibility – The selected alternative should provide for flexibility in the operation and maintenance of the facility given the daily and seasonal variations in flows, loads and effluent limits. All systems were targeted to have a similar level of flexibility, including the ability to add tertiary if future effluent limits are imposed (e.g., TN less than 3 mg/l).
- Life Cycle Cost – Life cycle cost, as measured by a "present worth analysis", is a standard economic tool that allows for the calculation of a single "cost" to represent the combination of capital cost and annual expenses for operation and maintenance. In essence, the present worth represents the amount of money that one would invest at the beginning of the project to pay for the capital costs and to allow periodic withdrawals to pay the annual expenses over a certain period at a given interest rate.
- Operational Complexity – The existing lagoon system is a very simple operation and, to the extent possible, the upgraded facilities should not be unnecessarily complex.
- Phase-ability – The ability to phase elements of construction can improve the affordability of an alternative. The extent to which a process alternative provides the ability to phase or to defer (e.g., in the case of processes which reliably remove nitrogen to 5 mg/l) construction will be considered advantageous. The extent to which the incremental cost to upgrade from 8 mg/l to 3 mg/l is minimized will also be considered advantageous.

5.2 REGIONAL WASTEWATER ALTERNATIVES (SPRING 2014)

5.2.1 Identification of Alternatives

At the outset of this project, the Town posed the question: ***would regional WWTF alternatives be more cost-effective than constructing an Exeter-only facility in Exeter?*** In order to address this question, a conceptual analysis was conducted for the following three broad alternatives:

1. A regional WWTF located in Exeter with effluent disposal to the Squamscott River;
2. A regional WWTF located in Exeter with effluent disposal to the Atlantic Ocean via a regional outfall shared with the Hampton WWTF; and
3. A regional WWTF located in Portsmouth (at the existing Pease WWTF) with effluent disposal to the Piscataqua River.

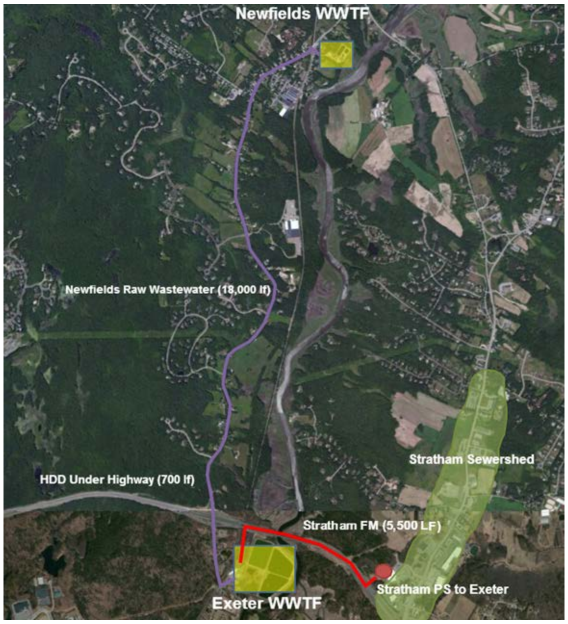
This analysis was completed in April 2014 and is reported herein to provide context for the remainder of this section.

In order to evaluate these alternatives, preliminary routing of conveyance piping (i.e., "transport to treatment" and "transport to disposal") was developed. Conceptual site figures for the regional alternatives are presented in **Figure 5-2**. Schematics of the regional alternatives are presented in **Figure 5-3**.

The sizing of conveyance, treatment and disposal systems were conceptualized based on projected wastewater flow rates from each community through the planning horizon (2040). The projected wastewater flows used in the analysis are summarized in **Table 5-1**, including source of the information. Actual sizing of treatment facilities could be tailored more closely to actual flow based on a phased construction approach and should be considered in more detail if one of these alternatives is selected.

FIGURE 5-2
LOCATION SCHEMATICS OF REGIONAL ALTERNATIVES

REGIONAL ALTERNATIVE 1



REGIONAL ALTERNATIVE 2

REGIONAL ALTERNATIVE 3

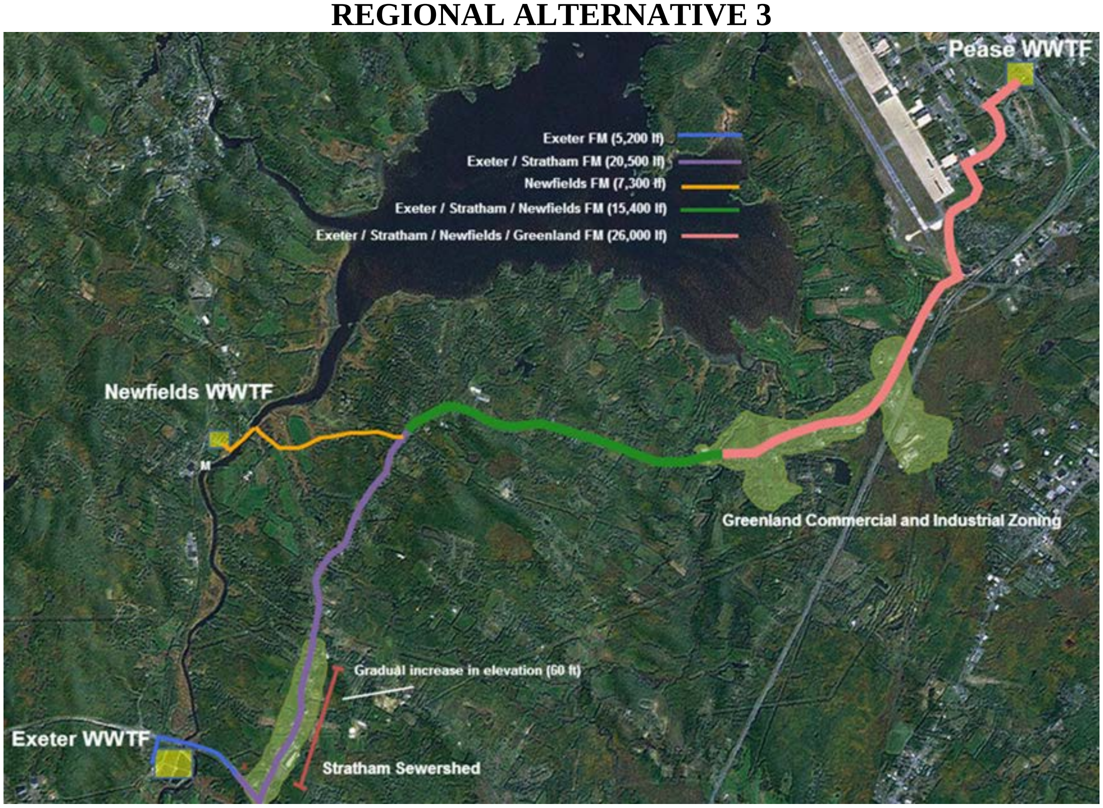


FIGURE 5-3
PROCESS SCHEMATICS OF REGIONAL ALTERNATIVES

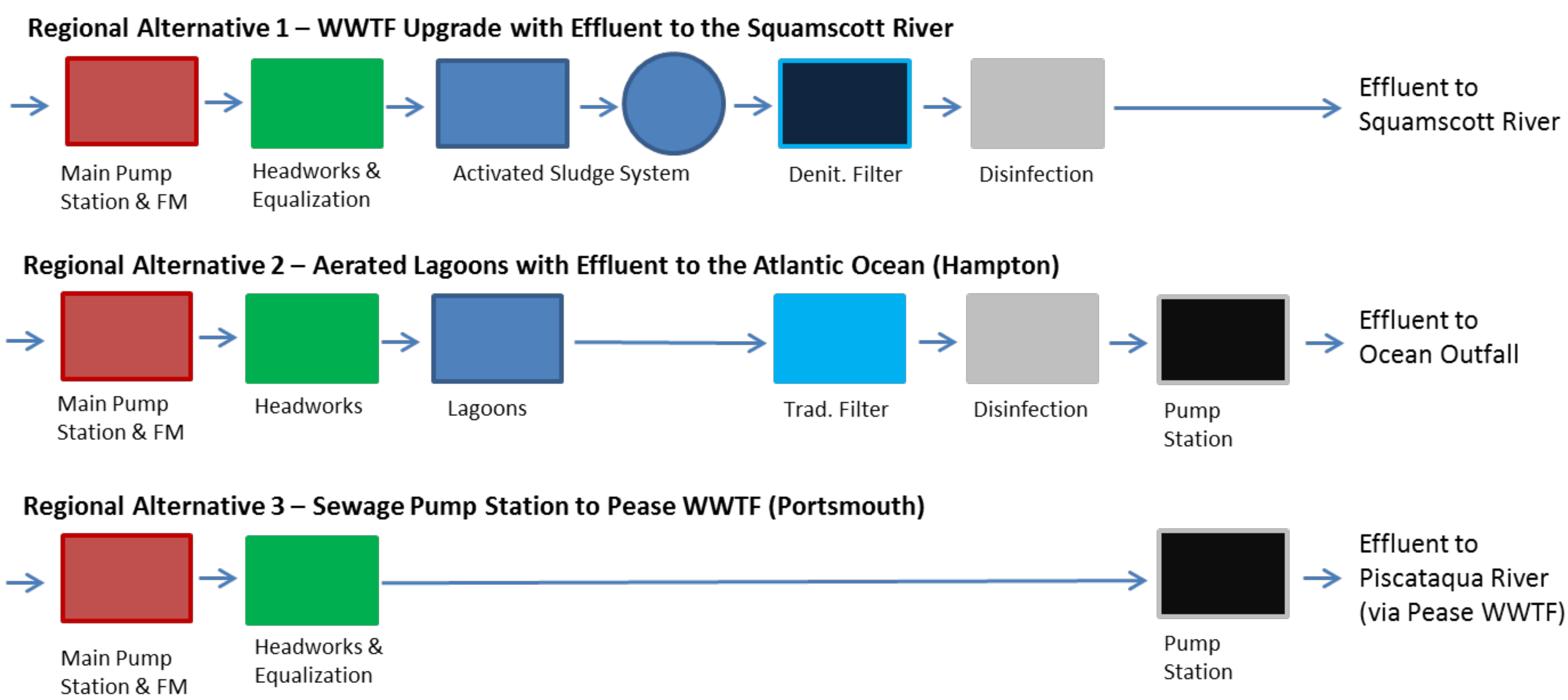


TABLE 5-1
SUMMARY OF PLANNING-LEVEL FLOWS BY TOWN

Town	Average Daily Flow (MGD)			Source
	Current	Planning Horizon	Build-out	
Exeter	1.70	2.40	2.60	Wright-Pierce (Section 2)
Stratham **	0.17 **	0.55 **	0.66	Kleinfelder, 2012
Newfields	0.05	0.08	0.12	AECOM, 2005
Greenland	0.17	0.32	0.32	Portsmouth (B.Geotz, 2014)
Portsmouth/Pease	0.60	1.35	1.35	Portsmouth (B.Geotz, 2014)
Total – Alternative 1	1.92	3.03	3.38	
Total – Alternative 2	1.92	3.03	3.38	
Total – Alternative 3	2.69	4.70	5.05	

** Stratham has since revised its future flow projections downward to 0.25-mgd through the planning horizon.

5.2.2 Regional Alternative 1: WWTF in Exeter with Effluent to Squamscott River

This alternative is summarized as follows:

- Communities involved: Exeter, Stratham, and Newfields.
- Collection system modifications:
  - Exeter: None.
  - Stratham: New pump station to Exeter WWTF.
  - Newfields: New forcemain from existing WWTF along Route 85 to Exeter WWTF.
- Exeter WWTF Modifications: Comprehensive upgrade including provisions for TN removal to 3-mg/l. Lagoon decommissioning would be required but is not included in this analysis.
- Newfields WWTF Modifications: Targeted upgraded to convert to a pump station. Lagoon decommissioning would be required but is not included in this analysis.
- Effluent Forcemain: None.
- Outfall: No modifications required.
- NPDES Permitting: Complete.

5.2.3 Regional Alternative 2: WWTF in Exeter with Effluent to Atlantic Ocean

This alternative is summarized as follows:

- Communities involved: Exeter, Stratham, Newfields, and Hampton.

- Collection system modifications:
  - Exeter: None.
  - Stratham: New pump station to Exeter WWTF.
  - Newfields: New forcemain from existing WWTF along Route 85 to Exeter WWTF.
  - Hampton: None.
- Exeter WWTF Modifications: Targeted upgrade of Exeter's WWTF including provisions for Headworks and Effluent Filtration (to capture algae from the lagoons). Upgrades for TN removal are not included. Lagoon decommissioning would not be required.
- Newfields WWTF Modifications: Targeted upgraded to convert to a pump station. Lagoon decommissioning would be required but is not included in this analysis.
- Hampton WWTF Modifications: None included.
- Effluent Forcemain: New forcemain from Exeter east on Route 101 where Hampton's effluent forcemain would merge to share a new outfall in the Atlantic Ocean. Hampton's existing effluent piping would require modifications to connect to the new forcemain. Provisions to minimize bacterial growth are not included in this analysis.
- Outfall: A new outfall with diffusers would need to be constructed approximately 1,500 linear feet offshore in the Atlantic Ocean. Hampton's 201 Facilities Plan Update (2006) showed two potential outfall locations – one off Winnacunnet Road and another off of Route 101. The outfall location will need to be carefully reviewed with Hampton, EPA, CLF, PREP and other interested stakeholders.
- NPDES Permitting: This option would require a new NPDES permit for the combined ocean discharge from Exeter WWTF and Hampton WWTF. Since this option would involve eliminating two NPDES permits upstream of Great Bay (Exeter and Newfields) and would relocate one NPDES permit out of a sensitive tidal creek (Hampton), EPA could view this option as a significant improvement. Further, it is assumed that an ocean outfall would be issued a NPDES permit without any effluent TN requirements. If TN removal were to be required, the WWTF costs would increase significantly and make this option the highest cost. It is unknown at this time whether CLF, PREP, DES, EPA and others would support or oppose this option. Significant opposition would likely be put forward by residents in the vicinity of the ocean outfall.

5.2.4 Regional Alternative 3: WWTF in Portsmouth with Effluent to the Piscataqua River

This alternative is summarized as follows:

- Communities involved: Exeter, Stratham, Newfields, Greenland, and Portsmouth.
- Collection system modifications:
  - Exeter: Convey untreated wastewater via a new forcemain to the Pease WWTF.
  - Stratham: Connect to the Exeter FM along Route 108 in Stratham.
  - Newfields: Connect to the Exeter FM via Squamscott Road at Route 33.
  - Greenland: Connect to the Exeter FM along Route 33.
  - Portsmouth (Pease service area): None.
- Exeter WWTF Modifications: Targeted upgrade to improve the Headworks. Lagoon decommissioning would be required but is not included in this analysis.
- Newfields WWTF Modifications: Targeted upgraded to convert to a pump station. Lagoon decommissioning would be required but is not included in this analysis.
- Pease WWTF Modifications: Comprehensive upgrade to accommodate the significant increase in flow with TN removal to 8 mg/l (see below).
- Effluent Forcemain: Not applicable.
- Outfall Modifications: The existing Pease WWTF outfall would need to be increased in diameter and expanded to provide additional diffusers. The Pease WWTF shares its outfall with the Newington WWTF and any potential impacts would need to be mitigated.
- NPDES Permitting: The Pease WWTF currently has a NPDES permit for 1.2 MGD. This option would require that the NPDES permit be reissued for 4.7 MGD. The anti-degradation provisions of the Clean Water Act may preclude this as an option. Since this option would involve eliminating two NPDES permits upstream of Great Bay (Exeter and Newfields), EPA could view this approach as a significant improvement which could pre-empt the anti-degradation provisions. Further, it is assumed that this location would be issued a NPDES permit with an effluent TN of 8 mg/l (as opposed to 3 mg/l). It is unknown at this time whether CLF, PREP, DES, EPA and others would support or oppose this option. It is possible that EPA could require that the existing outfall diffusers be relocated a significant distance down-river. Costs for outfall relocation are not included in this analysis.

5.2.5 Comparison of Regional Alternatives

Capital and annual O&M estimates costs were developed for each alternative in April 2014 and are summarized on **Table 5-2**. A summary of the advantages/disadvantages of the regional alternatives is presented in **Table 5-3**. As noted in **Section 5.2.4**, several elements have not been included in the cost presented below (e.g., lagoon decommissioning, Main Pump Station and forcemain upgrades, etc.).

TABLE 5-2
ORDER OF MAGNITUDE COSTS FOR REGIONAL ALTERNATIVES (APRIL 2014)

	Alternative 1 Exeter WWTF/ Squamscott River	**Alternative 2 Exeter WWTF/ Hampton WWTF/ Atlantic Ocean**	**Alternative 3 Pease WWTF/ Piscataqua River**
Project Capital Cost			
Construction - Transport to Treatment	$5,500,000	$5,500,000	$25,500,000
Construction – Treatment	$29,100,000	$10,300,000	$31,800,000
Construction - Transport to Disposal	$0	$21,200,000	$1,000,000
Contingency, Admin, Legal & Technical Services	$13,800,000	$14,800,000	$23,300,000
Total Capital Cost	**$48,400,000**	**$51,800,000**	**$81,600,000**
Total Annual O&M Cost	**$3,420,000**	**$3,760,000**	**$5,830,000**
20-Year Present Worth of O&M	$46,500,00	$51,100,000	$79,200,000
Total 20-Year Present Worth	**$94,900,000**	**$102,900,000**	**$160,800,000**
Exeter/Stratham/Newfields Share	**$94,900,000**	**$92,600,000**	**$114,000,000**

Notes:
1) ENR CCI 9700 (April 2014).
2) Transport to treatment costs include the items identified is Section 5.2 above including new pump stations in Exeter, Newfields, Stratham and Greenland. Treatment and transport to disposal costs include the items identified in Section 5.2. No cost was carried for outfall extension for Alternative 3.
3) Contingency and technical services are based on 40% of the Construction costs.
4) Annual O&M Costs are intended to represent the total Sewer Enterprise Funds costs (i.e., entire sewer system, transport to treatment, treatment, effluent transmission and disposal) and not just the WWTF costs.
5) Present worth calculated based on 4% interest for 20 years.
6) The Exeter/Stratham/Newfields share of the present worth was calculated as 100% of the transport to treatment costs and the prorated costs for the other categories, based on flow.
7) Regional Alternative 2 (Hampton) does not include any costs for nitrogen removal at the Exeter WWTF.

TABLE 5-3
ADVANTAGES AND DISADVANTAGES OF REGIONAL ALTERNATIVES

Options	Advantages	Disadvantages
Exeter WWTF with Effluent to Squamscott River	• Can be completed within the AOC schedule • Lowest total cost. • Middle "cost share for Exeter" • NPDES permitting is completed	• Even with the WWTF upgrade, some nitrogen remains in the Squamscott River and goes to Great Bay.
Exeter WWTF with Effluent to Atlantic Ocean (Hampton)	• Middle total cost • Lowest "cost share for Exeter" • 100% point source TN removal from Squamscott River (Exeter and Newfields WWTFs)	• Greatest difficulty inter-municipal hurdles. • Will likely have strong opposition from the public in Hampton. • Only cost effective if TN removal is not required in Exeter. • Will likely require AOC schedule modification • Multiple communities involved, potentially making consensus more difficult. • May not be able to secure a NPDES permit.
Pease WWTF with Effluent to Piscataqua River	• Inter-municipal hurdles can likely be surmounted if all parties are amenable. • 100% point source TN removal from Squamscott River (Exeter and Newfields WWTFs)	• Highest total capital cost. • Highest "cost share for Exeter" • Greatest number of inter-municipal hurdles. • Will likely require AOC schedule modification • Loss of "local control" for Exeter. • Multiple communities involved, potentially making consensus more difficult. • May not be able to secure a NPDES permit modification. May require costly outfall extension to Portsmouth Harbor (now or in the future) Future regulatory uncertainty related to 303(d) listing of Portsmouth Harbor.

5.2.6 Next Steps for Regional Alternatives

Based on this analysis, the most cost-effective approach was Regional Alternative 2 (Hampton); however, the Town decided that the technical and regulatory hurdles associated with this alternative were substantial and has decided not to pursue this alternative any further. The next most cost-effective approach was Regional Alternative 1 (Exeter), which also has the least political and regulatory uncertainty. It is possible that the Exeter WWTF may not need to achieve 3 mg/l total nitrogen at its WWTF, which would reduce the cost of this alternative. Regional Alternative 3 (Pease) has the highest cost for Exeter and has considerable technical, regulatory and cost uncertainty. It is possible that the Pease WWTF may need to achieve better than 8 mg/l total nitrogen or extend the outfall to Portsmouth Harbor, which would increase the cost of this alternative. Also, while Regional Alternative 3 would undoubtedly benefit Great Bay, it will have an as-of-yet unquantified impact on the Piscataqua River and Portsmouth Harbor (i.e., due to less natural attenuation).

It is important to note that there are three separate studies currently on-going which address regional wastewater management. These are identified below:

- The Town commissioned a separate study, initiated Spring 2014, to develop a more detailed analysis of Regional Alternative 3 (Pease). This separate study was completed in November 2014.
- The Town is participating in the WISE project, initiated Fall 2013, which is assessing the costs and benefits associated with non-point source nitrogen management. This separate study is on-going and is expected to be completed in March or April 2015.
- The City of Portsmouth recently commissioned a separate study, initiated September 2014, to analysis another regional alternative (i.e. upgrading the Pease WWTF to also incorporate all wastewater flow from the City, thereby increasing the target Pease WWTF flow to greater than 10 mgd). The City has commissioned a separate study to develop this alternative. This separate study is expected to be completed in April or May 2015.

A final decision on the cost-effectiveness of regional alternatives should be made with these additional studies in-hand.

5.3 ON-SITE NUTRIENT REMOVAL ALTERNATIVES (SUMMER 2014)

5.3.1 General

As noted previously, the purpose of this analysis is to select the on-site nutrient removal alternatives for the WWTF upgrade. A number of items have been considered "baseline" or "common" elements between the alternatives. These items are summarized below.

- Influent Equalization – The existing aerated lagoons are large and offer a low cost opportunity to convert a portion of these lagoons to off-line influent equalization. This will allow the Town to increase the capacity of the Main Pump Station in order to convey higher peak flows from the collection system to the WWTF without increasing the size of the WWTF. Using "peak shaving" approach, flow will be diverted into the basin during high flow events and will be conveyed back into the process after peak flows subside. Based on our calculations, 2 million gallons of influent equalization volume will allow for the peak instantaneous flow for the WWTF to be reduced from 13 MGD to 6.6 MGD. We have utilized 6.6 MGD peak instantaneous and peak day flow for the each of the on-site nutrient removal alternatives.

- Primary Clarification – There are no definitive requirements in the NHDES design regulations or in TR-16 (Guides for the Design of Wastewater Treatment Works, NEIWPCC, 2011) regarding whether primary clarifiers should be provided for a facility of this size. For the purposes of this planning-level analysis, we have elected to not include primary clarifiers in the treatment process based on our experience with similar sized facility, on our biological process modeling (described later in this section), and on the desire to eliminate the additional complexity that comes with primary treatment (additional tanks, equipment and sludge waste stream). We have left space on the site and in the preliminary hydraulic profile to include two primary clarifiers in the future (if desired). This decision does not impact the cost-effectiveness of the various nutrient removal alternatives relative to each other. If primary clarifiers were included, the WWTF would be incrementally more complex to operate but the nutrient removal activated sludge components would be smaller. This decision can be revisited in the preliminary design phase.

- Number of Nutrient Removal Treatment Trains – There are no definitive requirements in the NHDES design regulations or in TR-16 regarding the number of treatment trains required for the activated sludge systems (aeration tanks and secondary clarifiers; SBRs). The NHDES design regulations do require that three independent secondary clarifiers be provided for facilities with design average daily flows greater than 5 MGD. For purposes of this planning-level analysis, we have selected three treatment trains based on our experience with similar sized facilities, on the stringent nitrogen limits (more treatment units will allow for more precise control and "turndown") and on the ability to construct the facility in phases (e.g., two treatment trains initially, with a third in the future). This allows for a phasing and/or cost saving opportunity if needed. This decision can be revisited in the preliminary design phase.

- Separate Stage Tertiary Nitrogen Removal - There are no definitive requirements in the NHDES design regulations or in TR-16 regarding the number of treatment trains required for separate stage nitrogen removal (denitrification filters). All of the treatment processes identified herein will require separate stage tertiary treatment to achieve the ultimate effluent limit of 3.0 mg/l identified in the NPDES permit, if or when required. There are two main types of tertiary filtration processes for consideration; (1) biologically active filters and (2) traditional, non-biologically active filters. The type of filter required is determined by the level of treatment that occurs upstream of the filters. A biologically active filter (referred to herein as "denitrification filters") is a generic term for solids separation/filtration process that also includes bacteria attached to the filtration media. These filters will remove solids as well as convert nitrate to nitrogen gas for further nitrogen removal. These filters are typically capable of reducing the effluent nitrogen of nitrified wastewater to 3.0 mg/l.

  A non-biologically active filter (referred to herein as a "traditional filter") removes solids and does not provide any biological treatment. A modest 0.5 mg/l nitrogen reduction is expected with this treatment system. In general, these filters are significantly less complicated and less expensive to construct and operate than biologically active filters, but have limited nitrogen removal capacity. These filters must be paired with an upstream biological process that fully nitrifies and denitrifies.

The decision regarding the need for, and type of, tertiary treatment approach will be best determined once the new WWTF is on-line, the upgraded effluent quality can be assessed and the range of tertiary treatment equipment systems can be pilot-tested, as necessary. The timing of this will be determined in accordance with the AOC.

Potential cost saving opportunities as well as phasing opportunities are identified where appropriate herein and will be explored in greater detail in **Section 6**.

5.3.2 Identification of Alternatives for Nitrogen Removal

A broad array of technologies has been used to perform nitrogen removal at municipal wastewater treatment facilities. Common and less common technologies are listed below.

More Common	Less Common
Modified Ludzack-Ettinger (MLE)	Moving Bed Bioreactor (MBBR)
Four-Stage Bardenpho	Biolac
Sequencing Batch Reactor (SBR)	BioMag
Oxidation Ditch	Rotating Biological Contactors (Aerobic/Anoxic)
Schreiber Cyclic Aeration	De-ammonification
Integrated Fixed Film Activated Sludge (IFAS)	Trickling Filters
Membrane Bioreactors (MBR)	Breakpoint Chlorination
Denitrification Filters	Air Stripping

In terms of identifying a shortlist of processes for evaluation for the Exeter WWTF, we used the key criteria identified earlier in this section. Several of these processes are eliminated due to high life cycle cost (e.g., air stripping and breakpoint chlorination) and reliability for stringent nitrification/denitrification limits (e.g., RBCs, trickling filters). Several of these processes were eliminated because they are high-rate processes that are typically only cost effective on space-constrained sites (e.g., IFAS, MBBR, BAF, MBR, BioMag). The oxidation ditch process requires a very large amount of space and is less flexible than the remaining processes.

The process configurations selected for facility-specific evaluation to achieve 3 mg/l effluent total nitrogen are as follows:

1. Modified Ludzack Ettinger with Denitrification Filter
2. Four-Stage Bardenpho with Traditional Filter
3. Sequencing Batch Reactors with Denitrification Filter
4. Biolac with Denitrification Filter

Each process configuration will be arranged to allow for phased implementation in order to achieve an effluent total nitrogen limit of 8 mg/l in the near-term and 3 mg/l, if required by EPA in the longer-term. Each configuration is described in the following subsections.

For the purposes of this analysis, we have included a supplemental alkalinity system and a supplemental carbon system for all process configurations. Upgrade items which are required for an effluent total nitrogen of 8 mg/l are indicated in regular font whereas upgrade items which are required for an effluent total nitrogen of 3 mg/l are indicated in *italic font*.

5.3.3 Biological Process Modeling

A "steady-state" computer process model was developed in BioWIN 3.1 in order to analyze two process alternatives: the Modified-Ludzack Ettinger (MLE) process (exogenous) and the Four-Stage Bardenpho process (exogenous/endogenous). The modeling effort used the following key inputs and assumptions:

- Since the MLE and Bardenpho processes do not currently exist at the Exeter WWTF, it is not possible to develop a calibrated model; accordingly, default kinetic and stoichiometric process parameters were utilized. In some cases, default parameters were adjusted based on experience. The model results are used primarily as a tool to analyze applicable upgrade options.
- The model incorporated site-specific influent flow and load data as well as site-specific process tank sizing and configurations. A long-term operational record of the influent wastewater temperature was not available; however, the influent wastewater temperature

was set at 10 degrees C to simulate spring conditions. The aerobic solids retention time was held at 12 days for each process configuration to provide for complete nitrification at 10°C.

- Typical dissolved oxygen levels were set at 2.0 mg/l under annual average and maximum month conditions, with a minimum value of 1.0 mg/l under peak day loads.
- Peak daily and peak hourly flows were capped at 6.6 MGD based on the assumption that influent equalization will be incorporated at the WWTF.
- The MLE process was sized to produce 8 mg/l effluent total nitrogen at design annual average flows and up to 9.3 mg/l effluent total nitrogen at maximum month conditions. The Bardenpho process was sized to produce 3.5 mg/l effluent total nitrogen at design annual average flows and up to 3.8 mg/l effluent total nitrogen at maximum month conditions.
- A separate stage denitrification filter will be required for the MLE process to reliably achieve the 3 mg/l effluent total nitrogen limit; whereas a separate stage traditional filter will be required for the Bardenpho process.

Key conclusions from this modeling effort include:

- Supplemental alkalinity is required for the MLE and Bardenpho processes.
- Supplemental carbon is required for the Bardenpho process to achieve 3.5 mg/l effluent total nitrogen with the 0.56 million gallons of post-anoxic tankage modeled. If the post-anoxic volume were increased to 1.15 million gallons, the Bardenpho process could achieve 5 mg/l without supplemental carbon. A cost-benefit analysis can be conducted to determine which approach is preferable during the preliminary design phase.

An abbreviated summary of the model outputs are shown in **Table 5-4 and Table 5-5**. A technical memorandum summarizing the modeling effort is included as **Appendix B**.

TABLE 5-4
PROCESS MODEL OUTPUT – MLE ALTERNATIVE

	Annual Average (2 Trains Online)	**Annual Average** (3 Trains Online)	**Max Month** (3 Trains Online)
Aeration Tanks			
No. of Trains	3	3	3
No. of Zones per Train	2	2	2
Total Volume (MG)	1.47	2.20	2.20
Pre-Anoxic Volume (MG)	0.37	0.55	0.55
HRT (hr)	11.74	17.60	10.56
Aerobic SRT (days)	8.00	12.00	12.00
MLSS (mg/l)	2920	1950	4140
Supp. Alkalinity (lb/d $CaCO_{3)}$	1,500	1,500	2,500
Supp. Carbon (methanol gpd)	0	0	0
Secondary Clarifiers			
Tanks Online	2	3	3
Diameter (ft)	75	75	75
Depth (ft)	16	16	16
Effluent Quality			
Effluent BOD5 (mg/l)	3.5	3.2	3.8
Effluent TN (mg/l)	8.0	8.0	9.3
Effluent TN (lbs/day)	197	197	384
Effluent P (mg/l)	3.1	3.1	2.6
Effluent TSS (mg/l)	7.7	7.2	9.5
Waste Activated Sludge			
WAS (lb/d)	3,352	3,360	4,753

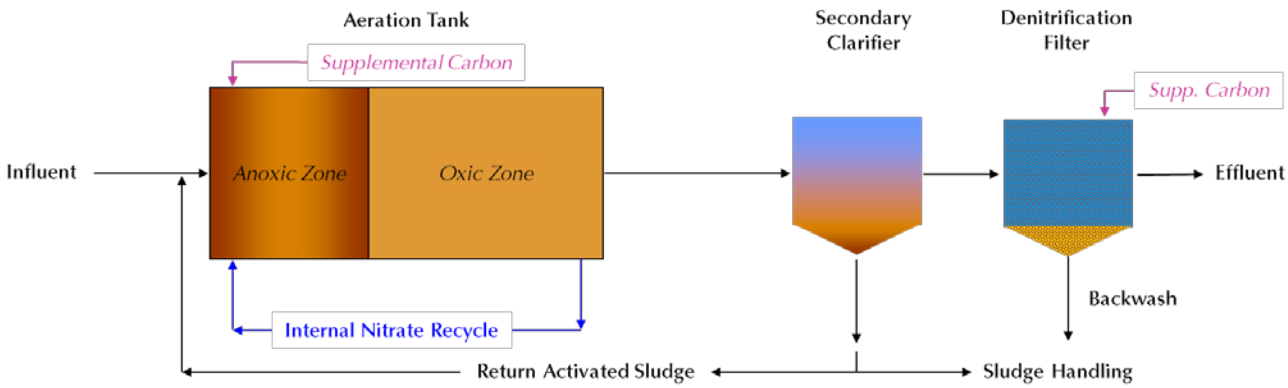
TABLE 5-5
PROCESS MODEL OUTPUT - FOUR-STAGE
BARDENPHO ALTERNATIVE

	Annual Average (2 Trains Online)	**Annual Average** (3 Trains Online)	**Max Month** (3 Trains Online)
Aeration Tanks			
No. of Trains	3	3	3
No. of Zones per Train	4	4	4
Total Volume (MG)	1.86	2.78	2.78
Pre-Anoxic Volume (MG)	0.37	0.55	0.55
Post-Anoxic Volume (MG)	0.37	0.56	0.56
HRT (hr)	14.84	22.26	13.33
Aerobic SRT (days)	8.00	8.00	12.00
MLSS (mg/l)	3310	2020	4110
Supp. Alkalinity (lb/d $CaCO_3$)	1,750	1,750	2,550
Supp. Carbon (methanol gpd)	100	100	25
Secondary Clarifier			
Tanks Online	2	3	3
Diameter (ft)	75	75	75
Depth (ft)	16	16	16
Effluent Quality			
Effluent BOD5 (mg/l)	3.4	2.4	3.0
Effluent TN (mg/l)	3.5	3.5	3.8
Effluent TN (lbs/day)	74	74	155
Effluent P (mg/l)	3.3	2.9	2.6
Effluent TSS (mg/l)	8.1	4.5	9.4
Waste Activated Sludge			
WAS (lb/d)	3,380	3,538	4,699

5.3.4 On-Site Alternative 1: Modified Ludzack-Ettinger with Denitrification Filter

The MLE process is similar to a traditional activated sludge system but with anoxic zones preceding the oxic (aerobic) zones. Influent wastewater which provides organic carbon and return activated sludge (RAS) which provides biomass are fed into the anoxic zone. Internal mixing recycles wastewater from the aerobic zone to the anoxic zone. The process flow diagram is shown in **Figure 5-4**.

FIGURE 5-4
MLE PROCESS SCHEMATIC



To achieve biological nitrogen removal, ammonia must first be completely transformed to nitrate (via nitrification) in the aerobic zone of the activated sludge system. Nitrates produced in the aerobic zone are then recycled back to the anoxic zone through a pumped internal recycle system allowing them to come in contact with soluble BOD from the influent, thus creating an environment conducive for denitrification.

The limit of technology for the MLE process is typically considered between 6 to 10 mg/l of effluent total nitrogen. The effluent total nitrogen level achieved is highly dependent on the amount of influent substrate carbon available for the denitrification process. Increasing the influent carbon to nitrogen ratio typically results in improved performance. To achieve effluent TN less than 3.0 mg/l, a denitrification filter and supplemental carbon system are required.

This option would consist of the following major components:

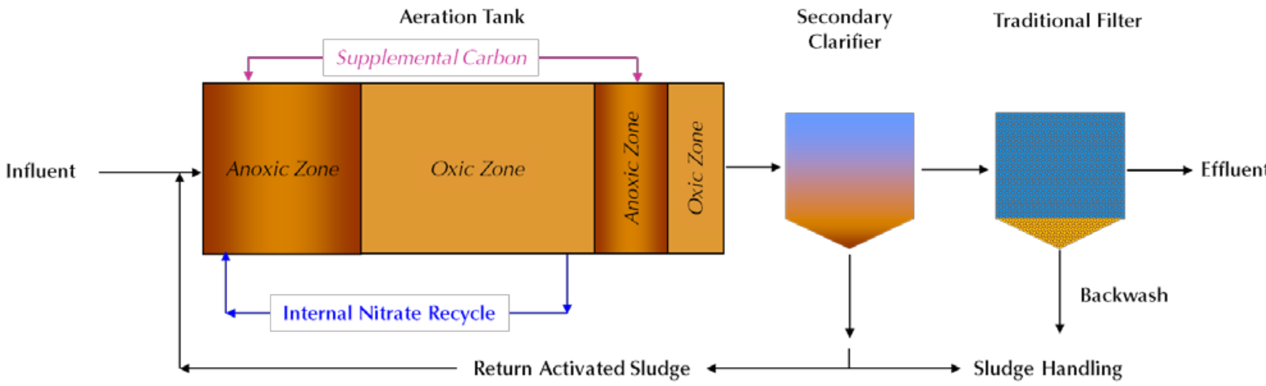
a. Flow splitter box to distribute flow between treatment tanks
b. Three concrete tanks for the activated sludge treatment process, with a total volume of 2.2 million gallons. Treatment tanks will be configured with an aeration tank component partitioned into anoxic and oxic zones. Anoxic zones will have submersible mixers. The oxic zones will have an internal recycle pump to recycle nitrate rich mixed liquor to the anoxic zone for denitrification.
c. Three 75-foot diameter secondary clarifiers and influent splitter box, with a total volume of 1.6 million gallons.
d. Supplemental alkalinity storage and feed system.
e. *Tertiary denitrification filter system and supplemental carbon storage and feed system (if an effluent TN limit of 5 mg/l or less is imposed).*

5.3.5 On-Site Alternative 2: Four-Stage Bardenpho with Traditional Filter

The 4-stage Bardenpho process is similar to the MLE process. It includes a primary anoxic zone, primary oxic (aerobic) zone, secondary anoxic zone, and reaeration zone in series as shown in **Figure 5-5**. The first anoxic zone and aerobic zone work the same as the MLE process. Nitrates are recycled from the effluent end of the first aerobic zone to the first anoxic zone. A second anoxic zone is provided after the aerobic zone for additional denitrification through biomass degradation to further reduce the effluent total nitrogen. The re-aeration zone at the end is provided to add dissolved oxygen to the wastewater prior to the secondary clarifiers. A supplemental carbon source is typically utilized in the second anoxic zone to provide sufficient substrate (carbon) to complete denitrification.

The limit of technology for the 4-stage Bardenpho process is considered to be 3.5 to 4.5 mg/L of effluent total nitrogen, depending on recalcitrant (non-degradable) organic nitrogen in the wastewater as well as effluent particulate nitrogen levels. To achieve a TN less than 8.0 mg/l, a supplemental carbon system is required. To achieve effluent TN less than 3.0 mg/l, a traditional filter system required.

FIGURE 5-5
4-STAGE BARDENPHO PROCESS SCHEMATIC



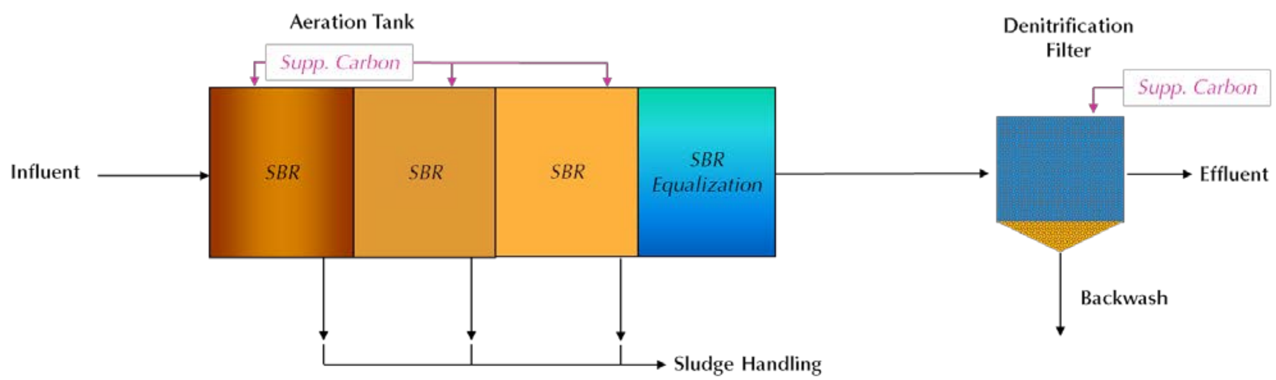
This option would consist of the following major components:

a. Flow splitter box to distribute flow between treatment tanks
b. Three concrete tanks for treatment process, with total volume of 2.8 million gallons. Treatment tanks will be configured with an aeration tank component partitioned into anoxic and oxic zones. Anoxic zones will have submersible mixers. The oxic zones will have an internal recycle pump to recycle nitrate rich mixed liquor to the anoxic zone for denitrification. Following the oxic zone is an additional anoxic zone to further denitrify and a reaeration zone to add oxygen to the tank effluent. Consider provisions for step feed of aeration tank influent to the secondary anoxic zone as a carbon source.
c. Three 75-foot diameter secondary clarifiers and influent splitter box, with a total volume of 1.6 million gallons.
d. Supplemental alkalinity storage and feed system
e. Supplemental carbon storage and feed system for the post-anoxic zone (if an effluent TN limit of 5 mg/l or less is imposed)
f. Traditional filter system (if an effluent TN limit of 3 mg/l or less is imposed)..

5.3.6 On-Site Alternative 3: Sequencing Batch Reactors with Denitrification Filters

The SBR activated sludge process utilizes a common tank for both aeration and clarification. SBR systems have five steps in common, which are carried out in sequence as follows: (1) fill, (2) react (aeration), (3) settle (sedimentation/clarification), (4) draw (decant), and (5) idle. Given the size of the facility, three SBRs are recommended to effectively treat influent wastewater and carryout nitrification/denitrification at the Exeter WWTF. Since aeration and clarification occurs in the same tank, the SBR process does not require secondary clarifiers; however, treated flows must be equalized after decanting to avoid the need to oversize downstream processes. To denitrify, the reaction stage alternates between aerobic and anoxic conditions by controlling the dissolved oxygen concentration within the SBR. A typical SBR process is shown in **Figure 5-6**.

FIGURE 5-6
SBR PROCESS SCHEMATIC



The limit of technology for the SBR process is considered to be 5.0 to 6.0 mg/L of effluent total nitrogen, depending on recalcitrant (non-degradable) organic nitrogen in the wastewater as well as effluent particulate nitrogen levels. To achieve effluent TN less than 3.0 mg/l, a denitrification filter and supplemental carbon system are required. SBR manufacturers indicate that 3.0 mg/l effluent nitrogen can be achieved with a traditional filter.

This option would consist of the following major components:

a. Flow splitter box to distribute flow between treatment tanks
b. Three concrete tanks for the SBRs, with a total volume of 5.3 million gallons. Treatment tanks will include installation of the SBR equipment including diffuser assemblies, mixers, transfer pumps, and decanters
c. Secondary equalization tank or basin (0.3 million gallons) and equipment including coarse diffusers and effluent transfer pumps.

d. Supplemental alkalinity storage and feed system.

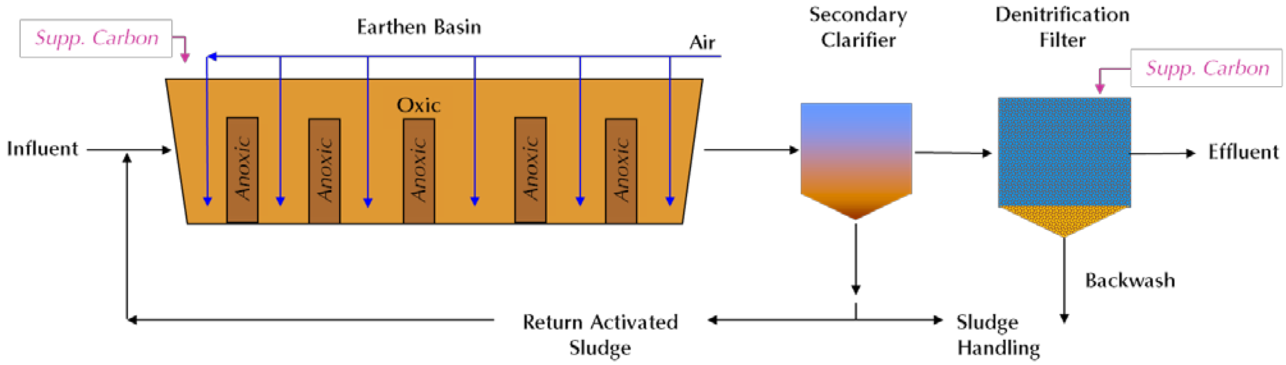
e. Supplemental carbon storage and feed system (if an effluent TN limit of 5 mg/l or less is imposed).

f. Tertiary treatment (denitrification or traditional) filter system (if an effluent TN limit of 3 mg/l or less is imposed).

5.3.7 On-Site Alternative 4: Biolac® with Denitrification Filters

Biolac® is an activated sludge system adapted for construction with an earthen basin. Oxygen is delivered to the wastewater via fine bubble membrane diffusers attached to diffuser assemblies and floating aeration chains. The aeration chains suspend the diffusers above the bottom of the basin without coming in contact with it. Mixing is provided by the diffuser assemblies which are moved back and forth from the force of the oxygen. Denitrification is achieved through a cyclic aeration process called Wave-Oxidation® (WaveOx) which alternates air flow distribution from the aeration chains creating multiple aerobic and anoxic zones within the treatment basin as shown in **Figure 5-7**.

FIGURE 5-7
BIOLAC® PROCESS SCHEMATIC



The limit of technology for the Biolac process is considered to be 8.0 mg/L of effluent total nitrogen. To achieve effluent TN less than 3.0 mg/l, a denitrification filter and supplemental carbon system are required.

This option would consist of the following major components:

a. Flow splitter box to distribute flow between treatment zones
b. New lagoon liner
c. Concrete walls (long axis) and earthen walls (short axes) to create three separate basins, with a total volume of 5.0 million gallons. Treatment basins will include installation of Biolac equipment including moving aeration chain, diffuser assemblies and controls.
d. Three 75-foot diameter secondary clarifiers and influent splitter box, with a total volume of 1.6 million gallons.
e. Supplemental alkalinity storage and feed system
f. *Tertiary denitrification filter system and supplemental carbon storage and feed system (if an effluent TN limit of 5 mg/l or less is imposed).*

5.3.8 Comparison of Regional On-Site Alternatives

A planning-level analysis was performed for each of the nitrogen removal options. Each option was developed to a consistent level of conservatism based on the future wastewater flows and loads presented in Section 3 of this report and based on the near-term effluent total nitrogen of 8 mg/l and future effluent total nitrogen of 3 mg/l. Each option was assumed to require a supplemental carbon system and tertiary denitrification filter to achieve a TN limit of 3.0 mg/l. A summary of the advantages and disadvantages of each option is presented in **Table 5-6**.

Planning-level capital cost and annual operations and maintenance cost estimates were developed for each of the options in the manner described in **Section 6** of this report. A summary of these costs are presented in current dollars in **Table 5-7**.

TABLE 5-6
ADVANTAGES AND DISADVANTAGES OF ON-SITE ALTERNATIVES

Alternatives	Advantages	Disadvantages
MLE with Denitrification Filters	• Common in cold-weather climate	• May have difficulty meeting 8 mg/l limit at future flows and loads if influent TKN trends higher. • More complex operation than Bardenpho or SBR if 5 mg/l limit is imposed.
Four-Stage Bardenpho with Traditional Filters	• Easily achieves TN less than 8 mg/l • Common in cold-weather climate • Tertiary upgrade may be avoided.	• Greatest complexity of the four alternatives
Sequencing Batch Reactors with Denitrification Filters	• Simplest operation if PLCs operational. • Greatest degree of automation • Does not require clarifiers (but does require secondary equalization) • Easily achieves TN less than 8 mg/l • Common in cold-weather climate • Tertiary upgrade may be avoided.	• Complex operation if PLC controllers fail.l
Biolac (Earthen Basin) with Denitrification Filters	• Similar to existing operation • Reuses existing lagoon basin	• Achieving 8 mg/l requires more operator awareness and input than Four-Stage Bardenpho or SBRs. • More likely to have foaming and filamentous issues than other processes evaluated • Relatively few installations of similar size with stringent TN limits in cold-weather climate • Requires an intermediate pump station between secondary clarifiers and denitrification filters because hydraulic gradeline is fixed at existing lagoon water surface. • More complex operation than Bardenpho or SBR if 5 mg/l limit is imposed.

TABLE 5-7
COSTS FOR ON-SITE NITROGEN REMOVAL ALTERNATIVES

Alternatives	Total Nitrogen 8 mg/l			Total Nitrogen 3 mg/l		
	Capital Cost ($$M)	20-Year Present Worth ($$M)	Present Worth per Pound TN Removed	Capital Cost ($$M)	20-Year Present Worth ($$M)	Present Worth per Pound TN Removed
1 – Modified Ludzack-Ettinger with Denitrification Filters	$19.7M	$25.3M	$231	$28.1M	$35.9M	$231
2 – Four-Stage Bardenpho with Traditional Filters	$22.8M	$29.3M	$200	**$27.1M**	**$35.0M**	**$225**
3 – Sequencing Batch Reactor with Denitrification Filters	$19.9M	$26.0M	**$190**	$28.3M	$36.0M	$233
4 – Biolac (Earthen Basin) with Denitrification Filters	**$18.8M**	**$25.0M**	$228	$29.3M	$37.8M	$243

Notes:
1) ENR CCI 9700.
2) Capital costs include an allowance for contingency and technical services (40%) for only the Biological Nutrient Removal portions of the project. Additional project costs associated with other portions of the WWTF (e.g., headworks, disinfection, biosolids, etc.) are not included. The remainder of the project costs are addressed elsewhere is Section 5 and in Section 6.
3) Present worth is based on 20 years at 4% interest and include only the "incremental annual O&M costs" for the BNR portions of the project. The remainder of the project costs are addressed elsewhere is Section 5 and in Section 6.
4) Present worth per pound of TN removed is based on the difference between the "baseline" (existing lagoon WWTF at 3.0-mgd and 20 mg/l effluent TN) vs each alternative at 3.0-mgd at an effluent TN concentration of 8 mg/l for MLE and Biolac, 5 mg/l for SBR and 4 mg/l for Bardenpho for the "Total Nitrogen 8 mg/l" columns. For the "Total Nitrogen 3 mg/l", all alternatives utilized 3 mg/l effluent TN.
5) Bold indicates the lowest cost per column.

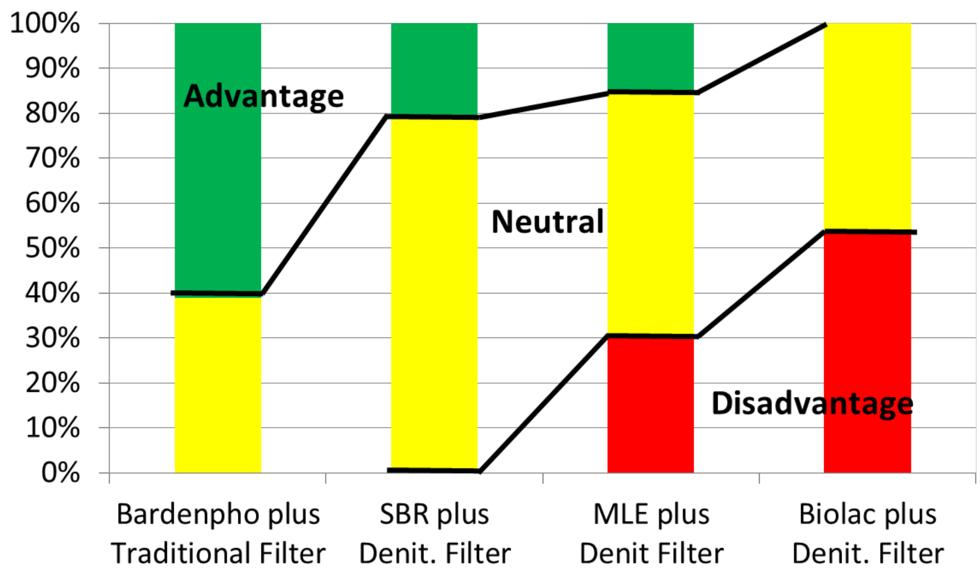
The alternatives were assessed qualitatively based on the evaluative criteria identified in Section 5.1.5. Key factors for each evaluative criterion were identified (e.g., present worth per pound of TN removed, similar installations, etc.). Since each of the alternatives was provided "a pathway to 3-mg/l effluent TN", phasing criteria were not included in the analysis. A value of "advantage" (A), "neutral" (N) or "disadvantage" (D) was assigned for each alternative and each criteria for each level of nitrogen removed. This analysis is presented in **Table 5-8** below.

TABLE 5-8
QUALITATIVE REVIEW OF ON-SITE NITROGEN REMOVAL ALTERNATIVES

	Cost			Reliability/ Flexibility			Operations			
Alternative	Capital Cost	Present Worth	Present Worth per Pound of TN Removed	Similar Installations (Size, Low TN & Cold Temps)	Flexibility	Ability to Add Primary Clarifiers in the Future	Complexity (Simplicity is an advantage)	Energy Use (less is an advantage)	Chemical Use (less is an advantage)	Requires Effluent Pump Station
Column Weightings	8.8%	13.2%	18.0%	15.0%	9.0%	6.0%	10.5%	6.0%	6.0%	7.5%
For 8 mg/l TN (AOC Compliance)										
1 - MLE	A	A	N	N	N	N	N	N	N	N
2 - Bardenpho	D	D	N	N	N	N	N	N	N	N
3 - SBR	N	N	N	N	N	N	A	N	N	N
4 - Biolac	A	A	N	N	N	N	N	N	N	N
For 5-mg/l TN										
1 - MLE	Cannot reliably achieve 5-mg/l TN									
2 - Bardenpho	D	N	A	A	N	N	D	D	A	N
3 - SBR	N	N	A	A	N	N	A	N	A	N
4 - Biolac	Cannot reliably achieve 5-mg/l TN									
For 3 mg/l TN (NPDES Compliance)										
1 - MLE plus Denit Filter	N	D	D	A	N	N	N	N	N	N
2 - Bardenpho plus Traditional Filter	A	A	A	A	N	N	N	N	A	N
3 - SBR plus Denit Filter	N	N	N	A	N	N	N	N	A	N
4 - Biolac plus Denit Filter	N	D	D	D	N	N	N	N	N	D

Given the importance of ultimately having a" pathway to compliance" with the NPDES permits, the Town wanted to conduct an additional analysis to weight the importance of the various categories. The additional analysis consisted of assigning "points" to each evaluative criteria category, based on the "column weightings" indicated in **Table 5-8**. For example, for Alterative 1 (MLE for 3-mg/l), 13.2 points and 18 points were assigned to "disadvantages", 15 points was assigned to "advantages" and the remainder of the points were assigned to "neutral". This approach was completed for each alternative for 3-mg/l. The results of this analysis is shown on **Figure 5-8** below.

FIGURE 5-8
ADDITIONAL ANALYSIS OF ON-SITE NITROGEN REMOVAL ALTERNATIVES



5.3.9 Recommended On-Site Nitrogen Removal Alternative

The following general conclusions are indicated:

- The alternatives present a broad range of capital costs, but have relatively similar present worth values. The systems with the higher capital cost have a lower annual O&M cost.
- The MLE, Bardenpho and SBR processes are widely used in the United States for similar sized facilities with stringent nitrogen limits and in cold-weather climates.

- Biolac has relatively few installations in the United States for this size facility with stringent nitrogen limits in a cold-weather climate. Biolac would be expected to have a greater temperature drop through the treatment process (due to its large surface area) which could result in reduced reliability to achieve low TN effluent in colder weather or colder wastewater months (more of a concern due to April permit limit).
- The Bardenpho and SBR options can both reliably achieve less than 5 mg/l effluent TN for the same costs presented under the 8 mg/l column. This is identified in the "capital cost per pound of TN removed" column.
- For 8 mg/l effluent TN, the lowest capital cost is Biolac; whereas, the highest is Bardenpho. Similarly, the lowest present worth is MLE and Biolac; whereas, the highest is Bardenpho.
- For 3 mg/l effluent TN, the lowest and present worth is Bardenpho.
- The lowest capital cost per pound of TN removed is Bardenpho and SBR; whereas the highest capital cost per pound of TN removed is MLE.
- There is a low incremental cost to achieve 5 mg/l with Bardenpho and SBR.
- The highest ranked alternatives for 8-mg/l TN is MLE or Biolac. The highest ranked alternative for 5-mg/l TN is SBR. The highest ranked alternative for 3-mg/l is Bardenpho.

Based on our review of the applicable technologies, including advantages, disadvantages and conceptual capital and operational costs, the recommended option is either On-Site Alternative No. 2 (Bardenpho) or On-Site Alternative No. 3 (SBR). These options will be carried forward into the facility-wide recommended plan, and the higher costs of On-Site Alternative No. 2, will be presented in **Section 6**.

5.4 BIOSOLIDS MANAGEMENT ALTERNATIVES

The Exeter WWTF currently stores all biosolids in the three aerated lagoons. No biosolids have ever been processed or disposed of from the three aerated lagoons. For the purpose of this analysis, it is assumed that the Exeter WWTF will be upgraded to one of the activated sludge treatment processes identified previously in this section and will require either mechanical thickening with liquid disposal, mechanical dewatering with solids disposal, or mechanical thickening followed by mechanical dewatering with solids disposal. The sludge quantities used in this analysis are summarized in **Table 5-9** below.

TABLE 5-9
CURRENT AND PROJECTED FUTURE SLUDGE PRODUCTION

SLUDGE PRODUCTION	CURRENT (2014)		DESIGN (2040)	
	MIN MONTH	AVERAGE	AVERAGE	MAX MONTH
Biological (lbs/d)[(1)]	1,456	2,240	3,360	4,753
Tertiary (lbs/d)[(2)]	0	0	1,170	1,949
Total (lbs/d)	1,456	2,240	4,530	6,702

Notes:
1. Biological sludge quantities were estimated in the Biowin process model.
2. Tertiary sludge quantities were estimated based on input from manufacturers. Under current conditions, the tertiary process would not be constructed.

5.4.1 Biosolids Alternative 1: Mechanical Thickening with Liquid Disposal

In this alternative, the waste sludge is assumed to be 0.6 percent solids and would be collected in three 150,000 gallon (450,000 gallon total) sludge storage tanks (SST). The SSTs would have provisions for mixing and aeration of the waste sludge. The waste sludge would be pumped out of the SSTs to two rotary drum thickeners (RDT) via two sludge feed pumps. The RDTs would utilize dilute polymer to flocculate the waste sludge delivered via a polymer activation system which would improve thickening.

RDTs are routinely used to thicken waste sludge to approximately 5 to 7 percent solids. Waste sludge would be thickened to 6 percent solids which would be stored in two 25,000 gallon (50,000 gallon total) thickened sludge storage tanks (TSST). The TSSTs would have a mixing system installed to keep the thickened waste sludge homogenous. The thickened waste sludge would then be pumped to a tanker for disposal by two thickened sludge pumps. The thickened waste sludge would then be trucked to a processing facility for disposal. For this analysis, it was assumed that the thickened waste sludge would be hauled and disposed of by Synagro at the Woonsocket Thermal Conversion Facility in Woonsocket, Rhode Island. ($0.20/Gal, personal communications with Synagro, 07/10/2014).

5.4.2 Biosolids Alternative 2: Mechanical Dewatering with Cake Disposal

In this alternative, the waste sludge is assumed to be 0.6 percent solids and would be collected in three 150,000 gallon (450,000 gallon total) SSTs. The SSTs would have provisions for mixing and aeration of the waste sludge. The SSTs would also have a decanting system which would thicken the waste sludge to approximately 1.5 percent solids. The decanted waste sludge would then be pumped by two sludge feed pumps to two mechanical dewatering systems (such as a screw press, centrifuge or rotary press). Dewatering systems utilize dilute polymer to promote flocculation of the waste sludge.

The dewatered waste sludge would then be conveyed via a conveyor system in to a hauling trailer, while the filtrate would be directed back to the headworks. The dewatered sludge could be disposed of as a solid waste at a secure landfill or could be post-processed for beneficial reuse. There are numerous beneficial reuse options for biosolids which have been post-processed to meet either Class A or B biosolids criteria (e.g., land application, topsoil amendments, composting, pellet fertilizers, etc.); which are often accomplished at an off-site facility by a contractor. For the purpose of this analysis, it was assumed that the dewatered sludge would be hauled to an off-site location for post-processing by a contractor for beneficial reuse ($100/wet ton, personal communication with RMI, 7/15/2014).

5.4.3 Biosolids Alternative 3: Mechanical Thickening, Mechanical Dewatering with Cake Disposal

In this alternative, the waste sludge assumed to be 0.6 percent solids would be thickened in two RDTs to 6 percent solids which would be stored in two 25,000 gallon (50,000 gallon total) thickened sludge storage tanks (TSST). The TSSTs would have a mixing system installed to keep the thickened sludge homogenous. The thickened sludge would then be pumped via two sludge feed pumps to two dewatering systems to be dewatered. The dewatered waste sludge would then be conveyed via a conveyor system in to a hauling trailer, which would be routinely hauled away. The filtrate from the thickening and dewatering systems would be directed back to headworks. For the purpose of this analysis, it was assumed that the dewatered sludge would be hauled to an off-site location for post-processing by a contractor for beneficial reuse ($100/wet ton, personal communication with RMI, 7/15/2014).

5.4.4 Comparison of Biosolids Alternatives

Capital cost, operation and maintenance costs and present worth were generated for each alternative. These are summarized in **Table 5-10** below.

TABLE 5-10
COSTS FOR BIOSOLIDS MANAGEMENT ALTERNATIVES

	Alternative 1 Mechanical Thickening Liquid Disposal	**Alternative 2** Mechanical Dewatering Cake Disposal	**Alternative 3** Mechanical Thickening Mechanical Dewatering Cake Disposal
Construction Cost[(1)]	$4,606,000	$5,529,000	$6,299,000
Annual O&M Costs			
Energy Cost[(2)]	$27,400	$28,600	$62,800
Disposal Cost[(3)]	$664,000	$378,000	$378,000
Polymer Cost[(4)]	$29,000	$71,000	$99,000
Maintenance Cost[(5)]	$17,700	$18,500	$36,600
Total O&M Cost	$738,100	$496,100	$576,400
Net Present Worth[(6)]	$14,638,000	$12,272,000	$14,133,000

Notes:
(1) Installation and electrical costs estimated at 20% of equipment cost each.
(2) Energy cost based on connected horsepower; average run time per year estimated as annual solids per equipment throughput capacity; average energy cost estimated at $0.14/kW-hr.
(3) Disposal costs based on budgetary pricing provided by Synagro ($0.20/gal) and RMI ($100/wet ton).
(4) RDT usage 10 lb active/dry ton; Screw Press usage 25 lb active/dry ton; Polymer cost estimated at $3.40/lb.
(5) Mechanical equipment maintenance cost based on 25% of operating hours at a labor cost of $40/hr.
(6) Present Worth is based on 20-year at 4.0% interest.
(7) ENR CCI 9700.

The advantages of Alternative 1 include the following:

- SST volume provides for 5 days of storage at future annual average sludge production
- Least complex operation and lowest capital cost

The disadvantages of Alternative 1 include the following:

- Highest net present worth, annual O&M costs, capital cost and truck trips per year
- Limited local disposal options for liquid sludge

The advantages of Alternative 2 include the following:

- Mid-complexity operation with the lowest net present worth and O&M costs.
- SST volume provides for 5 days of storage at future annual average sludge production
- There are several local disposal options for dewatered cake

The disadvantages of Alternative 2 include the following:

- None

The advantages of Alternative 3 include the following:

- Second lowest net present worth and O&M costs
- There are several local disposal options for dewatered cake

The disadvantages of Alternative 3 include the following:

- Smaller SST heightens dependence on proper O&M of the mechanical thickening system
- Most complex operation

5.4.5 Recommended Biosolids Alternative

Alternative 2 is the recommended biosolids management option based on having the lowest net present worth, the security of large sludge storage tanks and multiple local options to dispose of dewatered cake.

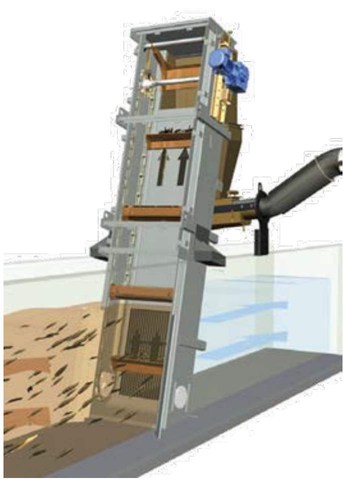
5.5 SCREENINGS AND GRIT REMOVAL ALTERNATIVES

The Main Pump Station was constructed during 1964 and included manual bar rack and detritor-type grit sump. The Town abandoned grit removal at the MPS in the mid-1980's due to regular clogging of the classifier. Grit still collects in the MPS grit collection sump and is removed monthly or when levels become problematic. Recently the MPS has been updated with two channel macerators, replacing the manual bar screen and previous channel macerator. The WWTF screenings and aerated grit system was constructed in 1998 and included manual bar rack and aerated grit removal. The WWTF aerated grit chamber and manual bar rack are still in operation but both systems have reached the end of their useful life and are recommended to be updated with any future upgrades to the facility. The purpose of this evaluation is to assess whether the Town should upgrade the screening and grit facility at the MPS or the WWTF. Two "location alternatives" were considered as part of the assessment for screenings and grit removal: constructing a new screenings/grit removal facility just upstream of the MPS; or constructing a new screenings/grit removal facility at the WWTF

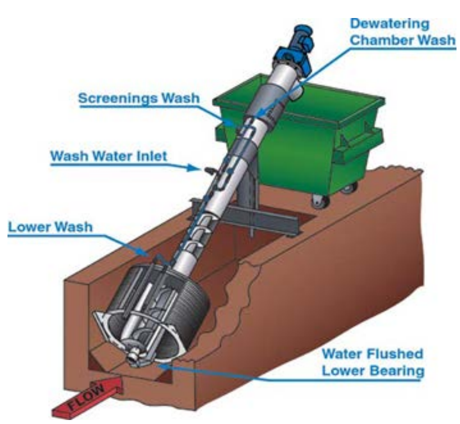
5.5.1 Screenings Equipment

Multiple equipment systems are applicable for either screening location. **Figure 5-8** below depicts typical screening systems.

FIGURE 5-9
SCREENING SYSTEMS



Vertical Screens



Rotary Drum Screens

Vertical Screens

There are numerous types of vertical screens, including climber screens; multi-rake screens and step screens. Climber screen employs a single rake arm connected to a cogwheel that rides up and down a pin rack located on the screen frame. Typically all moving parts are located above the waterline. Climber screens typically have 3/8” to 1/2”” bar spacing.

Multi-Rake Bar Screens have rakes attached to the dual chains to provide the screenings removal mechanism. A pair of sprockets are located in the bottom of the channel to provide for positive engagement of the rake to the bar screen. The chain rotates within the frame, reducing the overall size of the unit (height and length). Multi-rake screens typically have 1/4” to 3/8” bar spacing.

Step screens have a series of moving screen plates that rotate adjacent to a series of fixed screen plates. The moving screen plates move debris up the screen like an escalator. Typically all moving parts are located above the waterline. Step screens typically have 1/4” bar spacing.

Vertical screen systems typically discharge screenings into a screenings wash presses. The wash presses would wash out organics from the screenings to reduce odor potential and then be dewatered and compact the screenings. The dewatered screenings from each wash presses would be discharged through a discharge chute and into a screenings container.

Rotary Drum Fine Screen

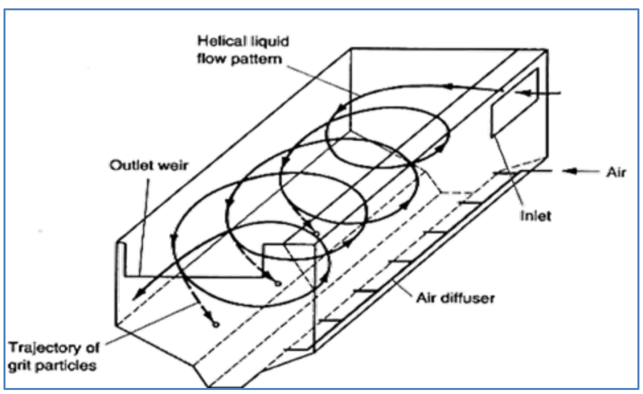
This in-channel, cylindrical bar screen will screen, wash, compact and transport screenings out of the influent wastewater. The angled installation minimizes the space requirements for required shallow installations. The screenings are removed from the cylindrical bars by a rotating rake that passed through the full depth of the bars. The entire unit would be constructed of 304 stainless steel.

As liquid flows through the screening basket the solids are trapped by the screen bars that form the circular basket. When the liquid rises to a predetermined level then the rake begins to rotate and clears the screen bars. When the rake reaches the top of the screen the captured material drops into the central screw conveyor and then the rake reverses to complete a cleaning pass. The central screw conveyor will wash and compact the collected material as it is transported to the discharge chute. Screenings are initially washed as they are deposited into the collection screw conveyor and then washed again in the upper section of the transport tube. The macerating action of the screw breaks down the large organic particles which are then washed back into the flow stream. A spray wash system in the dewatering chamber removes any collected material to ensure free drainage of water which is removed in the compaction process. The new screen would have perforations from 1-mm to 8-mm.

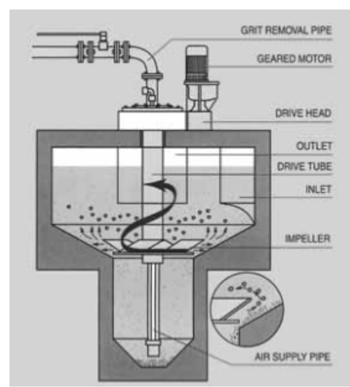
5.5.2 Grit Removal Equipment

For either location alternative, two grit removal technologies were considered: vortex grit removal and aerated grit removal. **Figure 5-9** depicts both technologies.

FIGURE 5-10
GRIT REMOVAL SYSTEMS



Aerated Grit Removal



Vortex Grit Removal

Vortex Grit Removal

Vortex grit removal is a well-established technology that uses centrifugal forces to separate the grit from the wastewater flow. The vortex can be generated with a paddle mixer ("forced vortex") or with hydraulic force ("induced vortex"). The grit slurry is pumped or drained to a hydrogritter (hydro-cyclone followed by a screw classifier), or to a grit washer for grit and organics separation prior to disposal into a roll off container. The grit washers are a smaller form of a vortex grit removal system that is used to wash away the organics from the grit and incorporates a dewatering screw for final transport.

The advantages of vortex grit removal include the following:

- Does not utilize aeration, and thus does not contribute oxygen to the flow that could hinder downstream biological nutrient removal processes
- Small footprint
- Lower operating and maintenance costs due to aeration blowers are not required
- Well-suited for odor control

The disadvantages of vortex grit removal include the following:

- Vortex grit removal is typically less effective than properly sized aerated grit removal
- High grit loadings during peak wet weather events can overload vortex systems resulting in clogging and compromised operation performance

Aerated Grit Chamber

Aerated grit chambers are designed to remove grit consisting of sand, gravel, cinders, or other heavy materials that have specific gravities or settling velocities generally greater than those of organic particles. In addition to these materials, grit contains eggshells, bone chips, seeds, coffee grounds, and large organic particles. The aerated grit chambers consist of a tank where positive displacement blowers provide air to diffusers on one side of the tank inducing a helical roll across the longitudinal forward flow. The helical roll pattern induced in the grit chamber causes grit to settle to the bottom of the chamber while keeping lighter organic material in suspension to be processed further downstream. If the velocity is too high, grit will be carried out of the tank; if it is too low, organic material will be removed with the grit. The turbulence in the tank also helps to scour organic material that has attached to the grit particles. Grit that is not well-washed and contains organic matter produces undesirable odors and attracts pests. The grit that settles at the bottom of the grit chamber is typically conveyed via a screw conveyor to a grit sump. The grit slurry could be pumped to a hydrogritter (hydro-cyclone followed by a screw classifier), or to a grit washer for separation prior to disposal into a roll off container.

The advantages of a new aerated grit removal system include the following:

- Properly sized aerated grit systems are more effective than vortex grit removal
- High grit loading during peak wet weather events can be stored in the grit chamber and processed as able

The disadvantages of a new aerated grit removal system include the following:

- Aerated grit removal technology contributes dissolved oxygen to the secondary influent, which would adversely affect the performance of nutrient removal process
- Higher operating and maintenance cost due to aeration blowers being required
- Not well-suited for implementing odor control

5.5.3 Locate Headworks at WWTF

As noted previously, screening and grit removal is currently performed at the WWTF. This option would consist of upgrading the existing facilities at the WWTF or of abandoning the existing systems and constructing a new screenings and grit facility at a hydraulic gradeline appropriate for the WWTF upgrade. There is ample room to construct either the vortex or aerated grit removal systems outside.

5.5.4 Locate Headworks at Main Pump Station

This option would consist of constructing a new screenings and grit removal facility at the Main Pump Station. Due to the hydraulic gradeline, the finished floor for screening and grit removal systems would be approximately 10-feet to 14-feet below grade and the bottom elevation would be approximately 18-feet to 24-feet below grade. Due to the proximity to adjacent public and private property, screening and grit removal systems would need to be enclosed in a building. Preliminary estimates indicate that the building would need to be approximately 25-feet by 45-feet. Due to limited parcel area, either option would require that the Town acquire property from an abutter or the gain the approval to use land within the Swazey Parkway. Contaminated soils are known to exist in the project area and therefore soils and groundwater generated from the site will require special handling and monitoring. The existing MPS would need to be renovated and brought up to current electrical, mechanical, fire and architectural codes.

5.5.5 Comparison of Headworks Alternatives

The advantages of constructing a new screenings and grit facility at the WWTF include:

- Space is not a limitation, public complaints related to odors and materials handling are unlikely, and the screening and grit facility can be built at the desired hydraulic gradeline.
- No known contaminated soils or groundwater.
- Grinders do an adequate job of minimizing pump clogging at the Main Pump Station.
- Flows from other communities (if connected) could be processed through the same screening and grit removal facility.

The disadvantages of constructing a new screenings and grit facility at the WWTF include:

- Continuing to pump raw sewerage from the MPS will continue to wear the pump and forcemain over time, resulting in increased O&M costs

The advantages of constructing a new screening and grit facility at the MPS include:

- Removing screenings prior to pumping will decrease incidents of pump clogging
- Removing grit prior to pumping will decrease the wear on the pumps, valves and forcemain

The disadvantages of constructing a new screening and grit facility at the MPS include:

- Excavation and dewatering would be challenging in the close vicinity of the Squamscott River due to high ground water levels
- Contaminated soils are known to be in the project area and would be expensive to monitor and dispose of during excavation
- The Town would need to acquire property (or construction/permanent easement) from an abutter or gain the approval to use land within the Swazey Parkway
- Screenings and grit disposal can be odorous and could result in public complaints. Odor control would be recommended
- Additional operator attention would be required at the MPS (which is not staffed)

5.5.6 Recommended Headworks Alternative

Based on the analysis above it recommended that the screenings and grit facility be constructed at the WWTF. With the limited space and contaminated soils at the MPS site, construction of the expansion would be very challenging and expensive.

5.6 DISINFECTION ALTERNATIVES

The most common means of disinfection at most wastewater facilities in New England is the addition of sodium hypochlorite to the effluent to chlorinate followed by the addition of sodium bisulfite to dechlorinate. An increasingly popular means of disinfection is ultraviolet (UV) light radiation. A discussion on the advantages and disadvantages of each system is presented below.

5.6.1 Chemical Disinfection

A chemical disinfection system consists of chemical fill station, bulk storage of sodium hypochlorite and sodium bisulfite with secondary containment, tank level sensors, tank vents and miscellaneous valves and piping; sodium hypochlorite and sodium bisulfite feed pumps such as peristaltic pumps or diaphragm pumps; Chlorine Contact Tank with miscellaneous gates and scum trough removal; sodium hypochlorite and sodium bisulfite carrier/dilution water; and a feed rate control system. Sodium hypochlorite addition rate is normally paced on effluent flow rate and trimmed on the chlorine residual taken at the upstream end of the Chlorine Contact Tank. Sodium bisulfite addition rate is normally flow paced and trimmed on the chlorine residual taken at the downstream end of the Chlorine Contact Tank. Mechanical mixers are commonly used at the points of chemical addition to provide positive mixing of effluent and chemical and the chlorine residual is measured with a free chlorine analyzer.

5.6.2 UV Disinfection

In order to provide effective UV radiation disinfection, the effluent needs to flow through open channels with multiple banks of UV light modules. A downstream level control device needs to be provided to maintain the adequate water level in the channel under low flow conditions and a recirculating sump pump may be necessary during extreme low flow conditions. UV radiation disinfection systems require provisions for measuring UV transmittance; a cleaning system to remove grease, dirt build-up and scaling on the lamps which minimizes disinfection performance; and a jib crane to perform routine maintenance such as bulb replacements. Per the State of New Hampshire Code of Administrative Rules, Env-Wq 700 Standards of Design and Construction for Sewerage and Wastewater Treatment Facilities, the UV radiation disinfection system must be enclosed in a ventilated building for year-round operation and pilot testing may be required to demonstrate effective disinfection.

UV light radiation systems have been gaining popularity in the past few years. For the most part, UV systems have been most commonly used in advanced wastewater treatment systems where suspended solids levels are consistently less than 30 mg/l and in places where chlorine residual would be a problem to groundwater or sensitive water bodies. However, improvements to UV disinfection systems such as different light intensities and bulb cleaning systems have led to increased use within secondary, activated sludge wastewater treatment systems. UV transmissivity is a critical parameter for the proper sizing of a UV disinfection system. If UV disinfection is selected transmissivity testing would need to be performed prior to design, preferably over several seasons.

5.6.3 Comparison of Disinfection Alternatives

Three options were considered for disinfection.

- *Chemical Disinfection Alternative A* consisted of relocating new sodium hypochlorite and sodium bisulfite bulk storage tanks and chemical pumps next to the existing Chlorination Building. This would require a building addition onto the existing Chlorination Building and reconfiguration of chemical piping. The Chlorine Contact Tank could be reused but would require crack repair.

- *Chemical Disinfection Alternative B* consisted of reusing the existing chemical disinfection system. This option would include reusing the existing sodium hypochlorite and sodium bisulfite bulk storage tanks, replacing the chemical recirculation pumps, chemical pumps and controls. The Chlorine Contact Tank could be reused but would require crack repair.

- *UV Disinfection* consisted of modifications to the existing Chlorine Contact Tanks with a new building prior to installing a UV disinfection unit. The UV disinfection system would need to be added to SCADA with provisions to stop discharging in the event of a power loss, in order to comply with Env-Wq 712.05.

Capital cost, operation and maintenance costs and present worth were generated for each alternative. These are summarized in **Table 5-11** below.

TABLE 5-11
COSTS FOR DISINFECTION SYSTEM ALTERNATIVES

	Chemical Disinfection Alternative A	**Chemical Disinfection Alternative B**	**UV Disinfection Alternative**
Capital Cost	$910,000	$420,000	$1,370,000
Annual O&M (Year 1)	$28,000	$28,000	$28,000
S. Hypochlorite (gallons)	17,500	17,500	0
S. Bisulfite (gallons	2,100	2,100	0
Electricity (kw-hrs)	Negligible	Negligible	104,000
Annual O&M (Year 20)	$91,000	$91,000	$64,000
S. Hypochlorite (gallons)	38,400	38,400	0
S. Bisulfite (gallons	3,700	3,700	0
Electricity (kw-hrs)	Negligible	Negligible	162,500
Net Present Worth	**$1,760,000**	**$1,240,000**	**$2,120,000**

Notes:
(1) Installation and electrical costs estimated at 20% of equipment cost each.
(2) Energy costs based on flow-proportional energy demand, current electrical cost and 3% per year inflation.
(3) Chemical costs are based on flow-proportional chemical use, current chemical costs and 3% per year inflation.
(4) Present Worth is based on 20-year at 4.0% interest.
(5) ENR CCI 9700

Advantages for Chemical Disinfection Alternative A include:

- Relocating the entire chemical disinfection system at the Chlorination Building would eliminate recirculating chemicals from the Control Building. Having all new components to the chemical disinfection system would improve reliability
- WWTF staff presently use chemical disinfection and are familiar with the process

Disadvantages for Chemical Disinfection Alternative A include:

- Second lowest net present worth
- Continue to utilize chemicals for disinfection

Advantages for Chemical Disinfection Alternative B include:

- Lowest net present worth
- WWTF presently use chemical disinfection and are familiar with the process

Disadvantages for Chemical Disinfection Alternative B include:

- Continue to utilize chemicals for disinfection

Advantages/disadvantages for UV disinfection alternative include:

- Exeter WWTF has expressed a strong interest in not storing hazardous chemicals onsite
- No toxic byproducts produced and discharged to the environment (water or air)
- No risk of overdosing
- No issues with chloramine formation due to partial nitrification

Disadvantages for UV Disinfection include:

- Still require a small hypochlorite system for filament and odor control

5.6.4 Recommended Disinfection Alternative

The least cost approach is to include a chemical disinfection system in the WWTF upgrade. However, the annual O&M cost associated with UV disinfection is lower than chemical disinfection over time. The significant reduction in the use of chemicals on-site is advantageous.

Either alternative meets NHDES regulations. The Town should discuss the advantages and disadvantages of each alternative.

5.7 LAGOON DECOMMISSIONING ALTERNATIVES

A meeting was held on July 3, 2014 with NHDES to discuss the acceptable methods for decommissioning the four lagoons at the Exeter WWTF. The meeting was attended by: NHDES (Mike Rainey, Stergios Spanos, Gloria Andrews, Lori Sommers, Dan Fenno); Town of Exeter (Michael Jeffers); and Wright-Pierce (Andy Morrill). Four methods were discussed as potentially viable. Each method is summarized below.

5.7.1 Decommissioning Method No. 1 – Cap and Monitor Lagoon

Method No. 1 would consist of sampling the sludge in Aerated Lagoons No. 1, No. 2, No. 3 and the Sludge Storage Lagoon. If the sludge is deemed acceptable by NHDES it would be hydraulically dredged/excavated from Aerated Lagoons No. 2, No. 3 and the Sludge Storage Lagoon into the portion of Aerated Lagoon No. 1 that will not be used for the two influent equalization basins. Aerated Lagoon No. 1 would then be drained and dewatered to have a soil cap installed over the stored sludge. Vents would be installed to monitor and relieve any released gases. The capped portion of Aerated Lagoon No. 1 could have end use restrictions depending on he contaminants found during sludge sampling. Aerated Lagoons No. 2, No. 3 and the Sludge Storage Lagoon would then require that the bottoms be tested free of sludge.

A NHDES approved Closure Plan would be required. The current Exeter WWTF Groundwater Discharge Permit would need to be amended and would likely require a hydrologic study to determine the proper groundwater well sampling points. The current groundwater sampling wells could be used if found suitable by NHDES. Groundwater sampling and gas monitoring would be required for a minimum of 30 years and would need to be bonded.

5.7.2 Decommissioning Method No. 2 – Dewater and Dispose of Sludge

Method No. 2 would consist of hydraulically dredging/excavating the sludge in Aerated Lagoons No. 1, 2, 3 and the Sludge Storage Lagoon. The sludge would then be dewatered and disposed of by a sub-contractor. The disposal of the dewatered sludge could either be through beneficial reuse as Class A or Class B biosolids or it could be deposited into a secure landfill (unclassified sludge). Class A dewatered sludge has the lowest disposal cost, followed by Class B dewatered sludge, while the unclassified dewatered sludge has the highest disposal cost. The landfill would require that the unclassified sludge be tested for contaminants and pass a paint filter test, which requires a total solid content of approximately 18%.

A NHDES approved Closure Plan would be required. To classify the sludge for disposal (i.e. Class A, Class B or unclassified) a Sludge Quality Certificate (SQC) needs to be obtained from NHDES. The SQC could be obtained by the Exeter WWTF or the Contractor. SQC testing requires that one composite sample be obtained for each lagoon to test for contaminants. The composite sample would consist of 20 to 40 grab samples throughout the lagoon. Once the sludge has been classified, dewatered and disposed, the bottom of each lagoon is required to be tested free of sludge.

5.7.3 Decommissioning Method No. 3 – Dry and Dispose of Sludge

Method No. 3 would consist of hydraulically dredging/excavating the sludge from Aerated Lagoons No. 1, No. 2, No. 3 and the Sludge Storage Lagoon to be dried and disposed of off-site. The sludge could be dried in geo-bags or an on-site drying bed. It takes a minimum of approximately two months for the sludge to dry before it can be disposed of properly. For best results, it is ideal if the sludge is able to dry through a winter freeze and spring thaw period. This method could be accomplished over several years, provided the intended procedure is outlined in the Closure Plan.

A NHDES approved Closure Plan and a SQC would be required. The dried sludge could be disposed of through beneficial reuse or deposited in a landfill, depending on the class of sludge determined in the SQC process. All lagoons would then require that the bottoms be tested free of sludge.

5.7.4 Decommissioning Method No. 4 – Keep Aerated Lagoons in Process

Method No. 4 would consist of keeping all aerated lagoons in the active process and would not require decommissioning of the lagoons. The sludge in the lagoons could then be removed and disposed of as required. Since the aerated lagoons cannot meet the NHDES permit and AOC as issued, this is not viable for the "on-site alternatives" described herein; however, it would be feasible for one of the "regional alternatives" described herein.

5.7.5 End Use of Decommissioned Lagoons

Once the lagoons are decommissioned there are three options for end use of the land: 1) fill the lagoons with clean water (i.e., not part of the treatment process); 2) fill the lagoons with backfill and reuse the site for municipal purposes (e.g., recreational uses, public works uses; etc.); or 3) removing all/portions of the lagoon embankments and restoring the area to flood plains and brackish wetlands for the Squamscott River.

A second meeting held with on October 8, 2014 with numerous agencies to discuss the potential for flood plain and wetlands restoration. This meeting was attended by: NHDES (Lori Sommers, Gloria Andrews, Tracey Wood, Mindy Bubier, Kevin Lucey, Frank Richardson); Inland Fisheries and Wildlife (Corey Riley, Cheri Patterson); Nature Conservatency (Ray Konisky); EPA (Joy Hilton, Mark Kern, Ed Reiner (EPA); UNH (Dave Burdick); Town of Exeter (Michael Jeffers, Jen Mates, Matt Berube, Jennifer Perry); and Wright-Pierce (Andy Morrill, Travis Pryor, Ed Leonard). Based on the discussions at the meeting, the general consensus was:

- This location represents a very good opportunity for a large flood plain and "low marsh" wetland restoration project (approx. 20 acres). From 1962 aerial photographs, it appears that the river meander was present prior to the construction of the lagoons.
- There are numerous phragmytes colonies in the area. If invasive species mitigation is not methodically done in advance, this location could serve as a seed area for phragmytes

propagation. UNH indicated that the Town should reach to numerous project partners for this work including NHDOT, NHDES, NRCS, Rockingham County Conservation Commission, the Town of Newfields and the Town of Stratham.

- NHDES indicated that the restoration project would likely rank high on competitive State and regional grant opportunities.

If any of the lagoons are restored to flood plains/wetlands for the Squamscott River, a Wetland Compensation Bank (WCB) could be utilized to offset decommissioning costs. Although the NHDES does not presently have WCB regulations in place, they would defer to the EPA and ACOE for guidance. If a WCB were established, the Town of Exeter would be compensated by other project proponents for placing its' wetlands into preservation. Drawbacks to establishing a WCB are that it could take several years for NHDES to consider the wetlands operational and it is unknown if there will be sufficient local projects requiring wetland mitigation.

Another option for offsetting the decommissioning costs would be the use of the Aquatic Resource Mitigation (ARM) Fund. The ARM Fund is a NHDES grant program where wetland mitigation compensation can be used for wetland restoration design, demolition, construction, legal fees and/or plantings. The restored wetlands would need to be placed in preservation for protection. Lori Sommers, NHDES Wetland Mitigation Coordinator, noted that there is a substantial amount of Seacoast Area grant funds that will be available in 2015 to 2016.

5.7.6 Comparison of Decommissioning Alternatives

Advantages/Disadvantages of Method No. 1:

- No sludge dewatering and disposal is required
- Sludge would be used as fill material in Aerated Lagoon No. 1
- Could be used with any new Exeter WWTF option
- Lagoons could be reclaimed or restored to flood plains/wetlands for the Squamscott River
- Groundwater and gas monitoring would be required for a minimum of 30 years
- Reuse of capped area could have restrictions depending on the sludge quality

Advantages/Disadvantages of Method No. 2:

- Quickest method of decommissioning
- Former lagoon areas would not have end use restrictions
- Could be used with most new Exeter WWTF options
- Lagoons could be reclaimed or restored to flood plains/wetlands for the Squamscott River

Advantages/Disadvantages of Method No. 3:

- Former lagoon areas would not have end use restrictions
- Could be used with most new Exeter WWTF option
- Lagoons could be reclaimed or restored to flood plains/wetlands for the Squamscott River
- Longest duration required to complete decommissioning

Advantages/Disadvantages of Method No. 4:

- No decommissioning tasks are required
- Lagoon areas could not be reclaimed or restored to flood plains/wetlands

Based on discussions with the Town, Method 1 and Method 4 are not desired or recommended. Method 2 and Method 3 are similar (i.e., both involve removing all biosolids) with the difference the time required to remove the sludge (i.e., Method 3 will take substantially longer). Since Lagoon No. 1 will be needed for influent equalization in the WWTF, Method 3 is not available for Lagoon No. 1 but could be used for Lagoon Nos. 2 and 3.

5.7.7 Estimates of Lagoon Sludge Quantities

The quantity of sludge in the lagoons has been estimated a few of times over the past 10 years. These reports have indicated potential range of sludge in the lagoons of between approximately 1,290 dry tons at 3% solids to 2,150 dry tons at 5% solids (Underwood, 2005) and approximately 1,800 dry tons at 4% solids (Wright-Pierce based on SolarBee service report, 2013). In October 2014, Wright-Pierce conducted a sludge survey in order to provide a more current assessment of the quantity and quality of sludge in the lagoons. This survey consisted of taking "sludge judge" measurements on a 100-foot grid in each of the three lagoons. A composite sludge sample was collected from each lagoon and was submitted for laboratory analysis in order to compare to the Sludge Quality Certification (SQC) metals criteria specified in Env-Wq 807.03(c). This analysis indicated a potential range of sludge in the lagoons of between approximately 1,850 dry tons at 3% solids and 3,080 dry tons at 5% solids. This is higher than the placeholder values utilized in the October 2014 *preliminary draft* report. The laboratory analysis also indicated that some metals (molybdenum and zinc) may slightly exceed the SQC values. Initial discussions with NHDES indicate that a waiver could potentially be pursued or that blending with wood ash may be needed. Ultimately, a more detailed assessment will be required by NHDES, at a point in time closer to the actual sludge removal, in order to obtain a SQC. For the purposes of this study, we will utilize a sludge quantity of 2,500 dry tons for Lagoons 1, 2 and 3 and an allowance of 500 dry tons for the Sludge Storage Lagoon. We will also assume that a SQC certificate can be obtained either with a waiver or blending. A memorandum summarizing this effort is included in **Appendix B**.

5.7.8 Recommended Decommissioning Method

A combination of Method 2 or Method 3 is recommended. The lagoon decommissioning cost depends greatly on the Sludge Quality Certificate, sludge volume and desired end use of the former lagoons. For the purposes of this study, it was assumed that Exeter would retain a contractor to dewater and dispose of the sludge as "unclassified waste" using Method 2. Preliminary construction cost estimates were developed for Method No. 2, including the three methods of end use. These costs are shown in **Table 5-12**.

TABLE 5-12
COSTS FOR LAGOONS DECOMMISSIONING ALTERNATIVES

	Method 2 with Reclaimed Land	Method 2 with Wetlands Restoration	Method 2 with Open Water
Permitting & Closure Plan	$50,000	$50,000	$50,000
Site Protection and Restoration	$300,000	$300,000	$300,000
Dewater and Dispose of Lagoon Solids	$3,000,000	$3,000,000	$3,000,000
Remove Lagoon Equipment & Structures	$150,000	$150,000	$150,000
Fill Lagoons	$10,000,000	$0	$0
Restore Area as Flood Plains	$0	$1,000,000	$0
Fill with Clean Water	$0	$0	$0
Contractor OH&P	$2,030,000	$680,000	$530,000
Contingency & Inflation	$2,330,000	$780,000	$600,000
Potential Grant Funding	$0	($300,000)	$0
Total Construction Cost	**$17,860,000**	**$5,660,000**	**$4,630,000**

Note:

1. ENR CCI 9700
2. Unit costs based on Jaffrey NH and Peterborough NH Lagoon Closure project bids.
3. Lagoon sludge volume estimate based on Wright-Pierce survey in October 2014 (placeholder of 2,500 dry tons for Lagoons 1, 2 and 3 plus 500 dry tons for the Sludge Storage Lagoon).
4. Biosolids disposal assumed to be unclassified ($1,000 per dry ton).
5. Lagoon earth fill estimated at 675,000 CY at $15/CY.
6. Wetlands and flood plain restoration cost is an allowance.
7. Contractor OH&P estimated at 15% of costs. Contingency and Inflation estimated at 15% of costs including Contractor OH&P.
8. Grant funding estimated based on discussions with NHDES Wetlands Mitigation Coordinator

5.8 SUMMARY OF ALTERNATIVES EVALUATIONS

The section presented the results of several alternatives evaluations. A number of these evaluations may be refined in the preliminary design phase of the project; however, the refinements would not be expected to change the recommendations.

- The recommended on-site WWTF approach is Alternative 2 (Bardenpho) or Alternative 3 (Sequencing Batch Reactor)
- The recommended biosolids management approach is Alternative 2 (Mechanical Dewatering with Cake Disposal).
- The recommended disinfection approach is UV disinfection.
- The recommended headworks approach is to construct new facilities at the WWTF.
- The recommended lagoon decommissioning approach is Method 2 (Dewater and Dispose of Solids) or Method 3 (Dry-in-place and Dispose of Solids) in combination with either wetlands restoration.

The items will be carried forward into the recommended plan for the on-site approach.

Final decisions regarding whether or not to participate in a potential regional wastewater management solution at Pease WWTF should be made when the results of three separate studies are in-hand (i.e., the Exeter-commissioned Pease WWTF Regional Study; the WISE project report; and the Portsmouth-commissioned Pease WWTF Regional Study). As noted previously in Section 5.2.6, the Exeter-commissioned Pease WWTF Regional Study is completed and the two remaining studies are expected to be completed in March/April 2015 and April/May 2015, respectively.

SECTION 6

RECOMMENDED PLAN

6.1 INTRODUCTION

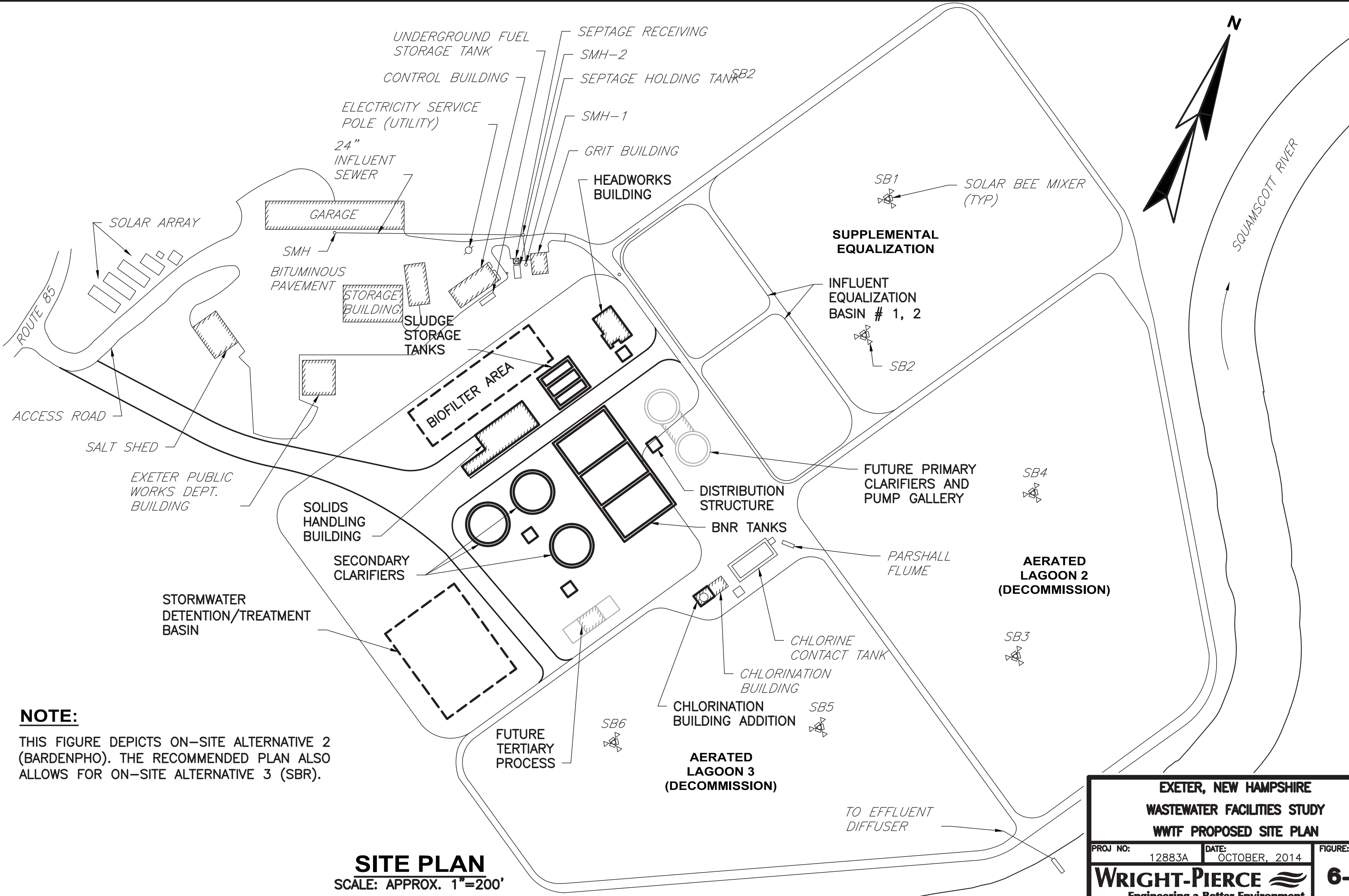
Section 5 of this report concluded that the on-site regional alternative was a cost-effective and practicable approach to addressing Exeter's NPDES permit and AOC. This section of the report presents the details of the recommended plan for the on-site regional alternative including phasing, estimated staffing requirements, estimated capital costs and estimated operations and maintenance costs. The details were developed for the purposes of quantifying the financial impacts of the project. Each of the details can be refined in the preliminary design phase.

6.2 RECOMMENDED PLAN

The basis for the recommended treatment facility improvements are described via unit process and/or building system in **Sections 3 and 5** of this report. The components of the recommended plan are included for a variety of reasons, including being:

- Required to meet current and/or identified future permit limits
- Required for equipment or process reliability or to meet NHDES regulations
- Required to reduce or eliminate combined sewer overflows
- Required to provide capacity for planned growth
- Required to address building or life-safety code-related issues
- Desired to improve energy efficiency/reduce operating costs
- Desired to increase revenues (e.g., septage receiving, "customer communities")
- Desired to improve efficiency of operations/utilization of staff
- Desired to better utilize existing spaces

As a point of reference, the recommended plan is consistent with "Future Scenario B" presented in **Section 4**. The proposed site plan and process schematic are presented as **Figure 6-1** and **Figure 6-2**, respectively. Phasing of project improvements is presented later in this section of the report.



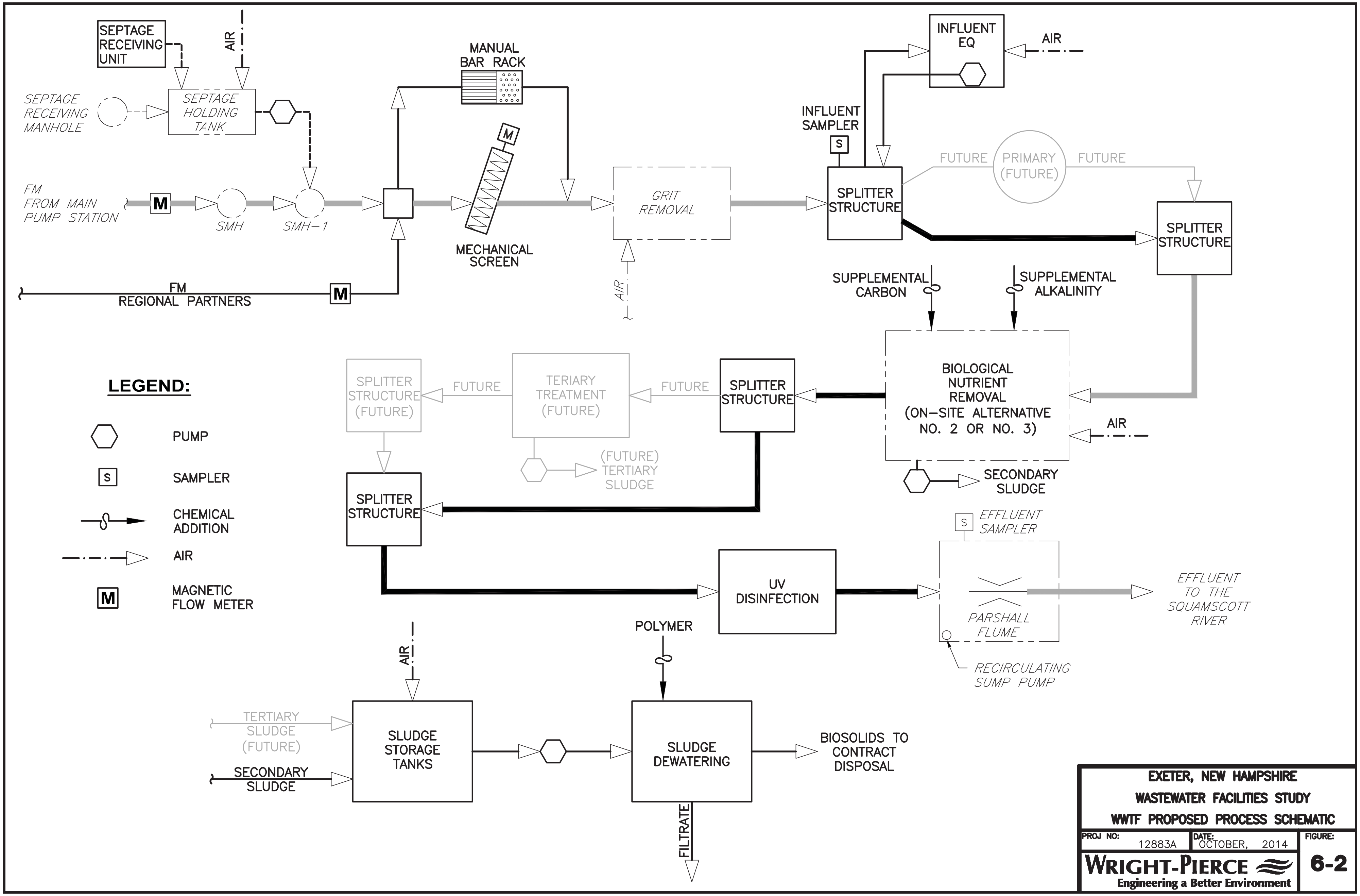
NOTE:

THIS FIGURE DEPICTS ON-SITE ALTERNATIVE 2 (BARDENPHO). THE RECOMMENDED PLAN ALSO ALLOWS FOR ON-SITE ALTERNATIVE 3 (SBR).

SITE PLAN

SCALE: APPROX. 1"=200'

EXETER, NEW HAMPSHIRE WASTEWATER FACILITIES STUDY WWTF PROPOSED SITE PLAN		
PROJ NO: 12883A	DATE: OCTOBER, 2014	FIGURE: 6-1
WRIGHT-PIERCE Engineering a Better Environment		


SEPTAGE RECEIVING UNIT
AIR
SEPTAGE RECEIVING MANHOLE
SEPTAGE HOLDING TANK
MANUAL BAR RACK
MECHANICAL SCREEN
FM FROM MAIN PUMP STATION
M
SMH
SMH-1
GRIT REMOVAL
AIR
FM
REGIONAL PARTNERS
INFLUENT EQ
AIR
INFLUENT SAMPLER
S
FUTURE
PRIMARY (FUTURE)
FUTURE
SPLITTER STRUCTURE
SPLITTER STRUCTURE
SUPPLEMENTAL CARBON
SUPPLEMENTAL ALKALINITY
BIOLOGICAL NUTRIENT REMOVAL (ON-SITE ALTERNATIVE NO. 2 OR NO. 3)
AIR
SECONDARY SLUDGE
SPLITTER STRUCTURE
FUTURE
TERIARY TREATMENT (FUTURE)
FUTURE
SPLITTER STRUCTURE (FUTURE)
(FUTURE) TERTIARY SLUDGE
SPLITTER STRUCTURE
EFFLUENT SAMPLER
UV DISINFECTION
PARSHALL FLUME
RECIRCULATING SUMP PUMP
EFFLUENT TO THE SQUAMSCOTT RIVER
LEGEND:
PUMP
SAMPLER
CHEMICAL ADDITION
AIR
MAGNETIC FLOW METER
POLYMER
TERTIARY SLUDGE (FUTURE)
SECONDARY SLUDGE
SLUDGE STORAGE TANKS
SLUDGE DEWATERING
FILTRATE
BIOSOLIDS TO CONTRACT DISPOSAL
EXETER, NEW HAMPSHIRE
WASTEWATER FACILITIES STUDY
WWTF PROPOSED PROCESS SCHEMATIC
PROJ NO: 12883A
DATE: OCTOBER, 2014
FIGURE: 6-2
WRIGHT-PIERCE
Engineering a Better Environment

6.2.1 Main Pump Station

- Provide new influent sluice gate to wetwell.
- Maintain existing grit sump for periodic manual cleanout. Maintain existing channel grinders.
- Upgrade the existing three pumps to dry-pit submersible pumps sized to convey the peak flows to the WWTF in order to eliminate future combined sewer overflows (CSOs). Pumps will be provided with variable frequency drives (VFDs) for variable speed pumping.
- Provide miscellaneous process upgrade including new suction/discharge piping, new link-type seals on wet-to-dry well wall penetrations and pressure injection of wetwell/drywell wall cracks.
- Provide new PLC-based control panel with new instrumentation, including wetwell level, combustible gas, wastewater flow and CSO flow. Upgrade connectivity to the WWTF SCADA system.
- Comprehensively upgrade the electrical service, main power distribution and automatic transfer switch. Retain the existing standby generator for continued use. Provide local disconnects and ESTOPS at process equipment. Upgrade the remainder of the electrical systems to include energy efficient lighting (interior and exterior), emergency lighting/exit signs, receptacles and fire alarm system (if required by the Fire Chief).
- Comprehensively upgrade the building and building systems, including: repairing the damaged base plates supporting the wall panels; replacing the exterior doors; creating separation between the "classified" Pump Room and the "unclassified" upper level (NFPA 820); replacing the damaged stair nosings at the exterior stairs; replacing the roofing system; repainting the interior spaces; and upgrading the heating, ventilating and plumbing systems.

6.2.2 Main Pump Station Forcemain

- Construct a new 16-inch diameter forcemain from the Pump Station to the WWTF (approximately 5,000 feet). Reline the existing forcemain from the Pump Station to the

WWTF (approximately 5,000 feet). This will allow for additional capacity and improved longevity of the existing piping. Consider the cost-effectiveness of open cut installation of two forcemains.

6.2.3 Influent Flow Measurement and Sampling

- Maintain the existing flow meter for continued use.
- Relocate the existing influent sampler to the new Headworks Building.
- If "customer communities" are allowed to connect to the Exeter WWTF, provide the ability to meter and sample flows from those communities separate from Exeter's influent.

6.2.4 Septage Receiving

- Provide a mechanical septage receiving unit to provide for fine screening (1/4") and screenings washing/compaction. The septage receiving unit should be provided with a flow meter to measure the volume of septage received. The unit will be insulated and heat-traced and be suitable for an exterior installation.
- Upgrade the existing Septage Tank including pressure injecting concrete cracks and adding instrumentation for level measurement.
- Construct a second Septage Tank, of similar volume, to allow for equalization of this load. Consider using the existing Aerated Grit Chamber.
- Upgrade the two septage transfer pumps including a new septage flow meter

6.2.5 Screening and Grit Removal

- Abandon the existing Grit Building for its current process functions. Repurpose the structure for alternate uses. If repurposed, comprehensively upgrade the building and building systems, including: repairing the minor cracks in the exterior masonry walls; cleaning the moss and organic growth at the base of the walls; installing new sealants at the control joints and around the perimeter of all wall penetrations; replacing the shingle roofing and eave flashing; replacing vinyl siding at gable ends; replacing existing doors;

repainting the interior surfaces; and upgrading the heating, ventilating and plumbing systems.

- Construct a new Headworks Building. Similar to the existing building on-site, this building would consist of cast-in-place concrete foundation and block wall with split-face block finish.
- Provide a mechanical fine screen (1/4” preferred) with screenings wash press and by-pass manual bar rack. Provide two vortex grit removal systems to allow for proper sizing under average and peak conditions, including two grit pumps and two grit classifiers/washers. Screening and grit removal systems will be sized for the peak instantaneous flow to the WWTF including flows from “customer communities” (if applicable).
- Provide instrumentation, controls and SCADA connectivity.

6.2.6 Influent Equalization Basin

- Create two lined off-line influent equalization basins within a portion of former Aerated Lagoon No. 1. The basins will be 1.0 million gallons each. The intent is to size the basins to limit the peak instantaneous flow to 6.6-mgd. The influent equalization basin sizing should be evaluated further in preliminary design to determine the optimum cost combination. That is, a larger equalization basin will make for a smaller peak design flow through the WWTF; however, the implications of winter/spring cold temperatures needs to be considered so as not to compromise nitrogen removal.
- Provide a triplex influent equalization pump station with instrumentation (level, flow), controls and SCADA connectivity.

6.2.7 Primary Treatment (Future)

- Arrange the site and hydraulic gradeline for the possible future inclusion of primary treatment.

6.2.8 Advanced Secondary Treatment/ Nitrogen Removal

- Construct three trains of activated sludge/ nitrogen removal process, including mixers, pumps, blowers, fine bubble diffused aeration systems, instrumentation (air flow, dissolved oxygen, ORP, nitrate, ammonia, TSS), control systems, flow splitter structures and site piping.
  - The Bardenpho configuration would include three aeration tanks, three internal recycle pumps, nine submersible mixers, three circular secondary clarifiers (75-foot diameter by 16-foot sidewater depth with rapid sludge removal withdrawal mechanism), secondary scum pump station, four return sludge pumps (three duty/one standby), two waste sludge pumps (one duty/one standby) and four aeration blowers (three duty/one standby). This equipment will be in the Solids Process Building, the Aeration Tanks and Clarifiers
  - The SBR configuration would include three SBR tanks, three mixers, three waste sludge pumps and four aeration blowers (three duty/one standby), one post-equalization tank with diffused aeration system. This equipment will be in the Solids Process Building, the SBR Tanks and Post-Equalization Tanks
- Construct a supplemental alkalinity system to maintain pH for process control (nitrification/denitrification) and effluent pH compliance. This system will have a bulk liquid storage tank and two chemical feed pumps. This system will be housed in the Solids Process Building
- Construct a supplemental carbon storage and feed system to achieve 3-mg/l effluent TN. This system will have a bulk liquid storage tank and three chemical feed pumps suitable for use with methanol, MicroC® or similar products. This system will be an exterior installation.

6.2.9 Tertiary Treatment (Future)

- Arrange the site and hydraulic gradeline for the future inclusion of tertiary treatment.

- Construct a three train traditional filtration system (cloth disk or sand), including appurtenant pumping, chemical, instrumentation and control systems. This system will be housed in the Tertiary Building.
- Consider the feasibility/viability of seasonal spray irrigation, in lieu of tertiary treatment, prior to implementation of a future WWTF upgrade. The Town has several large parcels in conservation which could potentially be used for this purpose.

6.2.10 Disinfection

- Remove the existing chlorination and dechlorination systems from the Control Building and from the Chlorination Building. Rename the building “Chlorination Building” to the “Disinfection Building”.
- Provide a UV disinfection system retrofitted in the existing Chlorine Contact Tank. Rename the “Chlorine Contact Tank” to the “Disinfection Tank”. Repairs cracks in the Disinfection Tank.
- Per NHDES regulations, construct a ventilated building around the UV disinfection system for year-round operation. In lieu of a large uninterruptible power supply, maintain a portion of former Aerated Lagoon No. 1 as “supplemental influent storage” to provide a means to stop discharging in the event of a power loss until the UV system is back up to full intensity.
- Provide instrumentation (level, flow, turbidity), controls and SCADA connectivity for the UV disinfection system.
- Provide new electrical service and main power distribution to the Disinfection Building. Provide local disconnects and ESTOPS at process equipment. Upgrade the remainder of the electrical systems to include energy efficient lighting (interior and exterior), emergency lighting/exit signs, receptacles and fire alarm system (if required by the Fire Chief).
- Comprehensively upgrade the Disinfection Building and building systems, including: repairing the minor cracks in the exterior masonry walls; cleaning the moss and organic growth at the base of the walls; installing new sealants at the control joints and around the perimeter of all wall penetrations; replacing the shingle roofing and eave flashing;

replacing vinyl siding at gable ends; replacing existing doors; repainting the interior surfaces; providing separation of electrical gear from process spaces; and upgrading the heating, ventilating and plumbing systems.

- Comprehensively upgrade the Control Building and building systems.

6.2.11 Effluent Flow Measurement and Sampling

- Upgrade the existing parshall flume insert and ultrasonic instrumentation.
- Maintain the existing effluent sampler for continued use. Add flow-pacing capability based on effluent flow rate.

6.2.12 Outfall

- No modifications anticipated within the planning period; however, note that the CAPE (Climate Adaptation Project Exeter) estimates a significant increase in flood elevation through the 21st century. At some point in the future, outfall modifications or an effluent pump station may be needed.

6.2.13 Sludge Processing Systems

- Construct a new Sludge Process Building with single sludge truck bay. Similar to the existing building on-site, this building would consist of cast-in-place concrete foundation and block wall with split-face block finish.
- Provide a sludge storage system including three Sludge Storage Tanks sized for 5 days of storage at design annual average conditions (i.e., 450,000 gallons total) with instrumentation (level), decanting and aeration systems. The decanting system is assumed to consist of telescoping valves. The aeration system is assumed to consist of three positive displacement blowers with diffused aeration grid (sized for 30 to 50 scfm per thousand cubic feet).
- Provide a mechanical sludge dewatering system including three sludge feed pumps (two duty, plus common standby), two dewatering machines (e.g., centrifuges or slow rotating

presses), two polymer make-down systems, sludge conveyors and truck bay leveling conveyor.

- Provide instrumentation, controls and SCADA connectivity for the sludge processing systems.

6.2.14 Support Systems

- Upgrade the existing process water to allow for on-going use of effluent for on-site cleaning. The new system should reuse the existing hydropneumatic tank and should replace the existing pumps, air compressor, instrumentation and controls to match the duties required for the upgraded facilities.
- Upgrade the existing Disinfection Tank scum pump station and redirect scum to the new Sludge Storage Tanks.
- Per NHDES regulations, provide new sodium hypochlorite bulk storage tank and chemical metering pumps to allow for miscellaneous process/filament control and odor mitigation uses. This is anticipated to be a 1,000 gallon tank with two chemical metering pumps. This system will be included in the Sludge Process Building.

6.2.15 Lagoon Decommissioning

- Abandon the existing Aerated Lagoons. Abandon/remove structures and piping.
- Conduct decommissioning of former Aerated Lagoon Nos. 1, 2 and the former Sludge Storage Lagoon in accordance with a NHDES-approved Closure Plan. Decommissioning is assumed to consist of hydraulically dredging, dewatering and disposal of the sludges as an “unclassified waste” by a construction contractor.
- Repurpose the former Sludge Storage Lagoon as the location for the majority of the new WWTF tankage and buildings.
- Repurpose former Aerated Lagoon No. 1 to new influent equalization basins.
- Restore brackish flood plains and tidal wetlands within former Aerated Lagoons No. 2 and No. 3 to brackish flood plains/tidal wetlands. Continue discussions with NHDES.

- Pursue NHDES grants (e.g., the Aquatic Resource Mitigation (ARM) Fund) to offset restoration costs for design, demolition, construction, legal fees and/or plantings.
- Prior to deciding on the fate of the lagoons, consider whether diurnal (river), tidal (river) or seasonal (spray irrigation) discharge strategies help the river the water quality objectives.

6.2.16 Civil-Site Improvements

- Construct a new 8-inch or 12-inch diameter water main from Summer Street to the Public Works Complex to provide potable water and fire protection flows (approximately 5,000 feet) for the Public Works Complex and WWTF.
- Construct a new access drive from Route 85 to the new facilities in order to minimize temporary construction traffic and permanent WWTF traffic on the existing Public Works facilities. WWTF related will increase over current, primarily due to biosolids hauling.
- Modify existing site to address parking and access for vehicles, maintenance activities, chemical deliveries, septage deliveries and biosolids hauling.
- Address stormwater management for new impervious areas, including stormwater harvesting for general purpose irrigation use. Stormwater detention ponds and/or rain gardens can be located within the footprint of the former Sludge Storage Lagoon and/or Aerated Lagoon No. 3.
- Construct new and/or upgraded site piping systems for raw sewage, equalization flows, activated sludge, return/waste sludge, scum and chemicals.
- Construct a new 12-inch water main from Water Street to the DPW site and WWTF.

6.2.17 Architectural Improvements

- Construct new Headworks Building and Sludge Process Building, as described above.
- Renovate/repurpose the existing Grit Building and Disinfection Building ("Chlorination Building"), as described above.

- As noted above, comprehensively renovate the existing Control Building and building systems, including: repairing the minor cracks in the exterior masonry walls; cleaning the moss and organic growth at the base of the walls; installing new sealants at the control joints and around the perimeter of all wall penetrations; replacing the shingle roofing and eave flashing; replacing vinyl siding at gable ends; replacing existing windows and doors; repainting the interior surfaces; providing separation between the "classified" Pump Room and the "unclassified" upper floor (NFPA 820); and upgrading the heating, ventilating and plumbing systems. In addition, create new spaces in the Control Building to facilitate operations including converting the existing chemical rooms to occupied functions such as meeting/break room, control room, storage and a workshop and making the spaces ADA-accessible.

6.2.18 Instrumentation Improvements

- Upgrade the existing SCADA system to incorporate the WWTF upgrade instrumentation, monitoring, control and alarming systems. The new SCADA system will include three workstations – two in the Control Building and one in the Solids Process Building.

6.2.19 Electrical Improvements

- Comprehensively upgrade the electrical service and main power distribution. The preliminary sizing of the new service entrance is 2000 ampere.
- Provide a new stand-alone, diesel-engine, standby generator and automatic transfer switch housed in a sound-attenuated enclosure. The preliminary sizing of the unit is estimated at 750 kw.
- Upgrade the site duct bank system for power distribution to existing and new buildings and tanks.
- Provide exterior site lighting for new driveways, tankage and buildings.
- Provide local disconnects and ESTOPS at process equipment. Upgrade the remainder of the electrical systems to include energy efficient lighting, emergency lighting/exit signs, receptacles and fire alarm system (if required by the Fire Chief).

6.2.20 Energy Efficiency/Green Design Improvements

The following types of energy efficient and green design elements will be evaluated and included where appropriate and cost effective. Examples include: natural and high efficiency lighting (with motion sensors in some locations); solar walls; effluent heat exchanger; air-to-air heat exchangers; energy recovery ventilators; minimize impervious surfaces; and light-colored roofing for reduced solar gain.

6.3 STAFFING

Currently, three personnel operate and maintain the WWTF including one Grade III operator, one Grade II operator and one full-time equivalent maintenance mechanics (two mechanics, part-time, shared with Public Works). The existing WWTF is a Grade II plant. Using the criteria established by NHDES in ENV-WS 901.18 ("Classification and Reclassification of Wastewater Treatment Plants"), the upgraded WWTF would become a Grade III facility after the Phase 1 upgrade and a Grade IV facility after the Phase 2 upgrade. Using the criteria established by EPA Publication MO-1 ("Estimated Staffing for Municipal Wastewater Treatment Facilities"), the upgraded WWTF is estimated to require five personnel after the Phase 1 upgrade and six personnel after the Phase 2 upgrade.

6.4 ESTIMATED CAPITAL COSTS

Planning-level project costs have been prepared for the recommended facilities. The planning-level costs were developed using standard cost estimating procedures consistent with industry standards utilizing concept layouts, unit cost information, and planning-level cost curves, as necessary. Total project capital costs include allowances of 40% of the estimated construction costs to account for construction contingency, project contingency, technical services as well as financing, administrative and legal expenses. Many factors arise during final design (e.g. foundation conditions, owner selected features and amenities, code issues, etc.) that cannot be definitively identified and estimated at this time. These factors are typically covered by the allowances described above; however, this allowance may not be adequate for all circumstances.

The project cost is presented in **Table 6-1.** These costs are in current dollars and are based on ENR Construction Cost Index 9846 (August 2014). The cost of the recommended plan is **$51,870,000**, which includes the WWTF upgrade to achieve 5 mg/l at a design flow of 3.0-mgd, the Main Pump Station upgrade, the Main Pump Station forcemain, DPW Complex watermain and lagoon decommissioning items. Additional information regarding the cost estimate is included in **Appendix C**. The cost for upgrades to achieve 3 mg/l and 8-mg/l are provided for informational purposes.

As described previously in this report, there are several areas of uncertainty related to existing conditions and this capital cost estimate, including WWTF influent sampling (refer to Section 2) and process selection (refer to Section 5). It is important to note that these items could have a significant impact on the costs (positive or negative). These items should be considered and resolved in the preliminary design phase.

6.5 ESTIMATED ANNUAL OPERATION AND MAINTENANCE COSTS

The Town's operations and maintenance (O&M) budget for wastewater collection, treatment and disposal for the 2014 fiscal year was **$467,000**, excluding existing debt service. An O&M budget for the first year of operation of the upgraded WWTF was prepared based on the estimated increases and decreases for specific line items of the budget. The current budget and the current flows and loads were considered the baseline. The estimated first year O&M budget for the upgraded facility is **$1,150,000**, excluding debt service, for the Recommended Plan (WWTF Upgrade with Bardenpho for design year 3-mgd to 5 mg/l effluent TN plus appurtenant facility components). Annual O&M costs are presented in **Table 6-2** and are presented in 2014 dollars. The O&M costs for upgrades to achieve 3 mg/l and 8-mg/l are provided for informational purposes. These estimates are based on the assumptions listed below.

- Biosolids disposal was assumed to $100/wet ton in current dollars.
- Flows and loads were assumed to increase by 5% over the 4 years between now and 2018.
- The Phase I upgrade is implemented and 2 new staff are hired.
- Major maintenance budgets were held constant (i.e., without inflation).

TABLE 6-1
ESTIMATED CAPITAL COSTS FOR RECOMMENDED PLAN COMPONENTS

	WWTF Upgrade 3.0-mgd 5-mg/l TN	Main Pump Station, Forcemain & Watermain	Lagoon Decommissioning	Notes
Construction	$31,400,000	$4,000,000	$5,500,000	1
Construction Contingency	$1,570,000	$200,000	$280,000	2
Technical Services	$6,460,000	$810,000	$1,110,000	3
Legal/Administrative/Financing	$400,000	$60,000	$80,000	4
Subtotal	$39,830,000	$5,070,000	$6,970,000	5,6
Total, Recommended Plan	**$51,870,000**			7

Notes:

1) Construction cost estimate is based on ENR CCI 9846; additional details are provided in Appendix C. The construction costs include a 15% design phase contingency to account for items that cannot be definitively identified at this time.
2) Construction contingency is based on 5% of the construction cost.
3) Technical services include design engineering, construction engineering, value engineering, and materials testing and is based on 20% of the construction costs.
4) Legal/administrative/financing includes customary costs for bond counsel, project advertisements and interim interest costs.
5) The "WWTF Upgrade subtotal" for a 3.0-mgd WWTF designed to achieve *8-mg/l effluent TN* is $36.2M. Refer to Appendix C for additional information.
6) The "WWTF Upgrade subtotal" for a 3.0-mgd WWTF designed to achieve *3-mg/l effluent TN* is $45.9M. Refer to Appendix C for additional information.
7) The NHDES cost estimate for the Exeter WWTF for 5.0-mg/l was $44.1M ("Analysis of Nitrogen Loading Reductions for WWTF and NPS in the Great Bay Estuary Watershed, Appendix E, December 2010, ENR 8660).

TABLE 6-2
ESTIMATED ANNUAL OPERATION & MAINTENANCE COSTS
(for various treatment levels with 3 treatment trains)

Category	**Current O&M Costs**		**Projected O&M Costs**	
Costs for TN 8 mg/l				
Salaries	3 staff	$124,000	5 staff	$227,000
Benefits	3 staff	$68,000	5 staff	$125,000
Buildings and System Maintenance	-	$49,000	-	$94,000
Chemicals, Licenses, Software				
Licenses, Software, etc	-	$54,000	-	$59,000
Hypochlorite	17,500 gal	$18,000	1,800 gal	$2,000
Bisulfite	3,250 gal	$6,000	0 gal	$0
Supp Alkalinity	n/a	$0	16,000 gal	$18,000
Supp Carbon	n/a	$0	7,500 gal	$21,000
Polymer	n/a	$0	8,000 gal	$44,000
Utilities				
Natural Gas	-	$11,000	-	$21,000
Electricity	1.1MW-hrs	$134,000	1.75MW-hrs	$231,000
Fuel	-	$2,000	-	$3,000
Gas Monitoring	-	$1,000	-	$1,000
Biosolids	n/a	$0	2,500 wet ton	$275,000
Total at Current Flows for 8-mg/l		**$467,000**		**$1,121,000**
Estimate at Mid-Point Flows for 8-mg/l				**$1,340,000**
Estimate at Design Year Flows for 8-mg/l				**$1,550,000**
Additional Costs for TN 5 mg/l				
Supp Carbon			0 gal	$0
Electricity			0.25MW-hrs	$33,000
Biosolids			0 wet ton	$0
Total at Current Flows for 5-mg/l				**$1,154,000**
Estimate at Mid-Point Flows for 5-mg/l				**$1,370,000**
Estimate at Design Year Flows for 5-mg/l				**$1,580,000**
Additional Costs for TN 3 mg/l				
Supp Carbon			12,000 gal	$33,000
Electricity			0.27MW-hrs	$36,000
Biosolids			700 wet ton	$77,000
Total at Current Flows for 3-mg/l				**$1,300,000**
Estimate at Mid-Point Flows for 3-mg/l				**$1,580,000**
Estimate at Future Flows for 3-mg/l				**$1,850,000**

Note: Current flows are 1.7-mgd. Mid-Point flows are 2.35-mgd. Design year flows are 3.0-mgd. All costs are presented in 2014 dollars (ENR CCI 9846).

6.6 PHASING

Section 6.2 of the report identifies a recommended plan to achieve 5-mg/l effluent total nitrogen for a design/permit flow of 3.0-mgd. The estimated project cost for this recommended plan, as described in **Section 6.4** ($51.87M), includes the WWTF upgrade, the Main Pump Station upgrade, Main Pump Station forcemain upgrades, DPW Complex watermain extension and lagoon decommissioning activities. The recommended plan includes capacity for future growth. The recommended plan also provides for more nitrogen removal than is required by the AOC but less than is required by the NPDES permit.

The WWTF upgrades can be phased in any number of ways depending on the Town's goals. The purpose of phasing is generally to defer costs in order to moderate the rate impacts to users. Several examples of ways the WWTF upgrades could be phased include:

- By capacity (i.e., the initial phase could be sized for less than the licensed 3.0 mgd);
- By level of treatment (i.e., the initial phase would be sized to meet 8 mg/l effluent TN to meet the AOC versus 3 mg/l effluent TN to meet the NPDES permit); or
- By component (e.g., items such as decommissioning or disinfection could be deferred).

Figure 6-3 identifies the anticipated influent flow rates over the planning period. As described in **Section 4**, the AOC requires that the Town evaluate the effectiveness of its Nitrogen Control Plan in 2023 and determine whether additional WWTF upgrades are needed. If the Town elected to "phase by capacity", flows are anticipated to be 2.2 mgd with regional contributions and 2.0 mgd without regional contributions by 2023 to 2025. **Table 6-3** identifies several approaches to "phase by level of treatment" and "phase by capacity". An initial cost analysis suggests that as much as 10% of the capital cost could be saved or deferred by phasing (refer to the December 2014 technical memorandum in **Appendix C**).

The actual phasing and/or cost saving opportunities should be explored early in the preliminary design phase in order to assess the costs, advantages and disadvantages of each potential opportunity.

FIGURE 6-3
CONCEPTS FOR PHASING OF ON-SITE ALTERNATIVES

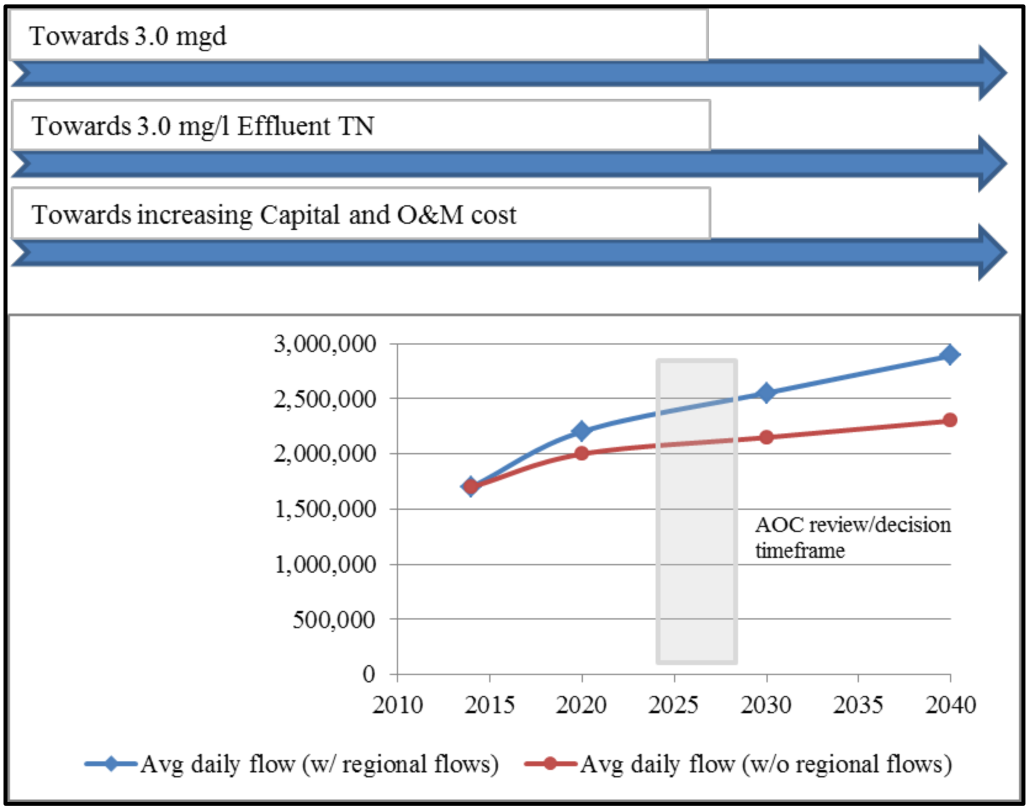


TABLE 6-3
POTENTIAL PHASING OPPORTUNITIES FOR ON-SITE ALTERNATIVES

Alternative	Initial Project	Future Project
2A	Construct Bardenpho for 3.0-mgd	Add Filters for 3.0-mgd
2B	Construct MLE for 3.0-mgd	Expand to Bardenpho, add Filters for 3.0-mgd
2C	Construct Bardenpho for 2.1-mgd	Expand and add Filters for 3.0-mgd
2D	Construct MLE for 3.0-mgd	Add Primary Clarifiers, re-rate to Bardenpho for 3.0-mgd, add Filters for 3.0-mgd
2E	Construct Bardenpho for 2.1-mgd now	Add Primary Clarifiers, re-rate to Bardenpho for 3.0-mgd, add Filters for 3.0-mgd
3A	Construct SBR for 3.0-mgd	Add Denit Filter for 3.0-mgd
3B	Construct SBR for 2.1-mgd	Add 3rd SBR and Denit Filter for 3.0-mgd

Note: The recommended plan is Alternative 2A "Initial Project".

SECTION 7

PROJECT COSTS AND FINANCING

7.1 INTRODUCTION

The recommended plan and its estimated costs are described in detail in Section 6. This section of the report identifies the potential funding sources, the recommended financing scenario as well as the implementation schedule. The recommended facilities are estimated to cost approximately $51.87 million (expressed in 2014 dollars, with inflation to mid-point of construction) to design/construct and will raise the "Treatment" portion of the Sewer Enterprise Fund from $467,000 to $1,150,000 annually to operate (expressed in 2014 dollars). The remainder of the sewer budget will remain unchanged. Therefore, the total annual sewer enterprise fund budget will increase from $2.45 million to $3.15 million, excluding new WWTF debt. The estimated annual debt repayment on a $51.87 million SRF loan is $3.57 million. The project costs for the recommended plan described herein will have a significant impact on the average sewer user rate. Based on the funding assumptions made herein, the total annual costs associated with the recommended plan is approximately $5.89 million (with no State Aid Grant, but with 15% SRF principal forgiveness), which is approximately 140% higher than the current total annual budget for the wastewater collection and treatment system.

The estimated project cost for this recommended plan includes the WWTF upgrade, the Main Pump Station upgrade, Main Pump Station forcemain upgrades, DPW Complex watermain extension and lagoon decommissioning activities. The recommended plan includes significant capacity for growth. There are a number of phasing and/or cost saving opportunities which can be explored in the preliminary design phase in order to assess the costs, advantages and disadvantages of each potential opportunity.

7.2 CAPITAL COST FUNDING SOURCES

There are several state and federal agencies from which the Town may be able to obtain financial assistance in the form of grants and/or low-interest loans. If the Town were to act as a regional host, additional funding sources may be available to incentivize a regional solution. These programs are described in the following paragraphs.

7.2.1 New Hampshire Department of Environmental Services

The New Hampshire Department of Environmental Services (NHDES) has several programs available to municipalities for the planning, design, and construction of wastewater infrastructure projects - the State Aid Grant (SAG) program, the SAG Plus program (also referred to as the House Bill 207 Septage Grant program), and the State Revolving Loan Fund (SRF) program. SAG grant funds are available in amounts of 20% of eligible project costs or, if sewer user fees are more than 20% above the state average, the grant amount increases to 30% of eligible costs. Based on the most recent NHDES Sewer User Charge Study (2010), the State average user fee was $575 and Exeter's average residential sewer user fee was $411; however, the projected average residential sewer user fee will be $1,060 with <u>no</u> SAG funding and with <u>no</u> CWSRF principal forgiveness. Based on the above information, Exeter would *qualify* for a 30% grant for the proposed project.

The SAG Plus program provides for grants based on the costs associated with receiving and treating septage at the WWTF. The amount of grant depends on the number of communities served (i.e. 10% for the host municipality plus 2% per additional municipality served up to a maximum of 5 additional municipalities). It is anticipated that the Exeter would *qualify* for a 10% grant for the septage related aspects of the proposed project. Approximately $1,800,000 of the project cost is for septage related aspects of the project and should qualify for a SAG Plus grant. Exeter's septage is currently discharged primarily to the Hampton WWTF.

The SRF loan program provides low-interest loans for the planning, design, and construction of municipal wastewater projects. Loan interest rates vary depending on the repayment period.

Currently, 20-year loans are at 3.168% interest (updated annually in October). It is anticipated that Exeter would qualify for and receive an SRF loan for this project.

The SAG and SAG Plus programs have been suspended since the fiscal issues in 2008. However, DES is hopeful that these grant programs will soon be reinstated. DES is accepting applications for the SRF loan program; however, DES issued a moratorium on new SAG and SAG Plus grant applications as of July 1, 2013. Accordingly, we have shown the project financing summary both with and without SAG/SAG Plus funds in **Table 7-1** (at the end of this section). In the past few years, DES has been providing "principal forgiveness" with its SRF loans. Based on the magnitude of the rate increase predicted, we have assumed that DES would provide 15% principal forgiveness if no SAG/SAG Plus funds are provided.

7.2.2 Aquatic Resource Mitigation (ARM) Fund

One option for offsetting the lagoon decommissioning costs would be the use of the Aquatic Resource Mitigation (ARM) Fund. The ARM Fund is a NHDES grant program where wetland mitigation compensation can be used for wetland restoration design, demolition, construction, legal fees and/or plantings. The restored wetlands would need to be placed in preservation for protection. Lori Sommers, NHDES Wetland Mitigation Coordinator, noted that there is a substantial amount of Seacoast Area grant funds that will be available in 2015 to 2016.

7.2.3 New Hampshire Municipal Bond Bank

The New Hampshire Municipal Bond Bank (NHMBB) has a loan program which provides low-interest loans for the planning, design, and construction of municipal wastewater projects. Loan interest rates vary depending on the repayment period. Currently 20-year loans are at 4.5% interest. It is anticipated that Exeter would qualify for and receive a NHMBB loan for this project.

7.2.4 New Hampshire Community Development Finance Authority

The New Hampshire Community Development Finance Authority (formerly the Office of State Planning) administers the Community Development Block Grant (CDBG) program with funds allocated by the U.S. Department of Housing and Urban Development. Grants are available in several different categories, including public facilities implementation grants for water and wastewater projects. Grant funds of up to $500,000 are available for eligible projects; however, these grants are very competitive. Although Exeter likely qualifies, we have assumed no CDBG funding for this project because it would preclude Exeter from pursuing CDBG funds for other infrastructure projects. If the Town wishes to pursue CDBG funding, we recommended that the Town meet with the Community Development Finance Authority to discuss potential project financing. CDBG applications are due in late January and in late July.

7.2.5 U.S. Department of Agriculture

The U.S. Department of Agriculture also has a grant and loan program, administered by Rural Development, that is available for the planning, design, and construction of municipal wastewater infrastructure projects for communities with a population of less than 10,000. Grant amounts and loan interest rates vary depending on the availability of funds and the median household income of the municipality. The main eligibility criterion is median household income (MHI). Specifically, if the municipality's MHI is below the State average, then it qualifies for up to 45% grant funding; however, if the municipality's MHI is below 80% of the State average, then it may qualify for up to 75% grant funding. The State average MHI based on the 2008-2012 American Community Survey 5-Year Estimates is $64,925. Exeter’s MHI is $72,231. On this basis, the Town would not qualify for any USDA Rural Development grant funding. Since Exeter’s population according to the 2010 U.S. Census was 14,306, the Town would likely not qualify for loan funding from USDA Rural Development either.

7.2.6 U.S. Economic Development Administration

The U.S. Economic Development Administration (EDA) has a grant program for municipal infrastructure construction necessary to attract or increase commercial and/or industrial development. Grants of 50% of project cost, up to a maximum of $1,000,000, are available. One of the primary eligibility criteria is that the project must create or maintain employment opportunities in an economically disadvantaged area. EDA does consider household income when awarding grants. Since Exeter's MHI is substantially higher than the state average, this will reduce the likelihood of receiving a grant. If the Town wanted to pursue EDA funding, it would need to present a compelling case that jobs would be created or maintained by this project. If the Town wishes to pursue EDA funding, we recommend a meeting with EDA to discuss potential project funding. At this time no EDA funding has been assumed in this analysis.

7.2.7 State and Tribal Assistance Grant

The State and Tribal Assistance Grant (STAG) is an appropriations-based grant for States, tribal and local governments for a variety of water and wastewater infrastructure projects. This grant is administered by the Environmental Protection Agency. This grant requires strong support by Town management, NHDES and the congressional delegation. Grants up to $2 million have previously been awarded, although a more typical grant award is $300,000 to $500,000. It is important to note that Congressional appropriations have recently come under fire, and STAG funding has been considerably reduced. The Town should consider applying for STAG funding; however, no funding has been assumed in this analysis.

7.2.8 Environmental Programs and Management Grant

The Environmental Programs and Management Grant (EPMG) is an appropriations-based grant for State and local governments for infrastructure projects. This grant is administered by the Environmental Protection Agency. This appropriations program has also come under fire recently and, based on conversations with NHDES personnel, grants have typically been reserved for State government agencies in recent history. On this basis, it is unlikely that the Town would receive any grant funding from this program; however, this program would be worth discussing with the US Congressional representative. No EPMG funding has been assumed in this analysis.

7.2.9 Unitil

Unitil provides energy rebate incentive grants for wastewater infrastructure projects. Depending on the design, Exeter should qualify for energy rebate grants for measures implemented to improve energy efficiency of new facilities. Based on our past experience with grants of this type, it is anticipated that the Town could qualify for and receive rebate grants in the range of $25,000 to $50,000. A Unitil grant of $50,000 has been assumed in this analysis.

7.2.10 Customer Communities

If Exeter constructs a regional facility and provides service to neighboring communities, some portion of the capital cost should be paid by the "customer community". Typically the customer community's share of the debt is based on the capacity allocation reserved for the customer community. This could be accomplished by the customer community securing a loan (thereby reducing Exeter's loan amount) or by the customer community paying its share of debt service annually. For the purposes of this analysis, we have utilized the latter approach in **Table 7-1**. Based on the capacities identified in Section 2 for Stratham and Newfields, customer communities have been assumed to require 10% of the WWTF capacity in the planning period; so, 10% of the debt service related to the WWTF Upgrade costs (i.e., $40M) is shown as revenue from other towns. Exeter will need to engage Stratham and Newfields to agree upon the capacity allocation, capital cost allocation, O&M cost allocation and other contractual details related to providing wastewater treatment service.

7.3 SEWER USER FEES

The quarterly sewer user rate is currently $4.44 per thousand gallons for the first 29,999 gallons of water used; $5.23 per thousand for use between 30,000 and 194,999 gallons; and $5.62 for use over 194,999 gallons. In addition, all users pay a service charge of $28.00 per meter per quarter. Existing "out of town" sewer users pay sewer user fees including a 15% surcharge as permitted by RSAs. For the purposes of this analysis, we have assumed that sewer user rates will continue to be utilized to pay for debt service and O&M costs.

The current annual sewer fee based on the NHDES criterion of 67,389 gallons per year is $411. The implementation of this project will result in approximately a 172% increase in the total annual wastewater collection and treatment budget. Assuming that customer communities contribute as described above, this project would result in an average annual charge of about $1,060 with no SAG/SAG Plus funds, no SRF principal forgiveness and no contributions from local property taxes.

7.4 INDUSTRIAL PRE-TREATMENT PROGRAM FEES

Sewer users in the Industrial Pre-Treatment Program pay a $100.00 annual Pre-treatment License fee. In addition, industrial users who discharge higher concentrations of biochemical oxygen demand (BOD) or total suspended solids (TSS) than the amounts allowed in the Sewer Use Ordinance pay a surcharge of $17.57 per 100 pounds over the allowable concentrations. Those who discharge excess fats, oil, and grease pay an additional $37.60 per 100 pounds over the allowable concentration. There is no existing surcharge in place for nitrogen or ammonia. The Town may want to review its surcharge rate structure in advance of any WWTF upgrades and determine if there is a need to modify these surcharges.

7.5 OTHER FEES

There are a number of existing and potential "other fees" which could be used to generate revenues for the necessary upgrades. These are presented below.

7.5.1 Existing Fees

Exeter currently has the following additional sewer related fees:

- Sewer Impact Fee - $4.85 per gallon per day for new connections or redevelopment to a more intense use. Flow rate based on 80% of the NH Design Rules WS: 1008.02.
- Sewer Entrance Fee - $300 per connection
- Out of Town Service Surcharge – Usage Charge plus 15% as permitted by RSAs
- Sewer Hook-up Fee - $300.00
- Sewer Repair/Replace Existing Service - $100.00

- Line Repair/Grease Violations – Actual Costs
- Sewer Assessment Fee – $4.85 per Gallon
- Sewer Call-out Fees - $100.00 First Violation; $250.00 Second Violation; $500.00 Third Violation)
- Emergency Sewer Call-out (non-municipal problem) - $190.00

The Town may want to review its rate structure in advance of any WWTF upgrades. For example, the cost of treating biochemical oxygen demand and suspended solids will likely increase substantially with the proposed upgrades. Therefore, the Town should adjust the surcharge fees to those users who discharge pollutants in concentrations that exceed the allowances in the Sewer Use Ordinance to reflect the additional costs.

7.5.2 Potential Future Fees

The Town could consider implementing additional targeted fees, as described below.

- <u>Septage Tipping Fees</u> – The recommended plan includes upgrades to existing septage processing facilities. The Town should establish a septage tipping fee.

- <u>Regional Host Fees</u> – If the Town served as a "host" for regional wastewater treatment and disposal, it could charge "host fees" to the "customer towns". These fees could be a flat fee or a variable fee and would be in addition to the user fees associated with actual flows and loads discharged to the treatment system. Note that the Town does currently charge an additional 15% to individual out of town users. Any additional wastewater flows received from customer towns could result in lower sewer user fees for Exeter users.

- <u>Private Infiltration/Inflow Fees</u> – Private I/I fees could be utilized as a cost-based incentive to have property owners remove private I/I sources from their property (e.g., roof leaders, sump pumps, etc.). If the property owner is unwilling or unable to remove the private I/I source, the Town would receive some additional revenue to account for the additional cost associated with these flows.

- Stormwater Fees – Stormwater fees could be utilized as a method to fund stormwater infrastructure and/or non-point source (NPS) nitrogen which results from stormwater on private property. These fees could be utilized to fund the NPS monitoring, study, tracking/accounting and implementation activities which are required by the AOC.

- Wetland Compensation Bank - If any of the lagoons are restored to flood plains/wetlands for the Squamscott River, a Wetland Compensation Bank (WCB) could be utilized to offset decommissioning costs. Although the NHDES does not presently have WCB regulations in place, they would defer to the EPA and ACOE for guidance. If a WCB were established, the Town of Exeter would be compensated by other project proponents for placing its' wetlands into preservation. Drawbacks to establishing a WCB are that it could take several years for NHDES to consider the wetlands operational and it is unknown if there will be sufficient local projects requiring wetland mitigation.

- Watershed Fees – As noted in Section 7, Exeter is one of 15 communities which contribute nitrogen to the Exeter-Squamscott River watershed. Based on the 2014 GBNNPS completed by NHDES, Exeter accounts for approximately 35% of the delivered load to the watershed. The Town should work with the watershed communities and the State to come up with an equitable methodology to address the allocation of nitrogen removal responsibilities and associated costs.

- Nitrogen Trading – Nitrogen trading is another avenue which is often discussed. The State of Connecticut has developed and implemented a successful point source Nitrogen Trading Program which resulted in significant cost savings while achieving WWTF nitrogen reductions since the baseline year of 2000.

Each of the above fee types has advantages, disadvantages and challenges (e.g., public acceptance, administrative complexity, Town Meeting approval, etc.). Analysis of these factors is beyond the scope of this study but should be considered in greater detail prior to advancing towards implementation.

7.6 LOCAL PROPERTY TAXES

Local property taxes currently are not used to fund any portion of the debt for wastewater facilities. As was noted in Section 7.3, the sewer user fee will significantly increase as a result of this project if user fees are the sole source of revenue for debt repayment. A case can be made to fund a portion of the debt service via local property taxes on the basis of "fairness" (i.e., the Town as a whole benefits from the recommended plan as the sewer system allows for a more densely developed downtown area which generates more commercial activity and more property taxes than would otherwise be possible without this infrastructure). This approach has been successfully utilized in other New Hampshire communities.

Expanding on the argument of fairness, it is important to note that there are additional beneficiaries of this project *who are not residents of the Town of Exeter*. As noted in Section 7.5.2, there are numerous potential approaches to secure contributions from regional beneficiaries; however, many of these approaches have no precedent in New Hampshire.

For the purposes of this analysis, we have assumed no contribution from local property taxes and no contribution from regional sources in **Table 7-1**. *However, the Town should consider utilizing property taxes to pay a portion of the debt and the Town should actively promote a regional discussion on regional funding sources*.

7.7 SEWER FUND

The Town's Sewer Fund had an unassigned balance (not audited) of $2,027,761 as of May 31, 2014. These funds are not reserved for any specific uses (e.g. unexpended contract commitments, collection system maintenance and repair, collection system inflow investigations, GIS mapping, budget shortfalls, etc.). These funds could be used to reduce the amount of project cost that needs to be borrowed or could be retained for future unanticipated costs. The Town is considering whether to utilize these funds to retire some outstanding debt service in 2014 and 2015; which would reduce the unassigned balance available. For the purposes of this analysis, we have assumed that $500,000 of unassigned Sewer Funds would be applied to the project in order to reduce the required borrowing and minimize the financial impact on the ratepayers.

7.8 PROJECT FINANCING SCENARIO

Although there are no grant commitments in place and no guarantees that grant funding will be obtained to help defray the capital cost associated with the recommended facilities, the project financing scenario presented below is believed to be a probable financing plan based on our discussions with the funding agencies as well as our prior experiences. The project financing scenario is presented in **Table 7-1**.

The most favorable means of securing a long-term note will be through the NHDES SRF program. The NHDES SRF rate is currently 3.168%. For the purposes of this analysis, we have assumed that the project costs will be financed through the NHDES SRF program by 20-year loan at *3.25% interest*.

We recommend that the Town begin raising the sewer rates now in order to minimize the immediate impact of such a large rate increase. Doing this will also start generating reserve funds that can be used to reduce any borrowing.

We also recommend that the Town re-evaluate all existing fees (including the impact fees, entrance fees, service charges, usage charges, industrial surcharges, etc.) and consider establishing the potential future fees identified herein (including septage tipping fee, I/I reduction fees, watershed fees, etc).

TABLE 7-1
PROJECT FINANCING SUMMARY

Item	Existing (2014)	With State Aid Grant (2018)	Without State Aid Grant (2018)
Total Project Capital Cost	$0	$51,870,000	$51,870,000
Project Capital Funding			
US Economic Development Administration	$0	$0	$0
State and Tribal Assistance Grant Funds	$0	$0	$0
NHDES Aquatic Resource Mitigation Fund	$0	$300,000	$300,000
Unitil Grant	$0	$50,000	$50,000
Revenue from Sewer Fund (Assumed)	$0	$500,000	$500,000
SRF Loan Amount	$0	$51,020,000	$51,020,000
Total Project Funding	$0	$51,870,000	$51,870,000
Annual Budget			
Existing Debt Service	$731,000	$731,000	$731,000
Total Operating & Maintenance Cost	$1,722,000	$2,419,000	$2,419,000
Project Debt Service	$0	$3,510,000	$3,510,000
Less Reimbursements and Revenues			
SAG Reimbursement (30% of Project)	$0	$1,053,000	$0
SAG Plus Reimbursement (10% of Septage)	$0	$180,000	$0
SRF Principle Forgiveness (15% Allowance)	$0	$0	$383,000
Revenue from Property Taxation	$0	$0	$0
Revenue from Septage Tipping Fees	$0	$50,000	$50,000
Revenue from Industrial Pretreatment Program	$0	$0	$0
Revenue from Regional Sources	$0	$0	$0
Revenue from Customer Communities - Debt	$0	$280,000	$280,000
Revenue from Customer Communities - O&M Initial	$0	$58,000	$58,000
Total Annual Revenue Requirement	$2,453,000	$5,039,000	$5,889,000
Rates			
Average Residential Sewer User Charge	$411	$844	$987
% Increase in Residential Sewer User Fee	-	105%	140%
% of Median Household Income (MHI)	0.6%	1.2%	1.4%

Notes:
1. Assumes SRF loan for 20 years at 3.25% interest rate.
2. Assumes 30% State Aid Grant received annually at time of SRF loan payment.
3. Assumes 10% SAG Plus received annually at time of SRF loan payment. Based on 10% of septage relatec
4. Average residential charge based on NHDES water use criterion of 67,389 gallons per year (90ccf per yeai
5. Exeter median household income $72,231 (2008-2012 American Community Survey 5-year Estimates).
6. Septage revenue assumed at 500,000 gallons per year at $0.10 per gallon.
7. ENR Construction Cost Index 9846 (August 2014).
8. Contribution from customer communities is based on 10% of the WWTF related debt.
9. Contribution from customer communities is based on 5% of WWTF related O&M (flow-based, initial year).

APPENDIX A
Permits and Related Correspondence

DEVINE MILLIMET

ATTORNEYS AT LAW

June 25, 2013

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Michael Wagner, Esq.
USEPA Region 1 – New England
5 Post Office Square
Mail Code: OES
Boston, MA 02109-3912

Re: Town of Exeter -- NPDES Permit No. NH0100871

Dear Mr. Wagner:

We would like to thank you and your colleagues at EPA for working with the Town of Exeter over the last few weeks to finalize an agreed-upon compliance order to address the limit for Total Nitrogen in the Town's Final NPDES Permit. As you fully appreciate, the Town disputes the legal validity of the discharge limit for Total Nitrogen of 3 mg/l and its underlying scientific basis. The Town has, nevertheless, agreed to enter into an Administrative Order on Consent (AOC) as a compromise on the nitrogen limit, and to avoid the cost of a legal challenge on this issue.

In this letter, the Town requests your acknowledgement of and concurrence with the two related issues set forth below.

1. As we have discussed, the Town reserves the right to challenge the underlying basis of EPA's decision in this Permit to require a nitrogen discharge limit of 3 mg/l in (1) other permitting proceedings (*e.g.*, subsequent NPDES permits for its WWTF, and storm water permits, if any), (2) any other EPA enforcement proceedings, and (3) any context or proceeding other than those relating to this AOC.

2. The second issue relates to Section IV. E. 2 of the AOC that allows the Town to submit by the deadline of December 31, 2023 a justification to extend the effective period of the interim limit of 8 mg/l. We seek here EPA's concurrence that the analysis that EPA would undertake, when and if the Town submits such a justification, will likely take into account (1) how well the treatment facility is performing relative to the interim limit set forth in Attachment 1.a, and (2) how quickly the new wastewater treatment facilities were completed and operating, as mitigating factors weighing in favor of extending the effective date of the interim discharge limit set forth in Attachment 1.a (or extending and lowering the interim limit).

Thank you for your consideration of these issues.

Very truly yours,

George Dana Bisbee

GDB:aec

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 1
5 Post Office Square, Suite 100
Boston, MA 02109-3912

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

JUN 24 2013

Mr. Russell Dean
Town Manager
10 Front Street
Exeter, NH 03833

Re: NPDES Permit No. NH0100871
Administrative Order on Consent Docket No. 13-010

Dear Mr. Dean:

Enclosed is the executed Administrative Order on Consent in the matter of the Town of Exeter, New Hampshire.

Sincerely,

Susan Studlien

Susan Studlien, Director
Office of Environmental Stewardship

Enclosure

cc: Attorney Dana Bisbee
Tracy Wood, NHDES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I

IN THE MATTER OF:	)	DOCKET NO. 13-010
	)	
Town of Exeter, New Hampshire NPDES Permit No. NH0100871	))	FINDINGS OF VIOLATION
	)	AND
Proceedings under Sections 308 and 309(a)(3) of the Clean Water Act, as amended, 33 U.S.C. §§ 1318 and 1319(a)(3)	))))	ADMINISTRATIVE ORDER ON CONSENT

I. STATUTORY AUTHORITY

The following FINDINGS are made and ORDER on CONSENT ("Order") issued pursuant to Sections 308(a) and 309(a)(3) of the Clean Water Act, as amended (the "Act"), 33 U.S.C. §§ 1318 and 1319(a)(3). Section 309(a)(3) of the Act grants to the Administrator of the U.S. Environmental Protection Agency ("EPA") the authority to issue orders requiring persons to comply with Sections 301, 302, 306, 307, 308, 318, and 405 of the Act and any permit condition or limitation implementing any of such sections in a National Pollutant Discharge Elimination System ("NPDES") permit issued under Section 402 of the Act, 33 U.S.C. § 1342. Section 308(a) of the Act, 33 U.S.C. § 1318(a), authorizes EPA to require the submission of any information required to carry out the objectives of the Act. These authorities have been delegated to the EPA, Region I Administrator, and in turn, to the Director of the EPA, Region I Office of Environmental Stewardship ("Director").

The Order herein is based on findings of violation of Section 301 of the Act, 33 U.S.C. § 1311, and the conditions of NPDES Permit No. NH0100871 and is issued with the consent of the Town of Exeter, New Hampshire. Pursuant to Section 309(a)(5)(A) of the Act, 33 U.S.C. § 1319(a)(5)(A), the Order provides a schedule for compliance that the Director has determined to be reasonable.

II. DEFINITIONS

Unless otherwise defined herein, terms used in this Order shall have the meaning given to those terms in the Act, 33 U.S.C. § 1251 *et seq.*, the regulations promulgated thereunder, and any applicable NPDES permit. For the purposes of this Order, "NPDES Permit" means the Town of Exeter's NPDES Permit, No. NH0100871, and all amendments or modifications thereto and renewals thereof as are applicable and in effect at the time.

III. FINDINGS

The Director makes the following findings of fact:

1. The Town of Exeter, New Hampshire ("Exeter" or "Town") is a municipality, as defined in Section 502(4) of the Act, 33 U.S.C. § 1362(4), established under the laws of the State of New Hampshire.

2. The Town is a person under Section 502(5) of the Act, 33 U.S.C. § 1362(5). The Town is the owner and operator of a Publicly Owned Treatment Works ("POTW"), which includes a wastewater collection system ("Collection System") and a wastewater treatment facility ("WWTF"), from which pollutants, as defined in Section 502(6) and (12) of the Act, 33 U.S.C. §§ 1362(6) and (12), are discharged to the Squamscott River.

3. The WWTF is a 3.0 million gallons per day ("MGD") secondary treatment facility that serves a population of approximately 10,000.

4. Section 301(a) of the Act, 33 U.S.C. § 1311(a), makes unlawful the discharge of pollutants to waters of the United States except, among other things, in compliance with the terms and conditions of an NPDES permit issued pursuant to Section 402 of the Act, 33 U.S.C. § 1342.

5. On December 12, 2012, the Town was issued the NPDES Permit by EPA under the authority of Section 402 of the Act, 33 U.S.C. § 1342. The NPDES Permit became effective on March 1, 2013 and superseded a permit issued on July 5, 2000. The NPDES Permit expires on March 1, 2018.

6. The NPDES Permit authorizes the Town to discharge pollutants from WWTF Outfall 001, a point source as defined in Section 502(14) of the Act, 33 U.S.C. § 1362(14), to the Squamscott River subject to the effluent limitations, monitoring requirements and other conditions specified in the NPDES Permit.

7. The Squamscott River flows into Great Bay, which drains into the Piscataqua River, which flows into to the Atlantic Ocean. All are waters of the United States under Section 502(7) of the Act, 33 U.S.C. § 1362(7), and the regulations promulgated thereunder.

8. Part I.A.1.a. of the NPDES Permit requires that total nitrogen in the discharges from WWTF Outfall 001 not exceed 3.0 milligrams per liter (mg/l).

9. Nitrogen is a pollutant as defined in Sections 502(6) and (12) of the Act, 33 U.S.C. §§ 1362(6) and (12).

10. The Town routinely discharges effluent from WWTF Outfall 001 containing total nitrogen in excess of 3.0 mg/l.

11. The Town's routine discharges of effluent from WWTF Outfall 001 containing total nitrogen in excess of 3 mg/l occur in violation of the NPDES Permit and Section 301(a) of the Act, 33 U.S.C. § 1311(a).

12. In accordance with Exeter's town charter, the funding for the new wastewater treatment facilities referenced in Section IV.A below must be approved by the Exeter Town Meeting. The Exeter Board of Selectmen will pursue that approval at the earliest possible date.

IV. ORDER

Accordingly, pursuant to Sections 308 and 309(a)(3) of the Act, it is hereby ordered that the Town shall:

A. WASTEWATER TREATMENT FACILITIES

1. By June 30, 2016, in accordance with New Hampshire Department of Environmental Services (NHDES) approval, the Town shall initiate construction of the wastewater treatment facilities necessary to achieve interim effluent limits set forth in Attachment 1.a of this Order.

2. By June 30, 2018, achieve substantial completion of construction of the WWTF in accordance with NHDES approval.

B. INTERIM EFFLUENT LIMITATIONS

1. From the effective date of this Order until the total nitrogen concentration limit included in Attachment 1.a of this Order becomes effective pursuant to Paragraph IV.B.2., below, the Town shall comply with the interim total nitrogen effluent limitations and monitoring requirements contained in Attachment 1 of this Order.

2. By June 30, 2019 or until 12 months after substantial completion of construction pursuant to Paragraph IV.A.2., above, whichever is sooner, the Town shall comply with the interim total nitrogen effluent limit and monitoring requirements contained in Attachment 1.a of this Order.

3. The interim limits in Attachment 1.a shall be in effect unless and until EPA determines that the Town has not complied with the milestones set forth in this Order. If and when EPA determines that the interim limits shall no longer remain in effect, the Town shall fund, design, construct and

operate additional treatment facilities to meet the NPDES Permit limit of 3.0 mg/l as soon as possible, and no later than 5 years from EPA's determination.

4. The Town shall operate the WWTF in a manner so as to maximize removal efficiencies and effluent quality, using all necessary treatment equipment available at the facility for optimization at the flow and load received but not requiring methanol or other carbon addition.

C. REPORTING (WASTEWATER TREATMENT FACILITIES)

1. Until July 15, 2018, the Town shall submit quarterly reports to EPA and the NHDES summarizing its compliance with the provisions of Paragraphs IV.A and IV.B of this Order. Progress reports shall be submitted on, or before, April 15th, July 15th, October 15th, and January 15th of each year. Each progress report submitted pursuant to this paragraph shall: a) describe activities undertaken during the reporting period directed at achieving compliance with this Order; b) identify all plans, reports, and other deliverables required by this Order that have been completed and submitted during the reporting period; and c) describe the expected activities to be taken during the next reporting period in order to achieve compliance with this Order.

D. NON-POINT SOURCE AND STORMWATER POINT SOURCE ACTIVITIES

1. Upon the effective date of this Order, the Town shall begin tracking all activities[1] within the Town that affect the total nitrogen load to the Great Bay Estuary. This includes, but is not limited to, new/modified septic systems, decentralized wastewater treatment facilities, changes to the amount of effective impervious cover, changes to the amount of disconnected impervious cover[2], conversion of existing landscape to lawns/turf and any new or modified Best Management Practices.

2. Upon the effective date of this Order, the Town shall begin coordination with the NHDES, other Great Bay communities, and watershed organizations in NHDES's efforts to develop and utilize a comprehensive subwatershed-based tracking/accounting system for quantifying the total nitrogen

[1] Pertains to activities that the Town should reasonably be aware of, e.g., activities that involve a Town review/approval process or otherwise require a notification to the Town.

[2] Impervious cover includes pavement and buildings.

loading changes associated with all activities within the Town that affect the total nitrogen load to the Great Bay Estuary.

3. Upon the effective date of this Order, the Town shall begin coordination with the NHDES to develop a subwatershed community-based total nitrogen allocation.

4. By September 30, 2018, submit to EPA and the NHDES a total nitrogen non-point source and point source stormwater control plan ("Nitrogen Control Plan"), including a schedule of at least five years for implementing specific control measures as allowed by state law to address identified non-point source and stormwater Nitrogen loadings in the Town of Exeter that contribute total nitrogen to the Great Bay estuary, including the Squamscott River. If any category of de-minimis non-point source loadings identified in the tracking and accounting program are not included in the Nitrogen Control Plan, the Town shall include in the Plan an explanation of any such exclusions. The Nitrogen Control Plan shall be implemented in accordance with the schedules contained therein.

E. REPORTING

1. Beginning January 31, 2014 and annually thereafter, the Town shall submit Total Nitrogen Control Plan Progress Reports to EPA and the NHDES that address the following:
   a. The pounds of total nitrogen discharged from the WWTF during the previous calendar year;
   b. A description of the WWTF operational changes that were implemented during the previous calendar year;
   c. The status of the development of a total nitrogen non-point source and storm water point source accounting system;
   d. The status of the development of the non-point source and storm water point source Nitrogen Control Plan,
   e. A description and accounting of the activities conducted by the Town as part of its Nitrogen Control Plan; and
   f. A description of all activities within the Town during the previous year that affect the total nitrogen load to the Great Bay Estuary. The annual report shall include sufficient information such that the nitrogen loading change to the watershed associated with these

activities can be quantified upon development of the non-point source/point source storm water accounting system.

2. By December 31, 2023, the Town shall submit an engineering evaluation that includes recommendations for the implementation of any additional measures necessary to achieve compliance with the NPDES Permit, or a justification for leaving the interim discharge limit set forth in Attachment 1.a in place (or lower the interim limit to a level below 8.0 mg/l but still above 3.0 mg/l) beyond that date. Such justification shall analyze whether:
   a. Total nitrogen concentrations in the Squamscott River and downstream waters are trending towards nitrogen targets;[3]
   b. Significant improvements in dissolved oxygen, chlorophyll a, and macroalgae levels have been documented; and
   c. Non-point source and storm water point source reductions achieved are trending towards allocation targets and appropriate mechanisms are in place to ensure continued progress.

V. NOTIFICATION PROCEDURES

1. Where this Order requires a specific action to be performed within a certain time frame, the Town shall submit a written notice of compliance or noncompliance with each deadline. Notification must be mailed within fourteen (14) calendar days after each required deadline. The timely submission of a required report shall satisfy the requirement that a notice of compliance be submitted.
2. If noncompliance is reported, notification shall include the following information:
   a. A description of the noncompliance.
   b. A description of any actions taken or proposed by the Town to comply with the lapsed schedule requirements.
   c. A description of any factors that explain or mitigate the noncompliance.
   d. An approximate date by which the Town will perform the required action.
3. After a notification of noncompliance has been filed, compliance with the past-due requirement shall be reported by submitting any required documents or providing EPA and NHDES with a written report indicating that the required action has been achieved.

[3] The Town shall account for precipitation in the trend analysis and baseline measurement.

4. Submissions required by this Order shall be in writing and shall be mailed to the following addresses:

United States Environmental Protection Agency
Region I – New England
5 Post Office Square - Suite 100
Boston, MA 02109-3912
Attn: Joy Hilton, Water Technical Unit (Mail Code: OES04-3)

New Hampshire Department of Environmental Services
Water Division
Wastewater Engineering Bureau
P.O. Box 95 - 29 Hazen Drive
Concord, NH 03302-0095
Attn: Tracy L. Wood, P.E.

VI. GENERAL PROVISIONS

1. The Town may, if it desires, assert a business confidentiality claim covering part or all of the information requested, in the manner described by 40 C.F.R. § 2.203(b). Information covered by such a claim will be disclosed by EPA only to the extent set forth in 40 C.F.R. Part 2, Subpart B. If no such claim accompanies the information when it is received by EPA, the information may be made available to the public by EPA without further notice to the Town. The Town should carefully read the above-cited regulations before asserting a business confidentiality claim since certain categories of information are not properly the subject of such a claim. For example, the Act provides that "effluent data" shall in all cases be made available to the public. See Section 308(b) of the Act, 33 U.S.C. § 1318(b).
2. This Order does not constitute a waiver or a modification of the terms and conditions of the NPDES Permit. The NPDES Permit remains in full force and effect. EPA reserves the right to seek any and all remedies available under Section 309 of the Act, 33 U.S.C. § 1319, as amended, for any violation cited in this Order.
3. The Town waives any and all claims for relief and otherwise available rights or remedies to judicial or administrative review which the Town may have with respect to any issue of fact or law set forth in this Order on Consent, including, but not limited to, any right of judicial review of the Section 309(a)(3) Compliance Order on Consent under the Administrative Procedure Act, 5 U.S.C. §§ 701-708.

4. This Order shall become effective upon receipt by the Town.

06/20/13
Date

Susan Studlien
Susan Studlien, Director
Office of Environmental Stewardship
U.S. Environmental Protection Agency, Region I

6/11/13
Date

Russell
Russell Dean, Town Manager
Town of Exeter, New Hampshire

ATTACHMENT 1

Interim Effluent Limits and Monitoring Requirements

	Mass		Concentration			
	Average Monthly (lbs/day)	Daily Maximum (lbs/day)	Average Monthly (mg/l)	Daily Maximum (mg/l)	Frequency	Type
Total Nitrogen[1]	Report	Report	Report	Report	1/Week	24-hour composite

[1] Total Nitrogen shall be calculated by adding the total kjeldahl nitrogen (TKN) to the total nitrate (NO_3-N) and nitrite (NO_2-N).

ATTACHMENT 1.a.

Interim Effluent Limits and Monitoring Requirements

	Mass		Concentration			
	Average Monthly (lbs/day)	Daily Maximum (lbs/day)	Average Monthly (mg/l)	Daily Maximum (mg/l)	Frequency	Type
Total Nitrogen[1] November 1st through March 31st	Report	Report	Report	Report	1/Week	24-hour composite
Total Nitrogen[1] April 1st through October 31st	Report	Report	8 mg/l[2]	Report	1/Week	24-hour composite

[1] Total Nitrogen shall be calculated by adding the total kjeldahl nitrogen (TKN) to the total nitrate (NO_3-N) and nitrite (NO_2-N). The permittee shall optimize the operation of the treatment facility for the removal of total nitrogen during the period but not requiring methanol or other carbon addition.

[2] Calculated on a 214 day seasonal rolling average.

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCAHRGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Clean Water Act, as amended, (33 U.S.C. §1251 et seq.; the "CWA"),

The Town of Exeter, New Hampshire

is authorized to discharge from the Town of Exeter Wastewater Treatment Plant located at

13 Newfields Road
Exeter, New Hampshire 03833

to the receiving water named:

Squamscott River (Hydrologic Basin Code: 01060003)

in accordance with the effluent limitations, monitoring requirements, and other conditions set forth herein.

The permit will become effective on the first day of the calendar month immediately following sixty days after signature.

This permit and the authorization to discharge expire at midnight, five (5) years from the effective date.

This permit supersedes the permit issued on July 5, 2000.

This permit consists of 18 pages in Part I including effluent limitations, monitoring requirements, etc., Attachments A (Marine Acute Toxicity Test Procedure and Protocol dated July 2012)**,** Attachment B (List of Combined Sewer Overflows), Sludge Compliance Guidance, and Part II including General Conditions and Definitions.

Signed this 12th day of December, 2012.

/S/ SIGNATURE ON FILE

Stephen S. Perkins, Director
Office of Ecosystem Protection
U.S. Environmental Protection Agency
Region I
Boston, Massachusetts

PART I.A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date and lasting through the expiration date, the permittee is authorized to discharge treated domestic and industrial wastewater from Outfall Serial Number 001 to the Squamscott River. Such discharges shall be limited and monitored by the permittee as specified below. Samples taken in compliance with the monitoring requirements specified below shall be taken at the end of all processes, including disinfection, or at an alternative representative location approved by the EPA and NHDES-WD.

Effluent Parameter	Effluent Limit			Monitoring Requirement	
	Average Monthly	Average Weekly	Maximum Daily	Frequency	Sample Type
Flow, MGD	Report	---	Report	Continuous	Recorder[1]
BOD_5; mg/l (lb/d)	30 (751)	45 (1126)	50 (1251)	2/Week[2]	Grab[13]
TSS; mg/l (lb/d)	30 (751)	45 (1126)	50 (1251)	2/Week[2]	Grab[13]
pH Range[3]; Standard Units	6.0 to 9.0 (See Section I.H.5.)			1/Day	Grab[13]
Fecal Coliform[3,4]; Colonies/100 ml	14	---	Report	1/Day	Grab
Fecal Coliform[3,4]; percent	---	---	Report	1/Day	Grab
Enterococci Bacteria[3,5]; Colonies/100ml	Report	---	Report	2/Week	Grab
Total Residual Chlorine[6]; mg/l	0.19	---	0.33	2/Day	Grab
Total Nitrogen[7] mg/l (lb/d) Applicable November 1 – March 31	Report	---	---	1/Week	Grab[13]
Total Nitrogen[7,8], mg/l (lb/d) Applicable April 1 – October 31	3.0 (75)	---	---	1/Week	Grab[13]
Whole Effluent Toxicity					
LC50[9,10,12]; Percent Effluent	---	---	100	2/Year	Grab[13]
Ammonia Nitrogen as N[11]; mg/l	---	---	Report	2/Year	Grab[13]
Total Recoverable Aluminum[11]; mg/l	---	---	Report	2/Year	Grab[13]
Total Recoverable Cadmium[11]; mg/l	---	---	Report	2/Year	Grab[13]
Total Recoverable Chromium[11]; mg/l	---	---	Report	2/Year	Grab[13]
Total Recoverable Copper[11]; mg/l	---	---	Report	2/Year	Grab[13]
Total Recoverable Lead[11]; mg/l	---	---	Report	2/Year	Grab[13]
Total Recoverable Nickel[11]; mg/l	---	---	Report	2/Year	Grab[13]
Total Recoverable Zinc[11]; mg/l	---	---	Report	2/Year	Grab[13]

* **SEE PAGES 4 AND 5 FOR FOOTNOTES.**

PART I.A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

2. During the period beginning on the effective date of this permit and lasting through the expiration date, the permittee is authorized to discharge stormwater and wastewaters from Combined Sewer Outfall Number 003 into Clemson Pond. These discharges are authorized only during wet weather. Such discharges shall be limited to the outfall listed, and shall be monitored by the permittee as specified below. Samples specified below shall be taken at a location that provides a representative analysis of the effluent.

Effluent Characteristic	**Discharge Limitation**	**Monitoring Requirement**	
	Wet Weather Event Maximum	**Measurement Frequency**	**Sample Type**
Escherichia coli Bacteria[3, 5, 14] (colonies/100 ml)	1000	1/Year	Grab

EXPLANATION OF FOOTNOTES APPLICABLE TO PART I.A.1 on page 2

1. The effluent flow shall be continuously measured and recorded using a flow meter and totalizer.

2. Influent concentrations of both BOD_5 and TSS shall be monitored two (2) days per month.

3. State certification requirement.

4. Fecal coliform shall be tested using an EPA approved test method (see 40 C.F.R. Part 136).

   The average monthly value for fecal coliform shall be determined by calculating the geometric mean using the daily sample results. Not more than 10 percent of the collected samples shall exceed a most probable number (MPN) of 43 per 100 ml for a 5-tube decimal dilution test. Furthermore, all fecal coliform data collected must be submitted with the monthly discharge monitoring reports (DMRs).

   The permittee is required to report two (2) statistics each month. One is the geometric mean fecal coliform value expressed in terms of "MPN per 100 ml" (reported as average monthly), and the second is the percentage of collected samples each month that exceeds an MPN of 43 per 100 ml for the 5-tube decimal dilution test referenced above. The latter statistic will be used to judge compliance with that part of the limit that reads "Not more than 10 percent of the collected samples shall exceed a most probably number (MPN) of 43 per 100 ml for a 5-tube decimal dilution test."

5. Enterococci and Escherichia coli bacteria shall be tested using an EPA approved test method (see 40 C.F.R. Part 136).

6. Total Residual Chlorine shall be tested using an EPA approved test method (see 40 C.F.R. Part 136). The method chosen to test total residual chlorine shall have a minimum level of detection of at least the total chlorine residual permit limit specified on page 2 of the permit.

7. Total nitrogen shall be calculated by adding the total kjeldahl nitrogen (TKN) to the total nitrate (NO_3) and nitrite (NO_2).

   The permittee shall report the monthly average mass and concentration each month.

8. The nitrogen limit is a rolling seasonal average limit, which is effective from April 1 – October 31 of each year. The first value for the seasonal average will be reported after an entire April through October period has elapsed following the effective date of the permit (results do not have to be from the same year). For example, if the permit becomes effective on May 1, 2013, the permittee will calculate the first seasonal average from samples collected during the months of May through October 2013 and April 2014, and report this average on the April 2014 DMR. For each subsequent month that the seasonal limit is in effect, the seasonal average shall be calculated using samples from that month and the previous six months that the limit was in effect.

The permittee shall optimize the operation of the treatment facility for the removal of total nitrogen during the period November 1 through March 31. All available treatment equipment in place at the facility shall be operated unless equal or better performance can be achieved in a reduced operational mode. The addition of a carbon source that may be necessary in order to meet the total nitrogen limit from April 1 through October 31 is not required during the period November 1 through March 31.

9. The permittee shall conduct acute toxicity tests on effluent samples using two species, mysid shrimp (*Mysidopsis bahia*) and inland silverside (*Menidia beryllina*), following the protocol in Attachment A (Marine Acute Toxicity Test Procedure and Protocol dated July 2012). Toxicity testing shall be performed two (2) times each year during the first quarter (January 1 – March 31) and third quarter (July 1 – September 30) of each year. Toxicity test results are to be submitted by the 15th day of the month following the end of the quarter sampled.

10. LC50 is defined as the percent of effluent (treated wastewater) that causes mortality to 50 percent of the test organisms. The permit limit of 100 percent is defined as a sample composed of 100 percent effluent.

11. For each whole effluent toxicity test the permittee shall report on the appropriate discharge monitoring report (DMR) the concentrations of ammonia nitrogen as nitrogen and total recoverable aluminum, cadmium, copper, chromium, lead, nickel, and zinc found in the 100 percent effluent sample. All these aforementioned chemical parameters shall be determined to at least the minimum quantification level (ML) show in Attachment A or as amended.

12. The permit shall be modified, or alternatively revoked and reissued, to incorporate additional toxicity testing requirements, including chemical specific limits, if the results of the toxicity tests indicate the discharge causes an exceedance of any State water quality criterion. Results from these toxicity tests are considered "New Information" and the permit may be modified as provided in 40 C.F.R. § 122.62(a)(2).

13. If the treatment plant is upgraded during the life of this permit to a treatment process that does not utilize lagoon treatment as the primary treatment technology, the effluent sample type shall change to a 24 hour composite sample upon completion of the upgrade.

14. The permittee shall sample the discharge from the combined sewer outfall listed in Attachment B at least once per year. All attempts must be made to begin sampling during the first one half hour after the outfall starts discharging. When this is not possible, a sample shall be collected as soon as possible after the beginning of the outfall starting to discharge. The "event maximum" value for Escherichia coli shall be reported on the appropriate DMR for the month sampled. Report a no discharge code of "E" (analysis not conducted) on the DMR for <u>all other months</u>.

    The permittee shall also perform CSO and receiving water sampling as described in Part I.F.3. below.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIRMENTS (Continued)

3. The discharge shall not cause a violation of the water quality standards of the receiving water.

4. The discharge shall be adequately treated to ensure that the surface water remains free from pollutants in concentrations or combinations that settle to form harmful deposits, float as foam, debris, scum, or other visible pollutants. It shall be adequately treated to ensure that the surface waters remain free from pollutants which produce odor, color, taste, or turbidity in the receiving waters which is not naturally occurring and would render it unsuitable for its designated uses.

5. The permittee's treatment facility shall maintain a minimum of 70 percent removal for BOD_5 and 65 percent for TSS. The percent removal shall be calculated based on average monthly influent and effluent concentrations. If the treatment plant is upgraded during the life of this permit to treatment process that does not utilize lagoon treatment as the primary treatment technology, the facility shall maintain a minimum of 85 percent removal for BOD_5 and TSS upon completion of the upgrade.

6. When the effluent discharged for a period of three consecutive months exceeds 80 percent of the 3.0 mgd design flow, 2.4 mgd, the permittee shall submit to the permitting authorities a projection of loadings up to the time when the design capacity of the treatment facility will be reached and a program for maintaining satisfactory treatment levels consistent with approved water quality management plans. Before the design flow will be reached, or whenever the treatment necessary to achieve permit limits cannot be assured, the permittee may be required to submit plans for facility improvements.

7. All publicly owned treatment works (POTWs) must provide adequate notice to both EPA-New England and the New Hampshire Department of Environmental Services – Water Division (NHDES-WD) of the following:

    a. Any new introduction of pollutants into the POTW from an indirect discharger in a primary industrial category (see 40 C.F.R. §122 Appendix A as amended) discharging process water;

    b. Any substantial change in the volume or character of pollutants being introduced into the POTW by a source introducing pollutants into the POTW at the time of issuance of the permit; and

    c. For the purpose of this paragraph, adequate notice shall include information on:

        i. The quantity and quality of effluent introduced into the POTW; and

        ii. Any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW

8. The permittee shall not discharge into the receiving waters any pollutant or combination of pollutants in toxic amounts.

B. UNAUTHORIZED DISCHARGES

The permit only authorizes discharges in accordance with the terms and conditions of this permit and only from the outfalls listed in Part 1.A.1 and Part 1.A.2 (see Attachment B) of this permit. Discharges of wastewater from any other point source are not authorized under this permit. Dry weather overflows are prohibited. All dry weather sanitary and/or industrial discharges from any CSO must be reported to EPA-New England and the State within 24 hours in accordance with the reporting requirements for plant bypass (see Paragraph D.1.e. of Part II of this permit).

C. OPERATION AND MAINTENANCE OF THE SEWER SYSTEM

Operation and maintenance of the sewer system shall be in compliance with the General Requirements of Part II and the following terms and conditions. The permittee is required to complete the following activities on its collection system:

1. Maintenance Staff

   The permittee shall provide an adequate staff to carry out the operation, maintenance, repair, and testing functions required to ensure compliance with the terms and conditions of this permit.

2. Preventative Maintenance Program

   The permittee shall maintain an ongoing preventative maintenance program to prevent overflows and bypasses caused by malfunctions or failures of the sewer system infrastructure. The program shall include an inspection program designed to identify all potential and actual unauthorized discharges.

3. Infiltration/Inflow

   The permittee shall control infiltration and inflow (I/I) into the sewer system as necessary to prevent high flow related unauthorized discharges from their collection systems and high flow related violations of the wastewater treatment plant's effluent limitations.

4. Collection System Mapping

Within 30 months of the effective date of the permit, the permittee shall prepare a map of the sewer collection system it owns. The map shall be on a street map of the community, with sufficient detail and at a scale to allow easy interpretation. The collection system information shown on the map shall be based on current conditions. Such map(s) shall include, but not be limited to the following:

   a. All sanitary sewer lines and related manholes;

b. All combined sewer lines and related manholes;
c. All combined sewer regulators and any known or suspected connections between the sanitary sewer and storm drain system (e.g. combined manholes);
d. All outfalls, including the treatment plant outfall(s), CSOs, combined manholes, and any known or suspected SSOs;
e. All pump stations and force mains;
f. The wastewater treatment facility(ies);
g. All surface waters (labeled);
h. Other major appurtenances such as inverted siphons and air release valves;
i. A numbering system which uniquely identifies overflow points, regulators and outfalls;
j. The scale and a north arrow; and
k. The pipe diameter, age and type of pipe, the length of pipe between manholes, the direction of flow, and the pipe rim and invert elevations.

5. Collection System O&M Plan

The permittee shall develop and implement a collection system operation and maintenance plan. The plan shall be submitted to EPA and NHDES **within six months of the effective date of this permit** (see page 1 of this permit for the effective date). The plan shall describe the permittee's programs for preventing I/I related effluent limit violations and all unauthorized discharges of wastewater, including overflows and by-passes.

The plan shall include:

a. A description of the overall condition of the collection system including a list of recent studies and construction activities;
b. A preventative maintenance and monitoring program for the collection system;
c. Recommended staffing to properly operate and maintain the sanitary sewer collection system;
d. The necessary funding level and the source(s) of funding for implementing the plan;
e. Identification of known and suspected overflows, including combined manholes. A description of the cause of the identified overflows, and a plan for addressing the overflows consistent with the requirements of this permit;
f. An ongoing program to identify and remove sources of I/I. The program shall include an inflow identification and control program that focuses on the disconnection and redirection of illegal sump pumps and roof down spouts; and
g. An educational public outreach program for all aspects of I/I control, particularly private inflow.

For each of the above activities that are not completed and implemented as of the submittal date, the plan shall provide a schedule for its completion.

D. ALTERNATE POWER SOURCE

In order to maintain compliance with the terms and conditions of this permit, the permittee shall provide an alternate power source with which to sufficiently operate the publicly owned treatment works, as defined at 40 C.F.R. § 122.2, which references the definition at 40 C.F.R. § 403.3(o).

E. SLUDGE CONDITIONS

1. The permittee shall comply with all existing Federal and State laws and regulations that apply to sewage sludge use and disposal practices and with the Clean Water Act (CWA) Section 405(d) technical standards.

2. The permittee shall comply with the more stringent of either State (Env-Wq 800) or Federal (40 C.F.R. Part 503) requirements.

3. The technical standards (Part 503 regulations) apply to facilities which perform one or more of the following use or disposal practices.

    a. Land Application – The use of sewage sludge to condition or fertilize the soil.
    b. Surface Disposal – The placement of sewage sludge in a sludge only landfill.
    c. Fired in a sewage sludge incinerator.

4. The 40 C.F.R. Part 503 conditions do not apply to facilities that place sludge within a municipal solid waste landfill (MSWLF). Part 503 relies on 40 C.F.R. Part 258 criteria, which regulates landfill disposal, for sewage sludge disposed of in a MSWLF. These conditions also do not apply to facilities which do not dispose of sewage sludge during the life of the permit, but rather treat the sludge (lagoon, reed beds), or are otherwise excluded under 40 C.F.R. Part 503.6.

5. The permittee shall use and comply with the attached Sludge Compliance Guidance document to determine appropriate conditions. Appropriate conditions contain the following items:

    a. General Requirements
    b. Pollutant Limitations
    c. Operational Standards (pathogen reduction and vector attraction reductions requirements)
    d. Management Practices
    e. Record Keeping
    f. Monitoring
    g. Reporting

    Depending on the quality of material produced by a facility all conditions may not apply to the facility.

6. If the sludge disposal method requires monitoring, the permittee shall monitor the pollutant concentrations, pathogen reduction, and vector attraction reduction at the following frequency. The frequency is based upon the volume of sewage sludge generated at the facility in dry metric tons per year.

   a. Less than 290.......................................1/Year
   b. 290 to less than 1,500.............................1/Quarter
   c. 1,500 to less than 15,000..........................6/Year
   d. 15,000 plus...1/Month

7. The permittee shall perform all required sewage sludge sampling using the procedures detailed in 40 C.F.R. Part 503.8.

8. When the permittee is responsible for an annual report containing the information specified in the regulations, the report shall be submitted by February 19th of each year. Reports shall be submitted to the address contained in the reporting section of the permit.

9. Sludge monitoring is not required by the permittee when the permittee is not responsible for the ultimate sludge use or disposal or when the sludge is disposed of in a MSWLF. The permittee must be assured that any third party contractor is in compliance with appropriate regulatory requirements. In such cases, the permittee is required only to submit an annual report by February 19th of each year containing the following information:

   a. Name and address of the contractor responsible for sludge use and disposal.
   b. Quantity of sludge in dry metric tons removed from the facility.

   Reports shall be submitted to the address contained in the reporting section of the permit.

F. COMBINED SEWER OVERFLOW CONDITIONS

1. Effluent Limitations

   a. During wet-weather periods, the permittee is authorized to discharge stormwater/wastewater from combined sewer overflows (CSOs) to receiving water (see Attachment B), subject to the following effluent limitations

      i. The discharges may not cause or contribute to violations of Federal or State water quality standards.

      ii. The discharges shall receive treatment at a level providing Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT) to control and abate conventional pollutants and Best Available Technology Economically Achievable (BAT) to control and abate non-conventional and toxic pollutants. EPA-New England has made a Best Professional Judgment

(BPJ) determination that BPT, BCT, and BAT for CSOs include the implementation of the nine Minimum Technology Based Limitations (MTBLs) specified below otherwise known as Nine Minimum Controls (NMC):

1. Proper operation and regular maintenance programs for the sewer system and the combined sewer overflow points;

2. Maximum use of the collection system for storage;

3. Review and modification of industrial pretreatment program requirements to assure CSO impacts are minimized;

4. Maximization of flow to the POTW for treatment;

5. Prohibition of dry weather overflows from CSOs;

6. Control of solid and floatable materials in CSO discharges;

7. Pollution prevention programs that focus on contaminant reduction activities;

8. Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts; and

9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls.

iii. Implementation of these nine minimum controls is required by the effective date of this permit. The permittee shall implement these controls in accordance with Part I.F.2 of this permit. Within one year from permit issuance, the permittee shall submit to EPA and NHDES-WD a report titled "Report on Nine Minimum Control Measures". This document must include a detailed analysis of specific activities the permittee has undertaken and will undertake to implement the nine minimum controls and additional controls beyond the nine minimum controls the permittee can feasibly implement. The specific activities included in the documentation must include the minimum requirements set forth in Part I.F.2 of the permit and additional activities the permittee can reasonably undertake.

2. Nine Minimum Controls – Minimum Implementation Levels

a. The Permittee must implement the nine minimum controls in accordance with their nine minimum controls documentation and with any revisions to that documentation that may be required. This implementation must include the following controls plus other controls the permittee can feasibly implement as set forth in the documentation.

b. Each CSO structure/regulator, pumping station and/or tidegate shall be routinely inspected, at a minimum of once per month, to insure that they are in good working condition and adjusted to minimize combined sewer discharges and tidal surcharging (Nine Minimum Control Numbers 1, 2, and 4). The following inspection results shall be recorded: date and time of the inspection, the general condition of the facility, and whether the facility is operating satisfactorily. If maintenance is necessary, the permittee shall record: the description of the necessary maintenance, the date the necessary maintenance was performed, and whether the observed problem was corrected. The permittee shall maintain all records of inspections for at least three years.

   Annually, not later than January 15th, the permittee shall submit a certification to EPA and the NHDES-WD which states that the previous calendar year's monthly inspections were conducted, results recorded, and records maintained.

   EPA and the NHDES-WD have the right to inspect any CSO related structure or outfall at any time without prior notification to the permittee

c. Discharges to the combined system of septage, holding tank wastes, or other material which may cause a visible sheen or containing floatable material are prohibited during wet weather when CSO discharge may be active (Nine Minimum Control Numbers 3, 6, and 7).

d. Dry weather overflows are prohibited (Nine Minimum Control Number 5). All dry weather sanitary and/or industrial discharges from CSOs must be reported to EPA and the NHDES-WD within 24 hours in accordance with the reporting requirements for plant bypass (paragraph D.1.e of Part II of this permit).

e. The permittee shall quantify and record all discharges from combined sewer outfalls (Nine Minimum Control Number 9). Quantification may be through direct measurement or estimation. When estimating, the permittee shall make reasonable efforts (i.e. gaging, measurement) to verify the validity of the estimation technique. The following information must be recorded for each combined sewer outfall for each discharge event:

   - Estimated duration (hours) of discharge;
   - Estimated volume (gallons) of discharge: and
   - National Weather Service precipitation data from the nearest gage where precipitation is available at daily (24-hour) intervals and the nearest gage where precipitation is available at one-hour intervals. Cumulative precipitation per discharge event shall be calculated.

The permittee shall maintain all records of discharges for at least six years after the effective date of this permit.

Annually, no later than January 15th, and in conjunction with the requirement in Part I.F.2.b. of this permit, the permittee shall submit a certification to EPA and the NHDES-WD which states that all discharges were recorded and records maintained for the previous calendar year.

f. The permittee shall install and maintain identification signs for all combined sewer outfall structures (Nine Minimum Control Number 8). The signs must be located at or near the combined sewer outfall structures and easily readable by the public. These signs shall be a minimum of 12 x 18 inches in size, with white lettering against a green background, and shall contain the following information:

TOWN OF EXETER
WET WEATHER
SEWAGE DISCHARGE
OUTFALL #

g. The permittee shall provide immediate notification to the NHDES-WD in the event of a CSO discharge.

h. The permittee shall provide notification to the public of CSO discharges and impacts on recreational uses of Clemson Pond and, if necessary, the Squamscott River.

3. CSO and Clemson Pond Monitoring

During the first full calendar year of the permit, the permittee shall perform sampling on the CSO inflow to Clemson Pond and at the outlet of Clemson Pond once per quarter. The permittee shall use NHDES Shellfish Monitoring Program stations to perform these samples. Influent samples to Clemson Pond shall be collected at Shellfish Monitoring Station SQMPS009 (42^{o} 59’ 4.92” N, 70^{o} 56’ 55.2” W). Samples at the outlet of Clemson Pond shall be collected just inside the tide gate and Shellfish Monitoring Station SQMPS010 (42^{o} 59’ 12.9” N, 70^{o} 57’ 1.98” W).

This sampling shall be performed once per quarter for a CSO event of at least 40,000 gallons. Samples shall be taken at each sampling station, SQMPS009 and SQMPS010 twice per day (2/day) for three (3) consecutive days. The first samples shall be collected as soon as practicable after the start of the CSO discharge.

Each sample collected shall be tested for Fecal Coliform Bacteria (MPN – 5 tube test), Enterococci Bacteria, salinity, and temperature.

At the end of the one year sampling period, the permittee shall submit the monitoring results to EPA and the NHDES by January 15th of the following year. If the monitoring data reveals the need to add additional limits or conditions the permit may be modified or alternatively revoked and reissued.

G. MONITORING AND REPORTING

Monitoring results shall be summarized for each calendar month and reported on separate Discharge Monitoring Report Form(s) (DMRs) postmarked no later than the 15th day of the month following the completed reporting period.

Signed and dated original DMRs and all other reports or notifications required herein or in Part II shall be submitted to the Director at the following address:

U.S. Environmental Protection Agency
Water Technical Unit (SMR-04)
5 Post Office Square - Suite 100
Boston, MA 02109-3912

Duplicate signed copies (original signature) of all written reports or notifications required herein or in Part II shall be submitted to the State at:

New Hampshire Department of Environmental Services (NHDES)
Water Division
Wastewater Engineering Bureau
29 Hazen Drive, P.O. Box 95
Concord, New Hampshire 03302-0095

All verbal reports or notifications shall be made to both EPA and NHDES.

H. STATE PERMIT CONDITIONS

1. The permittee shall not at any time, either alone or in conjunction with any person or persons, cause directly or indirectly the discharge of waste into the said receiving water unless it has been treated in such a manner as will not lower the legislated water quality classification or interfere with the uses assigned to said water by the New Hampshire Legislature (RSA 485-A:12).

2. This NPDES Discharge Permit is issued by EPA under Federal and State law. Upon final issuance by EPA, the New Hampshire Department of Environmental Services-Water Division (NHDES-WD) may adopt this permit, including all terms and conditions, as a State permit pursuant to RSA 485-A:13.

3. EPA shall have the right to enforce the terms and conditions of this Permit pursuant to federal law and NHDES-WD shall have the right to enforce the Permit pursuant to state law, if the Permit is adopted. Any modification, suspension or revocation of this Permit shall be effective only with respect to the Agency taking such action, and shall not affect the validity or status of the Permit as issued by the other Agency.

4. Pursuant to New Hampshire Statute RSA 485-A:13,I(c), any person responsible for a bypass or upset at a wastewater treatment facility shall give immediate notice of a bypass or upset to all public or privately owned water systems drawing water from the same receiving water and located within 20 miles downstream of the point of discharge regardless of whether or not it is on the same receiving water or on another surface water to which the receiving water is a tributary. The permittee shall maintain a list of persons, and their telephone numbers, who are to be notified immediately by telephone. In addition, written notification, which shall be postmarked within 3 days of the bypass or upset, shall be sent to such persons.

5. The pH range of 6.5 to 8.0 Standard Units (S.U.) must be achieved in the final effluent unless the permittee can demonstrate to NHDES-WD: (1) that the range should be widened due to naturally occurring conditions in the receiving water or (2) that the naturally occurring receiving water pH is not significantly altered by the permittee's discharge. The scope of any demonstration project must receive prior approval from NHDES-WD. In no case, shall the above procedure result in pH limits outside the range of 6.0 – 9.0 S.U., which is the federal effluent limitation guideline regulation for pH for secondary treatment and is found in 40 CFR 133.102(c).

6. Pursuant to New Hampshire Code of Administrative Rules, Env-Wq 703.07(a):

   (a) Any person proposing to construct or modify any of the following shall submit an application for a sewer connection permit to the department:

      (1) Any extension of a collector or interceptor, whether public or private, regardless of flow;

      (2) Any wastewater connection or other discharge in excess of 5,000 gpd;

      (3) Any wastewater connection or other discharge to a WWTP operating in excess of 80 percent design flow capacity based on actual average flow for 3 consecutive months;

      (4) Any industrial wastewater connection or change in existing discharge of industrial wastewater, regardless of quality or quantity; and

      (5) Any sewage pumping station greater than 50 gpm or serving more than one building.

7. For each new or increased discharge of industrial waste to the POTW, the permittee shall submit, in accordance with Env-Ws 904.14(e) an "Industrial Wastewater Discharge Request Application" approved by the permittee in accordance with 904.13(a). The "Industrial Wastewater Discharge Request Application" shall be prepared in accordance with Env-Ws 904.10.

8. Pursuant to Env-Ws 904.17, at a frequency no less than every five years, permittees are required to submit:

a. A copy of its current sewer use ordinance. The sewer use ordinance shall include local limits pursuant to Env-Ws 904.04 (a).

b. A current list of all significant indirect discharges to the POTW. As a minimum, the list shall include for each industry, its name and address, the name and daytime telephone number of a contact person, products manufactured, industrial processes used, existing pretreatment processes, and discharge permit status.

c. A list of all permitted indirect dischargers; and

d. A certification that the municipality is strictly enforcing its sewer use ordinance and all discharge permits it has issued.

9. If chlorine is used for disinfection, a recorder which continuously records the chlorine residual prior to dechlorination shall be provided. The minimum, maximum and average daily residual chlorine values, measured prior to dechlorination, shall be submitted with monthly Discharge Monitoring Reports. Charts from the recorder, showing the continuous chlorine residual shall be maintained by the permittee for a period no less than (5) years.

10. The Exeter Public Works Department/Wastewater Treatment Facility is responsible for immediately notifying the New Hampshire Department of Environmental Services, Watershed Management Bureau, Shellfish Section of possible high bacteria/virus loading events from the facility or its sewage collection infrastructure. Such events include:

a. Any lapse or interruption of normal operation of the Wastewater Treatment Plant's disinfection system, or other event that results in the discharge of sewage from the Wastewater Treatment Plant or sewer infrastructure (pump stations, manholes, combined sewer overflows, etc.) that has not undergone full treatment as specified in the NPDES permit, or

b. Daily flows in excess of the 3.0 MGD design flow for the facility, or

c. Daily post-disinfection effluent sample result of 43 fecal coliform/100ml or greater. Notification shall also be made for instances where NPDES-related bacteria sampling is not completed, or where the results of such sampling are invalid.

"Immediate" notification with respect to reporting daily post-disinfection effluent sample results shall mean "as soon as the laboratory tests are completed".

The notification requirement also applies to all incidents of combined sewer overflow discharges. Notification to the NHDES Shellfish Program shall be made using the program's 24-hour pager. Upon initial notification of a possible high bacteria/virus loading event, NHDES Shellfish Program staff will determine the most suitable interval for continued notification and updates on an event-by-event basis.

11. In addition to submitting DMRs, monitoring results shall also be summarized for each calendar month and reported on separate Monthly Operating Report Form(s) (MORs) postmarked no later than the 15th day of the month following the completed reporting period. Signed and dated MORs shall be submitted to:

New Hampshire Department of Environmental Services (NHDES)
Water Division
Wastewater Engineering Bureau
P.O. Box 95, 29 Hazen Drive
Concord, New Hampshire 03302-0095

I. SPECIAL CONDITIONS

1. pH Limit Adjustment

The Permittee may submit a written request to the EPA requesting a change in the permitted pH limit range to be not less restrictive than 6.0 to 9.0 Standard Units found in the applicable National Effluent Limitation Guideline (Secondary Treatment Regulations in 40 C.F.R. Part 133) for this facility. The Permittee's written request must include the State's letter containing an original signature (no copies). The State's approval letter shall state that the Permittee has demonstrated to the State's satisfaction that as long as discharges to the receiving water from a specific outfall are within a specific numeric pH range, the naturally occurring receiving water pH will be unaltered. The letter must specify for each outfall the associated numeric pH limit range. Until written notice is received by certified mail from the EPA indicating the pH limit range has been changed, the Permittee is required to meet the permitted pH limit range in the respective permit.

2. Requirements for POTWs with Effluent Diffusers

a) Effluent diffusers shall be maintained when necessary to ensure proper operation. Proper operation means that the plumes from each port will be balanced relative to each other and that they all have unobstructed flow. Maintenance may include dredging in the vicinity of the diffuser, cleaning out of solids in the diffuser header pipe, removal of debris and repair/replacement of riser ports and pinch valves.

b) Any necessary maintenance dredging must be performed only during the marine construction season authorized by the New Hampshire Fish and Game Department and only after receiving all necessary permits including those from the NHDES Wetlands Bureau, U.S. Coast Guard, and the U.S. Army Corps of Engineers.

c) To determine if maintenance will be required, the permittee shall have a licensed diver or licensed marine contractor inspect and videotape the operation of the diffuser. The inspections and videotaping shall be performed once every two years with the first inspection required during the first calendar year following final permit issuance.

d) Copies of a report summarizing the results of each diffuser inspection shall be submitted to EPA and NHDES-WD by December 31st of the year the inspection occurred. Where it is determined that maintenance will be necessary, the permittee shall also provide the proposed schedule for the maintenance.

3. Nonpoint Source Nitrogen Reductions

In order to achieve water quality standards in the Squamscott River significant reductions in non-point sources of total nitrogen are necessary in conjunction with achieving the total nitrogen limitations in this discharge permit. Achieving the necessary nonpoint source reductions will require collaboration between the State of New Hampshire and public, private, and commercial stakeholders within the watershed to: (1) complete nonpoint source loading analyses; (2) complete analyses of the costs for controlling sources; and (3) developing control plans that include:

a. A description of appropriate financing and regulatory mechanisms to implement the necessary reductions;

b. An implementation schedule to achieve reductions (this schedule may extend beyond the term of this permit); and

c. A monitoring plan to assess the extent to which the reductions are achieved.

Following issuance of the final permit, EPA will review the status of the activities described above in items (1), (2), and (3) at 12 month intervals from the date of issuance. In the event the activities described above are not carried out within the timeframe of this permit (5 years), EPA will reopen the permit and incorporate any more stringent total nitrogen limit required to assure compliance with applicable water quality standards.

The State of New Hampshire
Department of Environmental Services

Thomas S. Burack, Commissioner

January 23, 2012

MR. MICHAEL JEFFERS
EXETER WATER AND SEWER DEPT
13 NEWFIELDS ROAD
EXETER, NH 03833

GROUNDWATER DISCHARGE PERMIT

SUBJECT: EXETER – Exeter Wastewater Treatment Facility, Newfields Road, Groundwater Discharge Permit
Site# 198401079 / RSN# 25/ Activity# 179360

Dear Mr. Jeffers:

Please find enclosed the Groundwater Discharge Permit Number GWP-198401079-E-001, approved by the Water Division of the Department of Environmental Services (Department), for the discharge of treated domestic wastewater from the existing unlined lagoons.

Please note in Condition #12 that arsenic and boron are included in the regular groundwater sampling and volatile organic compound (VOC) sampling now includes analysis for 1,4-Dioxane performed with a detection limit of 0.25 micrograms per liter (ug/l) or less. The Department suggests you contact your laboratory to inform them of this requirement to ensure they use the appropriate analytical procedure.

Also note that if groundwater sampling has not been conducted the permittee is require to conduct a complete round of sampling and analysis within 60 days of the date of permit issuance.

Should you have any questions, please contact me at the Water Division at (603) 271-2858 or by e-mail at *Mitchell.locker@des.nh.gov*.

Sincerely,

Mitchell Locker, P.G.
Drinking Water & Groundwater Bureau

MDL/mdl/h:\Hydrology & Conservation\Programs\uic\2012mdl\permits\198401079-E-001 uwwlag
Enclosure
e-copy: Stephen Roy, DWGB
File # 198401079
Copy: Russ Dean, Administrator, Town of Exeter

NEW HAMPSHIRE DEPARTMENT OF
Environmental
Services

The

NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES

hereby issues

GROUNDWATER DISCHARGE PERMIT

NO. GWP-198401079-E-001

to the permittee

TOWN OF EXETER

for the discharge of domestic wastewater

in EXETER, NH

to the groundwater via unlined lagoon exfiltration

as depicted on the drawings titled "Groundwater Permit Application Plan"

TO: TOWN OF EXETER
10 FRONT STREET
EXETER, NH 03833
ATTN: MICHAEL JEFFERS

Date of Issuance: January 23, 2012
Date of Expiration: January 22, 2017

(continued)

Pursuant to authority in N.H. RSA 485-A:13, I(a), the New Hampshire Department of Environmental Services (Department), hereby grants this permit to discharge treated wastewater to the groundwater at the above described site, subject to the following conditions:

STANDARD DISCHARGE PERMIT CONDITIONS

1. The permittee shall not violate Ambient Groundwater Quality Standards adopted by the Department (N.H. Admin. Rules, Env-Wq 402) in the groundwater, at the boundary of the Groundwater Discharge Zone, as shown on the referenced site plan.

2. The permittee shall not cause groundwater degradation, which results in a violation of the surface water quality standards (N.H. Admin. Rules, Env-Wq 1700), in any surface water body at the boundary of the Groundwater Discharge Zone.

3. The permittee shall allow an authorized member of the Department staff, or its agent, to enter the property covered by this permit for the purpose of collecting information, examining records, collecting samples, or undertaking other action associated with the permit.

4. The permittee shall apply for renewal of this permit at least 90 days prior to its expiration date. The permittee shall continue to comply with all conditions in this permit until the permit is renewed or the facility is closed in accordance with all applicable requirements, regardless of whether a renewal application is filed.

5. This permit is transferable only upon written request to, and approval of, the Department. Compliance with the existing permit shall be established prior to ownership transfer. Transfer requests shall include the name and address of the person to whom the permit transfer is requested, signature of the current permittee, and a summary of all monitoring results to date.

6. The Department reserves the right, under N.H. Admin. Rules, Env-Wq 402, to require additional hydrogeologic studies and/or remedial measures if the Department receives information indicating a need for such work.

7. Issuance of this permit does not exempt the permittee from any other applicable or requisite local approvals that are stipulated by the municipality in which it is located.

8. The permittee shall submit as-built plans subsequent to additional monitoring well installation, system improvements or expansions, or any other construction activity associated with the treatment and disposal system.

9. Issuance of this permit is based on the groundwater discharge permit application package dated January 4, 2012.

10. All grit, oil, sludge, or other wastes which result from the operation of the treatment system shall be disposed of only in a facility approved by the Department for such disposal.

11. The permittee shall submit detailed design plans to the Department's Wastewater Engineering Bureau for review and approval for any proposed improvements and/or expansions prior to any construction activity. No discharge to expanded facilities shall be allowed without the written approval from the Department.

12. The permittee shall maintain a water quality monitoring program and submit monitoring results to the Department's Groundwater Discharge Permits Coordinator no later than 45 days after sampling. Samples shall be taken from on-site monitoring wells, listed on the following table in accordance with the schedule outlined therein.

Monitoring Locations	*Sampling Frequency	Parameters
MW- 2, 3, & 4	May and November Of each year	Arsenic, Boron, Chloride, Nitrate, pH, TKN, Total Phosphorus, Static Water Elevation, *Escherichia coli*, and Temp.
MW-2, 3, & 4	November 2014 and May 2017	**VOCs using EPA Method 8260B Drinking Water Metals
Effluent	Weekly	Continuous flow

** if groundwater sampling has not been conducted the permittee is require to conduct a complete round of sampling and analysis within 60 days of the date of permit issuance*
*** VOCs analysis shall include 1,4-Dioxane results with detection levels at 0.25 micrograms/liter (ug/l) or less*

Samples shall be obtained using sampling procedures and protocol described in "Practical Guide for Ground-Water Sampling," USEPA current edition, and "RCRA Ground-Water Monitoring Enforcement Guidance," USEPA current edition. Samples shall be analyzed by a laboratory certified by the U.S. Environmental Protection Agency or the New Hampshire Department of Environmental Services. Metals shall be analyzed for dissolved metals and must be field-filtered (with a 0.45-micron filter) and acidified at the time of sample collection. As referred to herein, the term "Drinking Water Metals" refers to: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.

13. The permittee shall notify the Department's Groundwater Discharge Permits Coordinator, in writing of alteration to, or abandonment of the lagoons.

14. An annual summary of groundwater quality data shall be submitted to the Department's Groundwater Discharge Permits Coordinator in the month of January using a format acceptable to the Department.

15. The wastewater treatment facility shall be operated and maintained by qualified operators, licensed by the Department if required in N.H. Admin. Rules, Env-Ws 901.

(continued)

16. The permittee shall submit completed monthly operations reports (MORs) to the Department's Wastewater Engineering Bureau, Operations Section.

17. If a regulated contaminant is detected in a monitoring well at a concentration that violates ambient groundwater quality standards, the permittee shall notify the Department's Groundwater Discharge Permits Coordinator within 10 days and prepare a response plan (in accordance with N.H. Admin. Rules, Env-Ws 1500) within 60 days of notifying the Department to ensure that groundwater quality criteria are not violated at the boundary of the Groundwater Discharge Zone. The permittee shall implement the response plan within 30 days of Department approval.

18. The property boundaries are considered the limits of the groundwater discharge zone for this permit.

Rene Pelletier, Assistant Director
Water Division

Under RSA 21-0:14 and 21-0:7-IV, any person aggrieved by any terms or conditions of this permit may appeal to the Water Council in accordance with RSA 541-A and N.H. Admin. Rules, Env-WC 200. Such appeal must be made to the Council within 30 days and must be addressed to the Chairman, Water Council, 29 Hazen Drive, PO Box 95, Concord, NH 03302-0095.

APPENDIX B
Technical Data and Memoranda

TOWN OF EXETER - WASTEWATER FACILITIES PLAN
SUMMARY OF NITROGEN LOADINGS BY GREAT BAY SUB-WATERSHED

		Great Bay Sub-Watershed				
		Exeter River (Squamscott River)	Lamprey River	Winnicut River	Hampton Harbor	Total
Demographics						
	Number of Towns	15	14	5	7	-
	Total Population	44,878	39,966	6,233	34,315	-
	Exeter Portion	13,294	411	22	584	
	Exeter Portion (%)	29.6%	1.0%	0.4%	1.7%	

Total Attenuated Nitrogen Load (Tons/yr)						
	Point Source	43.63	32.11	0.00	0.00	-
	NPS: Atmospheric Dep.	41.36	60.91	6.67	62.93	-
	NPS: Chemical Fertilizer	19.43	14.13	5.93	35.91	-
	NPS: Animal Waste	16.82	23.92	2.75	8.08	-
	NPS: Septic Systems	45.40	47.21	8.35	35.67	-
106.34	*TOTAL*	*166.65*	*178.28*	*23.69*	*142.59*	
Exeter Portion, Total Attenuated Load (Tons/yr)						
	Point Source	41.80	0.00	0.00	0.00	41.80
	NPS: Atmospheric Dep.	6.38	0.62	0.02	0.21	7.22
	NPS: Chemical Fertilizer	4.00	0.12	0.03	0.22	4.37
	NPS: Animal Waste	2.77	0.03	0.01	0.07	2.87
	NPS: Septic Systems	3.53	0.22	0.07	0.34	4.17
16.68	*TOTAL*	*58.48*	*0.98*	*0.13*	*0.85*	*60.44*
Exeter Portion (%)						
	Point Source	96%	0.0%	n/a	n/a	-
	NPS: Atmospheric Dep.	15%	1.0%	0.3%	0.3%	-
	NPS: Chemical Fertilizer	21%	0.8%	0.4%	0.6%	-
	NPS: Animal Waste	16%	0.1%	0.2%	0.9%	-
	NPS: Septic Systems	8%	0.5%	0.9%	1.0%	-
	TOTAL	*35%*	*0.6%*	*0.5%*	*0.6%*	-
	NPS Aggregate	*14%*	*0.7%*	*0.5%*	*0.6%*	
Threshold Load (Tons/yr)						
	River DO	140	226	24		-
	River Eelgrass	88	140	15		-
	Bay DO	n/a	n/a	n/a		-
	Bay Eelgrass	162	182	24		-
Removal Requirements (Tons/yr)						
	Based on 2003-2008 NPS data					
	River DO	71.2	12.8	6.6		-
	River Eelgrass	123.7	98.7	16.4		-
	Bay DO	n/a	n/a	n/a		-
	Bay Eelgrass	49.8	56.5	7.4		
	Based on DES NPS study data (2013)					
	River DO	26.7	-47.7	-0.3		-
	River Eelgrass	78.7	38.3	8.7		-
	Bay DO	n/a	n/a	n/a		-
	Bay Eelgrass	4.7	-3.7	-0.3		-

Sources

1 Piscataqua Region Estuaries Partnership. (2013). State of Our Estuaries. Durham, NH.

2 Trowbridge, P., Wood, M., Underhill, J., & Healy, D. (2013). *Great Bay Nitrogen Non-Point Source Study.* Concord: NH DES.

3 Trowbridge, P., Wood, M., Underhill, J., & Healy, D. (2013, May). Exeter GBNNPSS data.xlsx. Concord, New Hampshire.

4 Trowbridge, P. (2010). Analysis of Nitrogen Loading Reductions for Wastewater Treatment Facilities and Non-point Sources in the Great Bay Estuary Watershed. Concord: NH DES.

5 NH DES. (2012). Surface Water Quality Assessments. Retrieved December 6, 2013, from NH DES: http://www2.des.state.nh.us/WaterShed_SWQA/WaterShed_SWQA.aspx

6 NH DES. (2013). *FINAL SUBMITTED TO EPA - 2012 LIST OF THREATENED OR IMPAIRED WATERS THAT REQUIRE A TMDL.* Concord: NH DES.

NOTE: The PREP 2013 report uses Ave. effluent TN values based on various sources (see below) and annual ave flow data from 2009-2011.

TOWN OF EXETER - WASTEWATER FACILITIES PLAN
SUMMARY OF LAND USE BY GREAT BAY SUB-WATERSHED

		Great Bay Sub-Watershed			
Entire Watershed		Exeter River (Squamscott River)	Lamprey River	Winnicut River	Hampton Harbor
	Land Area (acres)	115,545	135,619	9,011	4,050
	Est. Area - Impervious (acres)	8,662	8,946	1,725	6,084
	Est. Area - Agricultural (acres)	7,085	6,694	961	1,540
	Est. Area - Managed Turf (acres)	306	77	444	69
	Est. Area - Surface Waters (acres)	1,622	3,622	138	1,849
	Est. No. of Septic Systems (total)	32,864	32,612	5,961	10,215
	Est. No. of Septic Systems (<200m)	86	1,544	128	288
	Est. No. of Centralized WWTFs	2	2	0	1
	Est. No. of Decentralized WWTFs	0	0	0	3

Exeter Portion					
	Land Area (acres)	10,977	1,546	20	270
	Est. Area - Impervious (acres)	1,176	84	12	87
	Est. Area - Agricultural (acres)	381	35	0	1
	Est. Area - Managed Turf (acres)	107	12	0	0
	Est. Area - Surface Waters (acres)	584	7	0	7
	Est. No. of Septic Systems (total)	2,534	411	13	250
	Est. No. of Septic Systems (<200m)	45	0	0	0
	Est. No. of Centralized WWTFs	1	0	0	0
	Est. No. of Decentralized WWTFs	0	0	0	0

Exeter Portion (%)					
	Land Area (acres)	10%	1.1%	0.2%	6.7%
	Est. Area - Impervious (acres)	14%	1%	1%	1%
	Est. Area - Agricultural (acres)	5%	1%	0%	0%
	Est. Area - Managed Turf (acres)	35%	16%	0%	0%
	Est. Area - Surface Waters (acres)	36%	0%	0%	0%
	Est. No. of Septic Systems (total)	8%	1.3%	0.2%	2.4%
	Est. No. of Septic Systems (<200m)	52%	0%	0%	0%
	Est. No. of Centralized WWTFs	50%	0%	n/a	0%
	Est. No. of Decentralized WWTFs	0%	0%	0%	0%

Sources

1 Memorandum of Agreement between The Great Bay Municipal Coalition and NHDES relative to Reducing Uncertainty in Nutrient criteria for the Great Bay/Piscataqua River Estuary. (2010, December)

2 Trowbridge, P., Wood, M., Underhill, J., & Healy, D. (2013). *Great Bay Nitrogen Non-Point Source Study.* Concord: NH DES.

3 Trowbridge, P., Wood, M., Underhill, J., & Healy, D. (2013, May). Exeter GBNNPSS data.xlsx. Concord, New Hampshire.

4 Trowbridge, P. (2010). Analysis of Nitrogen Loading Reductions for Wastewater Treatment Facilities and Non-point Sources in the Great Bay Estuary Watershed. Concord: NH DES.

5 NH DES. (2012). Surface Water Quality Assessments. Retrieved December 6, 2013, from NH DES: http://www2.des.state.nh.us/WaterShed_SWQA/WaterShed_SWQA.aspx

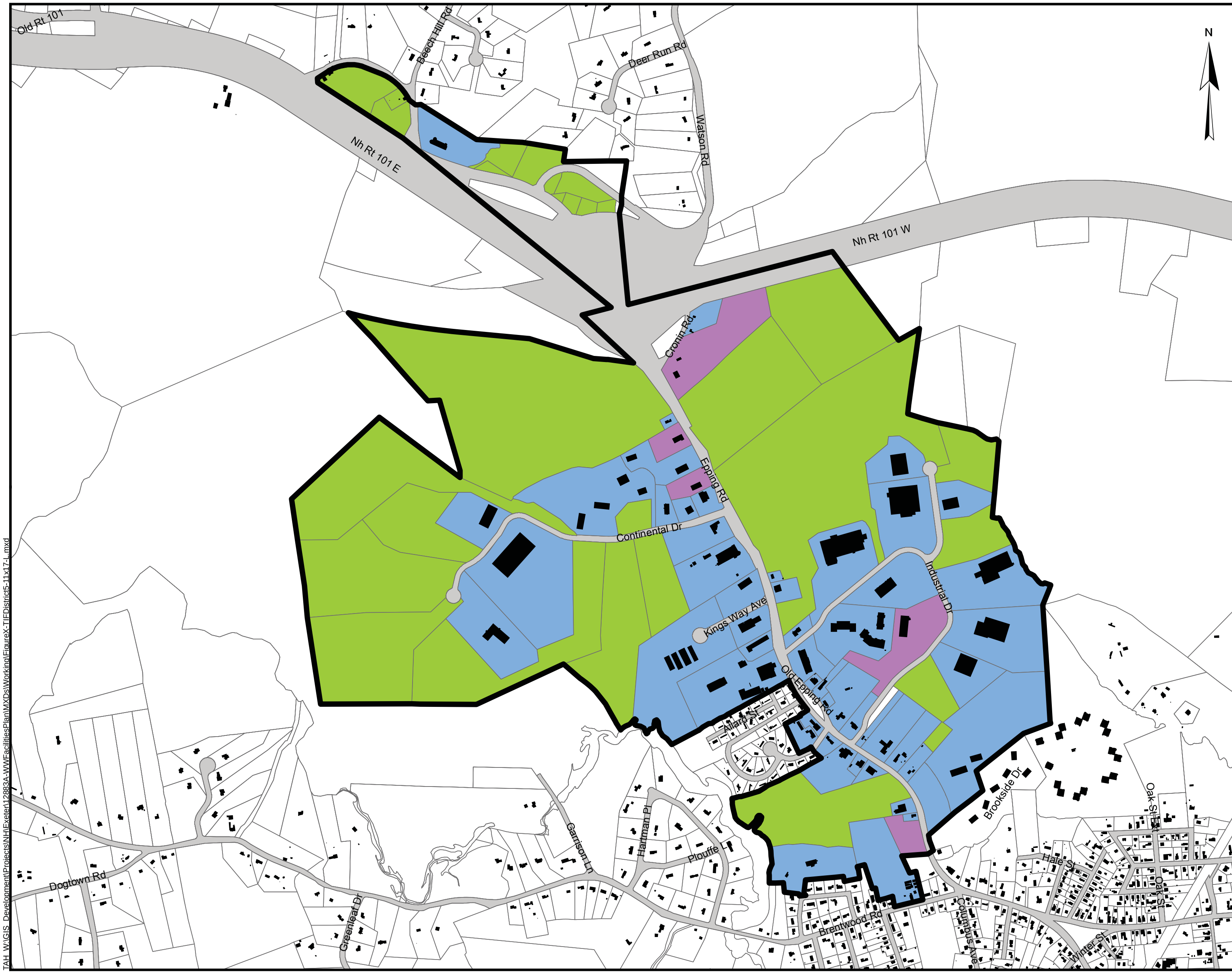
6 NH DES. (2013). *FINAL SUBMITTED TO EPA - 2012 LIST OF THREATENED OR IMPAIRED WATERS THAT REQUIRE A TMDL.* Concord: NI

Exeter - Wastewater Facilities Study
March 26, 2014
12883A

Wastewater Flow Projections per Zoning District

Zoning Description	Noumber of Parcels	Total Parcel Area	Total Parcel Area	Minimum Lot Size	Percent Buildable Area	Total Buildable Area	Total Buildable Area	New Residential Lots for Theoretical Buildout	Estimated Flow per		Existing Estimated Flow	Theoretical Buildout Estimated Flow	Probability of Occurring within Planning Horizon	Planning Horizon Estimated Flow	New Residential Lots for Planning Horizon
		Acres	SF	SF	Percent	SF	acres	Lots			gpd	gpd	Percent	gpd	Lots
Developable Parcel Within Sewer Area															
C-2 (Highway - Commercial)	6	30.16	1,313,576	20,000	86	1,129,675	25.93		1,500	gpdba		38,901	50	19,450	
C-3 (Epping Road Highway - Commercial)	3	24.18	1,053,429	40,000	89	937,552	21.52		1,500	gpdba		32,285	50	16,142	
CT (Corporate / Technology Park)	2	47.53	2,070,224	174,240	85	1,759,690	40.40		1,501	gpdba		60,636	50	30,318	
CT-1 (Corporate / Technology Park - 1)	5	96.79	4,216,373	87,120	88	3,710,408	85.18		1,500	gpdba		127,769	50	63,884	
I (Industrial)	3	68.76	2,995,102	40,000	85	2,545,836	58.44		2,000	gpdba		116,889	50	58,444	
NP (Neighborhood Professional)	4	23.48	1,022,759	20,000	78	797,752	18.31		1,500	gpdba		27,471	50	13,735	
PP (Professional / Technology Park)	2	24.54	1,068,894	87,120	89	951,316	21.84		1,500	gpdba		32,759	50	16,379	
R-1 (Low Density - Residential)	3	96.64	4,209,799	40,000	85	3,578,329	82.15	89	140	gpdlot		12,460	50	6,230	45
R-2 (Single Family - Residential)	7	40.66	1,770,994	15,000	89	1,576,184	36.18	105	140	gpdlot		14,700	50	7,350	53
Parcel with Redevelopment Potential															
C-1 (Central Area Commercial District)	9	9.22	401,819	5,000	90	361,637	8.30		1,500	gpdba		2,491	50	1,245	
C-2 (Highway - Commercial)	5	41.66	1,814,493	20,000	80	1,451,595	33.32		1,500	gpdba		9,997	50	4,999	
PP (Professional / Technology Park)	1	11.82	514,792	87,120	90	463,313	10.64		1,500	gpdba		3,191	50	1,595	
R-1 (Low Density - Residential)	5	181.98	7,927,262	40,000	75	5,945,447	136.49	148	140	gpdlot		4,144	50	2,072	74
R-2 (Single Family - Residential)	7	110.00	4,791,788	15,000	86	4,120,937	94.60	274	140	gpdlot		7,672	50	3,836	137
R-4 (Multi-Family Residential)	1	22.29	971,127	12,000	90	874,014	20.06	72	140	gpdlot		2,016	50	1,008	36
R-5 (Multi-Family District)	1	8.66	377,258	12,000	90	339,533	7.79	28	140	gpdlot		784	50	392	14
WC (Waterfront Commercial)	2	0.58	25,112	5,000	90	22,601	0.52		1,500	gpdba		156	50	78	
Existing Developed Parcel Near Potential Sewer Extension															
C-3 (Epping Road Highway Commercial)	1	5.25	228,714	40,000					1,000	gpd	1,000	1,000	100	1,000	0
R-1 (Low Density - Residential)	23	47.09	2,051,300	40,000					140	gpdlot	3,220	3,220	100	3,220	0
RU (Rural) Exeter High School	1	118.96	5,181,767	87,120					30,000	gpd	30,000	30,000	100	30,000	0
Developable Parcel Near Potential Sewer Extension															
C-3 (Epping Road Highway Commercial)	10	93.36	4,066,762	20,000	87	3,538,083	81.22		1,500	gpdba		121,835	50	60,917	
CT (Corporate / Technology Park)	2	28.79	1,254,200	174,240	70	877,940	20.15		1,500	gpdba		30,232	50	15,116	
I (Industrial)	1	18.55	808,038	40,000	80	646,430	14.84		2,000	gpdba		29,680	50	14,840	
R-1 (Low Density - Residential)	12	67.69	2,948,576	40,000	53	1,562,745	35.88	39	140	gpdlot		5,460	50	2,730	20
R-2 (Single Family - Residential)	2	105.41	4,591,446	15,000	86	3,948,644	90.65	263	140	gpdlot		36,820	50	18,410	132
NP (Neighborhood Professional)	2	6.73	293,159	20,000	88	257,980	5.92		1,500	gpdba		8,884	50	4,442	
Developable Parcel Outside Sewer Area															
C-3 (Epping Road Highway Commercial)	1	1.96	85,375	40,000	90	76,837	1.76		1,500	gpdba		2,646	50	1,323	
R-1 (Low Density - Residential)	21	314.35	13,692,965	87,120	78	10,680,513	245.19	122					50	0	61
R-2 (Single Family - Residential)	1	3.18	138,362	43,560	90	124,526	2.86	2					50	0	1
RU (Rural)	2	21.05	917,130	87,120	83	761,218	17.48	8					50	0	4
Totals	145	1,671.32	72,802,596			53,040,736	1,217.65	1,150			34,220	764,095		399,157	577

Notes:
1. Total Buildable Area was calculated by multiplying the Total Parcel Area by the Percent Buildable Area.
2. Percent Buildable Area was determined by subtracting out 75% of the wetlands, 100% of all water bodies and 10% of the total parcel area for roads and parking areas.
3. The Percent Buildable Area wetlands and water bodies were estimated through a visual review of the parcels on the Town of Exeter MapsOnline interactive website tool.
4. The wetlands shown on the Town of Exeter MapsOnline interactive website tool are taken from the Rockingham County Soil Survey.
5. Estimated Flow Per of 140 gpdlot for residential properties is based on the Town of Exeter Water Use data.
6. Estimated Flow Per of 1,500 gpdba for commercial properties and 2,000 gpdba for industrial properties are common flow projections used for wastewater studies.
7. The commercial and industrial Theoretical Buildout Estimate Flow was calculated by multiplying the Total Buildable Area by the respective Estimated Flow per.
8. The Theoretical Residential Lots was calculated by dividing the Total Buildable Area by the Minimum Lot Size.
9. The Theoretical Buildout Estimated Flow was calculated by multiplying the Theoretical Residential Lots by the Estimated Flow per.
10. The Planning Horizon Estimated Flow was calculated by multiplying the Theoretical Buildout Estimated Flow by the Probability of Occurring within the Planning Horizon.
11. The New Residential Lots for Planning Horizon was calculated by multiplying the Theoretical Residential Lots by the Probability of Occurring within the Planning Horizon.



- Building
- TIF District
- Developed, with water use data
- Developed, no water use data
- Undeveloped
- Other/Not in Project

Town of Exeter, NH, 2013; Town of Stratham, NH, 2013; Rockingham Planning Commission, 2014.
Note: Parcel selections are conceptual for the purposes of projecting future wastewater flows.

	Estimated Wastewater Flow (gallons per day)	
	Current	Planning Horizon
Developed Parcels	34,000	34,000
Undeveloped Parcels	0	261,000
Total	34,000	295,000

Exeter, NH
Epping Road TIF District

PROJ NO: 12883 DATE: Feb 2015 FIGURE: --

WRIGHT-PIERCE
Engineering a Better Environment

T:\AH W:\GIS_Development\Projects\NH\Exeter\12883A-WWFacilitiesPlan\MXDs\Working\FigureX-TIFDistrict5-11x17-L.mxd

From: Jennifer Perry <jperry@exeternh.gov>
Sent: Friday, April 03, 2015 4:05 PM
To: Russ Dean
Cc: Edward Leonard
Subject: Re: Wastewater

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Russ,
I am forwarding to Ed Leonard for inclusion in the Facilities Plan.
Thank you,
Jennifer

On Fri, Apr 3, 2015 at 1:17 PM, Russ Dean <rdean@exeternh.gov> wrote:
Jennifer is this sufficient or do you want more formal correspondence. Just let me know.

Thanks!

Russ
---------- Forwarded message ----------
From: **Paul Deschaine** <Pdeschaine@strathamnh.gov>
Date: Fri, Apr 3, 2015 at 1:12 PM
Subject: RE: Wastewater
To: Russ Dean <rdean@exeternh.gov>

That's been the working/planning number that has been used. Is this email sufficient?

Paul

From: Russ Dean [mailto:rdean@exeternh.gov]
Sent: Friday, April 03, 2015 10:48 AM
To: Paul Deschaine
Subject: Wastewater

Hi Paul,

Jen asked me to ask you if Stratham could put something in writing regarding the 250K per day number for wastewater. We need this confirmation to update the WWTF Plan.

Thanks!

Russ

--
Jennifer Royce Perry, P.E., Director
Exeter Public Works
13 Newfields Road
Exeter, NH 03833
(603) 773-6157
Enhancing, Preserving Community & Environment

Like us on Facebook!

Please note, effective May 2013, my new email address is jperry@exeternh.gov

WRIGHT-PIERCE
Engineering a Better Environment

MEMORANDUM

TO:	EJL, DAM, JRM	DATE:	June 10, 2014
FROM:	DLS, MPS, WDH	PROJECT No.:	12883A
SUBJECT:	Exeter, New Hampshire Wastewater Treatment Facility Preliminary Nutrient Removal Analysis for Facilities Plan		

1 INTRODUCTION

The purpose of this memorandum is to develop and analyze process alternatives for nitrogen removal at the Exeter Wastewater Treatment Facility. Process alternatives were evaluated in anticipation of seasonal (April through October) effluent total nitrogen (TN) limits of 8 and 3 mg/L.

2 FLOWS AND LOADS

Design flows and loads for the facility were projected in an earlier memo (Wright-Pierce, April 2014). A summary of the flows and loads data is presented in Table 1.

TABLE 1

PRELIMINARY FLOWS AND LOADS SUMMARY

	FLOW	BOD		TSS		TKN		TP	
PARAMETER	MGD	mg/L	lb/day	mg/L	lb/day	mg/L	lb/day	mg/L	lb/day
Annual Average	3.0	200	5,000	216	5,400	44.0	1100	6.0	150
Maximum Month	5.0	187	7,800	187	7,800	38	1600	5.4	225
Maximum Day	6.6	173	9,500	187	10,310	38	2100	3.1	290
Peak Instantaneous*	6.6*	-	-	-	-	-	-	-	-

*Peak instantaneous flow managed via influent equalization.

3 PRELIMINARY TECHNOLOGY SCREENING

Due to uncertainty in future permitting, a major criterion for technology selection will be its ability for phased expansion to ultimately meet the limit of technology for total nitrogen (TN), which is considered as 3 mg/L. The Town has negotiated an Administrative Order on Consent (AOC) that requires achieving a limit of 8 mg/L TN within five years. Therefore, the technologies evaluated are:

1. Modified Ludzack-Ettinger (to meet effluent TN of 8 mg/L)
2. 4-Stage Bardenpho (to meet effluent TN of 3.5 mg/L)
3. Tertiary denitrification filter for either process (to meet effluent TN of 3 mg/L)

These are described further below.

3.1 Modified Ludzack-Ettinger Process

The Modified Ludzack-Ettinger (MLE) process is configured with anoxic reactors preceding the aerated reactors of an activated sludge system. Influent wastewater and return activated sludge (RAS) are fed into the anoxic reactor. This configuration of the reactors uses the organic carbon present in the influent wastewater for denitrification. The process flow diagram is shown in Figure 1.

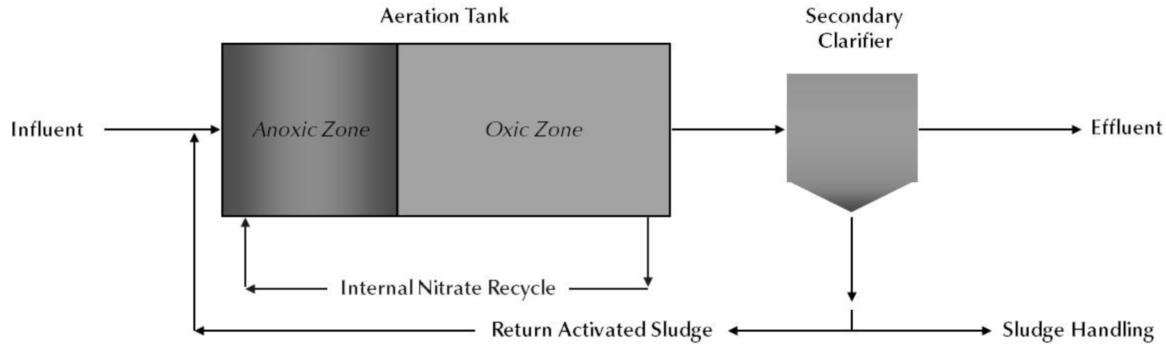


FIGURE 1

MLE PROCESS FLOW DIAGRAM

To achieve biological nitrogen removal, ammonia must first be completely transformed to nitrate (nitrification) in the oxic zone of the activated sludge system. Nitrates produced in the aerobic zone are then recycled back to the anoxic zone through a pumped internal recycle system, allowing them to come in contact with the raw soluble BOD_5, thus creating anoxic conditions within the zone conducive for denitrification.

The limit of technology for the MLE process is typically considered between 6 to 10 mg/l of effluent total nitrogen. The effluent total nitrogen level achieved is highly dependent on the amount of influent substrate carbon available for the denitrification process. Increasing the influent carbon to nitrogen ratio typically results in improved performance.

3.2 Four-Stage Bardenpho Process

The Bardenpho process has been used successfully to meet a total nitrogen limit of 3.0 mg/l. New England installations include Glastonbury, CT; Fairfield, CT; Stratford, CT; and Waterbury, CT. The 4-stage Bardenpho process, shown in Figure 2 includes a primary anoxic zone, primary oxic zone, secondary anoxic zone, and reaeration zone in series through the aeration tank. The first anoxic zone and oxic zone work essentially the same as the MLE process. Nitrates are recycled from the effluent end of the first oxic stage to the first anoxic stage. However, a secondary anoxic zone is also provided for additional denitrification to further reduce the effluent total nitrogen from this process. The re-aeration zone at the end is provided to add dissolved oxygen to the mixed liquor prior to the secondary clarifiers. To provide sufficient substrate (carbon) to complete the denitrification reactions, a supplemental carbon source is typically utilized in the secondary anoxic zone. This reduces the necessary size of the second anoxic zone compared to relying on endogenous decay.

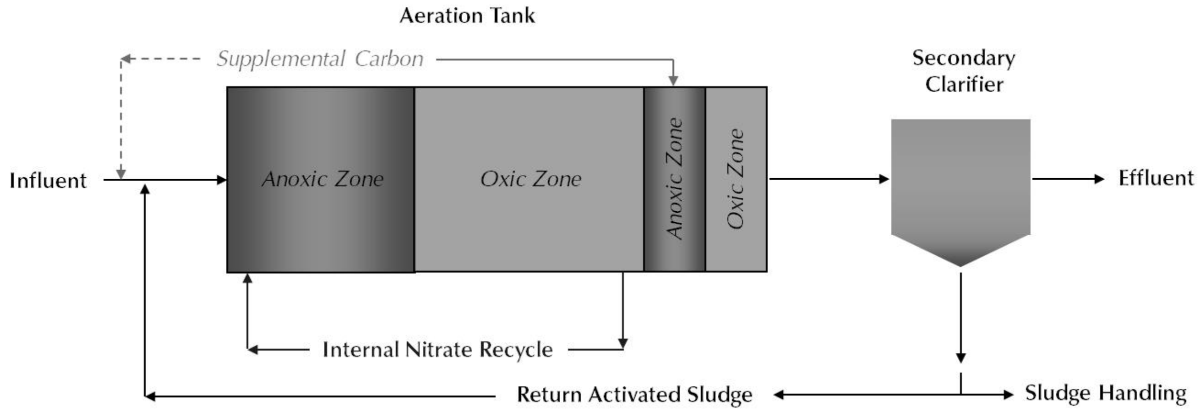


FIGURE 2

4-STAGE BARDENPHO PROCESS FLOW DIAGRAM

The limit of technology for the 4-stage Bardenpho process is considered to be 3.5 mg/L of effluent total nitrogen, depending on recalcitrant organic nitrogen in the wastewater as well as effluent particulate nitrogen levels. Effluent total nitrogen will consist of the following components: ammonia, nitrate/nitrate, and particulate and dissolved organic nitrogen. Ammonia reduction is achieved via nitrification which can occur in the existing secondary treatment process. The effluent ammonia level achievable via nitrification is a function of the sludge retention time and the process operating characteristics (i.e., temperature, pH, dissolved oxygen level, etc.). A well designed and operated system should routinely achieve an effluent ammonia level of less than 1.0 mg/l.

Nitrate/nitrite levels consistently below 0.5 mg/l should be achievable with an established nutrient removal process such as the 4-Stage Bardenpho process. Supplemental carbon should be included in the design (whether used or not) to provide some assurance that the process can reliably achieve the proposed limits under varying conditions.

The level of organic nitrogen in the effluent is difficult to predict, particularly because there is little information on recalcitrant dissolved organic nitrogen (rDON) quantities in the plant influent. rDON is an untreatable form of nitrogen characterized primarily as free amino acids and high molecular weight humic substances. Recalcitrant effluent dissolved organic nitrogen (rEDON) includes rDON and substances that are produced by treatment processes, such as biopolymers. rEDON typically ranges from 0.5 to 2 mg/l in municipal wastewater influent. Since a well-functioning nitrogen removal process consistently produces a total inorganic nitrogen concentration of up to 1.5 mg/l, a high influent rEDON value on a regular basis will prevent a wastewater treatment plant from achieving a 3 mg/l effluent TN limit.

Currently there is no consensus on a testing method to measure rEDON levels from a biological treatment process. It can be approximated by measuring dissolved organic nitrogen from the effluent of a pilot or full-scale plant, which is done by testing dissolved kjehldahl nitrogen and subtracting ammonia. Thus the ability of treatment processes to meet 3 mg/L effluent TN limits consistently at Exeter can only be determined by pilot or full-scale testing.

3.3 Tertiary Denitrification Filter

Tertiary technologies are installed downstream of secondary systems to provide additional nitrogen removal. These systems do not take advantage of influent carbon energy, so they require supplemental carbon to drive denitrification.

Denitrification filters represent a group of technologies that include the traditional sand-bed denitrification filters(such as Tetra denite® or Leopold elimi-NITE®), continuously-backwashed filters (such as Parkson Dynasand®), and filters with plastic media (Kruger Biostyr® or IDI BioFOR®). All use filter media for two primary functions: 1) act as a carrier material that supports biomass growth for denitrification and 2) as a filtration medium to remove a portion of solids from the liquid stream.

For the purpose of this evaluation, it is assumed that the activated sludge system will be used to reduce TN to less than 8 mg/L (MLE process) or 3.5 mg/L (Bardenpho process), and a tertiary denitrification filter will be used to meet future permit requirements of 3 mg/L or less.

4 DETAILED ALTERNATIVES ANALYSIS

The alternatives selected for further investigation were analyzed for their capability to meet the potential effluent TN limits of 8 and 3 mg/L. The alternatives were evaluated based on BioWin 4.0 process modeling results. In order to account for flexibility provided by the seasonal rolling average of the TN limit, the MLE alternative was developed to provide an effluent TN of 9.5 during maximum month loadings and 8 mg/L during average annual loadings. Likewise the 4-Stage Bardenpho alternative was developed to provide an effluent TN of 4 mg/L during maximum month loadings and 3.5 mg/L during average annual loadings. The process models were not calibrated due to limited data and therefore used Biowin default wastewater characterization, kinetic, and stoichiometric parameters.

Note that the modeling assumed no primary clarification in order to provide a basis of comparison of the MLE and 4-stage Bardenpho processes to alternative technologies.

4.1 Process Modeling Results

4.1.1 Modified Ludzack-Ettinger (MLE)

The MLE process was modeled at future design annual average and maximum month conditions to determine process requirements for treatment at future conditions to 8 mg/L TN. Preliminary loadings for future design annual average and maximum month loadings as listed in Table 1 forecast very high design influent TN concentrations. Influent TN should be verified with further sampling. If forecasted loadings remain unchanged, model results indicate that the MLE process will not be capable of achieving 8 mg/L and a 4-stage Bardenpho process will be needed.

In order to establish the maximum capacity of the MLE process to meet a TN limit of 8 mg/L without supplemental carbon addition, the model was used to simulate reduced influent TKN concentrations. Results are shown in Table 2.

The model results indicate that maximum design TKN concentrations of 37 mg/L (compared with preliminary design concentration of 44 mg/L) during average annual conditions and 36 mg/L (compared with preliminary design concentration of 38 mg/L) during maximum month conditions would be capable of being treated using the MLE process.

Wastewater temperature was assumed to be 10°C for modeling the maximum month scenario to account for the possibility of maximum month conditions occurring in April, when wastewater temperatures tend to be below average. Since the permit requirements are based on a 214-day rolling average (April 1 to October 31), 16°C was assumed for annual average conditions.

Influent VSS was assumed to be 90% of TSS, based on recent sampling results from the facility. Influent pH was assumed to be 7.0. Sampling indicated that influent alkalinity ranged from 100 to 150 mg/L $CaCO_3$. Therefore the alkalinity was assumed to be 150 mg/L $CaCO_3$. In order to foster optimal nitrification, the alkalinity should be sufficient to maintain pH for secondary treatment above 6.5.

TABLE 2
MLE PROCESS MODELING RESULTS – FUTURE DESIGN CONDITIONS

	Annual Average (2 Trains)	**Annual Average (3 Trains)**	**Max Month (3 Trains)**
Plant Influent			
Flow rate, mgd	3.00	3.00	5.00
Peak Day Flow Rate, mgd	6.60	6.60	6.60
Peak Inst. Flow Rate, mgd	9.50	9.50	9.50
Peak Inst. Flow Rate to Secondary Process, mgd	6.60	6.60	6.60
BOD5, mg/L	200	200	187
TSS, mg/L	216	216	187
VSS, mg/L	194	194	168
TKN, mg/L	37.0	37.0	36.0
NH3, mg/L	33.0	33.0	28.5
NOx, mg/l	0.0	0.0	0.0
P, mg/L	6.0	6.0	5.0
Ortho P, mg/l	3.4	3.4	2.8
Temp, C	16	16	10
Aeration Tanks			
No. of Tanks per Train	2	2	2
Total No. of Tanks	4	6	6
Total Volume, Mgal	1.47	2.20	2.20
HRT, Anoxic Zone, hr	2.94	4.40	2.64
MLVSS, Oxic Zone, mg/L	2329	1556	3313
MLSS, Oxic Zone, mg/L	2918	1950	4140
HRT, Oxic Zone, hr	8.81	13.20	7.92
HRT, Total, hr	11.74	17.60	10.56
Aerobic SRT, days	8.00	12.00	12.00
Actual Oxygen Requirement, lb/d	7,234	7,226	11,743
Standard Oxygen Requirement, lb/d	21,111	21,087	34,090
Total estimated airflow, scfm	2,710	2,710	4,450
Internal Recyle, mgd	12.00	12.00	20.00
Supplemental Alkalinity, lb/d $CaCO_3$	1,500	1,500	2,500
Supplemental Carbon, methanol gpd	0	0	0
Secondary Clarifiers			
No. of Tanks Online	2	3	3

	Annual Average (2 Trains)	Annual Average (3 Trains)	Max Month (3 Trains)
Diameter, ft	75	75	75
Depth, ft	16	16	16
SOR, average day, gal/sf/d	442	295	495
SLR, peak day, lb/sf/d	31.4	14.8	31.4
Effluent Quality			
Effluent BOD5, mg/l	3.5	3.2	3.8
Effluent COD, mg/l	31.6	30.9	32.0
Effluent TKN, mg/l	2.6	2.6	3.0
Effluent NH3, mg/l	1.0	1.0	1.0
Effluent NOx, mg/l	5.4	5.4	6.3
Effluent TN, mg/l	8.0	8.0	9.3
Effluent TN, lbs/day	197	197	384
Effluent P, mg/l	3.1	3.1	2.6
Effluent TSS, mg/l	7.7	7.2	9.5
Waste Activated Sludge			
Flow rate, mgd	0.06	0.07	0.0501
TSS, mg/L	7,061	5,817	12,383
VSS, mg/L	5,632	4,639	9,906
WAS, lb/d	3,352	3,360	4,753

Aeration tank volumes were designed to meet an effluent TN limit of 8 mg/L at an approximate MLSS concentration of 4,000 mg/L with 2 trains online for average annual loadings and 3 trains online for maximum month loadings.

The results from the analysis indicate that an MLE process could be used to meet an effluent TN permit limit of 8 mg/L under design annual average flow conditions. At maximum month conditions, the MLE process is able to achieve a TN concentration of 9.3 mg/L with three trains online.

As shown in Table 2, in order to provide sufficient aerobic solids retention time of 12 days at maximum month conditions to ensure nitrification at the low temperature of 10°C, a mixed liquor suspended solids (MLSS) concentration in the secondary system of 4,140 mg/L was maintained. State-point analysis was used to size the secondary clarifiers for this loading condition at peak daily flows. The graph in Figure 3 shows the state point assuming three 75-foot clarifiers on-line. In addition, state point analysis (not shown) indicated that sufficient clarification capacity for future average loadings could be provided with only two 75-foot clarifiers on-line. Surface Overflow Rates (SOR) and Solids Loading Rates (SLR) for this secondary clarifier area are shown in Table 2 and are well within TR-16 recommendations.

Aeration and mixing requirements for the MLE process are shown in Table 3.

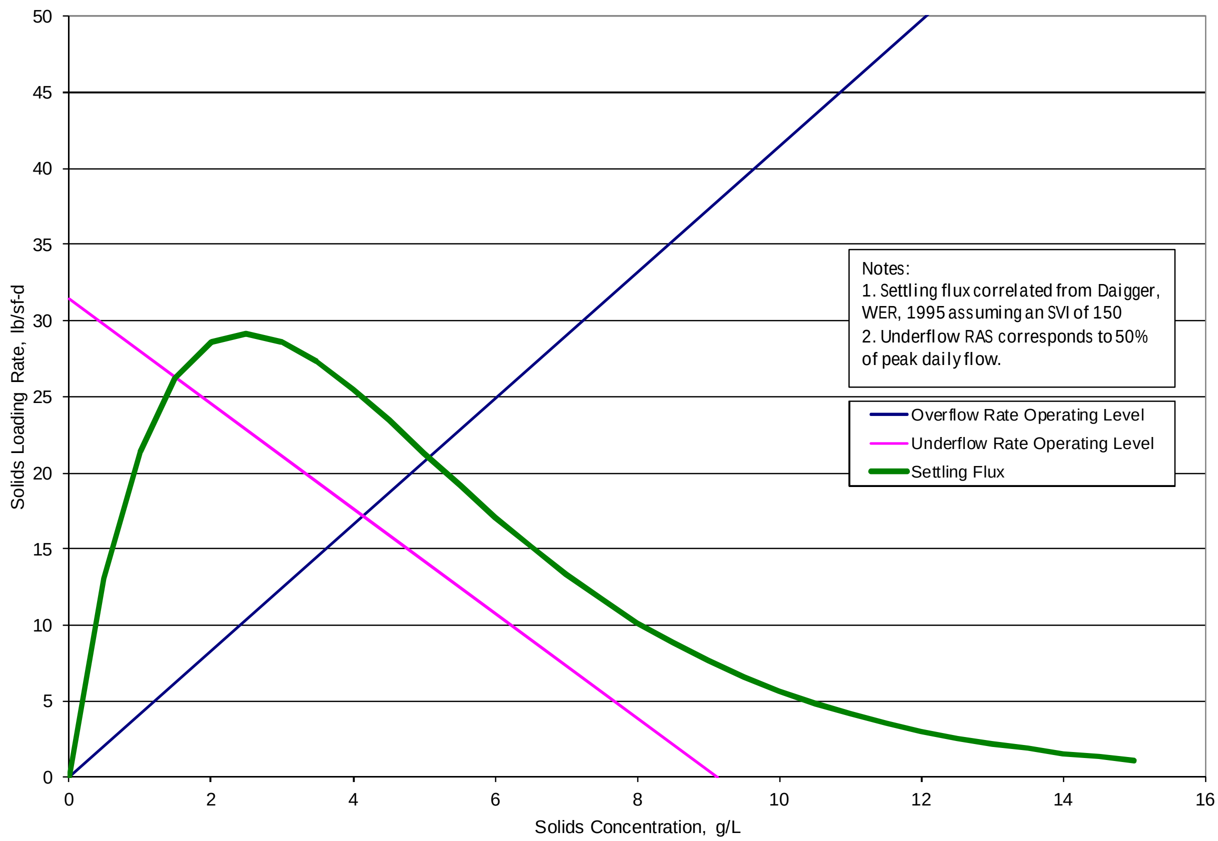


FIGURE 3

STATE POINT ANALYSIS FOR MLE PROCESS – FUTURE DESIGN CONDITIONS

TABLE 3

FUTURE AERATION AND MIXING REQUIREMENTS FOR MLE PROCESS

	Aeration Energy		Peak Day	
Mixing Energy	**Average Winter**	**Average Summer**	**Total Capacity Required**	**Air Demand**
(HP)	(HP)	(HP)	(HP)	
19	100	150	300	5,000 scfm @ 9.1 psi

Modeling indicated that an influent alkalinity of 150 mg/L CaCO3 would not be sufficient to maintain a secondary system pH greater than 6.5. Chemical addition requirements to maintain sufficient alkalinity are shown in Table 4.

TABLE 4

CHEMICAL ADDITION REQUIREMENTS FOR MLE PROCESS

	Alkalinity (lb/d $CaCO_3$)	Supplemental Carbon (gpd methanol)
Annual Average	1,500	0
Maximum Month	2,500	0

4.1.2 4-Stage Bardenpho

The 4-stage Bardenpho process was modeled at design annual average and maximum month conditions to determine the ability to meet TN concentration of 3.5 mg/L through the secondary process. Aeration tank volumes were designed to meet the effluent TN limit at an approximate MLSS concentration of 4,000 mg/L with 2 trains online for average annual loadings and 3 trains online for maximum month loadings. Results are shown in Table 5.

Pre-anoxic and pre-aerobic zone volumes were held to the same volumes as the MLE aeration tanks. Sizes were established to allow each system to meet its target effluent TN concentrations. This would allow future expansion of the MLE process to convert to a 4-stage Bardenpho through addition of post-anoxic and re-aeration zones to meet more stringent TN permit requirements.

Wastewater temperature was held at 10°C for both annual average and maximum month modeling to assume the worst-case temperature for design at all conditions.

Influent VSS was assumed to be 90% of TSS, based on recent sampling results from the facility. Influent pH was assumed to be 7.0. Influent alkalinity was assumed to be 150 mg/L CaCO3 based on sampling results.

TABLE 5
4-STAGE BARDENPHO PROCESS MODELING RESULTS – FUTURE DESIGN CONDITIONS

	Annual Average (2 Trains)	Annual Average (3 Trains)	Max Month (3 Trains)
Plant Influent			
Flow rate, mgd	3.00	3.00	5.00
Peak Day Flow Rate, mgd	6.60	6.60	6.60
Peak Inst. Flow Rate, mgd	9.50	9.50	9.50
Peak Inst. Flow Rate to Secondary Process, mgd	6.60	6.60	6.60
BOD5, mg/L	200	200	187
TSS, mg/L	216	216	187
VSS, mg/L	194	194	168
TKN, mg/L	44.0	44.0	38.0
NH3, mg/L	33.0	33.0	28.5
NOx, mg/l	0.0	0.0	0.0
P, mg/L	6.0	6.0	5.0
Ortho P, mg/l	3.4	3.4	2.8
Temp, C	10	10	10
Aeration Tanks			
No. of Tanks per Train	4	4	4
Total No. of Tanks	8	12	12
Total Volume, Mgal	1.86	2.78	2.78
Volume, Pre-Anoxic, Mgal	0.37	0.55	0.55
Volume, Post-Anoxic, Mgal	0.37	0.56	0.56
HRT, Total Anoxic, hr	5.92	8.88	5.30
Volume, Pre-Aerobic Mgal	1.10	1.65	1.65
Volume, Re-Aeration, Mgal	0.02	0.02	0.02
HRT, Pre-Aerobic, hr	8.80	13.20	7.92
HRT, Total Aerobic, hr	8.92	13.38	8.03
SRT, Aerobic, days	8.00	8.00	12.00
MLVSS, Oxic Zone, mg/L	2667	1631	3286
MLSS, Oxic Zone, mg/L	3310	2018	4109
HRT, Total, hr	14.84	22.26	13.33
Actual Oxygen Requirement, lb/d	8,136	8,004	11,820
Standard Oxygen Requirement, lb/d	23,743	23,358	34,310
Total estimated airflow, scfm	3,097	3,046	4,475
Internal Recyle, mgd	12.00	12.00	20.00
Supplemental Alkalinity Addition, lb/d $CaCO_3$	1,750	1,750	2,550
Supplemental Carbon Addition,	100	100	25

	Annual Average (2 Trains)	Annual Average (3 Trains)	Max Month (3 Trains)
methanol gpd			
Supplemental Carbon Addition, lbsCOD/day	991	991	248
Secondary Clarifier			
No. of Tanks Online	2	3	3
Diameter, ft	75	75	75
Depth, ft	16	16	16
SOR, average day, gal/sf/d	445	296	495
SLR, peak day, lb/sf/d	33.4	13.6	31.1
Effluent Quality			
Effluent BOD5, mg/l	3.4	2.4	3.0
Effluent COD, mg/l	32.4	28.4	32.3
Effluent TKN, mg/l	1.5	1.5	3.1
Effluent NH3, mg/l	1.0	1.0	1.0
Effluent NOx, mg/l	1.0	1.0	1.2
Effluent TN, mg/l	3.5	3.5	3.8
Effluent TN, lbs/day	74	74	155
Effluent P, mg/l	3.3	2.9	2.6
Effluent TSS, mg/l	8.1	4.5	9.4
Waste Activated Sludge			
Flow rate, mgd	0.0332	0.07	0.0459
TSS, mg/L	9,892	6,028	12,274
VSS, mg/L	7,967	4,868	9,807
WAS, lb/d	3,380	3,538	4,699

As shown in Table 3, expanding the MLE process presented in Section 4.1.1 to a 4-stage Bardenpho process with carbon addition will allow treatment to 3.5 mg/L TN. The model shows the Bardenpho process achieving TN concentrations 3.8 mg/L at maximum month conditions. As discussed previously, it is assumed that a tertiary denitrification filter will be used to achieve treatment to below 3 mg/L TN.

As shown in the Table 3, in order to provide sufficient aerobic solids retention time of 12 days at maximum month conditions to ensure nitrification at the low temperature of 10°C, a mixed liquor suspended solids (MLSS) concentration in the secondary system of 4,109 mg/L was maintained. State-point analysis was used to size the secondary clarifiers for this loading condition at peak daily flows. The graph in Figure 4 shows the state point assuming three 75-foot clarifiers on-line. In addition, state point analysis (not shown) indicated that sufficient clarification capacity for future average loadings could be provided with only two 75-foot clarifiers on-line. Surface Overflow Rates (SOR) and Solids Loading Rates (SLR) for this secondary clarifier area are shown in Table 5 and are well within TR-16 recommendations.

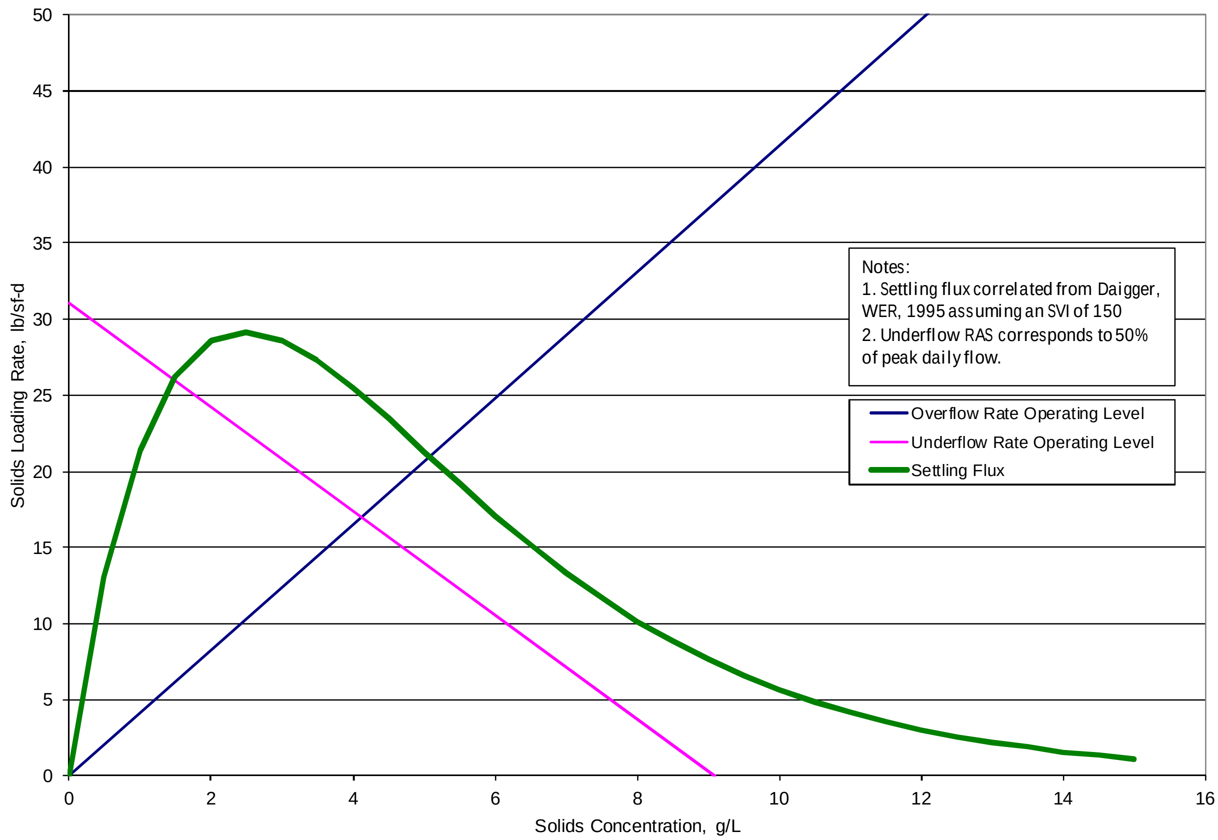


FIGURE 4

STATE POINT ANALYSIS FOR 4-STAGE BARDENPHO PROCESS – FUTURE DESIGN CONDITIONS

Aeration and mixing requirements for the 4-stage Bardenpho process are shown in Table 6. Chemical addition requirements to maintain sufficient alkalinity and for supplemental carbon are shown in Table 7. It should be noted that more supplemental carbon is estimated to be required for annual average conditions than maximum month conditions because the BOD:N ratio is greater and therefore the process is less carbon-limited during maximum month conditions. In addition, greater supplemental alkalinity is required for the 4-Stage Bardenpho than the MLE process due to the greater influent TKN treatment capacity, although the 4-Stage Bardenpho process has greater alkalinity recovery due to denitrification.

TABLE 6

FUTURE AERATION AND MIXING REQUIREMENTS FOR 4-STAGE BARDENPHO PROCESS

	Aeration Energy		**Peak Day**	
Mixing Energy	**Average Winter**	**Average Summer**	**Total Capacity Required**	**Air Demand**
(HP)	(HP)	(HP)	(HP)	
37	100	150	300	5,000 scfm @ 9.1 psi

TABLE 7

CHEMICAL ADDITION REQUIREMENTS FOR 4-STAGE BARDENPHO PROCESS

	Alkalinity (lb/d $CaCO_3$)	Supplemental Carbon (gpd methanol)
Annual Average	1,750	100
Maximum Month	2,550	60

5 ANALYSIS, EVALUATION, AND DISCUSSION

The following strategy was identified for plant modification to provide a phased approach to nitrogen removal:

1. Installation of an MLE process to meet AOC requirements of 8 mg/L TN
2. Future expansion to 4-Stage Bardenpho process with tertiary denitrification filters to meet future permit requirements of 3 mg/L TN, as required

5.1 Installation of MLE Process

Modeling was used to determine total aeration tank volumes. Three trains would be required to treat maximum month flows. A preliminary tank layout, assuming a sidewater depth of 18 feet, is shown in Figure 5.

To achieve proper settling conditions, each secondary clarifier was modeled with a 16-foot sidewater depth and 75-foot diameter.

The model was run using current flows and loads data (2011-2013) to determine the ability of the design MLE process to meet current conditions. Treatment of current annual average and maximum month wastewater flows and loads to 8 mg/L TN could be achieved with only one train online and with no chemical addition.

5.2 Expansion to 4-stage Bardenpho

Modeling was used to expand on the MLE aeration tank volumes by adding post-anoxic and re-aeration zones to each train. Additional tanks would need to be added to each train of the MLE process discussed above. A preliminary layout is shown in Figure 6.

With the addition of a post-anoxic zone, supplemental carbon will be required for denitrification, since most of the exogenous carbon in the wastewater influent is used up in the pre-anoxic zone. Therefore, storage and feed systems for supplemental carbon will be required. For modeling purposes, methanol was assumed as the carbon source. Carbon addition will vary depending on desired level of treatment. Various alternative sources for supplemental carbon are available and should be evaluated during preliminary design.

Secondary clarifier requirements for the 4-stage Bardenpho process are the same as for the MLE process.

5.3 Installation of a tertiary denitification filter

Additional denitrification to achieve an effluent TN limit of 3 mg/L could be achieved by adding a tertiary denitrification filter to treat secondary clarifier effluent from the 4-stage Bardenpho process. Installation of a tertiary system will require the additional construction of additional tanks, supplemental carbon storage and feed system, and equipment building.

WRIGHT-PIERCE
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MEMORANDUM

TO:	Project Team	DATE:	02 February 2015
FROM:	Ed Leonard, PE Andy Morrill, PE Michael Curry	PROJECT NO.:	12883A
SUBJECT:	Exeter, NH – Wastewater Facilities Plan Aerated Lagoon Sludge Survey		

INTRODUCTION

The Exeter WWTF includes three aerated wastewater lagoons. As part of the Wastewater Facilities Plan, a sludge sampling survey was conducted by Wright-Pierce with the purpose of refining the lagoon decommissioning cost estimate. This memorandum summarizes the survey procedures, sludge volume analysis, sludge sample analysis, and regulatory impacts.

SLUDGE LAGOON SURVEY

The purpose of the sludge lagoon survey was to assess the quantity and quality of the sludge in each lagoon. The sludge survey procedure proposed the use of three different test methods at each location using a portable TSS/solids probe, “sludge judge” and fish/depth finder. Different sampling methods were initially used to determine the most accurate and efficient means of sampling. After initial trials, it was found that the TSS/solids probe and fish/depth finder was not able to provide reliable data. Therefore all survey data was collected using the “sludge judge”.

The sludge survey was completed during the week of October 24, 2014. Sampling grids for each lagoon were created in 100-foot intervals and geo-referenced in a handheld GPS unit prior to the survey as shown on Figure 1. At each sample location, a 10-foot “sludge judge” was carefully lowered from the boat to the bottom of the lagoon. The sludge judge was then raised, and the sludge blanket thickness was measured and recorded.

One composite sludge sample was collected from each lagoon for laboratory analysis. The composite sample from each lagoon (1,500 mL) consisted of three randomly selected discrete samples (500 mL). The composite samples were thoroughly mixed and then split into duplicates (120 mL) and both duplicate samples were analyzed for selected metals and percent solids.

SLUDGE SAMPLE ANALYSIS

Both duplicate sludge samples for each lagoon were analyzed by a certified private laboratory for Sludge Quality Certification (SQC) metals specified in Env-Wq 807.03(c). The laboratory results are presented in the Analytical Report (Attachment A) and a summary of the laboratory results can be found in Table 1. Results indicate that two of the metals exceeded SQC Criteria in several of the samples. Molybdenum exceeded the SQC Criteria (35 mg/kg) in one of the samples in Lagoon 2 and both samples in Lagoon 3. Zinc exceeded the SQC Criteria (2,500 mg/kg) in both samples in Lagoon 1 and Lagoon 2.

Additional analyses are required to obtain a SQC, which are specified in Env-Wq 807.03(e) and are not included in this evaluation. These Interim Guidance Values (Attachment 2) for screening includes, but is not limited to: volatile organic compounds (VOCs); semi-volatile organic compounds (SVOCs); additional metals; pesticides; polychlorinated biphenyls (PCBs); dioxins; cyanides; and enteric virus. This screening analysis based on the Interim Guidance Values will determine the class sludge and site specific limitations.

Table 1: Sludge Metals Analysis

Analyte	*Lagoon 1*		*Lagoon 2*		*Lagoon 3*		Criteria for SQC Certification
	Dup. 1	Dup. 2	Dup. 1	Dup. 2	Dup. 1	Dup. 2	
Percent Solids (mg/kg)	4.62	4.86	3.69	4.42	2.65	2.56	-
Arsenic, Total (mg/kg)	24	24	20	18	16	21	32
Cadmium, Total (mg/kg)	<8.4	<8.0	<10	<8.6	<7.5	<7.5	14
Chromium, Total (mg/kg)	50	66	76	67	65	76	1,000
Copper, Total (mg/kg)	730	790	790	700	520	600	1,500
Lead, Total (mg/kg)	73	75	77	68	<74	<76	300
Mercury, Total (mg/kg)	4.3	2.8	2.3	2.3	<2.4	<2.5	10
Molybdenum, Total (mg/kg)	<21	26	**37**	33	**50**	**57**	35
Nickel, Total (mg/kg)	29	33	44	40	48	58	200
Selenium, Total (mg/kg)	<17	<16	<20	<17	<15	<15	28
Zinc, Total (mg/kg)	**3,300**	**3,500**	**2,900**	**2,600**	1900	2200	2,500

Note:

1. **Bold** font indicates a result above SQC Criteria (Env-Wq 807.03(c))

SLUDGE VOLUME ANALYSIS

The recorded sludge survey data points were used to develop GIS surface models of the lagoon sludge blankets for each lagoon. From these models, a wet sludge volume was calculated for each lagoon. The 3% to 5% range of solids concentrations for lagoon sludge was estimated based on sludge sampling laboratory results which ranged from 2.5% to 4.8% and from previous telephone communications with Paul Senesac of P.H. Senesac. Using the wet sludge volume, the dry weight of sludge was calculated over a 3% to 5% range of percent solids as shown in Table 2.

Table 2: Sludge Survey Results and Volume Analysis

Sludge Lagoon	Avg. Total Depth (ft)	Avg. Sludge Depth (ft)	Wet Sludge Volume (ft^3)	Wet Sludge Weight (tons)	Dry Sludge Weight (tons) based on Percent Solids		
					3%	4%	5%
No. 1	8.3	2.5	1,020,000	31,900	958	1,278	1,597
No. 2	7.7	1.3	490,000	15,200	457	609	762
No. 3	7.6	1.4	470,000	14,600	438	583	729
Total[1]	-	-	1,980,000	61,800	**1,853**	**2,471**	**3,088**

[1]Sludge Storage Lagoon not included in total.

REGULATORY IMPACTS

The data indicates that a SQC for the lagoon sludge could not be obtained in its current state due to molybdenum and zinc concentrations being marginally above the criteria value. Based on email correspondence with Mike Rainey (NHDES Residuals Management) on December 12, 2014, the lagoon sludge would require either 1) further treatment (i.e., blending) to lower the metals concentrations; or 2) a waiver to receive a SQC. Mr. Rainey indicated that waivers are not commonly granted and should not be considered a primary approach.

As a result, Wright-Pierce contacted Charley Hanson of Resource Management, Inc. by telephone on December 17, 2014, to discuss blending options to lower the metals concentrations in the sludge. Mr. Hanson indicated that wood ash could be blended with the dewatered sludge to effectively lower metals concentrations to below SQC criteria.

COST IMPACTS

Costs presented in Wastewater Facilities Plan were updated to reflect the findings of the initial aerated lagoon sludge survey. Based on telephone communications on December 17, 2014 with Paul Senesac of P.H. Senesac, the sludge dewatering and disposal unit cost of $1,000 per dry ton would be sufficient to include the added cost of wood ash blending. Estimated sludge dewatering and disposal costs are shown in Table 3.

Table 3: Estimated Sludge Dewatering and Disposal Costs

Sludge Lagoon	Total Cost Based on Percent Solids ($1,000/dry ton[1])		
	3%	4%	5%
No. 1	$960,000	$1,280,000	$1,600,000
No. 2	$460,000	$610,000	$770,000
No. 3	$440,000	$590,000	$730,000
Total	**$1,860,000**	**$2,480,000**	**$3,100,000**

[1]Sludge dewatering and disposal unit cost based on Town of Peterborough Lagoon Closure bid results (July 10, 2014, ENR CCI 9835) and discussions with P. H. Senesac

RECOMMENDATIONS

We offer the following recommendations.

- In the design phase, perform additional sampling and laboratory analysis in all three aerated lagoons to obtain an SQC based on the criteria listed in the NHDES Interim Guidance Values (Attachment 2).

- In the design phase, perform a sludge survey for the sludge storage lagoon to quantify the sludge volume and analyze samples for the metals specified in Env-Wq 807.03(c).

- Update the costs carried in the Wastewater Facilities Plan (Preliminary Draft, October 2014)

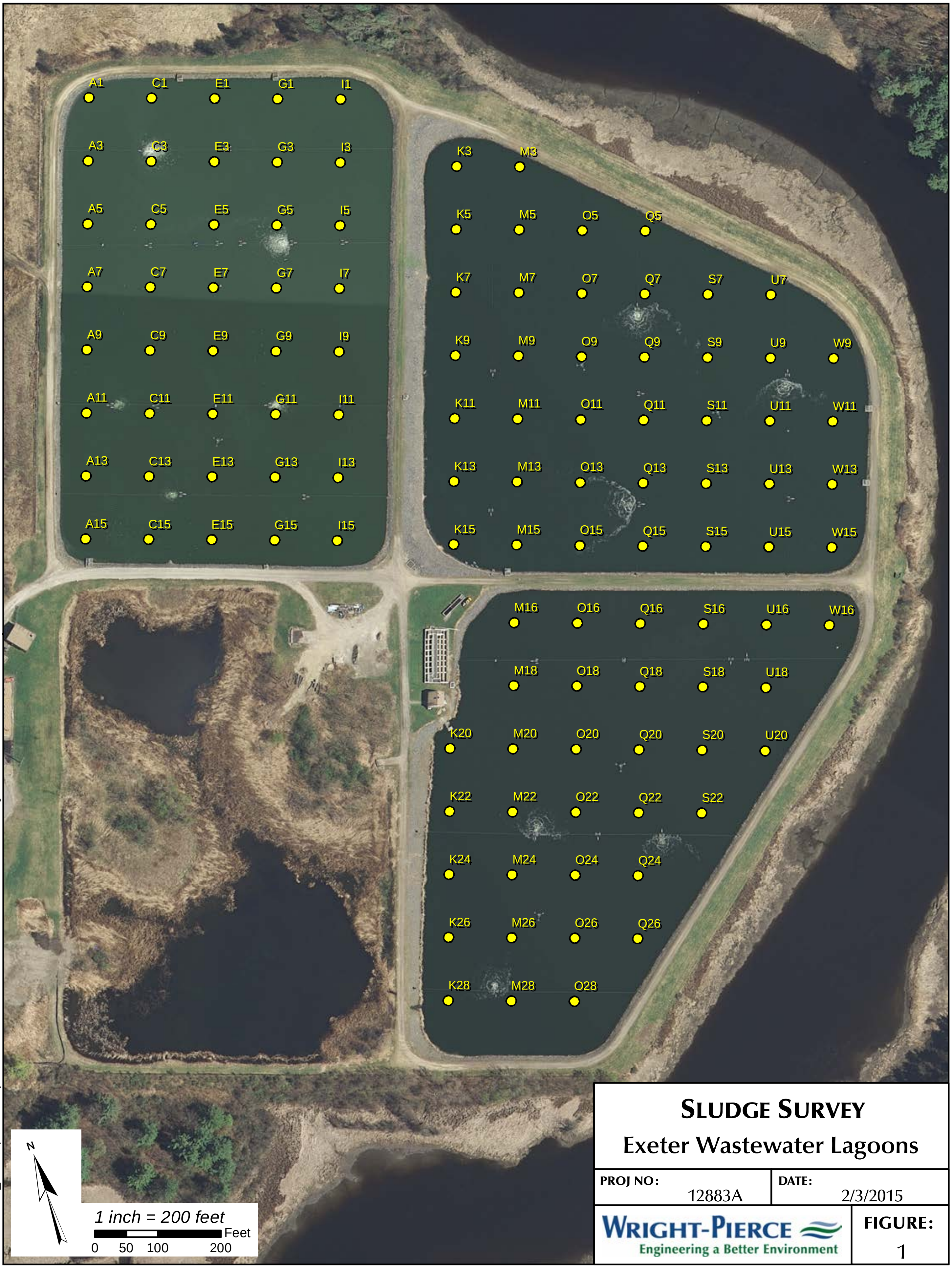
<u>Figure</u>

- Figure 1 – Sludge Survey Grid

<u>Attachments</u>

- Attachment A – Laboratory Analytical Report – Sludge Samples (January 8, 2015)

- Attachment B – Interim Guidelines (March 30, 2001)



SLUDGE SURVEY

Exeter Wastewater Lagoons

PROJ NO:	DATE:
12883A	2/3/2015

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FIGURE: 1

JMN W:\GIS_Development\Projects\NH\Exeter\12883A-WWFacilitiesPlan\MXDs\LagoonsGrid.mxd

ANALYTICAL REPORT

Lab Number:	L1425833
Client:	Wright-Pierce 230 Commerce Way Suite 302 Portsmouth, NH 03801
ATTN:	Michael Curry
Phone:	(603) 430-6094
Project Name:	EXETER WWTF LAGOONS
Project Number:	12883A
Report Date:	01/08/15

Certifications & Approvals: MA (M-MA086), NY (11148), CT (PH-0574), NH (2003), NJ NELAP (MA935), RI (LAO00065), ME (MA00086), PA (68-03671), USDA (Permit #P-330-11-00240), NC (666), TX (T104704476), DOD (L2217), US Army Corps of Engineers.

Project Name: EXETER WWTF LAGOONS
Project Number: 12883A

Lab Number: L1425833
Report Date: 01/08/15

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L1425833-01	LAGOON 1 SAMPLE 1	SOIL	EXETER, NH	10/27/14 12:00	10/29/14
L1425833-02	LAGOON 1 SAMPLE 2	SOIL	EXETER, NH	10/27/14 12:00	10/29/14
L1425833-03	LAGOON 2 SAMPLE 1	SOIL	EXETER, NH	10/29/14 09:30	10/29/14
L1425833-04	LAGOON 2 SAMPLE 2	SOIL	EXETER, NH	10/29/14 09:30	10/29/14
L1425833-05	LAGOON 3 SAMPLE 1	SOIL	EXETER, NH	10/29/14 11:00	10/29/14
L1425833-06	LAGOON 3 SAMPLE 2	SOIL	EXETER, NH	10/29/14 11:00	10/29/14

Project Name:	EXETER WWTF LAGOONS	**Lab Number:**	L1425833
Project Number:	12883A	**Report Date:**	01/08/15

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. All specific QC information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY

For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Client Services at 800-624-9220 with any questions.

Project Name:	EXETER WWTF LAGOONS	**Lab Number:**	L1425833
Project Number:	12883A	**Report Date:**	01/08/15

Case Narrative (continued)

Report Submission

This report replaces the report issued November 05, 2014. The reporting limits for Molybdenum were lowered on all samples, and for Selenium and Cadmium on samples L1425833-05 and -06.

At the client's request, the samples were also analyzed for Copper.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Lisa Westerlind

Title: Technical Director/Representative

Date: 01/08/15

METALS

Project Name:	EXETER WWTF LAGOONS	**Lab Number:**	L1425833
Project Number:	12883A	**Report Date:**	01/08/15

SAMPLE RESULTS

Lab ID:	L1425833-01	Date Collected:	10/27/14 12:00
Client ID:	LAGOON 1 SAMPLE 1	Date Received:	10/29/14
Sample Location:	EXETER, NH	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	5%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Antimony, Total	ND		mg/kg	42	--	1	10/30/14 21:02	11/04/14 20:33	EPA 3050B	1,6010C	MG
Arsenic, Total	24		mg/kg	8.4	--	1	10/30/14 21:02	11/04/14 20:33	EPA 3050B	1,6010C	MG
Beryllium, Total	ND		mg/kg	4.2	--	1	10/30/14 21:02	11/04/14 20:33	EPA 3050B	1,6010C	MG
Cadmium, Total	ND		mg/kg	8.4	--	1	10/30/14 21:02	11/04/14 20:33	EPA 3050B	1,6010C	MG
Chromium, Total	50		mg/kg	8.4	--	1	10/30/14 21:02	11/04/14 20:33	EPA 3050B	1,6010C	MG
Copper, Total	730		mg/kg	8.4	--	1	10/30/14 21:02	11/04/14 20:33	EPA 3050B	1,6010C	MG
Lead, Total	73		mg/kg	42	--	1	10/30/14 21:02	11/04/14 20:33	EPA 3050B	1,6010C	MG
Mercury, Total	4.3		mg/kg	1.5	--	1	10/31/14 09:01	10/31/14 14:52	EPA 7471B	1,7471B	MC
Molybdenum, Total	ND		mg/kg	21	--	1	10/30/14 21:02	11/04/14 20:33	EPA 3050B	1,6010C	MG
Nickel, Total	29		mg/kg	21	--	1	10/30/14 21:02	11/04/14 20:33	EPA 3050B	1,6010C	MG
Selenium, Total	ND		mg/kg	17	--	1	10/30/14 21:02	11/04/14 20:33	EPA 3050B	1,6010C	MG
Silver, Total	15		mg/kg	8.4	--	1	10/30/14 21:02	11/04/14 20:33	EPA 3050B	1,6010C	MG
Thallium, Total	ND		mg/kg	17	--	1	10/30/14 21:02	11/04/14 20:33	EPA 3050B	1,6010C	MG
Zinc, Total	3300		mg/kg	42	--	1	10/30/14 21:02	11/04/14 20:33	EPA 3050B	1,6010C	MG

Project Name: EXETER WWTF LAGOONS **Lab Number:** L1425833
Project Number: 12883A **Report Date:** 01/08/15

SAMPLE RESULTS

Lab ID: L1425833-02 Date Collected: 10/27/14 12:00
Client ID: LAGOON 1 SAMPLE 2 Date Received: 10/29/14
Sample Location: EXETER, NH Field Prep: Not Specified
Matrix: Soil
Percent Solids: 5%

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Antimony, Total	ND		mg/kg	40	--	1	10/30/14 21:02	11/04/14 20:36	EPA 3050B	1,6010C	MG
Arsenic, Total	24		mg/kg	8.0	--	1	10/30/14 21:02	11/04/14 20:36	EPA 3050B	1,6010C	MG
Beryllium, Total	ND		mg/kg	4.0	--	1	10/30/14 21:02	11/04/14 20:36	EPA 3050B	1,6010C	MG
Cadmium, Total	ND		mg/kg	8.0	--	1	10/30/14 21:02	11/04/14 20:36	EPA 3050B	1,6010C	MG
Chromium, Total	66		mg/kg	8.0	--	1	10/30/14 21:02	11/04/14 20:36	EPA 3050B	1,6010C	MG
Copper, Total	790		mg/kg	8.0	--	1	10/30/14 21:02	11/04/14 20:36	EPA 3050B	1,6010C	MG
Lead, Total	75		mg/kg	40	--	1	10/30/14 21:02	11/04/14 20:36	EPA 3050B	1,6010C	MG
Mercury, Total	2.8		mg/kg	1.3	--	1	10/31/14 09:01	10/31/14 14:54	EPA 7471B	1,7471B	MC
Molybdenum, Total	26		mg/kg	20	--	1	10/30/14 21:02	11/04/14 20:36	EPA 3050B	1,6010C	MG
Nickel, Total	33		mg/kg	20	--	1	10/30/14 21:02	11/04/14 20:36	EPA 3050B	1,6010C	MG
Selenium, Total	ND		mg/kg	16	--	1	10/30/14 21:02	11/04/14 20:36	EPA 3050B	1,6010C	MG
Silver, Total	17		mg/kg	8.0	--	1	10/30/14 21:02	11/04/14 20:36	EPA 3050B	1,6010C	MG
Thallium, Total	ND		mg/kg	16	--	1	10/30/14 21:02	11/04/14 20:36	EPA 3050B	1,6010C	MG
Zinc, Total	3500		mg/kg	40	--	1	10/30/14 21:02	11/04/14 20:36	EPA 3050B	1,6010C	MG

Project Name:	EXETER WWTF LAGOONS	**Lab Number:**	L1425833
Project Number:	12883A	**Report Date:**	01/08/15

SAMPLE RESULTS

Lab ID:	L1425833-03	Date Collected:	10/29/14 09:30
Client ID:	LAGOON 2 SAMPLE 1	Date Received:	10/29/14
Sample Location:	EXETER, NH	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	4%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Antimony, Total	ND		mg/kg	51	--	1	10/30/14 21:02	11/04/14 20:40	EPA 3050B	1,6010C	MG
Arsenic, Total	20		mg/kg	10	--	1	10/30/14 21:02	11/04/14 20:40	EPA 3050B	1,6010C	MG
Beryllium, Total	ND		mg/kg	5.1	--	1	10/30/14 21:02	11/04/14 20:40	EPA 3050B	1,6010C	MG
Cadmium, Total	ND		mg/kg	10	--	1	10/30/14 21:02	11/04/14 20:40	EPA 3050B	1,6010C	MG
Chromium, Total	76		mg/kg	10	--	1	10/30/14 21:02	11/04/14 20:40	EPA 3050B	1,6010C	MG
Copper, Total	790		mg/kg	10	--	1	10/30/14 21:02	11/04/14 20:40	EPA 3050B	1,6010C	MG
Lead, Total	77		mg/kg	51	--	1	10/30/14 21:02	11/04/14 20:40	EPA 3050B	1,6010C	MG
Mercury, Total	2.3		mg/kg	1.8	--	1	10/31/14 09:01	10/31/14 14:56	EPA 7471B	1,7471B	MC
Molybdenum, Total	37		mg/kg	26	--	1	10/30/14 21:02	11/04/14 20:40	EPA 3050B	1,6010C	MG
Nickel, Total	44		mg/kg	25	--	1	10/30/14 21:02	11/04/14 20:40	EPA 3050B	1,6010C	MG
Selenium, Total	ND		mg/kg	20	--	1	10/30/14 21:02	11/04/14 20:40	EPA 3050B	1,6010C	MG
Silver, Total	23		mg/kg	10	--	1	10/30/14 21:02	11/04/14 20:40	EPA 3050B	1,6010C	MG
Thallium, Total	ND		mg/kg	20	--	1	10/30/14 21:02	11/04/14 20:40	EPA 3050B	1,6010C	MG
Zinc, Total	2900		mg/kg	51	--	1	10/30/14 21:02	11/04/14 20:40	EPA 3050B	1,6010C	MG

Project Name: EXETER WWTF LAGOONS
Lab Number: L1425833
Project Number: 12883A
Report Date: 01/08/15

SAMPLE RESULTS

Lab ID: L1425833-04
Date Collected: 10/29/14 09:30
Client ID: LAGOON 2 SAMPLE 2
Date Received: 10/29/14
Sample Location: EXETER, NH
Field Prep: Not Specified
Matrix: Soil
Percent Solids: 4%

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Antimony, Total	ND		mg/kg	43	--	1	10/30/14 21:02	11/04/14 20:44	EPA 3050B	1,6010C	MG
Arsenic, Total	18		mg/kg	8.6	--	1	10/30/14 21:02	11/04/14 20:44	EPA 3050B	1,6010C	MG
Beryllium, Total	ND		mg/kg	4.3	--	1	10/30/14 21:02	11/04/14 20:44	EPA 3050B	1,6010C	MG
Cadmium, Total	ND		mg/kg	8.6	--	1	10/30/14 21:02	11/04/14 20:44	EPA 3050B	1,6010C	MG
Chromium, Total	67		mg/kg	8.6	--	1	10/30/14 21:02	11/04/14 20:44	EPA 3050B	1,6010C	MG
Copper, Total	700		mg/kg	8.6	--	1	10/30/14 21:02	11/04/14 20:44	EPA 3050B	1,6010C	MG
Lead, Total	68		mg/kg	43	--	1	10/30/14 21:02	11/04/14 20:44	EPA 3050B	1,6010C	MG
Mercury, Total	2.3		mg/kg	1.5	--	1	10/31/14 09:01	10/31/14 14:58	EPA 7471B	1,7471B	MC
Molybdenum, Total	33		mg/kg	22	--	1	10/30/14 21:02	11/04/14 20:44	EPA 3050B	1,6010C	MG
Nickel, Total	40		mg/kg	22	--	1	10/30/14 21:02	11/04/14 20:44	EPA 3050B	1,6010C	MG
Selenium, Total	ND		mg/kg	17	--	1	10/30/14 21:02	11/04/14 20:44	EPA 3050B	1,6010C	MG
Silver, Total	23		mg/kg	8.6	--	1	10/30/14 21:02	11/04/14 20:44	EPA 3050B	1,6010C	MG
Thallium, Total	ND		mg/kg	17	--	1	10/30/14 21:02	11/04/14 20:44	EPA 3050B	1,6010C	MG
Zinc, Total	2600		mg/kg	43	--	1	10/30/14 21:02	11/04/14 20:44	EPA 3050B	1,6010C	MG

Project Name:	EXETER WWTF LAGOONS	**Lab Number:**	L1425833
Project Number:	12883A	**Report Date:**	01/08/15

SAMPLE RESULTS

Lab ID:	L1425833-05	Date Collected:	10/29/14 11:00
Client ID:	LAGOON 3 SAMPLE 1	Date Received:	10/29/14
Sample Location:	EXETER, NH	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	3%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Antimony, Total	ND		mg/kg	74	--	1	10/30/14 21:02	11/04/14 21:08	EPA 3050B	1,6010C	MG
Arsenic, Total	16		mg/kg	15	--	1	10/30/14 21:02	11/04/14 21:08	EPA 3050B	1,6010C	MG
Beryllium, Total	ND		mg/kg	7.4	--	1	10/30/14 21:02	11/04/14 21:08	EPA 3050B	1,6010C	MG
Cadmium, Total	ND		mg/kg	7.5	--	1	10/30/14 21:02	11/04/14 21:08	EPA 3050B	1,6010C	MG
Chromium, Total	65		mg/kg	15	--	1	10/30/14 21:02	11/04/14 21:08	EPA 3050B	1,6010C	MG
Copper, Total	520		mg/kg	15	--	1	10/30/14 21:02	11/04/14 21:08	EPA 3050B	1,6010C	MG
Lead, Total	ND		mg/kg	74	--	1	10/30/14 21:02	11/04/14 21:08	EPA 3050B	1,6010C	MG
Mercury, Total	ND		mg/kg	2.4	--	1	10/31/14 09:01	10/31/14 14:59	EPA 7471B	1,7471B	MC
Molybdenum, Total	50		mg/kg	37	--	1	10/30/14 21:02	11/04/14 21:08	EPA 3050B	1,6010C	MG
Nickel, Total	48		mg/kg	37	--	1	10/30/14 21:02	11/04/14 21:08	EPA 3050B	1,6010C	MG
Selenium, Total	ND		mg/kg	15	--	1	10/30/14 21:02	11/04/14 21:08	EPA 3050B	1,6010C	MG
Silver, Total	19		mg/kg	15	--	1	10/30/14 21:02	11/04/14 21:08	EPA 3050B	1,6010C	MG
Thallium, Total	ND		mg/kg	30	--	1	10/30/14 21:02	11/04/14 21:08	EPA 3050B	1,6010C	MG
Zinc, Total	1900		mg/kg	74	--	1	10/30/14 21:02	11/04/14 21:08	EPA 3050B	1,6010C	MG

Project Name: EXETER WWTF LAGOONS **Lab Number:** L1425833
Project Number: 12883A **Report Date:** 01/08/15

SAMPLE RESULTS

Lab ID: L1425833-06 Date Collected: 10/29/14 11:00
Client ID: LAGOON 3 SAMPLE 2 Date Received: 10/29/14
Sample Location: EXETER, NH Field Prep: Not Specified
Matrix: Soil
Percent Solids: 3%

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Antimony, Total	ND		mg/kg	76	--	1	10/30/14 21:02	11/04/14 21:11	EPA 3050B	1,6010C	MG
Arsenic, Total	21		mg/kg	15	--	1	10/30/14 21:02	11/04/14 21:11	EPA 3050B	1,6010C	MG
Beryllium, Total	ND		mg/kg	7.6	--	1	10/30/14 21:02	11/04/14 21:11	EPA 3050B	1,6010C	MG
Cadmium, Total	ND		mg/kg	7.5	--	1	10/30/14 21:02	11/04/14 21:11	EPA 3050B	1,6010C	MG
Chromium, Total	76		mg/kg	15	--	1	10/30/14 21:02	11/04/14 21:11	EPA 3050B	1,6010C	MG
Copper, Total	600		mg/kg	15	--	1	10/30/14 21:02	11/04/14 21:11	EPA 3050B	1,6010C	MG
Lead, Total	ND		mg/kg	76	--	1	10/30/14 21:02	11/04/14 21:11	EPA 3050B	1,6010C	MG
Mercury, Total	ND		mg/kg	2.5	--	1	10/31/14 09:01	10/31/14 15:01	EPA 7471B	1,7471B	MC
Molybdenum, Total	57		mg/kg	38	--	1	10/30/14 21:02	11/04/14 21:11	EPA 3050B	1,6010C	MG
Nickel, Total	58		mg/kg	38	--	1	10/30/14 21:02	11/04/14 21:11	EPA 3050B	1,6010C	MG
Selenium, Total	ND		mg/kg	15	--	1	10/30/14 21:02	11/04/14 21:11	EPA 3050B	1,6010C	MG
Silver, Total	16		mg/kg	15	--	1	10/30/14 21:02	11/04/14 21:11	EPA 3050B	1,6010C	MG
Thallium, Total	ND		mg/kg	30	--	1	10/30/14 21:02	11/04/14 21:11	EPA 3050B	1,6010C	MG
Zinc, Total	2200		mg/kg	76	--	1	10/30/14 21:02	11/04/14 21:11	EPA 3050B	1,6010C	MG

Project Name: EXETER WWTF LAGOONS **Lab Number:** L1425833
Project Number: 12883A **Report Date:** 01/08/15

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Metals - Westborough Lab for sample(s): 01-06 Batch: WG736184-1										
Antimony, Total	ND		mg/kg	2.0	--	1	10/30/14 21:02	11/04/14 16:31	1,6010C	MG
Arsenic, Total	ND		mg/kg	0.40	--	1	10/30/14 21:02	11/04/14 16:31	1,6010C	MG
Beryllium, Total	ND		mg/kg	0.20	--	1	10/30/14 21:02	11/04/14 16:31	1,6010C	MG
Cadmium, Total	ND		mg/kg	0.20	--	1	10/30/14 21:02	11/04/14 16:31	1,6010C	MG
Chromium, Total	ND		mg/kg	0.40	--	1	10/30/14 21:02	11/04/14 16:31	1,6010C	MG
Copper, Total	ND		mg/kg	0.40	--	1	10/30/14 21:02	11/04/14 16:31	1,6010C	MG
Lead, Total	ND		mg/kg	2.0	--	1	10/30/14 21:02	11/04/14 16:31	1,6010C	MG
Molybdenum, Total	ND		mg/kg	1.0	--	1	10/30/14 21:02	11/04/14 16:31	1,6010C	MG
Nickel, Total	ND		mg/kg	1.0	--	1	10/30/14 21:02	11/04/14 16:31	1,6010C	MG
Selenium, Total	ND		mg/kg	0.40	--	1	10/30/14 21:02	11/04/14 16:31	1,6010C	MG
Silver, Total	ND		mg/kg	0.40	--	1	10/30/14 21:02	11/04/14 16:31	1,6010C	MG
Thallium, Total	ND		mg/kg	0.80	--	1	10/30/14 21:02	11/04/14 16:31	1,6010C	MG
Zinc, Total	ND		mg/kg	2.0	--	1	10/30/14 21:02	11/04/14 16:31	1,6010C	MG

Prep Information

Digestion Method: EPA 3050B

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Metals - Westborough Lab for sample(s): 01-06 Batch: WG736266-1										
Mercury, Total	ND		mg/kg	0.08	--	1	10/31/14 09:01	10/31/14 13:15	1,7471B	MC

Prep Information

Digestion Method: EPA 7471B

Lab Control Sample Analysis
Batch Quality Control

Project Name: EXETER WWTF LAGOONS
Project Number: 12883A
Lab Number: L1425833
Report Date: 01/08/15

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Total Metals - Westborough Lab Associated sample(s): 01-06 Batch: WG736184-2 SRM Lot Number: D083-540								
Antimony, Total	146		-		1-210	-		
Arsenic, Total	90		-		78-122	-		
Beryllium, Total	94		-		82-118	-		
Cadmium, Total	91		-		82-118	-		
Chromium, Total	92		-		79-121	-		
Copper, Total	95		-		80-120	-		
Lead, Total	89		-		81-119	-		
Molybdenum, Total	92		-		77-123	-		
Nickel, Total	89		-		82-118	-		
Selenium, Total	96		-		78-123	-		
Silver, Total	94		-		74-125	-		
Thallium, Total	86		-		78-122	-		
Zinc, Total	92		-		80-121	-		
Total Metals - Westborough Lab Associated sample(s): 01-06 Batch: WG736266-2 SRM Lot Number: D083-540								
Mercury, Total	100		-		75-126	-		

Matrix Spike Analysis
Batch Quality Control

Project Name: EXETER WWTF LAGOONS
Project Number: 12883A

Lab Number: L1425833
Report Date: 01/08/15

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Total Metals - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG736184-3 WG736184-4 QC Sample: L1425901-06 Client ID: MS Sample												
Antimony, Total	ND	47.2	42	89		34	75		75-125	**21**	Q	20
Arsenic, Total	3.6	11.3	14	92		12	77		75-125	15		20
Beryllium, Total	ND	4.72	4.6	97		4.4	97		75-125	4		20
Cadmium, Total	ND	4.82	4.7	98		4.4	95		75-125	7		20
Chromium, Total	14	18.9	31	90		30	88		75-125	3		20
Copper, Total	28	23.6	68	**169**	Q	46	79		75-125	**39**	Q	20
Lead, Total	120	48.2	310	**394**	Q	140	**43**	Q	75-125	**76**	Q	20
Molybdenum, Total	ND	94.5	84	89		81	89		75-125	4		20
Nickel, Total	15	47.2	56	87		54	86		75-125	4		20
Selenium, Total	ND	11.3	11	97		10	92		75-125	10		20
Silver, Total	ND	28.3	27	95		26	96		75-125	4		20
Thallium, Total	ND	11.3	9.6	85		9.3	85		75-125	3		20
Zinc, Total	93	47.2	310	**459**	Q	130	82		75-125	**82**	Q	20
Total Metals - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG736266-4 QC Sample: L1425818-01 Client ID: MS Sample												
Mercury, Total	ND	0.14	0.16	114		-	-		80-120	-		20

Lab Duplicate Analysis
Batch Quality Control

Project Name: EXETER WWTF LAGOONS
Project Number: 12883A

Lab Number: L1425833
Report Date: 01/08/15

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
Total Metals - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG736266-3 QC Sample: L1425818-01 Client ID: DUP Sample						
Mercury, Total	ND	ND	mg/kg	NC		20

INORGANICS
&
MISCELLANEOUS

Project Name: EXETER WWTF LAGOONS
Project Number: 12883A

Lab Number: L1425833
Report Date: 01/08/15

SAMPLE RESULTS

Lab ID: L1425833-01
Client ID: LAGOON 1 SAMPLE 1
Sample Location: EXETER, NH
Matrix: Soil

Date Collected: 10/27/14 12:00
Date Received: 10/29/14
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	4.62		%	0.100	NA	1	-	10/29/14 23:37	30,2540G	RT

Project Name: EXETER WWTF LAGOONS
Project Number: 12883A
Lab Number: L1425833
Report Date: 01/08/15

SAMPLE RESULTS

Lab ID: L1425833-02
Client ID: LAGOON 1 SAMPLE 2
Sample Location: EXETER, NH
Matrix: Soil
Date Collected: 10/27/14 12:00
Date Received: 10/29/14
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	4.86		%	0.100	NA	1	-	10/29/14 23:37	30,2540G	RT

Project Name: EXETER WWTF LAGOONS
Project Number: 12883A

Lab Number: L1425833
Report Date: 01/08/15

SAMPLE RESULTS

Lab ID: L1425833-03
Client ID: LAGOON 2 SAMPLE 1
Sample Location: EXETER, NH
Matrix: Soil

Date Collected: 10/29/14 09:30
Date Received: 10/29/14
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	3.69		%	0.100	NA	1	-	10/29/14 23:37	30,2540G	RT

Project Name:	EXETER WWTF LAGOONS	**Lab Number:**	L1425833
Project Number:	12883A	**Report Date:**	01/08/15

SAMPLE RESULTS

Lab ID:	L1425833-04	Date Collected:	10/29/14 09:30
Client ID:	LAGOON 2 SAMPLE 2	Date Received:	10/29/14
Sample Location:	EXETER, NH	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	4.42		%	0.100	NA	1	-	10/29/14 23:37	30,2540G	RT

Project Name: EXETER WWTF LAGOONS **Lab Number:** L1425833
Project Number: 12883A **Report Date:** 01/08/15

SAMPLE RESULTS

Lab ID: L1425833-05
Client ID: LAGOON 3 SAMPLE 1
Sample Location: EXETER, NH
Matrix: Soil

Date Collected: 10/29/14 11:00
Date Received: 10/29/14
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	2.65		%	0.100	NA	1	-	10/29/14 23:37	30,2540G	RT

Project Name: EXETER WWTF LAGOONS

Lab Number: L1425833

Project Number: 12883A

Report Date: 01/08/15

SAMPLE RESULTS

Lab ID: L1425833-06

Client ID: LAGOON 3 SAMPLE 2

Sample Location: EXETER, NH

Matrix: Soil

Date Collected: 10/29/14 11:00

Date Received: 10/29/14

Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	2.56		%	0.100	NA	1	-	10/29/14 23:37	30,2540G	RT

Lab Duplicate Analysis
Batch Quality Control

Project Name: EXETER WWTF LAGOONS
Project Number: 12883A

Lab Number: L1425833
Report Date: 01/08/15

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG735788-1 QC Sample: L1425833-01 Client ID: LAGOON 1 SAMPLE 1						
Solids, Total	4.62	4.64	%	0		20

Project Name: EXETER WWTF LAGOONS
Project Number: 12883A

Lab Number: L1425833
Report Date: 01/08/15

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Reagent H2O Preserved Vials Frozen on: NA

Cooler Information Custody Seal

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1425833-01A	Amber 120ml unpreserved	A	N/A	2.9	Y	Absent	BE-TI(180),AS-TI(180),AG-TI(180),CR-TI(180),MO-TI(180),NI-TI(180),TL-TI(180),TS(7),PB-TI(180),SB-TI(180),SE-TI(180),ZN-TI(180),HG-T(28),CD-TI(180)
L1425833-02A	Amber 120ml unpreserved	A	N/A	2.9	Y	Absent	BE-TI(180),AS-TI(180),AG-TI(180),CR-TI(180),MO-TI(180),NI-TI(180),TL-TI(180),TS(7),PB-TI(180),SB-TI(180),SE-TI(180),ZN-TI(180),HG-T(28),CD-TI(180)
L1425833-03A	Amber 120ml unpreserved	A	N/A	2.9	Y	Absent	BE-TI(180),AS-TI(180),AG-TI(180),CR-TI(180),MO-TI(180),NI-TI(180),TL-TI(180),TS(7),PB-TI(180),SB-TI(180),SE-TI(180),ZN-TI(180),HG-T(28),CD-TI(180)
L1425833-04A	Amber 120ml unpreserved	A	N/A	2.9	Y	Absent	BE-TI(180),AS-TI(180),AG-TI(180),CR-TI(180),MO-TI(180),NI-TI(180),TL-TI(180),TS(7),PB-TI(180),SB-TI(180),SE-TI(180),ZN-TI(180),HG-T(28),CD-TI(180)
L1425833-05A	Amber 120ml unpreserved	A	N/A	2.9	Y	Absent	BE-TI(180),AS-TI(180),AG-TI(180),CR-TI(180),MO-TI(180),NI-TI(180),TL-TI(180),TS(7),PB-TI(180),SB-TI(180),SE-TI(180),ZN-TI(180),HG-T(28),CD-TI(180)
L1425833-06A	Amber 120ml unpreserved	A	N/A	2.9	Y	Absent	BE-TI(180),AS-TI(180),AG-TI(180),CR-TI(180),MO-TI(180),NI-TI(180),TL-TI(180),TS(7),PB-TI(180),SB-TI(180),SE-TI(180),ZN-TI(180),HG-T(28),CD-TI(180)

*Values in parentheses indicate holding time in days

GLOSSARY

Acronyms

EDL - Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).

EPA - Environmental Protection Agency.

LCS - Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LCSD - Laboratory Control Sample Duplicate: Refer to LCS.

LFB - Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

MDL - Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

MS - Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.

MSD - Matrix Spike Sample Duplicate: Refer to MS.

NA - Not Applicable.

NC - Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.

NI - Not Ignitable.

RL - Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

RPD - Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

SRM - Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.

Footnotes

1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

A - Spectra identified as "Aldol Condensation Product".

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

Data Qualifiers

G	- The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.
H	- The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
I	- The lower value for the two columns has been reported due to obvious interference.
M	- Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.
NJ	- Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
P	- The RPD between the results for the two columns exceeds the method-specified criteria.
Q	- The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
R	- Analytical results are from sample re-analysis.
RE	- Analytical results are from sample re-extraction.
S	- Analytical results are from modified screening analysis.
J	- Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
ND	- Not detected at the reporting limit (RL) for the sample.

Report Format: Data Usability Report

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IV, 2007.

30 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WPCF. 18th Edition. 1992.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certification Information

Last revised December 16, 2014

The following analytes are not included in our NELAP Scope of Accreditation:

Westborough Facility
EPA 524.2: Acetone, 2-Butanone (Methyl ethyl ketone (MEK)), Tert-butyl alcohol, 2-Hexanone, Tetrahydrofuran, 1,3,5-Trichlorobenzene, 4-Methyl-2-pentanone (MIBK), Carbon disulfide, Diethyl ether.
EPA 8260C: 1,2,4,5-Tetramethylbenzene, 4-Ethyltoluene, Iodomethane (methyl iodide), Methyl methacrylate, Azobenzene.
EPA 8270D: 1-Methylnaphthalene, Dimethylnaphthalene,1,4-Diphenylhydrazine.
EPA 625: 4-Chloroaniline, 4-Methylphenol.
SM4500: Soil: Total Phosphorus, TKN, NO2, NO3.
EPA 9071: Total Petroleum Hydrocarbons, Oil & Grease.

Mansfield Facility
EPA 8270D: Biphenyl.
EPA 2540D: TSS
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

The following analytes are included in our Massachusetts DEP Scope of Accreditation, Westborough Facility:

Drinking Water
EPA 200.8: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl; **EPA 200.7**: Ba,Be,Ca,Cd,Cr,Cu,Na; **EPA 245.1:** Mercury;
EPA 300.0: Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B**
EPA 332: Perchlorate.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT, Enterolert-QT.**

Non-Potable Water
EPA 200.8: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn;
EPA 200.7: Al,Sb,As,Be,Cd,Ca,Cr,Co,Cu,Fe,Pb,Mg,Mn,Mo,Ni,K,Se,Ag,Na,Sr,Ti,Tl,V,Zn;
EPA 245.1, SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2340B, SM2320B, SM4500CL-E, SM4500F-BC, SM426C, SM4500NH3-BH, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **SM4500NO3-F, EPA 353.2**: Nitrate-N**, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, SM4500P-B, E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, SM14 510AC, EPA 420.1, SM4500-CN-CE, SM2540D.**
EPA 624: Volatile Halocarbons & Aromatics,
EPA 608: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045**: PCB-Oil.
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9222D-MF**.

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

CHAIN OF CUSTODY

PAGE 1 OF 1

Date Rec'd in Lab: 10/29/14

ALPHA Job #: L1425833

ALPHA ANALYTICAL — World Class Chemistry

8 Walkup Drive, Westboro, MA 01581, Tel: 508-898-9220
320 Forbes Blvd, Mansfield, MA 02048, Tel: 508-822-9300

Project Information

Project Name: Exeter WWTF Lagoons
Project Location: Exeter, NH
Project #: 12883A
Project Manager: Ed Leonard
ALPHA Quote #:

Client Information

Client: Wright - Pierce
Address: 230 Commerce Way, Suite 302 Portsmouth, NH
Phone: 603 570 7118
Email: michael.curry@wright-pierce.com

Report Information - Data Deliverables

☐ ADEx ☒ EMAIL

Billing Information

☒ Same as Client info PO #:

Regulatory Requirements & Project Information Requirements

☐ Yes ☒ No MA MCP Analytical Methods ☐ Yes ☒ No CT RCP Analytical Methods
☐ Yes ☒ No Matrix Spike Required on this SDG? (Required for MCP Inorganics)
☐ Yes ☒ No GW1 Standards (Info Required for Metals & EPH with Targets)
☐ Yes ☒ No NPDES RGP
☐ Other State /Fed Program ____ Criteria ____

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due: 11/5/14

Additional Project Information:

Please invoice to the attention of: Michael Curry

** metals list: As, Cd, Cr, Pb, Hg, Mo, Ni, Se, Zn, Sb, Be, Ag, Tl

ANALYSIS

VOC: ☐ 8260 ☐ 624 ☐ 524.2
SVOC: ☐ ABN ☐ PAH
METALS: ☐ MCP 13 ☐ MCP 14 ☐ RCP 15
METALS: ☐ RCRA5 ☐ RCRA8 ☐ PP13
EPH: ☐ Ranges & Targets ☐ Ranges Only
VPH: ☐ Ranges & Targets ☐ Ranges Only
☐ PCB ☐ PEST
TPH: ☐ Quant Only ☐ Fingerprint
Metals **

SAMPLE INFO
Filtration: ☐ Field ☐ Lab to do
Preservation: ☐ Lab to do

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler Initials	Metals **	Sample Comments	TOTAL # BOTTLES
25833-01	Lagoon 1 Sample 1	10/27/14	1200	SG	MC	X		
02	Lagoon 1 Sample 2	↓	↓	SG	MC	X		
03	Lagoon 2 Sample 1	10/29/14	0930	↓	↓	X		
04	Lagoon 2 Sample 2	↓	0930	↓	↓	X		
05	Lagoon 3 Sample 1	↓	1100	↓	↓	X		
06	Lagoon 3 Sample 2	↓	1100	↓	↓	X		

Container Type: A
Preservative: A

Container Type
P= Plastic
A= Amber glass
V= Vial
G= Glass
B= Bacteria cup
C= Cube
O= Other
E= Encore
D= BOD Bottle

Preservative
A= None
B= HCl
C= HNO_3
D= H_2SO_4
E= NaOH
F= MeOH
G= $NaHSO_4$
H = $Na_2S_2O_3$
I= Ascorbic Acid
J = NH_4Cl
K= Zn Acetate
O= Other

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	10/29/14 1430	[signature]	10/29/14 1430
[signature]	10/29/14	[signature] AAL	10-29-14 1620
[signature] AAL	10-29-14 1800	[signature]	10/29/14 1800

FORM NO: 01-01 (rev. 12-Mar-2012)

Attachment B. Interim Guidance Values for Assessing Sludge Quality

March 30, 2001

Compound	CAS	Class A Guidance Values	Class B and SPF Guidance Values		Detection Limit (mg/kg)
			Direct Contact	Leaching	
Section A. Volatile Organic Compounds					
Dichlorodifluoromethane	75-71-8	1,000 (a)	2,500 (a)	NCM	2 (1.0)
Chloromethane	74-87-3	2 (c)	170	2 (c)	2 (0.7)
Vinyl chloride	75-01-4	2 (c)	2 (c)	2	2 (0.4)
Bromomethane	74-83-9	2 (c)	60	2 (c)	2 (0.3)
Chloroethane	75-00-3	1,000 (a)	2,500 (a)	2,500 (a)	2 (1.0)
Trichlorofluoromethane	75-69-4	1,000 (a)	2,500 (a)	NCM	2 (1.0)
Diethyl ether	60-29-7	1,000 (a)	2,500 (a)	2,500 (a)	5.0
Acetone	67-64-1	200 (b)	2,500 (a)	200 (b)	5.0
1,1-Dichloroethene	75-35-4	3	2.500 (a)	3	2 (0.5)
Methylene chloride	75-09-2	2.2 (b)	290	2.2 (b)	2 (0.1)
Carbon disulfide	75-15-0	12 (b)	2,500 (a)	12 (b)	2 (0.2)
Methyl-tert-butylether (MTBE)	1634-04-4	2	1,200	2	2.0
trans-1,2-Dichloroethene	156-60-5	9	2,500 (a)	9	2 (1.0)
1,1-Dichloroethane	75-34-3	3	1,600	3	2 (1.0)
2-Butanone (MEK)	78-93-3	18 (b)	2,500 (a)	18 (b)	2 (1.0)
2,2-Dichloropropane	590-20-7	1,000 (a)	2,500 (a)	2,500 (a)	2 (1.0)
cis-1,2-Dichloroethene	156-59-2	2	1,600	2	2 (1.0)
Chloroform	67-66-3	6 (b)	360	6 (b)	2 (0.1)
Bromochloromethane	74-97-5	1,000 (a)	2,500 (a)	2,500 (a)	2 (1.0)
Tetrahydrofuran (THF)	109-99-9	7	2,500 (a)	7	2 (1.0)
1,1,1-Trichloroethane	71-55-6	42	2,500 (a)	42	2 (1.0)
1,1-Dichloropropene	563-58-6	1,000 (a)	2,500 (a)	2,500 (a)	2 (1.0)
Carbon tetrachloride	56-23-5	6	17	12	2 (1.0)
1,2-Dichloroethane	107-06-2	2.6 (b)	21	2.6 (b)	2 (0.08)
Benzene	71-43-2	2 (c)	75	2 (c)	2 (0.3)
Trichloroethene	79-01-6	2 (c)	200	2 (c)	2 (0.8)
1,2 Dichloropropane	78-87-5	2 (c)	32	2 (c)	2 (0.1)
Dichlorobromomethane	75-27-4	2 (c)	17	2 (c)	2 (0.02)
Dibromomethane	74-95-3	1,000 (a)	2,500 (a)	2,500 (a)	2 (1.0)
4-Methyl-2-pentanone (MIBK)	108-10-1	10	1,300	10	2 (1.0)
cis-1,3-Dichloropropene	10061-01-5	2 (c)	12	2 (c)	2 (0.5)
Toluene	108-88-3	100	2,500 (a)	100	2 (1.0)
trans-1,3-Dichloropropene	10061-02-6	2 (c)	12	2 (c)	2 (0.5)
1,1,2-Trichloroethane	79-00-5	2 (c)	20	2 (c)	2 (0.1)
2-Hexanone	591-78-6	1,000 (a)	2,500 (a)	2,500 (a)	5.0
1,3-Dichloropropane	142-28-9	1,000 (a)	2,500 (a)	2,500 (a)	2 (1.0)
Tetrachloroethene	127-18-4	2	42	2	2 (1.0)
Dibromochloromethane	128-48-1	2 (c)	8	2 (c)	2 (0.01)
1,2-Dibromoethane	106-93-4	2 (c)	2,500 (a)	2 (c)	2 (0.09)
Chlorobenzene	108-90-7	6	1,200	6	2 (1.0)
1,1,1,2-Tetrachloroethane	630-20-6	2	30	2	2 (1.0)
Ethylbenzene	100-41-4	140	2,500 (a)	140	2 (1.0)
m&p-Xylene	108-38-3 106-42-3	1,000 (a)	2,500 (a)	1,100	10
o-Xylene	95-47-6	1,000 (a)	2,500 (a)	1,100	5.0
Styrene	100-42-5	14	770	14	2 (1.0)

Compound	CAS	Class A Guidance Values	Class B and SPF Guidance Values		Detection Limit (mg/kg)
			Direct Contact	Leaching	
Bromoform	75-25-2	2 (c)	60	2 (c)	2 (0.1)
Isopropylbenzene	98-82-8	123	2,500 (a)	123	5.0
1,1,2,2-Tetrachloroethane	79-34-5	2 (c)	2	2 (c)	2 (0.02)
1,2,3-Trichloropropane	96-18-4	2 (c)	220	2 (c)	2 (1.0)
n-Propylbenzene	98-06-6	10	250	10	5.0
Bromobenzene	108-86-1	1000 (a)	2,500 (b)	2,500 (b)	2 (1.0)
1,3,5-Trimethylbenzene	108-67-8	27	250	27	5.0
2-Chlorotoluene	95-49-8	30	1,100	30	2 (1.0)
4-Chlorotoluene	106-43-4	21	800	21	2 (1.0)
tert-Butylbenzene	104-51-8	6	250	6	5.0
1,2,4-Trimethylbenzene	95-63-6	59	250	69	5.0
sec-Butylbenzene	135-98-8	7	250	7	5.0
p-Isopropyltoluene	99-87-6	59	250	250	5.0
1,3-Dichlorobenzene	541-73-1	45	1,900	45	5.0
1,4-Dichlorobenzene	106-46-7	6	17	9	5.0
n-Butylbenzene	104-51-8	18	250	18	5.0
1,2-Dichlorobenzene	95-50-1	66	2,000	66	5.0
1,2-Dibromo-3-chloropropane	96-12-8	2 (c)	2 (c)	2 (c)	2 (0.02)
1,2,4-Trichlorobenzene	120-82-1	15	210	15	2.0
Hexachlorobutadiene	87-68-3	2 (c)	2 (c)	2 (c)	2 (0.2)
Naphthalene	91-20-3	5	1,400	5	5.0
1,2,3-Trichlorobenzene	87-61-6	1,000 (a)	2,500 (a)	2,500 (a)	2.0
Section B. Semi-Volatile Organic Compounds					
1,2-Diphenylhydrazine (as Azobenzene)	122-66-7	2.5 (c)	2.5 (c)	2.5 (c)	2.5 (1.7)
2,4,5-Trichlorophenol	95-95-4	120	2,500 (a)	120	5.0
2,4,6-Trichlorophenol	88-06-2	2.5 (c)	94	2.5 (c)	2.5 (1.7)
2,4-Dichlorophenol	120-83-2	2.5 (c)	220	2.5 (c)	2.5 (1.7)
2,4-Dimethylphenol	105-67-9	4	1,500	4	2.5 (2.0)
2,4-Dinitrophenol	51-28-5	2.5 (c)	150	2.5 (c)	12
2,4-Dinitrotoluene	121-14-2	2.5 (c)	2.5 (c)	2.5 (c)	2.5 (1.7)
2,6-Dinitrotoluene	606-20-2	2.5 (c)	2.5 (c)	2.5 (c)	2.5 (1.7)
2-Chloronaphthalene	91-59-7	1,000 (a)	2,500 (a)	2,500 (a)	10
2-Chlorophenol	95-97-8	2.5 (c)	370	2.5 (c)	2.5 (2.0)
2-Methylnaphthalene	91-57-6	150	1400	150	5.0
2-Methylphenol (o-Cresol)	95-48-7	18	370	18	5.0
2-Nitroaniline	88-74-4	5.9	5.9	5.9	5.0
2-Nitrophenol	88-75-5	788	788	788	5.0
3,3'-Dichlorobenzidine	91-94-1	2.5 (c)	2.5 (c)	2.5 (c)	4.0
3-Nitroaniline	99-09-2	287	287	287	5.0
3&4-Methylphenol (m&p-Cresol)	106-44-5	130	410	410	5.0
4,6-Dinitro-2-methylphenol	534-52-1	9.8	9.8	9.8	12
4-Bromophenyl phenylether	85-68-7	1,000 (a)	2,500 (a)	2,500 (a)	10
4-Chloro-3-methylphenol	59-50-7	1,000 (a)	2,500 (a)	2,500 (a)	10
4-Chloroaniline	106-47-8	45 (b)	400	45 (b)	2.5 (1.3)
4-Chlorophenyl phenylether	7005-72-3	1,000 (a)	2,500 (a)	2,500 (a)	10
4-Nitroaniline	100-01-6	2.5 (c)	2.5 (c)	2.5 (c)	5.0
4-Nitrophenol	100-02-7	788	788	788	12
Acenaphthene	83-32-9	270	2,500 (a)	270	5.0
Acenaphthylene	208-96-8	300	2,500 (a)	300	5.0
Anthracene	120-12-7	1,000 (a)	2,500 (a)	2,500 (a)	5.0

Compound	CAS	Class A Guidance Values	Class B and SPF Guidance Values		Detection Limit (mg/kg)
			Direct Contact	Leaching	
Benzidine	92-87-5	2.5 (c)	2.5 (c)	2.5 (c)	12
Benzo (a) anthracene	56-55-3	2.5 (c)	2.5 (c)	NCM	2.5 (1.7)
Benzo (a) pyrene	50-32-8	2.5 (c)	2.5 (c)	2.5 (c)	2.5 (1.7)
Benzo (b) fluoranthene	205-99-2	7	20	NCM	5.0
Benzo (g,h,i) perylene	191-24-2	160	800	NCM	5.0
Benzo (k) fluoranthene	207-08-9	7	20	NCM	5.0
Bis (2-chloroethoxy) methane	111-91-1	1,000 (a)	2,500 (a)	2,500 (a)	5.0
Bis (2-chloroethyl) ether	111-44-4	2.5 (c)	2.5 (c)	2.5 (c)	2.5 (1.7)
Bis (2-chloroisopropyl) ether	39638-32-9	2.5 (c)	4	4	2.5 (2.0)
Bis (2-ethylhexyl) phthalate	117-81-7	39	110	NCM	5.0
Butyl Benzyl phthalate	85-68-7	810	930	810	5.0
Carbazole	86-74-8	2.5 (c)	32	2.5 (c)	2.5 (1.7)
Chrysene	218-01-9	70	200	NCM	5.0
Di-n-butyl phthalate	84-74-2	1,000 (a)	2,500 (a)	NCM	5.0
Di-n-octyl phthalate	117-84-0	1,000 (a)	1,600	1,600	5.0
Dibenzo (a,h) anthracene	53-70-3	2.5 (c)	2.5 (c)	NCM	2.5 (1.7)
Dibenzofuran	132-64-9	380	380	380	5.0
Diethyl phthalate	84-66-2	1,000 (a)	2,500 (a)	2,500 (a)	5.0
Dimethyl phthalate	131-11-3	1,000 (a)	2,500 (a)	1,500	5.0
Fluoranthene	206-44-0	270	1400	NCM	5.0
Fluorene	86-73-7	270	1400	510	5.0
Hexachlorobenzene	118-74-1	2.5 (c)	2.5 (c)	NCM	2.5 (1.7)
Hexachlorocyclopentadiene	77-47-4	36	150	NCM	5.0
Hexachloroethane	67-72-1	2.5 (c)	2.5 (c)	2.5 (c)	2.5 (1.7)
Indeno (1,2,3-cd) pyrene	193-39-5	2.5 (c)	2.5 (c)	NCM	2.5 (1.7)
Isophorone	78-59-1	2.5 (c)	1,100	2.5 (c)	2.5 (1.7)
N-Nitroso-di-n-propylamine	621-64-7	2.5 (c)	2.5 (c)	2.5 (c)	2.5 (1.7)
N-Nitrosodimethylamine	62-75-9	2.5 (c)	2.5 (c)	2.5 (c)	4.0
N-Nitrosodiphenylamine	86-30-6	2.5 (c)	130	2.5 (c)	2.5 (1.7)
Nitrobenzene	98-95-3	2.5 (c)	39	2.5 (c)	2.5 (1.7)
Pentachlorophenol	87-86-5	2.5 (c)	9	2.5 (c)	4.0
Phenanthrene	85-01-8	160	800	NCM	5.0
Phenol	108-95-2	56	2,500 (a)	56	5.0
Pyrene	129-00-0	160	800	NCM	5.0
Section C. Metals					
Total Arsenic	7440-38-2	STD	STD		10
Total Cadmium	7440-43-9	STD	STD		1.0
Total Chromium	16065-83-1	STD	STD		10
Total Copper	7440-50-8	STD	STD		10
Total Lead	7439-92-1	STD	STD		11
Total Mercury	7439-97-6	STD	STD		0.05
Total Molybdenum	7439-98-7	STD	STD		18
Total Nickel	7440-02-0	STD	STD		10
Total Selenium	7782-49-2	STD	STD		18
Total Zinc	7440-66-6	STD	STD		10
Total Antimony	7440-36-0	5	26	26	8
Total Beryllium	7440-41-7	0.95	0.95	0.95	0.1
Total Silver	7440-22-4	45	200	200	4.0
Total Thallium	7440-28-0	10 (c)	21	21	10
Section D. Pesticides					

Compound	CAS	Class A Guidance Values	Class B and SPF Guidance Values		Detection Limit (mg/kg)
			Direct Contact	Leaching	
Aldrin	309-00-2	0.3 (c)	0.3 (c)	NCM	0.3 (0.09)
Gamma-BHC (Lindane)	58-89-9	0.3 (c)	0.8	0.3 (c)	0.3 (0.09)
Alpha-BHC	319-84-6	0.3 (c)	0.3 (c)	0.3 (c)	0.3 (0.06)
Delta-BHC	319-86-8	4.4	4.4	4.4	0.3 (0.09)
Beta-BHC	319-85-7	0.3 (c)	0.6	0.3 (c)	0.3 (0.06)
Chlordane	57-74-9	0.8	2	NCM	0.8
4,4'-DDT	50-29-3	0.9	3	NCM	0.3 (0.09)
4,4'-DDE	72-55-9	0.7	2	NCM	0.3 (0.07)
4,4'-DDD	72-54-9	0.7	2	NCM	0.3 (0.07)
Alpha-Endosulfan	959-98-8	45	1,300	45	0.3 (0.07)
Beta-Endosulfan	33213-65-9	45	1,300	45	0.3 (0.07)
Endosulfan Sulfate	1031-07-8	1,000 (a)	2,500 (a)	2,500 (a)	0.3 (0.07)
Endrin	72-20-8	8	54	NCM	0.3 (0.07)
Endrin Aldehyde	7421-93-4	1,000 (a)	2,500 (a)	2,500 (a)	0.3 (0.07)
Heptachlor	76-44-8	0.3 (c)	0.7	NCM	0.3 (0.2)
Heptachlor Epoxide	1024-57-3	0.3 (c)	0.3	NCM	0.3 (0.07)
Toxaphene	8001-35-2	0.8 (c)	0.8 (c)	NCM	0.8
Section E. Polychlorinated Biphenyls					
PCB-1242	53469-21-9	STD	STD		1 (0.7)
PCB-1254	11097-69-1	STD	STD		1 (0.7)
PCB-1221	11104-28-2	STD	STD		1 (0.7)
PCB-1232	11141-16-5	STD	STD		1 (0.7)
PCB-1248	12672-29-6	STD	STD		1 (0.7)
PCB-1260	11096-82-5	STD	STD		1 (0.7)
PCB-1016	12674-11-2	STD	STD		1 (0.7)
Section F. Additional Analyses					
pH	na	na	na		na
Percent solids	na	na	na		na
nitrate-nitrite	14797-55-8 14797-65-0	na	na		30
Total Kjeldahl nitrogen	na	na	na		300
ammonia nitrogen	na	na	na		30
Total organic nitrogen	na	na	na		na
potassium	na	na	na		15
phosphorus	na	na	na		15
Section G. Dioxins					
2,3,7,8 TCDD & 2,3,7,8 TCDF	1746-01-6	STD	STD		5ppt TEQ
Remaining congeners of 2,3,7,8 TCDD	1746-01-6	STD	STD		5ppt TEQ
Section H. Cyanides					
Total cyanides	na	510	2,500 (a)	2,500 (a)	10
Section I. Enteric Virus					
Enteric Virus	na	STD	STD		1 PFU/ 4g

Notes:

(a) – For Class A, any risk value over 1,000 mg/kg was reduced to 1,000 mg/kg. For Class B, any risk value over 2,500 mg/kg was reduced to 2,500 mg/kg.

(b) – This value is the guidance value developed by SESOIL modeling for the stockpile scenario. See Table B for the reclamation and agriculture values.

(c) – Value based on the method detection limit

.

na - not applicable

NCM – Negligible contaminant movement

STD – Standard already established in the Env-Ws 800

(#) – number in parentheses indicates the detection limit currently required by the Env-Ws 800

H:\SEPTAGE& SLUDGE\SLUDGE\DATA\S-1CAL\GUIDANCE VALUES.DOC

APPENDIX C
Supporting Information for Planning-Level Cost Estimate

TOWN OF EXETER, NEW HAMPSHIRE
WASTEWATER FACILITIES PLAN
W-P PROJECT NO. 12883A
RECOMENDED PLAN COST ESTIMATE
ENR INDEX 9846 (August 2014)

TABLE 6-1
ESTIMATED CAPITAL COSTS FOR WWTF UPGRADES

Project Component		**Est. Cost** WWTF TN 3 mg/l	**Rec. Plan Est. Cost** WWTF TN 5 mg/l	**Est. Cost** WWTF TN 8 mg/l	**Rec. Plan Est. Cost** Main Pump Station FM & WM	**Rec. Plan Est. Cost** Lagoon Decommissioning	**Notes**
Construction		$36,200,000	$31,400,000	$28,600,000	$4,000,000	$5,500,000	1
Construction Contingency	5%	$1,810,000	$1,570,000	$1,430,000	$200,000	$280,000	2
Technical Services	20%	$7,240,000	$6,280,000	$5,720,000	$800,000	$1,100,000	3
Value Engineering		$100,000	$100,000	$100,000	$0	$0	4
Materials Testing	0.25%	$90,000	$80,000	$70,000	$10,000	$10,000	5
Asbestos and Lead Paint Abatement		$0	$0	$0	$0	$0	6
Direct Equipment Purchase		$0	$0	$0	$0	$0	7
Land Acquisition/Easements		$0	$0	$0	$0	$0	7
Legal/Administrative		$10,000	$10,000	$10,000	$10,000	$10,000	8
Financing	1%	$450,000	$390,000	$360,000	$50,000	$70,000	9
ENGINEER'S ESTIMATE		$45,900,000	$39,830,000	$36,290,000	$5,070,000	$6,970,000	10
Subtotal, Recommended Plan		-	$39,830,000	-	$5,070,000	$6,970,000	
Total, Recommended Plan		**$51,870,000**					

Notes
1.) Construction cost estimate details provided in Appendices. Costs based on ENR CCI 9846.
2.) Construction contingency is an allowance at 5% of construction cost.
3.) Technical services is an allowance at 20% of construction cost.
4.) Value engineering is an allowance assuming two sessions.
5.) Materials testing is an allowance based on similar sized projects.
6.) Asbestos and lead paint is not anticipated at the WWTF site, but should be evaluated at the Main Pump Station site.
7.) None anticipated
8.) Legal/administrative costs are for bond counsel and project advertisements.
9.) Financing is an allowance based on assumed interim financing costs at 1%.
10.) DES estimate for 5 mg/l effluent TN for Exeter was $44M ("Analysis of Nitrogen Loading Reductions for WWTF and NPS in the Great Bay Estuary Watershed", Dec 2010, ENR 8660).

TOWN OF EXETER, NEW HAMPSHIRE
WASTEWATER FACILITIES PLAN
W-P PROJECT NO. 12883A
RECOMENDED PLAN COST ESTIMATE
ENR INDEX 9846 (August 2014)

DESCRIPTION	EST. COST WWTF TN 3 mg/l	EST. COST WWTF TN 5 mg/l	EST. COST WWTF TN 8 mg/l	EST. COST Main Pump St. FM & WM	EST. COST Lagoon Decomm.
CIVIL					
MPS FORCEMAINS (5000 LF at $150/lf new and $100/lf slipline)				$1,250,000	
WWTF WATER MAIN (5000 lf at $150/LF)				$750,000	
WWTF SITE STRUCTURE EXCAVATION (includes 25% as ledge)	$770,000	$770,000	$580,000		
WWTF SITE PIPING	$750,000	$750,000	$560,000		
WWTF SITE WORK	$690,000	$690,000	$520,000		
WWTF SITE FILL FOR SLUDGE STORAGE LAGOON AREA	$440,000	$440,000	$440,000		
ARCHITECTURAL					
MAIN PUMP STATION MODIFICATIONS				$230,000	
CONTROL BUILDING MODIFICATIONS	$390,000	$390,000	$390,000		
GRIT BUILDING MODIFICATIONS (SEPTAGE RECEIVING)	$160,000	$160,000	$160,000		
HEADWORKS BUILDING (NEW)	$940,000	$940,000	$940,000		
CHEMICAL BUILDING MODIFICATIONS	$45,000	$45,000	$45,000		
DISINFECTION BUILDING (NEW)	$230,000	$230,000	$230,000		
SOLIDS PROCESSING BUILDING (NEW)	$2,185,000	$2,185,000	$2,185,000		
PROCESS EQUIPMENT & PIPING FINISHES	$110,000	$110,000	$110,000		
STRUCTURAL					
INFLUENT EQUALIZATION	$625,000	$625,000	$625,000		
AERATION TANKS / BNR (NEW)	$2,814,000	$2,814,000	$2,110,000		
SECONDARY CLARIFICATION & SCUM SYSTEM (NEW)	$1,780,000	$1,780,000	$1,780,000		
DISINFECTION MODIFICATIONS	$106,000	$106,000	$106,000		
SLUDGE STORAGE TANKS (NEW)	$555,000	$555,000	$555,000		
JUNCTION STRUCTURES (NEW)	$500,000	$500,000	$500,000		
PROCESS					
MAIN PUMP STATION UPGRADE				$186,000	
WWTF PROCESS DEMOLITION	$39,000	$39,000	$39,000		
SEPTAGE RECEIVING	$229,000	$229,000	$229,000		
SCREENINGS AND GRIT REMOVAL	$676,000	$676,000	$676,000		
INFLUENT EQUALIZATION BASINS	$153,000	$153,000	$153,000		
PRIMARY TREATMENT	Future phase	Future phase	Future phase		
AERATION TANKS / BNR	$1,205,000	$1,205,000	$900,000		
SECONDARY CLARIFICATION	$776,000	$776,000	$776,000		
SUPPLEMENTAL ALKALINITY SYSTEM	$66,000	$66,000	$66,000		
SUPPLEMENTAL CARBON SYSTEM	$270,000	Future phase	Future phase		
TERTIARY TREATMENT (including excavation, piping, building)	$3,100,000	Future phase	Future phase		
DISINFECTION	$528,000	$528,000	$528,000		
OUTFALL	$0	$0	$0		
SLUDGE STORAGE TANKS	$276,000	$276,000	$276,000		
SOLIDS PROCESSING SYSTEMS	$1,557,000	$1,557,000	$1,557,000		
PLANT WATER SYSTEM	$80,000	$80,000	$80,000		
ODOR CONTROL SYSTEMS (None)	$0	$0	$0		
JUNCTION STRUCTURES/GATES	$100,000	$100,000	$100,000		
HVAC/ PLUMBING	in Arch.	in Arch.	in Arch.	$75,000	
INSTRUMENTATION					
INSTRUMENTS	$259,000	$259,000	$190,000	$40,000	
CONTROL PANELS AND NETWORK	$270,000	$270,000	$270,000	$50,000	
SCADA SYSTEM HARDWARE / SOFTWARE	$138,000	$138,000	$138,000		
MOTOR OPERATORS	$95,000	$95,000	$70,000		
ELECTRICAL					
MAIN PUMP STATION				$270,000	
WWTF STANDBY POWER	$225,000	$225,000	$225,000		
WWTF ELECTRICAL DISTRIBUTION	$550,000	$550,000	$440,000		
WWTF ELECTRICAL SITE WORK	$250,000	$250,000	$250,000		
WWTF POWER & CONTROL CONDUIT & WIRING	$800,000	$800,000	$640,000		
WWTF FIRE-SECURITY-TELEPHONE	$100,000	$100,000	$100,000		
WWTF ELECTRICAL DEMOLITION	$75,000	$75,000	$75,000		
SPECIALS					
MOBILIZATION/DEMOBILIZATION	$250,000	$250,000	$250,000	$50,000	
SHEETING	$600,000	$600,000	$480,000	none	
PILES	none	none	none	none	
LEDGE REMOVAL	in Civil	in Civil	in Civil	in Civil	
GROUNDWATER DEWATERING	$150,000	$150,000	$150,000	in Civil	
LAGOON DECOMMISSIONING - SLUDGE REMOVAL & DISPOSAL				none	$3,310,000
LAGOON DECOMMISSIONING - RESTORATION				none	$1,000,000

TOWN OF EXETER, NEW HAMPSHIRE
WASTEWATER FACILITIES PLAN
W-P PROJECT NO. 12883A
RECOMENDED PLAN COST ESTIMATE
ENR INDEX 9846 (August 2014)

DESCRIPTION		EST. COST WWTF TN 3 mg/l	EST. COST WWTF TN 5 mg/l	EST. COST WWTF TN 8 mg/l	EST. COST Main Pump St. FM & WM	EST. COST Lagoon Decomm.
SUBTOTAL, CONSTRUCTION		$23,145,000	$19,775,000	$18,096,000	$2,466,000	$4,310,000
GENERAL CONTRACTOR OH&P, GENERAL CONDITIONS	15.0%	$3,472,000	$2,966,000	$2,714,000	$370,000	$0
SUBTOTAL, SUBCONTRACTORS		$2,762,000	$2,762,000	$2,398,000	$435,000	$0
GENERAL CONTRACTOR MARKUP	5.0%	$138,000	$138,000	$120,000	$22,000	$215,500
ELECTRICAL/ TELEPHONE ALLOWANCES		$50,000	$50,000	$50,000	$20,000	$0
BONDS AND INSURANCE	1.5%	$390,000	$340,000	$310,000	$40,000	$60,000
SUBTOTAL, CONSTRUCTION COSTS		$29,957,000	$26,031,000	$23,688,000	$3,353,000	$4,585,500
PROJECT MULTIPLIER, DESIGN CONTINGENCY	1.15					
PROJECT MULTIPLIER, INFLATION TO MIDPT CONST.	1.05					
ENGINEERS ESTIMATE OF CONSTRUCTION COST		**$36,200,000**	**$31,400,000**	**$28,600,000**	**$4,000,000**	**$5,500,000**

Project Name: **WWTF Upgrade**
Location: **Exeter NH**
Design Level: **Study - Site/Civil Estimate**

Date: **September 26, 2014**
By: **ejl**

	Items	Quantity	Unit	Unit Price	Total Price Current Project Costs
Item No.	General				
1	Traffic Control	0	LS	$2,500.00	$0
2	Contractor Mobilization & Staging	0	LS	$2,000.00	$0
3	Test Pits	10	EA	$500.00	$5,000
	Subtotal				$5,000.00
Item No.	Demolition				
4	Clear & Grub	9	AC	$6,000.00	$54,000
5	Tree Removal	0	EA	$1,000.00	$0
6	Stump Removal	0	EA	$600.00	$0
7	Strip and Stockpile Topsoil	0	CY	$12.00	$0
8	Remove Site Signage	0	EA	$250.00	$0
9	Misc Site Demo (INCLUDING LAGOON SPLITTER STRUCTURES)	1	LS	$20,000.00	$20,000
10	Pavement Removal & Disposal	1000	SY	$8.00	$8,000
11	Remove & Dispose Existing Catch Basin	0	EA	$750.00	$0
12	Remove Existing Chain Link Fence/Gates	250	LF	$10.00	$2,500
13	Remove Granite Curbing & Stockpile	0	LF	$10.00	$0
14	Remove & Dispose Bit Lip Curbing	0	LF	$15.00	$0
15	Remove & Dispose Wood Guard Rail	0	LF	$5.00	$0
16	Remove & Dispose Existing Light Poles	0	EA	$1,500.00	$0
	Subtotal				$84,500
	Sitework				
17	Site Grading	3630	CY	$5.00	$18,150
18	Aggregate Base Course (4")	385	CY	$20.00	$7,700
19	Aggregate Sub Base Course (12")	1167	CY	$18.00	$21,000
20	Bituminous Pavement Heavy Duty Wearing Surface Course	3500	SY	$30.00	$105,000
21	Temporary Trench Pavement	0	SY	$120.00	$0
22	Temporary Gravel Access Road	500	LF	$10.00	$5,000
23	Paved Walkways (2")	133	SY	$125.00	$16,667
24	Stone Dust Walkway	200	LF	$25.00	$5,000
25	Pavement Markings	1	LS	$2,000.00	$2,000
26	Handicap Warning Plate	1	EA	$750.00	$750
27	Reset Granite Curb	0	LF	$30.00	$0
28	New Granite Curb	0	LF	$40.00	$0
29	New Bit Lip Curb	900	LF	$5.00	$4,500
30	Miscellaneous Site Signage	1	LS	$2,000.00	$2,000
31	Bollards	30	EA	$600.00	$18,000
32	Landscaping	1	LS	$20,000.00	$20,000
33	Chain Link Fence	4000	LF	$30.00	$120,000
34	Fence Single Swing Gate	4	EA	$1,000.00	$4,000
35	Fence Double Swing Gate	2	EA	$3,000.00	$6,000
36	Timber Guard Rail	0	LF	$20.00	$0
37	Erosion & Sedmentation Controls	1	LS	$15,000.00	$15,000
38	Loam & Low Maint Seed	14520	SY	$3.00	$43,560
	Subtotal				$414,327
	Storm Drainage				
39	Paved Leak off	1	EA	$500.00	$500
40	Rain Gardens	2	EA	$10,000.00	$20,000
41	Catch Basins	10	EA	$2,000.00	$20,000
42	Drain Manholes	4	EA	$3,000.00	$12,000
43	18" - 24" RCP SD Piping	500	LF	$50.00	$25,000
44	Riprap Swale	30	LF	$20.00	$600
	Subtotal				$78,100
	Electrical				
45	Conduit Excavation, Sand Bedding, Backfill & Warning Tape	800	LF	$25.00	$20,000
46	Duct Bank Excavation, Sand Bedding, Backfill & Warning Tape	400	LF	$20.00	$8,000
47	Concrete Duct Banks	400	LF	$75.00	$30,000
48	Concrete Light Pole Base - PreCast	10	EA	$1,250.00	$12,500
49	Electric Manholes	8	EA	$4,000.00	$32,000
50	Electric Handhole	8	EA	$1,000.00	$8,000
	Subtotal				$110,500

Site Work and Utilities Construction $692,427
$690,000

TOWN OF EXETER, NEW HAMPSHIRE
WASTEWATER FACILITIES PLAN
W-P PROJECT NO. 12883A
RECCOMENDED PLAN COST ESTIMATE
PROCESS ITEMS

EQUIP. NAME	TAG	QUAN.	UNIT	DESIGN BASIS	Unit Cost	Installation Cost	Extended System Subtotal	Misc. Unaccounted For Items	System Extended Cost, Total
						20%			
						30%		0.0%	
MAIN PUMP STATION									
DEMOLITION		1	EA		$10,000		$10,000	$10,000	
INFLUENT SLUICE GATE		1	EA		$7,000	$2,100	$9,100	$9,100	
DRYPIT SUBM PUMPS		3	EA		$30,000	$9,000	$117,000	$117,000	
PIPING		1	EA		$50,000		$50,000	$50,000	
									$186,000
WWTF DEMOLITION									
CONTROL BUILDING		1	EA		$11,000		$11,000	$11,000	
GRIT BUILDING		1	EA		$11,000		$11,000	$11,000	
DISINFECTION BUILDING		1	EA		$6,000		$6,000	$6,000	
AERATED LAGOONS		1	EA		$11,000		$11,000	$11,000	
									$39,000
HEADWORKS BUILDING									
MECHANICAL SCREEN		1	EA	CLIMBER	$175,000	$35,000	$210,000	$210,000	
WASH PRESS		1	EA		$75,000	$15,000	$90,000	$90,000	
MANUAL BAR RACK & RAKE		1	EA	ALUMINUM	$6,000	$1,800	$7,800	$7,800	
STOP GATES		8	EA		$4,000	$1,200	$41,600	$41,600	
GRIT PADDLE WHEEL		2	EA	VORTEX	$30,000	$9,000	$78,000	$78,000	
GRIT WASHER		1	EA		$120,000	$24,000	$144,000	$144,000	
GRIT PUMP		2	EA	RECESSED IMPELLER	$25,000	$7,500	$65,000	$65,000	
PIPING - HEADWORKS		1	EA		$40,000		$40,000	$40,000	
									$676,000
PLANT WATER SYSTEM									
PW PUMPS		3	EA		$10,000	$3,000	$39,000	$39,000	
HYDROPNEUMATIC TANK		0	EA	USE EXISTING	$10,000	$3,000	$0	$0	
DUPLEX BASKET STRAINER		1	EA		$6,000	$1,800	$7,800	$7,800	
PIPING - PLANT WATER		1	LS		$15,000		$15,000	$15,000	

TOWN OF EXETER, NEW HAMPSHIRE
WASTEWATER FACILITIES PLAN
W-P PROJECT NO. 12883A
RECCOMENDED PLAN COST ESTIMATE
PROCESS ITEMS

EQUIP. NAME	TAG	QUAN.	UNIT	DESIGN BASIS	Unit Cost	Installation Cost	Extended System Subtotal	Misc. Unaccounted For Items	System Extended Cost, Total
						20%			
						30%		0.0%	
SEAL WATER SYSTEMS		1	EA		$10,000	$3,000	$13,000	$13,000	
PIPING - SEAL WATER		1	LS	1"	$5,000		$5,000	$5,000	
									$80,000
SLUDGE PROCESSING BUILDING									
SLUDGE FEED PUMPS/GRINDER		2	EA		$40,000	$12,000	$104,000	$104,000	
SCREW PRESS AND CONTROLS		2	EA		$350,000	$70,000	$840,000	$840,000	
CONVEYORS		75	LF		$1,750	$350	$157,500	$157,500	
PIPING - SL		1	LS		$30,000		$30,000	$30,000	
POLYMER MAKEUP SYSTEM		2	EA		$30,000	$9,000	$78,000	$78,000	
PIPING - DPOL		1	LS		$5,000		$5,000	$5,000	
SST DECANT SYSTEM		3	EA		$20,000	$6,000	$78,000	$78,000	
SST PD BLOWERS		3	EA		$40,000	$12,000	$156,000	$156,000	
SST AERATION DIFFUSERS		3	EA		$20,000	$6,000	$78,000	$78,000	
PIPING - AIR		1	LS		$25,000		$25,000	$25,000	
PIPING - PW		1	LS		$5,000		$5,000	$5,000	
									$1,556,500
SEPTAGE RECEIVING									
DEMOLISH EQUIPMENT		1	LS		$5,000	$1,500	$6,500	$6,500	
SEPTAGE RECEIVING MACHINE		1	EA		$150,000	$30,000	$180,000	$180,000	
SEPTAGE PUMP		1	EA		$15,000	$4,500	$19,500	$19,500	
SEPTAGE GRINDER		1	EA		$10,000	$3,000	$13,000	$13,000	
PIPING - SEPTAGE		1	LS		$10,000		$10,000	$10,000	
									$229,000
SUPPLEMENTAL ALKALINITY SYSTEM									
MAG HYDROX TANK & STAND	ALKT-1,2	1	LS	2550-GAL	$10,000	$3,000	$13,000	$13,000	
MAG HYDROX MIXER	ALKM-1,2	1	LS		$10,000	$3,000	$13,000	$13,000	
MAG HYDROX PUMPS	ALK-1,2	2	EA	PERISTALTIC	$5,800	$1,740	$15,080	$15,080	
PIPING - MAG HYDROX		500	LF	1.5"	$50		$25,000	$25,000	
									$66,080
EQUIP. AND PIPING FINISH PAINTING				IN DIVISION 9	2.0%	$5,254,000	$105,100	$105,100	
				RANGE: 2.0-3.0% OF EQUIP COST					$105,100
				TOTAL, EXCLUDING EQUIP. AND PIPING FINISH PAINT					

TOWN OF EXETER, NEW HAMPSHIRE
WASTEWATER FACILITIES PLAN
W-P PROJECT NO. 12883A
RECOMENDED PLAN COST ESTIMATE
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NOTE
PROCESS ITEMS SHOWN BELOW ARE EXAMPLES.
EDIT ALL ITEMS, INCLUDING UNIT COSTS TO SUIT PROJECT.

INSTRUMENTATION

NOTE: 1. THIS ESTIMATE EXCLUDES ALL STRUCTURAL, HVAC/PLUMBING, INSTRUM, ELECTRICAL COSTS, UNLESS SPECIFICALLY NOTED.

EQUIP. NAME		TAG	QUAN.	UNIT	DESIGN BASIS	*Unit Cost*	*Installation Cost*	*Extended System Subtotal*	*Misc. Unaccounted For Items*	*System Extended Cost, Total*	*Installation Extended Cost*
							20%		0%		
INSTRUMENTS											
MPS	LEVEL		2	EA		$3,000	$600	$7,200	$7,200		$1,200
	FLOAT		4	EA		$500	$100	$2,400	$2,400		$400
	FLOW METER		1	EA		$5,000	$1,000	$6,000	$6,000		$1,000
	COMB GAS DETECTOR		1	EA		$25,000	$5,000	$30,000	$30,000		$5,000
SEP	LEVEL ELEMENT		2	EA		$3,000	$600	$7,200	$7,200		$1,200
	FLOATS		4	EA		$500	$100	$2,400	$2,400		$400
	FLOW METER		2	EA		$5,000	$1,000	$12,000	$12,000		$2,000
HDW	LEVEL ELEMENTS		2	EA		$3,000	$600	$7,200	$7,200		$1,200
	CHANNEL HIGH LEVEL		1	EA		$500	$100	$600	$600		$100
	COMB GAS DETECTOR		1	EA		$25,000	$5,000	$30,000	$30,000		$5,000
BPH	DO		3	EA		$5,000	$1,000	$18,000	$18,000		$3,000
	ORP		3	EA		$3,000	$600	$10,800	$10,800		$1,800
	NITRATE OR AMMONIA		3	EA		$10,000	$2,000	$36,000	$36,000		$6,000
	TSS		1	EA		$10,000	$2,000	$12,000	$12,000		$2,000
	SCUM FLOATS		3	EA		$500	$100	$1,800	$1,800		$300
PF	PARSHALL FLUME FLOW ELEMENTS		2	EA	DUAL LE-FE (ULT)	$5,000	$1,000	$12,000	$12,000		$2,000
DIS	CHLORINE RES. ANALYZER		0	EA		$10,000	$2,000	$0	$0		$0
	HYP - LEVEL ELEMENT		1	EA		$3,000	$600	$3,600	$3,600		$600
	HYP - CONTAIN FLOAT		1	EA		$500	$100	$600	$600		$100
DEW	POL - LEVEL ELEMENT		2	EA		$3,000	$600	$7,200	$7,200		$1,200
	POL - CONTAIN FLOAT		2	EA		$500	$100	$1,200	$1,200		$200
	ALK - LEVEL ELEMENT		1	EA		$3,000	$600	$3,600	$3,600		$600
	ALK - CONTAIN FLOAT		1	EA		$500	$100	$600	$600		$100
	SLUDGE TANK LEVEL ELEMENTS		3	EA		$3,000	$600	$10,800	$10,800		$1,800
	SLUDGE TANK FLOATS		6	EA		$500	$100	$3,600	$3,600		$600
	DEWATERING FLOW METERS		2	EA	4" MAG	$3,000	$600	$7,200	$7,200		$1,200
	MISC. DEWATERING		1	LS		$10,000	$2,000	$12,000	$12,000		$2,000
CB	PLANT WATER SUCT VACUUM		1	EA		$3,000	$600	$3,600	$3,600		$600
	PLANT WATER DISCH PRESS		1	EA		$3,000	$600	$3,600	$3,600		$600
	PLANT WATER FLOW		1	EA	6" MAG	$5,000	$1,000	$6,000	$6,000		$1,000
										$259,200	
CONTROL PANELS & NETWORK GEAR											
	MAIN PUMP STATION		1	EA		$25,000	$5,000	$30,000	$30,000		$5,000
	HEADWORKS		1	EA		$25,000	$5,000	$30,000	$30,000		$5,000
	SEPTAGE		0	EA	OEM	$25,000	$5,000	$0	$0		$0
	SOLIDS PROCESS		1	EA		$25,000	$5,000	$30,000	$30,000		$5,000
	DEWATERING		0	EA	OEM	$25,000	$5,000	$0	$0		$0
	DISINFECTION BLDG		1	EA		$25,000	$5,000	$30,000	$30,000		$5,000
	CONTROL BLDG		1	EA		$25,000	$5,000	$30,000	$30,000		$5,000
	COM PANELS		2	EA		$15,000	$3,000	$36,000	$36,000		$6,000
	FIBER OPTIC		1	EA		$50,000	$10,000	$60,000	$60,000		$10,000
	MISSION CONNECTIONS		1	EA		$20,000	$4,000	$24,000	$24,000		$4,000
										$270,000	
SCADA & NETWORK GEAR											
	DEVELOPMENT NODE 1		1	EA		$10,000	$2,000	$12,000	$12,000		$2,000
	DEVELOPMENT NODE 2		1	EA		$10,000	$2,000	$12,000	$12,000		$2,000
	VIEW NODE 1		1	EA		$5,000	$1,000	$6,000	$6,000		$1,000
	PROCESS PROGRAMMING		1	EA		$50,000	$10,000	$60,000	$60,000		$10,000

TOWN OF EXETER, NEW HAMPSHIRE
WASTEWATER FACILITIES PLAN
W-P PROJECT NO. 12883A
RECOMENDED PLAN COST ESTIMATE
ENR INDEX 9846 (August 2014)

NOTE
PROCESS ITEMS SHOWN BELOW ARE EXAMPLES. EDIT ALL ITEMS, INCLUDING UNIT COSTS TO SUIT PROJECT.

INSTRUMENTATION

NOTE: 1. THIS ESTIMATE EXCLUDES ALL STRUCTURAL, HVAC/PLUMBING, INSTRUM, ELECTRICAL COSTS, UNLESS SPECIFICALLY NOTED.

EQUIP. NAME	TAG	QUAN.	UNIT	DESIGN BASIS	Unit Cost	Installation Cost	Extended System Subtotal	Misc. Unaccounted For Items	System Extended Cost, Total	Installation Extended Cost
						20%		0%		
REPORTING & MAINTENANCE		1	EA		$10,000	$2,000	$12,000	$12,000		$2,000
TESTING - PHASE 1		1	EA		$20,000	$4,000	$24,000	$24,000		$4,000
TRAINING - PHASE 1		1	EA		$10,000	$2,000	$12,000	$12,000		$2,000
									$138,000	
MOTOR OPERATORS										
MISC		6	EA		$13,200	$2,640	$95,040	$95,040		$15,840
									$95,040	
				TOTAL, EXCLUDING EQUIP. AND PIPING FINISH PAINT					**$762,240**	

EXETER, NH - WASTEWATER FACILITIES PLAN
COMPARISON OF NITROGEN REMOVAL ALTERNATIVES

INCREMENTAL PROJECT COSTS -INFLUENT EQUALIZATION

DISCIPLINE	QUAN	UNIT	Unit Cost	Install Cost	Extended System Subtotal	Misc. Unacct'd For Items	System Extended Cost, Total
				25%		0%	
Structural							
Liner	46,510	SF	$5		$232,550		$233,000
Sheeting (Walls)	10,120	SF	$35		$354,200		$354,000
Concrete		CY	$1,500		$0		$0
Railing and Walkway	1	LS	$30,000	$7,500	$37,500		$38,000
Site/Civil							
Excavation - EARTH	0	CY	$15		$0		$0
Excavation - LEDGE (ALLOWANCE)	0	CY	$70		$0		$0
Backfill	0	CY	$25		$0		$0
Site Work	0	LS	$125,000		$0		$0
Buried Piping	0	LS	$25,000		$0		$0
Fence Around Structure	830	LF	$30	$8	$31,125		$31,000
Gates	4	EA	$10,000	$2,500	$50,000		$50,000
EQ EFFLUENT PUMPING							
Equipment/Vendor Quote							
Pumps	3	EA	$30,000	$7,500	$112,500		$113,000
Piping, Valves, equipment pads, etc.	1	LS	$40,000		$40,000		$40,000
Instrumentation			$0				$0
Electrical			$0				$0
CONSTRUCTION COST ESTIMATE							**$153,000**

EXETER, NH - WASTEWATER FACILITIES PLAN
COMPARISON OF NITROGEN REMOVAL ALTERNATIVES

ALTERNATIVE 2
INCREMENTAL PROJECT COSTS - 4-STAGE BARDENPHO

DISCIPLINE	QUAN	UNIT	Unit Cost	Install Cost	Extended System Subtotal	Misc. Unacct'd For Items	System Extended Cost, Total
				25%		0%	
AERATION TANKS							
Equipment/Vendor Quote							
Influent Piping Modifications	2	EA	$15,000	$3,750	$37,500		$38,000
Screw Blowers - Main Duty AT	4	EA	$50,000	$12,500	$250,000		$250,000
Fine Bubble Diffusers	1	LS	$125,000	$31,250	$156,250		$156,000
S.S. Aeration Piping Fittings, Valves & Supports	1	LS	$90,000	$22,500	$112,500		$113,000
Submersible Mixers	12	EA	$30,000	$7,500	$450,000		$450,000
Internal Recycle Pumps	3	EA	$30,000	$7,500	$112,500		$113,000
X-inch Internal Recycle Piping	3	EA	$7,500	$1,875	$28,125		$28,000
Slide Gates	6	EA	$5,000	$1,250	$37,500		$38,000
Weirs - AT	3	EA	$5,000	$1,250	$18,750		$19,000
Structural							
Concrete Slab	2,000	CY	$500		$1,000,000		$1,000,000
Concrete Walls	2,137	CY	$750		$1,602,750		$1,603,000
Concrete Elevated slab	136	CY	$1,000		$136,000		$136,000
Handrails, Access platforms, etc.	3	EA	$25,000		$75,000		$75,000
Site/Civil					$0		
Excavation - EARTH (Total=15090)	11,318	CY	$15		$169,763		$170,000
Excavation - LEDGE (ALLOWANCE)	3,773	CY	$70		$264,075		$264,000
Backfill	3,400	CY	$25		$85,000		$85,000
Site Work	0	LS	$150,000		$0		$0
Buried Piping	0	LS	$100,000		$0		$0
Architectural		SF	$0				$0
Instrumentation			$0				$0
Electrical			$0				$0
FLOW SPLITTING							
Aeration Tank Influent	1	LS	$200,000		$200,000		$200,000
Secondary Clarifier Influent	1	LS	$200,000		$200,000		$200,000
OTHER							
Lagoon Decommissioning	0	EA	$2,000,000		$0		$0
Biosolids Processing	0	EA	$2,000,000		$0		$0
CONSTRUCTION COST ESTIMATE							**$1,205,000**

EXETER, NH - WASTEWATER FACILITIES PLAN
COMPARISON OF NITROGEN REMOVAL ALTERNATIVES

INCREMENTAL PROJECT COSTS - NEW 75-FOOT SECONDARY CLARIFIERS

DISCIPLINE	QUAN	UNIT	Unit Cost	Install Cost	Extended System Subtotal	System Extended Cost, Total
				25%		
SECONDARY CLARIFIERS						
Equipment/Vendor Quote (mechanism, density current baffles); OVIVO Dec 2013	3	EA	$150,000	$37,500	$562,500	$563,000
Concrete						
Concrete Slab	1,685	CY	$500		$842,500	$843,000
Concrete Walls	942	CY	$750		$706,500	$707,000
Launders/Elevated Slab	200	CY	$1,000		$200,000	$200,000
Handrails, Access platforms, etc.	3	EA	$10,000		$30,000	$30,000
Site/Civil						
Excavation - EARTH (5,200 CY)	3,900	CY	$15		$58,500	$59,000
Excavation - LEDGE (ALLOWANCE)	1,300	CY	$70		$91,000	$91,000
Backfill	2,725	CY	$25		$68,125	$68,000
Site Work	0	LS	$100,000		$0	$0
Buried Piping	0	LS	$75,000		$0	$0
Instrumentation			$0			$0
Electrical			$0			$0
SECONDARY SLUDGE PUMPING						
Equipment/Vendor Quote						
RAS PUMPS	4	EA	$20,000	$5,000	$100,000	$100,000
WAS PUMPS	2	EA	$15,000	$3,750	$37,500	$38,000
Piping, Valves, equipment pads, etc.	1	LS	$75,000		$75,000	$75,000
Instrumentation			$0			$0
Electrical			$0			$0
CONSTRUCTION COST ESTIMATE						**$776,000**

EXETER, NH - WASTEWATER FACILITIES PLAN
COMPARISON OF NITROGEN REMOVAL ALTERNATIVES

INCREMENTAL PROJECT COSTS - METHANOL SYSTEM

DISCIPLINE	QUAN	UNIT	Unit Cost	Total Cost	Install Cost	Extended System Subtotal	System Extended Cost, Total
					25%		
Methanol Equipment							
2,000 gal tank	1	EA	$30,379	$30,379	$7,595	$37,974	$38,000
1" Piping	500	LF	$27	$13,500	$3,375	$16,875	$17,000
3" Containment Pipe	500	LF	$52	$26,000	$6,500	$32,500	$33,000
Pumps	3	EA	$15,000	$45,000	$11,250	$56,250	$56,000
Pump Enclosures	1	EA	$5,000	$5,000	$1,250	$6,250	$6,000
Site/Civil							
Excavation - EARTH	52	CY	$15	$780		$780	$1,000
Excavation - LEDGE (ALLOWANCE)	22	CY	$70	$1,540		$1,540	$2,000
Backfill	15	CY	$25	$375		$375	$0
Site Work	1	LS	$50,000	$50,000		$50,000	$50,000
Struc Slab	40	CY	$500	$20,000		$20,000	$20,000
Architectural (Roof Structure Only)	375	SF	$100	$37,500			$38,000
Instrumentation	5%		$11,150	$558			$600
Electrical	20%		$44,600	$8,920			$8,900
SUBTOTAL, GENERAL CONTRACTOR							$271,000

EXETER, NH - WASTEWATER FACILITIES PLAN
COMPARISON OF NITROGEN REMOVAL ALTERNATIVES

INCREMENTAL PROJECT COSTS - NON-BIOLOGICALLY ACTIVE FILTER

DISCIPLINE		**QUAN**	**UNIT**	**Unit Cost**	**Install Cost**	**Extended System Subtotal**	**System Extended Cost, Total**
					25%		
NON-BIOLOGICALLY ACTIVE FILTER							
Equipment/Vendor Quote (discs and pumps) [Aqua Aerobics, June 2014]		1	EA	$700,000	$175,000	$875,000	$875,000
Concrete							
Concrete Slab		162	CY	$500		$80,889	$81,000
Concrete Walls		100	CY	$1,000		$100,000	$100,000
Elevated Slab		20	CY	$1,200		$24,000	$24,000
Handrails, Access platforms, Bypass, etc.		2	EA	$35,000		$70,000	$70,000
Site/Civil							
Excavation - EARTH		584	CY	$25		$14,595	$15,000
Excavation - LEDGE (ALLOWANCE)		250	CY	$100		$25,020	$25,000
Backfill		353	CY	$20		$7,060	$7,000
Site Work		1	LS	$50,000		$50,000	$50,000
Buried Piping		1	LS	$75,000		$75,000	$75,000
Architectural		1800	SF	$250		$450,000	$450,000
Instrumentation		5%		$66,100			$66,000
Electrical		25%		$330,500			$331,000
SUBTOTAL, GENERAL CONTRACTOR							$2,169,000
GENERAL CONTRACTOR OH&P AND GENERAL CONDITIONS	15.0%						$325,000
ELECTRICAL/ TELEPHONE ALLOWANCE							$0
BONDS & INSURANCES	2.0%						$50,000
UNIT PRICE ITEMS	0.0%						$0
PROJECT LOCATION MULTIPLIER	0%						$0
SUBTOTAL, CONSTRUCTION COSTS							$2,544,000
DESIGN CONTINGENCY	15%						$382,000
PROJECT MULTIPLIER, INFLATION TO MIDPT CONST.	6%		2 years				$153,000
ENGINEERS ESTIMATE OF CONSTRUCTION COST (2015, to midpoint)							**$3,079,000**

TOWN OF EXETER, NEW HAMPSHIRE
W-P PROJECT #12283A
WASTEWATER FACILITIES PLAN
JUN 2014 (ENR INDEX 9800)
CONSTRUCTION COST ESTIMATE - UV DISINFECTION OPTION

DESCRIPTION	QTY	UNITS	UNIT COST	SUBTOTAL COST	INSTALLATION COST 20%	TOTAL COST
CIVIL						
SITE WORK	0	EA	$5,000	$0		$0
ARCHITECTURAL						
DEMOLITION OF EXISTING CHEMICAL STORAGE SPACES	0	LS	$20,000	$0		$0
UV DISINFECTION BUILDING	0	SF	$250	$0		$0
STRUCTURAL						
STRUCTURAL DEMOLITION	1	LS	$5,000	$5,000		$5,000
UV DISINFECTION SLAB	20	CY	$500	$10,000		$10,000
CCT CONCRETE MODIFICATIONS	15	CY	$700	$10,500		$10,500
CRUSHED STONE	20	CY	$25	$500		$500
MISCELLANEOUS STRUCTURAL	1	LS	$60,000	$60,000		$60,000
JIB CRANE	1	EA	$20,000	$20,000		$20,000
PROCESS						
UV DISINFECTION SYSTEM	1	EA	$440,000	$440,000	$88,000	$528,000
HVAC/ PLUMBING	0		$0	$0		
INSTRUMENTATION						
INSTRUMENTATION - GENERAL		LS	$30,000	$0		$0
SCADA SYSTEM HARDWARE/ SOFTWARE		LS	$15,000	$0		$0
ELECTRICAL						
POWER & LIGHTING - GENERAL		LS	$125,000	$0		$0
CONSTRUCTION COST ESTIMATE						**$528,000**

EXETER, NH - WASTEWATER FACILITIES PLAN
COMPARISON OF NITROGEN REMOVAL ALTERNATIVES

INCREMENTAL PROJECT COSTS -SLUDGE STORAGE TANKS <1% (3@450,000 GAL CAPACITY)

DISCIPLINE		QUAN	UNIT	Unit Cost	Install Cost	Extended System Subtotal	Misc. Unacct'd For Items	System Extended Cost, Total	
					25%		0%		
SLUDGE STORAGE TANKS									
Concrete									
Concrete Slab		380	CY	$500		$190,000		$190,000	$555,000 In structural
Concrete Walls		420	CY	$750		$315,000		$315,000	
Concrete Elevated slab		0	CY	$1,000		$0		$0	
Handrails, access platforms, etc.		1	LS	$50,000		$50,000		$50,000	
Site/Civil									
Excavation - EARTH		549	CY	$15		$8,235		$8,000	$36,000 In Site excavation
Excavation - LEDGE (ALLOWANCE)		235	CY	$70		$16,450		$16,000	
Backfill		488	CY	$25		$12,200		$12,000	
Site Work		0	LS	$50,000		$0		$0	
Buried Piping		0	LS	$50,000		$0		$0	
PUMPING AND AERATION									
Equipment/Vendor Quote									
Sludge Pump			EA	$40,000	$10,000	$0		$0	MOVED TO PROCESS
Blower			EA	$25,000	$6,250	$0		$0	MOVED TO PROCESS
Piping, Valves, equipment pads, etc.			LS	$50,000		$0		$0	MOVED TO PROCESS
Instrumentation				$0				$0	
Electrical				$0				$0	
SUBTOTAL, GENERAL CONTRACTOR								$591,000	
GENERAL CONTRACTOR OH&P AND GENERAL CONDITIONS	15.0%							$89,000	
SUBTOTAL, SUBCONTRACTORS									
ELECTRICAL/ TELEPHONE ALLOWANCE								$0	
BONDS & INSURANCES	2.0%							$14,000	
UNIT PRICE ITEMS	0.0%							$0	
PROJECT LOCATION MULTIPLIER	0%							$0	
SUBTOTAL, CONSTRUCTION COSTS								$694,000	
DESIGN CONTINGENCY	15%							$104,000	
PROJECT MULTIPLIER, INFLATION TO MIDPT CONST.	6%		2 years					$42,000	
ENGINEERS ESTIMATE OF CONSTRUCTION COST (2015, to midpoint)								**$840,000**	

TOWN OF EXETER, NEW HAMPSHIRE
W-P PROJECT #12283A
WASTEWATER FACILITIES PLAN
JUL 2014
PRELIMINARY CONSTRUCTION COST ESTIMATE
LAGOON DECOMMISIONING - METHOD No. 2

	DEMO LAGOONS AND RESTORE WETLANDS			
DESCRIPTION OF TASKS	**QTY**	**UNITS**	**UNIT COST**	**TOTAL COST**
LAGOON DECOMMISIONING				
SITE PROTECTION AND RESTORATION [1]	1	LS	$300,000	$300,000
DEWATER AND DISPOSE OF LAGOON BIOSOLIDS				
LAGOON NO. 1 [1] [2] [3]	1,280	DT	$1,000	$1,280,000
LAGOON NO. 2 [1] [2] [3]	620	DT	$1,000	$620,000
LAGOON NO. 3 [1] [2] [3]	600	DT	$1,000	$600,000
SLUDGE STORAGE LAGOON [1] [2] [3] [4]	500	DT	$1,000	$500,000
TEST BOTTOM OF LAGOONS [5]	3	EA	$2,000	$6,000
DEMO LAGOON AND RESTORE WETLANDS	1	LS	$1,000,000	$1,000,000
ARM FUNDING	0	LS	-$300,000	$0
CONSTRUCTION COST ESTIMATE	**3,000**	**DT**		**$4,300,000**

Notes:
1. Unit costs based on Town of Peterborough Lagoon Closure 1 Bid Tab, dated July 10, 2014.
2. Lagoon dry ton biosolids estimated from sludge survey completed by Wright-Pierce on October 29, 2014.
3. Biosolids assumed to have 4% solids based on discussion with P.H. Senesac, Inc in Milton, VT.
4. Biosolids in Sludge Storage Lagoon estimated as the average of biosolids in Lagoon No. 1, 2 & 3.
5. Lagoon bottom testing points based on discussion with Mike Rainey, NHDES Residual Management Section.

WRIGHT-PIERCE
Engineering a Better Environment

MEMORANDUM

TO:	Jennifer Perry, Mike Jeffers	DATE:	December 10, 2014
FROM:	Ed Leonard	PROJECT NO.:	12833A
SUBJECT:	Wastewater Facilities Planning Follow-Up to Items from WSAC/BOS Meeting (3 December 2014)		

The cost information summarized in Section 6 of the October 2014 Preliminary Draft Wastewater Facilities Plan identified the recommended plan as "constructing Bardenpho for 3.0 mgd and 5 mg/l effluent TN" at an estimated capital cost of $40M. As discussed during the December 3 meeting, the recommended plan exceeds the requirements of the AOC ("AOC Plus"). Based on discussions held during the WSAC/BOS meeting on December 3, 2014, it was clear that there was interest in investigating approaches to reduce the initial cost of the project. Some phasing options were identified in Table 6-1; however, no cost information was provided at that time. In order to provide some additional context to this discussion, we provide the following additional information on cost reduction strategies.

1) Construct Bardenpho for 3.0 mgd to 5 mg/l in *two treatment trains* (versus the three treatment trains included in the recommended plan). This approach is still "AOC Plus" but would eliminate some of the operational flexibility provided in the three train arrangement. This approach would reduce the project cost to approximately $37M.

2) Construct MLE for 3.0 mgd to 8 mg/l in *three treatment trains*. This approach meets the AOC and includes the operational flexibility provided in the October 2014 report. This approach would reduce the project cost to approximately $36M.

3) Construct MLE for 3.0 mgd to 8 mg/l in *two treatment trains*. This approach meets the AOC but would eliminate some of the operational flexibility provided in the October 2014 report. This approach would reduce the project cost to approximately $34M.

4) Reduce "Rate of Growth" Projections and construct a smaller WWTF. This approach would require approval of EPA and DES in order to construct a WWTF smaller than the existing NPDES permit *capacity*. This approach could be configured as per strategies 1, 2 and 3 above. As described in Section 6.3 of the report, future flows would be expected to be 2.1 mgd (without Stratham or Newfields) to 2.4 mgd (with Stratham and Newfields) by the years 2023 to 2025. This rate of growth may also be optimistic and could perhaps extend to 2030.

In summary, strategies 1, 2 and 3 could reduce the initial capital cost into the range of $34M to $37M, with some operational and planning advantages and disadvantages. Strategy 4 could reduce capital costs even further. It is important to note that the recommended plan, as well as all of the above strategies, has a lower capital cost than that needed to comply with the NPDES permit (3.0 mgd to 3 mg/l) which is currently being compared to the Portsmouth Pease WWTF option.

Project Name: Exeter Wastewater Facilities Plan

Date: 25-Aug-14

Design Flow (mgd): 3.00
Hours/Day of Sludge Dewatering Operation 6.00
Productive Hours/Worker/Year 1,500

Table of Adjustment for Local Conditions

CATEGORY	LOCAL CONDITION	ADJUSTMENT					
		Operation	Maintenance	Supervisory	Clerical	Laboratory	Yardwork
PLANT LAYOUT	Average	0%	0%				0%
UNIT PROCESSES	Non-Std Equipt	10%	10%				
LEVEL OF TREATMENT	Advanced	10%	-20%	2%	2%	2%	10%
TYPE OF WASTE REMOVAL REQUIREMENT	Effluent Concentration	5%				10%	
INDUSTRIAL WASTE	Erratic	10%				10%	
PRODUCTIVITY OF LABOR	Average	0%	0%				
CLIMATE	Moderate Winters		0%				
TRAINING	Certification & No Continuing Ed.	0%		0%			
AUTOMATIC MONITORING	Monitoring With Feedback	-5%	5%				
AUTOMATIC SAMPLING	Influent & Effluent	-5%				-5%	
OFF-PLANT LABORATORY WORK	None					0%	
OFF-PLANT MAINTENANCE	None		0%				
AGE AND CONDITION OF EQUIPMENT	Relatively new & well cared for		0%				
TOTAL		25%	-5%	2%	2%	17%	10%

Annual Manhours

Unit Process/Category	Exists at Plant?	Operation	Maintenance	Supervisory	Clerical	Laboratory	Yardwork
Supervisory & Administrative				1,060			
Clerical					0		
Laboratory						1,130	
Yardwork							960
Raw Sewage Pumping at Plant	No		0				
Screening & Grinding	Yes	200	30				
Grit Removal	Yes	370	40				
Primary Clarification	No	0	0				
Aeration	Yes	940	880				
Secondary Clarification for Activated Sludge	Yes	530	300				
Chlorination	Yes	210	270				
Mixed Media Filtration	No	0	0				
Anaerobic Digestion	No	0	0				
Aerobic Digestion	No	0	0				
Gravity Thickening	No	0	0				
Flotation Thickening	No	0	0				
Sludge Drying Beds	No	0					
Sludge Dewatering	Yes	660	440				
Sludge Lagoons	No	0					
SUBTOTAL		2,910	1,960	1,060	0	1,130	960
SUBTOTAL ADJUSTED FOR LOCAL CONDITIONS		3,640	1,860	1,080	0	1,320	1,060
Number of Workers		2.4	1.2	0.7	0.0	0.9	0.7

Total Labor Hours/Year 8,960
Total Number of Workers 6.00 all
Total Number of Workers 5.28 excluding Supervisory and Clerical

NHDES Plant Grade per Env-WS 901.18 III for TN = 8mg/l

Project Name: Exeter Wastewater Facilities Plan
Design Flow (mgd): 3.00
Hours/Day of Sludge Dewatering Operation 6.00
Productive Hours/Worker/Year 1,500

Date: 25-Aug-14

Table of Adjustment for Local Conditions

CATEGORY	LOCAL CONDITION	ADJUSTMENT					
		Operation	Maintenance	Supervisory	Clerical	Laboratory	Yardwork
PLANT LAYOUT	Average	0%	0%				0%
UNIT PROCESSES	Non-Std Equipt	10%	10%				
LEVEL OF TREATMENT	Advanced	10%	-20%	2%	2%	2%	10%
TYPE OF WASTE REMOVAL REQUIREMENT	Effluent Concentration	5%				10%	
INDUSTRIAL WASTE	Erratic	10%				10%	
PRODUCTIVITY OF LABOR	Average	0%	0%				
CLIMATE	Moderate Winters		0%				
TRAINING	Certification & No Continuing Ed.	0%		0%			
AUTOMATIC MONITORING	Monitoring With Feedback	-5%	5%				
AUTOMATIC SAMPLING	Influent & Effluent	-5%				-5%	
OFF-PLANT LABORATORY WORK	None					0%	
OFF-PLANT MAINTENANCE	None		0%				
AGE AND CONDITION OF EQUIPMENT	Relatively new & well cared for		0%				
TOTAL		25%	-5%	2%	2%	17%	10%

Annual Manhours

Unit Process/Category	Exists at Plant?	Operation	Maintenance	Supervisory	Clerical	Laboratory	Yardwork
Supervisory & Administrative				1,060			
Clerical					0		
Laboratory						1,130	
Yardwork							960
Raw Sewage Pumping at Plant	No		0				
Screening & Grinding	Yes	200	30				
Grit Removal	Yes	370	40				
Primary Clarification	No	0	0				
Aeration	Yes	940	880				
Secondary Clarification for Activated Sludge	Yes	530	300				
Chlorination	Yes	210	270				
Mixed Media Filtration	Yes	690	470				
Anaerobic Digestion	No	0	0				
Aerobic Digestion	No	0	0				
Gravity Thickening	No	0	0				
Flotation Thickening	No	0	0				
Sludge Drying Beds	No	0					
Sludge Dewatering	Yes	660	440				
Sludge Lagoons	No	0					
SUBTOTAL		3,600	2,430	1,060	0	1,130	960
SUBTOTAL ADJUSTED FOR LOCAL CONDITIONS		4,500	2,310	1,080	0	1,320	1,060
Number of Workers		3.0	1.5	0.7	0.0	0.9	0.7

Total Labor Hours/Year 10,270
Total Number of Workers 6.80 all
Total Number of Workers 6.08 excluding Supervisory and Clerical

NHDES Plant Grade per Env-WS 901.18 IV for TN = 3mg/l

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