DRAFT

Coastal Wastewater Management Plan

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Town of Old Lyme, Connecticut
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EXECUTIVE SUMMARY

Leadership within the Old Lyme has recognized that the Town and the Water Pollution Control Authority can play important roles in addressing significant environmental challenges within the community. The Town has proactively accepted the responsibility of developing a community-wide solution to the wastewater issues that both the public at-large and private beach associations are facing. This Coastal Wastewater Management Plan is a continuation and culmination of prior work the Town has completed and serves as an important decision-making tool. This Plan was developed through tremendous collaboration of multiple parties and presents a comprehensive wastewater approach to the public and private stakeholders in Old Lyme. It also serves as a guide to navigating the next steps to a wastewater solution.

GOALS AND OBJECTIVES

In response to current on-site wastewater management limitations, recent Consent Orders, and the desire for a common solution for the Old Lyme coastal communities, the Town of Old Lyme contracted Woodard & Curran to perform detailed evaluations of local and regional wastewater management alternatives for the Project Study Area. This project, termed the Coastal Wastewater Management Plan, is focusing on a comprehensive analysis of short-term and long-term wastewater management needs within the Project Study Area, as well as wastewater infrastructure (collection, treatment, disposal and reuse), operation and maintenance (O&M) costs, annual and lifecycle costs, as well as non-cost factors including water balance, wastewater management preferences, and implementation measures to manage system capacity allocation.

BACKGROUND

The Project Study Area comprises the unsewered beach communities and neighborhoods south of and along Route 156, between the previously sewered Point-O-Woods neighborhood to the east, and the White Sand Beach neighborhood to the west. On-site wastewater systems in the Project Study Area have been problematic for several decades, as a result of aging systems, poor soils, shallow groundwater and small lots. Based on the results of the individual wastewater planning efforts in several of the beach communities, it is clear that significant on-site septic system challenges exist. Past planning documents recommended that more centralized treatment and disposal systems are needed due to on-site limitations.

Approximately ten years ago, the Point-O-Woods neighborhood was the first Old Lyme beach community to install sewer infrastructure through a regional interconnection to New London. Wastewater facilities plans were prepared for both the Old Colony Beach Club Association (OCBCA) and the Old Lyme Shores Beach Club Associations (OLSBCA) in 2011, which also recommended conveyance of wastewater to the New London Wastewater Treatment Facility (WWTF). CT-DEEP subsequently issued Consent Orders requiring full compliance by June 30, 2016.

WASTEWATER MANAGEMENT NEEDS ANALYSIS

The Project Study Area was divided into ten Sub-Areas. In order to evaluate and prioritize wastewater management needs for the ten Sub-Areas, a wastewater management needs analysis was conducted. Factors including lot size, utilities, soils data, topographic description, and proximity to natural resources were used to prioritize wastewater management needs. The needs analysis results closely parallel population densities in the Project Study Area. The Sub-Areas with the highest need for wastewater management solutions comprise the proposed Wastewater Service Area. The Wastewater Service Area represents over 90% of the sanitary flow from the Project Study Area.

FLOW PROJECTIONS

Average daily sanitary flows were estimated using the Town's census data and average water consumption. Average daily sanitary flow with an allowance for infiltration and inflow (I/I) was projected as well as maximum daily, peak hourly flows. The Town of Old Lyme experiences a 50% decline in population during the winter. Since the majority of this decline comes from residents in the Wastewater Service Area, it was assumed one third of the average summer time flows exist in the winter as the population decreases.

WASTEWATER MANAGEMENT ALTERNATIVES

All wastewater management plans consist of infrastructure components. In general, these include collection, treatment, disposal, and sometimes reuse. Two primary alternatives (Local Alternative and Regional Alternative) were developed and evaluated as part of the Coastal Wastewater Management Plan. The Regional Alternative is predicated on the use of the existing New London WPCF to treat wastewater from the Wastewater Service Area, and the Local Alternative relies on the construction of a new WPCF in Old Lyme, coupled with on-site subsurface disposal and reuse, to treat wastewater and dispose of effluent from the Wastewater Service Area.

As part of the Coastal Wastewater Management Plan, we evaluated collection system alternatives and developed an opinion of probable cost (OPC) for each collection system component for both the Local and Regional Alternatives. This analysis included an overview of each collection system alternative, capital and annual operation and maintenance cost projections, as well as other non-cost considerations related to the collection system components of the Local and Regional Alternatives.

COLLECTION OPTIONS

There are several collection system configurations. These include: gravity; low pressure; septic tank effluent gravity/pumping; and vacuum. The collection system alternatives within the High-Needs Sub-Areas comprising the Wastewater Service Area are identical for the Local and Regional Alternatives. In addition to the lowest capital cost and annual O&M costs, the gravity sewer option is advantageous because it provides a more resilient storm-ready system. With the majority of the Sub-Areas adjacent to the ocean and in flood zones, a gravity system can be designed for flooding with watertight manholes and backup generators at the pump stations that would keep the system functioning through severe storms.

The Regional Alternative collection system facilities consist of the individual Sub-Area collection systems, the regional common sewer in Old Lyme and approximately 10 miles of force main and gravity sewers to get to the New London Water Pollution Control Facility (WPCF). The collection system route to New London also consists of 5 downstream pump stations in East Lyme and Waterford. There are substantial capital needs in the East Lyme and Waterford collection systems if Old Lyme connects to this pipe network as part of the Regional Alternative.

TREATMENT OPTIONS

Three general types of treatment configurations were evaluated for the Local Alternative. These configurations consist of on-site, neighborhood/cluster, and centralized. It was determined that on-site septic systems and larger cluster systems would not be practical forms of treatment for the Wastewater Service Area. There are physical constraints making smaller systems an unviable option within the High Needs Sub-Areas. In addition, poor soils and high groundwater make on-site disposal systems challenging.

A centralized treatment facility with off-site disposal was identified to provide the best economies of scale for treatment. The effluent quality is an important factor for not only pollution removal but also providing options for water reuse opportunities. Two types of centralized wastewater treatment facilities were considered within Task 5 (Evaluation of Wastewater Treatment Alternatives): (1) Sequence Batch Reactor (SBR); and (2) Membrane Bio Reactor (MBR). These types of facilities would meet high quality effluent standards while being flexible to handle seasonal flow conditions. The MBR was recommended due to its superior effluent quality for reuse, as well as the small footprint, allowing a smaller site for the local WPCF building.

DISPOSAL AND REUSE OPTIONS

A few sites have been identified as locations for potential disposal and reuse systems. This Study focuses on 2 of those sites. Field investigations were performed in May and June of 2013 at the Black Hall Golf Course (Black Hall) and former driving range (Cherrystone) in Old Lyme.

There are two different disposal alternatives recommended for Old Lyme: (1) groundwater discharge – a very straightforward permitting process with CT DEEP; and (2) wastewater reuse – a more complicated permitting process with CT DEEP.

COMPARISON OF ALTERNATIVES AND RECOMMENDATIONS

The results of the collection, treatment and disposal/reuse alternatives evaluation were formed to develop the overall Local and Regional Alternatives. The collection system subtotal is based on the gravity sewer option, due to its lowest capital cost compared to the other collection system alternatives.

System Component	Capital	
	Local [1]	Regional
Collection	$31,100,000	$49,101,000
Treatment	$14,800,000	$8,455,000
Disposal / Reuse	$8,300,000	$0
Totals	$54,200,000	$57,556,000

1) Local and Regional Costs based on gravity systems for Service Area.

Although the capital cost for the new local WPCF in Old Lyme is higher than the buy-in costs associated with the New London WPCF, the cost difference is offset by the significantly higher collection cost associated with upgrading downstream sewers in East Lyme and Waterford for the Regional Alternative. Overall, the Local Alternative has an anticipated capital cost that is $3M less expensive than the Regional Alternative.

System Component	Annual O&M	
	Local [1]	Regional
Collection	$192,000	$589,000
Treatment[2]	$472,000	$186,000
Totals	$664,000	$775,000

1. Local and Regional based on gravity systems for Service Area.

2. Annual disposal / Reuse costs are included with treatment O&M.

The annual operation and maintenance cost for the Local Alternative is approximately $100,000 less expensive than that for the Regional Alternative. This is due primarily to the cost associated with paying New London for treatment costs, together with the additional cost associated with the long sewer system in East Lyme and Waterford, and the incremental cost to Old Lyme for maintaining its own extension to the sewer system under the Regional Alternative.

In addition to the cost benefits of the Local Alternative, there are several other non-cost factors that were considered by the Town in this evaluation. These include:

- Deferred Downstream Capital Improvements: For the Regional Alternative, future capital upgrades will be shared amongst the sewer users in New London, Waterford, East Lyme, and Old Lyme.
- Implementation of New Utility: The Local Alternative will come with challenges of implementation for facilities and additional construction in Old Lyme. Initial years for a new utility can be challenging, as connections are being made, and systems are started.
- Control of Flow Allocations: The Town of Old Lyme will have far better control of the allocation of sewer flows, capital costs, and annual costs for the Local Alternative. For the Regional Alternative, Old Lyme would only be a customer to the downstream communities, and would have less say in capital costs and apportionments.

PROPOSED ALTERNATIVE

The Local Alternative was selected. It has a lower capital cost, as well as a lower net annual cost per EDU. The gravity sewer options are the best fit for the regional and local alternatives. Similarly, the low pressure, STEP and STEG sewer alternatives are not the most appropriate options for either alternative, and should not be considered as part of the Local Alternative. The Local Alternative will also provide a far higher quality effluent than the Regional Alternative, better contributing to water quality in the area and along the Long Island Sound.

NEXT STEPS

Upon CT-DEEP's review of this Draft Plan, a subsequent meeting with the Town will be scheduled to: (1) discuss permitting impacts associated with the Local Alternative, (2) make any necessary revisions to the Final Plan, and (3) develop a detailed Implementation Plan. However, based on the milestones for completion (June 30, 2016) in the two outstanding Consent Orders, we feel strongly that the Town's Local Alternative can be implemented within this timeframe.

1. INTRODUCTION

This section of the Report provides an overview of the Project Study Area, a summary of past wastewater management studies, the project goals, and an overview of the scope of work to address these concerns in the Project Study Area.

1.1 PROJECT STUDY AREA

Old Colony Beach Club Association (Sub-Area 7)

The Project Study Area is shown in Figure 1-1, and consists of the currently unsewered beach communities and neighborhoods south of and along Route 156, between the previously sewered Point-O-Woods neighborhood to the east, and the White Sand Beach neighborhood to the west.

1.2 PAST WASTEWATER PLANNING IN STUDY AREA

On-site wastewater systems in the Project Study Area have been problematic for several decades, as a result of aging systems, poor soils, shallow groundwater and small lots. In addition, many of the neighborhoods in the Project Study Area consist of beach communities, which serve as individual wastewater utilities in old Lyme. Due to the challenging on-site wastewater management conditions, some of these communities have implemented, or are in the process of implementing, wastewater management solutions to address these challenges. An overview of recent wastewater management efforts in the Project Study Area follows.

1.2.1 Point-O-Woods Sewer System

Approximately ten years ago, the Point-O-Woods neighborhood was the first Old Lyme beach community to install sewer infrastructure. Centralized wastewater infrastructure was installed to alleviate poor on-site septic systems, driven primarily by shallow ledge and poor water quality resulting from the insufficient on-site systems. Point-O-Woods conveys its wastewater to New London through its own pump station and force main, flowing through the East Lyme and Waterford collection systems. The Point-O-Woods community is east of the Project Study Area as shown on Figure 1-1.

1.2.2 Old Colony Beach Club Association and Old Lyme Shores Beach Club Association

Wastewater facilities plans were prepared for both the Old Colony Beach Club Association (OCBCA) and the Old Lyme Shores Beach Club Associations (OLSBCA) in 2011. The wastewater facilities plans were prepared by RFP Engineering and Fuss & O'Neil respectively, and both reports concluded conventional on-site septic systems were no longer sustainable in the neighborhoods. Centralized sewer systems, conveying wastewater to the New London Wastewater Treatment Facility (WWTF), were recommended. In 2012, an addendum was issued by Fuss & O'Neil incorporating both the OCBCA and OLSBCA Facilities Plans, and recommending a combined collection system to convey sewers to the East Lyme collection system and eventually treatment at the New London WWTF.


Legend
Point O' Woods community
Project Study Area
Long Island Sound
156
Shore Rd
Old Shore Rd
Mile Creek Rd
Buttonball Rd
Cross Ln
Hatchett Point Rd
Osprey Rd
Griswold Point Rd
Springfield Rd
Meriden Rd
Brighton Rd
Seaside Ln
Hawthorn Dr
Dogwood Dr
W End Dr
Avenue A
Pond Rd
Sea Ln
Dennis Rd
North Ln
Connecticut Rd
Hough Rd
Sargents Rd
Carrington Rd
Seaview Rd
0 750 1,500 3,000 Feet
Service Layer Credits: Copyright:© 2012 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
Town of Old Lyme, CT
Project Study Area
FIGURE 1-1
WOODARD &CURRAN
SCALE: 1 in = 1,500 ft
DRAWN BY: ACB
DATE: December 2013
JOB NO.: 226617
DOC: 2013.12.09 - Fig 1-1 Project Study Area.mxd

1.2.3 Town's 2012 Preliminary Study

Lombardo Associates, Inc. (LAI) recently performed an alternatives analysis for the collection, treatment and dispersal of wastewater for portions of the Project Study Area. In the October 12, 2012 Report, LAI summarized two alternatives: (1) installation of a collection system within OCBCA and OLSBCA and conveyance of wastewater to the New London WWTF for treatment and surface water disposal; and (2) on-site collection and local treatment/disposal. The second alternative was sub-divided into: (A) nearby off-site sub-surface disposal or reuse; (B) treatment and disposal within the Beach Association confines; and (C) treatment through multiple cluster systems. This report concluded that the second alternative is less costly, and recommended further evaluation of the local alternative.

1.2.4 Miami Beach Wastewater Facilities Plan

Earlier in 2013, the Connecticut Department of Energy and Environmental Protection (CT-DEEP) approved the Plan of Study for a Wastewater Facilities Plan for the Miami Beach community. This project is underway, but the results are not yet available.

1.2.5 Summary

Based on the results of the individual wastewater planning efforts in several of the beach communities, it is clear that on-site septic system challenges exist in the Project Study Area. All of the past planning documents recommended that more centralized treatment and disposal systems are needed due to the on-site limitations. However, the implementation of stand-alone centralized systems by each neighborhood is facilitating overly redundant sewer infrastructure. As a result of these independent efforts, the Town is proactively evaluating wastewater management alternatives that more appropriately address alternatives that address the overall needs of the coastal community and the interests of all Town residents for short-term and long-term needs.

1.3 CURRENT REGULATORY FRAMEWORK

In addition to the past planning documents, there are several regulatory considerations that affect the beach communities in the Project Study Area. The following summary highlights these key regulatory considerations:

1.3.1 Long Island Sound Nitrogen

In 1998, the States of Connecticut and New York, together with the Environmental Protection Agency (EPA), adopted a plan for "Phase III Actions for Hypoxia Management" including nitrogen reduction targets of 58.5 percent for 11 "management zones" that comprise the Connecticut and New York portion of Long Island Sound watershed. CT-DEEP and the New York State Department of Environmental Conservation (NYSDEC) worked with the EPA and established a Total Maximum Daily Load (TMDL) for Long Island sound that included a 15-year plan for achieving water quality standards.

1.3.2 Consent Orders

When CT-DEEP approved the joint Wastewater Management Plan for OCBCA and OLDBCA, they subsequently issued Consent Orders to the OCBCA and the OLSBCA on August 14, 2012 and October 1, 2012, respectively. The Consent Orders required completion of bidding documents within 850 days of the Orders (October 30, 2014). As shown on Appendix D, the Consent Orders also require compliance by

June 30, 2016 to alleviate on-site disposal system challenges by reviewing alternatives and complying with appropriate regulatory wastewater standards.

1.3.3 Local Septic Regulations

For those beach communities where Wastewater Facilities Plans have not been completed, the Town, through its Sanitarian, continues to maintain records for on-site systems, in order to regulate these systems. In general, small lot size, poor soils and shallow groundwater force the Town, through its Sanitarian's office, to employ best-management practices for system upgrades. In many cases, sub-standard systems are upgraded, because that's all the land will allow, in the absence of centralized wastewater infrastructure. The Town estimates that approximately 50% of the on-site systems do not comply with current-day septic system guidelines and regulations.

1.4 PROJECT GOALS

In response to current on-site wastewater management limitations, recent Consent Orders, and the desire for a common solution for the Old Lyme coastal communities, the Town of Old Lyme contracted Woodard & Curran to perform more detailed evaluations of local and regional wastewater management alternatives for the Project Study Area. This project, termed the Coastal Wastewater Management Plan, is focusing on a more comprehensive analysis of short-term and long-term wastewater management needs within the Project Study Area, as well as wastewater infrastructure (collection, treatment, disposal and reuse), operation and maintenance (O&M) costs, annual and lifecycle costs, as well as non-cost factors including water balance, wastewater management preferences, and implementation measures to manage system capacity allocation.

1.5 SCOPE OF WORK

In order to build on the past planning documents, address the projects objectives, and maintain the Consent Order schedules for portions of the Project Study Area, the following scope of work was developed:

- <u>Task 1 – Grant Funding & Finance Assistance:</u> This task included securing a Clean Water Fund (CWF) grant for the planning phase work, as well as evaluating project funding and financing options once the recommended plan is finalized.
- <u>Task 2 – Project Initiation and Key Meetings:</u> Task 2 includes meetings with the Wastewater Task Force, Water Pollution Control Authority (WPCA), and Selectmen, as well as several Public Informational Meetings with the public to review observations, alternatives and recommendations.
- <u>Task 3 – Evaluation of sub surface Disposal and Reuse Alternatives:</u> This task emphasizes preliminary on-site testing at two sites including test pits, soil borings and monitoring wells, groundwater monitoring and slug testing, to estimate seasonal high water table, thus facilitating a hydraulic capacity analysis and hydrogeological modeling. The Task 3 scope will result in a primary basis of design for reach of these sites for disposal and reuse opportunities associated with the local alternative.

- Task 4 – Prioritization of Wastewater Needs in Project Areas: Task 4 includes a wastewater needs analysis for the ten (10) sub-areas, including an estimation of current and future sanitary flows. The prioritization of the needs analysis was used to develop the proposed service area for the highest-need areas.
- Task 5 – Evaluation of Wastewater Treatment Alternatives: This task includes an evaluation of wastewater treatment alternatives for the local alternative, including the impacts of collection system selection on wastewater treatment needs, as well as capital and annual costs for the various wastewater treatment alternatives.
- Task 6 – Evaluation of wastewater Collection Alternatives: Task 6 includes an evaluation of wastewater collection (i.e. sewer) alternatives for the local and regional alternatives, including the impacts of collection system section on infiltration and inflow (I/I), as well as capital and annual costs for the collection system alternatives.
- Task 7 – Evaluation of Regional Wastewater Management Alternatives: This task includes an evaluation of the regional alternative, including meetings with East Lyme, Waterford and New London to confirm capital/O&M cost needs, and to facilitate comparison with the local alternative.
- Task 8 – Development of Recommended Plan and Implementation Schedule: Task 8 includes development of the recommended plan, including integration of wastewater collection, treatment, disposal and reuse infrastructure, through capital, annual and lifecycle costs, implementation measures, and the preparation of a Report for the Project.

2. WASTEWATER MANAGEMENT NEEDS ANALYSIS

This section includes an overview of how the Project Study Area was sub-divided into smaller sections, termed Sub-Areas, to facilitate an evaluation of the long-term effectiveness of on-site systems, as well as the need for alternative wastewater management solutions. These wastewater management needs for each sub-area were compiled to prioritize flow allocations. The results for the wastewater management needs analysis serve as the basis for selection of wastewater collection, treatment, disposal and reuse alternatives.

2.1 PROJECT SUB-AREAS

The Project Study Area is shown in Figure 2-1, and consists of ten Sub-Areas along Long Island Sound. Each of the ten Sub-Areas is described below and listed in Table 2-1. In general, the Project Study Area consists of the currently unsewered beach communities and neighborhoods south of and along Route 156, between the previously sewered Point-O-Woods neighborhood to the east, and the White Sand Beach neighborhood to the west.

- Sub-Area 1: Includes Osprey and Griswold Point roads. This area is less densely populated with approximately 26 dwelling units and businesses among open space and farm land. The area is surrounded by the coastline to the south and west and lower lying wetlands.
- Sub-Area 2: Consists of the White Sand Beach community, including an estimated 204 dwelling units densely populated up to the shoreline with homes on the beach front. This sub-area also includes a club house set just to the west surrounded by beach and wetland areas.
- Sub-Area 3: Includes Haywagon Drive with approximately 27 dwelling units with new construction and larger lots than some of the other more densely populated Sub-Areas. This area is set back from the coastline and is primarily surrounded by wooded areas.
- Sub-Area 4: Similar to Sub-Area 3, Sub-Area 4 is comprised of newer construction homes and larger lot sizes than the other more densely populated beach communities. This Sub-Area includes an estimated 36 dwelling units along and off of Dogwood Drive.
- Sub-Area 5: Includes two beach associations: (1) Hawks Nest and (2) Miami Beach. This area is densely populated with approximately 392 dwelling units right up to the coastline and a strip of homes along the beach on W End Drive.
- Sub-Area 6: Includes the Sound View Beach Association, with an estimated 342 densely populated dwelling units up to the coastline, as well as non-residential buildings along Route 156.
- Sub-Area 7: Includes Old Colony Beach Association. This sub-area is densely populated with an estimated 219 dwelling units stretching from just north of Route 156 to the coastline. This Sub-Area is currently under a Consent Order (refer to Section 1).
- Sub-Area 8: Includes Old Lyme Shores Beach Association. Similar to Sub-Area 7, this Sub-Area starts just north 156 and stretches down to the coast line with an estimated 192 dwelling units. This Sub-Area is also currently under a Consent Order from the State of Connecticut as shown in Appendix A.
- Sub-Area 9: Includes Edge Lea, Dennis and Butler Roads with approximately 28 dwelling units set in less dense wooded areas. A portion of this Sub-Area is along the coastline although the majority of properties do not border the beach area.


Legend
Sub Areas
1 - Griswold Point & Osprey Road
2 - White Sand Beach
3 - Haywagon Drive
4 - Dogwood Drive
5 - Hawks Nest & Miami Beach
6 - Sound View Beach
7 - Old Colony Beach
8 - Old Lyme Shores Beach
9 - Edge Lea & Cutler Road
10 - Hatchet Point Road
N
S
E
W
Mile Creek Rd
Cedar Hollow Dr
Bailey Rd
Shore Rd
Pine Rd
Heflon Farm Rd
Homestead Cir
Buttonball Rd
Somerset Ln
Cross Ln
North Ln
Otter Rock Rd
Fairway Ln
156
Osprey Rd
Old Shore Rd
Griswold Point Rd
Springfield Rd
Meriden Rd
Brighton Rd
Seaside Ln
Haywagon Dr
Dogwood Dr
Center Beach Ave
Washington Ave
Hawks Nest Rd
Prospect St
Liberty St
Avenue A
W End Dr
Biscayne Blvd
Corsino Ave
Miami Ave
5th Ave
Portland Ave
Hartford Ave
Swan Ave
Pond Rd
Old Colony Rd
Gorton Ave
Sea Spray Rd
Billow Rd
Sea Ln
Edge Lea Rd
Dennis Rd
Hatchett Point Rd
Long Island Sound
0 700 1,400 2,800
Feet
Service Layer Credits: Copyright:© 2012 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
Town of Old Lyme, CT
Project Sub Areas
FIGURE 2-1
WOODARD & CURRAN
SCALE: 1 in = 1,400 ft
DRAWN BY: ACB
DATE: December 2013
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- Sub-Area 10: Includes Hatchet Point Road and approximately 11 dwelling units. This sparsely developed Sub-Area is a narrow stretch of land from 156 to the coast line surrounded by woodland areas to the north, east, and west and coast line to the south. Sub-Area 10 is the furthest Sub-Area to the east in the Project Study Area.

2.2 CRITERIA IMPACTING ON-SITE SYSTEMS

All of the existing development in the Project Study Area is served by on-site subsurface disposal systems. Previously approved planning reports for Sub-Areas 7 and 8 concluded that on-site septic systems are no longer viable. Based on historical data, discussions with Town staff, and past planning documents, several other Sub-Areas also have similar challenges and limitations.

Example of small lot sizes.

Example of close spacing between homes.

In order to evaluate and prioritize wastewater management needs for the ten Sub-Areas a wastewater management needs analysis was conducted. Since the effectiveness of on-site systems is related to multiple factors, the following factures and conditions were analyzed for this needs analysis:

- Lot Size – Individual parcels were ranked based on the size of the property minus the building footprint. Properties with a net available land less than 10,000 square feet were scored highest.
- Utilities – Assessors' data was used to determine utilizes present at each parcel. Lots listed with drinking water wells and septic systems on the same property were ranked highest.
- Soils Data (Drainage Classification) – The State of Connecticut soils types and classifications, including Drainage Classifications, are ranked from "very poor" to "excessive." Properties at both ends of the spectrum were scored highest.
- Topographic Description – Topographic descriptions were also included in the Town's Assessors' data. Developed parcels delineated as "swampy" were scored highest in this category.
- Location – The Town Assessors' data also included a list with generic locations described such as rural or water front. Water front areas were ranked highest due to their proximity to Natural Resources.

2.3 SUMMARY OF WASTEWATER MANAGEMENT NEEDS

The parcels in each Sub-Area were scored using a numbering system in all the categories above, and demonstrated a wide range of scores. High scores indicated parcels that exhibited poor quality for an on-site septic system. The parcel scores were averaged with the other parcels in the Sub-Area. In the case of Figure 2-2, an average Sub-Area need was determined by comparing the average parcel score per Sub-Area.

The needs analysis results closely parallel population densities in the Project Study Area. For example, Sub-Area 8 had the highest needs score with sub-areas 5, 7, 2 and 6 ranking just below in that order. All the High needs sub-areas shown in Figure 2-2 ranked almost double that of the score given to the Sub-Area 1 being the next highest average needs rank. Sub-Area 1 was given a medium rank mostly due to the soil types and drainage classifications, along with the large amount of coastline within the sub-area. The other remaining sub-areas scored the lowest within the Project Study Area; in general these areas had the most advantageous conditions to support a properly functioning on-site septic system.

2.4 HIGH NEEDS WASTEWATER SERVICE AREA

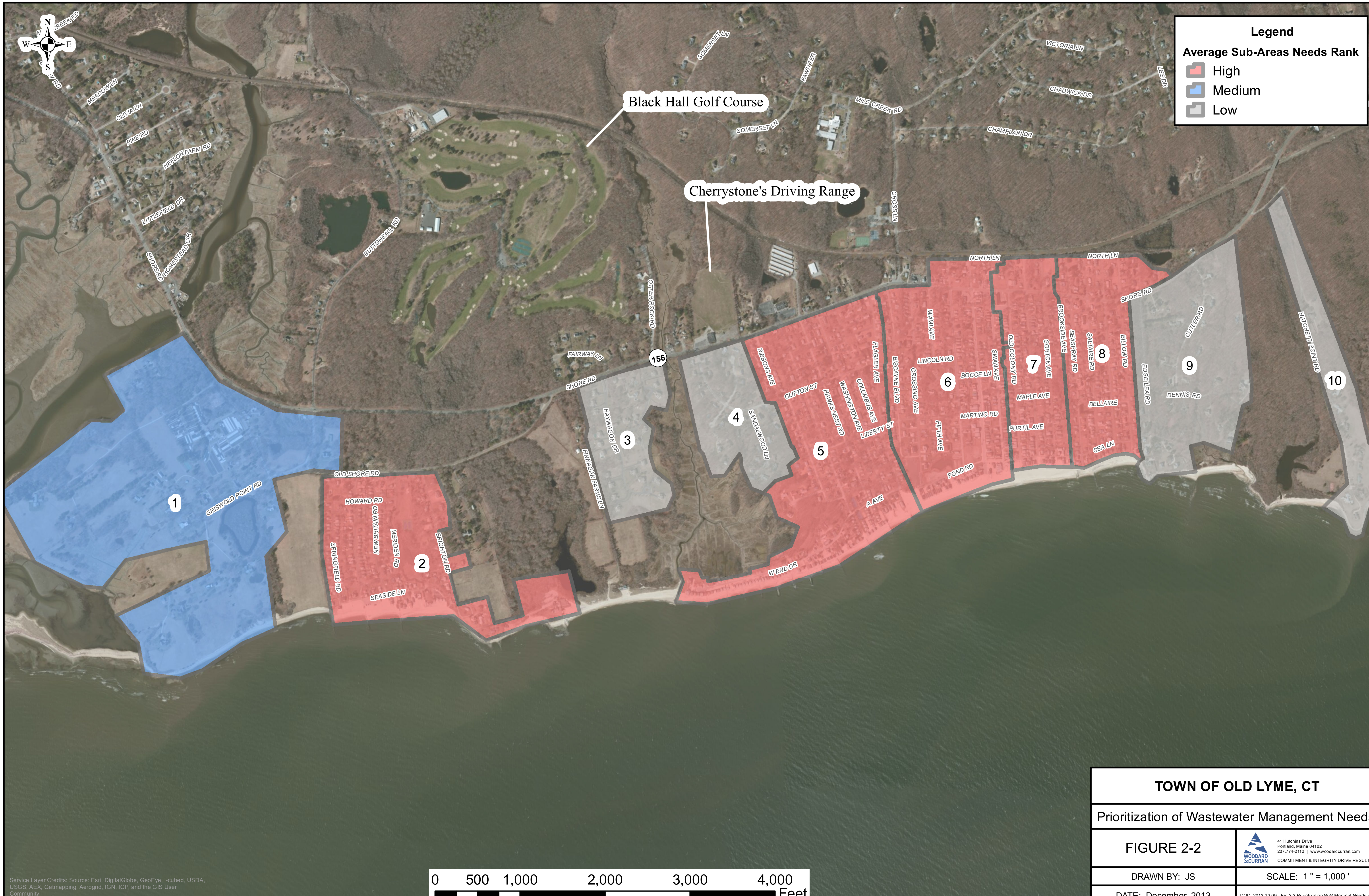
Sub-Areas 2, 5, 6, 7 and 8 have the highest need for wastewater management solutions in lieu of the existing on-site septic systems. The high-needs Sub-Areas comprise the proposed Wastewater Service Area, which is the focus for the alternatives analysis presented in the remainder of this Report. The Wastewater Service Area is shown in Figure 2-3.

The five high needs Sub-Areas that incorporate the Wastewater Service Area represent over 90% of the sanitary flow from the Project Study Area. This is due to the high needs Sub-Areas representing the most densely populated Sub-Areas.

Table 2-1 provides a summary of the Project Study Area and includes the estimated number of dwellings, average residential flow, maximum daily residential flow, needs ranking, and needs prioritization.

Table 2-1: Project Study Area and Needs Ranking

Sub-Area	Association or Street Name	Number of Equivalent Dwelling Units (EDU)	Estimated Average Daily Residential Flow (gpd)	Estimated Maximum Daily Residential Flow (gpd)	Needs Rank
1	Griswold Point & Osprey Road	26	4,680	9,360	Medium
2	White Sand Beach	204	36,720	73,440	High
3	Haywagon Drive	27	4,860	9,720	Low
4	Dogwood Drive	36	6,480	12,960	Low
5	Hawks Nest & Miami Beach	392	70,560	141,120	High
6	Sounds View	342	61,560	123,120	High
7	Old Colony Beach	219	39,420	78,840	High
8	Old Lyme Shores Beach	192	34,560	69,120	High
9	Edge Lea and Cutler Road	28	5,040	10,080	low
10	Hatchet Point Road	11	1,980	3,960	low
	Totals	1,477	265,860	531,720	


Legend
Average Sub-Areas Needs Rank
High
Medium
Low
Black Hall Golf Course
Cherrystone's Driving Range
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156
MEADOWLN
OLIVIA LN
PINE RD
HEFLON FARM RD
LITTLEFIELD DR
HOMESTEAD CIR
SHORE RD
BUTTONBALL RD
OTTER ROCK RD
FAIRWAY LN
SOMERSET LN
FAWNTER
MILE CREEK RD
VICTORIA LN
CHADWICK DR
CHAMPLAIN DR
LEE DR
CROSS LN
NORTH LN
OLD SHORE RD
GRISWOLD POINT RD
HOWARD RD
NEW BRITAIN RD
MERIDEN RD
BRIGHTON RD
SPRINGFIELD RD
SEASIDE LN
HAYWAGON DR
FINNAGAN FARMS LN
SANDALWOOD LN
RIBBONS AVE
CLIFTON ST
HAWKSNEST RD
WASHINGTON AVE
COLUMBUS AVE
FLAGLER AVE
LIBERTY ST
A AVE
W END DR
BISCAYNE BLVD
CROSSING AVE
MIAMI AVE
LINCOLN RD
FIFTH AVE
MARTINO RD
POND RD
SWAN AVE
BOCCE LN
OLD COLONY RD
GORTON AVE
MAPLE AVE
PURTIL AVE
BROOKSIDE AVE
SEASPRAY RD
SALTAIRE RD
BILLOW RD
BELLAIRE
SEA LN
EDGE LEA RD
CUTLER RD
DENNIS RD
HATCHETT POINT RD
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4,000
Feet
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
TOWN OF OLD LYME, CT
Prioritization of Wastewater Management Needs
FIGURE 2-2
WOODARD & CURRAN
41 Hutchins Drive
Portland, Maine 04102
207.774.2112 | www.woodardcurran.com
COMMITMENT & INTEGRITY DRIVE RESULTS
DRAWN BY: JS
SCALE: 1 " = 1,000 '
DATE: December, 2013
DOC: 2013.12.09 - Fig 2-2 Prioritization WW Mngmnt Needs.mxd

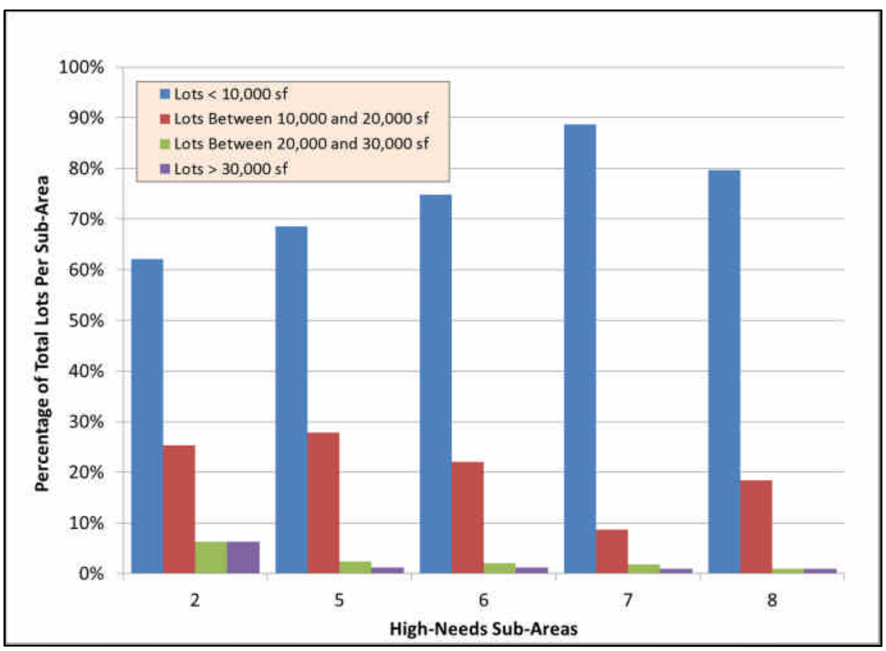
Table 2-2 provides a summary for the high-needs Wastewater Service Area. The proposed Wastewater Service Area consists of six (6) beach associations within these five (5) Sub-Areas. Table 2-2 summarizes the number of homes (equivalent dwelling units (or EDUs), estimated average daily residential flow, and estimated maximum daily residential flow. These projected flows are used as the basis for the alternatives analysis of our facilities planning values for the purpose of this management plan.

Table 2-2: High-Needs Wastewater Service Area

Sub-Area	Association or Street Name	Number of Equivalent Dwelling Units (EDU)	Estimated Average Daily Residential Flow (gpd)	Estimated Maximum Daily Residential Flow (gpd)
2	White Sand Beach	204	36,720	73,440
5	Hawks Nest & Miami Beach	392	70,560	141,120
6	Sounds View	342	61,560	123,120
7	Old Colony Beach	219	39,420	78,840
8	Old Lyme Shores Beach	192	34,560	69,120
	Totals	1,349	242,820	485,640

Figure 2-4 illustrates the primary common feature amongst the high-needs sub-areas that comprise the Wastewater Service Area. There are an abundance of small lots, where lots smaller than ¼-acre comprise 60% to 90% of the total lots in each Sub-Area. In general, a lot size of at least 3/4-acres is needed to site a fully-compliant septic system, where an on-site well also exists. Less than 10% of the lots in the entire Wastewater Service Area are larger than ¾-acre.

Figure 2-4: Lot Size Distribution for High-Needs Wastewater Service Area



Town of Old Lyme, CT

High Needs Wastewater Service Area

FIGURE 2-3

SCALE: 1 in = 800 ft	DRAWN BY: ACB
DATE: December 2013	JOB NO.: 226617
DOC: 2013.12.09 - High Needs WW Service Area.mxd	

3. CURRENT AND FUTURE FLOW PROJECTIONS

Section 3 provides a summary as to how current and future flows were estimated for the high-needs Wastewater Service Area. These base sanitary flows were used in Section 5, together with other flow sources (i.e. infiltrations and inflow) to develop collection system alternatives for the individual Sub-Areas.

3.1 ASSUMPTIONS FOR FLOW CALCULATIONS

This section summarizes how flows were estimated, including those for developed and undeveloped parcels. These flow estimates do not reflect future changes to zoning allowing more dense development in the Wastewater Service Area.

For existing developed residential properties, as well as future developable residential properties in the Wastewater Service Area, average daily sanitary flows were estimated using the Town's census data of 2.39 people per household with an average water consumption of 75 gallons per capita per day. The maximum daily sanitary flow was calculated as twice the average daily sanitary flow. Tables 3-1 and 3-2 include the Project Study Area, High-Needs Wastewater Service Area and assumed I/I flows. Note that I/I allowances vary based on the type of collection system selected. An overview of each type of collection system alternative is included in Section 5. For the few non-residential properties in the Wastewater Service Area, an EDU flow-equivalent was estimated.

Peak hour flows were also estimated to determine pump station capacities and sewer pipe diameters. The peak hour flows are based on a peaking factor of 4 multiplied by the average daily flow. For the purpose of downstream planning, the more conservative gravity system peak hour flows are used at a rate of 1.122 million gallons per day (gpd). Again this flow is derived from a peaking factor 4 multiplied by the average daily flow including I/I for a gravity system.

3.2 AVERAGE ANNUAL FLOW PROJECTIONS

Table 3-1 shows the flow projections for gravity and Septic Tank Effluent Gravity (STEG) systems. Estimated flows for gravity and STEG options are presented together because STEG systems rely on conventional gravity sewers to convey wastewater. A value of 400 gpd/idm (gallons per day per inch diameter mile) was used to project I/I flow contributions for these systems, which is a conservative estimate consistent with TR-16 (Guides for the Design of Wastewater Treatment Works). Table 3-1 also shows peak hour flows in gallons per minute (gpm) and maximum day flows in gallons per day (gpd). Maximum day flows are twice the average daily flow and include I/I, these flows are used to design the size of the Water Pollution Control Facility (WPCF). Maximum day flow is also used to determine the necessary size of the effluent disposal needed and reuse capacity.

Table 3-2 is similar to Table 3-1 and shows the potential flows from a Low Pressure Sewer (LPS) or Septic Tank Effluent Pump (STEP) system. LPS and STEP systems rely on smaller diameter piping with stronger connections and no traditional sewer manholes that a gravity or STEG system would have. This difference allows for a less conservative value for I/I since it is hard for groundwater to infiltrate the system. An I/I allowance of 100 gpd / idm from TR-16 was used for these pressurized collection systems represented. The benefit of less I/I in a system can greatly reduce the treatment and disposal sizes needed which are evaluated in the capital and annual costs for both the Local and Regional Alternatives. Based on the estimated length of the Wastewater Service Area, a LPS or STEP system would reduce maximum day flows by approximately 27,000 gallons per day or 5% of the daily flow.

Table 3-1: Summary of Gravity Wastewater Service Flows

Sub Area	# EDU's	Average Daily Flow			Max Flow (gpd)	Peak Hour (gpd)
		Residential Flow	I/I (gpd)	Includes I/I		
2	204	36,720	5,721	42,441	79,161	169,762
5	392	70,560	9,657	80,217	150,777	320,868
6	342	61,560	9,202	70,762	132,322	283,050
7	219	39,420	4,606	44,026	83,446	176,104
8	192	34,560	6,545	41,105	75,665	164,422
Common	0	0	1,891	1,891	1,891	7,564
Totals	1,477	265,860	45,688	311,548	577,408	1,246,194
Build Out	42	7,560	0	7,560	15,120	30,240
Totals	1,391	250,380	37,622	288,002	538,382	1,152,010

Table 3-2: Summary of LPS Wastewater Service Flows

Sub Area	# Houses	Average Daily Flow			Max Flow (gpd)	Peak Hour (gpd)
		Residential Flow	I/I (gpd)	Includes I/I		
2	204	36,720	1,434	38,154	74,874	152,615
5	392	70,560	2,588	73,148	143,708	292,590
6	342	61,560	2,136	63,696	125,256	254,784
7	219	39,420	1,152	40,572	79,992	162,286
8	192	34,560	1,636	36,196	70,756	144,785
Common	0	0	1,891	1,891	1,891	7,564
Build Out	42	7,560	0	7,560	15,120	30,240
Totals	1,391	250,380	10,836	261,216	511,596	1,044,864

3.3 SEASONAL FLOW VARIATIONS

The Wastewater Service Area is composed of beach associations, many of which have seasonal residents. Without any municipal water metered, it is hard to predict off season flows. It is our understanding that the majority of the residents close up their homes for the winter within the beach associations in the High Needs Sub-areas. Overall the Town of Old Lyme estimates a 50% decline in population during the winter since the majority of this decline comes from residents within the Beach Associations. It is assumed one third (33%) of the average summer time flows exist in the winter due to the population decreases. These seasonal flows are important to be considered when planning for the Local Alternatives treatment and disposal systems. Figure 3-1 illustrates the anticipated maximum day yearly flow, with low flows starting in the winter, peaking in the summer and declining in the fall. Maximum day flow is twice average day flow and used to give a better representation of the design capacities needed. Figure 3-2 presents the expected maximum daily flow over the course of one year. As shown, the maximum daily flow increases due to seasonal variations and is expected to be at the highest during the summer time.

Figure 3-1: Flow Projections for Wastewater Service Area

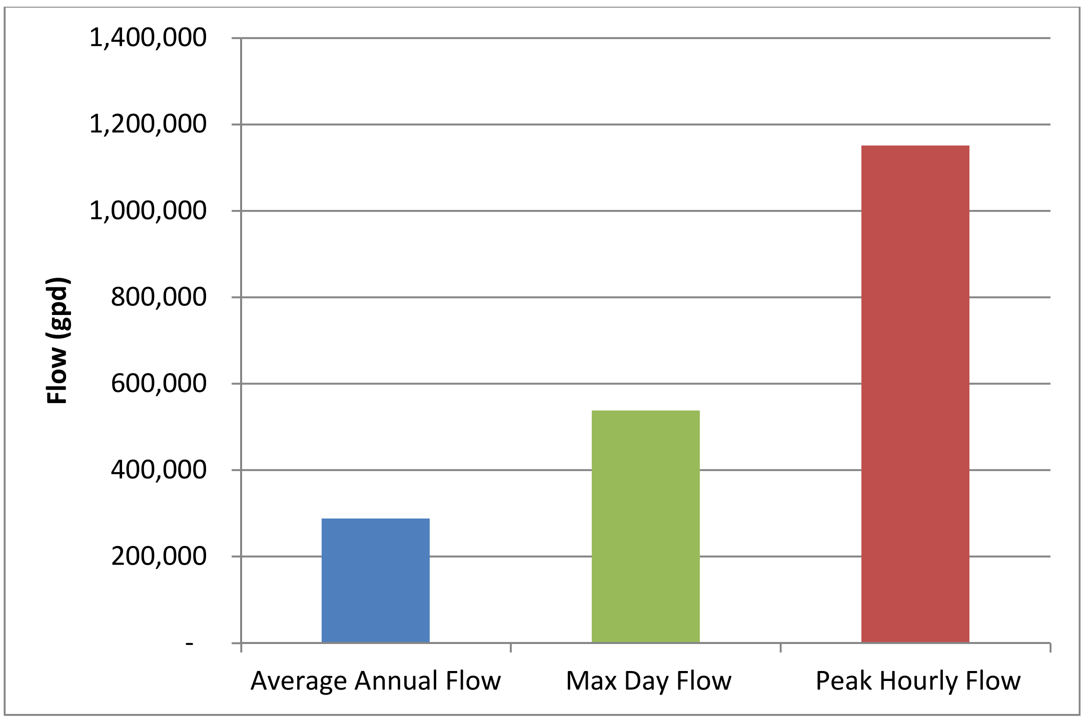
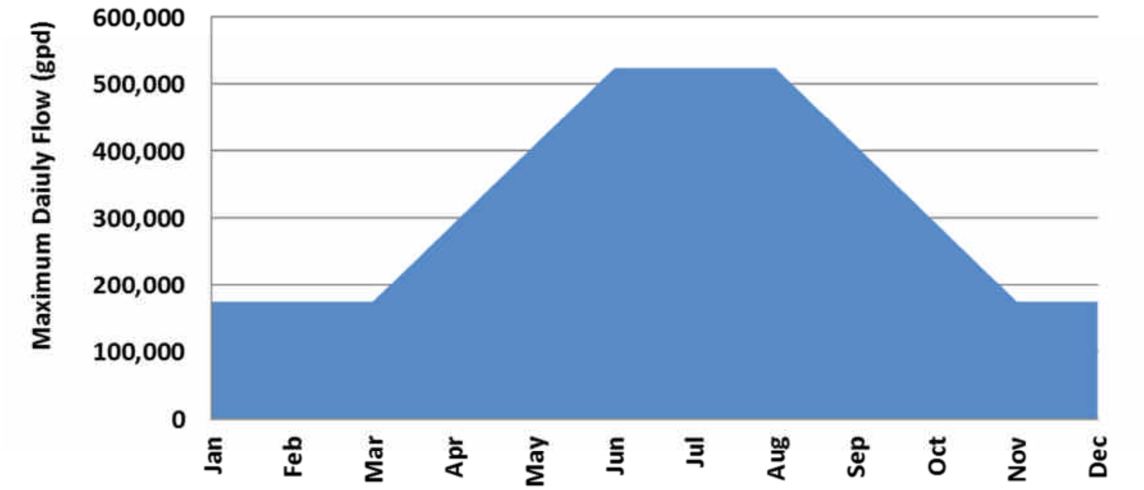


Figure 3-2: Anticipated Annual Flow Variations for Wastewater Service Area



4. OVERVIEW OF LOCAL AND REGIONAL ALTERNATIVES

4.1 OVERVIEW

Sections 1, 2 and 3 presented an overview of the project, a summary of past planning projects, the wastewater management needs analysis, and flow projections. This Section defines the overall wastewater management alternatives for the high-needs Wastewater Service Area, including: (1) a Regional Alternative; and (2) a Local Alternative.

4.2 WASTEWATER MANAGEMENT OVERVIEW

All wastewater management plans consist of infrastructure components. In general, these include collection, treatment, disposal, and sometimes reuse. The graphic on Page 4-2 illustrates the wastewater management framework for these components, as they relate to the alternatives in Old Lyme. This graphic was used as a guide early in the project, particularly during the public informational meetings, to educate the public on the options that exist for the Town and its residents.

For both Alternatives, collection, treatment, disposal and reuse components are driven by the location of the treatment system. For example, the Regional Alternative is predicated on the use of the existing New London WPCF to treat wastewater from the Wastewater Service Area. The Local Alternative on the other hand relies on the construction of a new WPCF in Old Lyme, coupled with on-site subsurface disposal and reuse, to treat wastewater and dispose of effluent from the Wastewater Service Area.

4.3 LOCAL ALTERNATIVE

The Local Alternative includes collection, treatment, disposal and reuse alternatives. Following is a brief overview of each component of the Local Alternative:

- Collection: Collection will utilize sewer infrastructure within the high-needs Wastewater Service Area, together with common sewer along Route 156 to convey the wastewater to a local treatment system.
- Treatment: Treatment is through a local water pollution control facility (WPCF) in Old Lyme. The level of treatment required will depend of the permit requirements associated with the permit(s) issued for disposal and/or reuse.
- Disposal and Reuse: Disposal and reuse of treated effluent will be discharging the effluent into the ground, commonly referred to as subsurface disposal.

Figure 4-1 summarizes the key components of collection, treatment, disposal and reuse infrastructure associated with the Local Alternative.

4.4 REGIONAL ALTERNATIVE

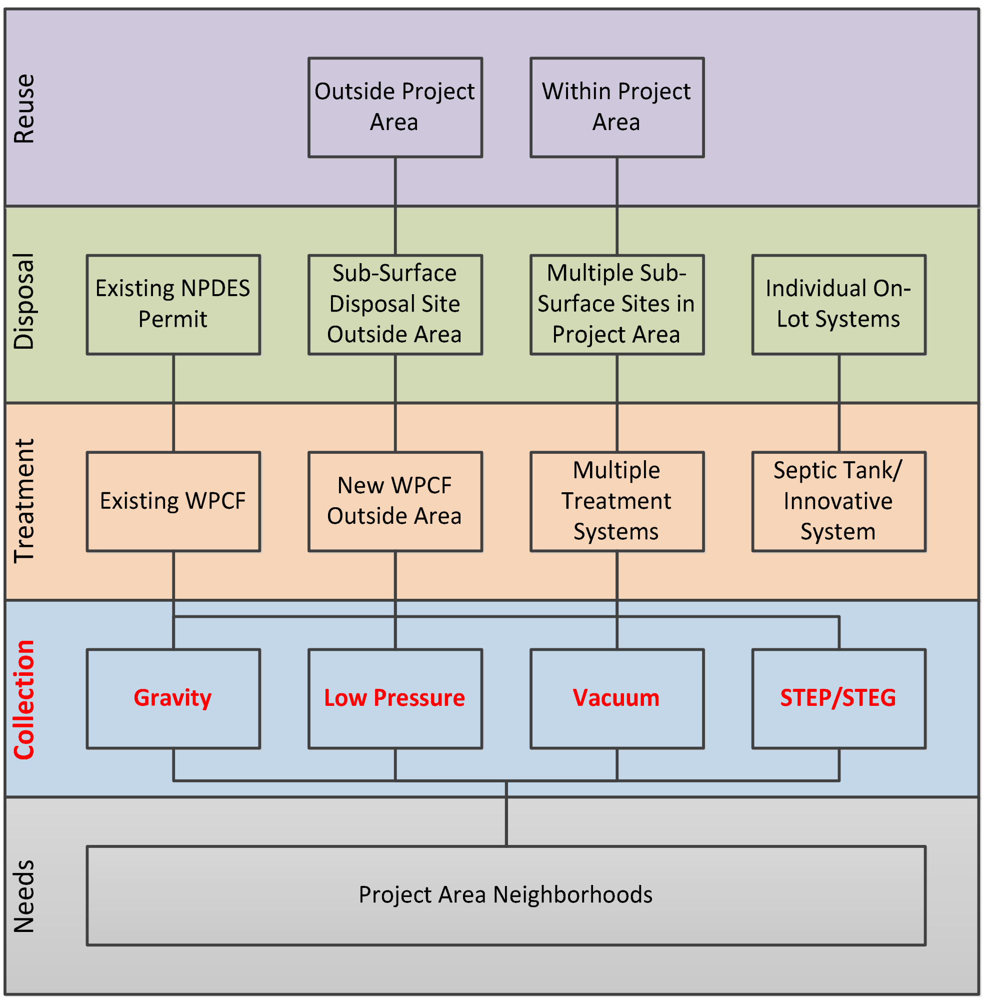
The Regional Alternative includes collection, treatment and disposal alternatives. Following is a brief overview of each component for the Regional Alternative:

- Collection: Similar to the Local Alternative, collection for the Regional Alternative will utilize sewer infrastructure within the high-needs Wastewater Service Area. In addition to the common sewer along Route 156, the Regional Alternative also includes common sewer in East Lyme and Waterford. The common sewer for the Regional Alternative would need to convey wastewater from the Wastewater Service Area through five existing pump stations in East Lyme and Waterford, together with 10+ miles of sewer mains, to reach the New London WPCF.

- Treatment: Treatment will be at the existing WPCF in New London. New London has a NPDES permit dictating level of treatment and permit criteria. The anticipated treatment requirements for the Local Alternative, and subsequent effluent quality, are far superior to those associated with the Regional Alternative.
- Disposal: The New London WPCF uses surface water discharge of treated effluent to the Thames River, which is in close proximity to the Long Island Sound.

Figure 4-2 summarizes the key components of collection, treatment and disposal infrastructure associated with the Regional Alternative.

Figure 4-3 illustrates the common aspects of the Local and Regional Alternatives, together with the key differences between them, especially related to treatment and disposal/reuse. The collection, treatment, disposal, and reuse components of each Alternative were used in Sections 5, 6 and 7 to develop and evaluate specific alternatives and costs for both options.



Summary of framework for wastewater management alternatives in Old Lyme.

Figure 4-1: Local Alternative Stick Diagram

Wastewater Management Plan Project

Town of Old Lyme, Connecticut

Updated on December 10, 2013

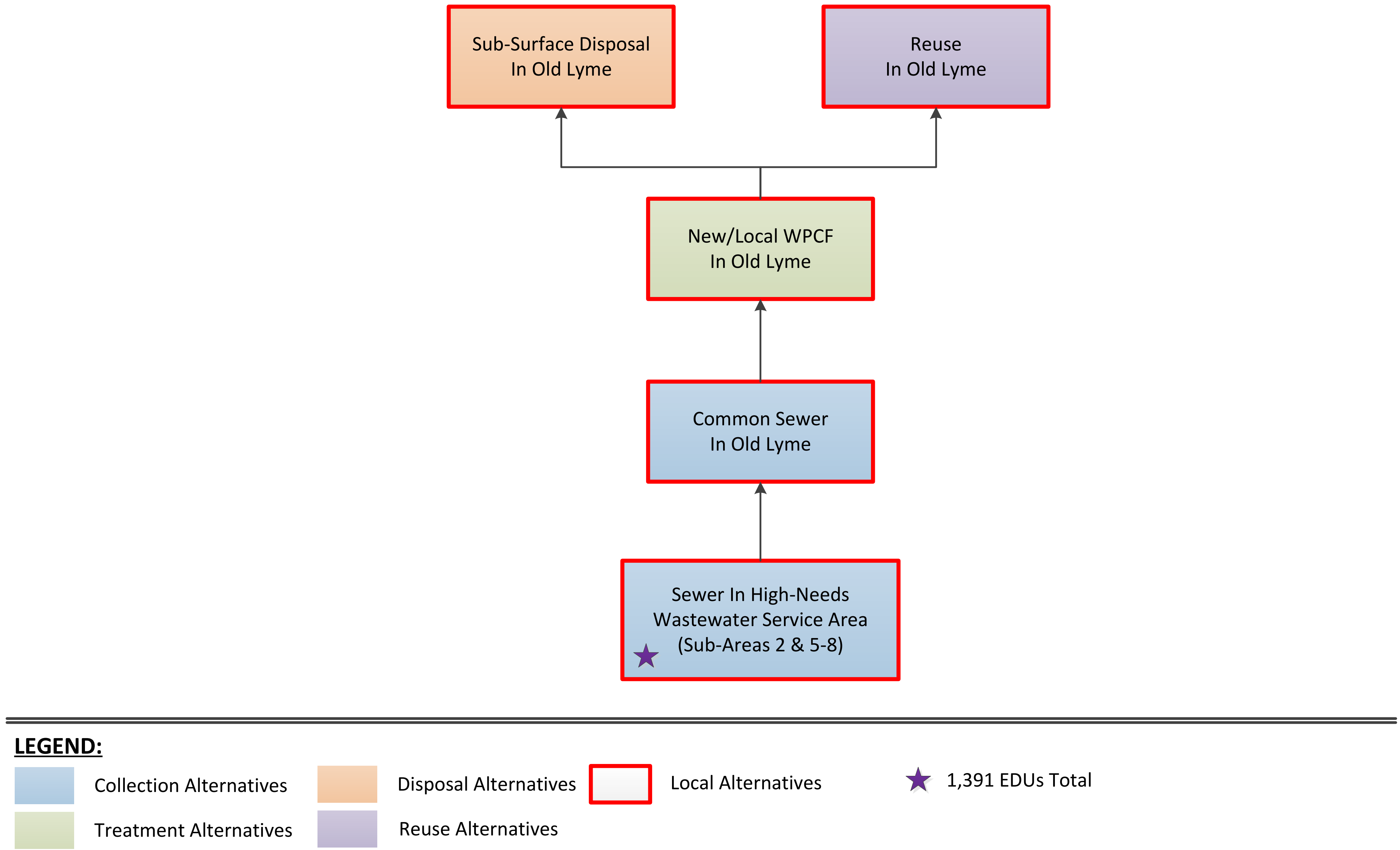
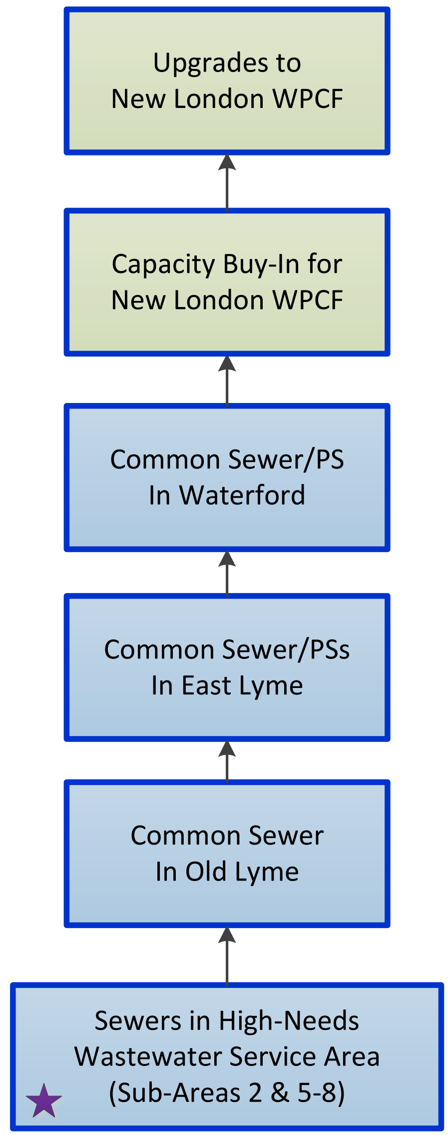


Figure 4-2: Regional Alternative Stick Diagram

Wastewater Management Plan Project

Town of Old Lyme, Connecticut

Updated on December 10, 2013



LEGEND:

Collection Alternatives

Treatment Alternatives

Disposal Alternatives

Reuse Alternatives

Regional Alternatives

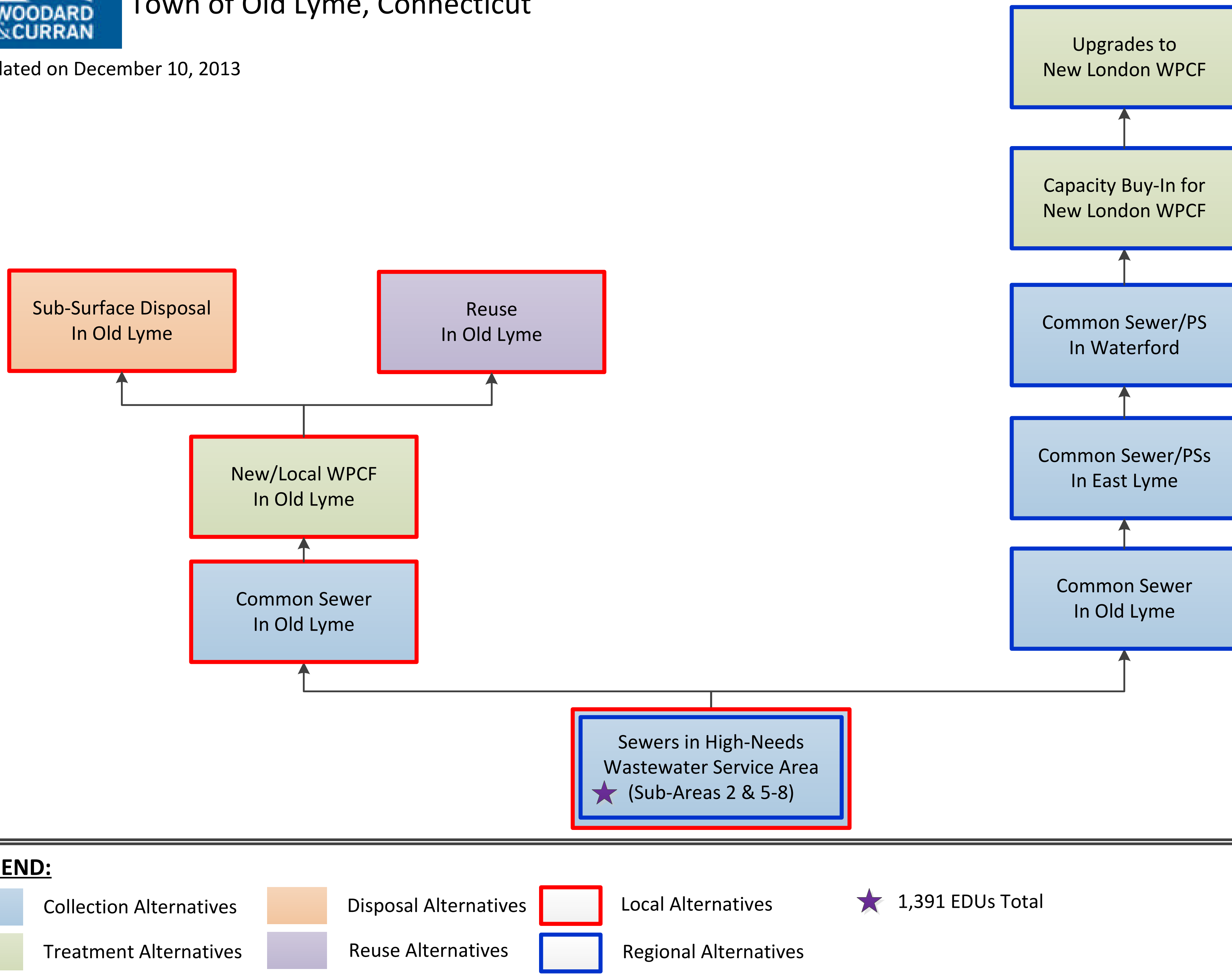
★ 1,391 EDUs Total

Figure 4-3: Summary of Local and Regional Alternatives

Wastewater Management Plan Project

Town of Old Lyme, Connecticut

Updated on December 10, 2013



5. COLLECTION SYSTEM ALTERNATIVES

5.1 OVERVIEW

As part of the Coastal Wastewater Management Plan, we evaluated collection system alternatives and developed an opinion of probable cost (OPC) for each collection system component for both the Local and Regional Alternatives. This Section includes an overview of each collection system alternative, capital and annual operation and maintenance cost projections, as well as other non-cost considerations related to the collection system components of the Local and Regional Alternatives.

In order to project the total anticipated capital cost to the homeowners, the OPC for each alternative includes ancillary items that are sometimes paid by each homeowner after construction. For example, the gravity sewer alternative includes the cost of abandoning the septic system and connecting a sewer lateral to the main. Similarly, the low pressure system option includes the costs associated with the on-site grinder pumps, as well as electrical improvements in the home.

5.2 COLLECTION SYSTEM TERMINOLOGY

There are several collection system configurations. These include: gravity; low pressure; septic tank effluent gravity/pumping; and vacuum. In order to evaluate the options for the Local and Regional Alternatives, following is a brief summary of sewer system options:

5.2.1 Gravity Sewer

A gravity collection system is the most conventional sewer collection system. A gravity sewer relies on an integrated system of pipes that are sloped to a lower elevation. In those systems where the low point is below the treatment system elevation or below other downstream parts of the collection system, a pump station is required to convey the wastewater to a higher desired elevation through a force main. This process is repeated until the wastewater reaches the treatment facility. Figure 5-1 illustrates the common features of a gravity sewer system. A well-constructed gravity system needs little maintenance (aside from the pump stations) because the majority of the system is non-mechanical, relying on gravity to convey the wastewater.

5.2.2 Low Pressure Sewer

A low Pressure System conveys wastewater through individual grinder pumps at each dwelling unit. The collection system relies on many pumps and valves to operate correctly. A typical low pressure sewer system is depicted in Figure 5-2. Due to the higher level of reliance on mechanical systems, low pressure sewers have a higher operation and maintenance cost than gravity sewers. Benefits to this type of system are that the pipes conveying the sewer flows are smaller in diameter than a gravity system and can be buried at a constant elevation just below the frost line. These factors make construction easier, and reduce the time and cost of excavation. In addition, I/I is generally lower in a low pressure sewer system than a gravity system.

Figure 5-1: Gravity Sewer System Overview

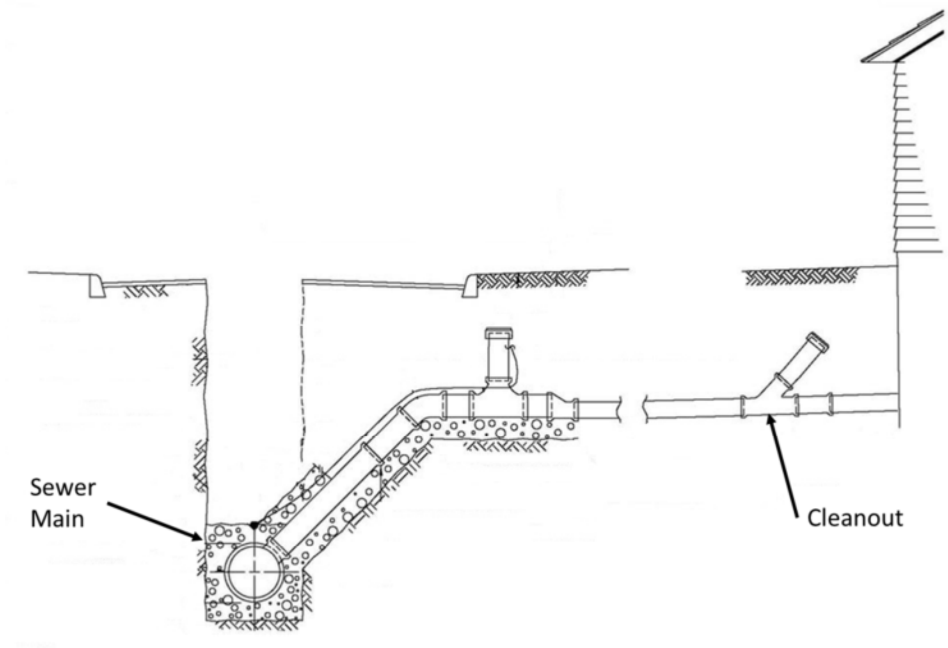
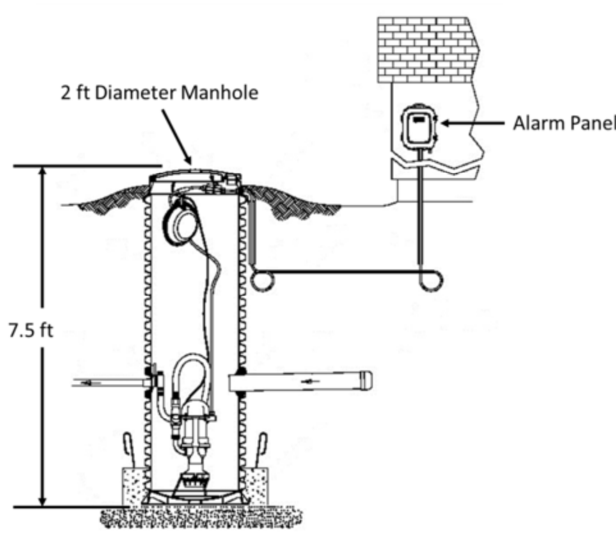


Figure 5-2: Low Pressure Sewer System Overview



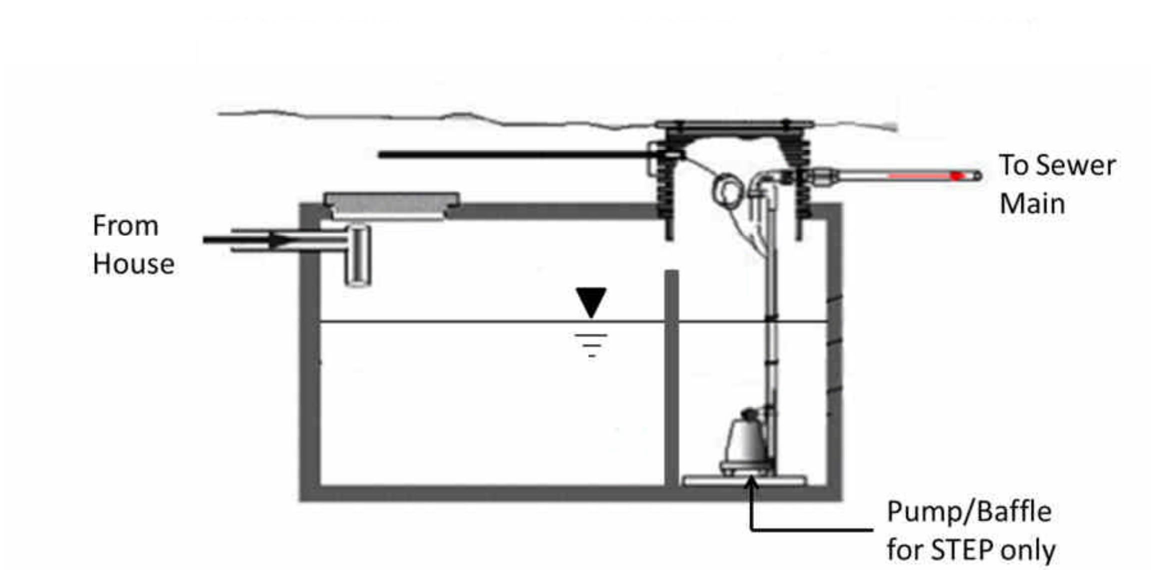
5.2.3 Septic Tank Effluent Gravity Sewer

A septic tank effluent gravity (STEG) system incorporates a conventional on-site septic tank with a conventional gravity collection system. The purpose of a STEG system is to pre-treat the wastewater, reducing solids and the biological load that needs to be treated. For some smaller STEG systems, septic tanks are the only treatment that occurs, and the gravity portion of the system allows the effluent to be redirected to a site where it can be disposed of, often through sub-surface disposal, which may not have been possible on the individual home lots due to soil and/or groundwater conditions. A STEG system schematic is shown in Figure 5-3. The advantages and disadvantages of the STEG system are similar to a gravity system. However, for small lots, the task of siting a modern/compliant septic tank can be challenging and costly, as compared to a gravity system.

5.2.4 Septic Tank Effluent Pump Sewer

A septic tank effluent pumping (STEP) system is very similar to the STEG system, where conventional on-site septic tanks are used to pre-treat the wastewater, reducing solids and the biological load that needs to be treated. The difference comes from how the wastewater is conveyed to the treatment plant for the STEP option. Instead of a STEG system, each individual septic tank would incorporate a pump to convey wastewater under pressure to the treatment, in a manner similar to that of a low pressure. A STEP system schematic is shown in Figure 5-3. The advantages and disadvantages of the STEP system are similar to a low pressure sewer system. Similar to the STEG option, the task of siting a modern/compliant septic tank can be challenging and costly for the STEP alternative, as compared to the low pressure option.

Figure 5-3: STEG/STEP Sewer System Overview

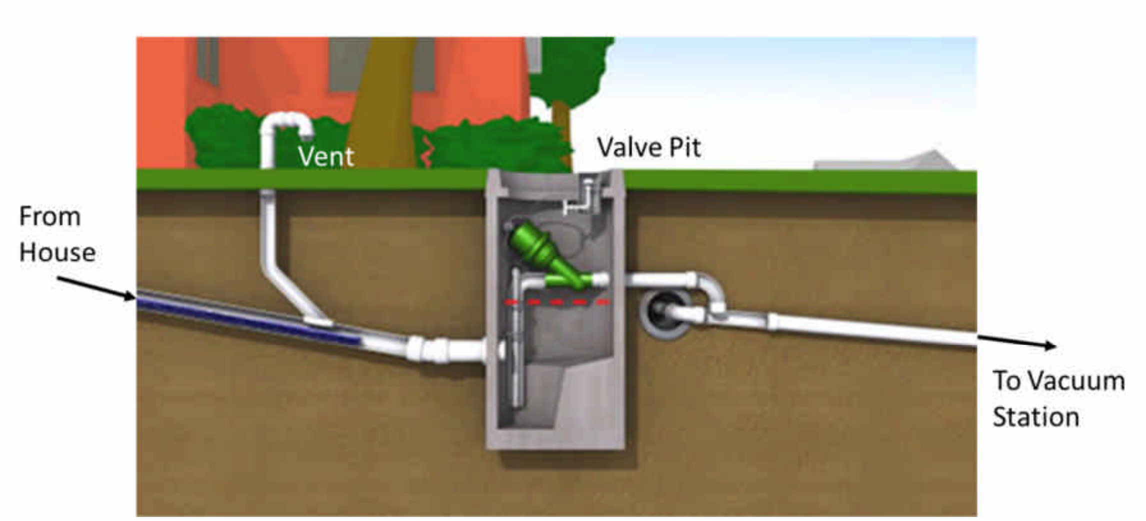


Typical Septic Tank Dimensions: 10 ft long x 5 ft wide x 6 ft deep

5.2.5 Vacuum Sewer

A vacuum sewer system can be seen as a cross between a gravity system and a low pressure sewer system. This is because the collection system conveys flow under pressure through smaller diameter pipes, similar to a low pressure sewer system. Vacuum systems are less common and make up a small percentage of the collection systems in the northeast. A vacuum sewer system is shown in Figure 5-4. Vacuum pump stations have limited capabilities for conveying flows over large differences in elevation, which require higher head or pressure requirements. Vacuum sewers are best implemented over large flat areas where one vacuum pump station can be used to convey a high percentage of the collection system flows similar to what may be seen in the central to mid-west areas of the United States.

Figure 5-4: Vacuum Sewer System Overview



5.3 COLLECTION SYSTEM ALTERNATIVE IN HIGH-NEEDS SUB-AREAS

The collection system alternatives within the High-Needs Sub-Areas comprising the Wastewater Service Area are identical for the Local and Regional Alternatives. Therefore, the following text highlight some of the key aspects of each sewer alternative, advantages, disadvantages, and costs.

Example of large pump station building in coastal community.

Example of small pump station building near beach neighborhood.

5.3.1 Gravity Alternative

In general, each Sub-Area would have 1 to 2 pump stations, set back from the shoreline, where wastewater would flow by gravity and then be pumped to an interceptor or common sewer in Route 156. One advantage to a gravity system that directly relates to a shoreline communities is its ability to be a storm ready system. With the majority of the Sub-Areas adjacent to the ocean and in flood zones, a gravity system can be designed for flooding with watertight manholes and backup generators at the pump stations that would keep the system functioning through severe storms. A common disadvantage to a gravity type system is the increase of I/I, which will increase treatment costs to account for this additional groundwater entering the system.

Capital costs for the gravity system are presented in Table 5-1. Considerations for the gravity sewer capital costs included a cost per linear foot of gravity pipe installed, which incorporates installation of sewer services and sewer manholes. Layouts of the gravity system were prepared to determine how many pump stations are required.

5.3.2 Low Pressure Alternative

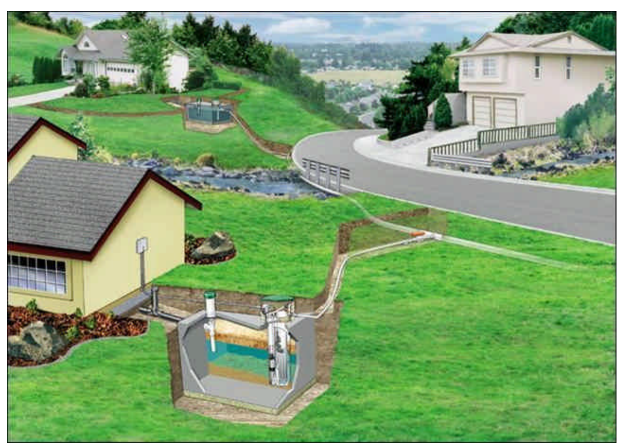
Costs for a LPS system include the cost for all dwelling units to have a grinder pump system installed at the house/cottage which included an assumption that many of the homes would need electrical upgrades to run the pumps. Also, many homes would need a watertight system for the grinder pump due to their proximity to the ocean (flood zone). Other costs included the installation of pipe per linear foot and include costs for valves and cleanouts. Table 5-2 includes the capital cost summary for the low pressure sewer alternative. The collection systems such a Low Pressure System (LPS) would be costly to build and maintenance challenging during times of lost power and flooding.

5.3.3 Septic Tank Effluent Gravity Alternative

Costs incorporated with a STEG system include the costs associated with a gravity system and additional costs for a new septic tank to be installed on each property. Table 5-3 includes the capital cost summary for the STEG sewer alternative. Maintenance costs for the collection system must also incorporate hauling sludge while the treatment plant capital and maintenance must also reflect differences in tank size needed for clarification and BOD removal and less yearly chemical addition.

5.3.4 Septic Tank Effluent Pump Alternative

Costs incorporated with a STEP system include the costs of a LPS system and the additional costs of a new septic tank to be installed on each property. Table 5-4 includes the capital cost summary for the low pressure sewer alternative. Maintenance costs for the collection system must also incorporate hauling sludge while the treatment plant capital and maintenance must also reflect differences in tank size needed for clarification and BOD removal and less yearly chemical addition.



Typical STEP sewer configuration.

5.3.5 Vacuum Alternative

For the purpose of this Coastal Wastewater Management Plan, vacuum sewers were preliminarily evaluated and eliminated from further consideration, due to the topography of the Project Study Area.

5.4 COMMON SEWER INFRASTRUCTURE

Each Sub-Area was evaluated independently for types of collection systems that would provide the best fit, both in terms of costs and non-cost factors. At the same time, all the individual collection systems are being conveyed to one local or regional treatment plant for the best economies of scale for treatment. Also construction and maintenance of independent collection systems must be considered when building and maintaining the system. To provide the best fit for the Wastewater Service Area to combine and convey flows to a common wastewater treatment plant for the Local Alternative, or a common pump station for the Regional Alternative a common sewer was priced and preliminarily designed separately.

5.4.1 Local Alternative Common Sewer

The Local Alternative common sewer would primarily be composed of a gravity sewer in Route 156 that would for the (purpose of this report) convey flows to a wastewater treatment facility just north of Sub-Areas 5 and 6. This approach would potentially not need an additional pump station and each Sub-Areas pump station would be used to convey the flow to the common pump sewer in Route 156. Table 5-5 includes a capital cost summary for the common sewer associated with the Local Alternative.

5.4.2 Regional Alternative Common Sewer

The Regional Alternative common sewer would convey wastewater in a similar fashion to the Local Alternative. The wastewater would be conveyed primarily by gravity to a common pump station just north of Sub-Areas 5 and 6. The Regional Alternative common sewer differs from the Local Alternative common sewer by an additional pump station and force main to get to the East Lyme collection system. For the purpose of this report the additional costs to get from Old Lyme to East Lyme are assumed to be similar to the quantities as provided in the 2012 Joint Facilities Plan Addendum for Sub-Areas 7 and 8 done plus any additional force main costs to account for the assumed location of the common pump station north of Sub-Areas 7and 8. Table 5-6 includes a capital cost summary for the common sewer associated with the Regional Alternative.

5.5 ANNUAL O&M COSTS

Annual O&M costs for all of the collection system options, for both the Local and Regional Alternatives, are summarized in Table 5-7.

5.6 REGIONAL ALTERNATIVE SEWER SYSTEM CONFIGURATIONS

The Regional Alternative collection system facilities consist of the individual Sub-Area collection systems, the regional common sewer in Old Lyme and approximately 10 miles of force main and gravity sewers to get to the New London Water Pollution Control Facility (WPCF). The collection system route to New London also consists of 5 downstream pump stations in East Lyme and Waterford.

The collection system for the Regional Alternative is the majority of the potential capital and annual costs. This can be seen by the overall distance the wastewater would need to travel shown in Figures 5-5 and 5-6. The downstream communities' sewer systems were not designed and built for future flows from neighboring communities and are approaching the flow capacities for their own future needs. To best match the current agreement between Point-O-Woods and East Lyme, capital and annual costs were evaluated based on flow percentages. Additionally, costs for potential capital upgrades for each pump station are divided based on a flow percentage for each community along with a premium percentage for Old Lyme flows, due to the need for capacity upgrades.

5.6.1 Downstream Sewers in East Lyme and Waterford

Table 5-8 depicts the capacities and flows for each of the downstream community pump stations, the downstream communities' future needs and the additional flows the Wastewater Service Area would reflect on each pump station. The basis of Table 5-8 comes from the 2007 East Lyme Capacity Analysis and Planning Report. The Waterford pump station flows and capacities are from the 2011 Waterford Wastewater facilities Plan Update.

As shown in the Table 5-8, all five (5) pump stations would need capacity upgrades to handle the flow from the Old Lyme Beach Associations or Sub-Area flows as described in section 2 of this report. Relatively speaking these pump stations are large and capacity upgrades are assumed to be 1.5 to 2.5 million for each pump station as Shown in Table 5-9. Table 5-9 also shows the assumed percentage of costs the Old Lyme Sub-Areas would be allocated.

Table 5-1: Capital Costs for Gravity Sewer Alternative

		Sub-Area									
Gravity Sewer Items	Unit Costs	2		5		6		7		8	
Dwelling Units		204		392		342		218		192	
8" Gravity Pipe[1] (LF)	$ 174	9,500	$ 1,653,000	15,900	$ 2,766,600	15,200	$ 2,644,800	12,250	$ 2,131,500	10,800	$ 1,879,200
Force Main 2"-3" HDPE[2] (LF)	$ 91	2,800	$ 254,800	2,850	$ 259,350	1,900	$ 172,900	1,900	$ 172,900	1,900	$ 173,000
Pump Stations[3] (LS)	$ 500,000	2	$ 1,000,000	2	$ 1,000,000	1	$ 500,000	1	$ 500,000	1	$ 500,000
Temp Trench Repair[4] (LF)	$ 17	9,500	$ 161,500	15,900	$ 270,300	15,200	$ 258,400	12,250	$ 208,250	10,800	$ 183,600
Mill / Overlay[5] (SF)	$ 5	15,000	$75,000	28,000	$140,000	30,000	$150,000	22,000	$110,000	22,000	$ 110,000
Rock Excavation[6] (CY)	$ 70	2,000	$ 140,000	3,000	$ 210,000	3,000	$ 210,000	2,000	$ 140,000	2,000	$ 140,000
Sub-Totals			$ 3,284,300		$ 4,646,250		$ 3,936,100		$ 3,262,650		$ 2,985,800
30% Contingency			$ 985,290		$ 1,393,875		$ 1,180,830		$ 979,000		$ 896,000
20% Engineering Services			$ 656,860		$ 929,250		$ 787,220		$ 653,000		$ 597,000
TOTAL			$ 4,926,450		$ 6,969,375		$ 5,904,150		$ 4,895,000		$ 4,478,800
Combined Wastewater Service Area									$ 27,200,000		

1. Sewer Manholes and Service connections are included in the unit cost of gravity piping

2. HDPE unit costs include all cleanouts and valve connections

3. Pump Stations unit costs are typical for all pump stations and include structures and equipment

4. Temporary Trench Paving assumes a 5 foot wide trench for all depths up to 12 feet

5. Mill overlay costs at $45 per square yard for Association roads only

6. Rock Excavation is assumed to be a 1 foot depth for every linear feet of trench for Gravity Piping

No permanent trench patch needed for Association roads only

Table 5-2: Capital Costs for Low Pressure Sewer Alternative

			Sub-Area										
Low Pressure Sewer Items	Unit Costs		2		5		6		7		8		
Dwelling Units			204		392		342		218		192		
3"-6" HDPE[1]	$	91	9,500	$ 864,500	17,100	$ 1,556,000	14,100	$ 1,283,000	13,000	$ 1,183,000	11,000	$ 1,001,000	
Grinder Pumps[2]	$	9,000	204	$ 1,836,000	392	$ 3,528,000	342	$ 3,078,000	218	$ 1,962,000	192	$ 1,728,000	
Spare Build out Equipment3	$	4,000	2	$ 8,000	21	$ 84,000	3	$ 12,000	1	$ 4,000	15	$ 60,000	
Temp Trench Repair (lf)	$	17	9,500	$ 161,500	17,100	$ 291,000	14,100	$ 240,000	13,000	$ 221,000	11,000	$ 187,000	
Mill / Overlay (SF)	$	5	15,000	$ 75,000	30,000	$ 150,000	28,000	$ 140,000	23,000	$ 115,000	22,000	$ 110,000	
Rock Excavation (CY)	$	70	880	$ 61,600	2,000	$ 140,000	1,000	$ 70,000	1,200	$ 84,000	1,000	$ 70,000	
Sub-Totals				$ 3,006,600		$ 5,749,000		$ 4,823,000		$ 3,569,000		$ 3,156,000	
30% Contingency				$ 901,980		$ 1,725,000		$ 1,447,000		$ 1,071,000		$ 947,000	
20% Engineering Services				$ 601,000		$ 1,150,000		$ 965,000		$ 714,000		$ 631,000	
TOTAL				$ 4,510,000		$ 8,624,000		$ 7,235,000		$ 5,354,000		$ 4,734,000	
Combined Wastewater Service Area										$ 30,500,000			

1. HDPE unit costs include all cleanouts and valve connections.
2. Grinder pump unit costs include installation and electrical upgrades.
3. Additional Cost of equipment for possible build out equipment costs only.
4. Temporary Trench Paving assumes a 5 foot wide trench for all depths up to 12 feet.
5. Mill overlay costs at $45 per square yard for Association roads only.
6. Rock Excavation is assumed to be a 0.5 foot depth for every linear feet of trench for LPS Piping.
No permanent trench patch needed for Association roads only.

Table 5-3: Capital Costs for STEG Sewer Alternative

		Sub-Area									
STEG Sewer Items	Unit Costs	2		5		6		7		8	
Dwelling Units		204		392		342		218		192	
8" Gravity Pipe[1] (LF)	$ 174	9,500	$ 1,653,000	15,900	$ 2,767,000	15,200	$ 2,645,000	12,250	$ 2,131,500	10,800	$ 1,879,000
Force Main 3"-6" HDPE (LF)	$ 91	2,800	$ 255,000	2,850	$ 259,000	1,900	$ 172,900	1,900	$ 172,900	1,900	$ 173,000
Septic Tanks[2]	$ 4,500	102	$ 459,000	196	$ 882,000	171	$ 769,500	109	$ 490,500	96	$ 432,000
Spare Build Out Equipment[3]	$ 2,000	2	$ 4,000	21	$ 42,000	3	$ 6,000	1	$ 2,000	15	$ 30,000
Pump Stations[4] (LS)	$ 500,000	2	$ 1,000,000	2	$ 1,000,000	1	$ 500,000	1	$ 500,000	1	$ 500,000
Temp Trench Repair[5] (lf)	$ 17	9,500	$ 162,000	15,900	$ 270,000	15,200	$ 258,000	12,250	$ 208,250	10,800	$ 183,600
Mill / Overlay[6] (SF)	$ 5	15,000	$ 75,000	28,000	$ 140,000	30,000	$ 150,000	22,000	$ 110,000	21,600	$ 108,000
Rock Excavation[7] (CY)	$ 70	2,000	$ 140,000	2,900	$ 203,000	3,000	$ 210,000	2,000	$ 140,000	2,000	$ 140,000
Sub-Totals			$ 3,748,000		$ 5,563,000		$ 4,711,000		$ 3,755,000		$ 3,446,000
30% Contingency			$ 1,124,000		$ 1,668,900		$ 1,413,000		$ 1,127,000		$ 1,034,000
20% Engineering Services			$ 750,000		$ 1,112,600		$ 942,200		$ 751,000		$ 689,000
TOTAL			$ 5,622,000		$ 8,344,500		$ 7,066,200		$ 5,633,000		$ 5,169,000
Combined Wastewater Service Area									$ 31,800,000		

1. Sewer Manholes and Service connections are included in the unit cost of gravity piping.

2. Septic tank unit costs include installation and are assumed for 50% of all existing homes.

3. Additional Cost of equipment for possible build out equipment costs only.

4. Pump Stations unit costs are typical for all pump stations and include structures and equipment.

5. Temporary Trench Paving assumes a 5 foot wide trench for all depths up to 12 feet.

6. Mill overlay costs at $45 per square yard for Association roads only.

7. Rock Excavation is assumed to be a 1 foot depth for every linear feet of trench for Gravity Piping.

No permanent trench patch needed for Association roads only.

Table 5-4: Capital Costs for STEP Sewer Alternative

		Sub-Area									
STEP Sewer Items	Unit Costs	2		5		6		7		8	
Dwelling Units		204		392		342		218		192	
3"-6" HDPE[1] (lf)	$ 91	9,500	$865,000	17,100	$1,556,000	14,100	$1,283,000	13,000	$1,183,000	11,000	$1,001,000
Grinder Pumps[2]	$ 9,000	204	$1,836,000	392	$3,528,000	342	$3,078,000	218	$1,962,000	96	$864,000
Septic Tanks[3]	$ 4,500	102	$459,000	196	$882,000	171	$769,500	109	$490,500	192	$864,000
Spare Build Out Equipment[4]	$ 6,000	2	$12,000	21	$126,000	3	$18,000	1	$6,000	15	$90,000
Temp Trench Repair[5] (lf)	$ 17	9,500	$162,000	17,100	$291,000	14,100	$240,000	13,000	$221,000	11,000	$187,000
Mill / Overlay[6] (SF)	$ 5	15,000	$75,000	30,000	$150,000	28,000	$140,000	23,000	$115,000	22,000	$110,000
Rock Excavation[7] (CY)	$ 70	1,000	$70,000	1,600	$112,000	1,000	$70,000	1,200	$84,000	1,000	$70,000
Sub-Totals			$ 3,479,000		$ 6,645,000		$ 5,598,500		$ 4,061,500		$ 3,186,000
30% Contingency			$ 1,043,700		$ 1,993,500		$ 1,679,550		$ 1,218,450		$ 955,800
20% Engineering Services			$ 695,800		$ 1,329,000		$ 1,119,700		$ 812,300		$ 637,200
TOTAL			$ 5,218,500		$ 9,967,500		$ 8,397,750		$ 6,092,250		$ 4,779,000
Combined Wastewater Service Area									$ 34,500,000		

1. HDPE unit costs include all cleanouts and valve connections

2. Grinder pump unit costs include installation and electrical upgrades

3. Septic tank unit costs include installation and are assumed for 50% of all existing homes

4. Additional Cost of equipment for possible build out equipment costs only

5. Temporary Trench Paving assumes a 5 foot wide trench for all depths up to 12 feet

6. Mill overlay costs at $45 per square yard for Association roads only

7. Rock Excavation is assumed to be a 0.5 foot depth for every linear feet of trench for LPS Piping

No permanent trench patch needed for Association roads only

Table 5-5: Capital Costs for Common Sewer for Local Alternative

		Sub-Area Forcemain to Gravity [2]						Route 156	
Local Common Sewer	Unit Costs	2		7		8		Gravity Main	
Dwelling Units		204		218		192		1348	
8" Gravity Pipe[1] (LF)	$ 174							3120	$ 543,000
Forcemain 2"-3" HDPE[1] (LF)	$ 91	4650	$ 423,000	1200	$ 109,000	1600	$ 145,600		
Temp Trench Repair (LF)	$ 15	4650	$ 69,750			1600	$ 24,000	3120	$ 47,000
Perment Trench Paving (LF)	$ 20	4650	$ 93,000			1600	$ 32,000	3120	$ 62,000
Mill / Overlay (SY)	$ 63	2583	$ 163,000			889	$ 56,000	1733	$ 109,000
Rock Excavation[3] (CY)	$ 70	400	$ 28,000	100	$ 7,000	100	$ 7,000	600	$ 42,000
Sub-Totals			$ 776,750		$ 116,000		$ 264,600		$ 803,000
30% Contingency			$ 233,000		$ 34,800		$ 79,000		$ 241,000
20% Engineering Services			$ 155,000		$ 23,200		$ 53,000		$ 161,000
Sub Totals			$ 1,164,750		$ 174,000		$ 397,000		$ 1,205,000
Combined Common Sewer						$2,900,000			

1. Common sewer costs include a gravity interceptor in Route 156 and additional forcemain costs for particular sub-areas to get to the gravity main.

2. Sub-Areas 5 and 6 are directly below the assumed common sewer and no additional forcemain is needed to connect.

3.Rock Excavation quantities include 0.5 feet for forcemain and 1 foot of depth for every linear foot of gravity pipe

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Table 5-6: Capital Costs for Common Sewer for Regional Alternative

Regional Common Sewer			
Item Description	Unit/Cost	QTY	Total Cost
12 inch Force Main (LF)	$ 105	14,500	$ 1,523,000
Additional Pump Station (EA)	$ 500,000	1	$ 500,000
Rock Excavation[1] (CY)	$ 90	1,300	$ 117,000
Temporary Trench Repair (LF)	$ 20	14,500	$ 290,000
Permanent Pavement (LF)	$ 23	14,500	$ 334,000
Mill & Overlay[2] (SY)	$ 63	22,750	$ 1,433,000
Stream Crossing[3] (EA)	$ 30,000	4	$ 120,000
Railroad Bridge Crossing Premium[3] (EA)	$ 200,000	1	$ 200,000
Sub- Totals			$4,517,000
Common Sewer in Old Lyme[4]			$2,900,000
Sub Totals			$7,417,000
30% Contingency			$ 2,225,000
20% Engineering Services			$ 1,483,000
TOTAL			$ 11,125,000

1. Assumes 0.5 feet of rock per every LF of trench (5 foot trench)

2. Mill Overlay assumes full travel lane for all state roads

3. Based on July 2012 Addendum to Wastewater Facilities Planning Reports

4. Common Sewer in Old Lyme details are shown in the Local Alternatives common sewer table.

Table 5-7: Annual O&M Costs for All Collection System Alternatives

Annual Cost Details		Collection Systems							
		Old Lyme Collection Systems				Regional Costs			
Category	Annual Description	Gravity	LPS	STEP	STEG	Gravity	LPS	STEP	STEG
Labor	Operation[1]	$99,200	$99,200	$99,200	$99,200				
	Engineering & legal	$5,000	$5,000	$5,000	$5,000				
	Tech Support[2]	$19,700	$19,700	$19,700	$19,700				
Power & Billing	Electricity	$11,000	$31,000	$31,000	$11,000				
	Billing (Additional Town Admin)	$5,000	$5,000	$5,000	$5,000				
Liquid/Solids	Chemical addition (odor Control)[3]	$10,200							
	Septic Pumping[4]			$215,800	$215,800				
	Chemical addition (Carbon Addition)								
Mech.	Equipment Replacement [5]	$42,000	$54,000	$54,000	$27,000				
Other	Downstream East Lyme and Waterford Fees[6]					$413,000	$375,000	$375,000	$413,000
	Sub-Totals	**$192,000**	**$214,000**	**$430,000**	**$383,000**	$413,000	$375,000	$375,000	$413,000
	Regional Totals[7]					**$605,000**	**$589,000**	**$805,000**	**$796,000**

1. Operation assumes 1 full time class III CT operator for the collection system in Old Lyme
2. Tech Support assumes 40 hours annually for mechanical, electrical, and instrumentation a year
3. Odor control assumes small amount of chemical addition needed for off season conditions at gravity pump stations
4. Septic Pumping Rates assume 3,500 gal tanks pumped every 2 years at 8 Cents per gallon and $20 tipping fee
5. Equipment Replacement assumes 1% to 3% of potential equipment capital costs annually
6. Regional Downstream costs assumes $3.93 per 1000 gallons for East Lyme Waterford O&M fees (based on East Lyme current costs)
7. Total Regional combines downstream costs to the annual collection costs in Old Lyme

Table 5-8: Downstream Pump Station Capacities (Regional Alternative)

Pump Station Name	Pump Station Capacity* (GPD)	*Existing Conditions*			*East Lyme Moderate Zoning Buildout* [3]			*With Old Lyme Contribution*		
		Peak Hour (GPD)	Capacity Used	Capacity Concerns	Peak Hour (GPD)	Capacity Used	Capacity Concerns	Peak Hour (GPD)	Capacity Used	Capacity Concerns
Niantic[1]	6,273,000	1,823,000	29%	No	5,456,000	87%	No	6,608,000	105%	Yes
Pattagansett[1]	5,164,000	1,096,000	21%	No	4,337,000	84%	No	5,489,000	106%	Yes
Bride Brook[1]	2,880,000	668,000	23%	No	1,661,000	58%	No	2,813,000	98%	Yes
Route 156[1]	2,703,000	680,000	25%	No	1,880,000	70%	No	3,032,000	112%	Yes
Waterford[2]	10,397,000	9,034,000	87%	No	n/a	n/a	n/a	10,186,000	98%	Yes

* Calculated with largest pump offline.

1) Based on 2007 Capacity Analysis and Planning Report

2) Based on 2011 Waterford Wastewater Facilities Plan Update

3) Based on data from East Lyme Report

Niantic Pump Station (East Lyme)

Bride Brook Pump Station (East Lyme)

Route 156 Pump Station (East Lyme)

Pattagansett Pump Station (East Lyme)

Table 5-9: Estimated Downstream Capital Needs (Regional Alternative)

Pump Station Name	Old Lyme % of Peak Hourly Flow	Estimated Additional Capital Cost Premium %	Capital Upgrade Cost	Estimated Old Lyme Capital Portion
Niantic	21%	29%	$2,500,000	$1,253,000
Pattagansett	27%	24%	$2,500,000	$1,264,000
Bride Brook	69%	10%	$2,000,000	$1,587,000
Route 156	61%	10%	$2,000,000	$1,426,000
Waterford	13%	10%	$1,500,000	$341,000
FM Pattagansett	21%	81%	$522,000	$532,000
FM Bride Brook	41%	62%	$1,507,000	$1,551,000
FM Route 156	38%	65%	$398,000	$410,000
Gravity	n/a	100%	$2,112,000	$2,112,000
		Totals	$15,039,000	$10,476,000

In addition to the pump station capital needs, it is assumed a percentage of the force main and gravity sewer collection systems would need upgrades similar to the capacity needs of the pump stations. Together the downstream pump station upgrades and collection system mains contribute to the cost of the Regional Alternatives capital collection system costs.

5.7 COST COMPARISON

Table 5-10 shows the breakdown of capital costs for each type of collection system within the Wastewater Service Area. Table 5-11 shows the total cost of the Local and Regional Alternatives collection system including anticipated annual O&M costs.

Table 5-10: Wastewater Service Area Capital Collection Costs

Collection System Type	Sewer Within High-Needs Sub-Areas	Common Sewer to Old Lyme WPCF[1] (Local Alternative)	Common Sewer to East Lyme Town Line[1] (Regional Alternative)
Gravity	$27,500,000	$3,600,000	$11,125,000
Low Pressure	$30,800,000	$3,600,000	$11,125,000
STEP	$34,700,000	$3,600,000	$11,125,000
STEG	$32,100,000	$3,600,000	$11,125,000

1. The common sewer systems would be a combination of force mains and gravity sewers regardless of the collection system type in the Wastewater Service Area.

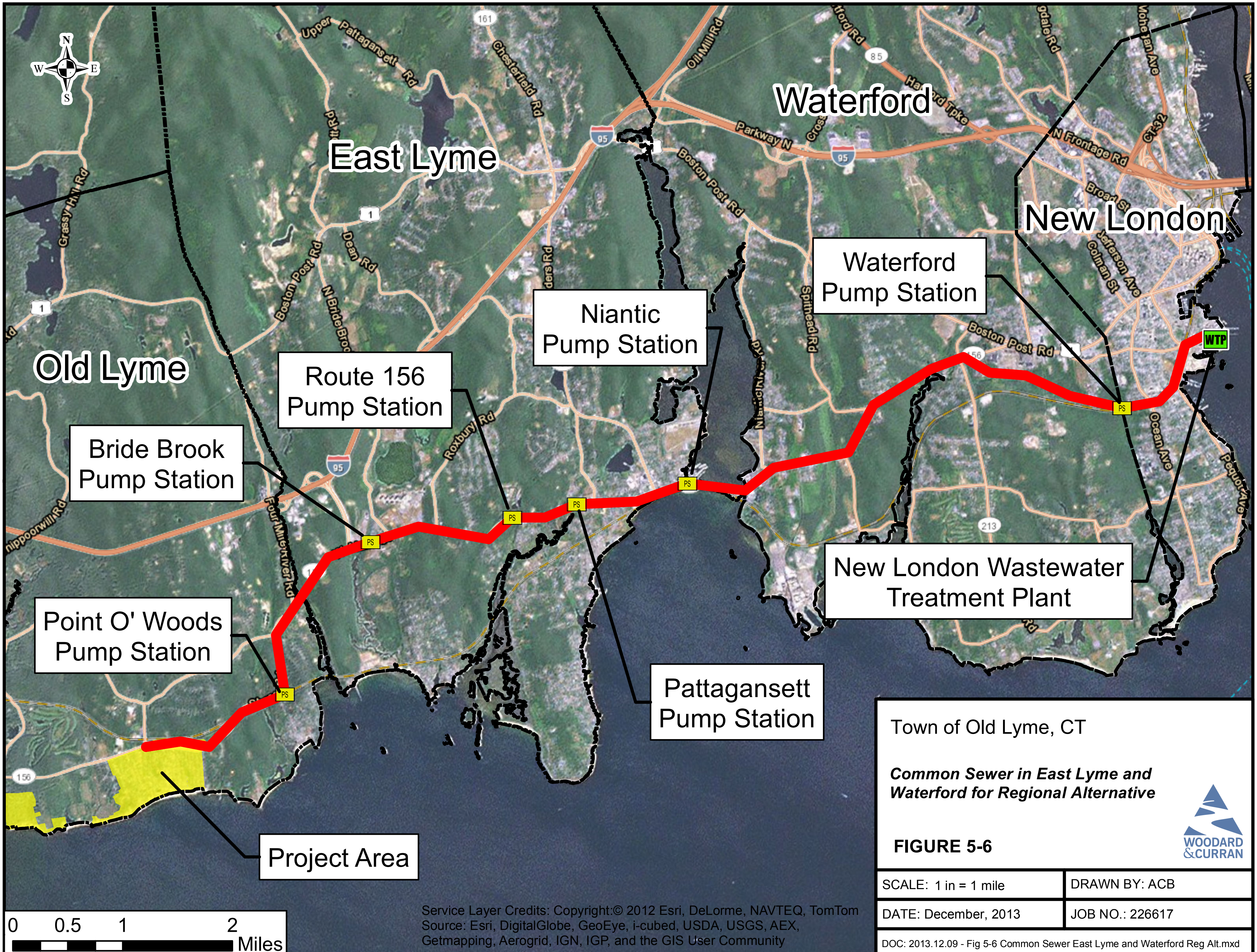
Table 5-11: Total Capital and Annual Collection Costs

Collection System Type	Local Alternative		Regional Alternative	
	Capital	Annual O&M	Capital	Annual O&M
Gravity	$31,100,000	$192,000	$49,101,000	$589,000
Low Pressure	$34,400,000	$214,000	$52,401,000	$534,000
STEP	$38,300,000	$430,000	$56,301,000	$534,000
STEG	$35,700,000	$383,000	$53,701,000	$589,000

Table 5-11 shows the capital and annual Operation & Maintenance (O&M) costs for the Local and Regional Alternatives. Costs under the Regional Alternative represent the sum of all the Wastewater Service Area collection systems, the common sewers, and any downstream pump station and collection system upgrades.

The Local Alternative is significantly less expensive for both capital and annual costs for the collection system aspect of this report. The costs under this Local Alternative represent only the sum of the Wastewater Service Area collection systems and the common sewer in Old Lyme. A breakdown of annual costs for both the Local and Regional Alternative are provided in Table 5-7.


Legend
Sanitary Sewer
Local Alternative Common Sewer
Regional Alternative Common Sewer
Town Line
Long Island Sound
Project Area
Flat Rock Hill Rd
Browns Ln
Briar Hill Dr
Peppermint Rdg
Stonewood Dr
Chestnut Hill Rd
Lantern Ln
River Rd
Bank Rd
Riverdale Lndg
Wildwood Dr
Oakridge Dr
Holly Ln
Nottingham Dr
Wychwood Rd
Cedar Hollow Dr
Mile Creek Rd
Victoria Ln
Lee Dr
Chadwick Dr
Windward Ln
Somerset Ln
Champlain Dr
Cross Ln
Connecticut Rd
Carrington Rd
Seaview Rd
Hough Rd
Sargents Rd
Joffre Rd
Buttonball Rd
Otter Rock Rd
Fairway Ln
Dogwood Dr
North Ln
Hatchett Point Rd
Cutler Rd
Dennis Rd
Edge Lea Rd
Center Beach Ave
Hawks Nest Rd
Washington Ave
Prospect St
Liberty St
Miami Ave
Biscayne Blvd
Corsino Ave
15th Ave
Portland Ave
Hartford Ave
Swan Ave
Old Colony Rd
Breen Ave
Gorton Ave
Sea Spray Rd
Brightwater Rd
Billow Rd
Sea Ln
Pond Rd
Avenue A
W End Dr
Old Shore Rd
Springfield Rd
Meriden Rd
Brighton Rd
Seaside Ln
Haywagon Dr
156
N
S
E
W
Service Layer Credits: Copyright:© 2012 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
0 750 1,500 3,000 Feet
Town of Old Lyme, CT
Common Sewer for Local and Regional Alternatives
FIGURE 5-5
WOODARD &CURRAN
SCALE: 1 in = 1,500 ft
DRAWN BY: ACB
DATE: December 2013
JOB NO.: 226617
DOC: 2013.12.09 - Fig 5-5 Common Sewer for Local and Reg Alt.mxd



N
S
E
W
Waterford
East Lyme
New London
Old Lyme
Waterford
Pump Station
Niantic
Pump Station
Route 156
Pump Station
Bride Brook
Pump Station
New London Wastewater
Treatment Plant
Point O' Woods
Pump Station
Pattagansett
Pump Station
Project Area
PS
WTP
Upper Pattagansett Rd
Chesterfield Rd
Oil Mill Rd
Hartford Tpke
Parkway N
N Frontage Rd
Boston Post Rd
Grassy Hill Rd
Dean Rd
N Bride Brook
Roxbury Rd
Four Mile River Rd
Spithead Rd
Broad St
Jefferson Ave
Colman St
Ocean Ave
Pequot Ave
Mohegan Ave
CT-32
Shippoorwill Rd
95
1
156
161
85
213
0
0.5
1
2
Miles
Service Layer Credits: Copyright:© 2012 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX,
Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
Town of Old Lyme, CT
Common Sewer in East Lyme and
Waterford for Regional Alternative
FIGURE 5-6
WOODARD
&CURRAN
SCALE: 1 in = 1 mile
DRAWN BY: ACB
DATE: December, 2013
JOB NO.: 226617
DOC: 2013.12.09 - Fig 5-6 Common Sewer East Lyme and Waterford Reg Alt.mxd

6. TREATMENT ALTERNATIVES

6.1 INTRODUCTION

Woodard & Curran developed an opinion of probable cost (OPC) for each treatment component for both the Local and Regional Alternatives as part of the Coastal Wastewater Management Plan. This Section includes: an overview of each treatment alternative; capital and annual operation and maintenance cost projections; as well as other non-cost considerations related to the treatment components of the Local and Regional Alternatives.

6.2 OVERVIEW OF LOCAL TREATMENT ALTERNATIVES

6.2.1 Treatment Configurations

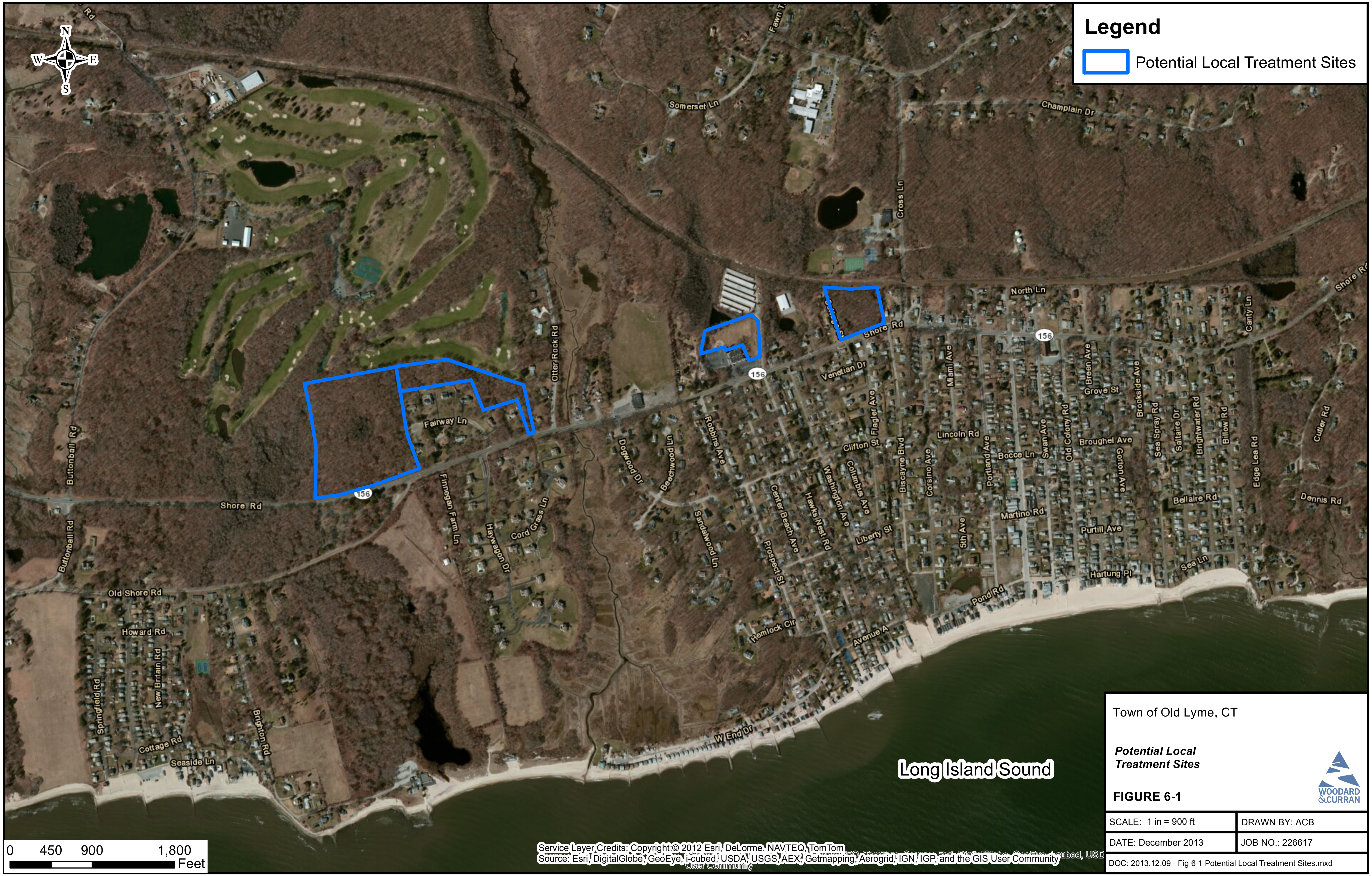
Three general types of treatment configurations were evaluated for the Local Alternative. These configurations consist of on-site, neighborhood/cluster, and centralized. It was determined that on-site septic systems and larger cluster systems would not be practical forms of treatment for the Wastewater Service Area. There are physical constraints making smaller systems an unviable option within the High Needs Sub-Areas. In addition, poor soils and high groundwater make on-site disposal systems challenging. Due to the high density of homes, lot sizes do not provide adequate amounts of space for proper treatment with traditional septic systems. Larger cluster systems could provide higher degrees of effluent quality but are also limited by available space. Similar to previous Wastewater Management Plans for Sub-Areas 7 and 8, a centralized treatment facility with off-site disposal would provide the best economies of scale for treatment. A WPCF would treat the flows from all the High Needs Sub-Areas while providing the highest wastewater effluent quality. The effluent quality is an important factor for not only pollution removal but also providing options for water reuse opportunities.

Example of on-site sub-surface disposal system construction in coastal community.

6.2.2 Local WPCF

For the purpose of planning and cost evaluations, a potential WPCF was evaluated at a location just north of Route 156 and Sub-Areas 5 & 6, as shown in Figure 6-1. This site was identified as a possible location that provides a central location to the Wastewater Service Area. Other locations are also being screened as possible WPCF sites.

Example of local WPCF with packaged treatment system.



Legend
Potential Local Treatment Sites
N
S
E
W
Somerset Ln
Champlain Dr
Cross Ln
North Ln
Shore Rd
156
Venetian Dr
Fairway Ln
Otter Rock Rd
Buttonball Rd
Shore Rd
Old Shore Rd
Howard Rd
New Britain Rd
Springfield Rd
Cottage Rd
Seaside Ln
Brighton Rd
Finnegan Farm Ln
Haywagon Dr
Cord Grass Ln
Dogwood Dr
Beechwood Ln
Robbins Ave
Sandalwood Ln
Center Beach Ave
Prospect St
Hawks Nest Rd
Washington Ave
Columbus Ave
Flagler Ave
Clifton St
Liberty St
Biscayne Blvd
Corsino Ave
Miami Ave
Lincoln Rd
5th Ave
Portland Ave
Bocce Ln
Swan Ave
Martino Rd
Old Colony Rd
Breen Ave
Grove St
Broughel Ave
Purtill Ave
Hartung Pl
Gorton Ave
Brookside Ave
Sea Spray Rd
Saltaire Dr
Brightwater Rd
Billow Rd
Bellaire Rd
Sea Ln
Edge Lea Rd
Canty Ln
Cutler Rd
Dennis Rd
Pond Rd
Avenue A
Hemlock Cir
W End Dr
Long Island Sound
0 450 900 1,800 Feet
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Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
Town of Old Lyme, CT
Potential Local Treatment Sites
FIGURE 6-1
WOODARD &CURRAN
SCALE: 1 in = 900 ft
DRAWN BY: ACB
DATE: December 2013
JOB NO.: 226617
DOC: 2013.12.09 - Fig 6-1 Potential Local Treatment Sites.mxd

Two types of centralized wastewater treatment facilities were considered within Task 5 (Evaluation of Wastewater Treatment Alternatives): (1) Sequence Batch Reactor (SBR); and (2) Membrane Bio Reactor (MBR). These two types of facilities would meet high quality effluent standards while being flexible to handle seasonal flow conditions.

The SBR process combines conventional settling and biological treatment in one stage. In this process, flow is diverted between multiple tanks where one tank is in a treatment mode while the other tank fills by receiving the influent flow. This process is repeated back and forth between a set number of tanks to handle the flows needed. SBR systems are not uncommon in the northeast but can reduce the size of the facility needed when compared to a conventional activated sludge plant. Depending on effluent quality requirements, some form of tertiary treatment, such as denitrification filter, is used to help polish the effluent before disinfection.

The MBR process is a newer technology rapidly growing in the industry especially with smaller localized facilities. An MBR process greatly reduces tank volumes needed by replacing conventional clarification processes with membranes that filter solids and other nutrients. The size reduction with an MBR facility commonly allows for a completely enclosed WPCF. Due to the filtration that occurs with a membrane process, MBR plants are able to achieve high quality effluent standards with less operational efforts.

Example of local WPCF adjacent to athletic fields.

Due to the potential of using a portion of the treated wastewater effluent as reuse water for irrigation, the highest quality effluent is required. An MBR treatment facility would be best capable of meeting and consistently maintaining both the CT guidelines for advanced pretreatment and EPA reuse guidelines for unrestricted irrigation applications. By investing in high quality treatment reuse options become available and will provide more cost effective effluent disposal options for the Town. An MBR facility could also be constructed fully enclosed, for aesthetics, reducing the footprint of the facility. Other alternatives for treatment facilities do exist that could meet the necessary requirements, a detailed design would be needed to fully understand the optimum treatment facility and potential cost savings.

6.2.3 Collection System Impacts on Treatment System and Costs

As noted in previous sections, the type of collection system used to convey the wastewater to the treatment facility will affect the capital and O&M cost of treatment. No matter which collection system is selected, an MBR process or similar would need to be installed.

The costs in Table 6-1 below have been presented for an MBR facility including the four types of collection systems evaluated. As shown in Table 6-1, the costs differ per type of collection system used. For example LPS and STEP systems could both reduce I/I flows to the WPCF and STEP / STEG systems could reduce the influent nutrient and solids loading at the treatment plant. Each option has its benefits and limitations. When STEP / STEG systems reduce nutrients at the WPCF, collection costs go up for home owners required to pay for septic tank pumping every 1 to 2 years. Also, nutrient reduction can have a negative impact on plant costs, and additional carbon source is likely to be needed. These costs are broken down in Tables 6-3 and 6-4.

Table 6-1: Summary of Local Treatment Costs for Different Collection System Options

SUMMARY OF LOCAL TREATMENT COSTS					
Item No.	Description	Gravity	LPS	STEG	STEP
1	Headworks Building[1]	$807,000	$767,000	$646,000	$613,700
2	MBR Building[2]	$4,994,000	$4,994,000	$4,744,000	$4,744,000
3	Pre-anoxic & Anoxic Tanks[3]	$458,000	$435,000	$412,000	$391,000
4	Admininstration Building addition	$144,000	$144,000	$144,000	$144,000
5	Influent Equalization[4]	$465,000	$442,000	$465,000	$233,000
6	Effluent Equalization[5]	$2,850,000	$2,708,000	$2,850,000	$2,708,000
Subtotal		$9,800,000	$9,500,000	$9,300,000	$8,900,000
Contingency	30%	$3,000,000	$2,900,000	$2,800,000	$2,700,000
Engineering	20%	$2,000,000	$1,900,000	$1,900,000	$1,800,000
Local Treatment Total		**$14,800,000**	**$14,300,000**	**$14,000,000**	**$13,400,000**

1. STEP and STEG systems assume no course screening is needed in the headworks.

2. STEP and STEG systems assume 5% reduction in total MBR building costs.

3. STEG System assumes a 10% reduction in Pre & Post Anoxic tanks.

4. STEP Systems assume 50% reduction for influent equilization and 5% reduction in Pre & Post Anoxic tanks.

5. LPS and STEP systems assume a 5% decline in effluent equilization.

As shown above in Table 6-1, the most expensive treatment alternative is when combined with a gravity system. This is due to higher annual flows and the fact that there is no settling taking place in the collection system such as a STEP /STEG system. The lowest cost is when treatment is combined with a STEP system because both flows and solids would be reduced prior to treatment. Overall, the costs of the WPCF vary minimally with different collection systems options. The higher capital and O&M costs of implementing a STEP system still make the gravity system a more economical choice for the Wastewater Service area.

Treatment for the Local Alternative would provide the Town of Old Lyme control over their future needs and water use. This could be an invaluable aspect as wastewater systems become regulated more stringently while existing infrastructure ages, resulting in costly upgrades and restrictions.

6.3 REGIONAL TREATMENT ALTERNATIVE

For the Regional Alternative, wastewater would be treated at the existing New London WPCF and discharged to the Thames River. No other options have been evaluated for a Regional Treatment Alternative. It is assumed the New London WPCF will undergo a facilities upgrade in the near future to meet both capacity and nutrient limits. The cost of which would be spread out to all the users based on the flow allocations from each community. These capital upgrade costs are presented and compared to the Local Alternatives treatment costs in Table 6-2. Also annual costs are estimated for both treatment alternatives presented in Tables 6-3 and 6-4.

Table 6-2: Regional Capital Cost Summary

Description	Cost
New London Buy in	$ 6,955,000
New London Facility Upgrade	$ 1,500,000
Total	$ 8,455,000

The New London Buy in price is a set price based on conversations with the governing authorities. The total cost is based on $5,000 dollars per estimated dwelling unit (EDU) in the Wastewater Service Area and includes the potential undeveloped parcels. The new London Facility Upgrade price is based on an estimated $50 million dollar upgrade with 3% flow allocation to Old Lyme and no premium percentage added. New London is in the process of developing a capital plan, so this is only a conceptual placeholder, based on upgrade costs at similarly sized facilities in Connecticut.

6.4 COST COMPARISON

The Local Treatment and the Regional Treatment Alternatives capital and annual O&M costs are presented below in Tables 6-3 and 6-4. The Local Alternative is more expensive than the Regional Alternative relative to treatment alone. This is due to the cost sharing that the New London WPCF is able to provide. Although the Regional Alternative incorporates the use if the existing New London WPCF for treatment, there are still substantial buy-in costs for Old Lyme residents to become regional sewer user.

Annual O&M costs for the local treatment alternative includes additional operators, power usage, equipment maintenance and chemical addition. Disposal and reuse annual costs such as power and potential Black Hall fee for reuse have been rolled into these Local Treatment Annual Costs. The Regional Alternative annual costs are based on flow percentages that incorporates all the necessary items represented in the Local Treatment. This is currently how the agreement between East Lyme and New London are written. Flow meters would be used to measure the amount of flow treated, and for every thousand gallons sent to the WPCF, approximately $1.77 would be charged to Old Lyme. This value is based on the current rates that New London charges and could go up based on New London's discrepancy.

Table 6-3: Treatment Cost Summary

Treatment System Based on Type of Sewer System	Local Alternative		Regional Alternative	
	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost
Gravity	$14,800,000	$472,000	$8,455,000	$186,000
Low Pressure	$14,300,000	$456,000	$8,455,000	$169,000
STEP	$13,400,000	$430,932	$8,455,000	$169,000
STEG	$14,000,000	$446,000	$8,455,000	$186,000

Table 6-4: Annual Treatment Costs

Annual Cost Details		Treatment			
		Local		Regional	
Category	Annual Description	Gravity & LPS	STEP / STEG	Gravity / STEG	LPS / STEP
Labor	Operation[1]	$195,100	$195,100		
	Engineering & legal	$5,000	$5,000		
	Technical Support[2]	$39,500	$39,500		
Power & Billing	Electricity	$22,500	$22,500		
	Billing (Additional Town Admin)				
Liquid/Solids	Chemical Addition[3]	$14,000	$4,200		
	Septic / Solids Pumping[3]	$19,700	$5,900		
	Carbon Addition[4]	$6,800	$15,000		
Mechanical	Equipment Replacement[5]	$104,000	$93,600		
Other	New London WPCF Fees[6]			$186,000	$169,000
	Black Hall Fee [7]	$65,000	$65,000		
	Totals	**$472,000**	**$446,000**	**$186,000**	**$169,000**

1. Local Treatment Operation assumes 2 full time class III operators for treatment in addition to the collection system operator.
2. Technical support assumes 80 hours annually for mechanical, electrical, and instrumentation a year.
3. STEP/STEG assumes a 30% decrease in solids handling and chemical addition (not including carbon addition).
4. Carbon addition needed to supplement BOD Loses for STEP/STEG assumed to be 10,000 Gallons Annually at $1.50/gallon.
5. Equipment Replacement Assumes 1% to 3% of potential equipment capital costs annually.
6. Regional Treatment Costs are based on $1.77 per 10,000 gallons annually.
7. Black Hall Reuse fee assumed to be a tax credit for use of property or O&M fee.

7. DISPOSAL AND REUSE ALTERNATIVES

7.1 OVERVIEW OF LOCAL DISPOSAL AND REUSE ALTERNATIVES

This section of the Report summarizes the effluent disposal and reuse alternatives associated with the Local Alternative. Flow projections from Section 3 served as the basis for locating sufficient disposal and reuse resources. These effluent flow allocations are summarized in Figure 7-2. As part of the Coastal Wastewater Management Plan, initial on-site testing was performed at two sites in Old Lyme, as shown in Figure 7-1. However, there are several potential disposal and reuse sites adjacent to the Project Study Area. The Town may choose to evaluate these sites at a later date based on future needs.

7.2 LOCAL SUBSURFACE INVESTIGATIONS

Commencement of test pits at Cherrystone site.

A subsurface investigation was done to fulfill Task 3 (Evaluation of sub surface Disposal and Reuse Alternatives) of the Scope of Services, as summarized in Section 1 of this Report. A few sites have been identified as locations for potential disposal and reuse systems. The Lombardo Associates Alternatives Analysis report identified 4 potential sites. This Study focuses on 2 of those sites. Field investigations were performed in May and June of 2013 at the Black Hall Golf Course (Black Hall) and former driving range (Cherrystone) in Old Lyme. The purpose of Woodard & Curran's investigation was to evaluate the aquifer properties at both locations and simulate the disposal of treated wastewater effluent at Cherrystone. A site map of the two properties is shown in Figure 7-1.

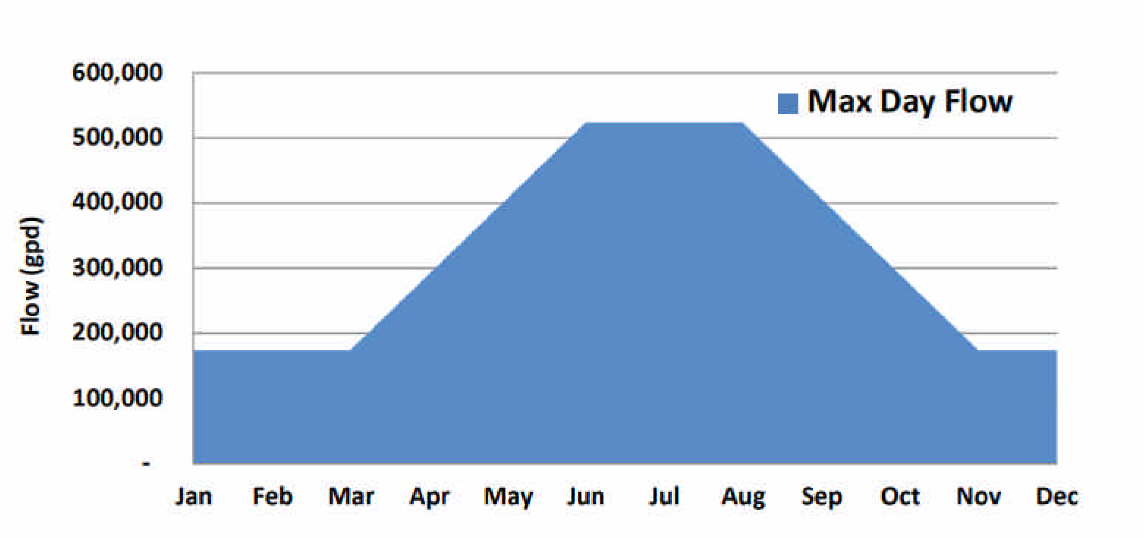
Woodard & Curran conducted the following activities:

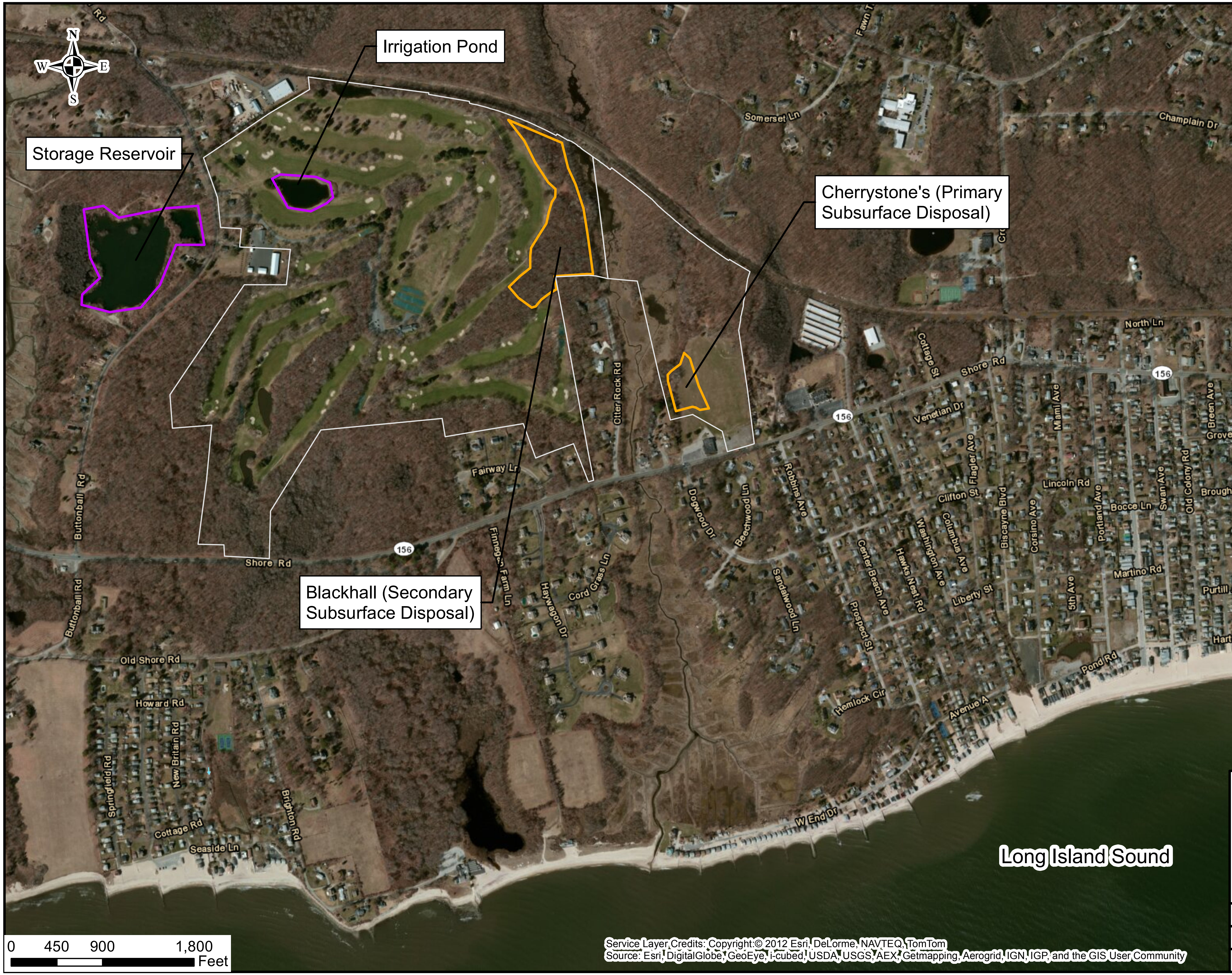
- Test Pitting (Cherrystone)
- Soil Borings/Monitoring Well Installation (Black Hall, Cherrystone)
- Seasonal High Water Table (SHWT) Calculations
- Aquifer Testing (Black Hall, Cherrystone)
- Water Level Monitoring (Black Hall, Cherrystone)
- Delineation of Subsurface Absorption System (SAS) facility (Cherrystone)
- Groundwater Mound Simulations (Cherrystone)

Open test pit at Cherrystone site.

Each of the aforementioned activities is summarized below. All Figures and Tables for the Subsurface Investigation are presented in Appendix B.

Figure 7-2: Anticipated Year-Round Flows





Town of Old Lyme, CT

Potential Effluent Disposal/Reuse Parcels

FIGURE 7-1

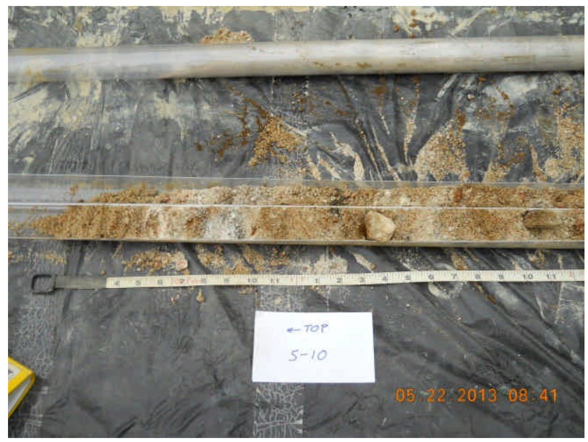
SCALE: 1 in = 900 ft	DRAWN BY: ACB
DATE: December 2013	JOB NO.: 226617

DOC: 2013.12.09 - Fig 7-1 Potential Effluent Disposal Reuse Parcels.mxd

7.2.1 Test Pitting – Cherrystone

Backfilled test pit at Cherrystone pit with standpipe.

In May 2013, Woodard & Curran, the Town of Old Lyme, and the Connecticut Department of Energy & Environment (CT-DEEP) monitored the excavation of seven test pits at the Cherrystone site. A map of historical and recent test-pit locations is included as Figure B-2. Details of the test pits are summarized in Table B-1. The objective of test pitting was to characterize the bedding, grain size, and transitions of various soil types. Historical test-pit data are available at Cherrystone, and the new pits are intended to fill spatial data gaps both laterally and vertically. Test pits were excavated to a depth of roughly 10 feet, or shallower if bedrock was encountered. Test pits TP-01, TP-04, and TP-05 encountered refusal, which is interpreted as granitic bedrock. Test pits TP-02, TP-03, TP-07, and TP-08 did not encounter refusal conditions. Boring logs of each test pit are included in Appendix C. In general, the test pits contained less than one foot of topsoil; roughly one to two feet of silty/sandy loam; and unconsolidated sands, gravel, cobbles, and boulders to the bottom of the test pit. The material beneath the loam was visually classified as permeable aquifer material. Perforated plastic standpipes were installed in each test pit prior to backfilling for future monitoring events and to mark the location of test pits.



Typical soil column obtained during test pits.

7.2.2 Soil Borings and Groundwater Wells – Cherrystone and Black Hall

In May 2013, Woodard & Curran contracted with Northeast Geotech, Inc. (NE Geotech) to advance soil borings and install monitoring wells at the Cherrystone and Black Hall properties. Monitoring wells allow soils to be classified at greater depths than do test pits, and allow water-level measurements and groundwater-flow directions to be obtained. Black Hall has an existing network of monitoring wells near its central irrigation pond (Figure B-3); therefore, soil investigations were conducted east of the pond. At four of the five locations (BH-1, BH-2, BH-4, and BH-5), the drill rig encountered refusal conditions prior to intersecting the water table, and monitoring wells therefore were not

Advancement of soil boring at Black Hall site.

installed. At location BH-3, groundwater was encountered before refusal, permitting the installation of a shallow (MW-3S) and deep (MW-3D) monitoring well couplet. Boring logs of soils and monitoring wells at Black Hall are included in Appendix C. In general, the top several feet of soils are silty with roots and other organic matter, underlain by sandy soils with varying amounts of gravel and silt.

In May 2013, Woodard & Curran observed NE Geotech advance four soil borings and complete the borings as monitoring wells at the Cherrystone property. The locations of the wells are shown on Figure B-2. Observations of soil generated from the borings are similar to those from test pits. The top two or three feet of soils are silty/sandy loams with roots and other organic matter, underlain by unconsolidated sands and gravel with varying amounts of cobbles and boulders. Visual observation suggests permeable aquifer material beneath the loam. Depths of the soil borings range from 11.5 feet (WC-4) to 30 feet (WC-2, WC-3). Locations WC-1 and WC-4 encountered refusal conditions, presumably bedrock, at 20.3 feet and 11.5 feet, respectively; locations WC-2 and WC-3 did not encounter refusal at the maximum proposed depth of 30 feet. The depths of refusal from historic and recent test pits (Table B-1) corroborate the interpretation of thicker soils in the western part of the Cherrystone property as noted during the advancement of soil borings. Boring logs of the Cherrystone wells are included in Appendix C.

7.2.3 Seasonal High Water Table – Black Hall and Cherrystone

In May and June 2013, Woodard & Curran monitored water levels at Cherrystone (four wells) and Black Hall (six wells) to determine the seasonal high water table (SHWT). The SHWT is calculated by comparing the water level at an observation well with the minimum depth to water (SHWT) at a sentinel well operated by the US Geological Survey (USGS) using the formula:

$$DTW_{SHWT,SITE} = DTW_{T,SITE} \times \frac{DTW_{SHWT,USGS}}{DTW_{T,USGS}},$$

Where:

$DTW_{SHWT,SITE}$ = Depth to water at the site during seasonal high water table;

$DTW_{T,SITE}$ = Depth to water at the site at time T during the monitoring period;

$DTW_{SHWT,USGS}$ = Depth to water at USGS sentinel well during seasonal high water table; and

$DTW_{T,USGS}$ = Depth to water at USGS sentinel well at time T during the monitoring period.

Time “T” was selected as 00:00 on June 16, 2013, the average time when site wells experienced a high water table (several precipitation events) during the May-June 2013 monitoring period. Using the above calculations for two USGS sentinel wells with similar water depths as those measured at Cherrystone and Black Hall (shown as identifiers 412916073121701 and 412825072410501), the seasonal high water table at the Cherrystone property is approximately 7 feet (WC-3) to 15 feet (WC-1, WC-2) (Table 2). The SHWT calculations at Cherrystone are roughly 1.5 to 2.5 feet shallower than the shallowest depth to water measured during the May-June 2013 monitoring period. The SHWT for WC-4 was not considered, as this well likely does not represent aquifer conditions, but rather is ponded water on top of a bedrock surface. The SHWT at Black Hall for the newly installed wells MW-3S and MW-3D ranges from approximately 12 to 19 feet (Table 2). SHWT calculations for the remaining Black Hall wells are not considered, as these wells are located in an area inaccessible to potential SAS construction and have prohibitively low hydraulic conductivity. A time series of USGS depth to water data is provided as Appendix C, and a time series of depth to water data at Cherrystone and Black Hall with superimposed USGS data is also provided in Appendix C.

7.2.4 Aquifer Testing – Black Hall and Cherrystone

In May 2013, Woodard & Curran conducted slug testing at five wells at Black Hall and three wells at Cherrystone to quantify the permeability of saturated soils. A slug test involves removing a slug of water from a monitoring well and measuring the rate of water-level recovery. The recovery rate and information about the aquifer geometry and well construction allow a calculation of saturated hydraulic conductivity (K), the ability of a geologic material to transmit water. Two wells, WC-1 (Cherrystone) and MW-H (Black Hall), did not receive slug testing due to an inadequate column of water in the well.

Monitoring wells installed at Black Hall site.

A summary of hydraulic conductivity calculations for each well at Cherrystone is presented in Table B-3. Hydraulic conductivity was calculated using the Bouwer & Rice solution, which applies to wells installed in unconfined aquifers (Bouwer & Rice, 1976). The program AquiferWin32 was used to process and model the aquifer response to slug testing (ESI, 2013). As noted, water-level data from well WC-4 may not be representative of aquifer conditions, as water in this well likely is "ponded" on a bedrock surface. Wells WC-2 and WC-3 at Cherrystone are interpreted as representative aquifer hydraulic conductivity values (250 ft/day and 80 ft/day, respectively), which fall within the literature range for unconsolidated sands and gravels (Freeze & Cherry, 1979). The notably greater value of hydraulic conductivity in WC-2 compared with the conductivity of WC-3 may reflect the greater thickness of saturated soils at WC-2, which allows a greater volume of material to recharge the well after the slug of water is removed. A printout of the slug-test results at WC-2 is shown in Figure B-4, illustrating the fitting of water-level response data.

Existing monitoring well at Black Hall site.

A summary of hydraulic conductivity calculations for each well at Black Hall is presented in Table B-3. The hydraulic conductivity ranges from less than 1 ft/day to approximately 16 ft/day, suggesting silty sands as the aquifer material. The soils at Black Hall appeared to contain a greater proportion of silt than did soils at Cherrystone, and grain size is an important factor in the ability of a geologic material to transmit water. Variations in the hydraulic conductivity of preexisting wells MW-A, MW-E, and MW-I may reflect the amount of silt in the soils, although it should be noted that boring logs and construction details for these wells are not available.

7.2.5 Monitoring Well Survey and Groundwater Flow

In August 2013, Pereira Engineering, Inc. (Pereira) completed an elevation survey of groundwater wells, soil borings, and test pits at the Cherrystone and Black Hall properties (Table B-1). The surveyed elevations allowed a determination of groundwater-flow direction at each property. The direction of groundwater flow at Cherrystone is to the west, toward Mile Creek (Figure B-5); and the direction of flow at Black Hall is toward the west, and there may be a southerly component discharging to wetlands south of the golf course (Figure B-6). A time series of water-table elevations for Cherrystone and Black Hall is presented in Appendix C.

Measurements of groundwater elevation and resulting contours (Figure B-5 and Figure B-6) allow a calculation of the groundwater-flow velocity at each parcel, using the equation:

$$v = \frac{K}{n_e} \times \frac{dh}{dx}, \text{ where}$$

v: Average macroscopic flow velocity (ft/day);

K: Hydraulic conductivity (ft/day);

n_e: Effective porosity (unitless);

dh: Change in hydraulic head (groundwater elevation);

dx: Lateral distance over which dh is measured; and

dh/dx: Hydraulic gradient (unitless).

At Black Hall, an average hydraulic conductivity of 5 ft/day, hydraulic gradient (dh/dx) of 0.01 (dh = 15 ft, dx = 1,400 ft), and effective porosity of 0.15 (literature value) were used to obtain a flow velocity of approximately 0.4 ft/day.

At Cherrystone, the hydraulic gradient was estimated using hydraulic head measurements from WC-1, WC-2, and WC-3; WC-4 likely represents water ponded in a bedrock depression and was not considered in calculations or subsequent simulations. These three wells are arranged in a linear fashion, which creates some uncertainty in determining the direction in which hydraulic head is changing at the greatest rate. However, during the subsurface investigation, attempts to install WC-1 east of its current location failed due to refusal conditions. The groundwater velocity was obtained using an average hydraulic conductivity of 150 ft/day, effective porosity of 0.20, and gradient of 0.003 (dh = 0.5 ft, dx = 170 ft), for a value of approximately 2.25 ft/day. Using the groundwater velocity, which was rounded to 2.5 ft/day, the 21-day travel time of groundwater at Cherrystone is about 55 feet.

7.2.6 Delineation of Facility

Assigning the aerial footprint of the subsurface absorption system (SAS) at the Cherrystone parcel was accomplished using hydrologic data collected from historical test pits logs and the recent groundwater investigation. The criteria for selecting an SAS area include thickness of permeable soils and boundaries imposed by surface-water bodies and property bounds. Ground-elevation data obtained by Pereira during summer 2013 were contoured using the computer program Surfer (Golden Software, 2004) and incorporated with geologic data to produce several cross sections through the study area. Depth to average SHWT (Table B-2) and confirmed and interpreted depths to bedrock then were superimposed on the cross sections. Using the calculated 21-day travel time, a buffer of 55 feet was given to the wetland and property boundaries surrounding Cherrystone. Two SAS delineations were assigned, as described below; both SASs are depicted on Figure B-7.

The first facility extent, the "small" SAS, was assigned assuming at least five feet of saturated soils beneath the average SHWT elevation. The western bounds of the SAS followed the buffer around property boundaries and the wetland. The northern, southern, and eastern extensions were based on cross sections and an interpreted five foot thick zone of saturated aquifer material; approximately 15 feet of unsaturated soils are present throughout the SAS delineation. The area of the "small" SAS is approximately 1.67 acres, or roughly 72,750 ft^2.

The "large" SAS was assigned assuming at least 10 feet of unsaturated soils above the average SHWT elevation or above the interpreted bedrock surface; a criterion of saturated soil thickness was not applied. Using the lateral extent of permeable soils, the eastern boundaries of this SAS were extended notably farther than those of the "small" SAS, for a total area of 3.52 acres, or approximately 153,300 ft^2.

7.2.7 Groundwater Model – Cherrystone

Groundwater mounding at the Cherrystone parcel was simulated using the Hantush equation for groundwater mounding beneath an infiltration basin (USGS 2010). Additional simulations were run using the MODFLOW numeric code with the graphical user interface Groundwater Vistas (ESI, 2011); mounding results of the MODFLOW simulations were less than those generated using the USGS Hantush simulations and are therefore not presented. The USGS mounding simulator incorporates the following input parameters to calculate mound height: Recharge Rate (ft/day), Specific yield (unitless), Hydraulic Conductivity (ft/day), Basin Dimensions (the simulator assumes a rectangular basin), Time (day), and Saturated Thickness (ft). For each simulation, the specific yield of the Cherrystone aquifer was set to 0.20 based on reference values for sandy material, and the time set to 250 days, a conservative estimate of the time for water at the eastern extent of the facility to reach the wetland.

Results of mounding simulations at the "Small" facility are summarized in Appendix C. Output, displayed as mounding heights at the center of the facility, is grouped by infiltration/recharge rate, and then subdivided by a range of hydraulic conductivity. The facility area, 1.67 acres, is simulated as a rectangle measuring 365 feet by 200 feet. The outline on Figure 7 for the small facility is not rectangular, but for the purposes of the simulator, both the small and large facilities are delineated as rectangles. A saturated thickness of 20 feet is used for the small facility, as suggested by cross sections. Mound heights exceeding eight feet are highlighted. The facility is assumed to penetrate three feet into the ground, and three feet of separation from the SHWT to the facility is required. Assuming the grade at well WC-3, the lowest lying well at Cherrystone, is raised to a level comparable with those of WC-2 and WC-1, eight feet of mounding is acceptable to maintain adequate separation. At the prescribed maximum infiltration rate of 1.2 gallons per day per square foot (gpd/ft^2) (87,600 gpd), the facility can maintain separation; simulated mounding does not surpass three feet. The infiltration rates were increased to 2 gpd/ft^2 and 3 gpd/ft^2 (146,000 gpd and 219,000 gpd, respectively) to evaluate the mounding during potential periodic high flows. As simulated, the mounding at the facility will be limited to five feet at 2 gpd/ft^2 and to seven feet at 3 gpd/ft^2.

The "Large" facility also was simulated, with results shown in Appendix C. The facility is roughly 3.52 acres, and is simulated as a rectangle with dimensions 510 feet by 310 feet. The mounding results include simulations at saturated thicknesses of 15 feet and 20 feet; extending the large facility to include unsaturated soils east of the small facility necessitated a consideration of reduced average thickness of saturated soils. Using the eight-foot mound cutoff, simulation results suggest that the large facility can withstand 1.2 gpd/ft^2 (190,000 gpd) at either saturated thickness. As the infiltration rate is increased to 2 gpd/ft^2 (316,000 gpd), mounding is acceptable at the higher end of hydraulic conductivity (150 ft/day and 200 ft/day).

Results of mounding simulations at the small and large facilities suggest that either facility can receive treated wastewater at 1.2 gpd/ft^2 (87,600 gpd at the small facility, 190,000 gpd at the large facility). As a greater area for wastewater disposal results in increased mounding, the simulated large facility can receive up to 2 gpd/ft^2 (316,000 gpd) at the interpreted average hydraulic conductivity of 150 ft/day, whereas the small facility can receive up to 3 gpd/ft^2 (219,000 gpd).

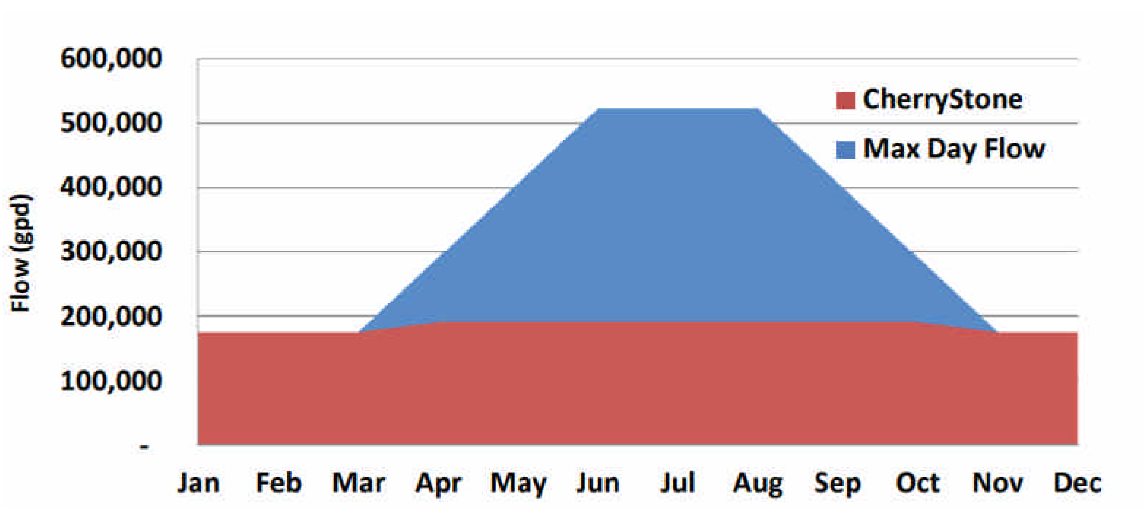
7.3 SUMMARY OF LOCAL DISPOSAL AND REUSE ALTERNATIVES

The subsurface investigations determined that there is enough capacity available on the Cherrystone and Black Hall sites to handle the proposed range of flows anticipated from the Wastewater Service Area. The Cherrystone site will likely handle all winter flows. The Black Hall site is capable of handling additional summer flows on its irrigated turf and/or within wooded areas to the east of the site, all within its current water diversion permit. Additional sub-surface disposal is available along the east side of the Black Hall site for peak flow events.

7.3.1 Sub-Surface Disposal at the Cherrystone Site

The max day flow increases due to seasonal variations and are expected to be at the highest during the summer time. Figure 7-2 presents the expected max day flow over the course of one year. Figure 7-3 presents the max day flow capacity at the Cherrystone site versus the anticipated annual max day flows. The Cherrystone site has the potential to take 100% of the winter time flow, which are anticipated to be 1/3 the max day summer time flows.

Figure 7-3: Year Round Flows vs. Primary Subsurface Disposal



7.3.2 Reuse at the Black Hall Site

The seasonal peaks for reuse at Black Hall and max day flows from the Wastewater Service Area very conveniently fluctuate together and represent a valuable disposal alternative for the seasonal demand of the Wastewater Service Area. Specifically, when flows from the Wastewater Service Area peak during the summer, the irrigation demands on the Black Hall Golf Course peak.

Existing storage reservoir (old gravel pit) for Black Hall irrigation

Figure 7-4 shows the additional max day disposal capability of Black Hall reuse irrigation. However, the max day disposal capacity over the entire 163 acre parcel is controlled by and therefore limited to the golf course irrigation needs. Currently the Golf Course has a water diversion permit of 238,000 gpd for irrigation purposes, but golf course management has indicated that they would like to use more.

Irrigation for the Black Hall Golf Course currently comes from the reservoir just west of the Black Hall parcel, which is believed to be a man-made rock quarry with no inlets or outlets. From the quarry, it is pumped to a central pond on the golf course where it is then used as irrigation water. Golf course irrigation is dependent upon the time of day and weather conditions, so it will be necessary to have sufficient storage to maintain max day flows from the WPCF. Storage would be accomplished by pumping to the existing quarry, where one foot of water level increase would be approximately one full day of storage at max flow and two days at average summer time flow.

Figure 7-4: Year Round Flows vs. Primary Subsurface Disposal and Black Hall Reuse

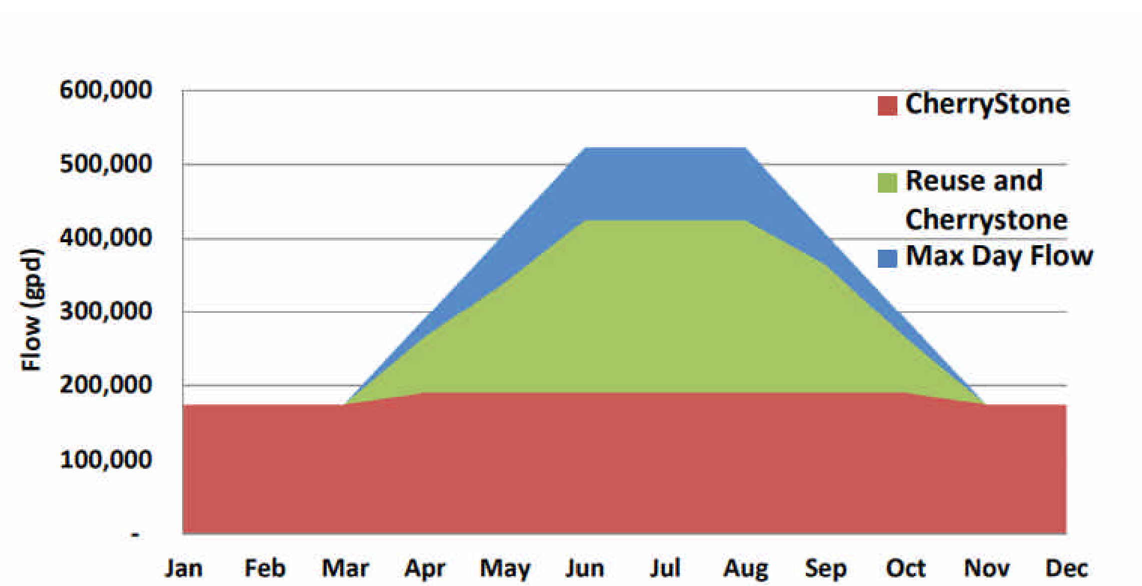
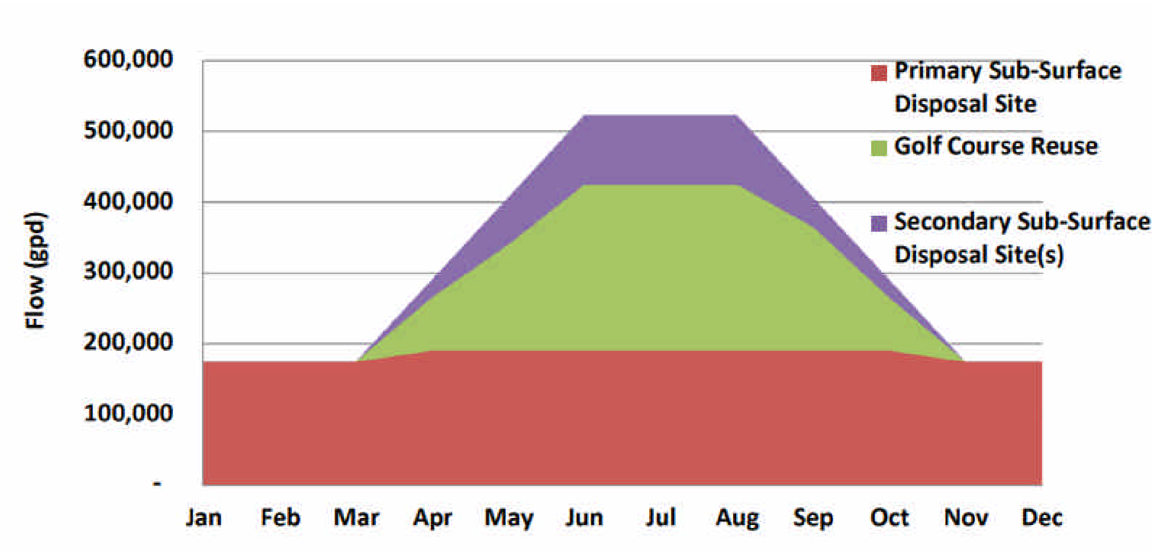


Figure 7-5: Year – Round Disposal and Reuse



7.3.3 Sub-Surface Disposal at Black Hall Site

It is also possible for additional disposal capacity on the Black Hall parcel through an increased water diversion permit or additional subsurface discharge systems similar to Cherrystone. Figure 7-5 presents the additional capacity needed to effectively handle max day conditions as (secondary sub-surface and Cherrystone as Primary sub-surface). The secondary subsurface systems are proposed on the east side of the Black Hall parcel. The additional area needed is approximately 2 acres at an infiltration rate of 1.2 gpd/ ft^2; this additional sub-surface disposal would need further detailed hydrogeological analysis prior to design.

7.4 LOCAL DISPOSAL & REUSE COSTS

The combined treated effluent disposal systems are all with the intention of allowing the water to go back to the aquifers from which it came. This system of subsurface disposal of large areas and limited infiltration rates becomes an expensive option that is not an additional cost for the Regional Alternative. The Regional Alternative cost for disposal is inexpensive due the surface water discharge permit the New London WPCF currently operates under these cost are included with annual treatment O&M. The costs presented in Table 7-4 below are assumed to be conservative effluent disposal options. It is likely open sand bed disposal systems at Cherrystone and alternate force main routes to Black Hall could drive down the cost of the sub-surface and Black Hall Reuse options. For cost breakdowns and assumptions, refer to Tables 7-1, 7-2 and 7-3.

Table 7-1: Cherrystone Subsurface Disposal Costs

Cherrystone Capital Costs				
Item	Unit	Unit/Cost	QTY	Cost
Additional Fill	CY	$27	18,000	$486,000
Forcemain[1]	LF	$300	500	$150,000
Site Preperation[2]	SY	$10	36,000	$360,000
Piping	LF	$35	19,500	$682,500
Sub Total:				$1,678,500
Contingency		30%		$503,550
Engineering		20%		$100,710
Total:				$2,300,000

1. Force main from assumed WWTP area assumes complete installation unit costs

2. Assumes 2 feet of top soil (A Horizon) to be bulldozed and used on site

Table 7-2: Reuse Black Hall Costs

Reuse Black Hall				
Item	Unit	Unit/Cost	QTY	Cost
Force main to Black Hall[1]	LF	$200	5,800	$1,160,000
Water main Extension[2]	LF	$300	2,000	$600,000
Clay Lining Storage Pond[3]	SY	$60	3,000	$180,000
Sub Total:				$1,940,000
Contingency		30%		$582,000
Engineering		20%		$116,400
Total:				$2,600,000

1. Force main from Cherrystone to Black Hall assumes complete installation, with cost sharing from common sewer
2. Assumes potential cost of water main extension to Black Hall
3. Assumes 3 inches of Clay lining for Storage pond at Black Hall

Table 7-3: Secondary Subsurface Disposal Costs

Secondary Subsurface Disposal				
Item	Unit	Unit/Cost	QTY	Cost
Drip Pipping[1]	LF	$70	23,000	$1,610,000
Forcemain[2]	LF	$175	5,000	$875,000
Sub Total:				$2,485,000
Contingency		30%		$745,500
Engineering		20%		$149,100
Total:				$3,400,000

1. Unit costs based on similar system construction costs.
2.Forcemain from storage pond along tree line to East side of Black Hall Parcel.

Table 7-4: Local Disposal and Reuse Cost Summary

Description	Capital Cost	Disposal Capacity
Sub-Surface Cherrystone	$2,300,000	190,000
Reuse Black Hall	$2,600,000	238,000
Additional Disposal Needed Black Hall	$3,400,000	110,000
Total:	$8,300,000	538,000

7.5 ANTICIPATED PERMITS AND REQUESTS OF CT-DEEP

There are two different disposal alternatives recommended for Old Lyme:

- groundwater discharge – a very straightforward permitting process with CT DEEP
- wastewater reuse – a more complicated permitting process with CT DEEP

7.5.1 Ground Water Discharge Permitting

CT-DEEP's Ground Water Discharge Permit Program regulates discharges to ground water from any source, including large septic systems, sewer service areas, agricultural waste management systems, and landfills. Groundwater discharge permitting is a fairly simple process in Connecticut.

The Old Lyme WPCA would develop and submit a permit application and CT-DEEP. CT-DEEP will review the application and determine if the proposed discharges will cause pollution to the waters of the state. To accomplish this, CT-DEEP staff will review the applications potential for:

1) adverse effects on existing and designated uses of the waters of the state as defined in Connecticut's Water Quality Standards and Criteria;
2) interference with or adverse effects upon the operation of a POTW; and
3) systems and methodologies proposed to counteract such adverse effects and to minimize the discharge of pollutants

All groundwater investigations performed to date has been conducted in accordance and under the supervision of the CT-DEEP. Therefore, several of the elements required in a Groundwater Discharge Permit application have been completed.

7.5.2 Wastewater Reuse Permitting

As water sources are becoming increasingly stressed throughout the country, utilities have turned to water reuse. Currently, most of the reclaimed water in the United States is used for irrigation (47%) and groundwater recharge (13%). Three states (CA, CO, and TX) currently utilize "potable reuse," which is the treatment of sanitary wastewater to a high standard which is then utilized for drinking water.

Permitting wastewater reuse in Connecticut can be somewhat confusing because the State of Connecticut is one of the few remaining states in the country without a Wastewater Reuse Policy or wastewater reuse permitting process. However, there is precedent for wastewater reuse in the State of Connecticut and therefore two different permitting options under existing CT-DEEP programs. Table 7-5 outlines the three currently known options for permitting wastewater reuse in Connecticut.

Table 7-5: Current Wastewater Reuse Permitting Options in Connecticut

Considerations	Permitting Options		
	Pretreatment Permit	**Underground Injection Control (UIC)**	**NPDES Permit**
Precedent in CT?	Yes	Yes	Yes
If so, where?	Lake of Isles, LLC (Foxwoods) Golf Course	- Indirect Reuse: o Brunswick School in Greenwich (2013 draft UIC permit to use portion of discharge for grey water)	- Convent of Sacred Heart in Greenwich received a 2012 final NPDES permit to discharge into pond system used by Fairview Country Club for golf irrigation
Complexity of Permitting Process	Above Average	Average	Above Average
Estimated Permitting Time	9 months	9 months	12 months
Potential Eligible Discharge Locations	- Locations where human health contact is controlled. Locations include: o Agriculture o Golf courses	- All locations into the ground	- All discharge locations into a pond, river, stream or other waterbody
General Permitting Steps	- Draft Permit Conditions & meet with CTDEEP. - Gather additional data; conduct Health Risk Assessment, etc. (as required). - Finalize Permit Conditions and submit final Permit application to CTDEEP. - Applicant is responsible for	- Draft Permit Conditions & meet with CTDEEP. - Gather additional data; conduct Health Risk Assessment, etc. (as required). - Finalize Permit Conditions and submit final Permit application to CTDEEP. - Applicant is responsible for	- Draft Permit Conditions & meet with CTDEEP. - Gather additional data; conduct Health Risk Assessment, etc. (as required). - Finalize Permit Conditions and submit final Permit application to CTDEEP. - Applicant is responsible for publishing a Notice of Application with a 30 day comment period.

Considerations	Permitting Options		
	Pretreatment Permit	**Underground Injection Control (UIC)**	**NPDES Permit**
	publishing a Notice of Application with a 30 day comment period.	publishing a Notice of Application with a 30 day comment period.	
Pros	- Precedent - Anticipate less than 1 year to permit. - Established permit process.	- Wastewater reuse already permitted under UIC Permit. - Anticipate less than 1 year to permit. - Established permit process. - More flexible permit option.	- Wastewater reuse already permitted under NPDES permit at Sacred Heart in Greenwich - Anticipate about 1 year to permit. - Established permit process.
Potential Issues	- None known	- No precedent for spray irrigation.	- None known

7.5.3 Requests of CT-DEEP

CT-DEEP is an important partner to the Town of Old Lyme and the Old Lyme WPCA in addressing its wastewater needs. The Town, WPCA and CT-DEEP all must continue to exhibit the spirit of cooperation we have seen during this study phase of the project. The CT-DEEP must remain open-minded to a creative wastewater solution that could become an important model for managing wastewater on the Connecticut shoreline.

Specific requests of the CT-DEEP are:

- Review Old Lyme Coastal Wastewater Management Plan (this report) and provide informal initial feedback;
- Meet with Town to discuss technical, permitting and funding options; and
- Work with Town during pre-permitting process to facilitate and expedite CT-DEEP review.

8. COMPARISON OF ALTERNATIVES AND RECOMMENDATIONS

8.1 INTRODUCTION

This section includes: a comparison of the Local and Regional Alternatives, including capital, a summary of operation and maintenance, as well as net annual costs; the recommended plan including the preferred alternative; and an implementation plan including coordination with other on-going wastewater planning efforts in Old Lyme Sub-Areas, input needed from CT-DEEP, and the anticipated schedule for implementing the recommended plan.

8.2 COMPARISON OF ALTERNATIVES

The following sub-sections highlight the differences between the Local and Regional alternatives including cost and non-cost factors, thus facilitating an objective decision by the Town that is in the best short-term and long-term interest of the overall Old Lyme coastal community

8.2.1 Capital Costs

Table 8-1 includes a summary of total capital costs for the Local and Regional Alternatives, including subtotals for collection, treatment and disposal/reuse. The collection system subtotal is based on the gravity sewer option, due to its lowest capital cost compared to the other collection system alternatives.

Table 8-1: Capital Cost Summary

System Component	Capital	
	Local [1]	Regional
Collection	$31,100,000	$49,101,000
Treatment	$14,800,000	$8,455,000
Disposal / Reuse	$8,300,000	$0
Totals	$54,200,000	$57,556,000

1) Local and Regional Costs based on gravity systems for Service Area.

Although the capital cost for the new local WPCF in Old Lyme is higher than the buy-in costs associated with the New London WPCF, the cost difference is offset by the significantly higher collection cost associated with upgrading downstream sewers in East Lyme and Waterford for the Regional Alternative. Overall, the Local Alternative has an anticipated capital cost that is $3M less expensive than the Regional Alternative.

8.2.2 Annual Operation & Maintenance Costs

Table 8-2 includes a summary of the anticipated annual operation and maintenance (O&M) costs for the Local and Regional Alternatives, including subtotals for collection and treatment (which includes disposal and reuse).

Table 8-2: Annual O&M Cost Summary

System Component	Annual O&M	
	Local [1]	Regional
Collection	$192,000	$589,000
Treatment[2]	$472,000	$186,000
Totals	$664,000	$775,000

1. Local and Regional based on gravity systems for Service Area.

2. Annual disposal / Reuse costs are included with treatment O&M.

The annual operation and maintenance cost for the Local Alternative is approximately $100,000 less expensive than that for the Regional Alternative. This is due primarily to the cost associated with paying New London for treatment costs, together with the additional cost associated with the long sewer system in East Lyme and Waterford, and the incremental cost to Old Lyme for maintaining its own extension to the sewer system under the Regional Alternative.

8.2.3 Total Annual Costs and Financing Options

In order to evaluate the net annual impacts of the anticipated capital costs on the sewer users, we considered several financing options, as follows:

- Table 8-3: Assumes 0% grant funding, with a market-based 4% interest rate for a 20-year term.
- Table 8-4: Assumes 0% grant funding, with a CWF-based 2% interest rate for a 20-year term.
- Table 8-5: Assumes a 25% small-community grant from CT-DEEP, with a CWF-based 2% interest rate for a 20-year term.

Based on the net annual capital costs for the three above financing options, it is critical for the Town to pursue and obtain the maximum possible grant funding from CT-DEEP to reduce the financial impact on the sewer users in the Wastewater Service Area.

Table 8-3: Total Annualized Costs (0% Grant, 4% Loan)

System Component	Local Alternative				Regional Alternative			
	Annualized Capital	Annual O&M	Annual Capital Cost per EDU	Annual O&M Cost per EDU	Annualized Capital	Annual O&M	Annual Capital Cost per EDU	Annual O&M Cost per EDU
Collection	$2,262,000	$192,000	$1,626	$138	$3,571,000	$589,000	$2,567	$423
Treatment	$1,076,000	$472,000	$774	$339	$615,000	$186,000	$442	$134
Disposal / Reuse[2]	$604,000	n/a	$434	n/a	$0	n/a	$0	n/a
Totals	$3,942,000	$664,000	$2,834	$477	$4,186,000	$775,000	$3,009	$557

1) Local and Regional Costs based on gravity systems for Service Area.

2) Disposal / Reuse annual costs for Local and Regional costs are included with treatment O&M.

Table 8-4: Total Annualized Costs (0% Grant, 2% Loan)

System Component	Local Alternative				Regional Alternative			
	Annualized Capital	Annual O&M	Annual Capital Cost per EDU	Annual O&M Cost per EDU	Annualized Capital	Annual O&M	Annual Capital Cost per EDU	Annual O&M Cost per EDU
Collection	$1,888,000	$192,000	$1,357	$138.03	$2,981,000	$589,000	$2,143	$423
Treatment	$898,000	$472,000	$646	$339.32	$513,000	$186,000	$369	$134
Disposal / Reuse[2]	$504,000	n/a	$362	n/a	$0	n/a	$0	n/a
Totals	$3,290,000	$664,000	$2,365	$477	$3,494,000	$775,000	$2,512	$557

1) Local and Regional Costs based on gravity systems for Service Area

2) Disposal / Reuse annual costs for Local and Regional costs are included with treatment O&M.

Table 8-5: Total Annualized Costs (25% Grant, 2% Loan)

System Component	Local Alternative				Regional Alternative			
	Annualized Capital	Annual O&M	Annual Capital Cost per EDU	Annual O&M Cost per EDU	Annualized Capital	Annual O&M	Annual Capital Cost per EDU	Annual O&M Cost per EDU
Collection	$1,416,000	$192,000	$1,018	$138	$2,235,750	$589,000	$1,607	$423
Treatment	$673,500	$472,000	$484	$339	$384,750	$186,000	$277	$134
Disposal / Reuse	$378,000	n/a	$272	n/a	$0	n/a	$0	n/a
Totals	$2,468,000	$664,000	$1,774	$477	$2,621,000	$775,000	$1,884	$557

1) Local and Regional Costs based on gravity systems for Service Area.

2) Disposal / Reuse annual costs for Local and Regional costs are included with treatment O&M.

8.2.4 Other Considerations

In addition to the cost benefits of the Local Alternative, there are several other non-cost factors that should be considered by the Town in this evaluation. These include:

- Deferred Downstream Capital Improvements: For the Regional Alternative, future capital upgrades will be shared amongst the sewer users in New London, Waterford, East Lyme, and Old Lyme.
- Implementation of New Utility: The Local Alternative will come with challenges of implementation for facilities and additional construction in Old Lyme. Initial years for a new utility can be challenging, as connections are being made, and systems are being started-up.
- Control of Flow Allocations: The Town of Old Lyme will have far better control of the allocation of sewer flows, capital costs, and annual costs for the Local Alternative. For the Regional Alternative, Old Lyme would only be a customer to the downstream communities, and would have less say in capital costs and apportionments.

8.3 RECOMMENDED PLAN

8.3.1 Proposed Alternative

The components of the recommended plan, the Local Alternative, are shown in Figure 8-1. Although both the Regional and Local Alternatives represent a significant investment for Old Lyme residents, the Local Alternative has a lower capital cost, as well as a lower net annual cost per EDU. The gravity sewer options are the best fit for the regional and local alternatives. Similarly, the low pressure, STEP and STEG sewer alternatives are not the most appropriate options for either alternative, and should not be considered as part of the Local Alternative. The Local Alternative will also provide a far higher quality effluent than the Regional Alternative, better contributing to water quality in the area and along the Long Island Sound.

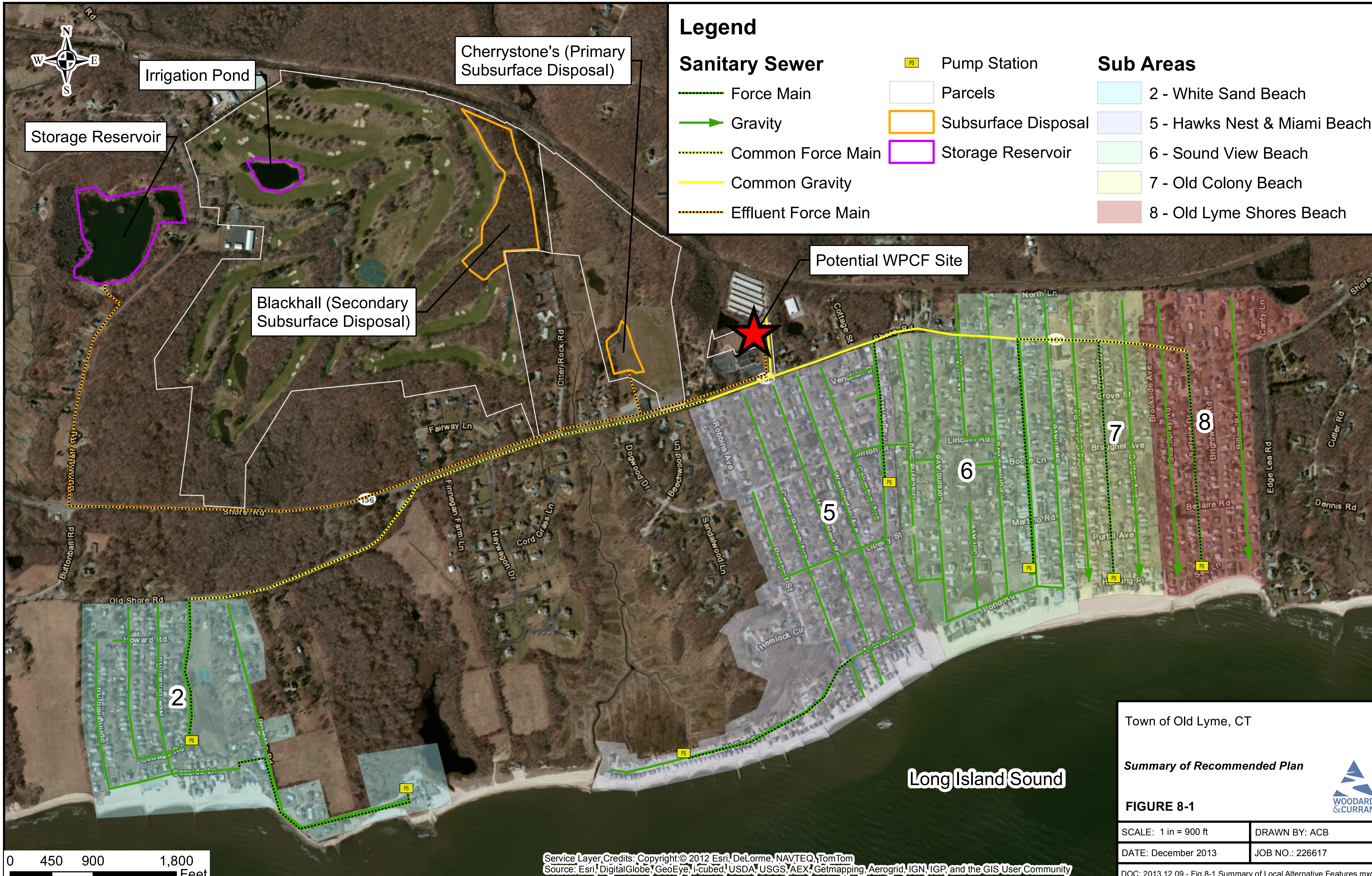
8.3.2 Coordination with Other Beach Communities

Wastewater facilities plans prepared for both the Old Colony Beach Club Association (OCBCA) and the Old Lyme Shores Beach Club Associations (OLSBCA) concluded that the Regional Alternative was the preferred alternative for Sub-Areas 7 and 8. However, these planning documents did not consider a Local Alternative serving a larger Old Lyme area. We do not believe that some of these costs are forecasted in other Facilities Plans, and there may even remain unpaid buy-in costs for the Point-O-Woods neighborhood. We have included all foreseeable downstream capital needs in the Regional Alternative, but the extent of downstream capital needs over the 20-year planning period is unknown.

Construction in beach communities requires close communication with project stakeholders.

8.3.3 Implementation Plan

Upon CT-DEEP's review of this Draft Report, a subsequent meeting with the Town will be scheduled to: (1) discuss permitting impacts associated with the Local Alternative, (2) make any necessary revisions to the Final Report, and (3) develop a detailed Implementation Plan. However, based on the milestones for completion (June 30, 2016) in the two outstanding Consent Orders, we believe that the Town's Local Alternative can also be implemented in this window of time, to ensure that not only Sub-Areas 7 and 8 are addressed during this schedule, but also the other high-needs areas in the Wastewater Service Area are addressed simultaneously.



Legend
Sanitary Sewer
Force Main
Gravity
Common Force Main
Common Gravity
Effluent Force Main
Pump Station
Parcels
Subsurface Disposal
Storage Reservoir
Sub Areas
2 - White Sand Beach
5 - Hawks Nest & Miami Beach
6 - Sound View Beach
7 - Old Colony Beach
8 - Old Lyme Shores Beach
Irrigation Pond
Storage Reservoir
Cherrystone's (Primary Subsurface Disposal)
Blackhall (Secondary Subsurface Disposal)
Potential WPCF Site
Long Island Sound
2
5
6
7
8
Shore Rd
Old Shore Rd
Fairway Ln
Finnegan Farm Ln
Haywagon Dr
Cord Grass Ln
Dogwood Dr
Beechwood Ln
Sandalwood Ln
Robbins Ave
Liberty St
Hemlock Cir
Lincoln Rd
Boston Ln
Hartung Pl
Purtill Ave
Grove St
Brougham Ave
Bellaire Rd
Edge Lea Rd
Dennis Rd
Cutler Rd
North Ln
Cottage St
Howard Rd
Buttonball Rd
Town of Old Lyme, CT
Summary of Recommended Plan
FIGURE 8-1
WOODARD & CURRAN
SCALE: 1 in = 900 ft
DRAWN BY: ACB
DATE: December 2013
JOB NO.: 226617
DOC: 2013.12.09 - Fig 8-1 Summary of Local Alternative Features.mxd
0 450 900 1,800 Feet
Service Layer Credits: Copyright:© 2012 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

APPENDIX A: CONSENT ORDERS

Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

79 Elm Street • Hartford, CT 06106-5127 www.ct.gov/deep Affirmative Action/Equal Opportunity Employer

STATE OF CONNECTICUT :
V. :
THE OLD COLONY BEACH CLUB ASSOCIATION :

Date of Issuance August 14, 2012

Order No. CO WRMU 12 001

CONSENT ORDER

A. With the agreement of The Old Colony Beach Club Association ("Old Colony"), the Commissioner of Energy and Environmental Protection ("the Commissioner") finds:

1. The Old Colony Beach Club Association is a specially chartered municipal corporation located in the Town of Old Lyme. Old Colony was incorporated in 1935 by Special Act 289. Old Colony has the power to levy and collect real estate taxes. By virtue of these powers, Old Colony qualifies for the funding of a sanitary sewer construction project from the State of Connecticut's Clean Water Fund Program.

2. Old Colony submitted for the Commissioner's review a Wastewater Management Plan for Old Colony dated October 25, 2011 and revised on January 20, 2012 (the "Plan") prepared by the consulting firm RFP Engineering and subsequently amended by the consulting firm Fuss and O'Neill, Inc on June 2012. This plan identified numerous areas within the boundaries of Old Colony that could not support onsite wastewater treatment due to the overall density of development, lack of adequate space or to adverse on-site subsurface conditions, such as shallow groundwater and rapidly draining soils. The report identified as the most technically and economically feasible alternative the conveyance of the wastewater to an offsite facility for treatment and disposal.

3. Old Colony has not implemented any structural solutions to address the wastewater disposal problems identified in the Plan.

4. After review of the Plan, staff of the DEEP concurs with the assessment of the conditions regarding wastewater disposal problems and the recommendations for conveyance of the wastewater off-site for treatment and disposal.

5. The implementation of the remedial actions specified in the Plan requires that Old Colony procure capacity in the regional sewerage system serving New London, Waterford, and East Lyme; and design and construct sanitary sewers to collect sanitary sewage within the boundaries of Old Colony through portions of the Town of Old Lyme, and convey it to the regional sewer system.

6. By virtue of the above, a community pollution problem exists and Old Colony is causing pollution of the waters of the State.

7. By agreeing to the issuance of this Consent Order, Old Colony makes no admission of fact or law except with respect to the matters addressed in paragraphs A.1 through A.6.

B. Old Colony shall undertake the following actions which the Commissioner, acting under Sections 22a-6, 22a-424, 22a-427, 22a-428 and 22a-458 of the Connecticut General Statutes, orders:

1. a. On or before sixty (60) days following the effective date of this Order, Old Colony shall retain one or more qualified consultants acceptable to the Commissioner to prepare the documents and implement or oversee the actions required by this order and shall, by that date, notify the Commissioner in writing of the identity of such consultants. Old Colony shall retain one or more qualified consultants acceptable to the Commissioner until this order is fully complied with, and, within ten days after retaining any consultant other than one originally identified under this paragraph, Old Colony shall notify the Commissioner in writing of the identity of such other consultant. The consultant(s) retained shall be a qualified professional engineer licensed to practice in Connecticut and shall be acceptable to the Commissioner. Old Colony shall submit to the Commissioner a description of a consultant's education, experience and training which is relevant to the work required by this order within ten days after a request for such a description. Nothing in this paragraph shall preclude the Commissioner from finding a previously acceptable consultant unacceptable.

b. Unless another deadline is specified in writing by the Commissioner, on or before eight hundred and fifty (850) days after approval of the Plan, Old Colony shall (1) submit for the Commissioner's review and written approval contract plans and specifications for the approved remedial actions, a revised list of all permits and approvals required for such actions, and a revised schedule for applying for and obtaining such permits and approvals, and (2) submit applications for all permits and approvals required under the Connecticut General Statutes for such actions. Old Colony shall use best efforts to obtain all required permits and approvals.

c. Old Colony shall perform the approved remedial actions in accordance with the approved schedule(s), but in no event shall the approved remedial actions be completed by later than June 30, 2016. Within fifteen days after completing such actions, Old Colony shall certify to the Commissioner in writing that the actions have been completed as approved.

d. Old Colony may request that the Commissioner approve, in writing, revisions to any document approved hereunder in order to make such document consistent with law or for any other appropriate reason.

2. Progress reports. On or before the last day of January, April, July and October of each year after issuance of this order and continuing until all actions required by this order have been completed as approved and to the satisfaction of the Commissioner, Old Colony shall submit a progress report to the Commissioner and the Town of Old Lyme First Selectman and Water Pollution Control Authority Chairman describing the actions which Old Colony has taken to comply with this order to date and an anticipated schedule of events to occur over the next 3 months

3. Full compliance. Old Colony shall not be considered in full compliance with this order until all actions required by this order have been completed as approved and to the satisfaction of the Commissioner.

4. Approvals. Old Colony shall use best efforts to submit to the Commissioner all documents required by this order in a complete and approvable form. If the Commissioner notifies Old Colony that any document or other action is deficient, and does not approve it with conditions or modifications, it is deemed disapproved, and Old Colony shall correct the deficiencies and resubmit it within the time specified by the Commissioner or, if no time is specified by the Commissioner, within thirty days of the Commissioner's notice of deficiencies. In approving any document or other action under this order, the Commissioner may approve the document or other action as submitted or performed or with such conditions or modifications as the Commissioner deems necessary to carry out the purposes of this order. Nothing in this paragraph shall excuse noncompliance or delay.

5. Definitions. As used in this order, "Commissioner" means the Commissioner or an agent of the Commissioner.

6. Dates. The date of submission to the Commissioner of any document required by this order shall be the date such document is received by the Commissioner. The date of any notice by the Commissioner under this order, including but not limited to notice of approval or disapproval of any document or other action, shall be the date such notice is personally

delivered or the date three days after it is mailed by the Commissioner, whichever is earlier. Except as otherwise specified in this order, the word "day" as used in this order means calendar day. Any document or action which is required by this order to be submitted or performed by a date which falls on a Saturday, Sunday or a Connecticut or federal holiday shall be submitted or performed on or before the next day which is not a Saturday, Sunday, or Connecticut or federal holiday.

7. Notification of noncompliance. In the event that Old Colony becomes aware that it did not or may not comply, or did not or may not comply on time, with any requirement of this order or of any document required hereunder, Old Colony shall immediately notify the Commissioner and shall take all reasonable steps to ensure that any noncompliance or delay is avoided or, if unavoidable, is minimized to the greatest extent possible. In so notifying the Commissioner, Old Colony shall state in writing the reasons for the noncompliance or delay and propose, for the review and written approval of the Commissioner, dates by which compliance will be achieved, and Old Colony shall comply with any dates which may be approved in writing by the Commissioner. Notification by Old Colony shall not excuse noncompliance or delay, and the Commissioner's approval of any compliance dates proposed shall not excuse noncompliance or delay unless specifically so stated by the Commissioner in writing.

8. Certification of documents. Any document, including but not limited to any notice, which is required to be submitted to the Commissioner under this order shall be signed by a principal executive officer or ranking elected official or a duly authorized representative of such person, as those terms are defined in section 22a-430-3(b)(2) of the Regulations of Connecticut State Agencies and by the individual or individuals responsible for actually preparing such document, each of whom shall certify in writing as follows: "I have personally examined and am familiar with the information submitted in this document and all attachments and certify that based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief, and I understand that any false statement made in this document or its attachments may be punishable as a criminal offense."

9. Noncompliance. Failure to comply with this order may subject Old Colony to an injunction and penalties under Chapters 439, and 445 or 446k of the Connecticut General Statutes.

10. False statements. Any false statement in any information submitted pursuant to this order may be punishable as a criminal offense under Section 22a-438 or 22a-131a of the Connecticut General Statutes or, in accordance with Section 22a-6, under Section 53a-157 of the Connecticut General Statutes.

11. Notice of transfer; liability of Old Colony and others. Until Old Colony has fully complied with this order, Old Colony shall notify the Commissioner in writing no later than fifteen days after transferring all or any portion of the operations which are the subject of this order, or obtaining a new mailing or location address. Old Colony ' obligations under this order shall not be affected by the passage of title to any property to any other person or Old Colony. Any future owner of the site may be subject to the issuance of an order from the Commissioner.

12. Commissioner's powers. Nothing in this order shall affect the Commissioner's authority to institute any proceeding or take any other action to prevent or abate violations of law, prevent or abate pollution, recover costs and natural resource damages, and to impose penalties for violations of law, including but not limited to violations of any permit issued by the Commissioner. If at any time the Commissioner determines that the actions taken by Old Colony pursuant to this order have not fully characterized the extent and degree of pollution or have not successfully abated or prevented pollution, the Commissioner may institute any proceeding to require Old Colony to undertake further investigation or further action to prevent or abate pollution.

13. Old Colony's obligations under law. Nothing in this order shall relieve Old Colony of other obligations under applicable federal, state and local law.

14. No assurance by Commissioner. No provision of this order and no action or inaction by the Commissioner shall be construed to constitute an assurance by the Commissioner that the actions taken by Old Colony pursuant to this order will result in compliance or prevent or abate pollution.

15. No effect on rights of other persons. This order shall neither create nor affect any rights of persons who or municipalities which are not parties to this order. This Consent Order shall not be admissible as evidence of fact or law in any proceeding except one to enforce the terms of this Consent Order.

16. Notice to Commissioner of changes. Within fifteen days of the date Old Colony becomes aware of a change in any information submitted to the Commissioner under this order, or that any such information was inaccurate or misleading or that any relevant information was omitted, Old Colony shall submit the correct or omitted information to the Commissioner.

17. Submission of documents. Any document required to be submitted to the Commissioner under this order shall, unless otherwise specified in writing by the Commissioner, be directed to:

Carlos Esguerra, Sanitary Engineer
Department of Energy and Environmental Protection
Water Management Bureau
Planning & Standards Division
79 Elm Street
Hartford, Connecticut 06106-5127

Old Colony consents to the issuance of this consent order without further notice. The undersigned certifies that he is fully authorized to enter into this consent order and to legally bind Old Colony to the terms and conditions of the consent order.

By: ______________________
Douglas Whalen
Chairman, Board of Governors
The Old Colony Beach Club Association
Date: July 25, 2012

Issued as a consent order of the Commissioner of Energy and Environmental Protection on 8/14, 2012.

____
Macky McCleary
Deputy Commissioner
Department of Energy and Environmental Protection

ORDER NO. CO WR MU 12 001
OLD COLONY

Note: This sheet is not a part of the order and is <u>only</u> attached to the original order which is retained in separate DEEP files which are accessible to the public with close supervision. The order <u>must</u> be mailed to Old Colony by certified mail, return receipt requested. If Old Colony is a business, send a certified copy of the order to the business alone and a plain copy to the attention of a person at the business.

Certification of Mailing

COWRMU 12 001

On July 23, 2012, at 2:00 a.m. (p.m.) I mailed a certified copy of Order No. ^ to the following, by placing it in the U.S. mail:

1. Douglas Whalen
   Chairman, Board of Governors
   Old Colony Beach Club Association
   41 Old Colony Road
   Old Lyme CT 06371

Certified mail number:

[NOTE: CERTIFIED COPY TO MUST BE SENT BY CERTIFIED MAIL]

CO WR MU 12-001

On July 23, 2012, at 2:00 a.m. (p.m.), I mailed an uncertified copy of Order No. ^ to the following, by placing it in the U.S. mail:

1. Honorable Bonnie Reemsnyder
   First Selectwoman.
   52 Lyme Street
   Old Lyme, CT 06371

2. Dimitri Tolchisnki, Chair
   Water Pollution Control Authority
   52 Lyme Street
   Old Lyme, CT 06371

(signature)
[Type name of person who did mailing] Patty Gilmore
[Type title] Office Assistant
[Date] 7/23/12

Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

79 Elm Street • Hartford, CT 06106-5127 www.ct.gov/deep Affirmative Action/Equal Opportunity Employer

STATE OF CONNECTICUT :
V. :
THE OLD LYME SHORES BEACH ASSOCIATION :

Date of Issuance 10/1/12

Order No. CO WR MU 12-002

CONSENT ORDER

A. With the agreement of The Old Lyme Shores Beach Association ("OLSBA"), the Commissioner of Energy and Environmental Protection ("the Commissioner") finds:

1. OLSBA is a specially chartered municipal corporation located in the Town of Old Lyme. OLSBA was established in 1947 by Special Act of the Legislature. OLSBA has the power to levy and collect real estate taxes. By virtue of these powers, OLSBA qualifies for the funding of a sanitary sewer construction project from the State of Connecticut's Clean Water Fund Program.

2. OLSBA submitted for the Commissioner's review a Wastewater Management Plan dated January 2012 prepared by the consulting firm Fuss & O'Neill, Inc., and subsequently amended by the same firm in of June 2012. This plan identified numerous areas within the boundaries of OLSBA that could not support onsite wastewater treatment due to the overall density of development, lack of adequate space or to adverse on-site subsurface conditions, such as shallow groundwater, bedrock, and rapidly draining soils. The report identified as the most technically and economically feasible alternative the conveyance of the wastewater to an offsite facility for treatment and disposal.

3. OLSBA has not implemented any structural solutions to address the wastewater disposal problems identified in the Plan.

4. After review of the Plan, staff of the DEEP concurs with the assessment of the conditions regarding wastewater disposal problems and the recommendations for conveyance of the wastewater off-site for treatment and disposal.

5. The implementation of the remedial actions specified in the Plan requires that OLSBA procure capacity in the regional sewerage system serving New London, Waterford, and East Lyme; and design and construct sanitary sewers to collect sanitary sewage within the boundaries of OLSBA and convey it through portions of the Town of Old Lyme, to the regional sewer system.

6. By virtue of the above, a community pollution problem exists and OLSBA is causing pollution of the waters of the State.

7. By agreeing to the issuance of this Consent Order, OLSBA makes no admission of fact or law except with respect to the matters addressed in paragraphs A.1 through A.6.

B. OLSBA shall undertake the following actions which the Commissioner, acting under Sections 22a-6, 22a-424, 22a-427, 22a-428 and 22a-458 of the Connecticut General Statutes, orders:

1. a. On or before sixty (60) days following the effective date of this Order, OLSBA shall retain one or more qualified consultants acceptable to the Commissioner to prepare the documents and implement or oversee the actions required by this order and shall, by that date, notify the Commissioner in writing of the identity of such consultants. OLSBA shall retain one or more qualified consultants acceptable to the Commissioner until this order is fully complied with, and, within ten days after retaining any consultant other than one originally identified under this paragraph, OLSBA shall notify the Commissioner in writing of the identity of such other consultant. The consultant(s) retained shall be a qualified professional engineer licensed to practice in Connecticut and shall be acceptable to the Commissioner. OLSBA shall submit to the Commissioner a description of a consultant's education, experience and training which is relevant to the work required by this order within ten days after a request for such a description. Nothing in this paragraph shall preclude the Commissioner from finding a previously acceptable consultant unacceptable.

   b. Unless another deadline is specified in writing by the Commissioner, on or before eight hundred and fifty (850) days after approval of the Plan, OLSBA shall (1) submit for the Commissioner's review and written approval contract plans and specifications for the approved remedial actions, a revised list of all permits and approvals required for such actions, and a revised schedule for applying for and obtaining such permits and approvals, and (2) submit applications for all permits and approvals required under the Connecticut General Statutes for such actions. OLSBA shall use best efforts to obtain all required permits and approvals.

c. OLSBA shall perform the approved remedial actions in accordance with the approved schedule(s), but in no event shall the approved remedial actions be completed by later than June 30, 2016. Within fifteen days after completing such actions, OLSBA shall certify to the Commissioner in writing that the actions have been completed as approved.

d. OLSBA may request that the Commissioner approve, in writing, revisions to any document approved hereunder in order to make such document consistent with law or for any other appropriate reason.

2. Progress reports. On or before the last day of January, April, July and October of each year after issuance of this order and continuing until all actions required by this order have been completed as approved and to the satisfaction of the Commissioner, OLSBA shall submit a progress report to the Commissioner and the Town of Old Lyme First Selectman and Water Pollution Control Authority Chairman describing the actions which OLSBA has taken to comply with this order to date and an anticipated schedule of events to occur over the next 3 months.

3. Full compliance. OLSBA shall not be considered in full compliance with this order until all actions required by this order have been completed as approved and to the satisfaction of the Commissioner.

4. Approvals. OLSBA shall use best efforts to submit to the Commissioner all documents required by this order in a complete and approvable form. If the Commissioner notifies OLSBA that any document or other action is deficient, and does not approve it with conditions or modifications, it is deemed disapproved, and OLSBA shall correct the deficiencies and resubmit it within the time specified by the Commissioner or, if no time is specified by the Commissioner, within thirty days of the Commissioner's notice of deficiencies. In approving any document or other action under this order, the Commissioner may approve the document or other action as submitted or performed or with such conditions or modifications as the Commissioner deems necessary to carry out the purposes of this order. Nothing in this paragraph shall excuse noncompliance or delay.

5. Definitions. As used in this order, "Commissioner" means the Commissioner or an agent of the Commissioner.

6. Dates. The date of submission to the Commissioner of any document required by this order shall be the date such document is received by the Commissioner. The date of any notice by the Commissioner under this order, including but not limited to notice of approval or disapproval of any document or other action, shall be the date such notice is personally delivered or the date three days after it is mailed by the Commissioner,

whichever is earlier. Except as otherwise specified in this order, the word "day" as used in this order means calendar day. Any document or action which is required by this order to be submitted or performed by a date which falls on a Saturday, Sunday or a Connecticut or federal holiday shall be submitted or performed on or before the next day which is not a Saturday, Sunday, or Connecticut or federal holiday.

7. Notification of noncompliance. In the event that OLSBA becomes aware that it did not or may not comply, or did not or may not comply on time, with any requirement of this order or of any document required hereunder, OLSBA shall immediately notify the Commissioner and shall take all reasonable steps to ensure that any noncompliance or delay is avoided or, if unavoidable, is minimized to the greatest extent possible. In so notifying the Commissioner, OLSBA shall state in writing the reasons for the noncompliance or delay and propose, for the review and written approval of the Commissioner, dates by which compliance will be achieved, and OLSBA shall comply with any dates which may be approved in writing by the Commissioner. Notification by OLSBA shall not excuse noncompliance or delay, and the Commissioner's approval of any compliance dates proposed shall not excuse noncompliance or delay unless specifically so stated by the Commissioner in writing.

8. Certification of documents. Any document, including but not limited to any notice, which is required to be submitted to the Commissioner under this order shall be signed by a principal executive officer or ranking elected official or a duly authorized representative of such person, as those terms are defined in section 22a-430-3(b)(2) of the Regulations of Connecticut State Agencies and by the individual or individuals responsible for actually preparing such document, each of whom shall certify in writing as follows: "I have personally examined and am familiar with the information submitted in this document and all attachments and certify that based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief, and I understand that any false statement made in this document or its attachments may be punishable as a criminal offense."

9. Noncompliance. Failure to comply with this order may subject OLSBA to an injunction and penalties under Chapters 439, and 445 or 446k of the Connecticut General Statutes.

10. False statements. Any false statement in any information submitted pursuant to this order may be punishable as a criminal offense under Section 22a-438 or 22a-131a of the Connecticut General Statutes or, in accordance with Section 22a-6, under Section 53a-157 of the Connecticut General Statutes.

11. Notice of transfer; liability of OLSBA and others. Until OLSBA has fully complied with this order, OLSBA shall notify the Commissioner in writing no later than fifteen days after transferring all or any portion of the operations which are the subject of this order, or obtaining a new mailing or location address. OLSBA's obligations under this order shall not be affected by the passage of title to any property to any other person or OLSBA. Any future owner of the site may be subject to the issuance of an order from the Commissioner.

12. Commissioner's powers. Nothing in this order shall affect the Commissioner's authority to institute any proceeding or take any other action to prevent or abate violations of law, prevent or abate pollution, recover costs and natural resource damages, and to impose penalties for violations of law, including but not limited to violations of any permit issued by the Commissioner. If at any time the Commissioner determines that the actions taken by OLSBA pursuant to this order have not fully characterized the extent and degree of pollution or have not successfully abated or prevented pollution, the Commissioner may institute any proceeding to require OLSBA to undertake further investigation or further action to prevent or abate pollution.

13. OLSBA's obligations under law. Nothing in this order shall relieve OLSBA of other obligations under applicable federal, state and local law.

14. No assurance by Commissioner. No provision of this order and no action or inaction by the Commissioner shall be construed to constitute an assurance by the Commissioner that the actions taken by OLSBA pursuant to this order will result in compliance or prevent or abate pollution.

15. No effect on rights of other persons. This order shall neither create nor affect any rights of persons who or municipalities which are not parties to this order. This Consent Order shall not be admissible as evidence of fact or law in any proceeding except one to enforce the terms of this Consent Order.

16. Notice to Commissioner of changes. Within fifteen days of the date OLSBA becomes aware of a change in any information submitted to the Commissioner under this order, or that any such information was inaccurate or misleading or that any relevant information was omitted, OLSBA shall submit the correct or omitted information to the Commissioner.

17. Submission of documents. Any document required to be submitted to the Commissioner under this order shall, unless otherwise specified in writing by the Commissioner, be directed to:

Carlos Esguerra, Sanitary Engineer
Department of Energy and Environmental Protection
Water Management Bureau
Planning & Standards Division
79 Elm Street
Hartford, Connecticut 06106-5127

OLSBA consents to the issuance of this consent order without further notice. The undersigned certifies that he is fully authorized to enter into this consent order and to legally bind OLSBA to the terms and conditions of the consent order.

By Paul J. Rowean
Paul Rowean
President
The Old Lyme Shores Beach Association
Date: 9/24/12

Issued as a consent order of the Commissioner of Energy and Environmental Protection on 10/1, 2012.

Macky McCleary
Deputy Commissioner
Department of Energy and Environmental Protection

ORDER NO. CO WR MU 12-002
OLSBA

Note: This sheet is not a part of the order and is only attached to the original order which is retained in separate DEEP files which are accessible to the public with close supervision. The order must be mailed to OLSBA by certified mail, return receipt requested. If OLSBA is a business, send a certified copy of the order to the business alone and a plain copy to the attention of a person at the business.

Certification of Mailing

COWRMU 12-002

On Oct 9, 2012, at 2:00 a.m./p.m. I mailed a certified copy of Order No. 1 to the following, by placing it in the U.S. mail:

1. Paul Rowean
President
The Old Lyme Shores Beach Association
29 Billow Road
Old Lyme, CT 06371

Certified mail number:

[NOTE: CERTIFIED COPY TO MUST BE SENT BY CERTIFIED MAIL]

COWRMU 12-002

On Oct 9, 2012, at 2:00 a.m./p.m. I mailed an uncertified copy of Order No. 1 to the following, by placing it in the U.S. mail:

1. Honorable Bonnie Reemsnyder
First Selectwoman.
52 Lyme Street
Old Lyme, CT 06371

2. Dimitri Tolchisnki, Chair
Water Pollution Control Authority
52 Lyme Street
Old Lyme, CT 06371

(signature)
[Type name of person who did mailing]
[Type title] Patty Gilmore
[Date] Office Assistant
10/9/12

APPENDIX B: SUBSURFACE INVESTIGATION (FIGURES & TABLES)

TABLE B-1
SUMMARY OF SUBSURFACE EXPLORATION

SITE	LOCATION	MEASURING POINT (MP)	MP ELEVATION (FT AMSL)	X (FT)	Y (FT)	DEPTH OF EXPLORATION (FEET)	REFUSAL
BLACK HALL	BH-1	GROUND SURFACE	32.08	1125369.81	667901.20	23.5	YES
	BH-2	GROUND SURFACE	45.74	1125238.76	667622.50	29.5	YES
	BH-4	GROUND SURFACE	33.06	1125282.69	666534.62	13.5	YES
	BH-5	GROUND SURFACE	54.69	1124281.05	666784.70	6.5	YES
	MW-3D	TOP OF PVC	56.12	1124714.24	667392.97	35.5	YES
		TOP OF CASING	56.23	1124714.39	667392.89		
		GROUND SURFACE	53.13	1124714.56	667393.27		
	MW-3S	TOP OF PVC	56.19	1124714.09	667391.35	35.5	YES
		TOP OF CASING	56.33	1124714.52	667391.26		
		GROUND SURFACE	53.12	1124714.64	667391.62		
	MW-A	TOP OF CASING	32.90	1124242.67	668150.61	16.4	UNKNOWN
		GROUND SURFACE	29.10	1124242.96	668150.56		
	MW-E	TOP OF CASING	26.76	1123522.72	668471.61	28.8	UNKNOWN
	MW-H	TOP OF CASING	31.01	1122927.21	668165.41	13.8	UNKNOWN
		GROUND SURFACE	29.29	1122927.05	668165.69		
	MW-I	TOP OF CASING	27.15	1123590.28	667862.59	5.4	UNKNOWN
		GROUND SURFACE	25.95	1123590.56	667862.66		
CHERRYSTONE	TH 5-06	GROUND SURFACE	19.22	1126433.33	667015.58	16.0	YES
	TH-1	GROUND SURFACE	19.12	1126600.71	666489.18	8.8	NO
	TH-10	GROUND SURFACE	23.60	1126558.22	666960.14	8.3	YES
	TH-11	GROUND SURFACE	21.76	1126745.29	666862.38	6.2	YES
	TH-12	GROUND SURFACE	23.08	1126788.81	666998.48	5.5	YES
	TH-13	GROUND SURFACE	18.07	1126432.36	667067.56	8.1	NO
	TH-2	GROUND SURFACE	21.17	1126840.41	666519.08	8.2	NO
	TH-20	GROUND SURFACE	18.94	1126406.10	666736.01	16.0	NO
	TH-21	GROUND SURFACE	13.02	1126389.26	666994.87	10.1	NO
	TH-22	GROUND SURFACE	14.27	1126343.04	666826.85	12.7	NO
	TH-4	GROUND SURFACE	21.91	1126822.45	666749.54	9.0	YES
	TH-5	GROUND SURFACE	23.10	1126628.31	666721.74	8.2	NO
	TH-6	GROUND SURFACE	19.92	1126448.84	666602.58	8.7	NO
	TH-7	GROUND SURFACE	16.87	1126313.62	666703.04	8.5	NO
	TH-8	GROUND SURFACE	13.31	1126374.60	666912.60	8.5	NO
	TH-9	GROUND SURFACE	22.75	1126483.39	666832.92	9.3	NO
	TP-01	GROUND SURFACE	21.24	1126718.82	666496.31	10.0	YES
	TP-02	GROUND SURFACE	19.57	1126481.04	666597.19	10.0	NO
	TP-03	GROUND SURFACE	19.34	1126369.07	666710.74	10.2	NO
	TP-04	GROUND SURFACE	23.13	1126551.57	666749.74	10.0	YES
	TP-05	GROUND SURFACE	21.83	1126742.36	666777.53	3.5	YES
	TP-07	GROUND SURFACE	23.17	1126610.43	666878.15	10.0	NO
	TP-08	GROUND SURFACE	19.95	1126432.60	666955.07	8.7	NO
	WC-1	TOP OF PVC	24.21	1126574.01	666585.57	20.3	YES
		TOP OF CASING	24.33	1126574.05	666585.56		
		GROUND SURFACE	21.14	1126574.54	666585.47		
	WC-2	TOP OF PVC	23.70	1126445.39	666751.55	30.0	NO
		TOP OF CASING	23.82	1126445.65	666751.60		
		GROUND SURFACE	20.55	1126444.96	666751.96		
	WC-3	TOP OF PVC	15.54	1126359.22	666912.24	30.0	NO
		TOP OF CASING	15.67	1126359.33	666912.22		
		GROUND SURFACE	12.45	1126359.91	666912.51		
	WC-4	TOP OF PVC	25.30	1126782.41	666721.12	11.5	YES
		TOP OF CASING	25.41	1126782.26	666721.00		
		GROUND SURFACE	22.35	1126782.71	666721.59		

NOTES:
X, Y expressed in Connecticut State Plane coordinates, North American Datum (NAD) 1983
Ft AMSL = feet above mean sea level

TABLE B-2
SEASONAL HIGH WATER TABLE CALCULATIONS
CHERRYSTONE

USGS Well	$DTW_{SHWT,USGS}$	$DTW_{T,USGS}$
412916073121701	10.79	11.17
412825072410501	6.22	8.38

Cherrystone Well	$DTW_{T,SITE}$	$DTW_{SHWT,SITE}$ using USGS Well:		
		412916073121701	412825072410501	AVERAGE
WC-1	17.06	16.48	12.66	14.57
WC-2	17.31	16.72	12.85	14.78
WC-3	9.56	9.23	7.10	8.17

Black Hall Well	$DTW_{T,SITE}$	$DTW_{SHWT,SITE}$ using USGS Well:		
		412916073121701	412825072410501	AVERAGE
MW-3S	16.06	15.51	11.92	13.72
MW-3D	21.78	21.04	16.17	18.60

NOTES:

$DTW_{SHWT,USGS}$ = Depth to water at seasonal high water table, USGS sentinel wells (feet below ground)

$DTW_{T,USGS}$ = Depth to water during 2013 monitoring period, USGS sentinel wells (feet below ground)

$DTW_{T,SITE}$ = Depth to water during 2013 monitoring period, site wells (feet below ground)

$DTW_{SHWT,SITE}$ = Depth to water at seasonal high water table, site wells (feet below ground)

$DTW_{T,USGS}$ and $DTW_{T,SITE}$ data were obtained at 00:00 on June 16, 2013, when the water table was relatively shallow throughout the study area

WC-4 not used in SHWT calculations because it does not represent the Cherrystone aquifer

*The water level in MW-A is above the ground surface due to localized hydrologic conditions, resulting in a depth to water less than zero

MW-A, MW-E, MW-H, and MW-I are not used in SHWT calculations because of inaccessibility to potential future designs and prohibitively low hydraulic conductivity

TABLE B-3
SUMMARY OF HYDRAULIC CONDUCTIVITY

SITE	WELL	K (ft/day)
CHERRYSTONE	WC-2	250
	WC-3	80
	WC-4	20
BLACK HALL	MW-A	0.13
	MW-E	12.5
	MW-I	0.11
	MW-3S	2.2
	MW-3D	16

NOTES:
K = Saturated hydraulic conductivity
*WC-4 likely does not represent Cherrystone aquifer conditions
WC-1 and MW-H did not have adequate water depth to perform slug testing

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DEDHAM, MA 02026
800.446.5518 | www.woodardcurran.com
COMMITMENT & INTEGRITY DRIVE RESULTS
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SITE PLAN

OLD LYME, CONNECTICUT

TOWN OF OLD LYME, CONNECTICUT

Legend

PARCEL

0 250 500 1,000 Feet

PN: 226617

BY: BVA

DATE: OCTOBER 2013

FIGURE B-1

Legend

- TEST PIT, 2013
- TEST PIT, HISTORICAL
- MONITOR WELL, 2013

RECEPTORS

- CHERRYSTONE WETLAND
- PARCEL BOUNDARY

0 50 100 200 Feet

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SUBSURFACE - CHERRYSTONE

OLD LYME, CONNECTICUT

TOWN OF OLD LYME, CONNECTICUT

PN: 226617

BY: BVA

DATE: OCTOBER 2013

FIGURE B-2

Legend

- SOIL BORING, 2013
- MONITOR WELL, 2013
- MONITOR WELL, HISTORICAL
- PARCEL BOUNDARY

0 150 300 600 Feet

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COMMITMENT & INTEGRITY DRIVE RESULTS

SUBSURFACE - BLACK HALL

OLD LYME, CONNECTICUT

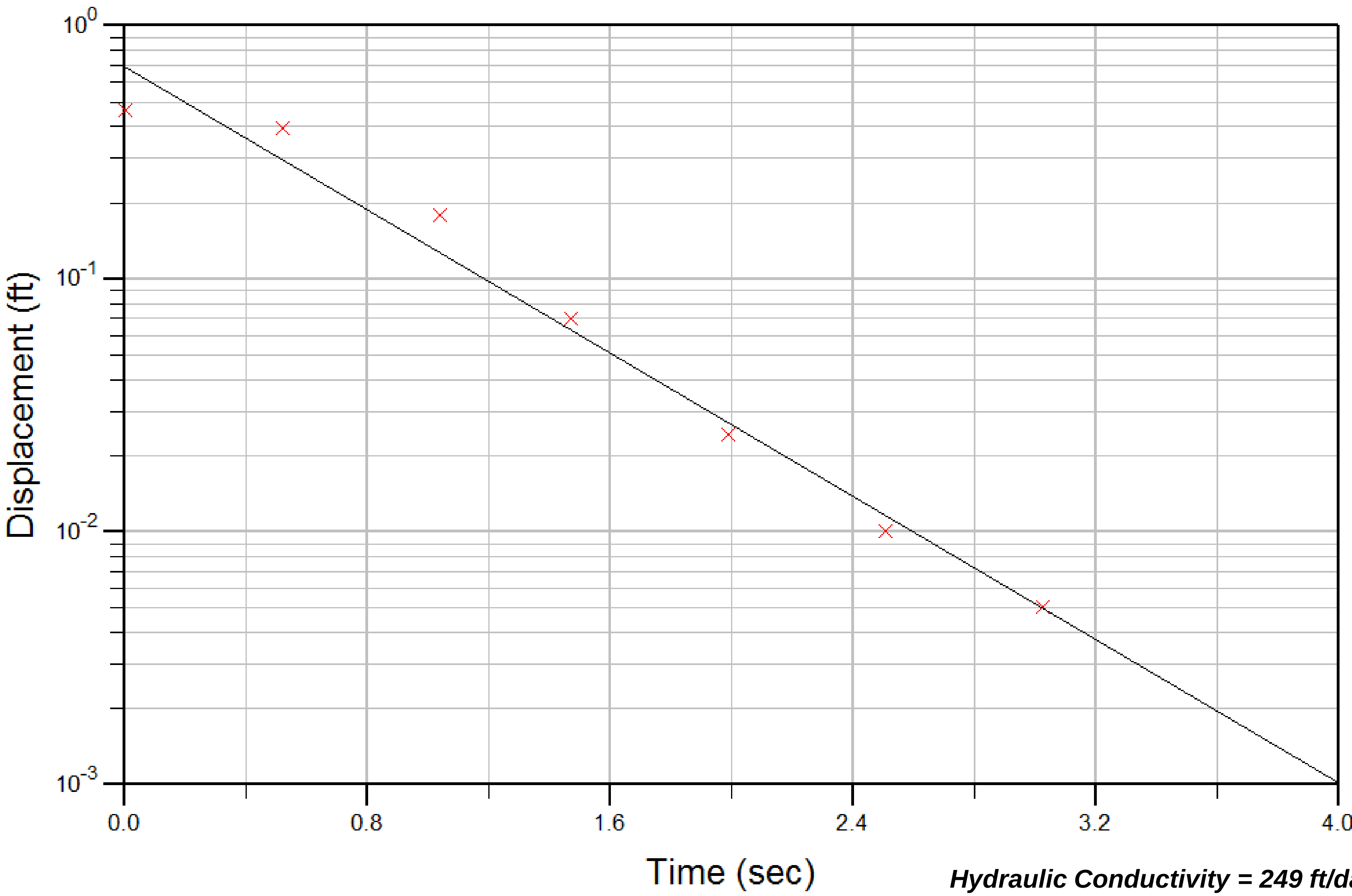
TOWN OF OLD LYME, CONNECTICUT

PN: 226617

BY: BVA

DATE: OCTOBER 2013

FIGURE B-3



Hydraulic Conductivity = 249 ft/day

WOODARD & CURRAN
COMMITMENT & INTEGRITY DRIVE RESULTS
980 Washington St, Suite 325
Dedham, MA 02026
T: 800.446.5518

SLUG TEST ANALYSIS: WC-2		Town of Old Lyme Old Lyme, Connecticut	JOB NO.: 226617.00 DATE: OCTOBER 2013 SCALE: NA
DESIGNED BY: BVA	**CHECKED BY: DP**		**FIGURE B-4**
DRAWN BY: BVA			

Legend

- CHERRYSTONE WETLAND
- PARCEL BOUNDARY
- MONITOR WELL AND GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)

0 50 100 200 Feet

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GROUNDWATER - CHERRYSTONE

OLD LYME, CONNECTICUT

TOWN OF OLD LYME, CONNECTICUT

PN: 226617

BY: BVA

DATE: OCTOBER 2013

FIGURE B-5

Legend

PARCEL BOUNDARY

MONITOR WELL AND GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)

GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)

0 150 300 600 Feet

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GROUNDWATER - BLACK HALL

OLD LYME, CONNECTICUT

TOWN OF OLD LYME, CONNECTICUT

PN: 226617

BY: BVA

DATE: OCTOBER 2013

FIGURE B-6

Legend

- TEST PIT, 2013
- TEST PIT, HISTORICAL
- MONITOR WELL, 2013

RECEPTORS

- CHERRYSTONE WETLAND
- 55 FOOT WETLAND BUFFER
- PARCEL BOUNDARY
- 55 FOOT PARCEL BUFFER

SAS FACILITY

- SMALL
- LARGE

0 50 100 200 Feet

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COMMITMENT & INTEGRITY DRIVE RESULTS

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SAS FACILITY - CHERRYSTONE

OLD LYME, CONNECTICUT

TOWN OF OLD LYME, CONNECTICUT

PN: 226617

BY: BVA

DATE: OCTOBER 2013

FIGURE B-7

APPENDIX C: SUBSURFACE INVESTIGATION - GROUNDWATER DATA AND BORING LOGS

Woodard & Curran
980 Washington St | Suite 325
Dedham, MA 02026
Telephone: 781.251.0200
Fax: 781.251.0847

TEST PIT NUMBER TP-01

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/30/13 **COMPLETED** 5/30/13
GROUND ELEVATION 21.24 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR Town of Old Lyme
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	Elevation
0			0.3	Dark brown, silty topsoil	21.0
2	SM		2.5	Light brown, damp, silty SAND loam; cohesive, roots, upward fining	18.7
4–10	SW		10.0	Light brown, dry, F-C SAND, Some F-C Gravel; cobbles, unconsolidated	11.2

Refusal at 10.0 feet.
Bottom of test pit at 10.0 feet.

Woodard & Curran
980 Washington St | Suite 325
Dedham, MA 02026
Telephone: 781.251.0200
Fax: 781.251.0847

TEST PIT NUMBER TP-02

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/30/13 **COMPLETED** 5/30/13
GROUND ELEVATION 19.57 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR Town of Old Lyme
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	Elevation
0				Dark brown, silty topsoil	
			0.7		18.9
	SM			Light brown, damp, silty SAND loam; cohesive, roots, little cobbles	
			1.4		18.2
2	SW			Light brown, dry, F-C SAND, Some F-C Gravel; little cobbles and boulders, unconsolidated	
4					
6					
8					
10			10.0		9.6

Bottom of test pit at 10.0 feet.

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TEST PIT NUMBER TP-03

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/30/13 **COMPLETED** 5/30/13
GROUND ELEVATION 19.34 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR Town of Old Lyme
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	Elevation
0		0.3	Dark brown, silty topsoil	19.0
	SM	2.8	Light brown, damp, silty SAND loam; cohesive, roots, little cobbles	16.5
	SW	10.2	Light brown, dry, F-C SAND, Some F-C Gravel; little cobbles and boulders, inch-scale layering from 6-10 feet	9.1

Bottom of test pit at 10.2 feet.

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TEST PIT NUMBER TP-04

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/30/13 **COMPLETED** 5/30/13
GROUND ELEVATION 23.13 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR Town of Old Lyme
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	Elevation
0				Dark brown, silty topsoil	
			0.7		22.4
	SM			Light brown, damp, silty SAND loam; cohesive, roots, little cobbles	
2			1.8		21.3
2–10	SW			Light brown, dry, F-C SAND, Some F-C Gravel; little cobbles and boulders	
10			10.0		13.1

Visual confirmation of granitic rock surface

Refusal at 10.0 feet.
Bottom of test pit at 10.0 feet.

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TEST PIT NUMBER TP-05

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/30/13 **COMPLETED** 5/30/13
GROUND ELEVATION 21.83 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR Town of Old Lyme
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	REMARKS	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	Elev.
0				1.0	Dark brown, damp, F SAND, Some Silt; roots	20.8
2	Boulder noted at 1-2 ft depth in sidewall Orange mottling	SM		3.5	Light brown, damp, F SAND, Some Silt	18.3

Visual confirmation of granitic rock surface

Refusal at 3.5 feet.
Bottom of test pit at 3.5 feet.

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TEST PIT NUMBER TP-07

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/30/13 **COMPLETED** 5/30/13
GROUND ELEVATION 23.17 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR Town of Old Lyme
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	Elevation
0				Dark brown, silty topsoil	
			1.3		21.9
2	SM			Brown, damp, silty SAND loam; cohesive	
			3.2		20.0
4	SW			Light brown, dry, F-C SAND, Some F-C Gravel and Cobbles	
6					
8	SW			Light brown-gray, damp, F-C SAND, Some Boulders	
10			10.0		13.2

Bottom of test pit at 10.0 feet.

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TEST PIT NUMBER TP-08

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/30/13 **COMPLETED** 5/30/13
GROUND ELEVATION 19.95 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR Town of Old Lyme
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	Elevation
0			0.6	Dark brown, silty topsoil	19.4
	SM		1.7	Light brown, damp, silty SAND loam; cohesive, roots, little cobbles	18.3
2, 4, 6, 8	SW		8.7	Light brown, dry, F-C SAND, Some F-C Gravel; little cobbles and boulders, unconsolidated	11.3

Bottom of test pit at 8.7 feet.

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BORING NUMBER BH-1

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/20/13 **COMPLETED** 5/20/13
GROUND ELEVATION 32.08 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	Elev.
0			Dark brown, dry, F SAND & SILT; roots Light brown, dry, F SAND, Some Silt, trace f. gravel and roots	
2		2.7		29.4
4	SW		Light brown-gray, dry, F-M SAND, trace f. gravel	
6–8	SW	8.9	Light brown, dry, F-C SAND, Little F-C Gravel	23.2
	SM	9.0	Light brown, dry, F-C SAND, Some Silt	23.1
10	SW		Light brown, dry, F-C SAND, Little F-C Gravel	
12	SP-SM		Dark brown, damp, F SAND, Little Silt and Roots	
	SW		Light brown, dry, F-C SAND, Little F-C Gravel	
	SP-SM		Light brown, damp, F SAND, Little Silt and Roots	
14	SW		Light brown, dry, F-C SAND, Little F-C Gravel	
16	SW		Light brown, damp, F-C SAND, trace f-c gravel	
18	SP		Light brown, damp, F SAND	
	SP-SM		Olive-gray, damp, F-M SAND, Little Silt and F Gravel	
			White rock fragments	
20	SW-SM		Olive-gray, damp, F-M SAND, Little Silt and F Gravel	
22	SW		Light brown-gray, damp, F-C SAND, Little F-C Gravel	
	SW	23.5	Brown-gray, damp, F-C SAND, Little F-C Gravel, trace silt	8.6

Refusal at 23.5 feet.
Bottom of borehole at 23.5 feet.

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BORING NUMBER BH-2

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/20/13 **COMPLETED** 5/20/13
GROUND ELEVATION 45.74 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	Elev.
0				Brown, dry, F-M SAND, Some Silt, little f. gravel and roots	
2				Light brown, dry, F-C SAND, Little Silt and F Gravel, roots	
			3.6		42.1
4	MH		3.9	Dark brown, damp, SILT, Some F SAND	41.8
	SM			Light brown, dry, F SAND, Some Silt, trace f. gravel	
			5.0		40.7
6	SP-SM			Light brown, dry, F SAND, Little Silt and F Gravel	
8	SW			Light gray, dry, F-C SAND, Some F-C Gravel	
10	SW-SM			Dark brown, damp, F-M SAND, Little Silt and F Gravel; red/gray mottling, cohesive	
	SW			Light gray, dry, F-C SAND, Little F Gravel	
12				Dry fragments of gneissic rock	
14	SW-SM			Dark brown, damp, F-M SAND, Little Silt and F Gravel; red/gray mottling, cohesive	
				Brown, dry, weathered granitic rock	
16	SW			Light brown, dry, F-M SAND, Little F-C Gravel	
18					
20				Dry fragments of gneissic rock	

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BORING NUMBER BH-2

CLIENT Town of Old Lyme, CT **PROJECT NAME** Old Lyme Wastewater Management

PROJECT NUMBER 226617 **PROJECT LOCATION** Old Lyme, CT

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION
20	SW-SM			Brown, dry, F-M SAND, Little Silt
	SW			Brown-yellow, dry, F-C SAND, Little F-C Gravel
22				
24				
				Dry fragments of gneissic rock
	SW			Light brown-gray, dry, F-M SAND, trace f. gravel and silt
26	SW-SM			Olive-gray, damp, F-M SAND, Little Silt, trace c. sand; cohesive
				Rock fragments
28	SW			Brown, damp, F-C SAND, Little F-C Gravel, trace silt; granitic rock fragment in spoon tip
			29.5	16.2

Refusal at 29.5 feet.
Bottom of borehole at 29.5 feet.

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BORING NUMBER BH-4

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/21/13 **COMPLETED** 5/21/13
GROUND ELEVATION 33.06 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	
0				Dark brown, damp, F SAND, Some Silt, trace f. gravel and roots	
				Light brown, damp, F-M SAND, Little Silt, trace f. gravel and roots	
2			1.9		31.2
				Rock fragments	
	SP			Light brown, damp, F SAND, Little F Gravel, trace silt	
	SP			Light gray, damp, F SAND, trace c. sand and roots	
4	SW			Orange-red, damp, F-C SAND, Some F-C Gravel, Little Silt	
	SW			Light brown-gray, damp, F-C SAND, Some F-C Gravel	
				Rock fragments	
6	SW			Olive-gray, damp, F-M SAND, Little F Gravel; cohesive	
				Brown-gray-white, damp, F-C SAND, Some F-C Gravel	
8	SW				
10				Light brown-gray, damp, F-C SAND, Some F-C Gravel, trace silt	
12	SW				
	SW		13.5	Black, damp, F-C SAND, Some F-C Gravel, trace silt	19.6

Refusal at 13.5 feet.
Bottom of borehole at 13.5 feet.

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BORING NUMBER BH-5

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/21/13 **COMPLETED** 5/21/13
GROUND ELEVATION 54.69 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	Elevation
0			Dark brown, damp, F SAND, Some Silt, roots and leaves	
			Light brown, damp, F SAND, Some Silt, roots; cohesive	
2		2.4		52.3
	SW	2.5	Yellow-orange, damp, F-C SAND	52.2
	SM	2.7	Light brown, damp, F SAND, Some Silt, roots; cohesive	52.0
	SW-SM		Pulverized rock fragments	
4			Light brown, damp, F-M SAND, Little Silt, trace f. gravel; cohesive, light gray mottling	
	SW		Light brown, damp, F-M SAND, trace f. gravel and silt	
6			Pulverized rock fragments	
	SW	6.5	Light brown, damp, F-M SAND, trace f. gravel and silt	48.2
	SW		Light brown, damp, F-M SAND, trace f. gravel; not cohesive	

Refusal at 6.5 feet.
Bottom of borehole at 6.5 feet.

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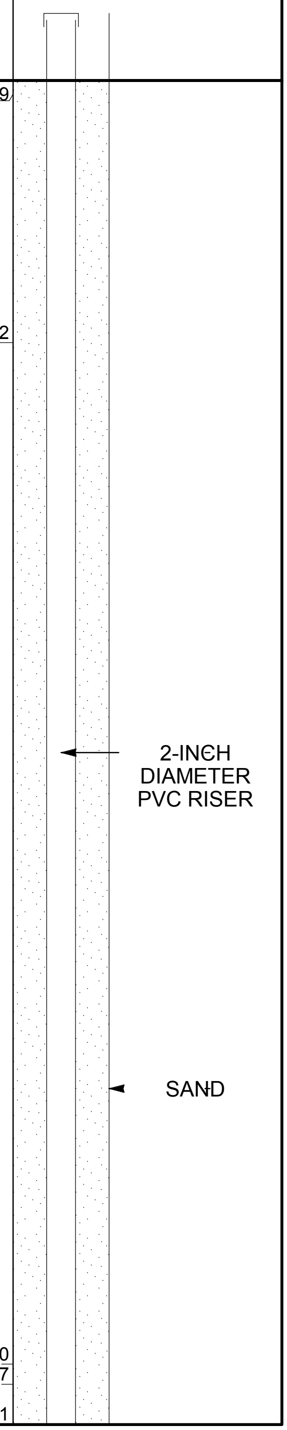
WELL NUMBER MW-3D

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/21/13 **COMPLETED** 5/21/13
GROUND ELEVATION 53.13 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING 22.99 ft / Elev 30.14 ft

DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	Elev.
0		0.2	Brown topsoil, roots	52.9
	SW		Light brown, dry, F-C SAND, Some F-C Gravel, little silt and roots	
2	SP-SM	3.9	Light brown-gray, dry, F SAND, Little Silt and Roots	49.2
4	SW		Brown-gray, dry, F-C SAND	
			Granitic rock fragments	
6 / 8	SW		Brown-white-gray, dry, F-C SAND, Some F-C Gravel, rock fragments	
10	SW		Light brown, damp, F-M SAND, Little F-C Gravel, trace silt	
12	SW		Brown, damp, F-C SAND, Little F-C Gravel	
	SW		Brown, moist, F-M SAND, trace f. gravel	
14	SW		Brown, moist, F-C SAND, Some F-C Gravel	
			Cave-in material	
16	SW		Brown-gray, dry, F-C SAND, Little F-C Gravel, trace silt	
	SW		Yellow-orange, damp, F-M SAND, trace f. gravel	
18	SW		Yellow-orange, moist, F-C SAND, trace f. gravel	
		19.1	Olive-gray, wet, F SAND	34.0
	SM	19.4	Olive-gray, wet, F SAND, Some Silt	33.7
20	SP	20.0	Olive-gray, wet, F SAND	33.1

WELL DIAGRAM



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WELL NUMBER MW-3D

CLIENT Town of Old Lyme, CT

PROJECT NAME Old Lyme Wastewater Management

PROJECT NUMBER 226617

PROJECT LOCATION Old Lyme, CT

DEPTH (ft)	U.S.C.S.	MATERIAL DESCRIPTION (Feet BGS)	Elev.	WELL DIAGRAM
20		Granitic rock fragments		
		Soils preserved for laboratory sampling		2-INCH DIAMETER PVC RISER
25	SW	Olive-gray, moist, F-M SAND, Little F-C Gravel and Silt; cohesive		BENTONITE SEAL
30	SW	Olive-gray, wet, F-M SAND, Little F-C Gravel and Silt; cohesive		SAND
32	SW	Brown, wet, F-C SAND		2-INCH DIAMETER PVC SCREEN
33.3	SW	Brown, wet, F-M SAND, Some F-C Gravel, trace silt		
34.1		Rock fragments: gneissic banding, secondary clay minerals	19.0	
35.5			17.6	

Refusal at 35.5 feet.
Bottom of borehole at 35.5 feet.

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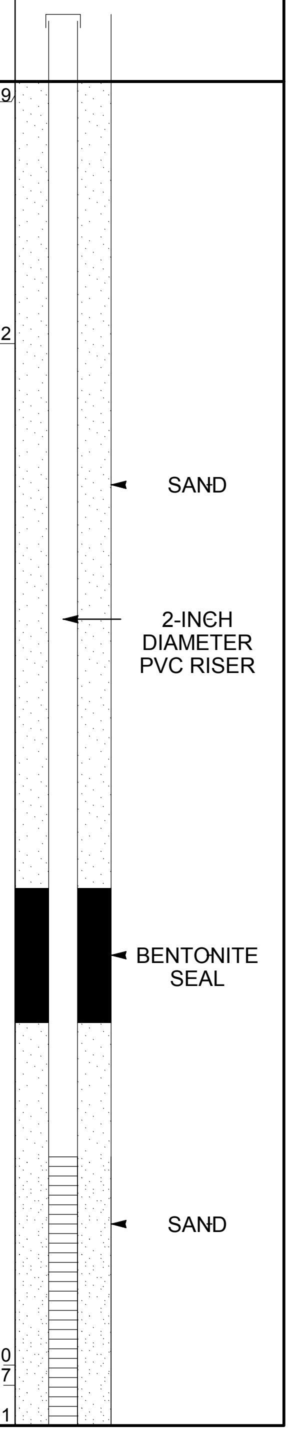
WELL NUMBER MW-3S

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/20/13 **COMPLETED** 5/20/13
GROUND ELEVATION 53.12 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING 17.89 ft / Elev 35.23 ft

DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	Elev.
0		0.2	Brown topsoil, roots	52.9
	SW		Light brown, dry, F-C SAND, Some F-C Gravel, little silt and roots	
	SP-SM	3.9	Light brown-gray, dry, F SAND, Little Silt and Roots	49.2
4	SW		Brown-gray, dry, F-C SAND Granitic rock fragments Soils preserved for laboratory sampling	
			Cave-in material	
16	SW		Brown-gray, dry, F-C SAND, Little F-C Gravel, trace silt	
	SW		Yellow-orange, damp, F-M SAND, trace f. gravel	
	SW		Yellow-orange, moist, F-C SAND, trace f. gravel	
18	SP	19.1	Olive-gray, wet, F SAND	34.0
	SM	19.4	Olive-gray, wet, F SAND, Some Silt	33.7
20	SP	20.0	Olive-gray, wet, F SAND	33.1

WELL DIAGRAM



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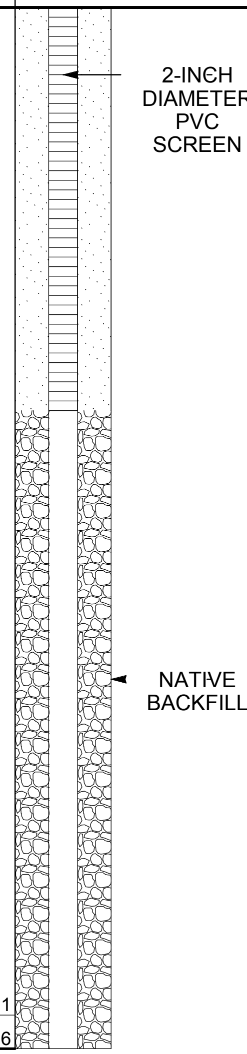
WELL NUMBER MW-3S

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION		WELL DIAGRAM
20	SM			Granitic rock fragments Olive-gray, saturated, F-M SAND, Some Silt, little f. gravel; cohesive Soils preserved for laboratory sampling		
22						
24						
26						
28						
30						
32						
34			35.0		18.1	
			35.5	Black, micaceous weathered rock	17.6	

Refusal at 35.5 feet.
Bottom of borehole at 35.5 feet.



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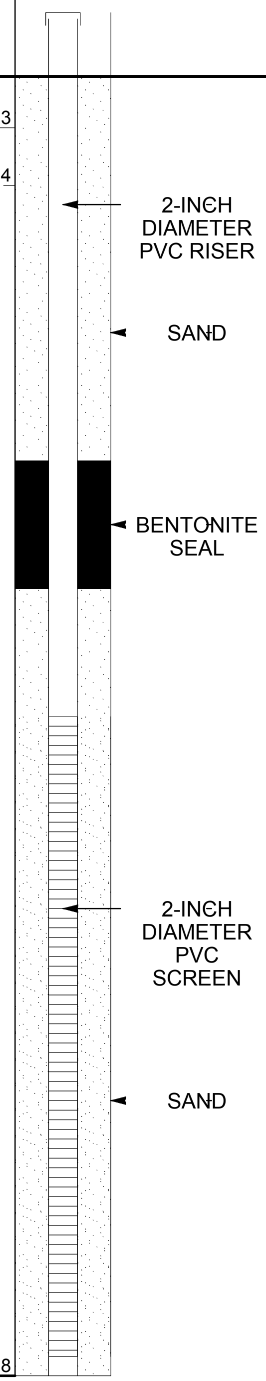
WELL NUMBER WC-1

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/22/13 **COMPLETED** 5/22/13
GROUND ELEVATION 21.14 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING 18.90 ft / Elev 2.24 ft

DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	Elev.
0			Brown, damp, F SAND, Some Silt, trace f. gravel and roots	
		0.8		20.3
	SP		Light brown, damp, F SAND, Some Gravel, little silt	
		1.7		19.4
2–16	SW		Light brown-gray, dry, F-C SAND, Some Gravel	
16–18	SW		Light brown-gray, moist, F-M SAND, trace f. gravel; cm-scale laminae	
18–20	SW		Light brown-gray, wet, F-C SAND, Some F-C Gravel	
		20.3		0.8



Refusal at 20.3 feet.
Bottom of borehole at 20.3 feet.

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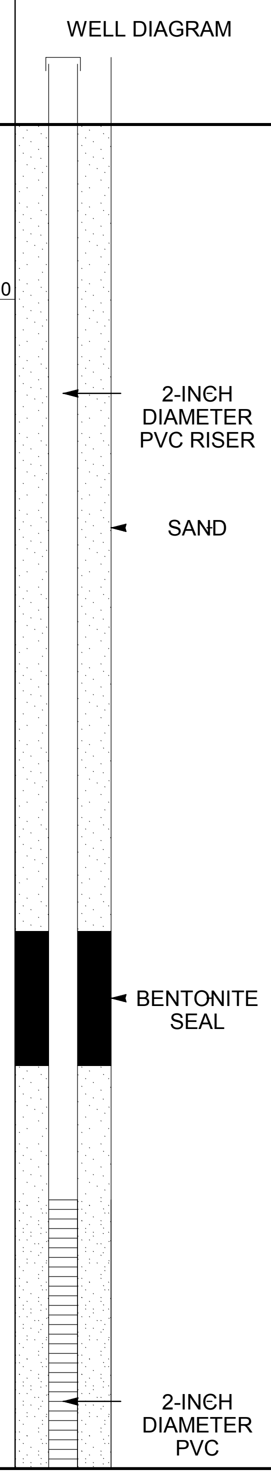
WELL NUMBER WC-2

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/22/13 **COMPLETED** 5/22/13
GROUND ELEVATION 20.55 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING 18.57 ft / Elev 1.98 ft

DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION
0			Brown, damp, F SAND, Some Silt, trace f. gravel and roots
			Light brown, damp, F SAND, Little Silt, trace f. gravel and roots
		2.6	
	SW		Light brown-gray, dry, F-C SAND, Some F-C Gravel
	SW		Light brown-gray, damp, F-C SAND, Some F-C Gravel
	SW		Light gray-brown, damp, F-C SAND, Little F Gravel
	SW		Light gray-brown, wet, F-C SAND, Little F Gravel

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20



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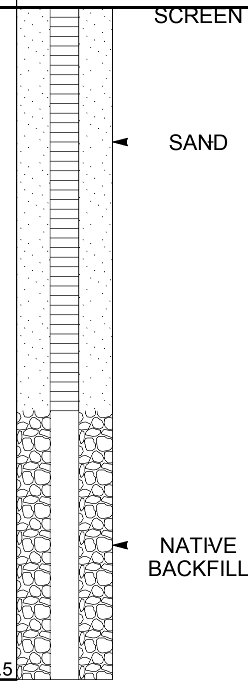
WELL NUMBER WC-2

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT

DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION
20–25	GW		Light brown-gray, wet, F-C GRAVEL, Some F-C Sand
	SW		Blue-gray, wet, F-M SAND, Little F Gravel, trace silt
26	SW		Light brown-gray, wet, F-C SAND, Little F Gravel
	SP		Light brown-gray, wet, F SAND; inch-scale laminae
	SW		Light brown-gray, wet, F-C SAND, Little F Gravel
28	SP		Light brown-gray, wet, F SAND; inch-scale laminae
	SW		Light brown-gray, wet, F-M SAND; inch-scale laminae
30	SW	30.0	Light brown-gray, wet, F-C SAND

WELL DIAGRAM



Bottom of borehole at 30.0 feet.

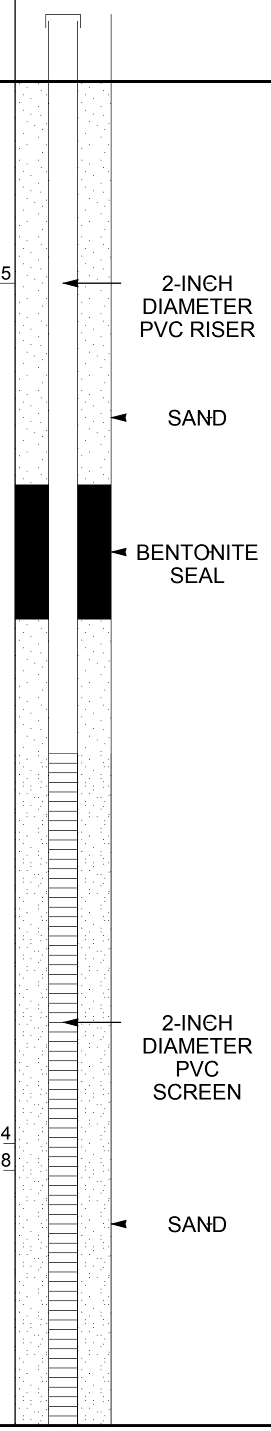
Woodard & Curran
980 Washington St | Suite 325
Dedham, MA 02026
Telephone: 781.251.0200
Fax: 781.251.0847

WELL NUMBER WC-3

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/22/13 **COMPLETED** 5/22/13
GROUND ELEVATION 12.45 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING 10.55 ft / Elev 1.90 ft

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG (Feet BGS)	MATERIAL DESCRIPTION	Elev.
0			Dark brown, damp, F SAND, Some Silt, trace c. sand and roots	
			Brown, damp, F SAND, Little Silt, trace f-c gravel and roots	
2				
		3.0		9.5
	SW		Yellow-orange-light gray, dry, F-C SAND, Little F-C Gravel	
4				
6				
8				
10	SW		Light brown-gray, damp, F-C SAND, Little F-C Gravel	
12	SW		Light brown-gray, wet, F-C SAND, Little F-C Gravel	
	SW		Light brown-gray, wet, F-C SAND, Some F-C Gravel	
14	SW		Light brown-gray, wet, F-M SAND	
		15.8		-3.4
16	SM		Light brown-gray, wet, F-M SAND, Some Silt	
		16.2		-3.8
	SW		Light brown-gray, wet, F-M SAND	
	SW		Light brown-gray, wet, F-M SAND, Some F-C Gravel	
18	SP		Light brown-gray, wet, F SAND, Little Silt	
	SW		Light brown-gray, wet, F-M SAND, Some F-C Gravel	
20				

WELL DIAGRAM



(Continued Next Page)

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Fax: 781.251.0847

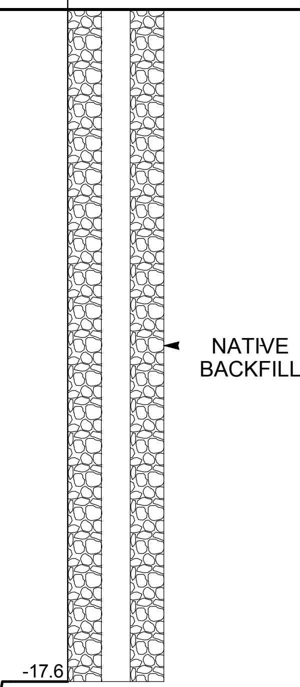
WELL NUMBER WC-3

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION
20	SW			Light brown-gray, wet, F-M SAND, trace f. gravel
25	SW			Light brown-gray, wet, F-C SAND, Some F-C Gravel
	SW			Light brown-gray, wet, F-M SAND, Some F-C Gravel; millimeter-scale laminae
	SW			Light brown-gray, wet, F-C SAND, Some F-C Gravel
	SW			Light brown-gray, wet, F-M SAND, Some F-C Gravel; millimeter-scale laminae
	SW			Light brown-gray, wet, F-C SAND, Some F-C Gravel
30	SW		30.0	Light brown-gray, wet, F-M SAND, Some F-C Gravel; millimeter-scale laminae

Bottom of borehole at 30.0 feet.

WELL DIAGRAM



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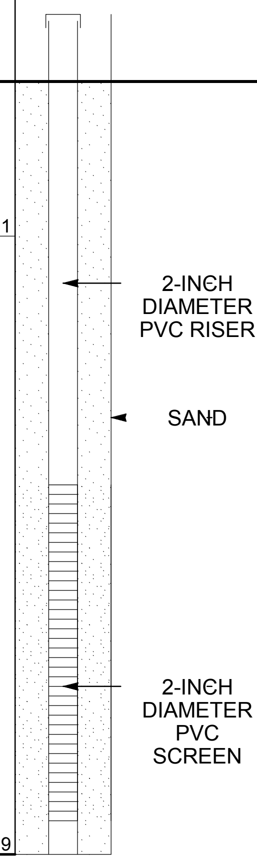
WELL NUMBER WC-4

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/22/13 **COMPLETED** 5/22/13
GROUND ELEVATION 22.35 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING 9.24 ft / Elev 13.11 ft

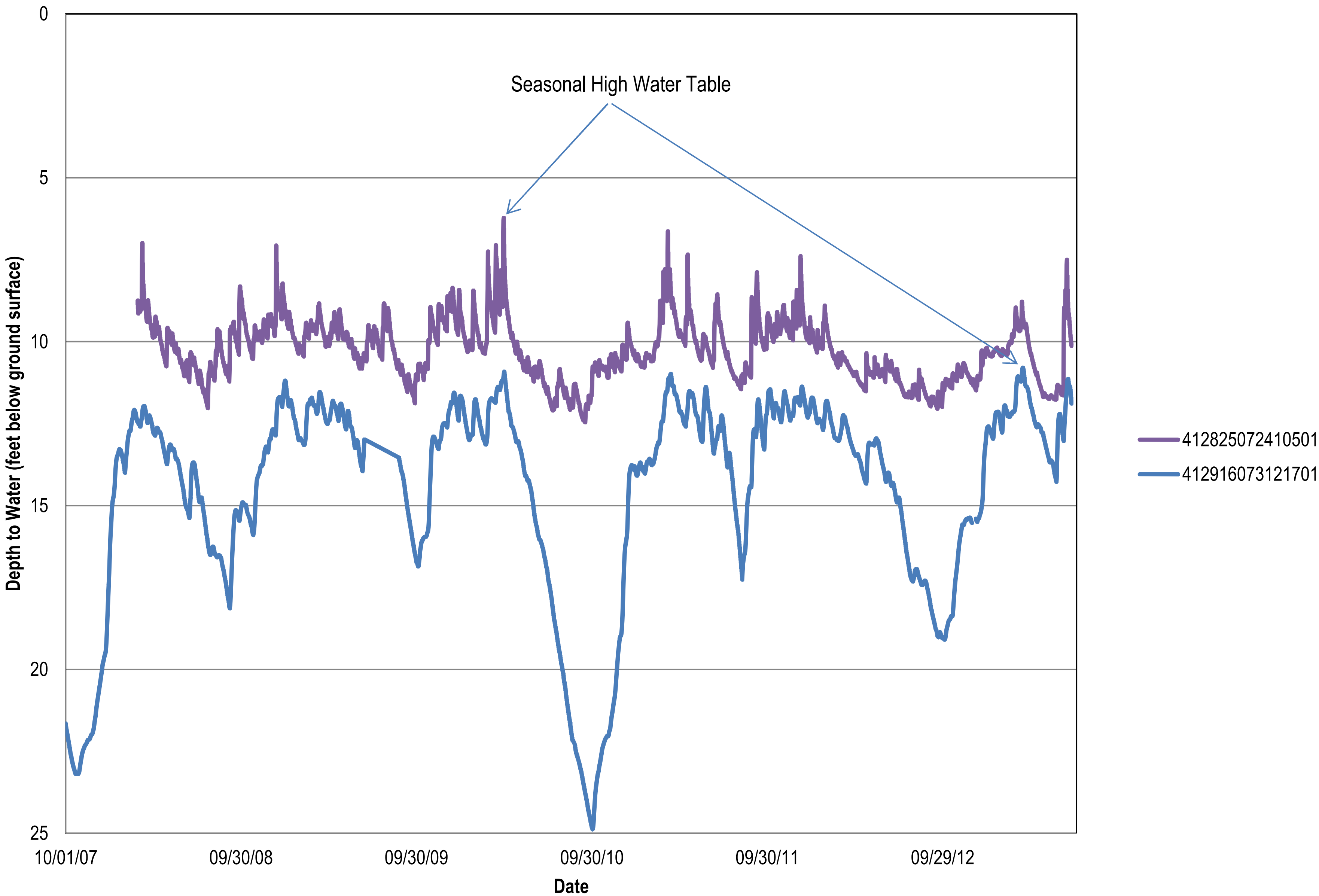
DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	Elev.
0				Brown, damp, F SAND, Some Silt, trace f. gravel	
				Light brown, damp, F SAND, Little Silt, trace f. gravel and c. sand	
2			2.3		20.1
	SW			Light brown-gray, dry, F-C SAND, Some F-C Gravel	
4	SW			Light brown-gray, dry, F-M SAND; cm-scale laminae	
6	SW			Brown, damp, F-M SAND, trace f. gravel	
8	SW			Light brown-gray, damp, F-M SAND, Some F-C Gravel	
	SW			Light brown-gray, wet, F-C SAND, trace f. gravel	
10	SW			Olive-gray, wet, F-C SAND, Little F Gravel, trace silt	
	SW		11.5	Orange-brown, damp, F-C SAND, Little Silt	10.9

WELL DIAGRAM

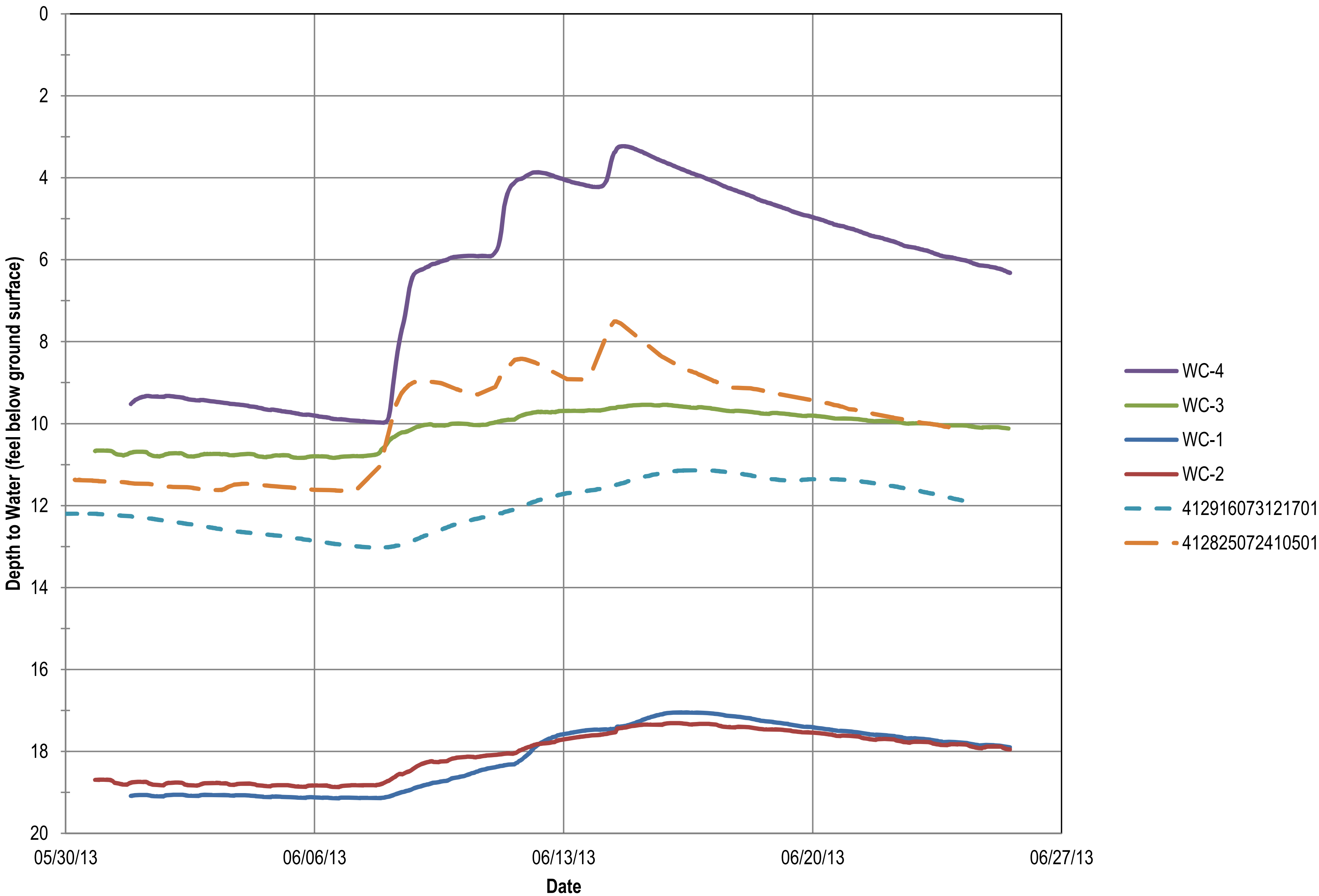


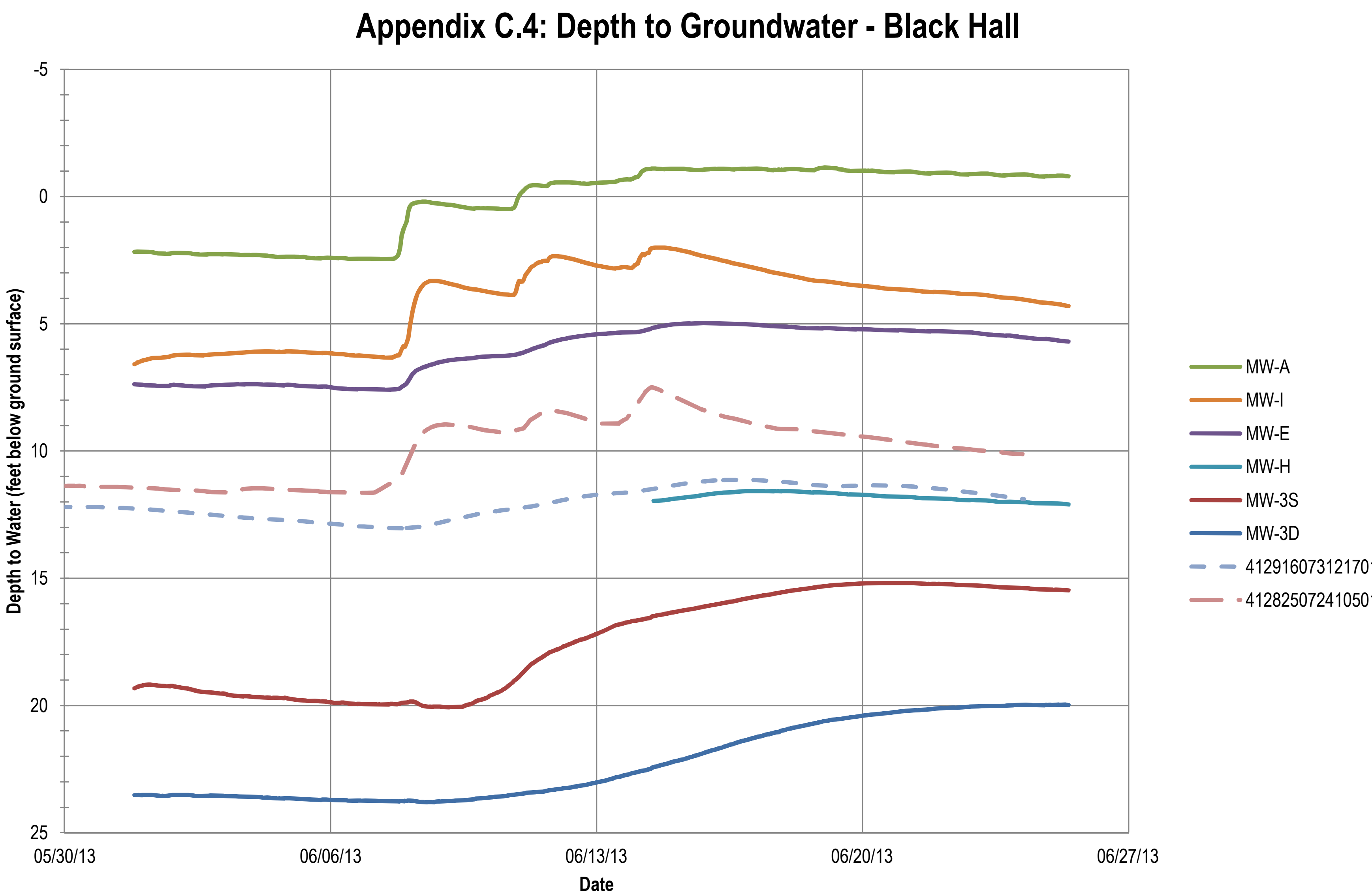
Refusal at 11.5 feet.
Bottom of borehole at 11.5 feet.

Appendix C.2: Depth to Groundwater - USGS Sentinel Wells



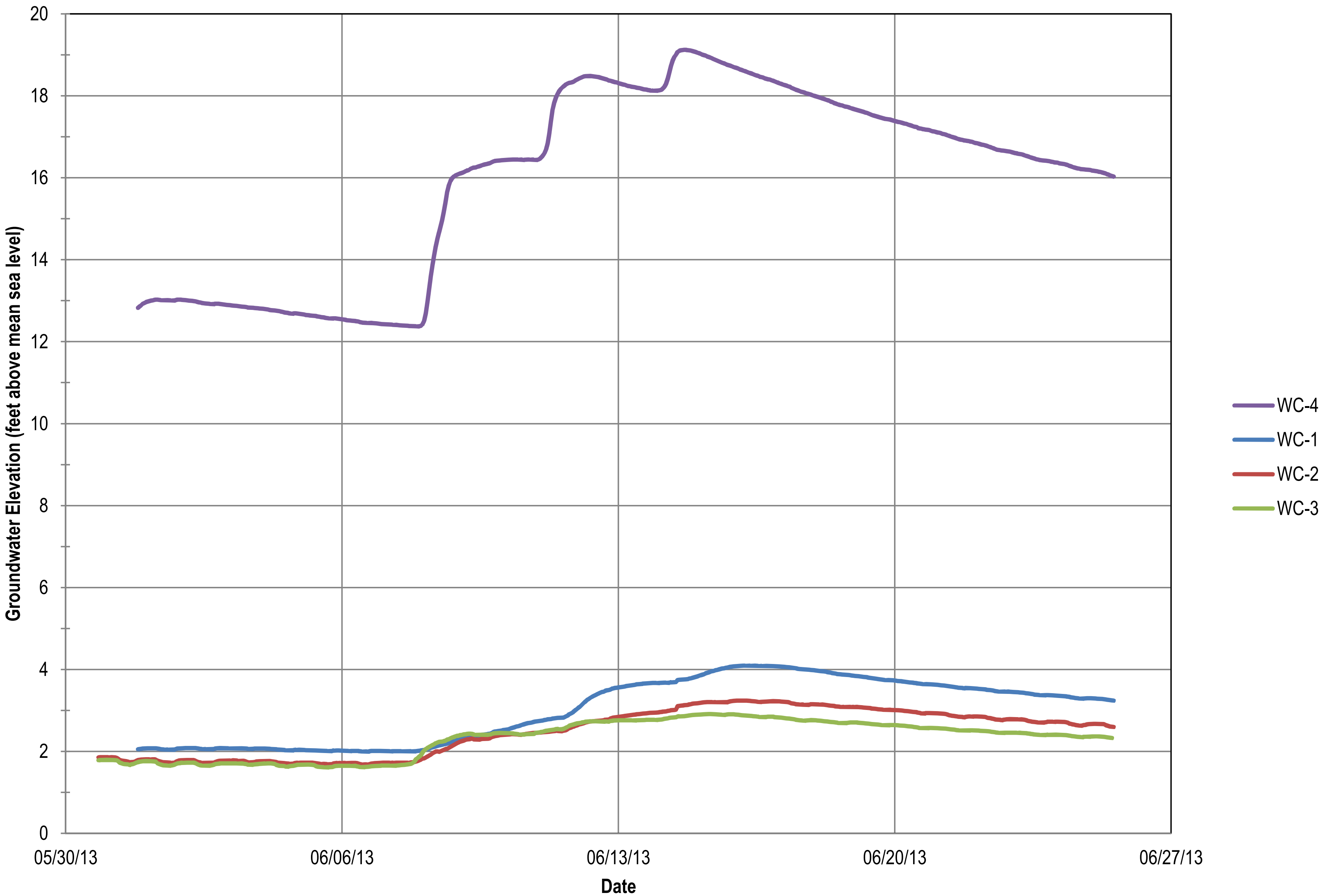
Appendix C.3: Depth to Groundwater - Cherrystone



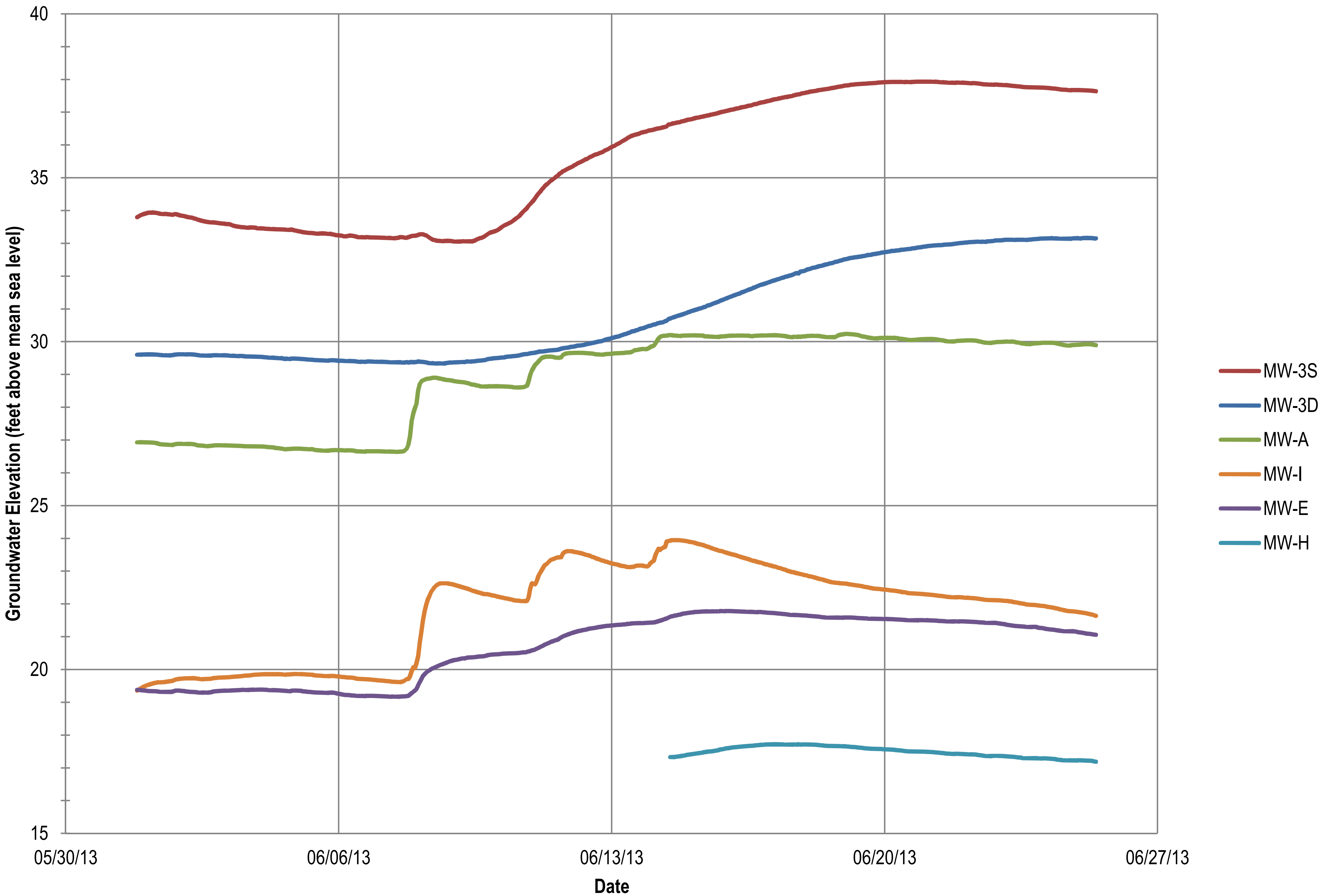


Appendix C.4: Depth to Groundwater - Black Hall
Depth to Water (feet below ground surface)
-5
0
5
10
15
20
25
05/30/13
06/06/13
06/13/13
06/20/13
06/27/13
Date
MW-A
MW-I
MW-E
MW-H
MW-3S
MW-3D
412916073121701
412825072410501

Appendix C.5: Groundwater Elevations - Cherrystone



Appendix C.6: Groundwater Elevations - Black Hall



APPENDIX C.7
CHERRYSTONE FACILITY - 1.67 AC.

Saturated Thickness = 20 feet	
Simulation 1: R = 1.2 gallons/ft^2/day	
	Mound (ft)
K = 100 ft/day	2.8
K = 150 ft/day	2.0
K = 200 ft/day	1.6
Total Flow = 87,600 gal/day	
Simulation 2: R = 2.0 gallons/ft^2/day	
	Mound (ft)
K = 100 ft/day	4.6
K = 150 ft/day	3.3
K = 200 ft/day	2.6
Total Flow = 146,000 gal/day	
Simulation 3: R = 3.0 gallons/ft^2/day	
	Mound (ft)
K = 100 ft/day	6.5
K = 150 ft/day	4.8
K = 200 ft/day	3.8
Total Flow = 219,000 gal/day	

NOTES:
K = Horizontal hydraulic conductivity
vertical conductivity is 1/10 of horizontal K
R = Infiltration rate
Mound heights are maximum, at center of facility

APPENDIX C.8
CHERRYSTONE FACILITY - 3.52 AC.

Saturated Thickness = 20 feet	
Simulation 1: R = 1.2 gallons/ft^2/day	
	Mound (ft)
K = 100 ft/day	5.1
K = 150 ft/day	3.8
K = 200 ft/day	3.0
Total Flow = 190,000 gal/day	
Simulation 2: R = 2.0 gallons/ft^2/day	
	Mound (ft)
K = 100 ft/day	8.2
K = 150 ft/day	6.1
K = 200 ft/day	4.9
Total Flow = 316,000 gal/day	

Saturated Thickness = 15 feet	
Simulation 1: R = 1.2 gallons/ft^2/day	
	Mound (ft)
K = 100 ft/day	6.2
K = 150 ft/day	4.6
K = 200 ft/day	3.7
Total Flow = 190,000 gal/day	
Simulation 2: R = 2.0 gallons/ft^2/day	
	Mound (ft)
K = 100 ft/day	9.6
K = 150 ft/day	7.3
K = 200 ft/day	5.9
Total Flow = 316,000 gal/day	

NOTES:

K = Horizontal hydraulic conductivity; vertical conductivity taken as 1/10 of horizontal

R = Infiltration rate

Mound heights are maximum, at center of facility

Highlighted cells indicate mounds exceeding eight feet