



Coastal Wastewater Management Plan

1699 King Street, Suite 406
Enfield, CT 06082
855.347.6788

woodardcurran.com
COMMITMENT & INTEGRITY DRIVE RESULTS

226617.01
Town of Old Lyme,
Connecticut
December 19, 2014

TABLE OF CONTENTS

| SECTION | PAGE NO. |
|---|--------------|
| ACKNOWLEDGMENTS | ACK-1 |
| EXECUTIVE SUMMARY | ES-1 |
| 1. INTRODUCTION | 1-1 |
| 1.1 Study Area..... | 1-1 |
| 1.2 Past Wastewater Planning In Study Area..... | 1-1 |
| 1.2.1 Point-O-Woods Sewer System..... | 1-1 |
| 1.2.2 Old Colony Beach Club Association and Old Lyme Shores Beach Club Association..... | 1-1 |
| 1.2.3 Town’s 2012 Preliminary Study..... | 1-3 |
| 1.2.4 Miami Beach Wastewater Facilities Plan..... | 1-3 |
| 1.2.5 Summary..... | 1-3 |
| 1.3 Current Regulatory Framework..... | 1-3 |
| 1.3.1 Long Island Sound Nitrogen..... | 1-3 |
| 1.3.2 Consent Orders..... | 1-3 |
| 1.3.3 Local Septic Regulations..... | 1-4 |
| 1.4 Project Goals..... | 1-4 |
| 1.5 Scope of Work..... | 1-4 |
| 2. WASTEWATER MANAGEMENT NEEDS ANALYSIS..... | 2-1 |
| 2.1 Study Sub-Areas..... | 2-1 |
| 2.2 First Stage Analytical Approach - Common Criteria Impacting On-Site Systems..... | 2-3 |
| 2.3 Summary of Study Area Common Wastewater Management Needs..... | 2-7 |
| 2.4 Second Stage Analytical Approach - Additional Qualitative Criteria..... | 2-8 |
| 2.5 Balancing Wastewater Management Needs and Costs..... | 2-12 |
| 2.6 Proposed Project Area..... | 2-13 |
| 2.7 Consistency with State Plan of Conservation and Development..... | 2-14 |
| 2.8 Impacts Associated with Hurricane Irene and Storm Sandy..... | 2-15 |
| 3. CURRENT AND FUTURE FLOW PROJECTIONS | 3-1 |
| 3.1 Assumptions for Flow Calculations..... | 3-1 |
| 3.2 Flow Projections..... | 3-1 |
| 3.3 Seasonal Flow Variations..... | 3-6 |
| 4. OVERVIEW OF LOCAL AND REGIONAL ALTERNATIVES | 4-1 |
| 4.1 Overview..... | 4-1 |
| 4.2 Wastewater Management Systems Overview..... | 4-1 |
| 4.3 Local Alternatives..... | 4-1 |
| 4.3.1 Local Alternative 1 with Subsurface Disposal and Reuse..... | 4-1 |
| 4.3.2 Local Alternative 2 with Surface Disposal to the Connecticut River..... | 4-1 |
| 4.4 Regional Alternative..... | 4-2 |
| 5. COLLECTION AND TRANSMISSION SYSTEM ALTERNATIVES..... | 5-1 |
| 5.1 Overview..... | 5-1 |
| 5.2 Collection System Terminology..... | 5-1 |

| | | |
|-----------|--|------------|
| 5.2.1 | Gravity Sewer..... | 5-1 |
| 5.2.2 | Low Pressure Sewer..... | 5-1 |
| 5.2.3 | Septic Tank Effluent Gravity Sewer | 5-2 |
| 5.2.4 | Septic Tank Effluent Pump Sewer | 5-3 |
| 5.2.5 | Vacuum Sewer..... | 5-3 |
| 5.3 | Collection System Alternative in Project Area | 5-4 |
| 5.3.1 | Gravity Alternative | 5-5 |
| 5.3.2 | Low Pressure System Alternative | 5-5 |
| 5.3.3 | Septic Tank Effluent Gravity Alternative | 5-5 |
| 5.3.4 | Septic Tank Effluent Pump Alternative | 5-5 |
| 5.3.5 | Vacuum Alternative..... | 5-6 |
| 5.4 | Transmission System Infrastructure | 5-6 |
| 5.4.1 | Local Alternative Transmission System..... | 5-6 |
| 5.4.2 | Regional Alternative Transmission System..... | 5-6 |
| 5.4.3 | Odor Control Measures For the Transmission System..... | 5-6 |
| 5.5 | Annual O&M Costs | 5-7 |
| 5.6 | Regional Alternative Sewer System Configurations..... | 5-7 |
| 5.6.1 | Downstream Sewers in East Lyme and Waterford..... | 5-8 |
| 5.7 | Cost Comparison..... | 5-20 |
| 6. | TREATMENT ALTERNATIVES | 6-1 |
| 6.1 | Introduction..... | 6-1 |
| 6.2 | Overview of Local Treatment Alternatives | 6-1 |
| 6.2.1 | Treatment Configurations | 6-1 |
| 6.2.2 | Local WPCF..... | 6-1 |
| 6.2.2.1 | SBR WPCF | 6-3 |
| 6.2.2.2 | MBR WPCF..... | 6-3 |
| 6.2.3 | Local WPCF Recommendations..... | 6-4 |
| 6.2.3.1 | Collection System Impacts on Treatment System and Costs | 6-4 |
| 6.3 | Regional Treatment Alternative | 6-5 |
| 6.4 | Cost Comparison..... | 6-6 |
| 7. | DISPOSAL AND REUSE ALTERNATIVES..... | 7-1 |
| 7.1 | Local Alternative 1 with Subsurface Diposal and Reuse | 7-1 |
| 7.1.1 | Local Subsurface Investigations | 7-1 |
| 7.1.1.1 | Test Pitting – Cherrystone..... | 7-4 |
| 7.1.1.2 | Soil Borings and Groundwater Wells – Cherrystone and Black Hall..... | 7-4 |
| 7.1.1.3 | Seasonal High Water Table – Black Hall and Cherrystone | 7-5 |
| 7.1.1.4 | Aquifer Testing – Black Hall and Cherrystone | 7-6 |
| 7.1.1.5 | Monitoring Well Survey and Groundwater Flow..... | 7-6 |
| 7.1.1.6 | Delineation of Facility | 7-7 |
| 7.1.1.7 | Groundwater Model – Cherrystone | 7-8 |
| 7.1.2 | Summary of Local Alternative 1 – Subsurface Disposal and Reuse | 7-8 |
| 7.1.2.1 | Sub-Surface Disposal at the Cherrystone Site | 7-8 |
| 7.1.2.2 | Reuse at the Black Hall Site | 7-10 |
| 7.1.2.3 | Sub-Surface Disposal at Black Hall Site | 7-11 |
| 7.1.3 | Local Alternative 1 – Subsurface Disposal & Reuse Costs | 7-11 |

| | | |
|-----------|--|------------|
| 7.2 | Local Alternative 2 with Surface Disposal to Connecticut River | 7-13 |
| 7.2.1 | Disposal Costs | 7-14 |
| 7.3 | Anticipated Permits..... | 7-15 |
| 7.3.1 | Groundwater Discharge Permitting | 7-15 |
| 7.3.2 | Surface Water Discharge Permitting | 7-15 |
| 7.3.3 | Wastewater Reuse Permitting..... | 7-16 |
| 8. | COMPARISON OF ALTERNATIVES AND RECOMMENDATIONS | 8-1 |
| 8.1 | Introduction..... | 8-1 |
| 8.2 | Comparison of Alternatives..... | 8-1 |
| 8.2.1 | Capital Costs for Project Area | 8-1 |
| 8.2.2 | Annual Operation & Maintenance Costs for Project Area | 8-2 |
| 8.2.3 | Regional Alternative for Project Area | 8-2 |
| 8.2.4 | Capital Cost Sharing and Financing for Project Area | 8-2 |
| 8.2.5 | Other Considerations | 8-3 |
| 8.3 | Plan development and Public Review Process | 8-4 |
| 8.4 | Recommended Plan | 8-4 |
| 8.4.1 | Proposed Project Area | 8-4 |
| 8.4.2 | Proposed Alternative..... | 8-5 |
| 8.4.3 | Coordination with Other Beach Communities..... | 8-5 |
| 8.4.4 | Capital Cost Allocation for Project Area..... | 8-5 |
| 8.5 | Implementation Plan | 8-5 |
| 8.5.1 | Management Planning with the Beach Communities | 8-6 |
| 8.5.2 | Funding/Finance Considerations | 8-6 |
| 8.5.3 | Public Outreach & Participation..... | 8-6 |
| 8.5.3.1 | Response to CEPA Scoping Notice | 8-6 |
| 8.5.4 | Schedule to Complete the Program | 8-8 |

LIST OF TABLES

| TABLE | PAGE NO. |
|-------------|---|
| Table ES-1: | High Needs Sub-Areas..... ES-1-2 |
| Table ES-2: | Anticipated Costs for Local and Regional Alternatives for Project Area |
| Table 2-1: | Density of Development by Sub-Area |
| Table 2-2: | Nitrogen Attenuation..... |
| Table 2-3: | Initial Study Area Needs Ranking..... |
| Table 2-4: | Selected Subsurface Sewage Disposal System Setbacks Based on CT-DPH Standards |
| Table 2-5: | Comparison of Additional Data for Selected Sub-Areas ¹ |
| Table 2-6: | Nitrogen and Bacterial Limits Number of Exceedances ¹ |
| Table 2-7: | Marine Bacterial Counts |
| Table 2-8: | Final Needs Prioritization by Sub-Area..... |
| Table 2-9: | Project Area Sub-Areas..... |
| Table 2-10: | Project Applicability to OPM Growth Management Principles |
| Table 3-1: | Summary of Gravity and STEG Projections for Project Area |
| Table 3-2: | Summary of LPS and STEP Projections for High Needs Sub-Areas..... |
| Table 5-1: | Capital Costs for Gravity Sewer Alternative – Collector Sewer |
| Table 5-2: | Capital Costs for Low Pressure Sewer Alternative – Collector Sewer..... |
| Table 5-3: | Capital Costs for STEG Sewer Alternative – Collector Sewer..... |

| | | |
|-------------|---|------|
| Table 5-4: | Capital Costs for STEP Sewer Alternative – Collector Sewer | 5-12 |
| Table 5-5: | Capital Costs for Local Alternative Gravity/STEG Transmission System | 5-13 |
| Table 5-6: | Capital Costs for Local Alternative LPS/STEP Transmission System | 5-14 |
| Table 5-7: | Capital Costs for Regional Alternative Gravity/STEG Transmission System..... | 5-15 |
| Table 5-8: | Capital Costs for Regional Alternative LPS/STEP Transmission System..... | 5-16 |
| Table 5-9: | Annual O&M Costs for Collection System | 5-17 |
| Table 5-10: | Downstream Pump Station Capacities (Regional Alternative)..... | 5-18 |
| Table 5-11: | Estimated Downstream Capital Needs (Regional Alternative) | 5-19 |
| Table 5-12: | Wastewater Service Area Capital Collection Costs | 5-21 |
| Table 5-13: | Total Capital and Annual Collection Costs | 5-21 |
| Table 6-1: | Summary of Local Treatment Costs for Different Collection System Options | 6-5 |
| Table 6-2: | Regional Treatment Capital Cost Summary | 6-6 |
| Table 6-3: | Annual O&M Costs for Treatment System..... | 6-7 |
| Table 6-4: | Treatment Cost Summary | 6-7 |
| Table 7-1: | Primary Subsurface Disposal Costs | 7-12 |
| Table 7-2: | Reuse Costs..... | 7-12 |
| Table 7-3: | Secondary Subsurface Disposal Costs | 7-13 |
| Table 7-4: | Local Alternative 1 – Subsurface Disposal and Reuse Cost Summary | 7-13 |
| Table 7-5: | Local Alternative 2 – Surface Water Discharge to CT River - Disposal Cost Summary | 7-14 |
| Table 7-6: | Current Wastewater Reuse Permitting Options in Connecticut | 7-17 |
| Table 8-1: | Summary of Advantages & Limitations of Alternatives Proposed..... | 8-1 |
| Table 8-2: | Total Capital and Annual O&M Costs for Project Area | 8-2 |
| Table 8-3: | Summary of Gravity Flow Projections for Project Area..... | 8-8 |
| Table 8-4: | Project Area Cost Sharing Concept for Regional Alternative – Anticipated Capital and Equivalent Uniform Annual Costs (EUAC) | 8-9 |

LIST OF FIGURES

| FIGURE | PAGE NO. | |
|--------------|--|--------|
| Figure ES-1: | Study Sub-Areas | ES-1-5 |
| Figure ES-2: | Proposed Project Area | ES-1-6 |
| Figure ES-3: | Summary of Anticipated Total Capital Cost Sharing (2017 Costs) Regional Alternative - Project Area | ES-1-7 |
| Figure 1-1: | Study Area..... | 1-2 |
| Figure 2-1: | Study Sub-Areas | 2-2 |
| Figure 2-2: | Lot Size Distribution of Study Area | 2-6 |
| Figure 2-3: | Estimated Minimum Subsurface Disposal System Setbacks for CT-DPH Compliance..... | 2-9 |
| Figure 2-4: | Soil Drainage Classification..... | 2-16 |
| Figure 2-5: | Sea Level Rise & Coastal Flooding Impacts..... | 2-17 |
| Figure 2-6: | FEMA Flood Hazard Zones | 2-18 |
| Figure 2-7: | Water Supply Sources..... | 2-19 |
| Figure 2-8: | Wastewater Management Needs Summary | 2-20 |
| Figure 2-9: | Project Area Sub-Areas..... | 2-21 |
| Figure 3-1: | Flow Projections from Project Area Sub-Areas | 3-5 |
| Figure 3-2: | Flow Projections for Project Area (Gravity Sewer System..... | 3-6 |
| Figure 3-3: | Flow Summary – Point-O-Woods | 3-7 |
| Figure 4-1: | Summary of Framework for Wastewater Management Alternatives in Old Lyme | 4-3 |
| Figure 4-2: | Local Alternatives Diagram..... | 4-4 |
| Figure 4-3: | Regional Alternative Diagram..... | 4-5 |

| | | |
|-------------|---|------|
| Figure 4-4: | Summary of Local and Regional Alternatives..... | 4-6 |
| Figure 5-1: | Typical Gravity Sewer Service Lateral..... | 5-2 |
| Figure 5-2: | Typical Low Pressure Sewer Grinder Pump System..... | 5-2 |
| Figure 5-3: | Typical STEG/STEP Septic Tank Configuration..... | 5-3 |
| Figure 5-4: | Typical Vacuum Sewer Lateral..... | 5-4 |
| Figure 5-5: | Transmission System for Local Alternatives..... | 5-22 |
| Figure 5-6: | Transmission System for Regional Alternative..... | 5-23 |
| Figure 5-7: | Existing Sewer Infrastructure for Regional Alternative..... | 5-24 |
| Figure 6-1: | Potential Wastewater Treatment Facility Sites for Local Alternatives..... | 6-1 |
| Figure 6-2: | New London WPCF – Existing Treatment System for Regional Alternative..... | 6-8 |
| Figure 7-1: | Anticipated Year-Round Flows for High Needs Sub-Areas..... | 7-2 |
| Figure 7-2: | Potential Effluent Disposal/Reuse Parcels for Subsurface Disposal – Local Alternative 1..... | 7-3 |
| Figure 7-3: | Year Round Flows vs. Primary Subsurface Disposal..... | 7-9 |
| Figure 7-4: | Year Round Flows vs. Primary Subsurface Disposal and Black Hall Reuse for the Project Area..... | 7-10 |
| Figure 7-5: | Year – Round Disposal and Reuse for the High Needs Sub-Areas..... | 7-11 |
| Figure 7-6: | Potential Surface Water Discharge Location – Local Alternative 2..... | 7-18 |
| Figure 8-1: | Proposed Project Area..... | 8-10 |
| Figure 8-2: | Summary of Anticipated Total Capital Cost Sharing (2017 Costs) Regional Alternative..... | 8-11 |
| Figure 8-3: | Summary of Anticipated Net Capital Cost Sharing Assuming 25% Grant (2017 Costs) - Regional Alternative..... | 8-12 |
| Figure 8-4: | Summary of Anticipated Net Capital Cost Sharing per EDU Assuming 25% Grant (2017 Costs) - Regional Alternative..... | 8-13 |
| Figure 8-5: | Summary of Anticipated Net Annual Costs per EDU (2017 Costs) Regional Alternative..... | 8-14 |
| Figure 8-6: | Anticipated Net Monthly Costs per EDU (2017 Costs) vs. Typical Monthly Expenses - Regional Alternative..... | 8-15 |
| Figure 8-7: | Key Critical Path Steps for Wastewater Planning and Implementation Steps..... | 8-16 |

APPENDICES

| | |
|-------------|---|
| Appendix A: | Consent Orders |
| Appendix B: | Subsurface Investigation (Figures & Tables) |
| Appendix C: | Subsurface Investigation - Groundwater Data and Boring Logs |
| Appendix D: | Groundwater Quality Data from 2012 NLJ Report |
| Appendix E: | Marine Bacterial Count Data |
| Appendix F: | CEPA Scoping Notice & Comment Documents |

APPENDIX B

| | |
|-------------|--|
| Table B-1: | Summary of Subsurface Exploration |
| Table B-2: | Seasonal High Water Table Calculations Cherrystone |
| Table B-3: | Summary of Hydraulic Conductivity |
| Figure B-1: | Site Plan |
| Figure B-2: | Subsurface – Cherrystone |
| Figure B-3: | Subsurface – Black Hall |
| Figure B-4: | Slug Test Analysis: WC-2 |
| Figure B-5: | Groundwater – Cherrystone |
| Figure B-6: | Groundwater Black Hall |
| Figure B-7: | SAS Facility - Cherrystone |

Acknowledgments

We would like to acknowledge the following people and entities for their direct significant contributions to this project and the development of this Report.

- Town of Old Lyme
 - Board of Selectman
 - Bonnie Reemsnyder, First Selectwoman
 - Mary Jo Nosal
 - Skip Sibley
 - Sanitarian – Sonia Marino
 - Health Department – Patti Myers
 - Administrative Support – Catherine Frank
- Old Lyme WPCA
 - Kurt Zemba, Chairman
 - Andrea Lombard
 - Dimitri Tolchinski
 - Donna Bednar
 - Douglas Wilkerson
 - Ernest Lorda
 - Frank Chan
 - Robert McCarthy
 - Richard Pendergast
 - Tom Risom
 - Chris Seery, Administrative Support
- WPCA Attorney Andrew Lord
- Beach Associations
 - Old Colony Beach Club Association
 - Old Lyme Shores Beach Club Association
 - Miami Beach Association
 - Hawks Nest Beach Association
 - Sound View Beach Association
 - White Sand Beach Association
 - F&O – Kurt Mailman
- Black Hall Golf Course
- Town of East Lyme
 - Paul Formica, First Selectman
 - Brad Kargl, Town Engineer
- Town of Waterford
 - Jim Barteli, Public Works
- Tali Soto, Chief Engineer
- The Connecticut Department of Energy and Environmental Protection
 - Denise Ruzicka
 - Dennis Greci
 - Carlos Esguerra
 - George Hicks
 - Corinne Fitting
 - Mike Hart
 - Joe Wetteman
 - Ossie Inglese
 - Margot Ward

Executive Summary

BACKGROUND

Leadership within Old Lyme recognizes that the Town, the Water Pollution Control Authority (WPCA) and the public all play important roles in addressing environmental challenges within their community. The Town has proactively accepted the responsibility of developing a progressive solution to the existing wastewater management challenges along the Old Lyme coastline. This updated Coastal Wastewater Management Plan Report is a continuation and culmination of prior work that the Town and chartered beach associates have completed and serves as an important planning tool. This Report was developed through tremendous collaboration of multiple parties and presents a comprehensive wastewater solution for specific areas of Old Lyme. It also serves as a guide to navigating the implementation plan for the recommendations.

STUDY AREA

The Study Area, shown in Figure ES-1, 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 Study Area have been problematic for several decades, as a result of many combinations of factors including aging systems, poorly draining soils, soils that excessively drain with tidal movements, shallow groundwater, small lots, and excessive development density. Based upon the results of individual wastewater planning efforts by several of the chartered beach associations, it is clear that significant on-site septic system challenges and pollution problems exist in the Study Area. Past planning documents recommended that centralized solutions with off-site treatment and disposal are needed due to those documented wastewater disposal limitations.

PROJECT GOALS

In response to current on-site wastewater management limitations, recent Consent Orders, comments received from CT-DEEP in response to the Town's 2012 Preliminary Study, public input, and the desire for a common solution for the Old Lyme coastal neighborhoods, the Town of Old Lyme retained Woodard & Curran to perform detailed evaluations of local and regional wastewater management alternatives for the Study Area. This project, termed the Coastal Wastewater Management Plan, focuses on the balance of short-term and long-term wastewater management needs within the Study Area, while considering wastewater infrastructure (collection, treatment, disposal and reuse), operation and maintenance (O&M) costs, annual and lifecycle costs, as well as non-cost factors. Non-cost factors include capacity allocation, wastewater management goals, and implementation measures to support the Town's current character and desire to avoid future growth via sewer construction.

NEEDS ANALYSIS

The Study Area was divided into thirteen Sub-Areas, as shown in Figure ES-1. In order to evaluate and prioritize wastewater management needs for the thirteen Sub-Areas, a wastewater management needs analysis was conducted. Factors including lot size, soil permeability, density of development, nitrogen attenuation, coastal sea level rise, groundwater conditions, water supply and age of septic systems were used to prioritize wastewater management needs.

PROPOSED PROJECT AREA

The Sub-Areas with the greatest need for wastewater management solutions comprise the proposed High Needs Sub-Areas. Table ES-1 lists the six Sub-Areas identified as High Needs Sub-Areas, including estimated equivalent dwelling units (EDUs) and average daily flow for each Sub-Area. The High Needs Sub-Areas are also shown in Figure ES-2.

Table ES-1:High Needs Sub-Areas

| Sub-Area ID | Association or Street Name | Number of Equivalent Dwelling Units (EDU) | Average Daily Flow (GPD) |
|--------------|----------------------------|---|--------------------------|
| 5A | Miami Beach | 236 | 51,025 |
| 5B | Hawks Nest Beach | 269 | 57,299 |
| 6 | Sound View Beach | 229 | 45,493 |
| 7 | Old Colony Beach Club | 218 | 43,967 |
| 8 | Old Lyme Shores Beach | 206 | 43,625 |
| MTA B | Miscellaneous Town Area B | 41 | 9,077 |
| Total | | 1,199 | 250,487 |

ALTERNATIVES ANALYSIS

Wastewater management systems are comprised of infrastructure components that generally include collection, treatment, disposal, and sometimes reuse. Two different primary wastewater management alternatives (the Local Alternative and the Regional Alternative) were developed and evaluated as part of the Coastal Wastewater Management Plan. The primary distinction between the two alternatives is that the Regional Alternative is predicated on the use of the existing New London WPCF to treat wastewater from the Project Area Sub-Areas, and the Local Alternative relies upon the construction of a new treatment facility in Old Lyme, coupled with either local subsurface disposal and reuse, or a new surface water discharge permit for the Connecticut River.

Each wastewater management alternative was evaluated and the collection, treatment and disposal/reuse options were summarized and estimates of probable costs were developed. Table ES-2 summarizes the anticipated costs for the Local and Regional Alternatives for the Project Area.

Table ES-2:Anticipated Costs for Local and Regional Alternatives for Project Area

| System Component | Capital ¹ | | | Annual O&M | | |
|------------------|---------------------------|-------------------------------|---------------------|--|-------------------------------|------------------|
| | Local #1 - Disposal/Reuse | Local #2 - CT River Discharge | Regional | Local #1 - Disposal/Reuse ¹ | Local #2 - CT River Discharge | Regional |
| Collection | \$23,529,000 | \$23,529,000 | \$29,952,000 | \$217,000 | \$217,000 | \$336,000 |
| Treatment | \$14,500,000 | \$14,500,000 | \$5,995,000 | \$532,000 | \$532,000 | \$76,000 |
| Disposal | \$12,800,000 | \$9,457,000 | \$0 | N/A ² | N/A ² | N/A ² |
| Totals | \$50,829,000 | \$47,486,000 | \$35,947,000 | \$749,000 | \$749,000 | \$412,000 |

1. Local and Regional Costs based on gravity sewer collection systems for Project Area.

2. Annual Disposal and Reuse costs are included with Treatment O&M.

Relative to capital costs, the collection system costs for the Regional Alternative are significantly higher than those for the Local Alternatives. This is primarily because the Regional alternative includes pump station, force main and gravity sewer needs in East Lyme and Waterford that are triggered by the proposed connection. However, the anticipated treatment costs are much lower for the Regional Alternative than for the Local Alternatives, since new and costly treatment systems are not required for the Regional Alternative. Overall, the Regional Alternative is approximately \$15M less than the Local Alternatives. However, there is greater potential for major deferred capital expenses for the Regional Alternatives. For example, New London has not developed a capital plan for their WPCF, which would identify long term capital improvements for which Old Lyme would be required to contribute to in the future. The same can be said for the extent of future capital needs in East Lyme and Waterford, which would also require that Old Lyme contribute to these costs.

With regard to annual O&M costs, we estimate that the annual O&M costs for the Local Alternative are approximately \$340,000 more expensive than that for the Regional Alternative. This cost differential could change depending in the extent of external contract operations services utilized by the Town and beaches. We also note that Old Lyme has less control over future escalations in annual O&M costs with the Regional Alternative.

There were several non-cost factors that were considered by the Town in this evaluation. These include:

- Implementation of New Utility: Both the Local and Regional Alternative included the establishment of a new wastewater utility, thus presenting unique implementation challenges. Initial years for a new utility can be difficult, as connections are being made, and systems are commissioned and connections are being made.
- Control of Flow Allocations: To ensure a successful project and meet the commitment to the new sewer users, the Town of Old Lyme will need to manage the allocation of sewer flows, capital costs, and annual costs. This will require active and continued participation from the Old Lyme Water Pollution Control Authority (WPCA) and an increased understanding of the various related factors.

RECOMMENDED PLAN

Despite the slightly higher annual O&M cost projections for the Regional Alternative, as well as the anticipated deferred capital costs associated with the Regional Alternative, the Regional Alternative capital cost projection is approximately \$15M lower than the Local Alternatives for the Project area. This is predicated upon a cooperative approach between the Town and the chartered beach associations. This collaboration includes common pump station/force main sharing and sewerage across/through municipal boundaries, which facilitates the maximization of cost sharing. If the Town and the chartered beaches decided to connect to New London independently using multiple individual pump stations and force mains, the costs for the Regional Alternative would be much higher. Therefore, based on the cooperative effort, as described, and endorsed by CT-DEEP, we recommend the Regional Alternative be implemented. Figure ES-2 shows the regional alternative for the Project Area.

Woodard & Curran performed a cost analysis on the Regional Alternative to determine the net annual cost to the property owners in the Project Area for both capital cost and debt service. Figure ES-3 summarizes the anticipated project appropriations for each Sub-Area (Town managed and chartered beach areas), excluding the grant funds (25%) anticipated from CT-DEEP.

IMPLEMENTATION PLAN

There are four major elements of the Implementation Plan for the Coastal Wastewater Management Project. These include:

1. management planning with the Beach Communities,
2. funding/finance considerations,
3. continued public outreach and participation, and
4. management of the schedule to complete the program.

Management Planning With the Beach Communities

The Town of Old Lyme and the Chartered Beach Communities have made tremendous progress in positioning the Coastal Wastewater Management Project for success. The parties have realized the power of collaboration and will realize significant cost savings through the implementation of a single unified program. Going forward, the stakeholders will need to continue to work together on the design elements of the project. The team will work collaboratively throughout the Project.

Funding/Finance Considerations

The representatives of the Project Area understand that the Coastal Wastewater Management Project will be self-funded, meaning that the users of the system will pay their pro-rata share of the project costs (on an EDU basis). The project will be implemented utilizing CT-DEEP Clean Water Funds. These funds reimburse the participant with a grant for 55% of planning costs, and 25% of design and construction costs. The Town of Old Lyme (Sub-Areas 5B, 6 and MTA-B) will appropriate funds for their respective share of the program while Miami Beach (Sub-Area 5A), Old Colony Beach (Sub-Area 7) and Old Lyme Shores (Sub-Area 8) have each already appropriated their respective shares.

Public Outreach & Participation

Public outreach and participation to date has been a key focus of the Town, the Old Lyme WPCA, and the chartered beaches. For example, the Town has had more than 30 public meetings and informational sessions on the project to date. Public input has already had a positive impact in shaping the recommended plan.

The Town and WPCA are committed to continuing to provide education and outreach opportunities as the Project is implemented. The current schedule of public outreach includes (but will not be limited to):

- Public Informational Meeting – Winter/Spring 2015
- Town Meeting/Referendum – Spring/Summer 2015
- Design Public Meeting – Summer/Fall 2015
- Construction Public Meeting – Spring/Summer 2016
- Public Ribbon Cutting – Summer 2019

Schedule to Complete the Program

Old Colony Beach Club and Old Lyme Shores Beach (Sub-Areas 7 and 8) have outstanding Consent Orders requiring completion of construction by June 30, 2016. While we believe that the Town's Regional Alternative can be implemented concurrently with the Beach Association projects, there will need to be an adjustment by CT-DEEP to the current Consent Order schedules.

We propose the following schedule milestones:

- Town Meeting (appropriation of project funds) – Spring/Summer 2015
- Design – Spring/Summer 2015 thru Spring 2016
- Construction – Spring/Summer 2016 thru Winter 2018
- Commissioning, start-up and integration – Winter 2018 thru Summer/Fall 2019

Legend

Sub-Areas

- 1 - Griswold Point & Osprey Road
- 2 - White Sand Beach
- 3 - Haywagon Drive
- 4 - Dogwood Drive
- 5A - Miami Beach
- 5B - Hawks Nest Beach
- 6 - Sound View Beach
- 7 - Old Colony Beach Club
- 8 - Old Lyme Shores Beach
- 9 - Edge Lea & Cutler Road
- 10 - Hatchet Point Road
- Miscellaneous Town Areas A/B



Town of Old Lyme, CT

Study Sub-Areas

FIGURE ES-1

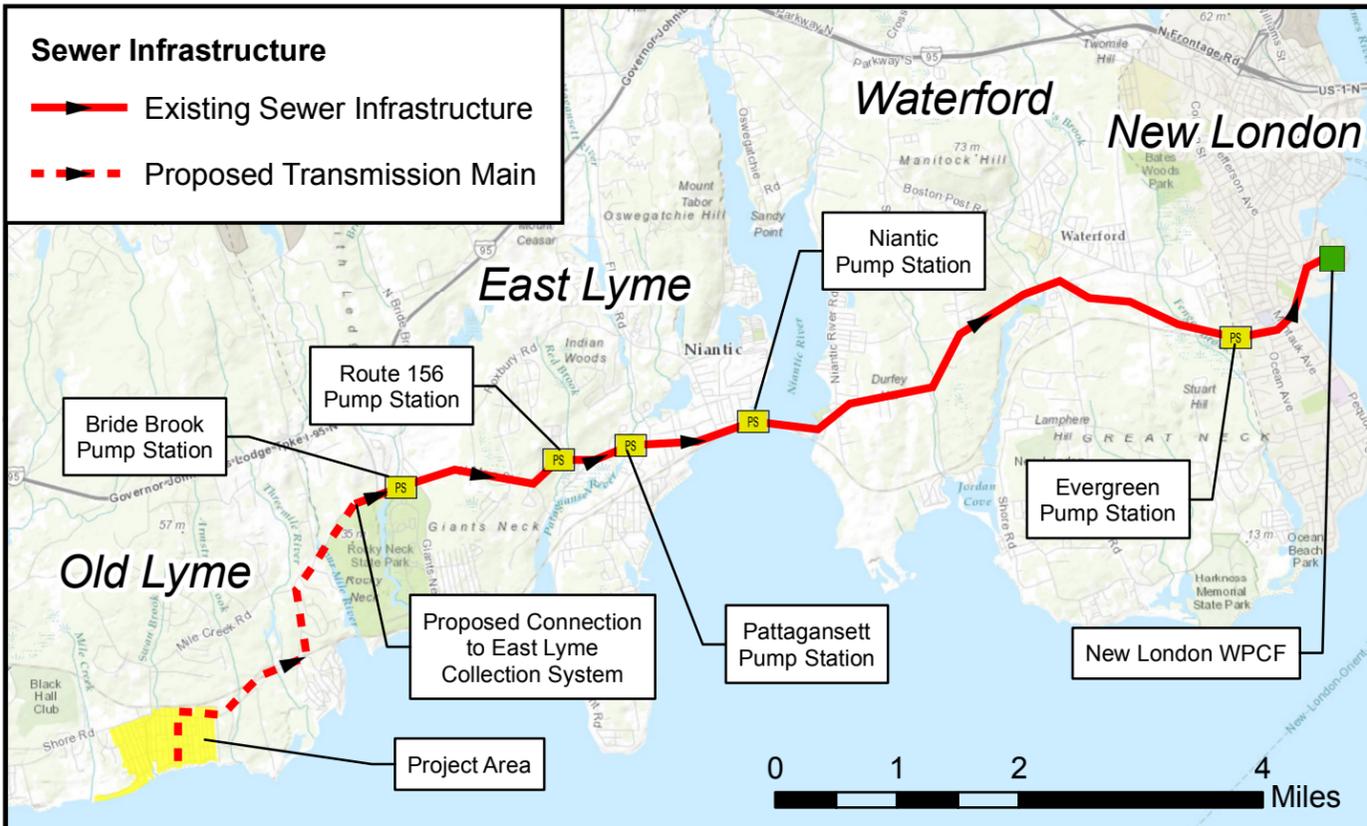
SCALE: 1 in = 1,000 ft DRAWN BY: ACB

DATE: December 18, 2014 JOB NO.: 226617

DOC: 2014-11-18_Fig_2-1_Project_Sub_Areas.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
 Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors



Legend

| | |
|---------------------|---------------------------|
| Pump Station | Sub-Areas |
| Transmission Main | 5A - Miami Beach |
| Gravity Sewer Pipes | 5B - Hawks Nest Beach |
| Sewer Service Area | 6 - Sound View Beach |
| Parcels | 7 - Old Colony Beach Club |
| | 8 - Old Lyme Shores Beach |
| | Miscellaneous Town Area B |

Town of Old Lyme, CT

Proposed Project Area - Regional Alternative

FIGURE ES-2

SCALE: 1 in = 600 ft

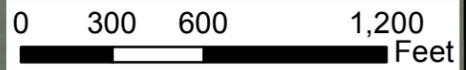
DATE: December 18, 2014

DRAWN BY: ACB

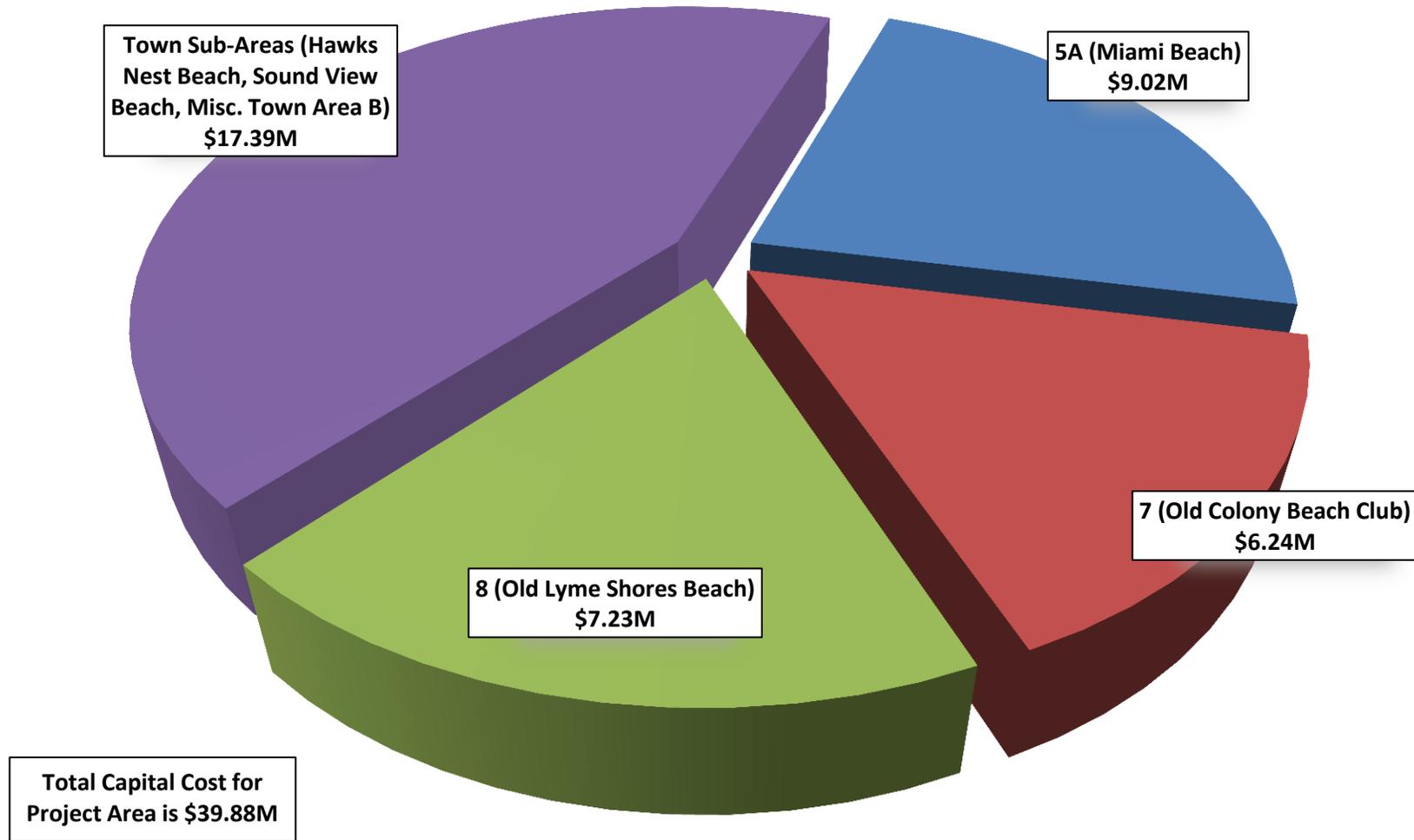
JOB NO.: 226617

DOC: 2014-11-18_Fig_8-1_Recommended_Alt.mxd

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, ©



**Figure ES-3: Summary of Anticipated Total Capital Cost Sharing
(2017 Costs) Regional Alternative - Project Area**



1. INTRODUCTION

This section of the Report provides an overview of the Study Area, a summary of past wastewater management studies, an outline of the Project goals, and an overview of the scope of work to facilitate a recommended plan to achieve the Town's wastewater management goals.

1.1 STUDY AREA



Old Colony Beach Club Association (Sub-Area 7)

The Study Area is shown in Figure 1-1, and comprises the currently unsewered neighborhoods and chartered beach associations south of and along Route 156, between the previously sewered Point-O-Woods neighborhood to the east, and the Griswold Point neighborhood to the west.

1.2 PAST WASTEWATER PLANNING IN STUDY AREA

On-site wastewater systems in the Study Area have been problematic for several decades, due to the combination of aging systems, poor soils, shallow groundwater, small lots and density of development. Since many of the neighborhoods in the Study Area consist of chartered beach

associations with Water Pollution Control Authorities (WPCAs) independent of the Town, there have been other prior efforts to evaluate on-site wastewater management challenges and alternative solutions. Due to the difficult on-site wastewater management conditions, some of these chartered beach associations 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 Study Area follows.

1.2.1 Point-O-Woods Sewer System

Approximately ten years ago, the Point-O-Woods neighborhood became the first chartered beach associations in Old Lyme to construct sewer infrastructure. Centralized wastewater infrastructure was installed to alleviate poor on-site septic systems, driven primarily by shallow ledge, high groundwater 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 pump station and force main were not sized to accommodate future sewer needs to the west. The Point-O-Woods community is located east of the Study Area and is depicted on Figure 1-1.

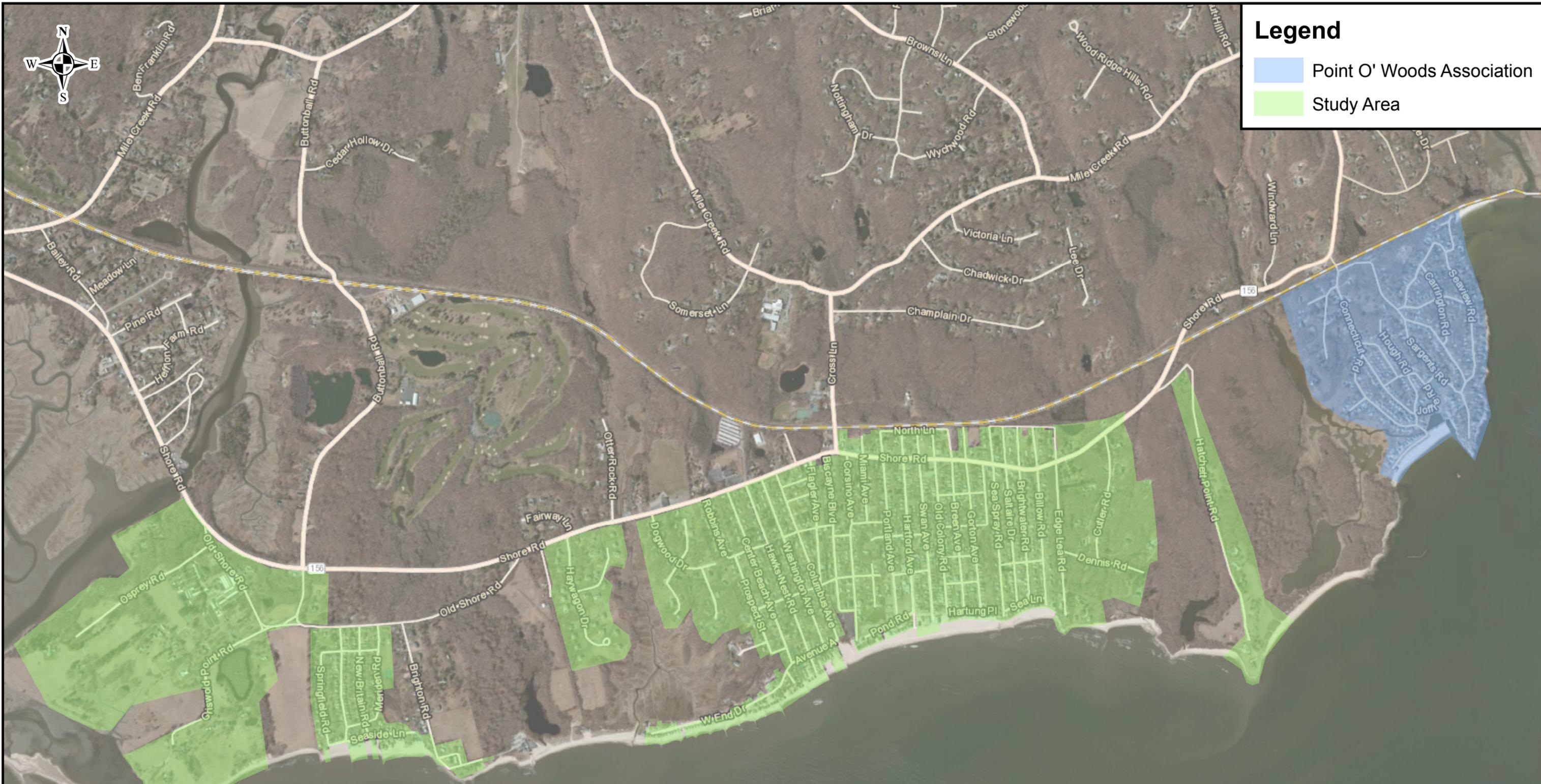
1.2.2 Old Colony Beach Club Association and Old Lyme Shores Beach Club Association

Wastewater facilities plans were prepared for both the Old Colony Beach Club Association (OCBCA) and the Old Lyme Shores Beach Association (OLSBA) in 2011. The wastewater facilities plans were prepared by RFP Engineering and Fuss & O'Neill 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 Water Pollution Control Facility (WPCF), were recommended. In 2012, Fuss & O'Neill issued an addendum that consolidated the recommendations of both the OCBCA and OLSBA Facilities Plans, and recommended a joint collection system to convey sewers to the East Lyme collection system for treatment at the New London WPCF.



Legend

- Point O' Woods Association
- Study Area

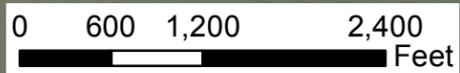


Long Island Sound

Town of Old Lyme, CT

Study Area

FIGURE 1-1



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
 Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

SCALE: 1 in = 1,200 ft

DRAWN BY: ACB

DATE: December 15, 2014

JOB NO.: 226617

DOC: 2014-11-18_Fig_1-1_Project_Study_Area.mxd

1.2.3 Town's 2012 Preliminary Study

Lombardo Associates, Inc. (LAI) was retained to perform a preliminary assessment of possible wastewater management alternatives for portions of the Study Area. In their October 12, 2012 Report, LAI summarized two alternatives: (1) installation of a collection system within OCBCA and OLSBA and conveyance of wastewater to the New London WPCF for treatment and disposal; and (2) on-site collection and local treatment/disposal. The second alternative was sub-divided into: (A) nearby off-site sub-surface disposal and/or reuse; (B) treatment and disposal within the Beach Association confines; and (C) treatment through multiple cluster systems. The LAI report concluded that the second alternative would be less costly, and recommended further evaluation of the local alternatives.

1.2.4 Miami Beach Wastewater Facilities Plan

In 2013, the Connecticut Department of Energy and Environmental Protection (CT-DEEP) approved a Plan of Study for a Wastewater Facilities Plan for the Miami Beach community. Fuss & O'Neill completed the Draft Report in December 2013, which recommended that Miami Beach connect to the Regional system in conjunction with OLSBCA and OCBCA.

1.2.5 Summary

Based on the results of the individual wastewater planning efforts in three of the chartered beach associations, it is clear that on-site septic system challenges exist in the Study Area. The CT-DEEP reviewed and approved the facilities plans, which recommended that more centralized treatment and disposal systems are needed due to the on-site wastewater management limitations. As a result of these independent efforts, the Town is proactively evaluating wastewater management alternatives that more holistically address wastewater management solutions that address the overall needs of the coastal community and the interests of all Town residents for short-term and long-term needs to: (1) mitigate the potential for overly redundant solutions for individual undersized infrastructure; (2) avoid secondary growth; and (3) address the needs of the Town-managed neighborhoods in the Study Area.

1.3 CURRENT REGULATORY FRAMEWORK

In addition to the past planning documents, there are several regulatory considerations that affect the framework of wastewater management needs in the 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 OLSBA, they subsequently issued Consent Orders to the OCBCA and the OLSBA on August 14, 2012 and October 1, 2012, respectively. The Consent Orders require completion of bidding documents within 850 days of the Orders (October 30, 2014). As shown on Appendix A, the Consent Orders also require that by June 30, 2016, on-site disposal system challenges will be alleviated by reviewing alternatives and complying with appropriate regulatory wastewater standards. CT-DEEP has not yet issued a consent order for Miami Beach.

1.3.3 Local Septic Regulations

The Town, through its Sanitarian, continues to maintain records for on-site systems throughout the Town, including the Project Area. In general, small lot size, poor soils and shallow groundwater necessitate that the Town to employ best-management practices for septic system upgrades at existing developed parcels. In some cases, substandard systems are repaired by optimizing the space available, but may not fully meet the requirements of the Public Health Code due to site constraints, nor meet the State's maximum density guidelines for excessive development contributing to nutrient pollution (i.e. nitrogen). These limitations were extensively documented in the Facilities Plans for aforementioned chartered beach associations, and are also summarized for the Town-managed portions of the Study Area in this Report.

1.4 PROJECT GOALS

In response to current on-site wastewater management limitations, recent Consent Orders, and the desire for a solution for the Study Area, the Town of Old Lyme selected Woodard & Curran to perform more detailed evaluations of local and regional wastewater management alternatives for the Study Area. This project, termed the Coastal Wastewater Management Plan, focused on a more comprehensive analysis of short-term and long-term wastewater management needs within the 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 supporting the Town's character and growth management goals, 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 Project objectives, and maintain the intent of the Consent Orders and their respective schedules for the chartered beach associations, the following scope of work was developed:

- Task 1 – Grant Funding & Finance Assistance: Included securing a Clean Water Fund (CWF) grant from CT-DEEP for the planning phase work, as well as evaluating project funding and financing options once the recommended plan is finalized.
- Task 2 – Project Initiation and Key Meetings: Included meetings with the Wastewater Task Force, WPCA, and Selectmen, as well as dozens of Public Meetings to review observations, alternatives and recommendations, and incorporate public comment in the preparation of the Report.
- Task 3 – Evaluation of Sub Surface Disposal and Reuse Alternatives: Emphasized 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 resulted in a primary basis of design for use of these sites for disposal and reuse opportunities associated with the local alternative.
- Task 4 – Prioritization of Wastewater Needs in Project Areas: Included a wastewater needs analysis for the thirteen (13) Sub-Areas, including an estimation of current and future sanitary flows. The prioritization of the needs analysis was used to develop the proposed wastewater management service area for the highest-need Sub-Areas.
- Task 5 – Evaluation of Wastewater Treatment Alternatives: Included 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: Included an evaluation of wastewater collection (i.e. sewer) alternatives for the local and regional alternatives, including the impacts of collection system flows relative to 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: Included an evaluation of the regional alternative, including meetings with East Lyme, Waterford and New London to estimate capital/O&M cost needs, and to facilitate comparison with the local alternative.
- Task 8 – Development of Recommended Plan and Implementation Schedule: Included 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 Project Report

The original scope of work was incorporated into our Draft Report of December 2013. In April 2014, the Town received review comments from CT-DEEP. The Town and Woodard & Curran met with CT-DEEP in May 2014 to review the comments, suggestions and requests for changes to the alternatives analysis and the recommended plan. In July 2014, CT-DEEP approved an Amendment to the Scope of Services for the Coastal Wastewater Management Plan, which facilitated additional evaluation of local and regional wastewater management alternatives, serving to facilitate preparation of the updated Draft Report of October 2014. Following their review of the October 2014 Report, CT-DEEP provided additional review comments in November 2014, which served as the basis for the updates that are incorporated in this Final Report, of December 2014.

2. WASTEWATER MANAGEMENT NEEDS ANALYSIS

This section includes an overview of how the Study Area was bifurcated into smaller sections, termed Sub-Areas, to facilitate an evaluation of the long-term suitability of onsite subsurface disposal systems, as well as an analysis of the need for alternative wastewater management solutions to mitigate on-site limitations, including pollution concerns. 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 STUDY SUB-AREAS

The Study Area shown in Figure 2-1 is comprised of thirteen Sub-Areas along Long Island Sound. Each of the thirteen 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 sewerer 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 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, and is densely developed up to the shoreline with homes on the beachfront.
- Sub-Area 3: Includes Haywagon Drive 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 is off of Dogwood Drive.
- Sub-Area 5A: Includes the Miami Beach Association. This chartered beach association is densely populated to the coastline.
- Sub-Area 5B: Includes the Town-managed Hawks Nest Beach Association. This area is densely populated up to the coastline with a strip of homes along the beach on West End Drive.
- Sub-Area 6: Includes Sound View Beach, and is densely populated EDUs up to the coastline. Residential as well as non-residential buildings along Route 156 and Hartford Avenue are included in this total.
- Sub-Area 7: Includes Old Colony Beach Club Association (OCBCA). This chartered beach association is densely populated, stretching from 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 (OLSBA). Similar to Sub-Area 7, this chartered beach association starts just north 156 and stretches down to the coast line. 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, 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
- 5A - Miami Beach
- 5B - Hawks Nest Beach
- 6 - Sound View Beach
- 7 - Old Colony Beach Club
- 8 - Old Lyme Shores Beach
- 9 - Edge Lea & Cutler Road
- 10 - Hatchet Point Road
- Miscellaneous Town Areas A/B



Town of Old Lyme, CT

Study Sub-Areas

FIGURE 2-1

| | |
|---|-----------------|
| SCALE: 1 in = 1,000 ft | DRAWN BY: ACB |
| DATE: November 20, 2014 | JOB NO.: 226617 |
| DOC: 2014-11-18_Fig_2-1_Project_Sub_Areas.mxd | |



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
 Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

- Sub-Area 10: Includes Hatchet Point Road. This sparsely developed Sub-Area is a narrow stretch of land from 156 to the coastline surrounded by woodland areas to the north, east, and west and coastline to the south. Sub-Area 10 is the furthest Sub-Area to the east in the Study Area.
- Miscellaneous Town Area A: This sub-area is adjacent to Sub-Area 2 and consists of Griswold Avenue, Brighton Road and Seaside Lane.
- Miscellaneous Town Area B: This sub-area is located north of Route 156 bordering Sub-Areas 5A, 6, 7 and 8, with some residential and non-residential developments.

2.2 FIRST STAGE ANALYTICAL APPROACH - COMMON CRITERIA IMPACTING ON-SITE SYSTEMS

All of the existing development in the Study Area is currently served by on-site subsurface disposal systems. Previously approved planning reports for Sub-Areas 7¹ and 8² 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. Examples of some challenges in the Study Area are depicted in Photos 1 and 2.



Photo 1: Example of small lot size



Photo 2: Example of close spacing between homes

In their January 13, 2000 letter, the Connecticut Department of Public Health (CTDPH) summarized their concern for groundwater pollution in densely developed residential areas, specifically focusing on nitrogen pollution. In the letter, soils with adequate hydraulic capacity are described by CTDPH as still being at risk for groundwater pollution from nitrogen or microorganisms in high-density developments. The CTDPH technical standards for on-site subsurface sewage disposal systems³ allow construction of septic systems on small lots, provided the soil is hydraulically capable of handling the wastewater flows. However, the letter recommends nitrogen analysis on parcels where the density of development exceeds one bedroom per 0.167 acre, or 6 bedrooms per acre.

Woodard & Curran performed a needs analysis to evaluate and prioritize wastewater management needs for each of the Sub-Areas within the Study Area. Data obtained from prior Reports, the CT-DEEP, Assessor's files, sanitarian records, and the National Oceanic and Atmospheric Administration (NOAA) were used to summarize land uses, associated soil drainage conditions, density of development, nitrogen attenuation, and sea level rise concerns. The objective of the needs analysis was to determine the specific Sub-Areas where conventional on-site subsurface disposal systems are inadequate.

¹ Old Colony Beach Club Association Draft Wastewater Management Plan, October 2011 – RFP Engineering

² Old Lyme Shores Beach Association Wastewater Facilities Planning Report, December 2011 – Fuss & O'Neill

³ Connecticut Public Health Code – On-Site Sewage Disposal Regulations, and Technical Standards for Subsurface Sewage Disposal Systems, January 2011 – Connecticut Department of Public Health

We used a two-stage analytical approach in the needs analysis evaluation. The first stage approach was based on a rating criteria matrix and common criteria to all 13 Sub-Areas within the study area that would impact on-site septic systems. The second stage approach considered additional qualitative criteria pertaining to specific Sub-Areas that would impact the overall needs analysis.

We utilized an analytical quantitative approach in the first stage of the needs analysis. First, we evaluated each Sub-Area based on lot size, development density, soil drainage classification, coastal flooding impacts, and nitrogen attenuation. Second, we developed a rating matrix to evaluate the thirteen previously defined Sub-Areas to rank their needs. The quantitative needs analysis criteria are summarized as follows:

- Lot Size – Individual parcels were rated based on the acreage of the property. Properties with less than 0.25 acres of land were rated the highest, while properties larger than 1.0 acre were rated the lowest. Individual parcel ratings were averaged together to determine the overall rating for each Sub-Area. Figure 2-2 illustrates the predominance of small lots (< 0.25 acres, shown in blue) within specific Sub-Areas, primarily Sub-Areas 2, 5A, 5B, 6, 7, 8, and MTA-B. Sub-Areas 1, 9, and 10 show a distinct lack of small lots, where the majority of lots are over 1.0 acre. Sub-Areas 3, 4, and MTA-A include moderately sized lots between 0.25 and 1.0 acre.
- Development Density – Density of development is a surrogate for assessing unit wastewater loading. For this analysis, the number of EDUs, total area per Sub-Area, and number of people per EDU (or bedrooms per EDUs) were used to calculate the development density for each Sub-Area, in units of bedrooms per acre. Table 2-1 summarizes the development density of each Sub-Area and compares it to the CT DPH guideline threshold of 6.0 bedrooms per acre. Sub-Areas with more than 16 bedrooms per acre were rated the highest, and those with less than 6 bedrooms per acre were rated the lowest. A comparison between Table 2-1 and Figure 2-2 shows a similar distribution between high development density and small lot size among the Sub-Areas.
- Soil Drainage Classification – The Connecticut DEEP classified soils throughout the State in terms of drainage characteristics. Soil drainage classification was used to approximate the ability of soils in each Sub-Area to accept wastewater from on-site septic systems. The DEEP’s soil drainage classification is based on observations of the water table, soil saturation, proximity to water bodies, and soil characteristics. Soils are classified by drainage ability, including “excessively drained,” “well drained,” and “poorly drained.” Soils considered “very poorly drained,” “poorly drained,” and “somewhat poorly drained” were rated the highest, in that order, while the remaining soil classifications were rated equally and lowest. Figure 2-4 illustrates the distribution of each soil drainage type per Sub-Area. The overall rating for each Sub-Area is based on percentage of each soil present in that Sub-Area. Soils classified as “excessively drained” are considered good for accepting large volumes of flow, but may negatively impact retention time for removal of nutrients. In terms of wastewater acceptance, excessively drained soils are rated low as negative effects on retention time are accounted for by development density.
- Sea Level Rise & Coastal Flooding Impacts – Those Sub-Areas containing low-lying areas and significant coastline are most prone to coastal flooding from sea level rise and flooding. Figure 2-5 shows the parts of the Study Area affected by sea level rise at heights of 1, 3, and 5 feet, based on data obtained from the National Oceanic and Atmospheric Administration (NOAA). Each Sub-Area was rated based on susceptibility to flooding according to percent area affected by sea level rise at 1, 3, and 5 feet. While 5-foot sea level rise has the greatest impact, it is the least likely sea level rise to occur, and therefore rated the lowest. Accordingly, 1-foot sea level rise areas were rated the highest. Figure 2-6 shows flood hazard zones from the Federal Emergency Management Agency (FEMA), which is similar to the NOAA data, but shows areas inundated by flood waters for 100-year and 500-year flood events. Due to the similarities in the data represented by each data set, only the NOAA sea level rise data was used as part of the needs analysis.

- Nitrogen Attenuation** – Nitrogen is attenuated in groundwater through natural physical and biological processes, and the rate of attenuation is dependent upon many factors. For the needs analysis, we considered the overall land area available for nitrogen attenuation and the number of EDUs in each Sub-Area. A total effluent flow rate for each Sub-Area was calculated assuming an average water use rate of 180 gpd/EDU (2.39 people per household time 75 gpcd). Assuming an average effluent total nitrogen concentration of 40 mg/L, and an average rate of rainfall in Connecticut of 50 inches per year, the average attenuated total nitrogen concentration in groundwater for each Sub-Area was calculated as the mass of nitrogen entering the ground via effluent divided by the volume of rainfall. Table 2-2 summarizes the attenuated total nitrogen concentrations for each Sub-Area. Those Sub-Areas with the highest attenuated nitrogen concentrations were rated highest for the needs analysis.

According to the CTDPH guidelines, nitrogen analysis should be performed on high-density developments. Table 2-1 summarizes the Study Area data relative to the CTDPH guidelines for development density for each Sub-Area, assuming an average number of bedrooms per EDU of 3.0 for those Sub-Areas where Town Sanitarian records data was not provided. According to the United States Census Bureau American Factfinder⁴, the majority of homes in the Town of Old Lyme (41.8%) have 3 bedrooms each, followed by 23.2% at 4 bedrooms, and 21.6% at 2 bedrooms each. A total of eight Sub-Areas in the Study Area exceed the CTDPH’s development density guideline. Existing EDUs were estimated using Town records (offices of the Assessor and Sanitarian), Old Lyme’s GIS building layer and Fuss & O’Neill’s Sub-Area shape files. Primary buildings of area greater than 400 square feet and labeled as type generic were considered one EDU where sanitarian records were not available.

Table 2-1: Density of Development by Sub-Area

| Sub-Area ID | Description | EDUs | Estimated Average Number of Bedrooms per EDU ¹ | Total Land Area (Acres) | Number of Bedrooms per Acre | DPH Guideline Bedrooms per Acre ² | Guideline Exceeded |
|-------------|------------------------------|------|---|-------------------------|-----------------------------|--|--------------------|
| 1 | Griswold Point & Osprey Road | 26 | 3.0 | 189.5 | 0.4 | 6.0 | No |
| 2 | White Sand Beach | 159 | 3.0 | 36.9 | 12.9 | 6.0 | Yes |
| 3 | Haywagon Drive | 27 | 3.0 | 32.2 | 2.5 | 6.0 | No |
| 4 | Dogwood Drive | 36 | 3.0 | 33.4 | 3.2 | 6.0 | No |
| 5A | Miami Beach | 236 | 3.0 | 66.4 | 10.7 | 6.0 | Yes |
| 5B | Hawks Nest Beach | 269 | 3.1 | 60.2 | 13.8 | 6.0 | Yes |
| 6 | Sound View Beach | 229 | 2.7 | 34.4 | 18.0 | 6.0 | Yes |
| 7 | Old Colony Beach Club | 218 | 3.0 | 34.2 | 19.1 | 6.0 | Yes |
| 8 | Old Lyme Shores Beach | 206 | 3.0 | 45.8 | 13.5 | 6.0 | Yes |
| 9 | Edge Lea and Cutler Road | 28 | 3.0 | 68.4 | 1.2 | 6.0 | No |
| 10 | Hatchet Point Road | 11 | 3.0 | 33.3 | 1.0 | 6.0 | No |
| MTA-A | Miscellaneous Town Area A | 28 | 3.0 | 8.9 | 9.4 | 6.0 | Yes |
| MTA-B | Miscellaneous Town Area B | 41 | 2.6 | 14.0 | 7.6 | 6.0 | Yes |

1. Average Number of Bedrooms per Residential EDU calculated for Sub-Areas 5B, 6, and MTA-B based on provided Town Sanitarian data. 3.0 assumed for other Sub-Areas

2. From Connecticut Department of Public Health 2011 Regulations and Technical Standards for Subsurface Sewage Disposal Systems.

⁴ <http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml> – 2008-2012 American Community Survey 5-Year Estimates. Accessed October 10, 2014.

As shown in Figure 2-2, there is an abundance of small lots, where lots smaller than ¼-acre comprise 75% of the total lots in all Sub-Areas. As a rate rule of thumb, a lot size of at least ¾-acres is needed to site a fully compliant septic system, where an on-site well also exists. Only 8% of the lots in the entire Study Area are larger than ¾-acre.

Figure 2-2: Lot Size Distribution of Study Area

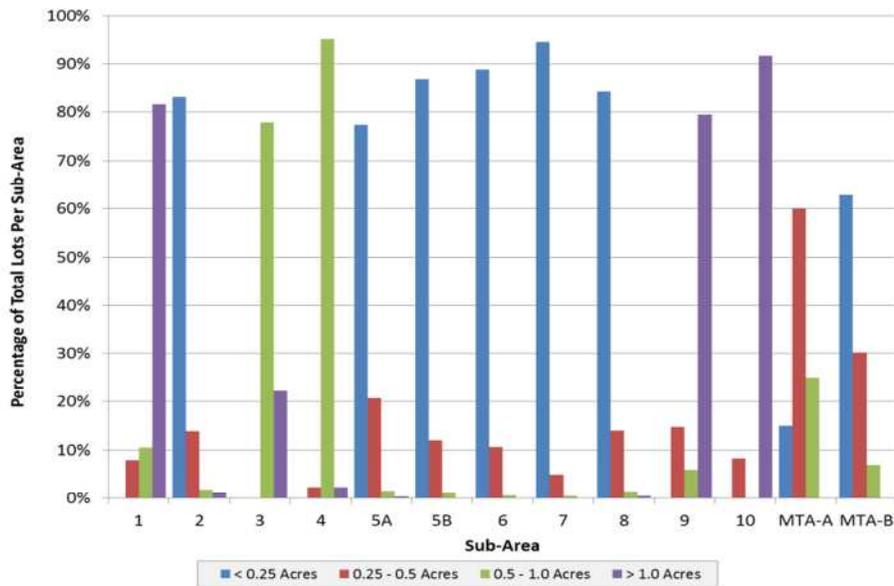


Table 2-2: Nitrogen Attenuation

| Sub-Area ID | Description | EDUs | Average Daily Flow (gpd) ¹ | Total Land Area (Acres) | Average Annual CT Rainfall (in/year) ² | Effluent Total Nitrogen Concentration (mg/L) ³ | Attenuated Total Nitrogen Concentration (mg/L) |
|-------------|------------------------------|------|---------------------------------------|-------------------------|---|---|--|
| 1 | Griswold Point & Osprey Road | 26 | 4,680 | 189.5 | 50.0 | 40.0 | 0.3 |
| 2 | White Sand Beach | 159 | 28,620 | 36.9 | 50.0 | 40.0 | 8.3 |
| 3 | Haywagon Drive | 27 | 4,860 | 32.2 | 50.0 | 40.0 | 1.6 |
| 4 | Dogwood Drive | 36 | 6,480 | 33.4 | 50.0 | 40.0 | 2.1 |
| 5A | Miami Beach | 236 | 42,480 | 66.4 | 50.0 | 40.0 | 6.9 |
| 5B | Hawks Nest Beach | 269 | 48,240 | 60.2 | 50.0 | 40.0 | 8.6 |
| 6 | Sound View Beach | 229 | 41,220 | 34.4 | 50.0 | 40.0 | 12.9 |
| 7 | Old Colony Beach Club | 218 | 39,240 | 34.2 | 50.0 | 40.0 | 12.3 |
| 8 | Old Lyme Shores Beach | 206 | 37,080 | 45.8 | 50.0 | 40.0 | 8.7 |
| 9 | Edge Lea and Cutler Road | 28 | 5,040 | 68.4 | 50.0 | 40.0 | 0.8 |
| 10 | Hatchet Point Road | 11 | 1,980 | 33.3 | 50.0 | 40.0 | 0.6 |
| MTA-A | Miscellaneous Town Area A | 28 | 5,040 | 8.9 | 50.0 | 40.0 | 6.1 |
| MTA-B | Miscellaneous Town Area B | 41 | 7,380 | 14.0 | 50.0 | 40.0 | 5.7 |

1. Assumes 180 gpd/EDU.

2. Average annual Connecticut precipitation source: <http://www.weather.com/weather/wxclimatology/monthly/graph/06371>

3. Effluent nitrogen concentration of 40 mg/L per Metcalf and Eddie, 4th Ed. 2003, assuming medium strength wastewater.

As shown in Table 2-2, the attenuated total nitrogen is a function of the ratio of EDUs to total land area. All other inputs are assumed and held constant. For each Sub-Area, a higher density of development may result in a lower capacity for attenuation of nitrogen.

2.3 SUMMARY OF STUDY AREA COMMON WASTEWATER MANAGEMENT NEEDS

Each Sub-Area was given a total ranking based on a weighted sum of the five needs analysis criteria. As stated previously, the first stage of the needs analysis is based solely on data available for all 13 Sub-Areas within the Study Area. Subsequent data impacting the overall needs analysis is presented in Section 2.4. Overall a wide range of values was observed, where high values are indicative of cumulative needs that negatively impact on-site disposal system suitability. Table 2-3 summarizes the rating by criteria and total ranking for each Sub-Area. Based upon the total value, each Sub-Area was assigned a priority, indicating its need for an alternative solution of wastewater management to on-site subsurface disposal. As shown in Table 2-3, the factors with the greatest effect on overall need appear to be lot size, development density, and nitrogen attenuation since soil drainage classification and sea level rise are relatively consistent throughout the Study Area.

Table 2-3: Initial Study Area Needs Ranking

| Sub-Area ID | Description | Criteria Name (Weighting Factor) | | | | | Total Ranking | Priority ⁶ |
|-------------|------------------------------|----------------------------------|----------------------------------|---|-----------------------------|-----------------------------------|---------------|-----------------------|
| | | Lot Size ¹ | Development Density ² | Soil Drainage Classification ³ | Sea Level Rise ⁴ | Nitrogen Attenuation ⁵ | | |
| | | (4) | (5) | (4) | (3) | (3) | | |
| 1 | Griswold Point & Osprey Road | 1.3 | 1.0 | 1.3 | 1.3 | 1.0 | 22.3 | Low |
| 2 | White Sand Beach | 3.8 | 3.0 | 1.1 | 1.2 | 3.0 | 47.2 | High |
| 3 | Haywagon Drive | 1.8 | 1.0 | 1.0 | 1.0 | 1.0 | 22.2 | Low |
| 4 | Dogwood Drive | 2.0 | 1.0 | 1.2 | 1.3 | 1.0 | 24.7 | Low |
| 5A | Miami Beach | 3.7 | 3.0 | 1.2 | 1.4 | 3.0 | 47.8 | High |
| 5B | Hawks Nest Beach | 3.9 | 3.0 | 1.1 | 1.4 | 3.0 | 48.2 | High |
| 6 | Sound View Beach | 3.9 | 4.0 | 1.1 | 1.2 | 4.0 | 55.6 | High |
| 7 | Old Colony Beach Club | 3.9 | 4.0 | 1.1 | 1.2 | 4.0 | 55.6 | High |
| 8 | Old Lyme Shores Beach | 3.8 | 3.0 | 1.0 | 1.1 | 3.0 | 46.5 | High |
| 9 | Edge Lea and Cutler Road | 1.4 | 1.0 | 1.6 | 1.1 | 1.0 | 23.3 | Low |
| 10 | Hatchet Point Road | 1.2 | 1.0 | 1.2 | 1.2 | 1.0 | 21.2 | Low |
| MTA-A | Miscellaneous Town Area A | 2.9 | 2.0 | 1.0 | 1.6 | 3.0 | 39.4 | Medium |
| MTA-B | Miscellaneous Town Area B | 3.6 | 2.0 | 1.6 | 1.0 | 3.0 | 42.8 | High |

1. 1 point assigned for percent of lots greater than 1.0 acre, 2 points for 0.5 to 1.0 acres, 3 points for 0.25 to 0.5 acres, and 4 points for less than 0.25 acres.

2. 1 point assigned for a density of less than 6 bedrooms per acre, 2 points for 6-10, 3 points for 10-16, and 4 for greater than 16.

3. Percent of Sub-Area that is Very poorly drained = 4 points, Poorly drained = 3, Somewhat poorly drained = 2, Moderately well drained or better = 1.

4. Percentage of Sub-Area within 1 foot sea level rise zone is assigned 4 points, 3 foot zone is 3 points, 5 foot zone is 2 points, and else is 1.

5. Attenuated Nitrogen Concentration of less than 1 mg/L is assigned 1 point, 1 - 6 mg/L 2 points, 6 - 12 mg/L 3 points, greater than 12 mg/L 4 points.

6. A Total Ranking of more than 40 is high priority, between 30 and 40 medium, and less than 30 low. Minimum possible is 19.

The first stage of the needs analysis results closely parallel population densities in the Study Area. For example, Sub-Areas 2, 5A, 5B, 6, 7, 8, and Miscellaneous Town Area B ranked as high priority with total ratings of more than 40 each. By comparing these results with the lot size distribution shown in Figure 2-2 and the development density shown on Table 2-1, it is clear that these Sub-Areas have elevated needs.

After Miscellaneous Town Area B, with a total ranking of 42.8, the next highest ranked Sub-Area is Miscellaneous Town Area A, with a total ranking of 39.4. This was the only Sub-Area to receive a medium priority primarily due to smaller lot size, but development density and nitrogen attenuation were also factors. In general, the lowest priority Sub-Areas has the most advantageous conditions to support properly functioning on-site septic systems, including lower development density, larger lot sizes and better ability to attenuate nitrogen.

2.4 SECOND STAGE ANALYTICAL APPROACH - ADDITIONAL QUALITATIVE CRITERIA

During the second stage of the needs analysis, we considered five additional criteria pertaining to specific Sub-Areas, including White Sand Beach, Hawks Nest Beach, Sound View Beach, and Miscellaneous Town Area-B. The five criteria are:

- Existing septic system compliance
- Age of septic systems
- Percentage of properties with onsite water supply wells
- Depth to groundwater
- Groundwater quality data

The supplemental information related to these five additional criteria was provided by the Town Sanitarian.

The CT-DPH has defined minimum setback distances for subsurface sewage disposal systems. Shown in Table 2-4, are typical setback distances required by CT-DPH.

Table 2-4: Selected Subsurface Sewage Disposal System Setbacks Based on CT-DPH Standards

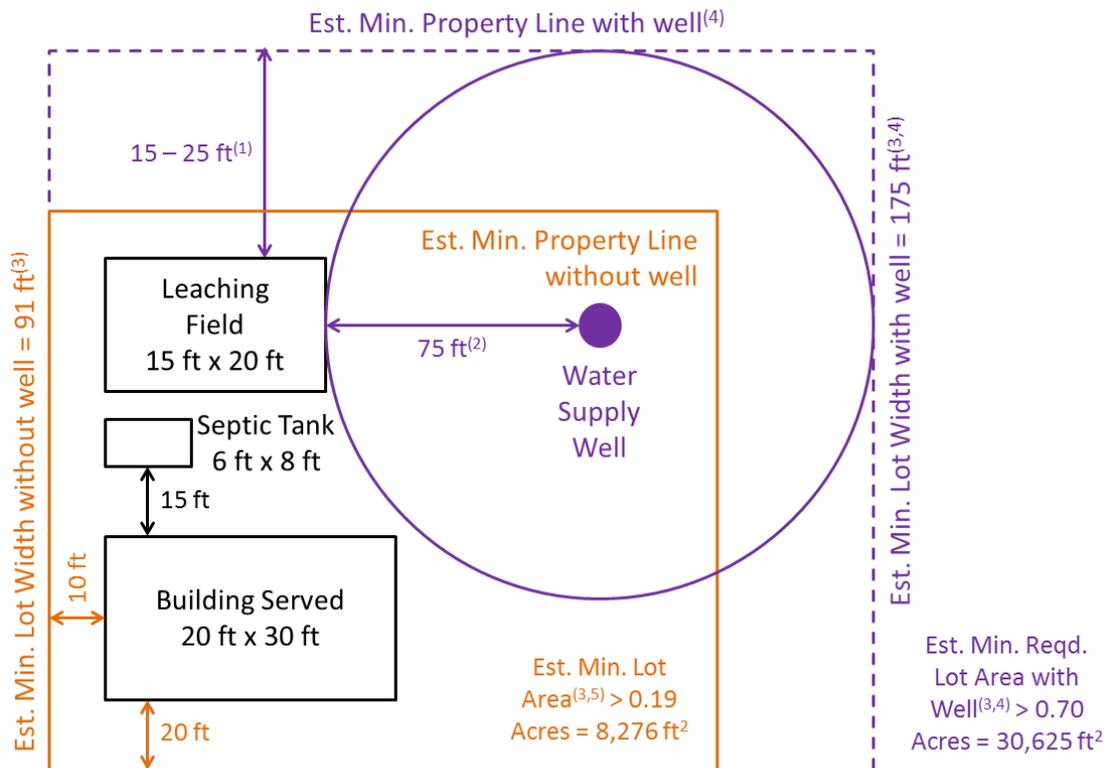
| Item | Separating Distance ¹ (Feet) |
|--|---|
| Water Supply Well (< 10, 10-50, > 50 gpm) | 75, 150, 200 |
| Human habitation on adjacent property | 15 |
| Building served | 15 |
| Open watercourse | 50 |
| Property Line (Upgradient or on sides, downgradient) | 15, 25 |
| Potable water lines | 10 |
| Accessory Structure | 10 |

1. From Table 1 of CT DPH Onsite Sewage Disposal Regulations and Technical Standards for Subsurface Sewage Disposal, 2011.

Illustrated in Figure 2-3, is an example property with a subsurface disposal system and the estimated minimum required lot size for the property with and without a water supply well. The estimated minimum lot size with an onsite well are based on CT-DPH standards for subsurface sewage disposal systems, while the minimum lot size without a well is based on the minimum acreage to attenuate a typical effluent total nitrogen concentration to 10 mg/L, the EPA and Connecticut limit for drinking water. On average, all of the high and medium priority Sub-Areas identified in Table 2-3 have lot areas smaller than 0.7 acres, which suggest that many of these lots have a very high likelihood of not complying with CT-DPH standards assuming they have water supply wells onsite. On average, Hawks Nest

Beach and Sound View Beach have lot areas smaller than 0.19 acres, suggesting that most likely these two Sub-Areas do not meet the minimum estimated required lot area with or without an onsite well. As shown in Table 2-4, houses in adjacent parcels also have a minimum separation distance of 15 feet from subsurface sewage disposal systems.

Figure 2-3: Estimated Minimum Subsurface Disposal System Setbacks for CT-DPH Compliance



1. 15 ft if property line is upgradient or on sides of leaching field, 25 ft is downgradient.
2. 75 ft for withdrawal rate of less than 10 gpm, 150 ft for 10 to 50 gpm, or 200 ft for greater than 50 gpm.
3. Assuming square lots.
4. Assuming minimum setbacks (75+75+15+10 = 175 ft).
5. Minimum lot size necessary for total nitrogen concentration at property line of less than 10 mg/L.

Age of septic system construction were provided by the Town sanitarian for four Sub-Areas, including White Sand Beach, Hawks Nest Beach, Sound View Beach, and Miscellaneous Town Area B. Table 2-5 summarizes the percent of septic systems in each of these four Sub-Areas that were constructed prior to 1980. Septic systems built prior to 1980 typically were not designed to meet long term acceptance rates (LTAR). Therefore, on-site wastewater disposal systems built before 1980 have a very high likelihood of failure due to insufficient soil porosity or loss of acceptance over time, and due to the lack of design and construction controls placed on these systems prior to this date. The significance of this date is that prior to 1980 there were rules pertaining to the design and construction monitoring of onsite wastewater disposal systems, but these requirements were significantly less stringent and enforcement by the State Department of Public Health was ineffective.

Table 2-5 shows that the fraction of septic systems constructed before 1980 in White Sand Beach is approximately one quarter less than that of Sound View Beach and Miscellaneous Town Area B, and half than that of Hawks Nest Beach. Of these four Sub-Areas, White Sand Beach has the smallest fraction of septic systems which may not meet

LTAR design considerations. LTAR are necessary to maintain natural attenuation of nutrients, pathogens, and flow. Septic system leaching fields may become fouled over time due to poor soils or over loading.

The Town Sanitarian also provided a list of properties with onsite wells for three Sub-Areas, including Hawks Nest Beach, Sound View Beach and Miscellaneous Town Area B. Table 2-5 shows the percentage of properties with onsite water supply wells in each Sub-Area. According to the data provided, Hawks Nest Beach and Miscellaneous Town Area B have the highest percentage of properties with on-site wells instead of public water supply.

A list of geocoded addresses that are connected to the public water supply system within the Study Area was provided by Connecticut Water (CT Water). Based on this data, parcels that are connected to the public water supply system were estimated for each Sub-Area and presented in Figure 2-7. Figure 2-7 suggests that there is likely a large number of properties within Hawks Nest Beach and Miscellaneous Town Area B that have onsite water supply wells, which correlates with the data presented in Table 2-5.

Also presented in Table 2-5, are the percentages of test pits with observed groundwater. Insufficient depth to groundwater increases the risk of wastewater breakout and reduces attenuation of effluent. According to CT-DPH guidelines, the bottom of any leaching system should be at a minimum of 18 inches above the maximum groundwater level, while a typical leaching field requires 24 inches of cover. In general, minimum depth to groundwater for a typical septic system should be greater than 42 inches to facilitate proper separation from groundwater without a mounded system.

Table 2-5 shows that White Sand Beach has a distinctly lower frequency of groundwater observance at 26.8%, about one third than that of Sound View Beach. While the majority of test pits in each Sub-Area were drilled to similar depths, White Sand Beach test pits often showed roots rather than groundwater or evidence of mottling. Table 2-5 also shows a high percentage of test pits with groundwater observed for Sound View (approximately 92%), which suggests the existence of shallow groundwater in Sound View. In addition, the average test pit depth to groundwater for Sound View appears to be the shallowest compared to the other Sub-Areas investigated, with an average depth to groundwater estimated at 52 inches below the surface.

Table 2-5: Comparison of Additional Data for Selected Sub-Areas¹

| Sub-Area ID | Description | % of Septic Systems Built prior to 1980 | Percentage of Properties with onsite Wells | Average Test Pit Depth to Groundwater (in) | Percentage of Test Pits with Groundwater Observed |
|-------------|---------------------------|---|--|--|---|
| 2 | White Sand Beach | 15.9% | - | 64 | 26.8% |
| 5B | Hawks Nest Beach | 31.7% | 73.4% | 64 | 61.4% |
| 6 | Sound View Beach | 20.8% | 42.6% | 52 | 91.8% |
| MTA-B | Miscellaneous Town Area B | 21.4% | 79.2% | 54 | 81.8% |

1. Based on data provided by the Town Sanitarian

Groundwater quality data was also provided by the Town sanitarian for the Hawks Nest Beach and Sound View Beach Sub-Areas, and included nitrogen species concentrations and bacterial counts. Table 2-6 summarizes the number of occurrences where nitrogen and bacteria limits for drinking water and wastewater effluent were exceeded. The presented data was collected between June 25, 1998 and June 19, 2012 from seven sample stations within the Hawks Nest Beach Sub-Area and five sample stations within the Sound View Sub-Area, and was retrieved from the 2012 Nathan Jacobson (NLJ) report⁵ (see Appendix D).

⁵ 8/21/2012 Nathan Jacobson Report on Town of Old Lyme Groundwater Quality

Table 2-6 shows that Hawks Nest has experienced elevated levels of nitrogen during the sampling period, consisting primarily of nitrate. The NLJ report's data analysis also shows that the total nitrogen consists mostly of nitrate. During the sampling period, EPA and CT-DPH standards for nitrate and total nitrogen drinking water were exceeded four and five times, respectively. Sound View experienced a similar number of exceedances for total nitrogen at nine, however the data analysis shows that total nitrogen consisted mostly of ammonia and organic nitrogen, a strong indicator of the presence of raw wastewater. The presence of high levels of nitrate in Hawks Nest groundwater compared to the other Sub-Areas suggests that nitrification may be occurring at a faster rate within this Sub-Area.

Both Hawks Nest and Sound View have shown elevated levels of multiple varieties of bacteria, as shown in Table 2-6. The limits presented in Table 2-6 are required by the EPA to ensure safe public use of wastewater effluent receiving waters. However, the EPA's safe drinking water standards are much more stringent. Two principal drinking water standards are adopted by the EPA, including (1) Maximum Contaminant Level Goal (MCLG) – a non-enforceable, health based goal set at a level with an adequate margin of safety to ensure no adverse effect on human health, and (2) Maximum Contaminant Level (MCL) – an enforceable standard set as close to the MCLG as feasible using best available treatment technology and taking cost and analytical capability into consideration. While these standards do not apply to private systems serving less than 25 individuals, they give a good base line for drinking water safety.

The Total Coliform Rule in the Safe Drinking Water Act (SDWA) specifies a MCLG of zero for total coliforms (which includes fecal coliforms and E. coli). The MCL for total coliforms allows for a limited number of positive samples, at most 5% of samples per month. Where less than 40 samples are collected per month, as is the case with the data collected for the NLJ report, the limit is one positive sample per month. Samples for Hawks Nest and Sound View were collected approximately biannually. Approximately 95% of samples in Hawks nest were positive for fecal coliform, and 92% of samples in Sound View were positive. It should be noted that fecal coliforms are indicative of human waste contamination, and are only a fraction of the total coliforms that may be present. The regular occurrence of coliform bacteria in Hawks Nest and Sound View samples suggests inadequate treatment of wastewater prior to discharge into the ground, and likely contamination of drinking water for onsite wells in these areas.

Table 2-6: Nitrogen and Bacterial Limits Number of Exceedances¹

| Sub-Area ID | Description | Nitrate | Nitrite | Total Nitrogen | Total Coliform | Fecal Coliform | Fecal Streptococcus | E. Coli |
|----------------|------------------|---------------------------------------|--------------------------------------|-------------------------------------|---------------------------|--------------------|---------------------------|--------------------|
| Limit (Source) | | 10 mg/L as N (EPA Drinking Water Std) | 1 mg/L as N (EPA Drinking Water Std) | 10 mg/L (CT DPH Drinking Water Std) | 200 #/100 mL ² | 200 #/100 mL (EPA) | 200 #/100 mL ² | 126 #/100 mL (EPA) |
| 5B | Hawks Nest Beach | 4 | 0 | 5 | 8 | 3 | 4 | 2 |
| 6 | Sound View | 0 | 0 | 9 | 2 | 2 | 5 | 1 |

1. Based on 2012 NLJ Report
2. The US EPA's fecal coliform limit is used for analytical purposes.

Additional data on marine bacterial counts were provided by the Town Sanitarian (see Appendix E) and summarized in Table 2-7. This data set pertains to six Sub-Areas, including White Sand Beach, Miami Beach, Hawks Nest Beach, Sound View Beach, Old Colony Beach Club, and Old Lyme Shores Beach. The marine water bacterial data was Sound View collected between May 22 and September 17, 2014. Generally, the average bacterial count varies little between the Sub-Areas and in every case it is below the threshold for public safety established by the EPA of 35 enterococci colonies per 100 mL for marine water. The CTDPH standards for bathing water are less strict, with a

limit at 104 enterococci colonies per 100 mL. However, the EPA limit was exceeded by individual samples several times throughout the sampling period in five out of six of the Sub-Areas tested.

Table 2-7: Marine Bacterial Counts

| Sub-Area ID | Description | Average Enterococci Count ¹ (Colonies/100mL) | Times EPA Limit Exceeded ¹ |
|-------------|-----------------------|---|---------------------------------------|
| 2 | White Sand Beach | 7.9 | 2 |
| 5A | Miami Beach | 18.7 | 4 |
| 5B | Hawks Nest Beach | 15.9 | 3 |
| 6 | Sound View Beach | 10.0 | 1 |
| 7 | Old Colony Beach Club | 8.1 | 0 |
| 8 | Old Lyme Shores Beach | 10.6 | 1 |

1. Data provided by the Town Sanitarian

The second stage of the needs analysis suggests that White Sand Beach has a lower number of old septic systems (constructed prior to 1980) and has far fewer test pits with shallow depth to groundwater compared to the other high priority Sub-Areas. In addition, White Sand Beach is located approximately 5,000 feet from the rest of the high priority Sub-Areas.

2.5 BALANCING WASTEWATER MANAGEMENT NEEDS AND COSTS

The Town of Old Lyme presented needs analysis information and a preliminary cost summary to Town residents on September 30, 2014. During the presentation, a few residents within the High Needs Sub-Areas expressed concern over various pollution factors (development density, soils, septic system failures, depth to groundwater, etc.) and net costs per EDU. To address these concerns, CT-DEEP facilitated a Project Workshop on October 15, 2014 to review the need analysis, costs, and concerns expressed by the public. As a result of the workshop and unique Needs Analysis factors as mentioned in Section 2.4 (soils, age of septic systems, cost, depth to groundwater, and groundwater quality data), CT-DEEP, Woodard & Curran, the Town and Fuss & O'Neill (representatives to the chartered beach associations), agreed to remove White Sand Beach (Sub Area 2) and Miscellaneous Town Area A (MTA-A) from the proposed Project Area, and make those two Sub Areas designated as future High Needs Sub Areas. We recommend that these two Sub-Areas be monitored and further evaluated based on future pollution and/or septic failure concerns. All parties agreed that no other unique conditions exist within the High Needs Sub Areas that would justify the exclusion of other Sub-Areas from the proposed Project Area. The final results of the needs analysis are shown in Table 2-8 and shown graphically in Figure 2-8, with color coding assigned by priority.

Table 2-8: Final Needs Prioritization by Sub-Area

| Sub-Area ID | Description | EDUs | Priority |
|-------------|------------------------------|------|----------|
| 1 | Griswold Point & Osprey Road | 26 | Low |
| 2 | White Sand Beach | 159 | Medium |
| 3 | Haywagon Drive | 27 | Low |
| 4 | Dogwood Drive | 36 | Low |
| 5A | Miami Beach | 236 | High |
| 5B | Hawks Nest Beach | 269 | High |
| 6 | Sound View | 229 | High |
| 7 | Old Colony Beach Club | 218 | High |
| 8 | Old Lyme Shores Beach | 206 | High |
| 9 | Edge Lea and Cutler Road | 28 | Low |
| 10 | Hatchet Point Road | 11 | Low |
| MTA-A | Miscellaneous Town Area A | 28 | Medium |
| MTA-B | Miscellaneous Town Area B | 41 | High |

2.6 PROPOSED PROJECT AREA

Sub-Areas 5A, 5B, 6, 7, 8, and Miscellaneous Town Area B have the highest need for wastewater management solutions in lieu of the existing on-site septic systems. These Sub-Areas make up the proposed Project Area and are the focus of the alternatives analysis presented in the remainder of this Report. The proposed Project Area is shown in Figure 2-9. The six Sub-Areas in the proposed Project Area represent about 80% of the sanitary flow from the Study Area. This is due to these Sub-Areas representing the most densely populated fraction of the Study Area.

Table 2-9 provides a summary for the Project Area, consisting of five (5) beach associations within these six (6) Sub-Areas. Table 2-9 also summarizes the number of homes (or EDUs) in each of the Sub-Areas.

Table 2-9: Project Area Sub-Areas

| Sub-Area | Description | Number of Equivalent Dwelling Units (EDU) |
|--------------|---------------------------|---|
| 5A | Miami Beach | 236 |
| 5B | Hawks Nest Beach | 269 |
| 6 | Sound View Beach | 229 |
| 7 | Old Colony Beach Club | 218 |
| 8 | Old Lyme Shores Beach | 206 |
| MTA-B | Miscellaneous Town Area B | 41 |
| Total | | 1,199 |

2.7 CONSISTENCY WITH STATE PLAN OF CONSERVATION AND DEVELOPMENT

The Office of Policy and Management has developed a Plan of Conservation and Development (POCD) for the State of Connecticut outlining six growth management principles for guiding intelligent community development. The POCD is intended for comparison to community and municipal plans where development will make use of state funding. The six growth management principles are listed in Table 2-10 and the project's applicability to each is briefly summarized.

Table 2-10: Project Applicability to OPM Growth Management Principles

| Growth Management Principle # | Description | Project Area Applicability |
|-------------------------------|---|--|
| 1 | Redevelop and revitalize regional centers and areas with existing or currently planned physical infrastructure | N/A |
| 2 | Expand housing opportunities and design choices to accommodate a variety of household types and needs | N/A |
| 3 | Concentrate development around transportation nodes and along major transportation corridors to support the viability of transportation options | Project Area is centered around route 156. A Bike path and bus route are planned for alternative modes of transportation. |
| 4 | Conserve and restore the natural environment, cultural and historical resources, and traditional rural lands | Collection and treatment of wastewater will reduce nitrogen loading to Long Island sound and protect local groundwater quality |
| 5 | Protect and ensure the integrity of environmental assets critical to public health and safety | Protects quality of groundwater supplying public and private water systems by removal of non-compliant septic systems |
| 6 | Promote integrated planning across all levels of government to address issues on a statewide, regional and local basis | Inter-municipal agreements encourage sharing of existing wastewater infrastructure, assuming regional solution is adopted. |

Growth management principles 4 and 5 are primarily concerned with protecting the environment and natural resources that contribute to public health, including aquifers for public and private water supply. Principle number 3 encourages growth and development around existing transportation hubs to reduce congestion due to traffic and offer alternative forms of transportation. Planned upgrades to the Hartford Avenue corridor include a bus route and a bike path from route 156 to the beachfront. The Regional Alternative (discussed further in Chapter 4) is consistent with growth management principle 6 in that it requires inter-municipal agreements between the Town of Old Lyme, East Lyme, Waterford, and New London, and encourages sharing of existing and potentially under-utilized infrastructure.

Wastewater collection systems typically facilitate growth and development within the sewer service area; however, the Town of Old Lyme is concerned with overdevelopment within the Project Area. Maintaining appropriate zoning regulations is the single best measure to avoid induced growth. Existing lots within the proposed Project Area are mostly quarter acre residential, with some quarter acre commercial lots in MTA-B, and a strip of mixed development along Hartford Avenue in Sound View Beach. The preponderance of existing high-density residential development on highly desirable lots near beachfront reduces the possibility of undesirable additional development. There are also very few undeveloped parcels within the proposed Project Area, lessening the potential for urban sprawl.

The recommended plan, described further in Section 8, is based solely on existing development in the proposed Project Area. There are no allowances for future development or growth, which will otherwise have to be supported by on-site systems. The Town of Old Lyme has a sewer avoidance policy, and the WPCA has made exception only to facilitate a solution to on-going existing on-site problems for those lots included in the proposed Project Area.

2.8 IMPACTS ASSOCIATED WITH HURRICANE IRENE AND STORM SANDY

In addition to the above Needs Analysis, one of the goals of this Project is to improve coastal resiliency in the Project Area. During Storm Sandy, the Old Lyme coastline communities were hit hard, including a storm surge that brought waters from the Long Island Sound further inland than normal. Several homes were damaged, and the high waters flooded properties and septic systems along the coastline. Following are several photos that illustrate the damage left in the wake of Storm Sandy.



Examples of Damage Left by Storm Sandy in Old Lyme Beach Associations

The proposed project will reinforce coastal infrastructure by eliminating flood-prone septic systems in the Project Area. In addition, washouts by rising tides will no longer compromise the septic systems. This will allow homeowners to better fortify their properties by using parts of their properties that were previously occupied by a leaching field. Gravity sewers with deeper infrastructure and flood-proof manhole covers will protect the wastewater infrastructure. The proposed pump station(s) will be sited at elevations above flood levels, with emergency generators and independent fuel sources, to maintain sewer service during extreme events.

The proposed sewers will allow homeowners to upgrade their properties, better use parts of the lots currently occupied by septic systems, to provide more storm-ready reinforcements. Specifically, the proposed pump station to be constructed as part of this project will be constructed above flood waters, of concrete and reinforced materials, including an emergency generator and remote monitoring system with back-up, allowing continuous sewer service to the project area, providing safe and sanitary conditions that have never existed in this area.

The undersized and failing septic systems that currently discharge to groundwaters and surface waters in the project area negatively impact surrounding environmentally sensitive areas. The proposed sewers will eliminate these discharges. In addition, since there is almost no undeveloped land in the project area, there will not be secondary development pressures that would otherwise impact environmental areas in other communities that extend sewer service. Beach closures related to bacterial contamination in the project area will also be eliminated, thus improving swimming and recreational activities that allow the residents to enjoy the natural beauty of the wildlife throughout the project area. Lastly, the odors from surface breakout at leaching systems will no longer occur after sewers are constructed. This has been a significant source of past nuisance conditions for residents.

Legend

 Sub-Areas

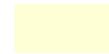
Soil Classification

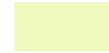
Source: CT DEEP

 Excessively drained

 Somewhat excessively drained

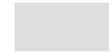
 Well drained

 Moderately well drained

 Somewhat poorly drained

 Poorly drained

 Very poorly drained

 Not rated

Sub-Area Key

- 1 - Griswold Point & Osprey Road
- 2 - White Sand Beach
- 3 - Haywagon Drive
- 4 - Dogwood Drive
- 5A - Miami Beach
- 5B - Hawks Nest Beach
- 6 - Sound View Beach
- 7 - Old Colony Beach Club
- 8 - Old Lyme Shores Beach
- 9 - Edge Lea & Cutler Road
- 10 - Hatchet Point Road



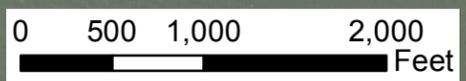
Long Island Sound

Town of Old Lyme, CT

Soil Drainage Classification

FIGURE 2-4

| | |
|--|-----------------|
| SCALE: 1 in = 1,000 ft | DRAWN BY: ACB |
| DATE: December 10, 2014 | JOB NO.: 226617 |
| DOC: 2014-11-18_Fig_2-4_Soil_Class.mxd | |



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
 Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

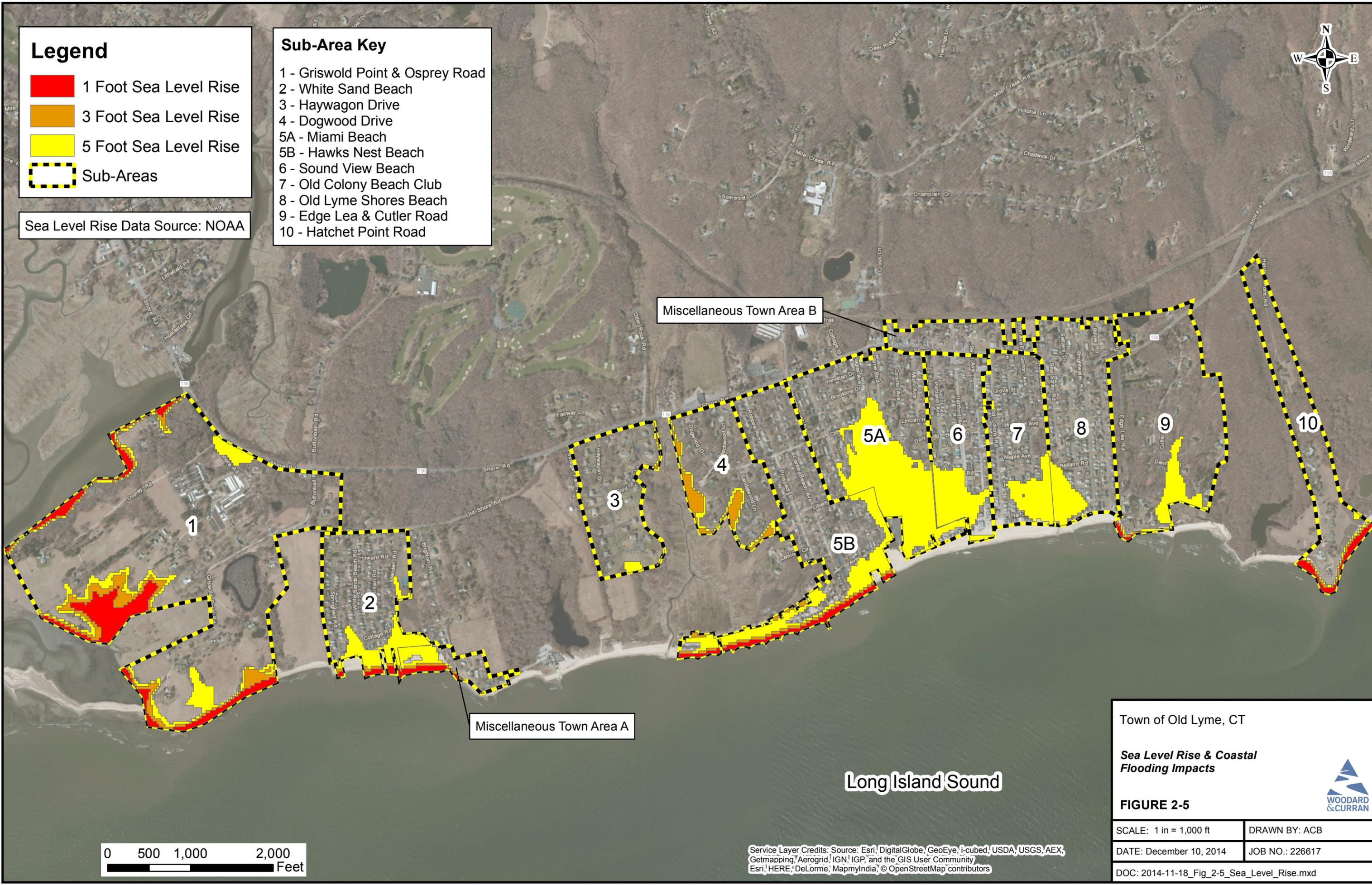
Legend

- 1 Foot Sea Level Rise
- 3 Foot Sea Level Rise
- 5 Foot Sea Level Rise
- Sub-Areas

Sub-Area Key

- 1 - Griswold Point & Osprey Road
- 2 - White Sand Beach
- 3 - Haywagon Drive
- 4 - Dogwood Drive
- 5A - Miami Beach
- 5B - Hawks Nest Beach
- 6 - Sound View Beach
- 7 - Old Colony Beach Club
- 8 - Old Lyme Shores Beach
- 9 - Edge Lea & Cutler Road
- 10 - Hatchet Point Road

Sea Level Rise Data Source: NOAA



Miscellaneous Town Area B

Miscellaneous Town Area A

Long Island Sound

Town of Old Lyme, CT

Sea Level Rise & Coastal Flooding Impacts



FIGURE 2-5

SCALE: 1 in = 1,000 ft DRAWN BY: ACB

DATE: December 10, 2014 JOB NO.: 226617

DOC: 2014-11-18_Fig_2-5_Sea_Level_Rise.mxd

0 500 1,000 2,000
Feet

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

Legend

 Sub-Areas

FEMA Flood Hazard Zones

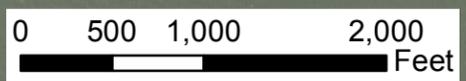
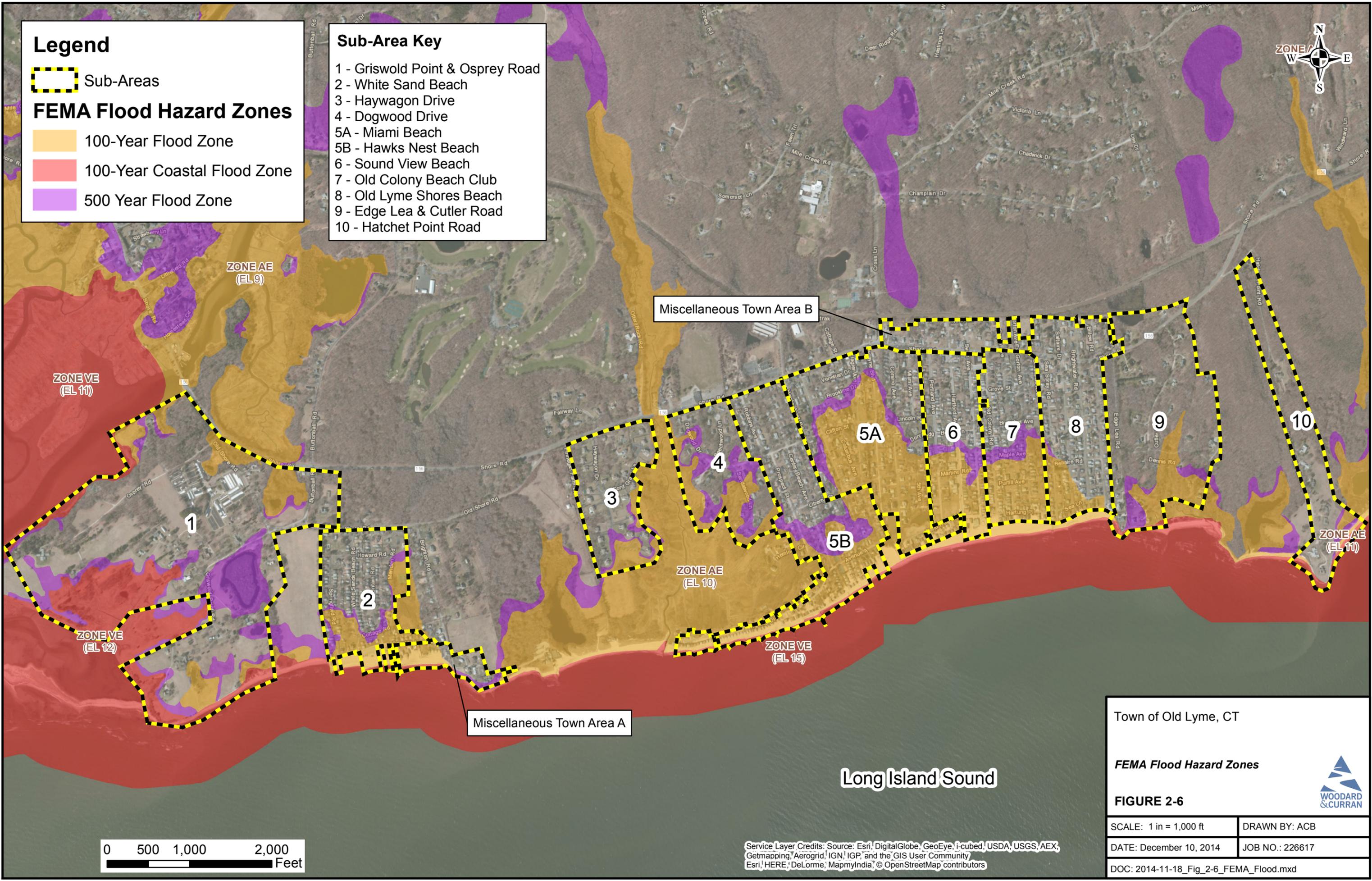
 100-Year Flood Zone

 100-Year Coastal Flood Zone

 500 Year Flood Zone

Sub-Area Key

- 1 - Griswold Point & Osprey Road
- 2 - White Sand Beach
- 3 - Haywagon Drive
- 4 - Dogwood Drive
- 5A - Miami Beach
- 5B - Hawks Nest Beach
- 6 - Sound View Beach
- 7 - Old Colony Beach Club
- 8 - Old Lyme Shores Beach
- 9 - Edge Lea & Cutler Road
- 10 - Hatchet Point Road



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
 Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

Town of Old Lyme, CT

FEMA Flood Hazard Zones

FIGURE 2-6

SCALE: 1 in = 1,000 ft DRAWN BY: ACB

DATE: December 10, 2014 JOB NO.: 226617

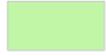
DOC: 2014-11-18_Fig_2-6_FEMA_Flood.mxd

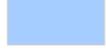


Legend

 Sub-Areas

Parcel Water Supply Source

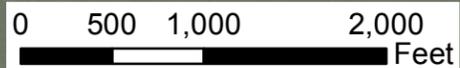
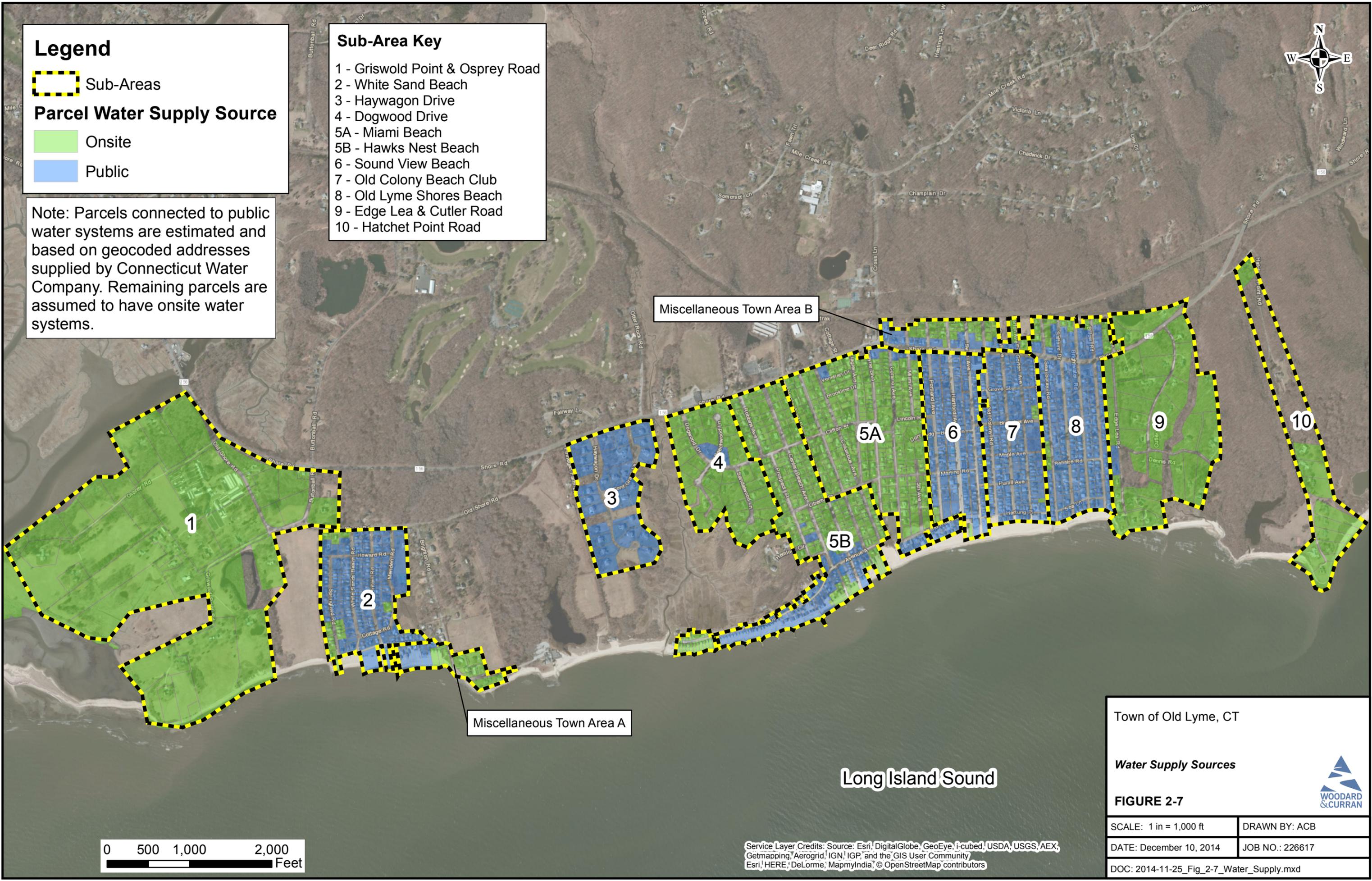
 Onsite

 Public

Sub-Area Key

- 1 - Griswold Point & Osprey Road
- 2 - White Sand Beach
- 3 - Haywagon Drive
- 4 - Dogwood Drive
- 5A - Miami Beach
- 5B - Hawks Nest Beach
- 6 - Sound View Beach
- 7 - Old Colony Beach Club
- 8 - Old Lyme Shores Beach
- 9 - Edge Lea & Cutler Road
- 10 - Hatchet Point Road

Note: Parcels connected to public water systems are estimated and based on geocoded addresses supplied by Connecticut Water Company. Remaining parcels are assumed to have onsite water systems.



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
 Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

Town of Old Lyme, CT

Water Supply Sources

FIGURE 2-7

SCALE: 1 in = 1,000 ft DRAWN BY: ACB

DATE: December 10, 2014 JOB NO.: 226617

DOC: 2014-11-25_Fig_2-7_Water_Supply.mxd



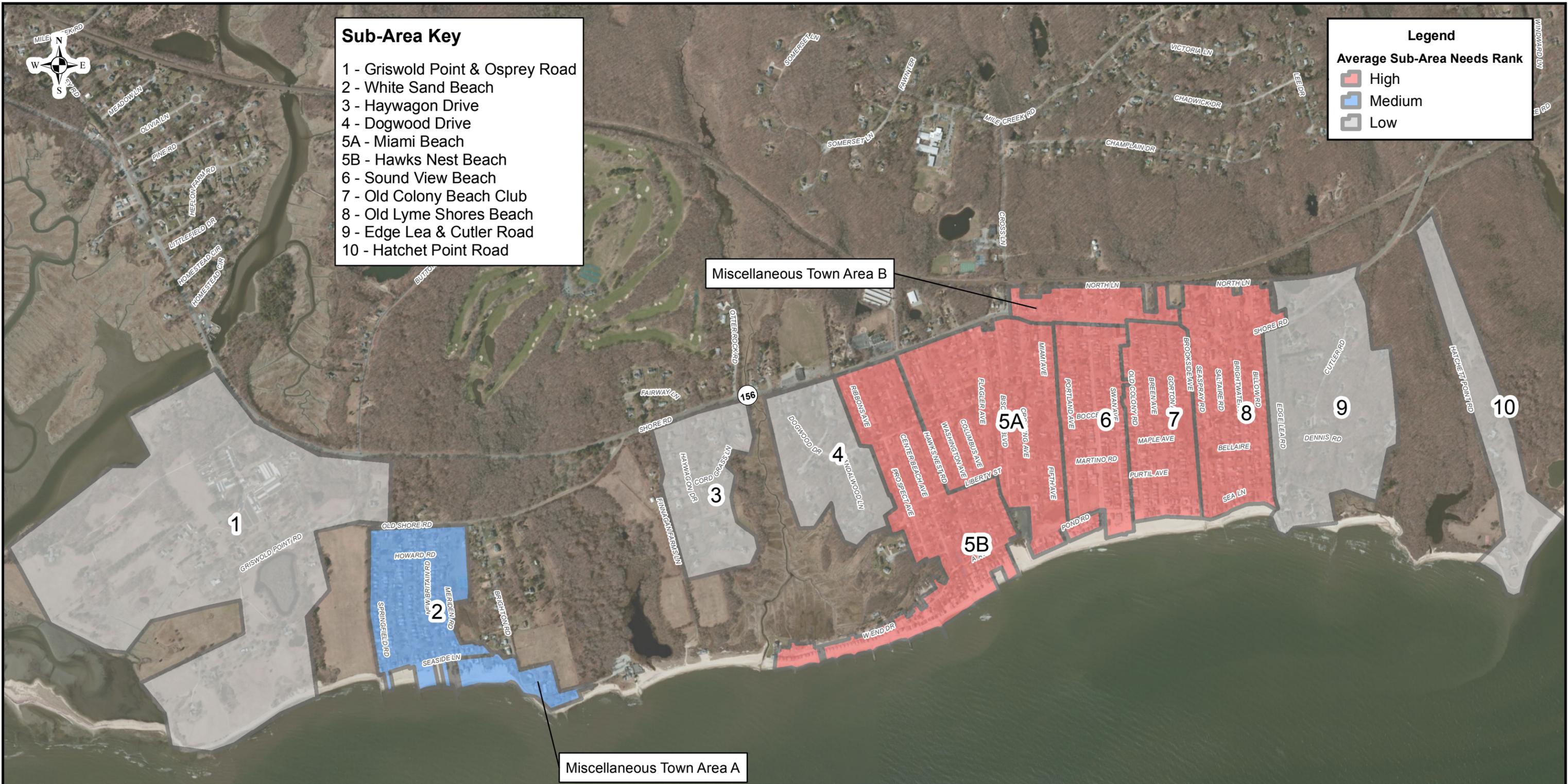


- Sub-Area Key**
- 1 - Griswold Point & Osprey Road
 - 2 - White Sand Beach
 - 3 - Haywagon Drive
 - 4 - Dogwood Drive
 - 5A - Miami Beach
 - 5B - Hawks Nest Beach
 - 6 - Sound View Beach
 - 7 - Old Colony Beach Club
 - 8 - Old Lyme Shores Beach
 - 9 - Edge Lea & Cutler Road
 - 10 - Hatched Point Road

Legend

Average Sub-Area Needs Rank

- High
- Medium
- Low



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

Wastewater Management Needs Summary

FIGURE 2-8

| | |
|---|-----------------|
| SCALE: 1 in = 1,000 ft | DRAWN BY: ACB |
| DATE: December 10, 2014 | JOB NO.: 226617 |
| DOC: 2014-11-18_Fig_2-8_Priority_WW_Mng_Needs.mxd | |



Legend

Sub-Areas

- 5A - Miami Beach
- 5B - Hawks Nest Beach
- 6 - Sound View Beach
- 7 - Old Colony Beach Club
- 8 - Old Lyme Shores Beach
- Miscellaneous Town Area B



Miscellaneous Town Area B

5A

6

7

8

5B

Long Island Sound



| | |
|---|-----------------|
| Town of Old Lyme, CT | |
| <i>Project Area Sub-Areas</i> | |
| FIGURE 2-9 | |
| SCALE: 1 in = 400 ft | DRAWN BY: ACB |
| DATE: December 10, 2014 | JOB NO.: 226617 |
| DOC: 2014-11-18_Fig_2-9_High_Needs_WW_Svc_A.mxd | |



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

3. CURRENT AND FUTURE FLOW PROJECTIONS

Section 3 provides a summary as to how current and future flows were estimated for the proposed Project Area. These estimated sanitary flows were used in Section 5, together with other estimated flow sources, including infiltration and inflow (I/I), to develop and evaluate collection system alternatives for the individual Sub-Areas comprising the Project Area.

3.1 ASSUMPTIONS FOR FLOW CALCULATIONS

For existing developed properties in the Project Area, the following assumptions were used for flow calculations:

- The average daily flow is the sum of sanitary flow (residential and non-residential) and estimated inflow/infiltration (I/I).
- I/I was estimated for each Sub-Area based on 2011 TR-16 design guidelines (Guides for the Design of Wastewater Treatment Works) based on an I/I allowance of 400 gpd/idm (gallons per day per inch-diameter-mile of pipe), using assumed 8-inch diameter pipes and a gravity sewer system layout. A lower unit I/I rate of 100 gpd/idm was used for the low pressure and vacuum sewer alternatives.
- The average daily sanitary flow was 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 unit water consumption assumption is also consistent with TR-16 guidelines.
- The maximum daily sanitary flow was calculated as twice the average daily sanitary flow, plus I/I.
- Peak hour flows were estimated to determine pump station capacities and sewer pipe diameters. The peak hour flow was calculated by multiplying the sanitary flow by a peaking factor of 4, plus I/I, based on Figure 2-1 of TR-16 design guidelines.
- There are no future flow allocations from currently undeveloped parcels in the project area.
- The number of EDUs used for the flow projections is based on a combination of: (1) the Town Assessor's data for the Town-management high-needs Sub-Areas comprising the Project Area; (2) data provided by Fuss & O'Neill for the three chartered beach associations; and (3) the Town's GIS data, including building/structure counts for the Sub-Areas that were excluded from the recommended Project Area.

3.2 FLOW PROJECTIONS

Table 3-1 shows the flow projections for gravity and septic tank effluent gravity (STEG) collective 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 estimate I/I flow contributions for these systems, which is a conservative estimate consistent with TR-16 guidelines. Table 3-1 also shows peak hour hourly flows in gallons per minute (gpm), and maximum daily flows in gallons per day (gpd). Maximum daily flows are twice the average daily flow, plus I/I. These flows are used to design the size of the proposed Water Pollution Control Facility (WPCF) for the Local Alternative. Maximum daily flow is also used to determine the necessary size of the effluent disposal and reuse systems for the Local Alternatives, as well as the size of the transmission force main for the Regional Alternative.

Table 3-2 is similar to Table 3-1 but 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 pressure piping without traditional sewer manholes associated with a gravity or STEG system. This difference allows for a more moderate I/I flow estimate since it is hard for groundwater to infiltrate LPS/STEP systems. An I/I allowance of 100 gpd / idm from TR-16 was used for these pressurized collection systems. The primary benefit of less I/I in a system is reduced treatment and disposal capital and annual costs for the Local Alternative, as well as lower pumping costs for the Regional

Alternative. Based on the estimated pipe lengths to serve the Project Area, a LPS or STEP system would reduce maximum daily flows by an estimated 26,000 gallons per day, or 6% of the max daily flow.

Figure 3-1 summarizes the flow projections per Sub-Area for the gravity sewer alternative, and shows all the Sub-Areas included as part of the proposed Project Area. 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.

Table 3-1: Summary of Gravity and STEG Projections for Project Area

| Sub-Area ID | Description | Equivalent Dwelling Units (EDU) | Average Daily Flow (GPD) | | | Max Daily Flow (GPD) ⁴ | Peak Hourly Flow (GPD) ⁵ |
|--------------------|---------------------------|---------------------------------|--------------------------|------------------|----------------|-----------------------------------|-------------------------------------|
| | | | Sanitary Flow | I/I ³ | Total | | |
| 5A ² | Miami Beach | 236 | 42,480 | 8,545 | 51,025 | 93,505 | 178,465 |
| 5B ¹ | Hawks Nest Beach | 269 | 48,420 | 8,879 | 57,299 | 105,719 | 202,559 |
| 6 ¹ | Sound View Beach | 229 | 41,220 | 4,273 | 45,493 | 86,713 | 169,153 |
| 7 ² | Old Colony Beach Club | 218 | 39,240 | 4,727 | 43,967 | 83,207 | 161,687 |
| 8 ² | Old Lyme Shores Beach | 206 | 37,080 | 6,545 | 43,625 | 80,705 | 154,865 |
| MTA-B ¹ | Miscellaneous Town Area B | 41 | 7,380 | 1,697 | 9,077 | 16,457 | 31,217 |
| Total | | 1,199 | 215,820 | 34,667 | 250,487 | 466,307 | 897,947 |

1. Existing EDU counts for Sub-Areas 5B, 6, and MTA-B are based on Town Sanitarian records and include commercial contributions.
2. Existing EDU counts for Sub-Areas 5A, 7, and 8 are based on Fuss & O'Neill's Sub-Area shape files.
3. I/I estimate is based on a preliminary gravity sewer layout of 8-inch pipe, assuming 400 gpd/idm.
4. Maximum Daily Flow is the Sanitary Flow multiplied by a safety factor of 2, added to I/I.
5. Peak Hourly Flow is the Sanitary Flow multiplied by a peaking factor of 4, added to I/I.

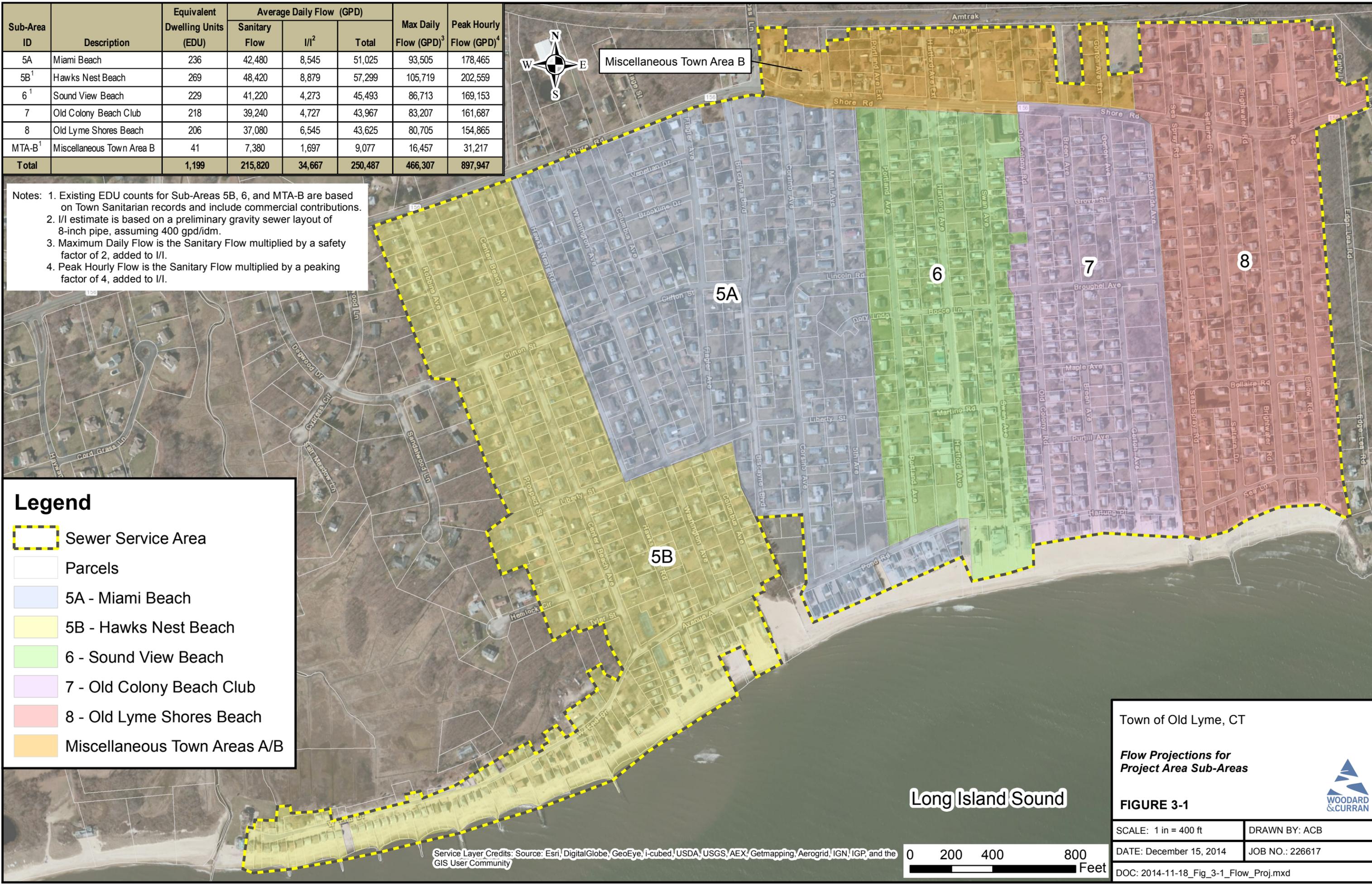
Table 3-2: Summary of LPS and STEP Projections for High Needs Sub-Areas

| Sub-Area ID | Description | Equivalent Dwelling Units (EDU) | Average Daily Flow (GPD) | | | Max Daily Flow (GPD) ⁴ | Peak Hourly Flow (GPD) ⁵ |
|--------------------|---------------------------|---------------------------------|--------------------------|------------------|----------------|-----------------------------------|-------------------------------------|
| | | | Sanitary Flow | I/I ³ | Total | | |
| 5A ² | Miami Beach | 236 | 42,480 | 2,136 | 44,616 | 87,096 | 172,056 |
| 5B ¹ | Hawks Nest Beach | 269 | 48,420 | 2,220 | 50,640 | 99,060 | 195,900 |
| 6 ¹ | Sound View Beach | 229 | 41,220 | 1,068 | 42,288 | 83,508 | 165,948 |
| 7 ² | Old Colony Beach Club | 218 | 39,240 | 1,182 | 40,422 | 79,662 | 158,142 |
| 8 ² | Old Lyme Shores Beach | 206 | 37,080 | 1,636 | 38,716 | 75,796 | 149,956 |
| MTA-B ¹ | Miscellaneous Town Area B | 41 | 7,380 | 424 | 7,804 | 15,184 | 29,944 |
| Total | | 1,199 | 215,820 | 8,667 | 224,487 | 440,307 | 871,947 |

1. Existing EDU counts for Sub-Areas 5B, 6, and MTA-B are based on Town Sanitarian records and include commercial contributions.
2. Existing EDU counts for Sub-Areas 5A, 7, and 8 are based on Fuss & O'Neill's Sub-Area shape files.
3. I/I estimate is based on a preliminary LPS layout, assuming 100 gpd/idm.
4. Maximum Daily Flow is the Sanitary Flow multiplied by a safety factor of 2, added to I/I.
5. Peak Hourly Flow is the Sanitary Flow multiplied by a peaking factor of 4, added to I/I.

| Sub-Area ID | Description | Equivalent Dwelling Units (EDU) | Average Daily Flow (GPD) | | | Max Daily Flow (GPD) ³ | Peak Hourly Flow (GPD) ⁴ |
|--------------------|---------------------------|---------------------------------|--------------------------|------------------|----------------|-----------------------------------|-------------------------------------|
| | | | Sanitary Flow | I/I ² | Total | | |
| 5A | Miami Beach | 236 | 42,480 | 8,545 | 51,025 | 93,505 | 178,465 |
| 5B ¹ | Hawks Nest Beach | 269 | 48,420 | 8,879 | 57,299 | 105,719 | 202,559 |
| 6 ¹ | Sound View Beach | 229 | 41,220 | 4,273 | 45,493 | 86,713 | 169,153 |
| 7 | Old Colony Beach Club | 218 | 39,240 | 4,727 | 43,967 | 83,207 | 161,687 |
| 8 | Old Lyme Shores Beach | 206 | 37,080 | 6,545 | 43,625 | 80,705 | 154,865 |
| MTA-B ¹ | Miscellaneous Town Area B | 41 | 7,380 | 1,697 | 9,077 | 16,457 | 31,217 |
| Total | | 1,199 | 215,820 | 34,667 | 250,487 | 466,307 | 897,947 |

Notes: 1. Existing EDU counts for Sub-Areas 5B, 6, and MTA-B are based on Town Sanitarian records and include commercial contributions.
2. I/I estimate is based on a preliminary gravity sewer layout of 8-inch pipe, assuming 400 gpd/idm.
3. Maximum Daily Flow is the Sanitary Flow multiplied by a safety factor of 2, added to I/I.
4. Peak Hourly Flow is the Sanitary Flow multiplied by a peaking factor of 4, added to I/I.



Legend

- Sewer Service Area
- Parcels
- 5A - Miami Beach
- 5B - Hawks Nest Beach
- 6 - Sound View Beach
- 7 - Old Colony Beach Club
- 8 - Old Lyme Shores Beach
- Miscellaneous Town Areas A/B

Town of Old Lyme, CT

Flow Projections for Project Area Sub-Areas

FIGURE 3-1

SCALE: 1 in = 400 ft DRAWN BY: ACB

DATE: December 15, 2014 JOB NO.: 226617

DOC: 2014-11-18_Fig_3-1_Flow_Proj.mxd

Long Island Sound



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

3.3 SEASONAL FLOW VARIATIONS

Portions of the proposed Project Area include seasonal use. Since a good portion of the Project Area does not have metered drinking water, it is difficult to estimate current water consumption, future sanitary flows, and thus challenging to predict seasonal flow variations. It is our understanding that some of the residents close up their homes for the winter. Overall, the Town of Old Lyme estimates a 50% decline in population during the winter months. Based on data provided by the Town of East Lyme for the previously sewered Point-O-Woods neighborhood, where sewers were constructed approximately four years ago, actual wastewater flows are considerably lower than projected design flows. The average flow from May 2013 through August 2014 was approximately 20,000 gpd, which is approximately 19% of the 105,000 gpd design flow estimated during the design phase for that project. These seasonal flows are important to be considered when considering treatment and disposal alternatives and costs for the Local Alternatives, as well as the timing of downstream infrastructure needs (i.e. East Lyme, Waterford and New London) for the Regional Alternative.

Figure 3-2 presents the projected average daily flow, maximum daily flow, and peak hourly flow for the proposed Project Area. Figure 3-3 illustrates Point-O-Woods flow data from April 2013 to July 2014. Based on our review of the Point-O-Woods flow data, as well as discussions with CT-DEEP, we estimate that the Year One flow rates, upon completion of the sewer construction activities, will be approximately one third of the design flow projections. This data is shown, along with the design flows, in Figure 3-2.

Figure 3-2: Flow Projections for Project Area (Gravity Sewer System)

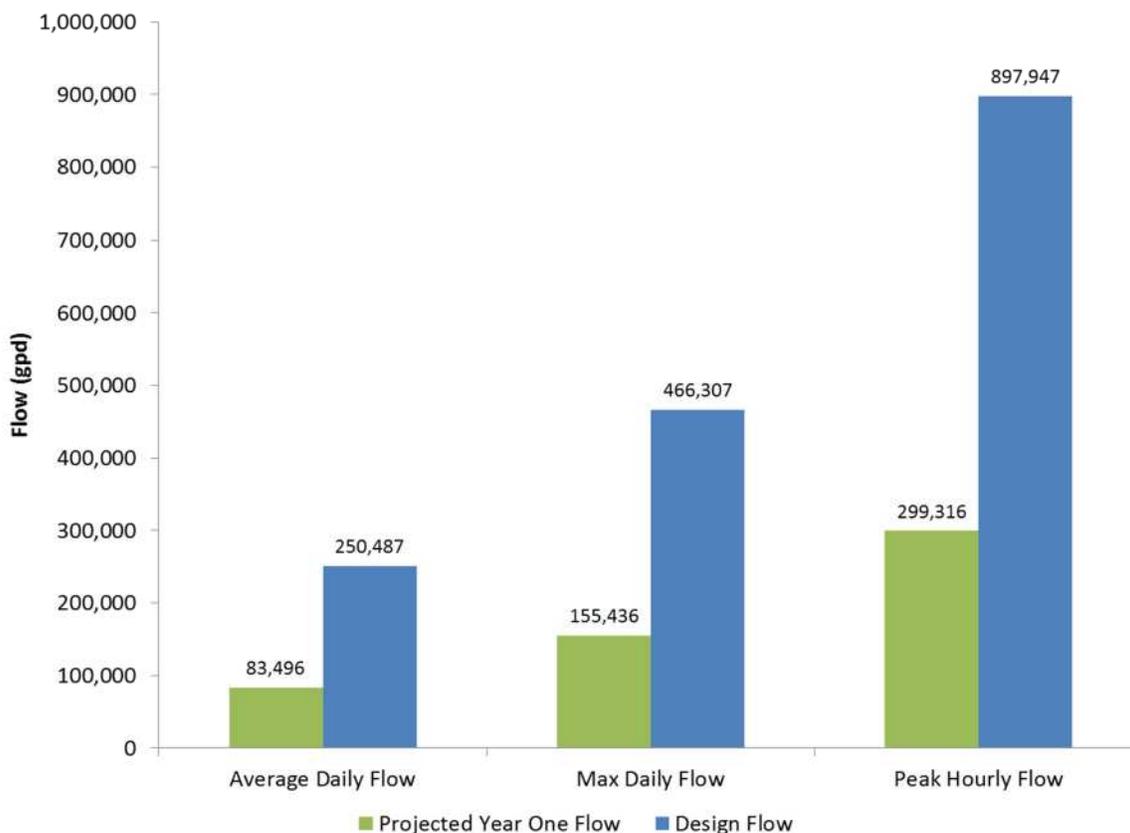
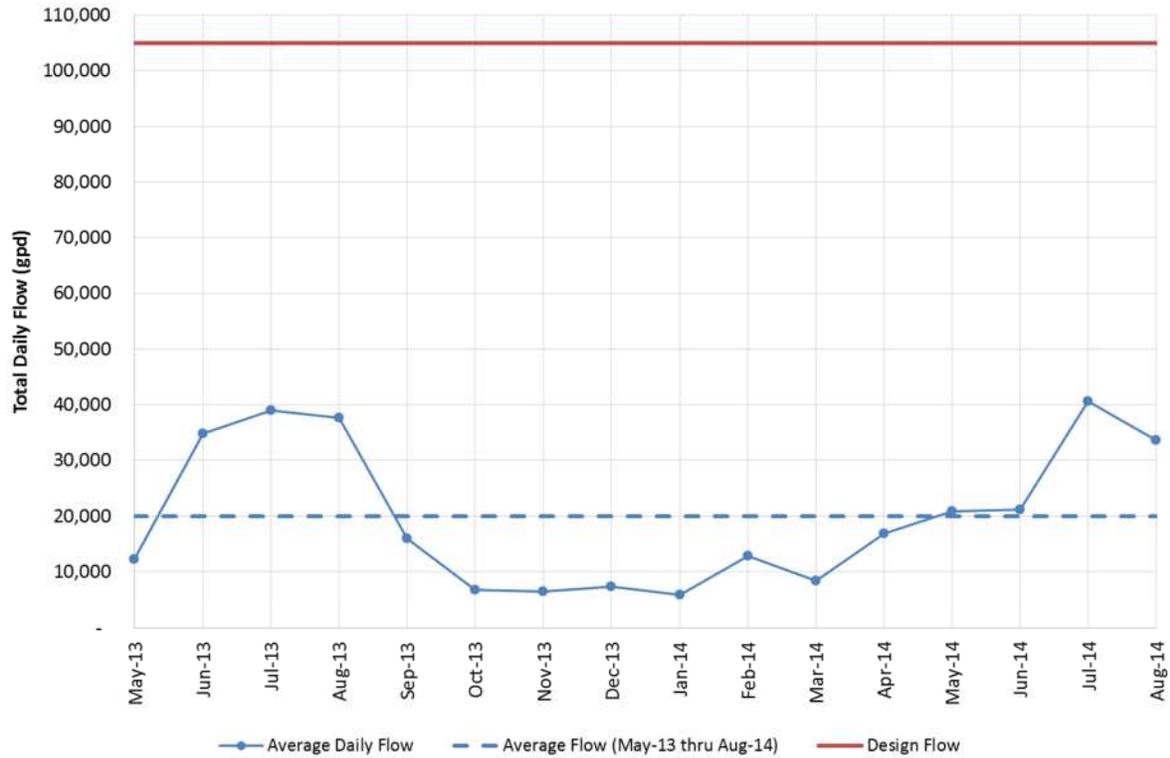


Figure 3-3: Flow Summary – Point-O-Woods



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 presents the overall wastewater management alternatives for the Project Area, including: (1) a Local Alternative with subsurface disposal and/or reuse; (2) a Local Alternative with surface disposal; and (3) a Regional Alternative.

4.2 WASTEWATER MANAGEMENT SYSTEMS OVERVIEW

Wastewater management systems consist of various infrastructure components which generally include: collection, treatment, disposal, and sometimes reuse. Figure 4-1 illustrates the wastewater management framework for these infrastructure 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 were explored as part of the planning phase.

For all of the alternatives, the collection, treatment, disposal and reuse components are driven by the location of the treatment system and disposal site. For example, the Regional Alternative is predicated on the use of the existing New London WPCF to treat wastewater from the Project Area. Both Local Alternatives on the other hand rely on the construction of a new WPCF in Old Lyme, coupled with either local subsurface disposal/reuse or surface disposal to a nearby surface water (i.e. Connecticut River). The difference between the two Local Alternatives is the location(s) where treated effluent is disposed of or reused.

4.3 LOCAL ALTERNATIVES

4.3.1 Local Alternative 1 with Subsurface Disposal and Reuse

Local Alternative 1 includes multiple collection, treatment, disposal and reuse options. Following is a brief overview of each component of Local Alternative 1:

- Collection and Transmission System: Collection will utilize sewer infrastructure within the Project Area to collect wastewater and convey it to a common point for transmission to the treatment location. The collection and transmission system alternatives are discussed in Chapter 5.
- Treatment: Treatment will be accomplished with 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. Treatment alternatives are discussed in Chapter 6.
- Disposal and Reuse: Disposal of treated effluent will be accomplished by discharging effluent into the ground, commonly referred to as subsurface disposal. To supplement disposal, effluent reuse for surface irrigation is a key component of the Local Alternative 1. Disposal and Reuse alternatives are discussed in Chapter 7.

4.3.2 Local Alternative 2 with Surface Disposal to the Connecticut River

Local Alternative 2 also includes multiple collection, treatment, and disposal options. Following is a brief overview of each component of this second Local Alternative:

- Collection and Transmission System Similar to Local Alternative 1: Collection will utilize sewer infrastructure within the Project Area to collect wastewater and convey it to a common point for transmission

to the treatment location. The collection and transmission system alternatives are identical to those identified for Local Alternative 1 and are discussed in Chapter 5.

- Treatment: Treatment will be accomplished with a local WPCF in Old Lyme. The level of treatment required will depend of the permit requirements associated with the permit issued for disposal. Treatment alternatives are identical to those identified for Local alternative 1 and are discussed in Chapter 6.
- Disposal: Disposal of treated effluent will be accomplished by discharging effluent to the Connecticut River. Disposal alternatives are discussed in Chapter 7.

Figure 4-2 summarizes the key components of collection, treatment, disposal and/or reuse infrastructure associated with both of the Local Alternatives.

4.4 REGIONAL ALTERNATIVE

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

- Collection and Transmission System: Similar to the Local Alternatives, collection for the Regional Alternative will utilize sewer infrastructure within the Project Area. In addition to the proposed transmission main from the Project Area to existing sewer in East Lyme, the Regional Alternative transmission system will use approximately ten miles of existing gravity sewer and force mains, and five existing pump stations in East Lyme, Waterford, and New London to convey wastewater to the New London WPCF. The collection and transmission system alternatives are discussed in Section 5.
- Treatment: Treatment will be accomplished at the existing WPCF in New London. New London has an existing NPDES permit dictating the level of treatment and permit criteria. The anticipated treatment requirements for the Local Alternative, and subsequent effluent quality, will depend on the selected treatment technology. Treatment alternatives are discussed in Chapter 6.
- Disposal: The New London WPCF performs surface water discharge of treated effluent to the Thames River, which is in close proximity to Long Island Sound.

Figure 4-3 depicts the key components of collection, treatment and disposal infrastructure associated with the Regional Alternative.

Figure 4-4 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 for the Local and Regional Alternatives were used in Sections 5, 6 and 7 to develop and evaluate specific alternatives and costs for both options.



Figure 4-1: Summary of Framework for Wastewater Management Alternatives in Old Lyme
 Wastewater Management Plan Project
 Town of Old Lyme, Connecticut

Updated on December 19, 2014

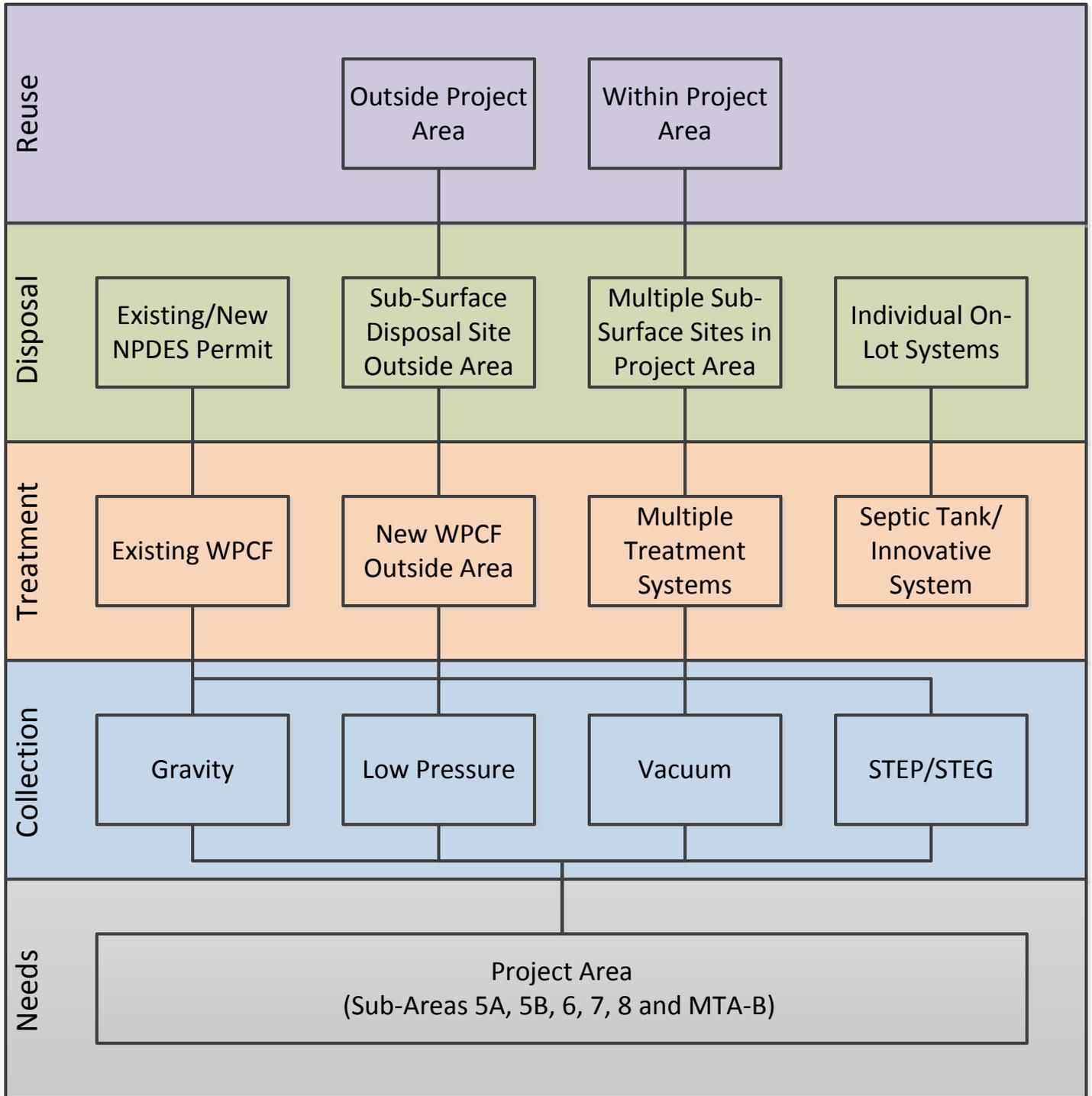


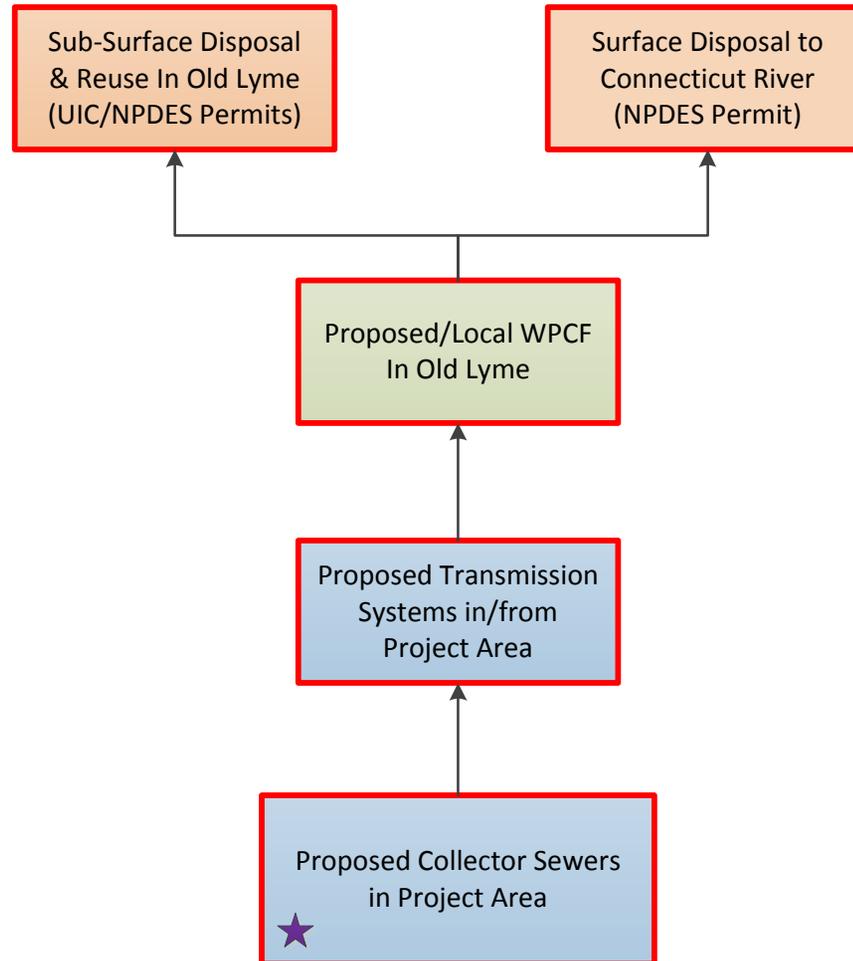


Figure 4-2: Local Alternatives Stick Diagram

Wastewater Management Plan Project

Town of Old Lyme, Connecticut

Updated on December 18, 2014



LEGEND:

- Collection Alternatives
- Treatment Alternatives
- Disposal/Reuse Alternatives
- Local Alternatives
- 1,199 EDUs Total

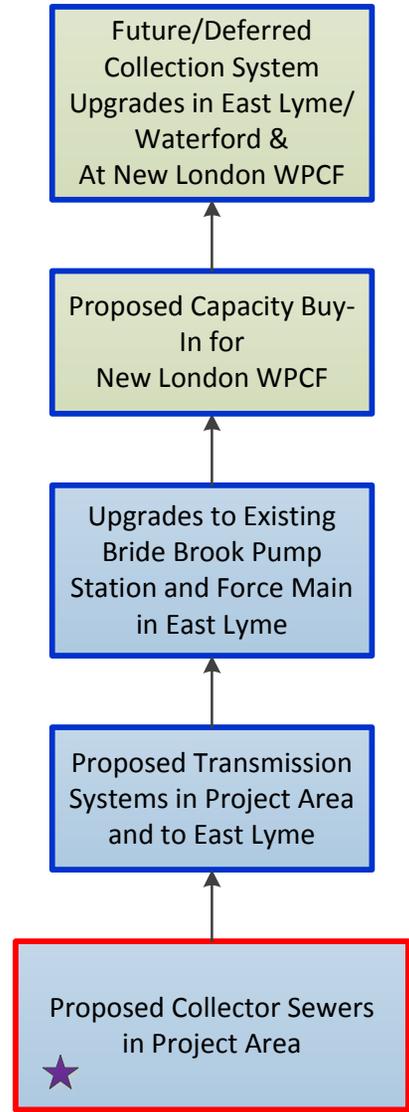


Figure 4-3: Regional Alternative Stick Diagram

Wastewater Management Plan Project

Town of Old Lyme, Connecticut

Updated on December 18, 2014



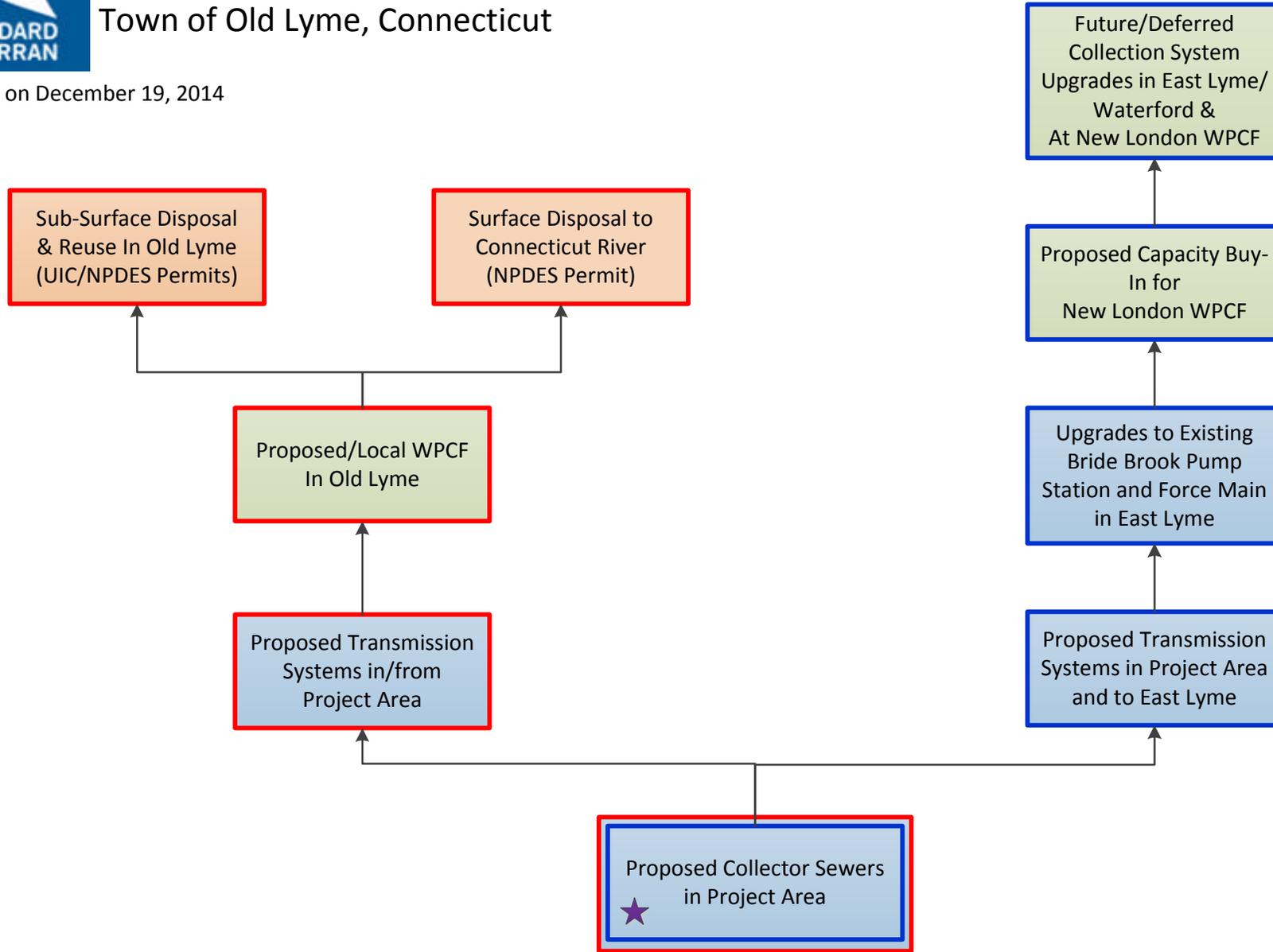
LEGEND:

- | | | | | | |
|--|-------------------------|---|-----------------------------|--|------------------|
|  | Collection Alternatives |  | Disposal/Reuse Alternatives |  | 1,199 EDUs Total |
|  | Treatment Alternatives |  | Local Alternatives | | |



Figure 4-4 – Summary of Local and Regional Alternatives Wastewater Management Plan Project Town of Old Lyme, Connecticut

Updated on December 19, 2014



LEGEND:

- Collection Alternatives
- Treatment Alternatives
- Disposal/Reuse Alternatives
- ★ 1,199 EDUs Total
- Local Alternatives
- Regional Alternatives

5. COLLECTION AND TRANSMISSION SYSTEM ALTERNATIVES

5.1 OVERVIEW

As part of the Coastal Wastewater Management Plan, we evaluated collection and transmission system alternatives and developed an opinion of probable cost (OPC) for each collection system (type and component) for both the Local and Regional Alternatives. This Section includes an overview of each collection and transmission system alternative, capital and annual operation and maintenance cost projections, as well as other non-cost considerations related to the collection and transmission system components for 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 low pressure system option includes the costs associated with the on-site grinder pumps, as well as electrical improvements in the home. However, all collection system alternatives exclude the cost of abandoning the existing septic system, and connecting the plumbing from the home to either the lateral stub or pumping unit.

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, a brief summary of each sewer system option follows.

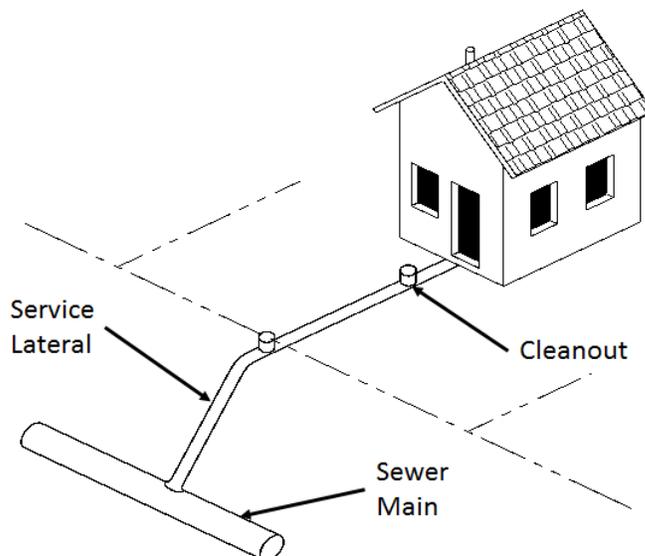
5.2.1 Gravity Sewer

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 sewer lateral for 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 the natural force of gravity to convey the wastewater.

5.2.2 Low Pressure Sewer

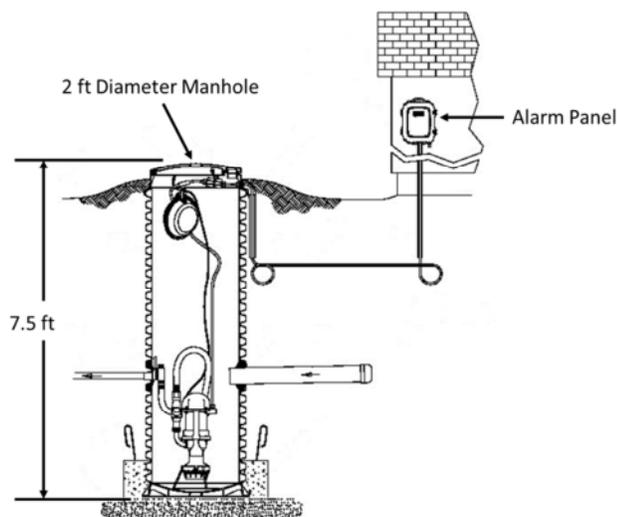
A low pressure system conveys wastewater through individual grinder pumps at each dwelling unit. The low pressure collection system relies on individual pumps and valves to each property. A typical low pressure sewer system is depicted in Figure 5-2. Due to the higher level of reliance on mechanical 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: Typical Gravity Sewer Service Lateral



Adapted from source: http://www.stpete.org/water/wwater_collection_and_maintenance.asp

Figure 5-2: Typical Low Pressure Sewer Grinder Pump System



Adapted from source: <http://thelakesatoxford.com/Sewer%20information/E-One%20manual.html>

5.2.3 Septic Tank Effluent Gravity Sewer

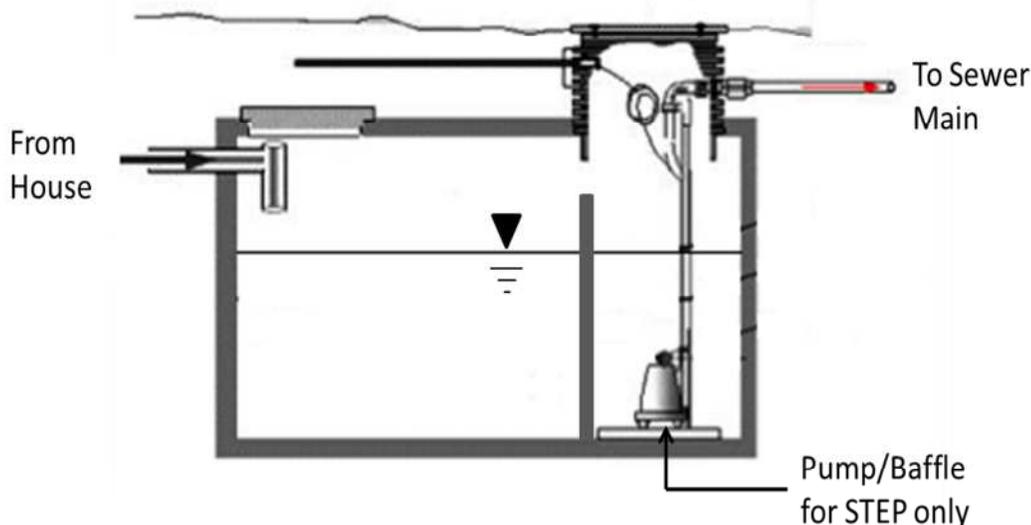
A septic tank effluent gravity (STEG) system incorporates a conventional on-site septic tank with a conventional gravity collection system. The purpose of a STEG system is to pre-treat the wastewater, reducing solids and the biological load that needs to be treated. For some smaller STEG systems, septic 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 poor soils and/or high 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 is based on 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: Typical STEG/STEP Septic Tank Configuration



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

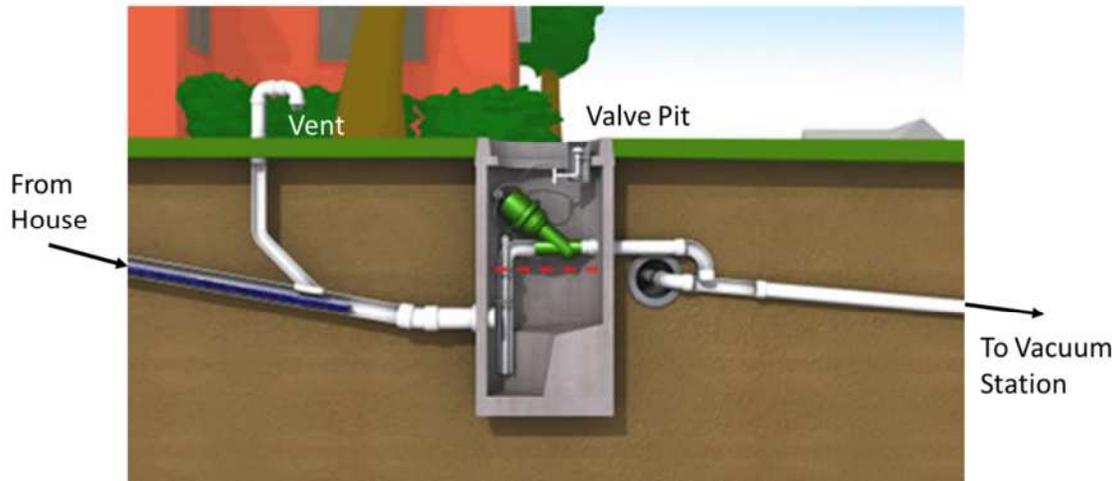
Adapted from source: <http://lillyseptic.com/septic-system-services/septic-tank-pumping-service/>

5.2.5 Vacuum Sewer

A vacuum sewer system is a unique sewer option that can be seen as a cross between a gravity system and a low pressure sewer system. This is because the collection system conveys flow from the home to the street line via gravity, and then 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 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. Vacuum sewer systems have a narrow hydraulic operating range

Figure 5-4: Typical Vacuum Sewer Lateral



Adapted from source: http://www.technohaus.ru/index.php?ukey=auxpage_ob-ugle-naklona-i-ego-rol-i-v-kanalizacionnoj-sisteme

5.3 COLLECTION SYSTEM ALTERNATIVE IN PROJECT AREA

The collection system alternatives within the Project Area are very similar for the Local and Regional Alternatives. Therefore, the following text highlights 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 coastal neighborhood

5.3.1 Gravity Alternative

In general, the Project Area would have one pump station set back from the shoreline where wastewater would flow by gravity, and then be pumped to an interceptor or common transmission system in or along Route 156. One advantage to a gravity system that directly relates to a shoreline community is its ability to be storm ready. With the majority of the Project Area adjacent to the ocean and in some cases adjacent to flood zones, a gravity system can be designed with flood-proof features including watertight manholes and backup generators at the pump stations that would keep the system functioning during severe weather events. A common disadvantage to a gravity type system is the elevated I/I potential, which can increase conveyance and treatment costs, entering the system.

Capital costs for the gravity system are presented in Table 5-1. Considerations for the gravity sewer capital costs include a cost per linear foot of gravity pipe installed, which incorporates installation of sewer services and sewer manholes. Preliminary layouts of the gravity system were prepared to estimate how many pump stations are required. It should be noted that the costs associated with connection of individual houses to the gravity sewer and the demolition and/or removal of the existing septic and/or leaching systems are not included.

5.3.2 Low Pressure System Alternative

Costs for a LPS system include the expenses for all equivalent dwelling units to have a grinder pump system installed at the house/building, which included an assumption that many of the homes would need electrical upgrades to accommodate the grinder 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. Note that the costs associated with the connection of individual houses to the low pressure system (LPS) and the demolition and/or removal of the existing septic and/or leaching systems are not included. However, and as mentioned before, the costs related to the installation of the grinder pumps, as well as anticipated electrical improvements in the home are included. Due to the density of development in the Project Area, and the number of grinder pumps required, the LPS costs are high. In addition, maintenance of grinder pumps during power outages would be operator intensive.

5.3.3 Septic Tank Effluent Gravity Alternative

Costs associated with a STEG system include the costs for a gravity system and additional costs for a new septic tank to be installed on many of the properties. 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. Note that the costs associated with the STEG sewer connection system to the individual houses and the demolition and/or removal of the existing septic and/or leaching systems are not included.

5.3.4 Septic Tank Effluent Pump Alternative

Costs incorporated with a STEP system include the LPS system components 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 STEP 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



Typical STEP Sewer Configuration. Source: http://www.orengo.com/systems/wastewater_collection.cfm

removal and less yearly chemical addition. Note that the costs associated with the STEP sewer connection system to the individual houses and the demolition and/or removal of the existing septic and/or leaching systems are not included.

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 size topography of the Project Area, as well as the distance from the East Lyme receiving systems.

5.4 TRANSMISSION SYSTEM INFRASTRUCTURE

Each of the Project Area Sub-Areas are evaluated independently for the 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 operating the system. To provide the best fit for the Project Area Sub-Areas by combining and conveying flows to a common wastewater treatment plant for the Local Alternative, or a common pump station for the Regional Alternative, the cost for a transmission system was estimated and preliminarily designed separately.

5.4.1 Local Alternative Transmission System

The Local Alternative transmission system would primarily be composed of a combination of force main and 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 5A and 5B. Table 5-5 includes a capital cost summary for the gravity/STEG transmission system associated with the Local Alternative. The costs for this option include one pump station at the Sound View Beach Association (Sub-Area 6) to convey flows from the Project Area Sub-Areas to the proposed Water Pollution Control Facility (WPCF). Table 5-6 includes a capital cost summary for the LPS/STEP transmission system associated with the Local Alternative. This option would potentially not need any additional pump station to convey the flows to the gravity sewer in Route 156. Figure 5-5 shows the proposed transmission system for the local alternatives.

5.4.2 Regional Alternative Transmission System

The Regional Alternative transmission system would convey wastewater in a similar configuration as the Local Alternative. The wastewater would be conveyed primarily through a force main to a common pump station, potentially located in Sub-Area 6, as shown in Figure 5-6. The Regional Alternative transmission system differs from the Local Alternative transmission system by the additional 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 plus any additional force main costs to account for the assumed location of the common pump station in Sub-Area 6.

Table 5-7 includes a capital cost summary for the gravity/STEG transmission system associated with the Regional alternative, and Table 5-8 summarizes the capital cost for the LPS/STEP transmission system associated with the Regional Alternative.

5.4.3 Odor Control Measures For the Transmission System

Based on the length of the proposed force main from the proposed Old Lyme Pump Station to the East Lyme collection system, coupled with the seasonal flow variations, the elevated hydraulic residence time in the force main, may result in the potential generation of hydrogen sulfide. Hydrogen sulfide can lead to odors and corrosion problems

downstream. Therefore, the proposed Project includes several measures to minimize odor and corrosion potential. These include:

- Since the Year 1 flows following construction will likely be far lower than the projected design flows for the entire Project Area, we have incorporated two parallel force mains between the pump station and the East Lyme collection system. The smaller 6-inch diameter pipe will convey low flows in initial years, as well as off-peak seasonal flows during winter months. This will significantly decrease the hydraulic residence time in the pipe and decrease the potential for odors and corrosion. As flows increase, and during peak summer months, the second larger (10-inch) force main will convey flows, maintaining a higher pumping rate.
- In addition to the two force mains, provisions for an odor control chemical (i.e. Bioxide) will be integrated in the Pump Station design. This will minimize the potential for odors at the Pump Station, especially during warmer months.
- Lastly, a second chemical facility, located along the force main near Route 156, will provide additional odor control provisions, to minimize the potential for odor and corrosion concerns at the downstream discharge in East Lyme.

It should be noted that the increase in flows to the East Lyme and Waterford pump stations will increase average daily flows through the system, absent increases in pumping rates, and therefore the potential for odors and corrosion in downstream receiving sewers should actually decrease following connection of the Old Lyme system to the downstream sewers.

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 5-9.

As part of this project, we reviewed available wastewater flow data for the Point-of-Woods sewer system. Roughly four years after sewers were constructed in Point-of-Woods, average annual flows are approximately 20% of the design flows estimated during the planning phase for that project. Since the Town's current project included similar flow criteria as did Point-of-Woods, we believe that Year 1 flows following construction will be much lower than design flow estimates. For the purpose of estimating flows and respective O&M costs, we assumed that Year 1 flows would be approximately one-third (33%) of the design flow estimate. Therefore, the annual costs associated with the project, which will be based on gallons-used, will be much lower in initial years following construction than they may be 5 to 10 years after sewers are constructed.

5.6 REGIONAL ALTERNATIVE SEWER SYSTEM CONFIGURATIONS

The Regional Alternative collection system facilities comprise the future individual Sub-Area collection systems, the future regional transmission system in Old Lyme, as well as the existing downstream conveyance infrastructure, which is comprised of approximately 10 miles of existing force main and gravity sewers to get to the New London Water Pollution Control Facility (WPCF). As shown in Figure 5-7, the collection system route to New London also consists of five downstream pump stations in East Lyme and Waterford (Bride Brook, Route 156, Pattagansett, Niantic, and Evergreen pump stations).

The collection system for the Regional Alternative includes the majority of the potential capital and annual costs. This is attributed to the overall distance the wastewater would need to travel, as shown in Figures 5-6 and 5-7. To best match the current agreement between Point-O-Woods and East Lyme, capital and annual costs were estimated 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 conservative price sharing contingency for Old Lyme flows,

due to the accelerated timing of capacity upgrades in East Lyme. Based on discussion with CT-DEEP, East Lyme and Waterford, future downstream capital cost upgrades will be implemented on as-needed basis as Old Lyme flows increase to projected design capacities.

5.6.1 Downstream Sewers in East Lyme and Waterford

Table 5-10 depicts the capacities and flows for each of the downstream community pump stations, the downstream communities' future needs, and the additional flows the Project Area would reflect on each pump station. As shown in Table 5-10, the Old Lyme flow contribution from the Project Area is estimated under two different flow conditions: (1) flows expected one year after project completion (Year One flows) and (2) design flows, which correspond to complete community connection to sewer within the Project Area. As discussed in Section 3.3, Year One flow is expected to be approximately one third of the Project Area design flow, based on data collected from Point O' Woods. The basis of Table 5-10 is 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 mentioned in section 5-4, we are planning to incorporate two parallel force mains (6" and 10") between the pump station and the East Lyme collection system. This will allow Old Lyme to minimize peak flows to East Lyme until the flows go above 33% of design projections. This could be several years down the road, if consistent with post-construction flow trends from Point-O-Woods.

As shown in Table 5-10 and based on Year-1 flow projections, it does not appear that any of the East Lyme pump stations will be above their rated capacities. However, we did include relocation and replacement of the Bride Brook Pump Station, per the on-going mechanical and hydraulic limitations, as part of the proposed Project.

Table 5-11 summarizes the downstream infrastructure capital needs for the Regional Alternative. As shown, all capital needs for the downstream infrastructure, except Bride Brook pump station and force main, are to be deferred and will implemented on an as needed basis, to be discussed with East Lyme and Waterford.

Table 5-11 also shows the assumed percentage of costs that would be allocated to the Project Area, as percentage of peak hourly design flow. The downstream pump station, force main, and collection system gravity main upgrades contribute to the cost of the Regional Alternative capital collection system costs.

Table 5-1: Capital Costs for Gravity Sewer Alternative – Collector Sewer

| Gravity Sewer Items | Unit | Unit Price | Sub-Area | | | | | | | | | | | |
|---|------|------------|------------------|--------------------|-----------------------|--------------------|----------------------|--------------------|---------------------------|--------------------|---------------------------|--------------------|---------------------|--------------------|
| | | | 5A - Miami Beach | | 5B - Hawks Nest Beach | | 6 - Sound View Beach | | 7 - Old Colony Beach Club | | 8 - Old Lyme Shores Beach | | Misc. Town Area B | |
| Equivalent Dwelling Units | | | 236 | | 269 | | 229 | | 218 | | 206 | | 41 | |
| | | | Qty | Total | Qty | Total | Qty | Total | Qty | Total | Qty | Total | Qty | Total |
| 8" Gravity Pipe ¹ | LF | \$100 | 11,800 | \$1,180,000 | 11,600 | \$1,160,000 | 5,900 | \$590,000 | 6,600 | \$660,000 | 9,600 | \$960,000 | 4,200 | \$420,000 |
| 12" Gravity Pipe ¹ | LF | \$125 | 1,700 | \$213,000 | 800 | \$100,000 | 700 | \$88,000 | 800 | \$100,000 | 700 | \$88,000 | 0 | \$0 |
| Trench Repair ² | LF | \$20 | 13,500 | \$270,000 | 12,400 | \$248,000 | 6,600 | \$132,000 | 7,400 | \$148,000 | 10,300 | \$206,000 | 4,200 | \$84,000 |
| Milling ³ | LF | \$35 | 13,500 | \$473,000 | 12,400 | \$434,000 | 6,600 | \$231,000 | 7,400 | \$259,000 | 10,300 | \$361,000 | 4,200 | \$147,000 |
| Full Width Overlay | LF | \$35 | 13,500 | \$473,000 | 12,400 | \$434,000 | 6,600 | \$231,000 | 7,400 | \$259,000 | 10,300 | \$361,000 | 4,200 | \$147,000 |
| Rock Excavation ⁴ | CY | \$70 | 2,500 | \$175,000 | 2,300 | \$161,000 | 1,200 | \$84,000 | 1,400 | \$98,000 | 1,900 | \$133,000 | 800 | \$56,000 |
| Trench Dewatering | LF | \$40 | 13,500 | \$540,000 | 12,400 | \$496,000 | 6,600 | \$264,000 | 7,400 | \$296,000 | 10,300 | \$412,000 | 4,200 | \$168,000 |
| Environmental Protection | LF | \$10 | 3,375 | \$34,000 | 3,100 | \$31,000 | 1,650 | \$17,000 | 1,850 | \$19,000 | 2,575 | \$26,000 | 1,050 | \$11,000 |
| Police Detail ⁵ | Days | \$960 | 284 | \$273,000 | 260 | \$250,000 | 139 | \$133,000 | 155 | \$149,000 | 216 | \$207,000 | 88 | \$84,000 |
| Subtotal | | | | \$3,631,000 | | \$3,314,000 | | \$1,770,000 | | \$1,988,000 | | \$2,754,000 | | \$1,117,000 |
| 40% Contingency, Legal and Engineering Services | | | | \$1,452,000 | | \$1,326,000 | | \$708,000 | | \$795,000 | | \$1,102,000 | | \$447,000 |
| TOTAL⁶ | | | | \$5,083,000 | | \$4,640,000 | | \$2,478,000 | | \$2,783,000 | | \$3,856,000 | | \$1,564,000 |
| Combined Project Area⁷ | | | | | | | | | | | | | \$20,404,000 | |

1. Sewer Manholes and Service lateral stubs are included in the unit cost of gravity piping
2. Trench Repair assumes 3" of pavement at 6.5 ft wide
3. Milling assumes 1.5" of pavement at full width of the road
4. Rock Excavation is assumed to be a 1 foot depth for every linear feet of trench for Gravity Piping
5. Assuming pipe is laid at a rate of 100 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge \$60/hr at 8 hr/day
6. All Totals rounded to the nearest \$1,000
7. Costs associated with the connection of individual houses to the gravity sewer and the demolition and/or removal of existing septic and/or leaching systems are not included

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

| Low Pressure Sewer Items | Unit | Unit Price | Sub-Area | | | | | | | | | | | |
|---|------|------------|------------------|--------------------|-----------------------|--------------------|----------------------|--------------------|---------------------------|--------------------|---------------------------|---------------------|-------------------|--------------------|
| | | | 5A - Miami Beach | | 5B - Hawks Nest Beach | | 6 - Sound View Beach | | 7 - Old Colony Beach Club | | 8 - Old Lyme Shores Beach | | Misc. Town Area B | |
| Equivalent Dwelling Units | | | 236 | | 269 | | 229 | | 218 | | 206 | | 41 | |
| | Unit | Unit Price | Qty | Total | Qty | Total | Qty | Total | Qty | Total | Qty | Total | Qty | Total |
| 1.5"-6" PVC Force Main ¹ | LF | \$40 | 13,600 | \$544,000 | 12,400 | \$496,000 | 6,500 | \$260,000 | 7,400 | \$296,000 | 10,300 | \$412,000 | 4,200 | \$168,000 |
| Grinder Pumps ² | EA | \$7,000 | 236 | \$1,652,000 | 269 | \$1,883,000 | 229 | \$1,603,000 | 218 | \$1,526,000 | 206 | \$1,442,000 | 41 | \$287,000 |
| Electrical Panel Upgrades ² | EA | \$2,000 | 59 | \$118,000 | 67 | \$135,000 | 57 | \$115,000 | 55 | \$109,000 | 52 | \$103,000 | 10 | \$21,000 |
| Trench Repair ³ | LF | \$20 | 13,600 | \$272,000 | 12,400 | \$248,000 | 6,500 | \$130,000 | 7,400 | \$148,000 | 10,300 | \$206,000 | 4,200 | \$84,000 |
| Milling ⁴ | LF | \$35 | 13,600 | \$476,000 | 12,400 | \$434,000 | 6,500 | \$228,000 | 7,400 | \$259,000 | 10,300 | \$361,000 | 4,200 | \$147,000 |
| Full Width Overlay | LF | \$35 | 13,600 | \$476,000 | 12,400 | \$434,000 | 6,500 | \$228,000 | 7,400 | \$259,000 | 10,300 | \$361,000 | 4,200 | \$147,000 |
| Rock Excavation ⁵ | CY | \$70 | 1,300 | \$91,000 | 1,100 | \$77,000 | 600 | \$42,000 | 700 | \$49,000 | 1,000 | \$70,000 | 400 | \$28,000 |
| Trench Dewatering | LF | \$20 | 13,600 | \$272,000 | 12,400 | \$248,000 | 6,500 | \$130,000 | 7,400 | \$148,000 | 10,300 | \$206,000 | 4,200 | \$84,000 |
| Environmental Protection | LF | \$10 | 3,400 | \$34,000 | 3,100 | \$31,000 | 1,625 | \$16,000 | 1,850 | \$19,000 | 2,575 | \$26,000 | 1,050 | \$11,000 |
| Police Detail ⁶ | Days | \$960 | 286 | \$275,000 | 219 | \$210,000 | 115 | \$110,000 | 131 | \$126,000 | 182 | \$175,000 | 74 | \$71,000 |
| Subtotal | | | | \$4,210,000 | | \$4,196,000 | | \$2,862,000 | | \$2,939,000 | | \$3,362,000 | | \$1,048,000 |
| 40% Contingency, Legal and Engineering Services | | | | \$1,684,000 | | \$1,678,000 | | \$1,145,000 | | \$1,176,000 | | \$1,345,000 | | \$419,000 |
| TOTAL⁷ | | | | \$5,894,000 | | \$5,874,000 | | \$4,007,000 | | \$4,115,000 | | \$4,707,000 | | \$1,467,000 |
| Combined Project Area⁸ | | | | | | | | | | | | \$26,064,000 | | |

1. PVC unit costs include all cleanouts, valve connections and vaults
2. Grinder pump unit costs include installation. Electrical panel upgrades are assumed to be required by 1/4 of homes
3. Trench Repair assumes 3" of pavement at 6.5 ft wide
4. Milling assumes 1.5" of pavement at full width of the road
5. Rock Excavation is assumed to be a 0.5 foot depth for every linear feet of trench for LPS Piping
6. Assuming pipe is laid at a rate of 150ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge \$60/hr at 8 hr/day
7. All Totals rounded to the nearest \$1,000
8. Costs associated with the connection of individual houses to the LPS and the demolition and/or removal of existing septic and/or leaching systems are not included

Table 5-3: Capital Costs for STEG Sewer Alternative – Collector Sewer

| STEG Sewer Items | Unit | Unit Price | Sub-Area | | | | | | | | | | | |
|---|------|------------|------------------|--------------------|-----------------------|--------------------|----------------------|--------------------|---------------------------|--------------------|---------------------------|---------------------|-------------------|--------------------|
| | | | 5A - Miami Beach | | 5B - Hawks Nest Beach | | 6 - Sound View Beach | | 7 - Old Colony Beach Club | | 8 - Old Lyme Shores Beach | | Misc. Town Area B | |
| Equivalent Dwelling Units | | | 236 | | 269 | | 229 | | 218 | | 206 | | 41 | |
| | | | Qty | Total | Qty | Total | Qty | Total | Qty | Total | Qty | Total | Qty | Total |
| 8" Gravity Pipe ¹ | LF | \$100 | 13,000 | \$1,300,000 | 6,400 | \$640,000 | 6,300 | \$630,000 | 6,800 | \$680,000 | 9,600 | \$960,000 | 2,500 | \$250,000 |
| 12" Gravity Pipe ¹ | LF | \$125 | 2,200 | \$275,000 | 3,400 | \$425,000 | 200 | \$25,000 | 800 | \$100,000 | 700 | \$88,000 | 0 | \$0 |
| Septic Tanks ² | EA | \$4,500 | 118 | \$531,000 | 135 | \$605,000 | 115 | \$515,000 | 109 | \$491,000 | 103 | \$464,000 | 21 | \$92,000 |
| Trench Repair ³ | LF | \$20 | 15,200 | \$304,000 | 9,800 | \$196,000 | 6,500 | \$130,000 | 7,600 | \$152,000 | 10,300 | \$206,000 | 2,500 | \$50,000 |
| Milling ⁴ | LF | \$35 | 15,200 | \$532,000 | 9,800 | \$343,000 | 6,500 | \$228,000 | 7,600 | \$266,000 | 10,300 | \$361,000 | 2,500 | \$88,000 |
| Full Width Overlay | LF | \$35 | 15,200 | \$532,000 | 9,800 | \$343,000 | 6,500 | \$228,000 | 7,600 | \$266,000 | 10,300 | \$361,000 | 2,500 | \$88,000 |
| Rock Excavation ⁵ | CY | \$70 | 2,800 | \$196,000 | 1,800 | \$126,000 | 1,200 | \$84,000 | 1,400 | \$98,000 | 1,900 | \$133,000 | 500 | \$35,000 |
| Trench Dewatering | LF | \$40 | 15,200 | \$608,000 | 9,800 | \$392,000 | 6,500 | \$260,000 | 7,600 | \$304,000 | 10,300 | \$412,000 | 2,500 | \$100,000 |
| Environmental Protection | LF | \$10 | 3,800 | \$38,000 | 2,450 | \$25,000 | 1,625 | \$16,000 | 1,900 | \$19,000 | 2,575 | \$26,000 | 625 | \$6,000 |
| Police Detail ⁶ | Days | \$960 | 152 | \$146,000 | 98 | \$94,000 | 65 | \$62,000 | 76 | \$73,000 | 103 | \$99,000 | 25 | \$24,000 |
| Subtotal | | | | \$4,462,000 | | \$3,189,000 | | \$2,178,000 | | \$2,449,000 | | \$3,110,000 | | \$733,000 |
| 40% Contingency, Legal and Engineering Services | | | | \$1,785,000 | | \$1,276,000 | | \$871,000 | | \$980,000 | | \$1,244,000 | | \$293,000 |
| TOTAL⁷ | | | | \$6,247,000 | | \$4,465,000 | | \$3,049,000 | | \$3,429,000 | | \$4,354,000 | | \$1,026,000 |
| Combined Project Area⁸ | | | | | | | | | | | | \$22,570,000 | | |

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. Trench Repair assumes 3" of pavement at 6.5 ft wide

4. Milling assumes 1.5" of pavement at full width of the road

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

6. Assuming pipe is laid at a rate of 100 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge \$60/hr at 8 hr/day

7. All Totals rounded to the nearest \$1,000

8. Costs associated with the connection of individual houses to the STEG sewer and the demolition and/or removal of existing septic and/or leaching systems are not included

Table 5-4: Capital Costs for STEP Sewer Alternative – Collector Sewer

| STEP Sewer Items | Unit | Unit Price | Sub-Area | | | | | | | | | | | |
|---|------|------------|------------------|--------------------|-----------------------|--------------------|----------------------|--------------------|---------------------------|--------------------|---------------------------|---------------------|-------------------|---------------------|
| | | | 5A - Miami Beach | | 5B - Hawks Nest Beach | | 6 - Sound View Beach | | 7 - Old Colony Beach Club | | 8 - Old Lyme Shores Beach | | Misc. Town Area B | |
| Equivalent Dwelling Units | | | 236 | | 269 | | 229 | | 218 | | 206 | | 41 | |
| | Unit | Unit Price | Qty | Total | Qty | Total | Qty | Total | Qty | Total | Qty | Total | Qty | Total |
| 1.5"-6" PVC Force Main ¹ | LF | \$40 | 13,600 | \$544,000 | 12,400 | \$496,000 | 6,500 | \$260,000 | 7,400 | \$296,000 | 10,300 | \$412,000 | 4,200 | \$168,000 |
| Grinder Pumps ² | EA | \$7,000 | 236 | \$1,652,000 | 269 | \$1,883,000 | 229 | \$1,603,000 | 218 | \$1,526,000 | 206 | \$1,442,000 | 41 | \$287,000 |
| Electrical Panel Upgrades ² | EA | \$2,000 | 59 | \$118,000 | 67 | \$135,000 | 57 | \$115,000 | 55 | \$109,000 | 52 | \$103,000 | 10 | \$21,000 |
| Septic Tanks ³ | EA | \$4,500 | 118 | \$531,000 | 135 | \$605,000 | 115 | \$515,000 | 109 | \$491,000 | 103 | \$464,000 | 21 | \$92,000 |
| Trench Repair ⁴ | LF | \$20 | 13,600 | \$272,000 | 12,400 | \$248,000 | 6,500 | \$130,000 | 7,400 | \$148,000 | 10,300 | \$206,000 | 4,200 | \$84,000 |
| Milling ⁵ | LF | \$35 | 13,600 | \$476,000 | 12,400 | \$434,000 | 6,500 | \$228,000 | 7,400 | \$259,000 | 10,300 | \$361,000 | 4,200 | \$147,000 |
| Full Width Overlay | LF | \$35 | 13,600 | \$476,000 | 12,400 | \$434,000 | 6,500 | \$228,000 | 7,400 | \$259,000 | 10,300 | \$361,000 | 4,200 | \$147,000 |
| Rock Excavation ⁶ | CY | \$70 | 1,300 | \$91,000 | 1,100 | \$77,000 | 600 | \$42,000 | 700 | \$49,000 | 1,000 | \$70,000 | 400 | \$28,000 |
| Trench Dewatering | LF | \$20 | 13,600 | \$272,000 | 12,400 | \$248,000 | 6,500 | \$130,000 | 7,400 | \$148,000 | 10,300 | \$206,000 | 4,200 | \$84,000 |
| Environmental Protection | LF | \$10 | 3,400 | \$34,000 | 3,100 | \$31,000 | 1,625 | \$16,000 | 1,850 | \$19,000 | 2,575 | \$26,000 | 1,050 | \$11,000 |
| Police Detail ⁷ | Days | \$960 | 240 | \$230,000 | 219 | \$210,000 | 115 | \$110,000 | 131 | \$126,000 | 182 | \$175,000 | 74 | \$71,000 |
| Subtotal | | | | \$4,696,000 | | \$4,801,000 | | \$3,377,000 | | \$3,430,000 | | \$3,826,000 | | \$1,140,000 |
| 40% Contingency, Legal and Engineering Services | | | | \$1,878,000 | | \$1,920,000 | | \$1,351,000 | | \$1,372,000 | | \$1,530,000 | | \$456,000 |
| TOTAL⁸ | | | | \$6,574,000 | | \$6,721,000 | | \$4,728,000 | | \$4,802,000 | | \$5,356,000 | | \$ 1,596,000 |
| Combined Project Area⁹ | | | | | | | | | | | | \$29,777,000 | | |

1. PVC unit costs include all cleanouts, valve connections and vaults
2. Grinder pump unit costs include installation. Electrical panel upgrades are assumed to be required by 1/4 of homes
3. Septic tank unit costs include installation and are assumed for 50% of all existing homes
4. Trench Repair assumes 3" of pavement at 6.5 ft wide
5. Milling assumes 1.5" of pavement at full width of the road
6. Rock Excavation is assumed to be a 0.5 foot depth for every linear feet of trench for LPS Piping
7. Assuming pipe is laid at a rate of 150 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge \$60/hr at 8 hr/day
8. All Totals rounded to the nearest \$1,000
9. Costs associated with the connection of individual houses to the STEP sewer and the demolition and/or removal of existing septic and/or leaching systems are not included

Table 5-5: Capital Costs for Local Alternative Gravity/STEG Transmission System

| Sub-Areas | | 5A, 5B, 6, 7, 8 and MTA-B | |
|--|-------------|---------------------------|--------------------|
| Dwelling Units | | 1,199 | |
| Item Description | Unit Cost | Qty | Total |
| 12" Gravity Pipe (LF) | \$125 | 2,422 | \$303,000 |
| Forcemain 6"-8" (LF) | \$50 | 1,950 | \$98,000 |
| Pump Stations (EA) | \$1,300,000 | 1 | \$1,300,000 |
| Trench Repair ¹ (LF) | \$15 | 4,372 | \$66,000 |
| Permanent Trench Paving ² (LF) | \$20 | 4,372 | \$87,000 |
| Milling ³ (LF) | \$20 | 4,372 | \$87,000 |
| Rock Excavation ⁴ (CY) | \$70 | 400 | \$28,000 |
| Trench Dewatering (LF) | \$40 | 4,372 | \$175,000 |
| Environmental Protection (LF) | \$10 | 618 | \$6,000 |
| Police Detail (Days) ⁵ | \$960 | 85 | \$82,000 |
| Subtotal | | | \$2,232,000 |
| 40% Contingency, Legal, & Engineering Services | | | \$893,000 |
| TOTAL | | | \$3,125,000 |

1. Trench Repair assumes 3" of pavement repair at a 6.5 ft width
2. Permanent Trench Paving assumes 2" of pavement and 15 ft wide travel lane
3. Milling assumes 15 ft wide travel lane for all state roads
4. Assumes 0.5 feet of rock per every LF of trench (5 foot trench)
5. Assuming gravity pipe is laid at a rate of 100 ft/day, forcemain at 150 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge \$60/hr at 8 hr/day

Table 5-6: Capital Costs for Local Alternative LPS/STEP Transmission System

| Sub-Areas | | 5A, 5B, 6, 7, 8 and MTA-B | |
|--|-----------|---------------------------|------------------|
| Dwelling Units | | 1,199 | |
| Item Description | Unit Cost | Qty | Total |
| 12" Gravity Pipe (LF) | \$125 | 2,422 | \$303,000 |
| Trench Repair ¹ (LF) | \$15 | 2,422 | \$36,000 |
| Permanent Trench Paving ² (LF) | \$20 | 2,422 | \$48,000 |
| Milling ³ (LF) | \$20 | 2,422 | \$48,000 |
| Rock Excavation ⁴ (CY) | \$70 | 200 | \$14,000 |
| Trench Dewatering (LF) | \$20 | 2,422 | \$48,000 |
| Environmental Protection (LF) | \$10 | 606 | \$6,000 |
| Police Detail (Days) ⁵ | \$960 | 51 | \$49,000 |
| Subtotal | | | \$552,000 |
| 40% Contingency, Legal, & Engineering Services | | | \$221,000 |
| TOTAL | | | \$773,000 |

1. Trench Repair assumes 3" of pavement repair at a 6.5 ft width
2. Permanent Trench Paving assumes 2" of pavement and 15 ft wide travel lane
3. Milling assumes 15 ft wide travel lane for all state roads
4. Assumes 0.5 feet of rock per every LF of trench (5 foot trench)
5. Assuming gravity pipe is laid at a rate of 100 ft/day, forcemain at 150 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge \$60/hr at 8 hr/day

Table 5-7: Capital Costs for Regional Alternative Gravity/STEG Transmission System

| Sub-Areas | | 5A, 5B, 6, 7, 8 and MTA-B | |
|--|-------------|---------------------------|---------------------|
| Dwelling Units | | 1,199 | |
| Item Description | Unit Cost | Qty | Total |
| 6" Force Main ¹ (LF) | \$35 | 15,760 | \$552,000 |
| 10" Force Main ¹ (LF) | \$45 | 15,760 | \$709,000 |
| Pump Stations (EA) | \$1,500,000 | 1 | \$1,500,000 |
| Odor Control | \$400,000 | 1 | \$400,000 |
| Air Release Manholes | \$15,000 | 6 | \$90,000 |
| Trench Repair ² (LF) | \$15 | 15,760 | \$236,000 |
| Permanent Trench Paving ³ (LF) | \$20 | 15,760 | \$315,000 |
| Milling ⁴ (LF) | \$20 | 15,760 | \$315,000 |
| Rock Excavation ⁵ (CY) | \$70 | 1,500 | \$105,000 |
| Stream Crossing ⁶ (EA) | \$30,000 | 3 | \$90,000 |
| Railroad Bridge Crossing Premium ⁶ (EA) | \$200,000 | 1 | \$200,000 |
| Trench Dewatering (LF) | \$40 | 31,520 | \$1,261,000 |
| Environmental Protection (LF) | \$10 | 3,940 | \$39,000 |
| Police Detail ⁷ (Days) | \$960 | 278 | \$267,000 |
| Sub- Totals | | | \$6,079,000 |
| 40% Contingency, Legal, & Engineering Services | | | \$2,432,000 |
| TOTAL | | | \$ 8,511,000 |

1. 6" and 10" Force Mains laid in same trench to accommodate seasonal flow variations

2. Trench Repair assumes 3" of pavement repair at a 6.5 ft width

3. Permanent Trench Pavement assumes 2" of pavement and 15 ft wide travel lane

4. Milling assumes 15 ft wide travel lane for all state roads

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

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

7. Assuming forcemain is laid at a rate of 150 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge \$60/hr at 8 hr/day

Table 5-8: Capital Costs for Regional Alternative LPS/STEP Transmission System

| Sub-Areas | | 5A, 5B, 6, 7, 8 and MTA-B | |
|--|-------------|---------------------------|--------------------|
| Dwelling Units | | 1,199 | |
| Item Description | Unit Cost | Qty | Total |
| 6" Force Main ¹ (LF) | \$35 | 15,760 | \$552,000 |
| 10" Force Main ¹ (LF) | \$45 | 15,760 | \$709,000 |
| Pump Stations (EA) | \$1,500,000 | 1 | \$1,500,000 |
| Odor Control | \$400,000 | 1 | \$400,000 |
| Air Release Manholes | \$15,000 | 6 | \$90,000 |
| Trench Repair ² (LF) | \$15 | 15,760 | \$236,000 |
| Permanent Trench Paving ³ (LF) | \$20 | 15,760 | \$315,000 |
| Milling ⁴ (LF) | \$20 | 15,760 | \$315,000 |
| Rock Excavation ⁵ (CY) | \$70 | 1,500 | \$105,000 |
| Stream Crossing ⁶ (EA) | \$30,000 | 3 | \$90,000 |
| Railroad Bridge Crossing Premium ⁶ (EA) | \$200,000 | 1 | \$200,000 |
| Trench Dewatering (LF) | \$20 | 31,520 | \$630,000 |
| Environmental Protection (LF) | \$10 | 3,940 | \$39,000 |
| Police Detail ⁷ (Days) | \$960 | 278 | \$267,000 |
| Sub- Totals | | | \$5,448,000 |
| 40% Contingency, Legal, & Engineering Services | | | \$2,179,000 |
| TOTAL | | | \$7,627,000 |

1. 6" and 10" Force Mains laid in same trench to accommodate seasonal flow variations

2. Trench Repair assumes 3" of pavement repair at a 6.5 ft width

3. Permanent Trench Paving assumes 2" of pavement and 15 ft wide travel lane

4. Milling assumes 15 ft wide travel lane for all state roads

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

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

7. Assuming forcemain is laid at a rate of 150 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge \$60/hr at 8 hr/day

Table 5-9: Annual O&M Costs for Collection System

| 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 | \$75,000 | \$75,000 | \$75,000 | \$75,000 | | | | |
| | Engineering & legal | \$15,000 | \$15,000 | \$15,000 | \$15,000 | | | | |
| | Tech Support ² | \$19,700 | \$19,700 | \$19,700 | \$19,700 | | | | |
| Power & Billing | Electricity | \$25,000 | \$15,000 | \$15,000 | \$25,000 | | | | |
| | Billing (Additional Town Admin) | \$10,000 | \$10,000 | \$10,000 | \$10,000 | | | | |
| Liquid/Solids | Chemical addition (odor Control) ³ | \$30,000 | \$40,000 | \$40,000 | \$30,000 | | | | |
| | Septic Pumping ⁴ | | | \$215,800 | \$215,800 | | | | |
| | Chemical addition (Carbon Addition) | | | | | | | | |
| Mech. | Equipment Replacement ⁵ | \$42,000 | \$28,000 | \$28,000 | \$42,000 | | | | |
| | | | | | | | | | |
| Other | Downstream East Lyme and Waterford Fees ^{6,7} | | | | | \$119,000 | \$106,000 | \$106,000 | \$119,000 |
| | | | | | | | | | |
| | Sub-Totals | \$217,000 | \$203,000 | \$419,000 | \$433,000 | \$119,000 | \$106,000 | \$106,000 | \$119,000 |
| | Regional Totals⁸ | | | | | \$336,000 | \$309,000 | \$525,000 | \$552,000 |

1. Operation assumes an allowance for contract operation of the collection systems

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 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 \$3.92 per 1000 gallons for East Lyme Waterford O&M fees (based on East Lyme current costs and 33% of the Average Daily Flow)

7. Regional Downstream Costs are based on anticipated average daily flows per Tables 3-1 and 3-2

8. Total Regional combines downstream costs to the annual collection costs in Old Lyme

Table 5-10: Downstream Pump Station Capacities (Regional Alternative)

| Town | Pump Station (PS) | Pump Station Capacity ¹ (GPD) | Existing Conditions | | | East Lyme Moderate Zoning Buildout ⁴ | | | With Old Lyme Contribution at Year One Flow ⁵ | | | With Old Lyme Contribution at Design Flow | | |
|-----------|---------------------------|--|---------------------|---------------|--------------------------------|---|---------------|--------------------------------|--|---------------|--------------------------------|---|---------------|--------------------------------|
| | | | Peak Hour (GPD) | Capacity Used | Potential Capacity Limitations | Peak Hour (GPD) | Capacity Used | Potential Capacity Limitations | Peak Hour (GPD) | Capacity Used | Potential Capacity Limitations | Peak Hour (GPD) | Capacity Used | Potential Capacity Limitations |
| East Lyme | Bride Brook ² | 2,880,000 | 668,000 | 23% | Not likely | 1,661,000 | 58% | Not Likely | 967,000 | 34% | Not likely | 2,559,000 | 89% | Appears likely |
| | Route 156 ² | 2,703,000 | 680,000 | 25% | Not likely | 1,880,000 | 70% | Not Likely | 979,000 | 36% | Not likely | 2,778,000 | 103% | Appears likely |
| | Pattagansett ² | 5,164,000 | 1,096,000 | 21% | Not likely | 4,337,000 | 84% | Not Likely | 1,395,000 | 27% | Not likely | 5,235,000 | 101% | Appears likely |
| | Niantic ² | 6,273,000 | 1,823,000 | 29% | Not likely | 5,456,000 | 87% | Not Likely | 2,122,000 | 34% | Not likely | 6,354,000 | 101% | Appears likely |
| Waterford | Evergreen ³ | 10,397,000 | 9,034,000 | 87% | Not likely | N/A | N/A | N/A | 9,333,000 | 90% | Not likely | 9,932,000 | 96% | Appears likely |

1. Calculated with largest pump offline.

2. Based on Fuss & O'Neil 2007 Wastewater System Capacity Analysis Planning Report.

3. Based on Wright-Pierce 2011 Waterford Wastewater Facilities Plan Update.

4. Based on Fuss & O'Neil Wastewater Collection System Capacity Analysis Planning Report, Table V-2, page 42, dated September 2007.

5. Total flows including Old Lyme contribution at Year One are the sum of existing conditions flows and Year One peak hourly flow.

Table 5-11: Estimated Downstream Capital Needs (Regional Alternative)

| Town | Downstream Sewer Infrastructure | Old Lyme % of Peak Hourly Design Flow | Estimated Additional Capital Cost Premium % | Capital Upgrade Cost ¹ | Estimated Old Lyme Capital Share | Estimated Non-Old Lyme Capital Share |
|--------------|---|---------------------------------------|---|-----------------------------------|----------------------------------|--------------------------------------|
| East Lyme | Bride Brook PS | 35% | 10% | \$2,000,000 | \$902,000 | \$1,098,000 |
| | Bride Brook FM | 35% | 10% | \$300,000 | \$135,000 | \$165,000 |
| | Route 156 PS ² | 32% | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) |
| | Gravity Sewer Downstream of Route 156 FM Discharge ² | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) |
| | Pattagansett PS ² | 17% | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) |
| | Niantic PS ² | 14% | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) |
| | Niantic FM ² | 14% | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) |
| Waterford | Evergreen PS ² | 10% | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) |
| New London | New London WPCF ² | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) | Deferred (TBD) |
| Total | | | | \$2,300,000 | \$1,037,000 | \$1,263,000 |

1. Capital Upgrade Costs include 40% engineering, contingency, and legal fees

2. Upgrades to infrastructure are deferred capital costs to be determined (TBD)



Niantic Pump Station (East Lyme)



Bride Brook Pump Station (East Lyme)



Route 156 Pump Station (East Lyme)



Pattagansett Pump Station (East Lyme)

5.7 COST COMPARISON

Table 5-12 shows the breakdown of capital costs for each type of collection system within the Project Area. Table 5-13 shows the total cost of the Local and Regional Alternative collection systems including anticipated annual Operation & Maintenance (O&M) costs.

Table 5-12: Wastewater Service Area Capital Collection Costs

| Collection System Type | Collector Sewer ³ | Local Alternative Transmission System ^{1,2,4} | Regional Alternative Transmission System ^{1,4} |
|------------------------|------------------------------|--|---|
| Gravity | \$20,404,000 | \$3,125,000 | \$8,511,000 |
| Low Pressure | \$26,064,000 | \$773,000 | \$7,627,000 |
| STEG | \$22,570,000 | \$3,125,000 | \$8,511,000 |
| STEP | \$29,777,000 | \$773,000 | \$7,627,000 |

1. Transmission System layouts consist of a combination of gravity sewer and force main required to convey flows from the Project Area to the treatment site (local or regional)
2. Two Local Alternatives were investigated but share the same Collector Sewer and Transmission System Costs.
3. Collector Sewer Costs are based on total costs in Tables 5-1, 5-2, 5-3, and 5-4
4. Transmission Costs are based on total costs in Tables 5-5, 5-6, 5-7, and 5-8

Table 5-13 shows the capital and annual O&M costs for the Local and Regional Alternatives. Costs under the Regional Alternative represent the sum of all the Project Area Sub-Areas collection systems, the transmission system, and any downstream pump station and collection system upgrades.

The Local Alternatives are significantly less expensive for both capital and annual costs for the collection system aspect of this report. The costs under the Local Alternatives represent only the sum of the Project Area Sub-Areas collection systems and the transmission system in Old Lyme. A breakdown of annual costs for both the Local and Regional Alternative are provided in Table 5-9.

Table 5-13: Total Capital and Annual Collection Costs

| Collection System Type | Local Alternative ¹ | | Regional Alternative | |
|------------------------|--------------------------------|-------------------------|----------------------|-------------------------|
| | Capital | Annual O&M ² | Capital | Annual O&M ² |
| Gravity | \$23,529,000 | \$217,000 | \$29,952,000 | \$336,000 |
| Low Pressure | \$26,837,000 | \$203,000 | \$34,728,000 | \$309,000 |
| STEG | \$25,695,000 | \$433,000 | \$32,118,000 | \$552,000 |
| STEP | \$30,550,000 | \$419,000 | \$38,441,000 | \$525,000 |

1. Two Local Alternatives were investigated but share the same collection system costs.
2. Annual O&M Costs are based on total costs in Table 5-9



Legend

- Pump Stations
- Potential WPCF Site

Sewer Pipes

- Gravity
- Transmission Main

Sub-Areas

- 5A - Miami Beach
- 5B - Hawks Nest Beach
- 6 - Sound View Beach
- 7 - Old Colony Beach Club
- 8 - Old Lyme Shores Beach
- Miscellaneous Town Area B

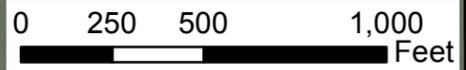
Note: Gravity Collector Sewers Not Shown for Clarity



Proposed Common Pump Station

Miscellaneous Town Area B

Long Island Sound



Town of Old Lyme, CT

Transmission System for Local Alternatives

FIGURE 5-5

| | |
|--|-----------------|
| SCALE: 1 in = 500 ft | DRAWN BY: ACB |
| DATE: December 17, 2014 | JOB NO.: 226617 |
| DOC: 2014-11-18_Fig_5-5_Local_Collection.mxd | |

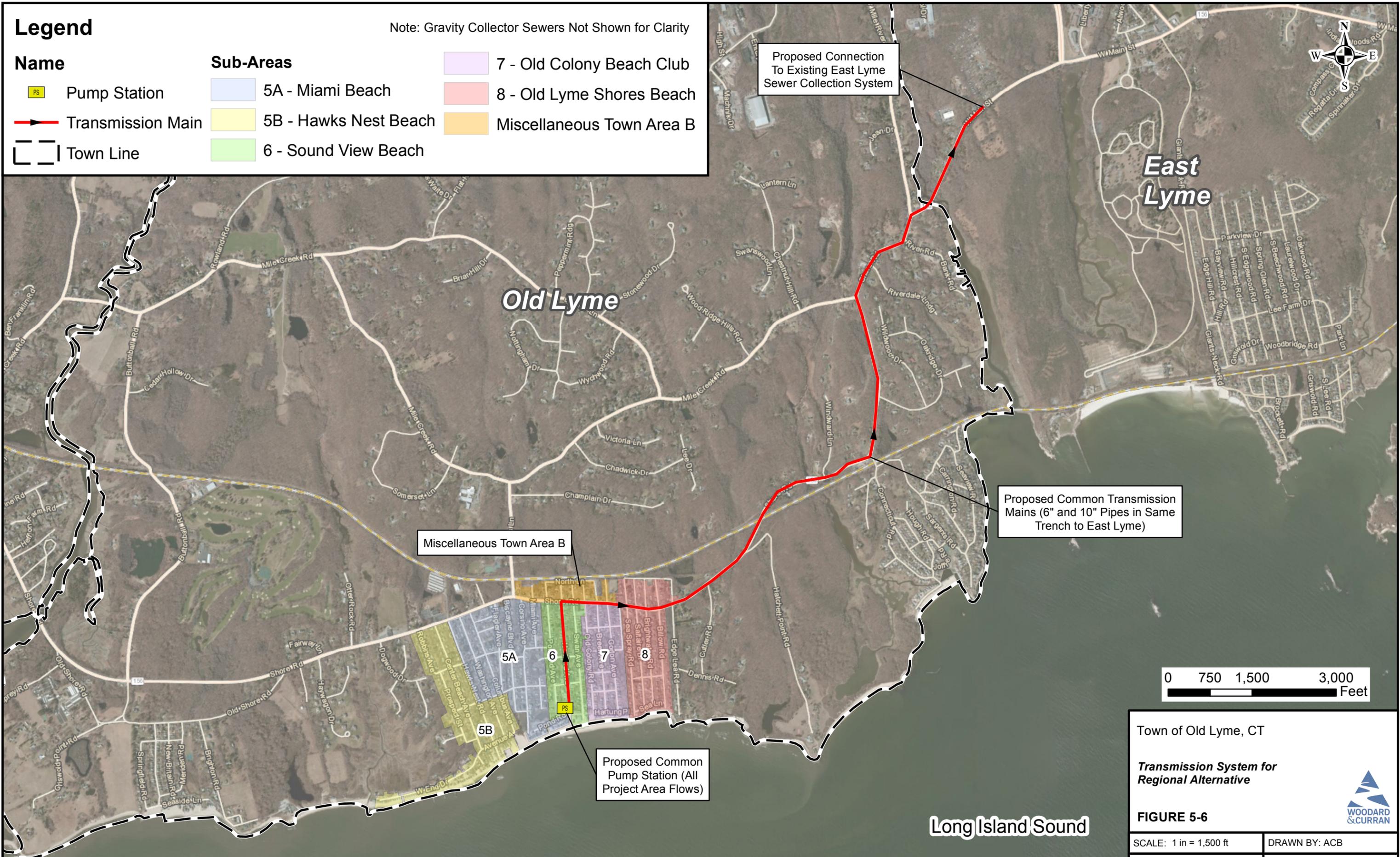


Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Legend

| Name | Sub-Areas | |
|-------------------|-----------------------|---------------------------|
| Pump Station | 5A - Miami Beach | 7 - Old Colony Beach Club |
| Transmission Main | 5B - Hawks Nest Beach | 8 - Old Lyme Shores Beach |
| Town Line | 6 - Sound View Beach | Miscellaneous Town Area B |

Note: Gravity Collector Sewers Not Shown for Clarity



Proposed Common Transmission Mains (6" and 10" Pipes in Same Trench to East Lyme)

Miscellaneous Town Area B

Proposed Common Pump Station (All Project Area Flows)



Town of Old Lyme, CT

Transmission System for Regional Alternative



FIGURE 5-6

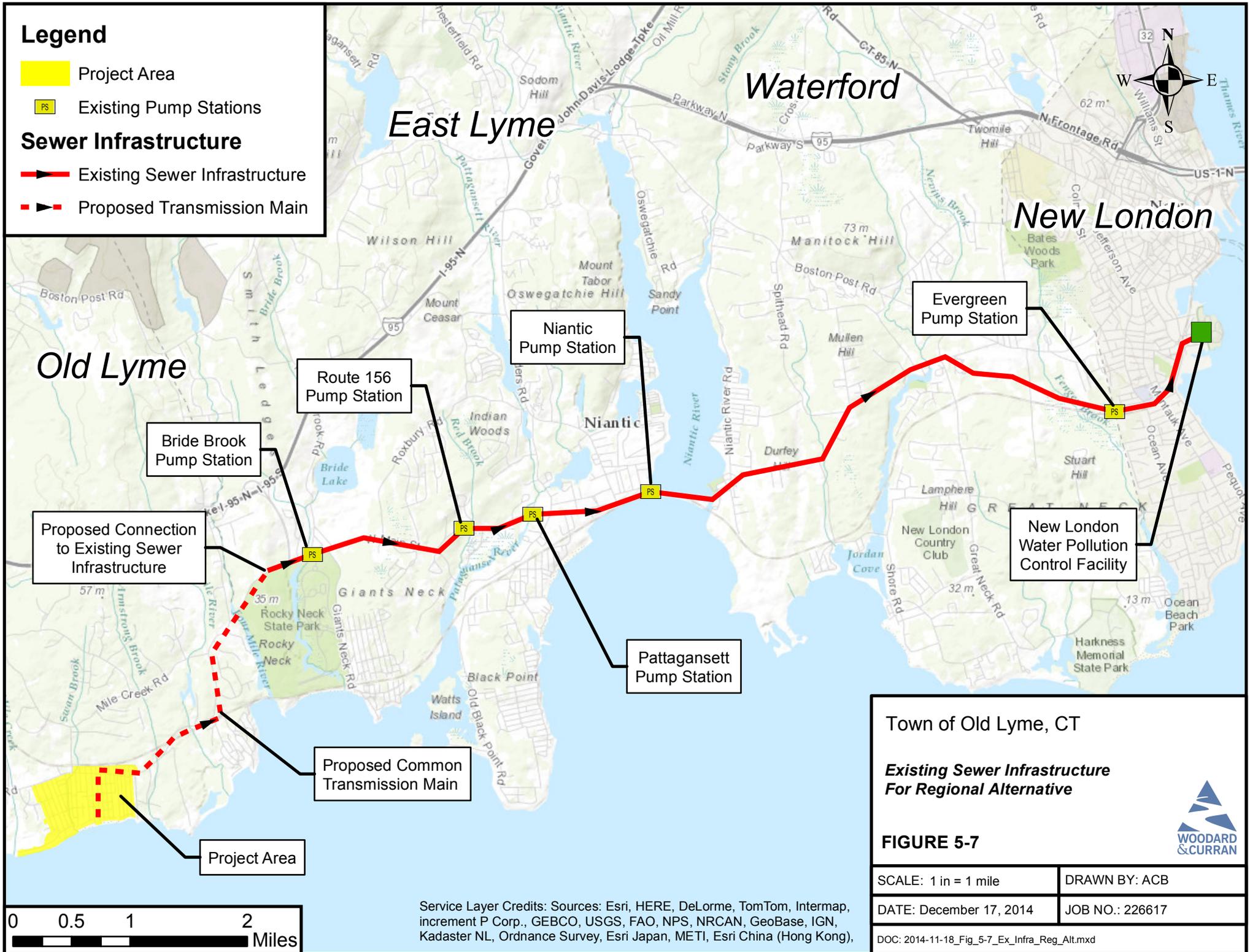
| | |
|---|-----------------|
| SCALE: 1 in = 1,500 ft | DRAWN BY: ACB |
| DATE: December 17, 2014 | JOB NO.: 226617 |
| DOC: 2014-11-18_Fig_5-6_Regional_Collection.mxd | |

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Long Island Sound

Legend

- Project Area
- PS Existing Pump Stations
- Sewer Infrastructure**
- Existing Sewer Infrastructure
- Proposed Transmission Main



Town of Old Lyme, CT

**Existing Sewer Infrastructure
For Regional Alternative**

FIGURE 5-7



| | |
|--|-----------------|
| SCALE: 1 in = 1 mile | DRAWN BY: ACB |
| DATE: December 17, 2014 | JOB NO.: 226617 |
| DOC: 2014-11-18_Fig_5-7_Ex_Infra_Reg_Alt.mxd | |

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong),

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 comprise 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 Project Area. There are physical constraints making smaller systems an unviable option within the High Needs Sub-Areas, including poor soils and high groundwater. 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 advanced treatment systems but are also limited by available space. Similar to the conclusions of previous Wastewater Management Plans for Sub-Areas 5A, 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 Project Area 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.

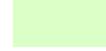
6.2.2 Local WPCF

For the purpose of planning development of alternatives and cost estimates, a potential WPCF site was evaluated at a location just north of Route 156 and Sub-Areas 5A and 5B, as shown in Figure 6-1. This site (Site 3) was identified as a possible location that provides a central location to the Project Area. Other locations are also being screened as possible WPCF sites.



Example of local WPCF with packaged treatment system

Legend

-  Potential Local Treatment Sites
-  Project Area



Town of Old Lyme, CT

Potential Treatment Sites For Local Alternatives

FIGURE 6-1



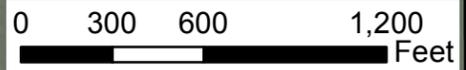
SCALE: 1 in = 600 ft DRAWN BY: ACB

DATE: December 17, 2014 JOB NO.: 226617

DOC: 2014-11-18_Fig_6-1_Trtmnt_Sites_Local.mxd

Long Island Sound

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community



The following four criteria were used to consider Site 3 as a potential location for a local WPCF:

1. **Site Land Use:** An undeveloped site, such as Site 3, may be desirable because of the site preparation costs, with fewer potential infrastructure conflicts to be resolved than a currently occupied site or previously developed non-residential site.
2. **Natural Resources:** Sites within specially designated natural resource areas should be avoided. The development of areas designated as wild, scenic, recreational, or habitats of endangered species may be prohibited, or at minimum, result in complicated permitting processes. In addition, the presence of a sensitive feature, such as a wetland, would affect site suitability.
3. **Elevation and Topography:** Site 3 is a relatively low level site that would facilitate the flow of wastewater from portions of the service area by gravity, and minimize the number of pumping stations in the collection system. In addition, Site 3 is a relatively flat site compared to the other potential sites, which generally should facilitate construction activities and minimize grading differentials on the site.
4. **Buffer Zones:** The site suitability is affected by the amount of isolation and buffer area needed between plant processes and sensitive features and between plant processes and other property owners. By selecting Site 3, additional buffer area was secured to reduce the potential for odors and noise intrusion to the surrounding community.

Other factors such as economical and technical considerations may also influence the selection of sites and should be considered as part of the Local Alternative.

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 BioReactor (MBR). These two types of facilities would meet high quality effluent standards while being flexible to accommodate seasonal flow variations anticipated within the Project Area.

6.2.2.1 SBR WPCF

The SBR process is designed to treat wastewater while eliminating the need for secondary clarifiers and return activated sludge (RAS). A series of five steps occurs within each reactor, where first it is filled with wastewater and secondly completely mixed and aerated for a specific reaction time. Thirdly, after the reaction time, mixing and aeration cease and solids are settled out. Fourthly, decanting is performed, where effluent is drawn from the middle of the reactor above the sludge blanket. The fifth and last step allows for idle time. A minimum of two reactors, and preferably three, are necessary for continuous flow application to allow one reactor to fill while the other reacts, settles and drains.

SBR systems are common in the northeast and can reduce the size of the facility needed when compared to a conventional activated sludge plant. Depending on effluent quality requirements, tertiary treatment, such as a denitrification filter, is often used to help polish the effluent before disinfection.

6.2.2.2 MBR WPCF

The MBR process is a newer technology rapidly growing in the industry, especially with smaller localized facilities. An MBR process 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 fewer treatment steps.

6.2.3 Local WPCF Recommendations

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



Example of local WPCF adjacent to athletic fields.

both the Connecticut 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 exist that could meet the necessary requirements and a conceptual design and permit clarification would be needed to fully understand the optimum treatment facility and potential cost savings.

6.2.3.1 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 operation and maintenance (O&M) cost of treatment. No matter which collection system is selected, an MBR process or similar would need to be installed to achieve the anticipated treatment level requirements.

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 homeowners required to pay for septic tank pumping (approximately every 1 to 2 years). Also, nutrient reduction can have a negative impact on plant costs, and an additional carbon source is likely to be needed. These costs are summarized in Tables 6-3 and 6-4.

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

| Item No. | Description | Gravity | LPS | STEG | STEP |
|------------------------------------|--|---------------------|---------------------|---------------------|---------------------|
| 1 | Headworks Building ¹ | \$807,000 | \$767,000 | \$646,000 | \$613,700 |
| 2 | MBR Building ^{2,6} | \$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 | Administration Building | \$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 |
| 7 | Land Acquisition | \$500,000 | \$500,000 | \$500,000 | \$500,000 |
| Subtotal | | \$10,300,000 | \$10,000,000 | \$9,800,000 | \$9,400,000 |
| Contingency & Engineering Services | | 40% | \$4,200,000 | \$4,000,000 | \$3,800,000 |
| Local Treatment Total | | \$14,500,000 | \$14,000,000 | \$13,800,000 | \$13,200,000 |

1. STEP and STEG systems assume no coarse 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 equalization and 5% reduction in Pre & Post Anoxic tanks.
5. LPS and STEP systems assume a 5% decrease in effluent equalization.
6. MBR Building costs include disinfection and backup power generation facilities costs.

As shown above in Table 6-1, the most costly capital treatment alternative occurs when treatment is combined with a gravity collection system. This is due to higher annual flows when including I/I considerations and the fact that there is no preceding solids removal in the collection system as occurs with a STEP /STEG system. The lowest capital 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 total capital and O&M costs of implementing a STEP system still make the gravity system a more economical choice for the Project Area.

A non-cost factor that treatment for the Local Alternative would provide for the Town of Old Lyme is 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. An aerial view of New London WPCF is shown in Figure 6-2. No other options have been evaluated for a Regional Treatment Alternative. Although New London does not currently have a WPC capital plan, we assume that the New London WPCF will undergo a facilities evaluation and series of upgrades in the future related to renewal of mechanical equipment and emerging permit requirements. Typically, the cost of such capital upgrades would be spread out to all the users based on the flow allocations from each community. Given the lack of a capital plan, the costs associated with upgrading the New London WPCF are difficult to project and were considered as future/deferred costs as shown in Table 6-2.

The Old Lyme buy-in fee from New London will be a set price, on an EDU basis, based on preliminary conversations with the New London governing authorities. This report includes a conservative allowance, per EDU, for planning purposes. The regional treatment capital costs are presented and compared to the Local Alternatives treatment costs in Table 6-2. Also, the annual costs for both treatment alternatives are estimated and presented in Tables 6-3 and 6-4.

Table 6-2: Regional Treatment Capital Cost Summary

| Description | Cost Range |
|--------------------------------------|---------------------------|
| New London Buy in ¹ | \$3,597,000 - \$5,995,000 |
| New London WPCF Upgrade ² | Future (TBD) |
| Total³ | \$5,995,000 |

1. *Based on the anticipated range for connection fee to New London (\$3,000 to \$5,000 per EDU)*
2. *Upgrade the New London WPCF is a future/deferred capital cost to be determined (TBD)*
3. *Based on a maximum conservative allowance (per EDU) pending discussions between Old Lyme and New London*

6.4 COST COMPARISON

The Local Treatment and the Regional Treatment Alternatives capital and annual O&M costs for the Project Area 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 for the existing WPCF, as opposed to constructing a new WPCF. Although the Regional Alternative incorporates the use of the existing New London WPCF for treatment, there are still substantial treatment/disposal buy-in costs for Old Lyme residents to become regional sewer user.

Annual treatment O&M costs for the Local Alternative include 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 included with the Local Alternative Treatment annual costs. The Regional Alternative annual costs are based on flow percentages that incorporate all the necessary items represented in the Local Treatment. This is currently how the Agreement between East Lyme and New London is written. Flow meters would be used to measure the amount of flow treated, and for every thousand gallons sent to the WPCF, approximately \$2.50 would be charged to Old Lyme. This value is based on the current rates that New London charges East Lyme and is scheduled to go up by 8% in October 2014 according to the Town of East Lyme.

Table 6-3: Annual O&M Costs for Treatment System

| Annual Cost Details | | Treatment | | | |
|---------------------|--------------------------------------|------------------|------------------|-----------------|-----------------|
| | | Local | | Regional | |
| Category | Annual Description | Gravity & LPS | STEP / STEG | Gravity / STEG | LPS / STEP |
| Labor | Operation ¹ | \$237,600 | \$237,600 | | |
| | Engineering & legal | \$15,000 | \$15,000 | | |
| | Technical Support ² | \$39,500 | \$39,500 | | |
| Power & Billing | Electricity | \$30,000 | \$30,000 | | |
| | 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 ^{6,7} | | | \$76,000 | \$68,000 |
| | Black Hall Fee ⁸ | \$65,000 | \$65,000 | | |
| Totals | | \$532,000 | \$506,000 | \$76,000 | \$68,000 |

1. Local Treatment Operation assumes 2 full time class III and class II operators and 1 laborer for treatment.
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 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 \$2.50 per 1000 gallons annually and 50% of the Average Daily Flow
7. Regional Treatment Costs are based on anticipated average daily flows per Tables 3-1 and 3-2
8. Black Hall Reuse fee assumed to be a tax credit for use of property or O&M fee.

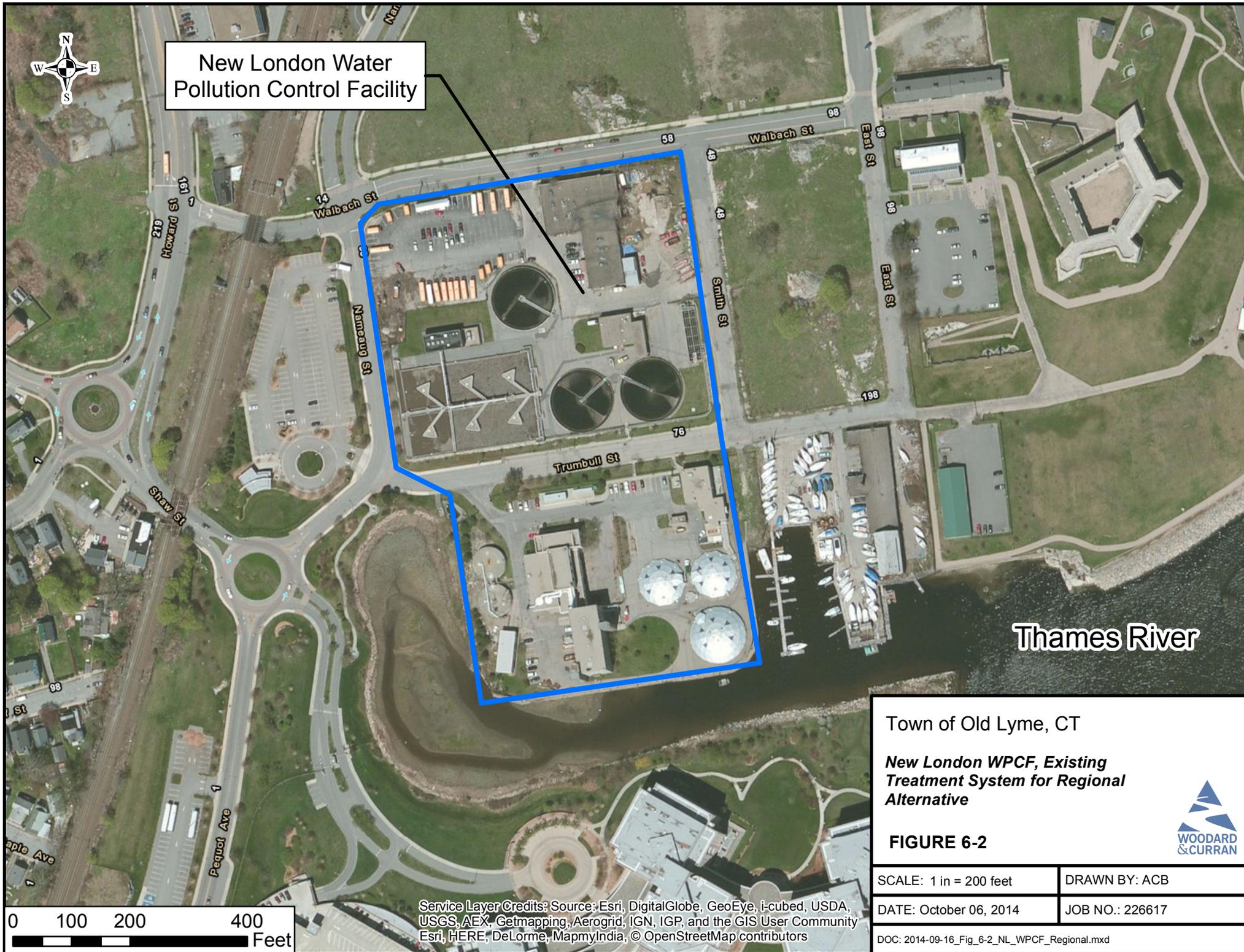
Table 6-4: Treatment Cost Summary

| Treatment System Based on Type of Sewer System | Local Alternative | | Regional Alternative | |
|--|---------------------------|------------------------------|---------------------------|------------------------------|
| | Capital Cost ¹ | Annual O&M Cost ² | Capital Cost ³ | Annual O&M Cost ² |
| Gravity | \$14,500,000 | \$532,000 | \$5,995,000 | \$76,000 |
| Low Pressure | \$14,000,000 | \$532,000 | \$5,995,000 | \$68,000 |
| STEP | \$13,200,000 | \$506,000 | \$5,995,000 | \$68,000 |
| STEG | \$13,800,000 | \$506,000 | \$5,995,000 | \$76,000 |

1. Capital Costs for the Local Alternative are based on total costs in Table 6-1
2. Annual O&M Costs are based on total costs in Table 6-3
3. Capital Costs for the Regional Alternative are based on total cost in Table 6-2



New London Water Pollution Control Facility



Thames River

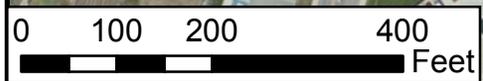
Town of Old Lyme, CT

New London WPCF, Existing Treatment System for Regional Alternative

FIGURE 6-2



| | |
|--|-----------------|
| SCALE: 1 in = 200 feet | DRAWN BY: ACB |
| DATE: October 06, 2014 | JOB NO.: 226617 |
| DOC: 2014-09-16_Fig_6-2_NL_WPCF_Regional.mxd | |



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

7. DISPOSAL AND REUSE ALTERNATIVES

This section of the Report summarizes the effluent disposal and reuse alternatives associated with the two Local Alternatives. Local Alternative 1 consists of pumping effluent from the local treatment site to a primary subsurface disposal site (Cherrystone), a storage reservoir for reuse and irrigation, and a secondary subsurface disposal site (Black Hall) when needed. Local Alternative 2 consists of pumping effluent from the local treatment site to the Connecticut River via a new surface water discharge permit. An evaluation of each Local Alternative follows.

7.1 LOCAL ALTERNATIVE 1 WITH SUBSURFACE DIPOSAL AND REUSE

Flow projections from Section 3 served as the basis for locating sufficient disposal and reuse resources. These effluent flow allocations are summarized in Figure 7-1. The projected Year One and design flow patterns were estimated based on Point O' Woods flow data multiplied by a ratio of averages. The average expected Year One flow was assumed to be one third of the average design flow. As part of the Coastal Wastewater Management Plan, initial on-site testing was performed at two of the more than four potential sites in Old Lyme, as shown in Figure 7-2. However, there are likely several additional potential disposal and reuse sites adjacent to the Study Area. The Town may choose to evaluate these sites at a later date based on future needs.



Commencement of test pits at Cherrystone site.

7.1.1 Local Subsurface Investigations

A subsurface investigation was performed as a part of 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 four potential sites. This investigation focuses on two of those sites they had identified. 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 soil 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 7-2.

Woodard & Curran conducted the following activities:

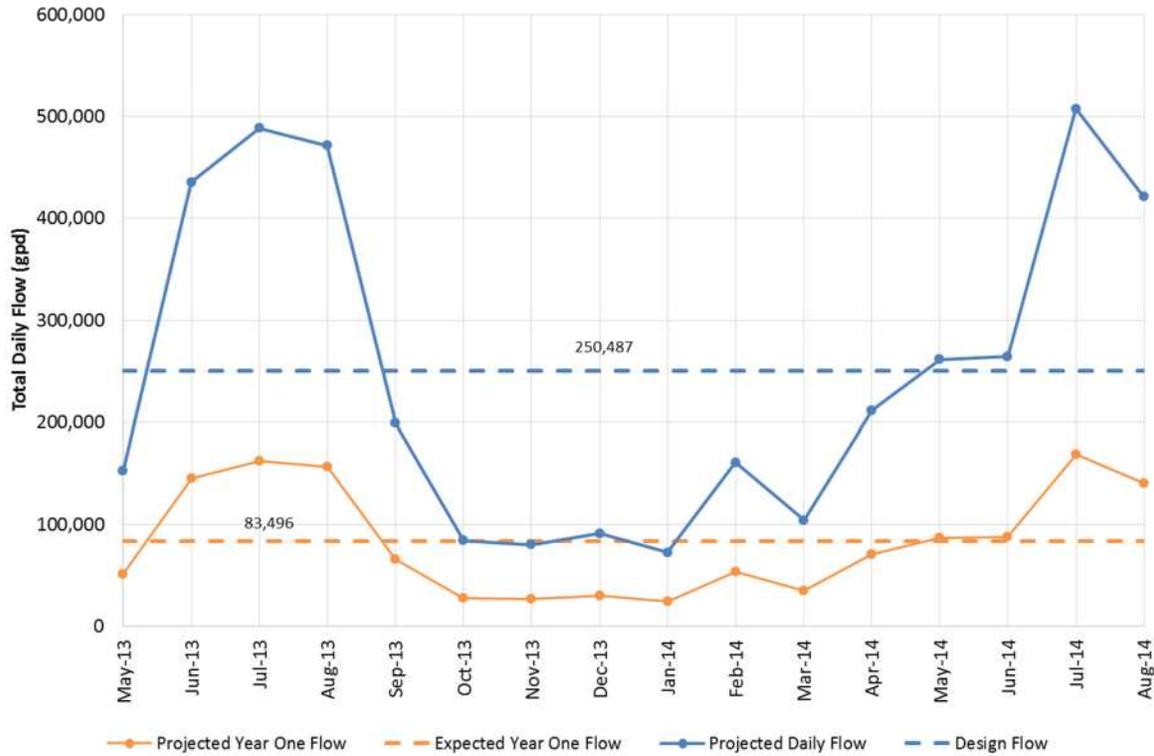
- Test Pitting (Cherrystone)
- Soil Borings/Monitoring Well Installation (Black Hall, Cherrystone)
- Seasonal High Water Table (SHWT) Calculations
- Aquifer Testing (Black Hall, Cherrystone)
- Water Level Monitoring (Black Hall, Cherrystone)
- Delineation of subsurface Soil Absorption System (SAS) facility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

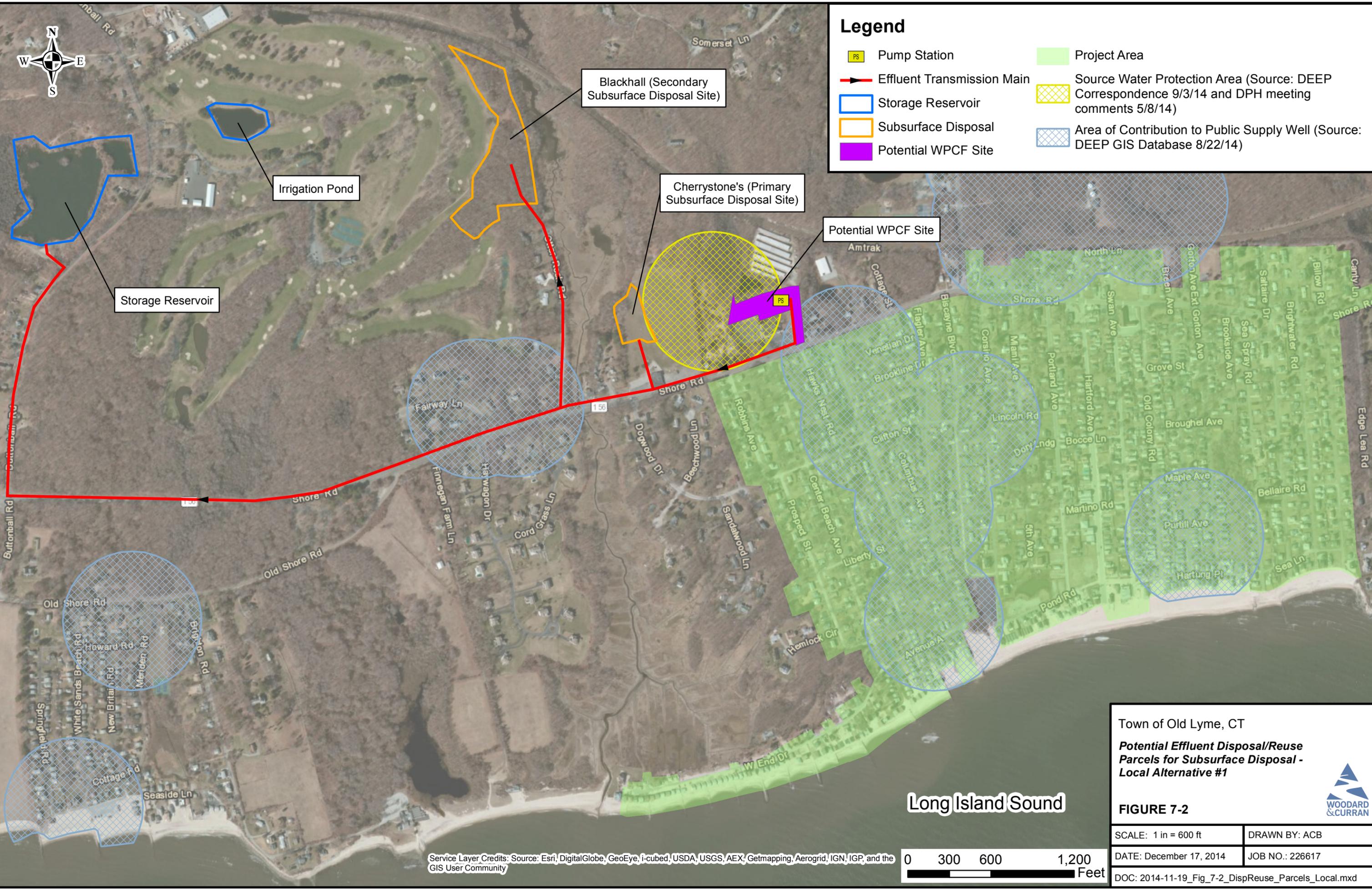
Figure 7-1: Anticipated Year-Round Flows for High Needs Sub-Areas





Legend

- PS Pump Station
- Effluent Transmission Main
- Storage Reservoir
- Subsurface Disposal
- Potential WPCF Site
- Project Area
- Source Water Protection Area (Source: DEEP Correspondence 9/3/14 and DPH meeting comments 5/8/14)
- Area of Contribution to Public Supply Well (Source: DEEP GIS Database 8/22/14)



Blackhall (Secondary Subsurface Disposal Site)

Irrigation Pond

Storage Reservoir

Cherrystone's (Primary Subsurface Disposal Site)

Potential WPCF Site

Town of Old Lyme, CT
**Potential Effluent Disposal/Reuse
 Parcels for Subsurface Disposal -
 Local Alternative #1**



FIGURE 7-2

| | |
|---|-----------------|
| SCALE: 1 in = 600 ft | DRAWN BY: ACB |
| DATE: December 17, 2014 | JOB NO.: 226617 |
| DOC: 2014-11-19_Fig_7-2_DispReuse_Parcels_Local.mxd | |

Long Island Sound

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community



7.1.1.1 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



Typical soil column obtained during test pits.

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.

7.1.1.2 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 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.



Advancement of soil boring at Black Hall site.

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.

7.1.1.3 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, 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 USGS sentinel wells are located in the Towns of Southbury and Durham, Connecticut (shown as identifiers 412916073121701 and 412825072410501, respectively). 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.

It should be noted that the Southbury and Durham sentinel wells were selected to establish seasonal high groundwater conditions because of: (1) the availability of daily water-level records during the monitoring period and (2) the similarity of water level depths to the Cherrystone and Black Hall site wells. There is another USGS well closer to the Project Area, but the water level data for that well was not appropriate for this analysis.

7.1.1.4 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.

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.



Monitoring wells installed 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.

7.1.1.5 Monitoring Well Survey and Groundwater Flow



Existing monitoring well at Black Hall site.

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.

7.1.1.6 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 a 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) was 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 ft².

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 ft².

7.1.1.7 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/ft²) (87,600 gpd), the facility can maintain separation; simulated mounding does not surpass three feet. The infiltration rates were increased to 2 gpd/ft² and 3 gpd/ft² (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/ft² and to seven feet at 3 gpd/ft².

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/ft² (190,000 gpd) at either saturated thickness. As the infiltration rate is increased to 2 gpd/ft² (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/ft² (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/ft² (316,000 gpd) at the interpreted average hydraulic conductivity of 150 ft/day, whereas the small facility can receive up to 3 gpd/ft² (219,000 gpd).

7.1.2 Summary of Local Alternative 1 – Subsurface Disposal and Reuse

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.

7.1.2.1 Sub-Surface Disposal at the Cherrystone Site

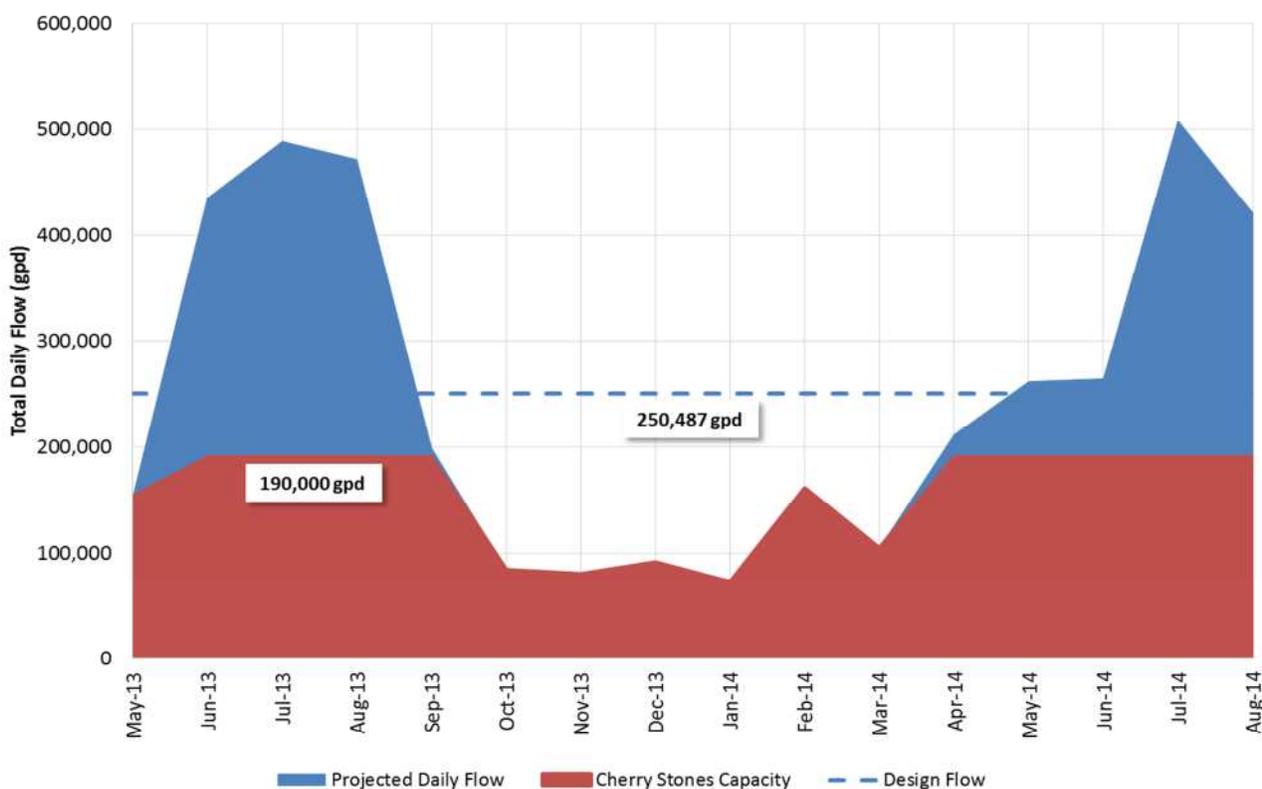
The max day flow increases due to seasonal variations and are expected to be at the highest during the summer time. Figure 7-1 presents the expected max day flow over the course of the year. Figure 7-3 presents the max day

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, as shown in Figure 7-3, where the flow curve remains below the 190,000 gpd capacity of the Cherrystone site.

Following submittal of the December 2013 Draft Report, CT-DEEP provided information on the existence of three drinking water wells located east of the Cherrystone site as shown in Figure 7-2, including two community wells operated by Connecticut Water Company and one non-community well owned by South Shore landing. It should be noted that according to CT-DEEP GIS data base, accessed on August 22, 2014, these wells are not part of the GIS layer representing the area of contribution to public supply well as shown in Figure 7-2.

Although it is unclear whether the presence of these potable wells represents a conflict with the proposed use of the Cherrystone site as a primary subsurface disposal site, or whether the wells could be relocated, given their modest capacities. Additional onsite testing and groundwater modeling would be necessary to evaluate the real impact of subsurface discharge on a drinking water well. However, based on the timing of the data provided by CT-DEEP during May 2014 meeting with CTDPH, coupled with the timetables for the existing Consent Orders, the Cherrystone site and Local Alternative 1 were not further studied or considered as part of this updated Report.

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



7.1.2.2 Reuse at the Black Hall Site

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

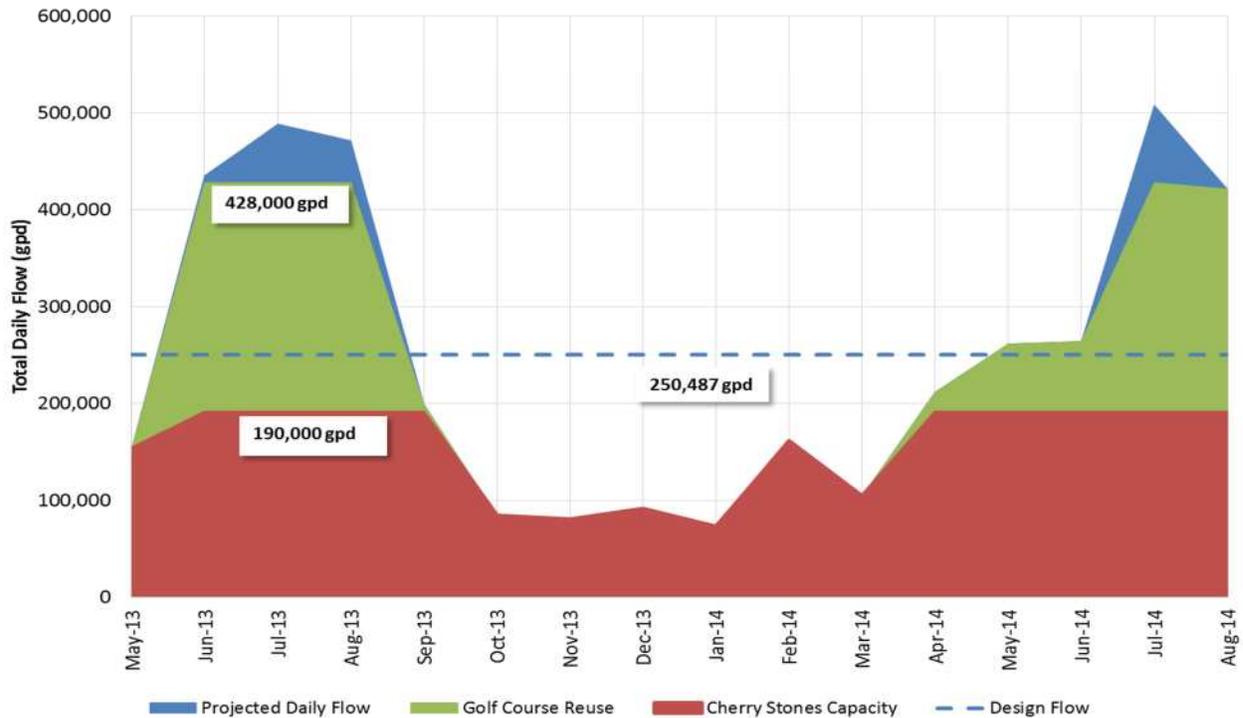


Existing storage reservoir (old gravel pit) for Black Hall irrigation

Figure 7-4 shows the additional max day disposal capability of Black Hall Golf Course 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.

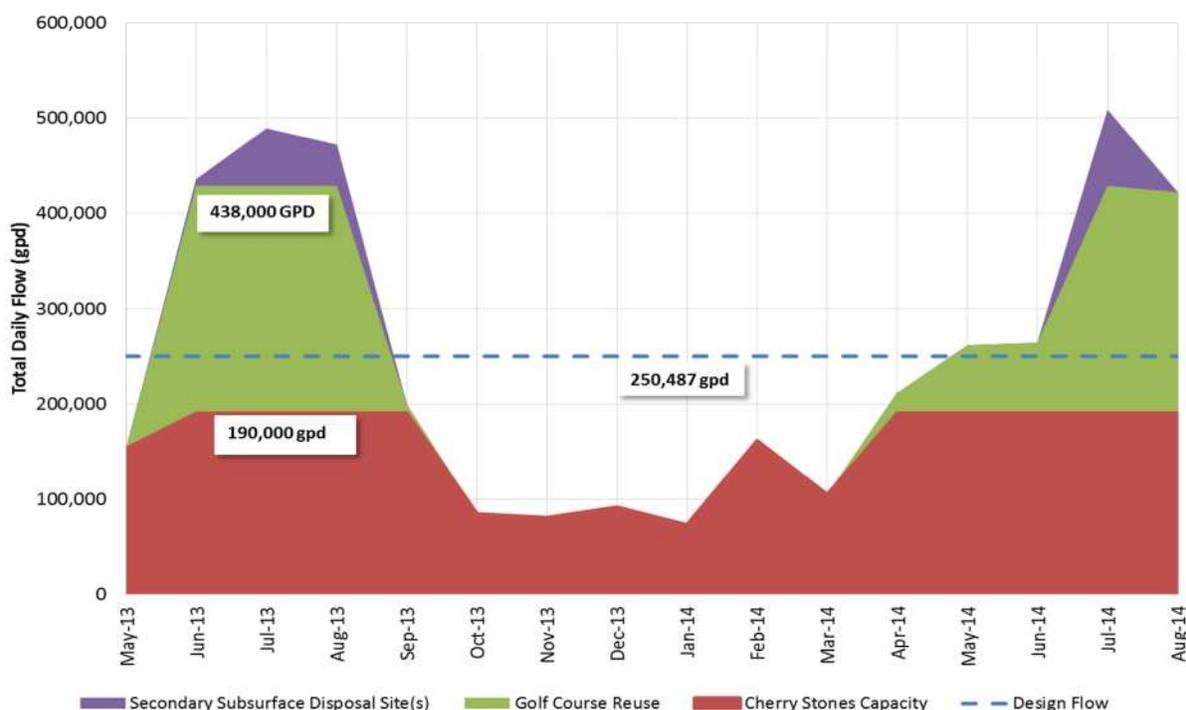
Figure 7-4: Year Round Flows vs. Primary Subsurface Disposal and Black Hall Reuse for the Project Area



7.1.2.3 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 accommodate maximum daily flow 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 two acres at an infiltration rate of 1.2 gpd/ft²; this additional sub-surface disposal would need further detailed hydrogeological analysis prior to design.

Figure 7-5: Year – Round Disposal and Reuse for the High Needs Sub-Areas



7.1.3 Local Alternative 1 – Subsurface Disposal & Reuse Costs

The combined effluent disposal systems are consistent 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 to the surface water discharge permit the New London WPCF currently operates under. These costs are included with annual treatment O&M. The local subsurface disposal and reuse costs are summarized in Table 7-4 based on conservative effluent disposal options. It is likely that 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. Based on the timing of the additional drinking water well data provided by CT-DEEP in May 2014, together with the timelines for the Consent Orders at the chartered beaches, the local reuse alternatives were not further explored as part of this updated Draft Report.

Table 7-1: Primary Subsurface Disposal Costs

| Item | Unit | Unit/Cost | QTY | Cost ³ |
|---|------|-------------|--------|-------------------|
| Additional Fill | CY | \$27 | 18,000 | \$486,000 |
| 10" Force Main ¹ | LF | \$275 | 1,800 | \$495,000 |
| Pump Station | EA | \$1,500,000 | 1 | \$1,500,000 |
| Site Preparation ² | SY | \$10 | 36,000 | \$360,000 |
| Piping | LF | \$35 | 19,500 | \$683,000 |
| Permitting | EA | \$200,000 | 1 | \$200,000 |
| Subtotal | | | | \$3,724,000 |
| Contingency, Legal and Engineering Services | | 40% | | \$1,490,000 |
| Total | | | | \$5,214,000 |

1. Force Main from proposed WPCF area assumes complete installation unit costs
2. Assumes 2 feet of top soil to be used on site
3. All costs are rounded to the nearest \$1,000

Table 7-2: Reuse Costs

| Item | Unit | Unit/Cost | QTY | Cost ⁴ |
|---|------|-----------|-------|-------------------|
| 10" Force Main to Black Hall ¹ | LF | \$275 | 6,700 | \$1,843,000 |
| Water Main Extension ² | LF | \$275 | 2,800 | \$770,000 |
| Storage Reservoir Clay Lining ³ | SY | \$60 | 3,000 | \$180,000 |
| Permitting | EA | \$200,000 | 1 | \$200,000 |
| Subtotal | | | | \$2,993,000 |
| Contingency, Legal and Engineering Services | | 40% | | \$1,197,000 |
| Total | | | | \$4,190,000 |

1. Force Main from Cherrystone to Black Hall assumes complete installation
2. Assumes potential cost of watermain extension to Black Hall
3. Assumes 3 inch thick clay lining for Storage Reservoir at Black Hall
4. All costs are rounded to the nearest \$1,000

Table 7-3: Secondary Subsurface Disposal Costs

| Item | Unit | Unit/Cost | QTY | Cost ⁴ |
|---|------|-----------|--------|-------------------|
| Drip Piping ¹ | LF | \$70 | 23,000 | \$1,610,000 |
| 10" Forcemain ² | LF | \$275 | 2,000 | \$550,000 |
| Easement ³ | SY | \$300 | 220 | \$66,000 |
| Permitting | EA | \$200,000 | 1 | \$200,000 |
| Subtotal | | | | \$2,426,000 |
| Contingency, Legal and Engineering Services | | 40% | | \$970,000 |
| Total | | | | \$3,396,000 |

1. Unit costs based on similar system construction costs.
2. Forcemain from Route 156 along Otter Rock Road.
3. Easement required to pass through empty Residential Lot at end of Otter Rock Road, assumed 10 ft wide.
4. All costs are rounded to the nearest \$1,000

Table 7-4: Local Alternative 1 – Subsurface Disposal and Reuse Cost Summary

| Description | Capital Cost | Disposal Capacity Range GPD |
|---|--------------|-----------------------------|
| Primary Subsurface Disposal System ¹ | \$5,214,000 | 190,000 ⁴ |
| Reuse ² | \$4,190,000 | 238,000 ⁵ |
| Secondary Subsurface Disposal System ³ | \$3,396,000 | 110,000 ⁶ |
| Total | \$12,800,000 | 538,000 |

1. Cherrystone Driving Range - Capital Costs based on Table 7-1
2. Irrigation at Black Hall Golf Course - Capital Costs based on Table 7-2
3. Black Hall Golf Course - Capital Costs based on Table 7-3
4. Disposal capacity based on infiltration rate of 1.2 gallons per SF per day, 21 days of travel time, while maintaining 3 feet of separation during mounding
5. Disposal capacity based on the permit for Black Hall Golf Course
6. Disposal capacity based on disposal area of 2.8 acres

7.2 LOCAL ALTERNATIVE 2 WITH SURFACE DISPOSAL TO CONNECTICUT RIVER

In addition to Local Alternative 1, where disposal of effluent consisted of groundwater discharge and reuse for irrigation, a surface-water-discharge alternative was recommended by CT-DEEP in their April 2014 comments, and subsequently investigated in this updated Report. Local Alternative 2 consists of sewer infrastructure necessary to convey treated effluent from a local WPCF site to a potential outfall located along the Connecticut River. Figure 7-6 illustrates the potential force main route used to evaluate surface water discharge for Local Alternative 2.

The Connecticut River was chosen as the receiving water body due to its proximity to the Project Area, its large size, and its established capacity for assimilation of effluent. No other surface water bodies near the Project Area are of sufficient size to absorb the projected effluent flows. A pump station located at the local WPCF site would convey effluent through approximately five miles of force mains along route 156 to the outfall at Ferry Road. This route crosses three bridges over rivers and one bridge over a railroad. Due to the length of the route and the elevation changes associated with it, multiple air release structures will be required to avoid air binding of the pipe. A potential outfall is located at Ferry Road adjacent to the Connecticut River, about 2.5 miles north of Long Island Sound.

7.2.1 Disposal Costs

Table 7-5 shows the costs associated with Local Alternative 2. This cost estimate included trench work, and paving for one lane of a State Road at 15 feet wide. Also included in this cost estimate are the anticipated administrative and legal fees associated with a new NPDES permit required for the new surface water discharge to the Connecticut River.

Table 7-5: Local Alternative 2 – Surface Water Discharge to CT River - Disposal Cost Summary

| Gravity Sewer Items | Unit | Unit Cost | Quantity | Cost ⁸ |
|---|------|--------------|----------|---------------------|
| 10-inch Transmission Main ¹ | LF | \$ 60 | 26,555 | \$ 1,593,000 |
| Air Release Manholes | EA | \$ 15,000 | 6 | \$ 90,000 |
| Pump Station | EA | \$ 1,500,000 | 1 | \$ 1,500,000 |
| Chemical Addition | EA | \$ 400,000 | 1 | \$ 400,000 |
| Trench Repair ² | LF | \$ 15 | 26,555 | \$ 398,000 |
| Permanent Trench Paving ³ | LF | \$ 20 | 26,555 | \$ 531,000 |
| Milling ⁴ | LF | \$ 20 | 26,555 | \$ 531,000 |
| Rock Excavation ⁵ | CY | \$ 70 | 2,500 | \$ 175,000 |
| Trench Dewatering | LF | \$ 20 | 26,555 | \$ 531,000 |
| River/Bridge Crossing ⁶ | EA | \$ 30,000 | 3 | \$ 90,000 |
| Railroad Bridge Crossing Premium ⁶ | EA | \$ 200,000 | 1 | \$ 200,000 |
| Environmental Protection | LF | \$ 10 | 6,639 | \$ 66,000 |
| Police Detail ⁷ | Days | \$ 960 | 469 | \$ 450,000 |
| Permitting | EA | \$ 200,000 | 1 | \$ 200,000 |
| Subtotal | | | | \$ 6,755,000 |
| 40% Contingency and Engineering Services | | | | \$ 2,702,000 |
| Total Cost | | | | \$ 9,457,000 |

1. Transmission main unit costs include all cleanouts and valve connections
2. Trench Repair assumes 3" of pavement at 6.5 ft wide
3. Permanent Trench Pavement assumes 2" of pavement and 15 ft wide travel lane
4. Milling assumes 15 ft wide travel lane for all state roads
5. Assumes 0.5 feet of rock per every LF of trench (5 foot trench)
6. Based on July 2012 Addendum to Wastewater Facilities Planning Reports
7. Assuming forcemain is laid at a rate of 150 ft/day, trench repaired at 100 ft/day, paving at 1000 ft/day, and 2 officers charge \$60/hr at 8 hr/day
8. All costs are rounded to the nearest \$1,000

7.3 ANTICIPATED PERMITS

There are three different disposal alternatives that were explored as part of this project, including:

- Groundwater discharge – a fairly straightforward permitting process with CT DEEP
- Wastewater reuse – a more complicated permitting process with CT DEEP, which is not well established in the State of Connecticut
- Surface water discharge – a straight-forward but very detailed permitting process. However, there have been very limited new surface water discharge permits for a new WPCF in the past 20+ years

7.3.1 Groundwater Discharge Permitting

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

The Old Lyme WPCA would develop and submit a permit application to CT-DEEP. CT-DEEP would 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 application 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 Publicly Owned Treatment Works (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 have been conducted in accordance and under the supervision of the CT-DEEP. Therefore, several of the preliminary elements required in a Groundwater Discharge Permit application have already been initiated.

7.3.2 Surface Water Discharge Permitting

CT-DEEP's Wastewater Discharge from Domestic Sewage Treatment Works regulates wastewater treated by domestic sewage treatment facilities which discharge to surface waters of the state. Surface water discharge permitting is a straight-forward but very detailed application process in Connecticut. However, new surface water discharge permits are very rare (the most recent new approved surface discharge was for Deep River, prior to 1990).

The Old Lyme WPCA would develop and submit a permit application. CT-DEEP will review the application and determine if the proposed discharges will cause pollution to the waters of the State. The application will be reviewed by CT-DEEP for:

- Adherence to public notice requirements
- Consistency with the Connecticut Coastal Management Act
- Compliance with 2011 Connecticut Water Quality Standards
- Site plans including a process flow diagram
- Proposed operations and maintenance plan

Based upon the aforementioned surface water discharge permitting application requirements, we believe that surface water discharge permitting carries a relatively high-cost of approval and an unknown likelihood of success.

7.3.3 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 challenging because the State of Connecticut is one of four 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 three different permitting options under existing CT-DEEP programs. Table 7-6 outlines the three currently known options for permitting wastewater reuse in Connecticut.

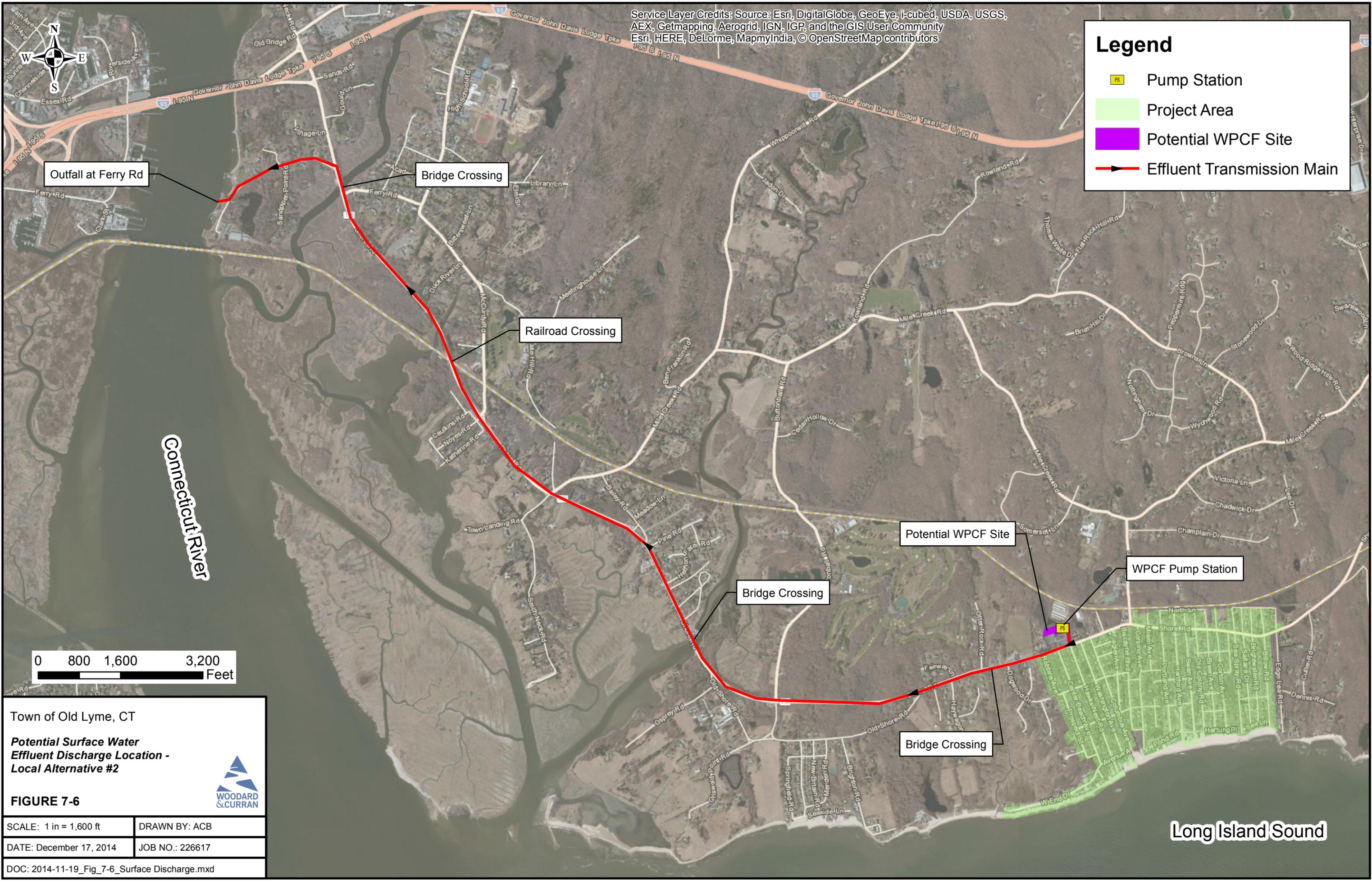
Table 7-6: Current Wastewater Reuse Permitting Options in Connecticut

| 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 had an existing discharge into a pond system used by Fairview Farms Country Club for irrigation. In 2012, a NPDES permit was issued to reauthorize the existing discharge |
| 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 publishing a Notice of Application with a 30 day comment period. | - 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. | - 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. |
| 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. | - The 2011 Connecticut Water quality standards prohibit the discharge of treated wastewater into class A or SA waterbodies, which includes manmade reservoirs. |

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

Legend

- Pump Station
- Project Area
- Potential WPCF Site
- Effluent Transmission Main



Town of Old Lyme, CT

**Potential Surface Water
Effluent Discharge Location -
Local Alternative #2**

FIGURE 7-6



| | |
|---|-----------------|
| SCALE: 1 in = 1,600 ft | DRAWN BY: ACB |
| DATE: December 17, 2014 | JOB NO.: 226617 |
| DOC: 2014-11-19_Fig_7-6_Surface Discharge.mxd | |

Long Island Sound

8. COMPARISON OF ALTERNATIVES AND RECOMMENDATIONS

8.1 INTRODUCTION

This Section includes: a comparison of the Local and Regional Alternatives, including capital costs, operation and maintenance costs, and net annual costs; the recommended plan including the proposed alternative; and the framework for an implementation plan including coordination with other on-going wastewater planning efforts in the Project Area, 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 interests of the Town and the Project Area Sub-Areas. The advantages and limitations of each alternative proposed are summarized in Table 8-1.

Table 8-1: Summary of Advantages & Limitations of Alternatives Proposed

| Alternative | Advantages | Limitations |
|---|--|--|
| Local Alternative 1 Disposal/Reuse | <ul style="list-style-type: none"> - No intermunicipal agreements required - Higher quality effluent - More control over annual O&M costs - Possibility of water reuse opportunities | <ul style="list-style-type: none"> - Higher capital and O&M costs - New local WPCF and permitting required - Additional pump station required at WPCF - More substantial land requirements - Complicated permitting process |
| Local Alternative 2 CT River Discharge | <ul style="list-style-type: none"> - No intermunicipal agreements required - More control over O&M costs | <ul style="list-style-type: none"> - Higher capital and O&M costs - New local WPCF required - Additional pump station required at WPCF - Land requirements - Additional permitting to cross resources - Easement(s) required |
| Regional Alternative | <ul style="list-style-type: none"> - Lower capital and O&M costs - No new WPCF required - Moderate permitting requirements - Minimal property acquisitions - Less construction required | <ul style="list-style-type: none"> - Multiple intermunicipal agreements required - Future downstream infrastructure upgrades anticipated - Less control over future escalations in annual O&M costs by downstream communities |

8.2.1 Capital Costs for Project Area

Table 8-2 includes a summary of total projected capital costs for the Project Area 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 8-2: Total Capital and Annual O&M Costs for Project Area

| System Component | Capital ¹ | | | Annual O&M | | |
|------------------|---------------------------|-------------------------------|---------------------|--|-------------------------------|------------------|
| | Local #1 - Disposal/Reuse | Local #2 - CT River Discharge | Regional | Local #1 - Disposal/Reuse ¹ | Local #2 - CT River Discharge | Regional |
| Collection | \$23,529,000 | \$23,529,000 | \$29,952,000 | \$217,000 | \$217,000 | \$336,000 |
| Treatment | \$14,500,000 | \$14,500,000 | \$5,995,000 | \$532,000 | \$532,000 | \$76,000 |
| Disposal | \$12,800,000 | \$9,457,000 | \$0 | N/A ² | N/A ² | N/A ² |
| Totals | \$50,829,000 | \$47,486,000 | \$35,947,000 | \$749,000 | \$749,000 | \$412,000 |

1. Local and Regional Costs based on gravity sewer collection systems for Project Area.

2. Annual Disposal and Reuse costs are included with Treatment O&M.

As shown in Table 8-2, the collection system capital costs for the Regional Alternative are significantly higher than those for the Local Alternative. This is because the Regional Alternative includes pump stations, force mains, and gravity sewer needs in East Lyme and Waterford resulting from by the proposed connection. However, the anticipated treatment costs are much lower for the Regional Alternative than for the Local Alternatives, since new treatment systems are not required for the Regional Alternative. Overall, the Regional alternative has an anticipated capital cost that is approximately \$15M less than the Local Alternative. However, there is greater potential for major deferred capital expenses for the Regional Alternative. For example, New London has not developed a capital plan for their WPCF, of which Old Lyme would be required to contribute in the future. The same can be said about future capital needs in East Lyme and Waterford, which would also require that Old Lyme contribute to these costs.

8.2.2 Annual Operation & Maintenance Costs for Project Area

In addition to the capital costs for designing and constructing the recommended plans, there will also be an annual O&M cost for the Town to both operate and maintain the system. The operation and maintenance (O&M) cost associated with the system primarily consists of costs to operate and maintain the wastewater collection system, pump station(s), force main(s), maintenance of the mechanical pumping equipment, annual replacement costs, treatment costs, chemical addition costs, power costs, and administrative costs.

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

The results of the cost analysis suggest that the annual O&M costs for the Local Alternative are approximately \$340,000 more expensive than that for the Regional Alternative. This cost differential could change depending in the extent of external contract operations services utilized by the Town and beaches. We also note that Old Lyme has less control over future escalations in annual O&M costs with the Regional Alternative.

8.2.3 Regional Alternative for Project Area

Following submittal of the December 2013 Draft Report, CT-DEEP provided in May 2014 information on existing potable wells adjacent to the primary subsurface disposal site that would have required relocation of the wells and/or additional testing and groundwater modeling on other available testing sites. However, based on the status of the ongoing regional sewer connection project to New London by the chartered beach associations, the Town, CT-DEEP and chartered beaches agreed to pursue the Regional Alternative together as a single recommended plan, which relies on treatment and disposal through the New London WPCF. The components of the Regional Alternative for the Project Area are shown in Figure 8-1.

8.2.4 Capital Cost Sharing and Financing for Project Area

Woodard & Curran performed an analysis on the Regional Alternative for the Project Area Sub-Areas to determine the net annual cost to the property owners in the Project Area for both capital cost and debt service. The most

favorable anticipated financing terms are through the State Clean Water Fund (CWF) program which would finance the eligible capital cost, excluding the buy-in costs associated with the New London WPCF. The CWF program is a CT-DEEP financial assistance program that allows communities to receive grants and low interest loans with a payback period of up to 20 years. For the purpose of this analysis, we assumed a 25% small-community grant based on the Priority List issued by CT-DEEP, with a CWF-based 2% interest rate for a 20-year loan. Note that the Town may also be eligible to receive an additional 5% grant from CT-DEEP if the Town managed and chartered beaches agree to establish a regional WPCA. This management alternative can be explored following appropriation of project funds by the Town.

To present the capital and O&M costs to an Equivalent Uniform Annual Cost (EUAC), we calculated the Capital Recovery Factor (CRF) based on the annual interest rate (2%) and the design period (20 years). The capital EUAC was then estimated by multiplying the amount financed by the CRF. The results of this analysis are summarized in Table 8-4.

Table 8-4 includes a summary of anticipated capital and annualized capital / O&M costs for each of the Sub-Area groupings that comprise the Project Area. The Town managed Sub-Areas (Hawks Nest, Sound View, and Miscellaneous Area B) are shown as one grouping. The proposed allocation of capital costs by Sub-Area is shown on an equivalent dwelling units (EDU) basis. Annual O&M cost projections are similarly shown. Figure 8-4 illustrates the net capital cost per EDU for the Project Area.

Based on the net annual capital costs, 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 Project Area.

The following debt recovery methods are options to recover the costs to finance a typical wastewater utility project:

- Betterment assessments based on the fixed uniform rate (linear foot frontage and/or property area) or the uniform unit method (number of existing/potential sewer units);
- Supplementation by special assessments such as connection charges, interest, fines, etc.;
- User charges; and
- Property taxes.

The Town will utilize benefit assessments to recover funding and financing costs for the proposed Project. Therefore, only property owners within the Project Area will be assessed Project costs. No changes to the mill rate (general taxation) are proposed as part of this Project.

8.2.5 Other Considerations

In addition to the cost benefits of the Regional 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: Both Local and Regional Alternatives included the establishment of a new wastewater utility, and 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 need to manage the allocation of sewer flows, capital costs, and annual costs.

- Utilities: As we undergo efforts to provide public sewer service to the residents of the Old Lyme beach communities, it is prudent to evaluate other utility needs in the area. These other utilities potential include water supply and power.

Water Supply: Like many of the chartered beach associations, the Town is exploring water distribution system needs in / to the Town managed parts of the High Needs Sub-Areas. The Town is working with CT-DPH, Connecticut Water, the Sanitarian, local water suppliers, and project stakeholders to evaluate these needs, develop costs, and present water improvement recommendations.

Based upon an initial review of Hawk's Nest Beach and Sound view, it is clear that there are existing drinking water system improvement needs. At Hawk's Nest, there is a single line supplying water to a limited area of the beach community with no distribution system looping. There are also many private residential wells with seasonal water supply (piping) challenges. In Sound View, there is generally a good public water supply source however there are seasonal water piping challenges that require attention. In addition, Connecticut Water has developed a capital needs list for Sound View that requires outside funding to implement.

It should be noted that the Town may qualify for funding assistance from the CT-DPH Drinking Water State Revolving Fund program to address water needs in these areas. In addition, there are likely cost savings opportunities if water and wastewater projects are designed and constructed concurrently. As water system conversations and investigations continue, recommendations will be developed and presented to the Town.

Power: Connecticut Light & Power currently provides electricity to the Old Lyme beach communities. This power is supplied to the residents via overhead electrical lines. There are areas and residents of the beach communities that currently receive minimal power service and would likely be open to electrical system improvements. However, since electrical service is currently overhead and CL&P has no intention of implementing a costly underground electrical program, there is no cost or technical advantages of including broad-scale electrical improvements in this project.

8.3 PLAN DEVELOPMENT AND PUBLIC REVIEW PROCESS

The Town established a public workshop process as part of this Coastal Wastewater Management Plan Project to solicit input from stakeholders and partner agencies including CT-DEEP and chartered beach associations. Workshops were held during the development of this Updated Report to provide opportunities for interested parties to provide their input and/or feedback throughout the planning process.

To date, there have been more than 30 public meetings in which the Coastal Wastewater Management Plan Project was discussed. The recommended plan was presented to stakeholders during a focused public information meeting on September 30, 2014. Public comment has already helped shape the current plan, and we expect this to continue through project implementation.

8.4 RECOMMENDED PLAN

8.4.1 Proposed Project Area

Figure 8-1 shows the proposed Project Area, which is comprised of six Sub-Areas. Table 8-2 includes a summary of total capital and O&M costs for the Project Area associated with 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 8-3 summarizes the flow projections by Sub-Areas for the Project Area.

8.4.2 Proposed Alternative

The components of the Recommended Plan (the Regional Alternative) are shown in Figure 8-1. Despite the anticipated deferred capital costs associated with the Regional Alternative, the Regional Alternative capital cost projection is much lower than the Local Alternatives. This is predicated on the cooperative approach between the Town and the chartered beach association. 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 Regional Alternative.

The common pump station/force main sharing, and sewerage across municipal boundaries, facilitates the maximization of cost sharing. If the Town and the chartered beaches decided to connect to New London with several individual pump stations and force mains, the costs for the Regional Alternative would be much higher. Therefore, based on the cooperative effort, as described, and endorsed by CT-DEEP, we recommend the Regional Alternative be implemented.

8.4.3 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. The three chartered beach associations are seeking appropriations for Project costs independent of the Town.



Construction in beach communities requires close communication with project stakeholders.

8.4.4 Capital Cost Allocation for Project Area

Table 8-4 includes a summary of anticipated capital and annualized capital / O&M costs for each of the Sub-Area groupings. The Town managed Sub-Areas (Hawks Nest, Sound View, and Miscellaneous Area B) are shown as one grouping. The proposed allocation of capital costs by Sub-Area is shown on an equivalent dwelling units (EDU) basis. Annual O&M cost projections are similar shown.

Figure 8-2 summarizes the anticipated capital cost appropriations for each Sub-Area (Town managed and chartered beach areas). Figure 8-3 shows the net capital costs for each Sub-Area excluding the anticipated grant funds (25%) from CT-DEEP. Figure 8-4 illustrates the net capital cost per EDU for each of the Sub-Areas. Finally, Figure 8-5 shows the anticipated net annual cost per EDU for the project area, and Figure 8-6 highlights the projected monthly wastewater costs as compared to other household utility costs.

8.5 IMPLEMENTATION PLAN

There are four major elements of the Implementation Plan for the Coastal Wastewater Management Project. These include: (1) management planning with the Beach Communities, (2) funding/finance considerations, (3) continued public outreach and participation, and (4) management of the schedule to complete the program.

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 Regional Alternative, (2) make any necessary revisions to the Final Report,

(3) develop the intermunicipal agreements (IMA), (4) evaluate project consistency with Connecticut Environmental Policy Act (CEPA) requirements, and (5) develop a detailed Implementation Plan. However, based on the milestones for completion in the two outstanding Consent Orders Sub-Areas 7 and 8, we believe that the Town's Regional Alternative can also be concurrently implemented (upon adjustment of the Consent Order schedules) to allow not only Sub-Areas 7 and 8, but also the other Sub-Areas comprising the Project Area, to be addressed simultaneously. Figure 8-7 shows the key critical path steps for wastewater planning and implementation steps.

8.5.1 Management Planning with the Beach Communities

The Town of Old Lyme and the Chartered Beach Communities have made tremendous progress in positioning the Coastal Wastewater Management Project for success. The parties have realized the power of collaboration and will realize significant cost savings through the implementation of a single unified program.

Going forward, the stakeholders will need to continue to work together on the design elements of the project. The team will work collaboratively throughout the Project.

8.5.2 Funding/Finance Considerations

The representatives of the Project Area understand that the Coastal Wastewater Management Project will be self-funded, meaning that the users of the system will pay their pro-rata share of the project costs (on an EDU basis). The project will be implemented utilizing CT-DEEP Clean Water Funds. These funds reimburse the participant with a grant for 55% of planning costs, and 25% of design and construction costs. The Town of Old Lyme (Sub-Areas 5B, 6 and MTA-B) will appropriate funds for their respective share of the program while Miami Beach (Sub-Area 5A), Old Colony Beach (Sub-Area 7) and Old Lyme Shores (Sub-Area 8) have each already appropriated their respective shares.

The stakeholders are also investigating other funding opportunities. For example, the Town of Old Lyme has already submitted an application for a grant under a State Resiliency Program that would have a significant positive reduction in the cost of the Project for the users in the Project Area.

8.5.3 Public Outreach & Participation

Public outreach and participation to date has been a key focus of the Town, the Old Lyme WPCA, and the chartered beaches. For example, the Town has had more than 30 public meetings and informational session on the project. Public input to date has already had a positive impact in shaping the recommended plan.

The Town and WPCA are committed to continuing to provide education and outreach opportunities as the Project is implemented. The current schedule of public outreach includes (but will not be limited to):

- Public Informational Meeting – October 2014
- Town Meeting – November 2014
- Design Public Meeting – May 2015
- Construction Public Meeting – April 2016
- Public Ribbon Cutting – June 2019

8.5.3.1 Response to CEPA Scoping Notice

CT-DEEP submitted a CEPA Scoping Notice through the Environmental Monitor in July 2014. The Scoping Notice included a project description, a map of the proposed Project Area, the proposed sewer system layout in the Project

Area, as well as a figure illustrating the alignment of the existing downstream receiving sewers in East Lyme and Waterford. During the public comment period, State agencies, members of the public and other interest groups were afforded the opportunity to provide comment letters to CT-DEEP as shown in Appendix F. Following is a summary of each of the four comment letters that were received by CT-DEEP, as well as a statement for each summarizing how these comments were considering and incorporated in this updated Report:

- *Eric Thomas of CT-DEEP submitted an email, dated August 20, 2014, inquiring as to whether the Niantic Pump Station and/or force main in East Lyme were going to be upgraded as part of the proposed project. Mr. Thomas inquired as to the current condition of the Niantic force main below the Niantic River. There are no proposed upgrades to the Niantic Pump Station as part of this project, and the design pumping rate of the Niantic Pump Station is not expected to change as a result of the proposed Old Lyme project. Woodard & Curran did mention this comment to East Lyme Water & Sewer staff at a Fall 2014 meeting. East Lyme is in the process of considering future needs at the Niantic Pump Station, and should coordinate any potential force main evaluation tasks with CT-DEEP as part of their independent project work.*
- *Marcy Balint of the State of Connecticut submitted an email on August 20, 2014, via David Fox (also of the State), to CT-DEEP. The email summarizes comments regarding the project's consistency with the State's Water Quality policies, coastal resiliency, and climate change considerations. As a result of these comments, Woodard & Curran and CT-DEEP met in November 2014 to update the wastewater management needs analysis to ensure that it considered sea level rise, coastal resiliency, and other measures to improve coastal management and water quality goals. The proposed project is only serving existing development, and there are no allowances for future flows associated with in-fill development as part of the proposed project. CT-DEEP has stated that the future loan/grant agreement, through CWF funding, will include a provision stating that only existing wastewater needs from previously developed parcels can be served through the proposed wastewater infrastructure to be constructed, and funded by CT-DEEP.*
- *Ellen Blaschinski of the Department of Public Health submitted a letter to CT-DEEP on August 22, 2014. The letter included questions relating to the sewers supporting future growth in the proposed service area. As well as statements related to confirming that existing septic systems will be properly abandoned and other sensitive environmental and public health considerations be included in the proposed project. In response to these comments, the proposed sewer service area has been updated to eliminate undeveloped lots, include only existing development, and does not include any flow allowances for future development. This is consistent with the Town of Old Lyme's long-standing goal to avoid sewers, except in this case where it is the only viable and cost-effective alternative to solve existing on-site wastewater management challenges and pollution problems.*
- *David Potts of Killingworth, Connecticut submitted a letter to CT-DEEP on August 8, 2014. The letter advocates for solutions relying on the continued use of on-site wastewater (i.e. septic systems) with local sub-surface disposal systems. As part of this project and updated Report, on-site systems were eliminated as a viable cost-effective alternative in the proposed Project Area. The wastewater management needs analysis in Section 2 summarizes these considerations as well as reasons why on-site systems are not the most appropriate alternative in the proposed Project Area. In addition, more centralized on-site "Local" alternatives were considered in Section 7, but the costs are higher than those for the Regional Alternative, and there are more significant permitting requirements for the centralized/local alternatives.*
- *Bruce Wittchen, Connecticut Office of Policy & Management submitted a letter to CT-DEEP on August 22, 2014. The letter is requesting clarification on the rationale for the alternative selection (comparing them to historic Town committee meeting minutes), expectations for expansion of sewer service area, and how climate change considerations are being incorporated. This report clearly details the options and alternatives in Section 1-7 and explains the rationale for recommendations in Section 8. This report*

represents a culmination of numerous meetings and introduces new data, therefore it builds upon and likely supercedes historic meeting minute items. Regarding expansion of the sewer area, Section 2.7 reviews the sewer need areas consistency with the State Plan of Conservation and Development. Lastly, climate change is a major consideration within the Needs Assessment in Section 2 and resiliency being a requirement of design of the sewer solution, has already been considered in the siting of sewer infrastructure and will continue to be incorporated into the design.

Upon CT-DEEP's review of this updated Report, Woodard & Curran and the Town of Old Lyme will work with CT-DEEP to develop an Environmental Impact Evaluation (EIE), as required by the CEPA Scoping Notice conclusions. The EIE will be subsequently advertised in the Environmental Monitor to receive any additional public comment on the proposed project. We anticipate that the EIE will be completed in January 2015.

8.5.4 Schedule to Complete the Program

Old Colony Beach Club and Old Lyme Shores Beach (Sub-Areas 7 and 8) have outstanding Consent Orders requiring completion of construction by June 30, 2016. While we believe that the Town's Regional Alternative can be implemented concurrently with the Beach Association projects, there will need to be an adjustment by CT-DEEP to the current Consent Order schedules.

We propose the following schedule milestones:

- Town Meeting (appropriation of project funds) – Spring/Summer 2015
- Design – Spring/Summer 2015 thru Spring 2016
- Construction – Spring/Summer 2016 thru Winter 2018
- Commissioning, start-up and integration – Winter 2018 thru Summer/Fall 2019

Figure 8-7 illustrates the key critical path steps for implementation plan.

Table 8-3: Summary of Gravity Flow Projections for Project Area

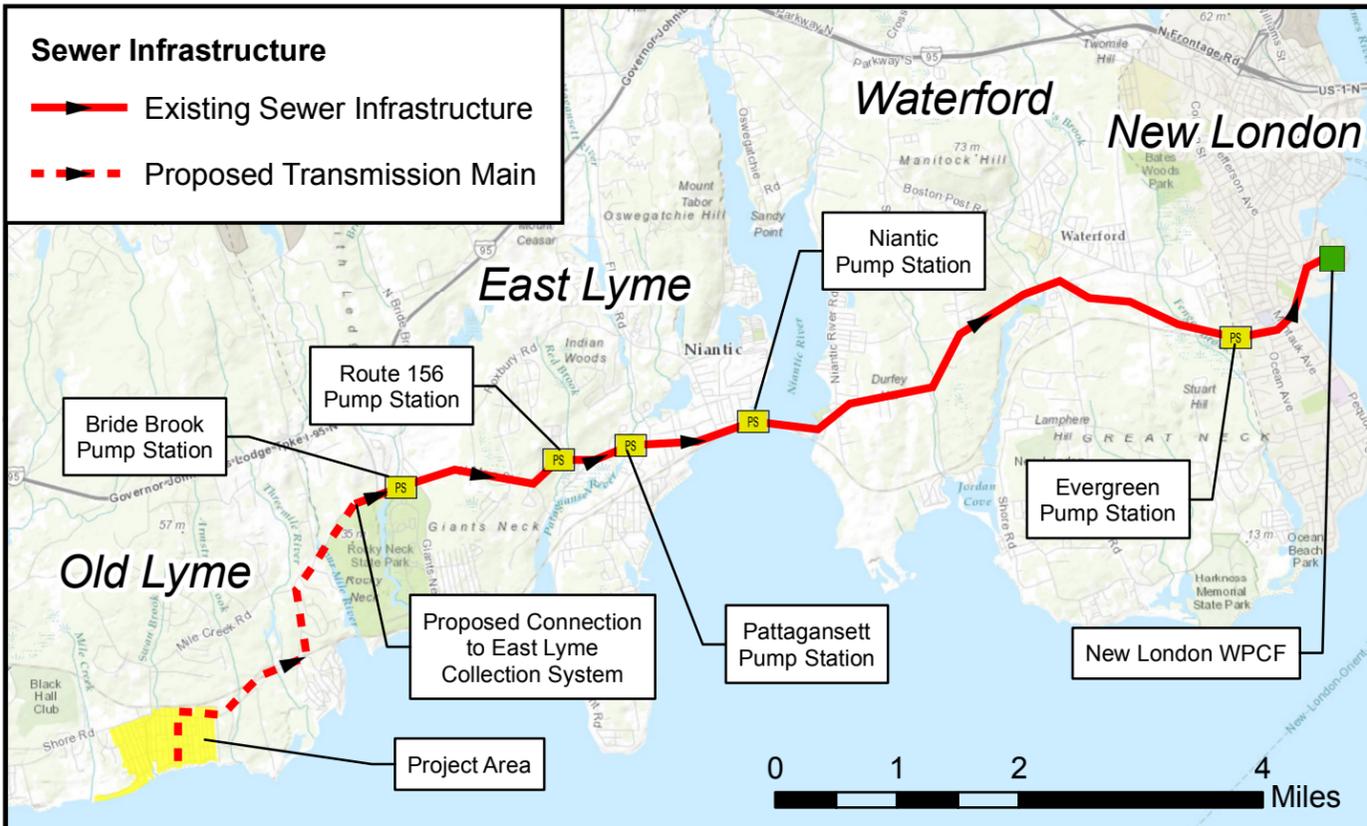
| Sub-Area ID | Description | Equivalent Dwelling Units (EDU) | Average Daily Flow (GPD) | | | Max Daily Flow (GPD) ⁴ | Peak Hourly Flow (GPD) ⁵ |
|--------------------|---------------------------|---------------------------------|--------------------------|------------------|----------------|-----------------------------------|-------------------------------------|
| | | | Sanitary Flow | I/I ³ | Total | | |
| 5A ² | Miami Beach | 236 | 42,480 | 8,545 | 51,025 | 93,505 | 178,465 |
| 5B ¹ | Hawks Nest Beach | 269 | 48,420 | 8,879 | 57,299 | 105,719 | 202,559 |
| 6 ¹ | Sound View Beach | 229 | 41,220 | 4,273 | 45,493 | 86,713 | 169,153 |
| 7 ² | Old Colony Beach Club | 218 | 39,240 | 4,727 | 43,967 | 83,207 | 161,687 |
| 8 ² | Old Lyme Shores Beach | 206 | 37,080 | 6,545 | 43,625 | 80,705 | 154,865 |
| MTA-B ¹ | Miscellaneous Town Area B | 41 | 7,380 | 1,697 | 9,077 | 16,457 | 31,217 |
| Total | | 1,199 | 215,820 | 34,667 | 250,487 | 466,307 | 897,947 |

1. Existing EDU counts for Sub-Areas 5B, 6, and MTA-B are based on Town Sanitarian records and include commercial contributions.
2. Existing EDU counts for Sub-Areas 5A, 7, and 8 are based on Fuss & O'Neill's Sub-Area shape files.
3. I/I estimate is based on a preliminary gravity sewer layout of 8-inch pipe, assuming 400 gpd/idm.
4. Maximum Daily Flow is the Sanitary Flow multiplied by a safety factor of 2, added to I/I.
5. Peak Hourly Flow is the Sanitary Flow multiplied by a peaking factor of 4, added to I/I.

Table 8-4: Project Area Cost Sharing Concept for Regional Alternative – Anticipated Capital and Equivalent Uniform Annual Costs (EUAC)

| Sub-Area Description | Chartered Beach Associations Sub-Areas | | | Town Sub-Areas | Total |
|---|--|-----------------------|-----------------------|---|---------------------|
| | 5A | 7 | 8 | 5B, 6, MTA-B | |
| | Miami Beach | Old Colony Beach Club | Old Lyme Shores Beach | Hawks Nest Beach, Sound View Beach, & Misc. Town Area B | |
| # Equivalent Dwelling Units (EDUs) | 236 | 218 | 206 | 539 | 1,199 |
| Cost Component | | | | | |
| Capital Cost Summary | | | | | |
| Collector Sewer | \$5,083,000 | \$2,783,000 | \$3,856,000 | \$8,682,000 | \$20,404,000 |
| Common Transmission System | \$1,675,000 | \$1,547,000 | \$1,462,000 | \$3,826,000 | \$8,510,000 |
| East Lyme & Waterford Upgrades | \$204,000 | \$189,000 | \$178,000 | \$466,000 | \$1,037,000 |
| Treatment @ New London WPCF | \$1,180,000 | \$1,090,000 | \$1,030,000 | \$2,695,000 | \$5,995,000 |
| Total Capital Cost Sharing (2014 Cost) | \$8,142,000 | \$5,609,000 | \$6,526,000 | \$15,669,000 | \$35,946,000 |
| Total Capital Cost Sharing (2017 Cost)¹ | \$8,897,000 | \$6,129,000 | \$7,131,000 | \$17,122,000 | \$39,279,000 |
| DEEP CWF Grant ² | \$1,902,000 | \$1,235,000 | \$1,501,000 | \$3,544,000 | \$8,182,000 |
| Net Capital Cost Sharing | \$6,995,000 | \$4,894,000 | \$5,630,000 | \$13,578,000 | \$31,097,000 |
| EUAC Summary | | | | | |
| Capital EUAC³ | \$427,800 | \$299,300 | \$344,300 | \$830,400 | \$1,901,800 |
| Cost per EDU Summary | | | | | |
| Net Capital Cost Sharing per EDU | \$29,600 | \$22,400 | \$27,300 | \$25,200 | - |
| Annual Capital cost per EDU | \$1,810 | \$1,370 | \$1,670 | \$1,540 | - |
| Monthly O&M Cost per EDU | \$30 | \$30 | \$30 | \$30 | - |
| Annual O&M Cost per EDU | \$340 | \$340 | \$340 | \$340 | - |
| Net Monthly Capital Cost per EDU | \$150 | \$110 | \$140 | \$130 | - |

1. Costs escalated to anticipated mid-point of construction (2017) at an annual inflation rate of 3%
2. Assumes 25% small-community grant from CT-DEEP (Grant exclude New London capacity buy-in cost)
3. Assumes 2% interest for 20 years (A/P = 0.0612) ENR 9516



Legend

| | |
|---------------------|---------------------------|
| Pump Station | Sub-Areas |
| Transmission Main | 5A - Miami Beach |
| Gravity Sewer Pipes | 5B - Hawks Nest Beach |
| Sewer Service Area | 6 - Sound View Beach |
| Parcels | 7 - Old Colony Beach Club |
| | 8 - Old Lyme Shores Beach |
| | Miscellaneous Town Area B |

Town of Old Lyme, CT

Proposed Project Area - Regional Alternative

FIGURE 8-1

SCALE: 1 in = 600 ft

DATE: December 17, 2014

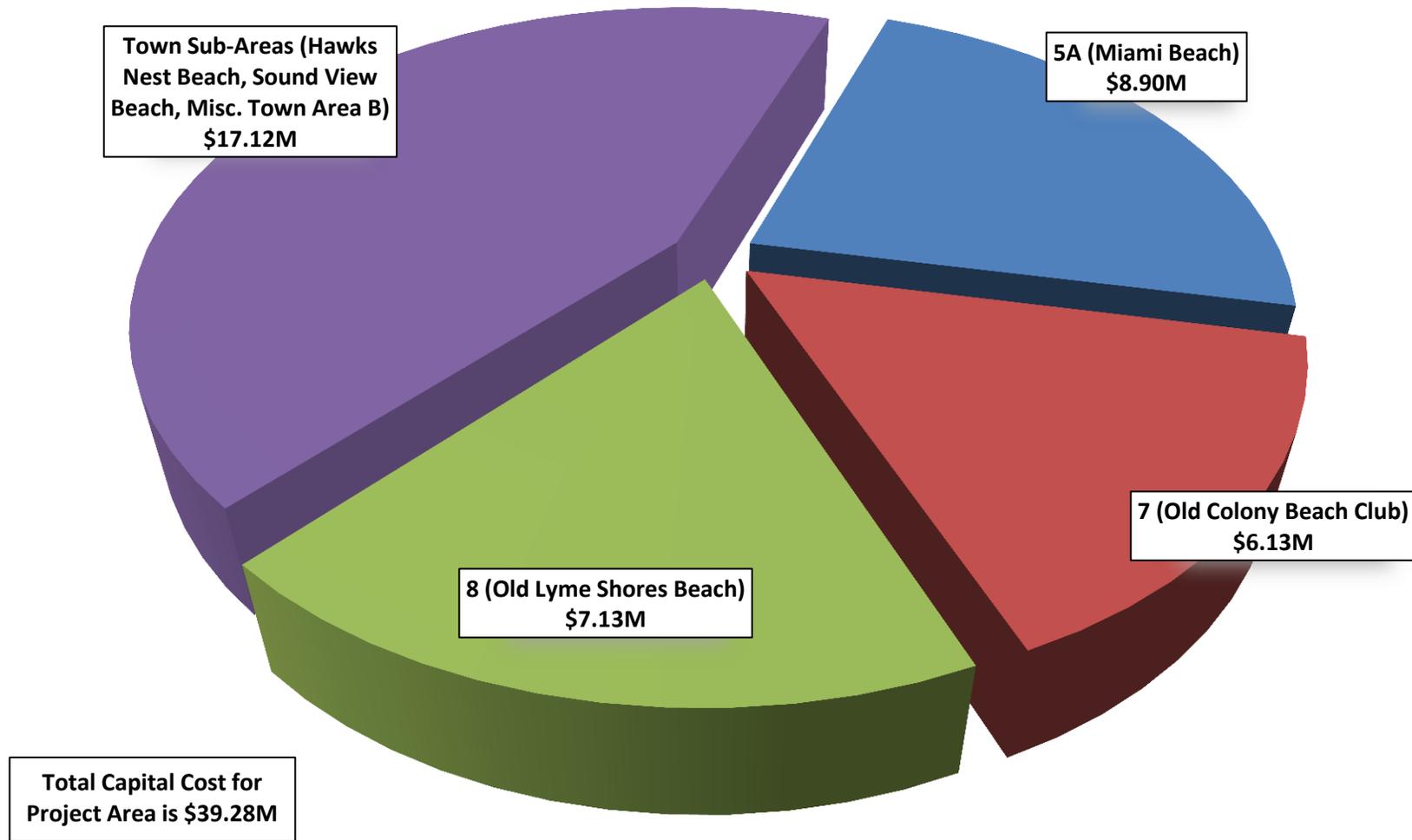
DRAWN BY: ACB

JOB NO.: 226617

DOC: 2014-11-18_Fig_8-1_Recommended_Alt.mxd

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, ©

**Figure 8-2: Summary of Anticipated Total Capital Cost Sharing
(2017 Costs) Regional Alternative - Project Area**



**Figure 8-3: Summary of Anticipated Net Capital Cost Sharing
Assuming 25% Grant (2017 Costs) - Regional Alternative - Project Area**



■ Collector Sewer ■ Common Transmission System ■ East Lyme & Waterford Upgrades ■ Treatment @ New London WPCF

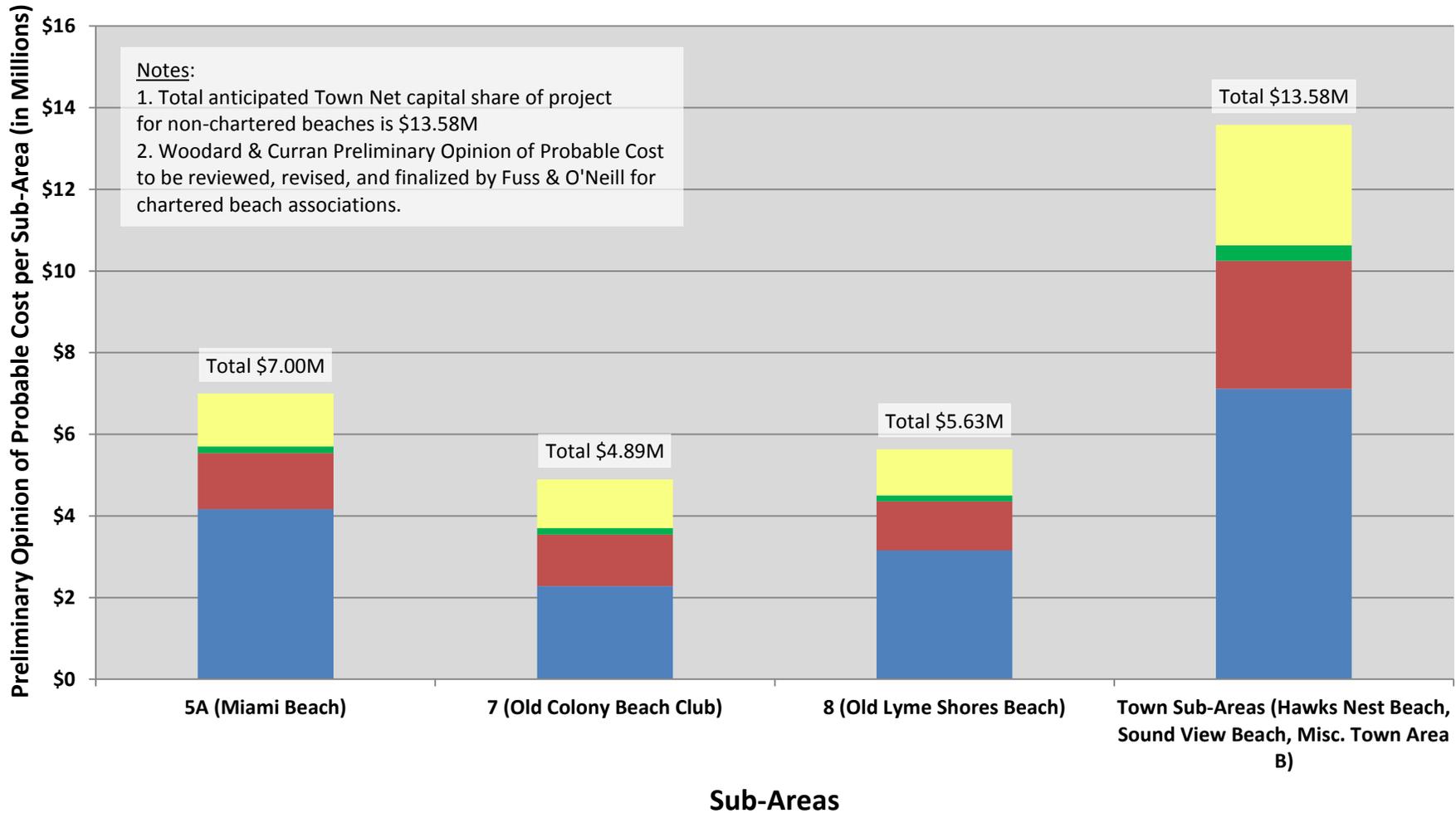


Figure 8-4: Summary of Anticipated Net Capital Cost Sharing per EDU Assuming 25% Grant (2017 Costs) - Regional Alternative - Project Area

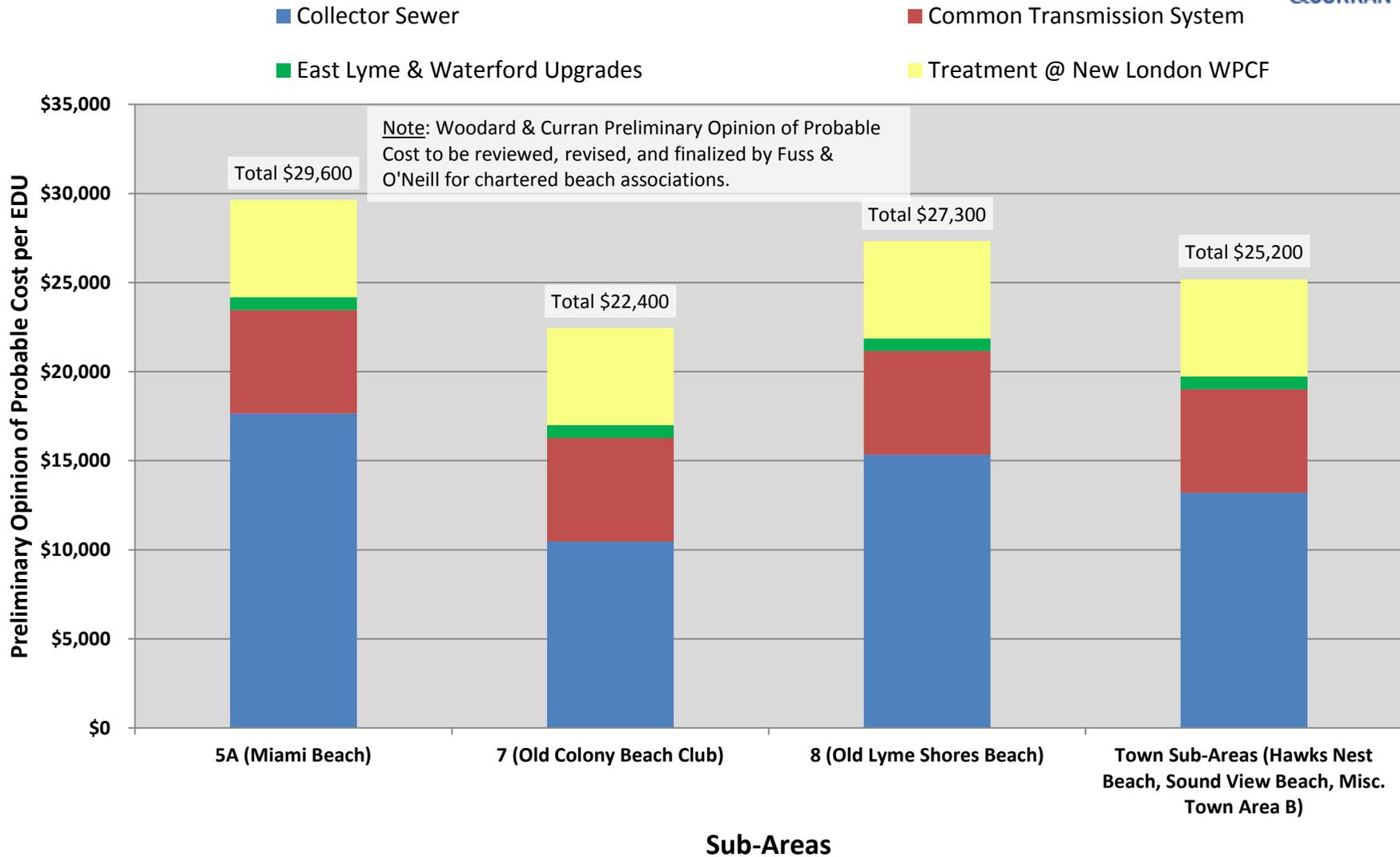


Figure 8-5: Summary of Anticipated Net Annual Costs per EDU (2017 Costs) - Regional Alternative - Project Area



■ Annual O&M ■ Capital EUAC

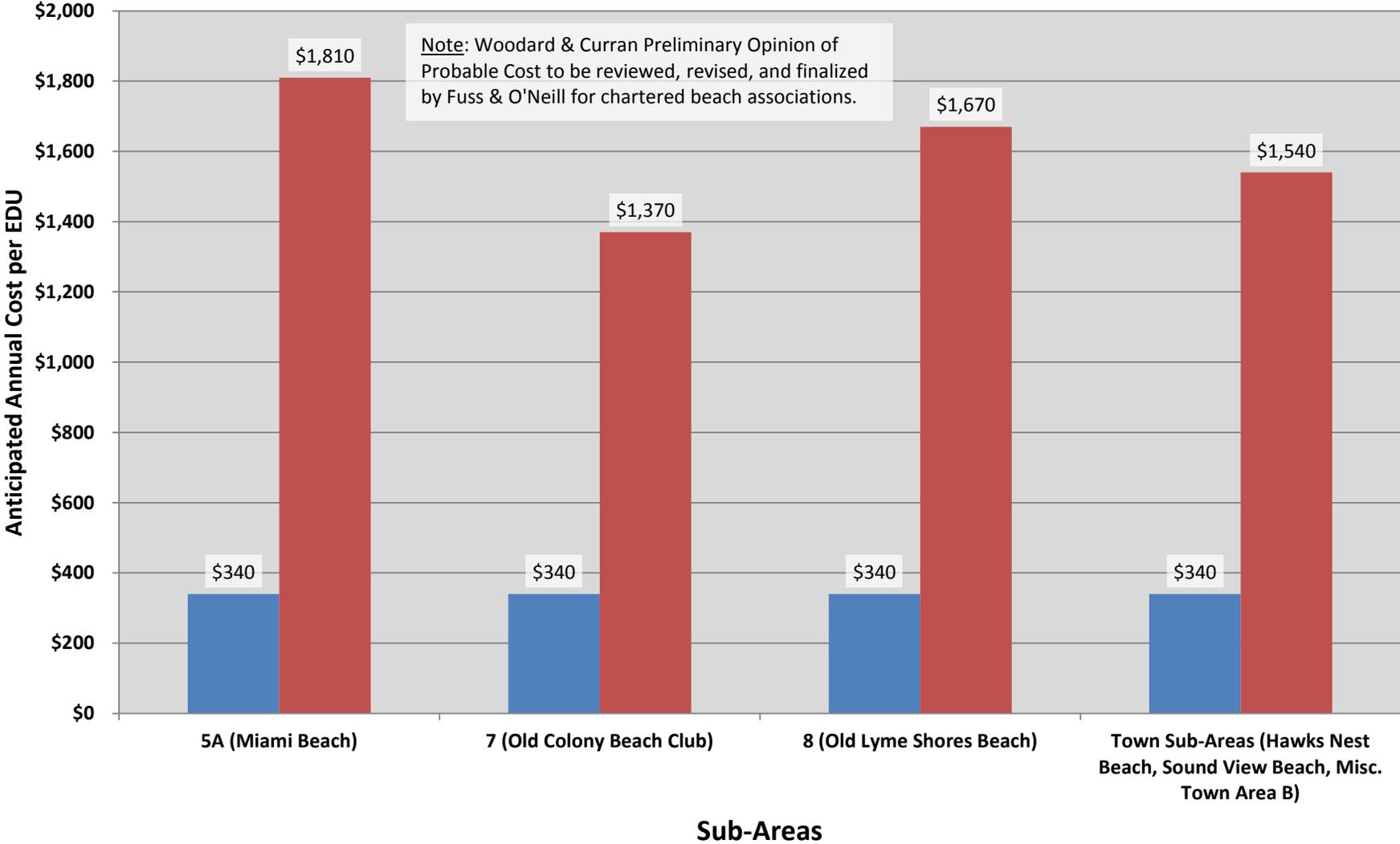


Figure 8-6: Anticipated Net Monthly Costs per EDU (2017 Costs) vs. Typical Monthly Expenses - Regional Alternative - Project Area

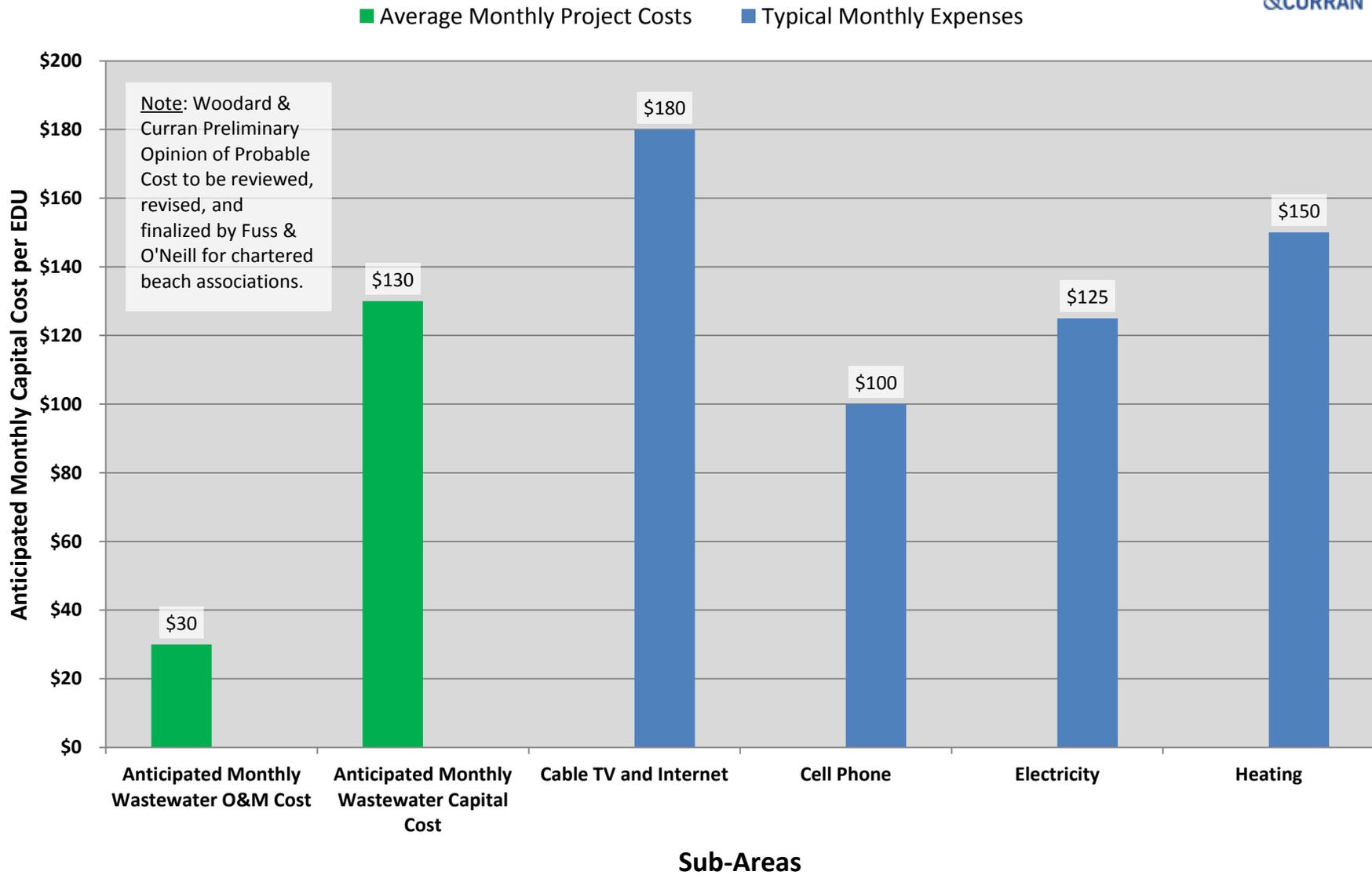
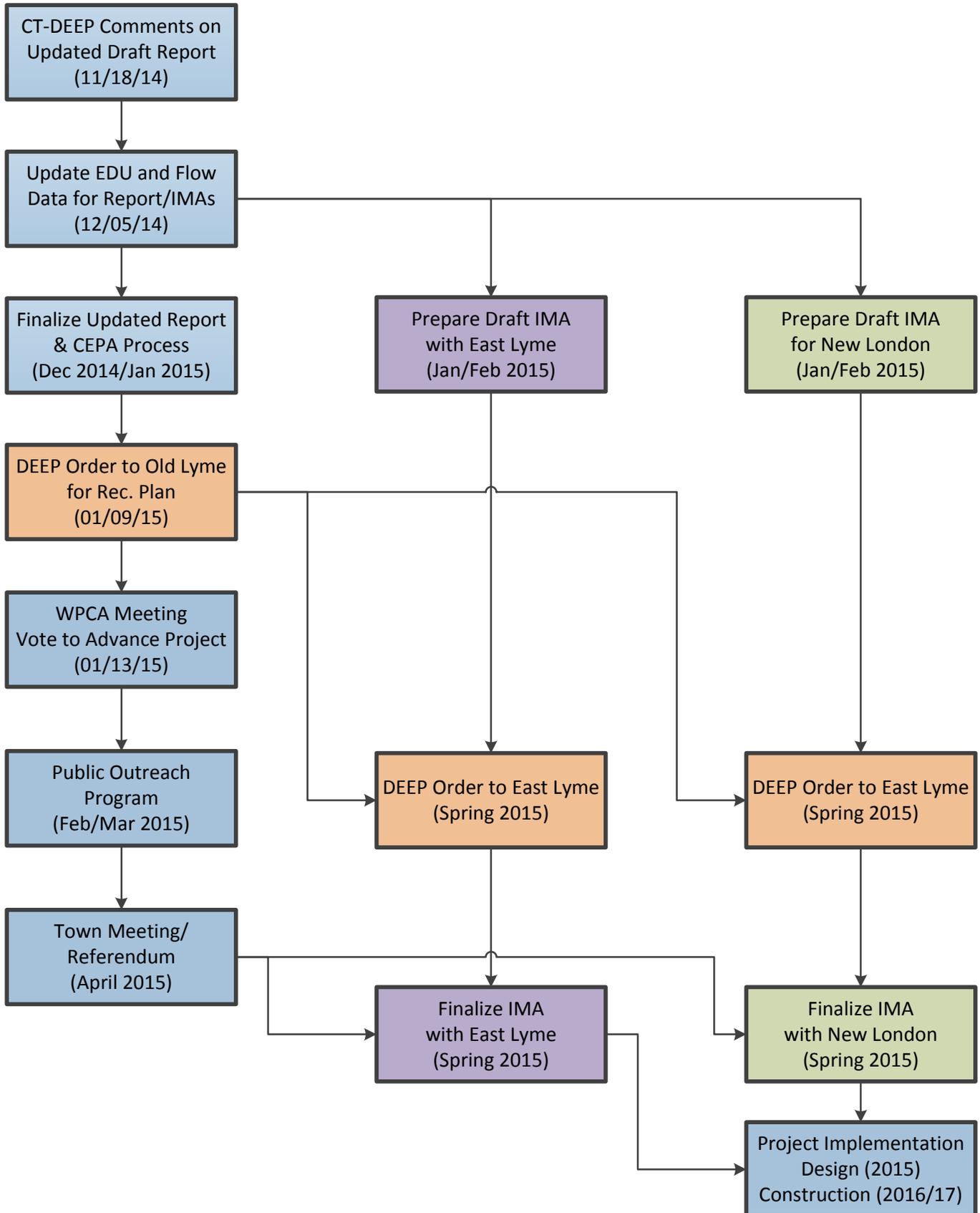


Figure 8-7

**Key Critical Path Steps for Wastewater Planning and Implementation Steps
Town of Old Lyme, Connecticut**

Updated on December 18, 2014



APPENDIX A: CONSENT ORDERS

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

Date of Issuance August 14, 2012

Order No. CO WR MU 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

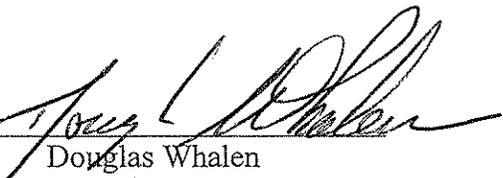
delivered or the date three days after it is mailed by the Commissioner, whichever is earlier. Except as otherwise specified in this order, the word "day" as used in this order means calendar day. Any document or action which is required by this order to be submitted or performed by a date which falls 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 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 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

COWR MU 12 001

On July 23, 2012, at 2:00 a.m. (p.m.) I mailed a certified copy of Order No. Λ 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]

COWR MU 12-001

On July 23, 2012, at 2:00 a.m. (p.m.) I mailed an uncertified copy of Order No. Λ 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
office Assistant

[Date]

7/23/12

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,

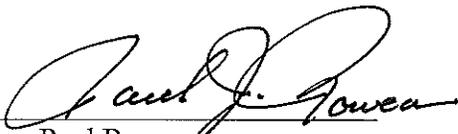
whichever is earlier. Except as otherwise specified in this order, the word "day" as used in this order means calendar day. Any document or action which is required by this order to be submitted or performed by a date which falls on a Saturday, Sunday or a Connecticut or federal holiday shall be submitted 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.

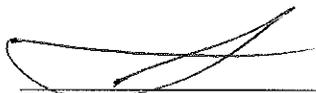
11. Notice of transfer; liability of OLSBA and others. Until OLSBA has fully complied with this order, OLSBA shall notify the Commissioner in writing no later than fifteen days after transferring all or any portion of the operations which are the subject of this order, or obtaining a new mailing or location 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 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

COWR MU 12-002

On Oct 9, 2012, at 2:00 a.m./p.m. I mailed a certified copy of Order No. A 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]

COWR MU 12-002

On Oct 9, 2012, at 2:00 a.m./p.m. I mailed an uncertified copy of Order No. A 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 | | | |
| | | TOP OF CASING | 56.23 | 1124714.39 | 667392.89 | | 35.5 | YES |
| | | GROUND SURFACE | 53.13 | 1124714.56 | 667393.27 | | | |
| | MW-3S | TOP OF PVC | 56.19 | 1124714.09 | 667391.35 | | | |
| | | TOP OF CASING | 56.33 | 1124714.52 | 667391.26 | | 35.5 | YES |
| | | 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 | | | |
| | | TOP OF CASING | 24.33 | 1126574.05 | 666585.56 | | 20.3 | YES |
| | WC-2 | GROUND SURFACE | 21.14 | 1126574.54 | 666585.47 | | | |
| | | TOP OF PVC | 23.70 | 1126445.39 | 666751.55 | | | |
| | | TOP OF CASING | 23.82 | 1126445.65 | 666751.60 | | 30.0 | NO |
| | WC-3 | GROUND SURFACE | 20.55 | 1126444.96 | 666751.96 | | | |
| | | TOP OF PVC | 15.54 | 1126359.22 | 666912.24 | | | |
| | | TOP OF CASING | 15.67 | 1126359.33 | 666912.22 | | 30.0 | NO |
| | WC-4 | GROUND SURFACE | 12.45 | 1126359.91 | 666912.51 | | | |
| TOP OF PVC | | 25.30 | 1126782.41 | 666721.12 | | | | |
| TOP OF CASING | | 25.41 | 1126782.26 | 666721.00 | | 11.5 | YES | |
| | 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**

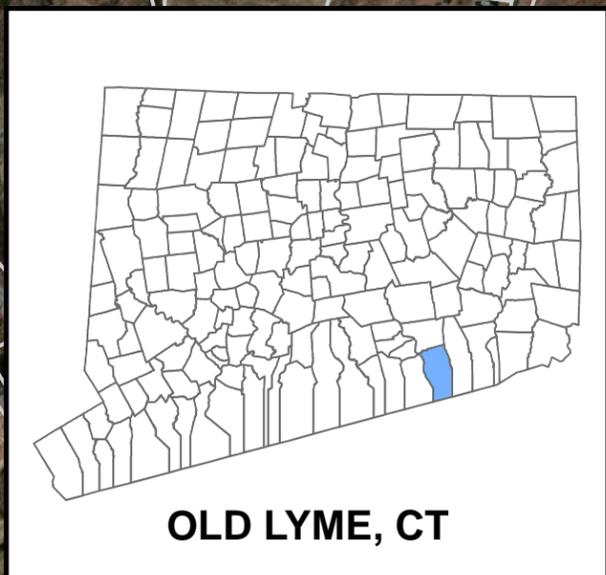
| SITE | WELL | K (ft/day) |
|-------------|-------|------------|
| CHERRYSTONE | WC-2 | 250 |
| | WC-3 | 80 |
| | WC-4 | 20 |
| BLACK HALL | MW-A | 0.13 |
| | MW-E | 12.5 |
| | MW-I | 0.11 |
| | MW-3S | 2.2 |
| | MW-3D | 16 |

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



**BLACKHALL
GOLF COURSE**

CHERRYSTONE

Legend
 □ PARCEL



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

980 WASHINGTON STREET | SUITE 325
 DEDHAM, MA 02026
 800-446-5518 | www.woodardcurran.com
**WOODARD
& CURRAN**
 COMMITMENT & INTEGRITY DRIVE RESULTS

SITE PLAN

OLD LYME, CONNECTICUT
 TOWN OF OLD LYME,
 CONNECTICUT

PN: 226617
 BY: BVA
 DATE: OCTOBER 2013

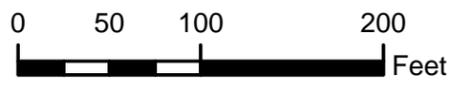
FIGURE B-1



- Legend**
- TEST PIT, 2013
 - TEST PIT, HISTORICAL
 - ⊕ MONITOR WELL, 2013

- RECEPTORS**
- ▨ CHERRYSTONE WETLAND
 - ▭ PARCEL BOUNDARY

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



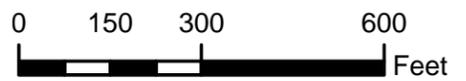
**SUBSURFACE -
 CHERRYSTONE**

OLD LYME, CONNECTICUT
 TOWN OF OLD LYME,
 CONNECTICUT



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

- Legend**
- SOIL BORING, 2013
 - ⊕ MONITOR WELL, 2013
 - ⊕ MONITOR WELL, HISTORICAL
 - ▭ PARCEL BOUNDARY

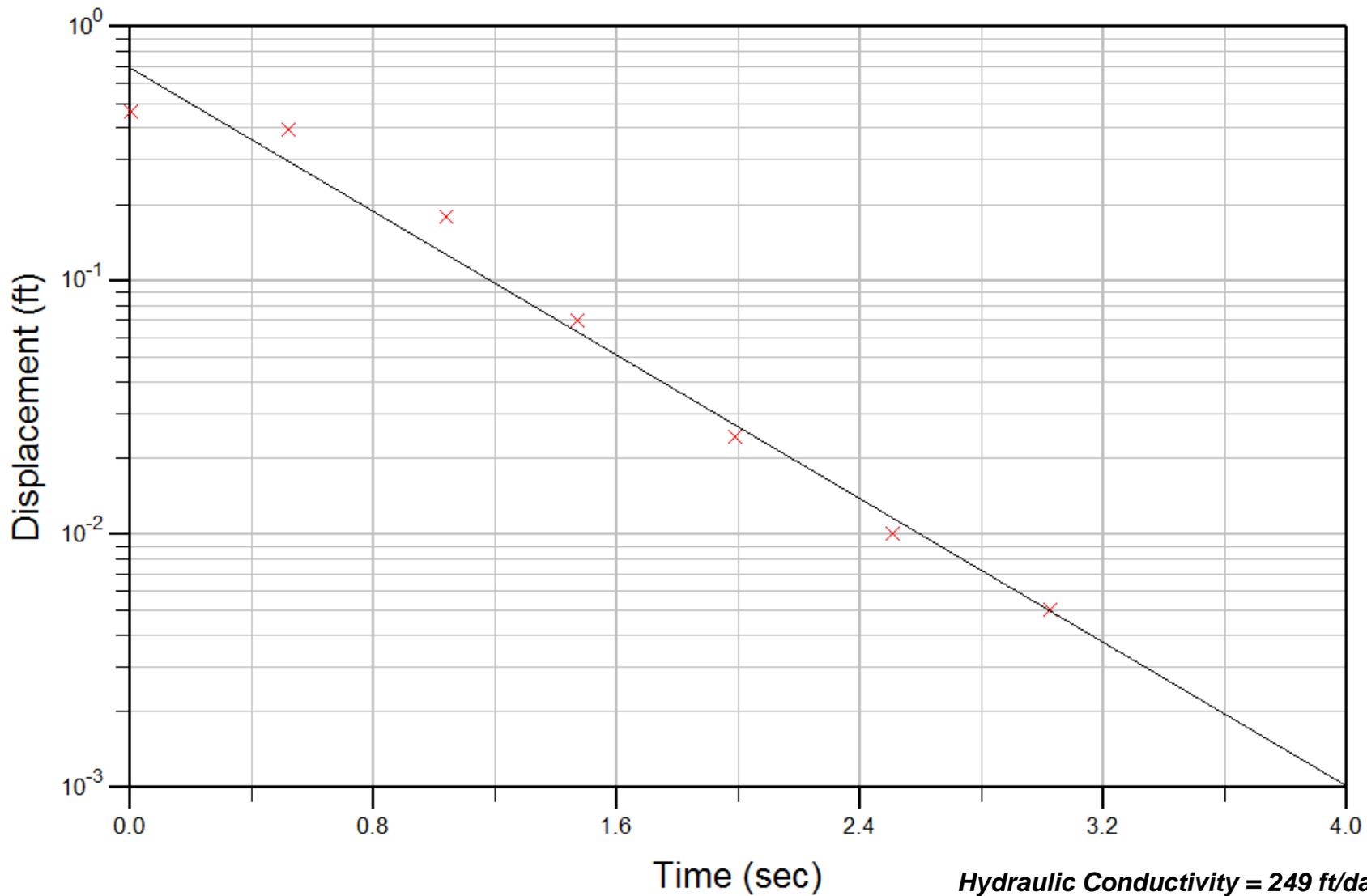


980 WASHINGTON STREET | SUITE 325
 DEDHAM, MA 02026
 800-446-5518 | www.woodardcurran.com
WOODARD & CURRAN
 COMMITMENT & INTEGRITY DRIVE RESULTS

**SUBSURFACE -
 BLACK HALL**

OLD LYME, CONNECTICUT
 TOWN OF OLD LYME,
 CONNECTICUT

PN: 226617
 BY: BVA
 DATE: OCTOBER 2013
FIGURE B-3



**COMMITMENT & INTEGRITY
DRIVE RESULTS**

980 Washington St, Suite 325
Dedham, MA 02026
T: 800.446.5518

SLUG TEST ANALYSIS: WC-2

DESIGNED BY: BVA

CHECKED BY: DP

DRAWN BY: BVA

Town of Old Lyme
Old Lyme, Connecticut

JOB NO.: 226617.00
DATE: OCTOBER 2013
SCALE: NA

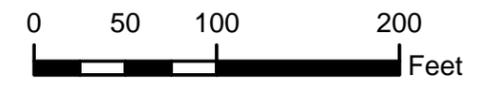
FIGURE B-4



NOTE: GROUNDWATER ELEVATIONS MEASURED JUNE 25, 2013

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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




 980 WASHINGTON STREET | SUITE 325
 DEDHAM, MA 02026
 800-446-5518 | www.woodardcurran.com
 COMMITMENT & INTEGRITY DRIVE RESULTS

GROUNDWATER - CHERRYSTONE

OLD LYME, CONNECTICUT
 TOWN OF OLD LYME,
 CONNECTICUT

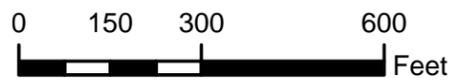
PN: 226617
 BY: BVA
 DATE: OCTOBER 2013
FIGURE B-5



NOTE: GROUNDWATER ELEVATIONS MEASURED JUNE 25, 2013

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

- Legend**
- PARCEL BOUNDARY
 - MONITOR WELL AND GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
 - GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)



980 WASHINGTON STREET | SUITE 325
 DEDHAM, MA 02026
 800-446-5518 | www.woodardcurran.com
WOODARD & CURRAN
 COMMITMENT & INTEGRITY DRIVE RESULTS

GROUNDWATER - BLACK HALL

OLD LYME, CONNECTICUT
 TOWN OF OLD LYME,
 CONNECTICUT

PN: 226617
 BY: BVA
 DATE: OCTOBER 2013
FIGURE B-6

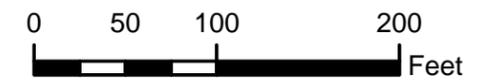


Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

- 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



**SAS FACILITY -
 CHERRYSTONE**

OLD LYME, CONNECTICUT
 TOWN OF OLD LYME,
 CONNECTICUT

APPENDIX C: SUBSURFACE INVESTIGATION - GROUNDWATER DATA AND BORING LOGS

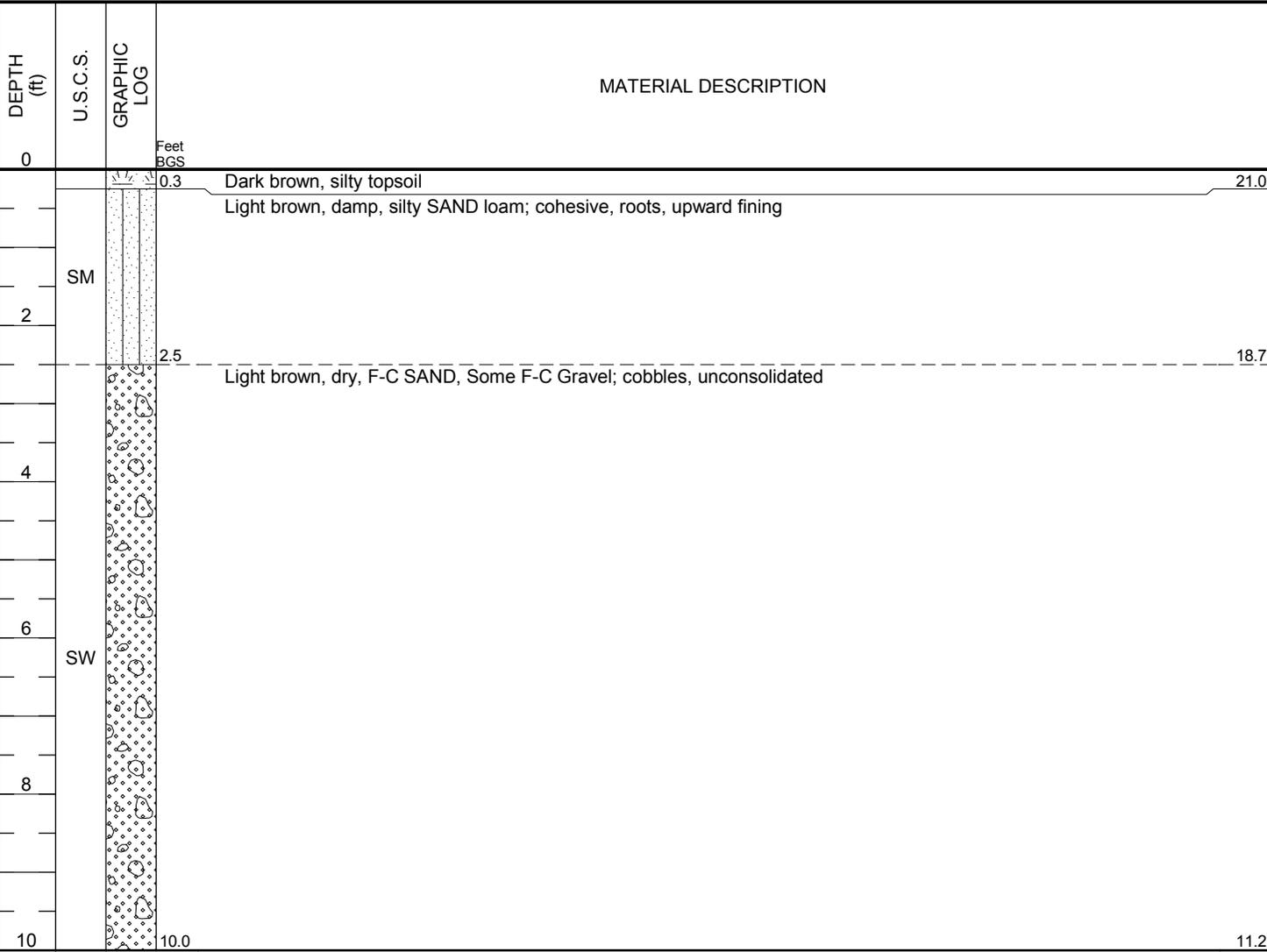


Woodard & Curran
 980 Washington St | Suite 325
 Dedham, MA 02026
 Telephone: 781.251.0200
 Fax: 781.251.0847

TEST PIT NUMBER TP-01

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \ICHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WP\EXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLDLYME_2013.GPJ

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





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

TEST PIT NUMBER TP-02

PAGE 1 OF 1

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \ICHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\PIEXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLDLYME_2013.GPJ

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 | MATERIAL DESCRIPTION | |
|------------|----------|-------------|--|------|
| 0 | | | Dark brown, silty topsoil | |
| 0.7 | | | Light brown, damp, silty SAND loam; cohesive, roots, little cobbles | 18.9 |
| 1.4 | | | Light brown, dry, F-C SAND, Some F-C Gravel; little cobbles and boulders, unconsolidated | 18.2 |
| 2 | | | | |
| 4 | | | | |
| 6 | | | | |
| 8 | | | | |
| 10 | | | | 9.6 |

Bottom of test pit at 10.0 feet.

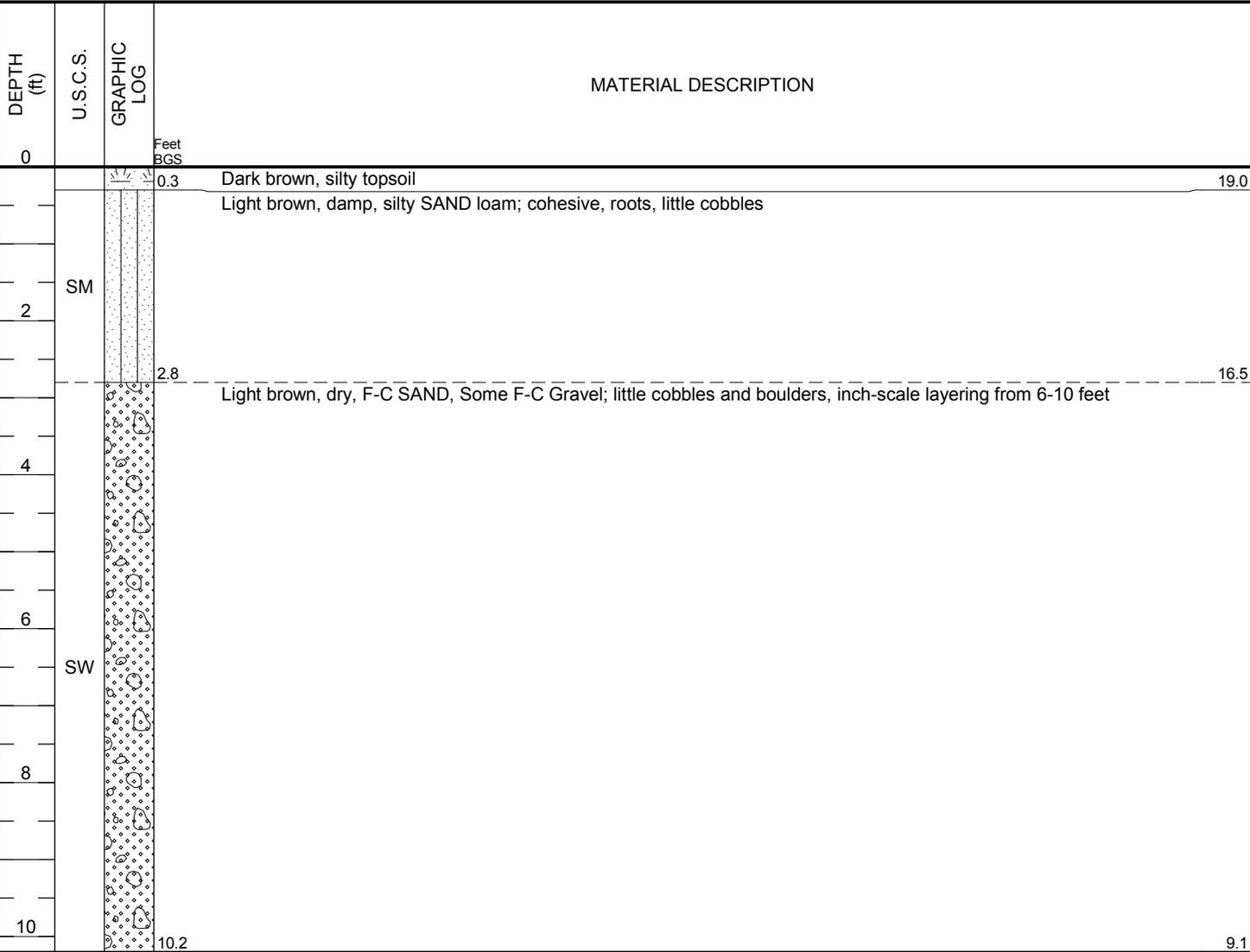


Woodard & Curran
 980 Washington St | Suite 325
 Dedham, MA 02026
 Telephone: 781.251.0200
 Fax: 781.251.0847

TEST PIT NUMBER TP-03

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \ICHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPEXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLDLYME_2013.GPJ

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



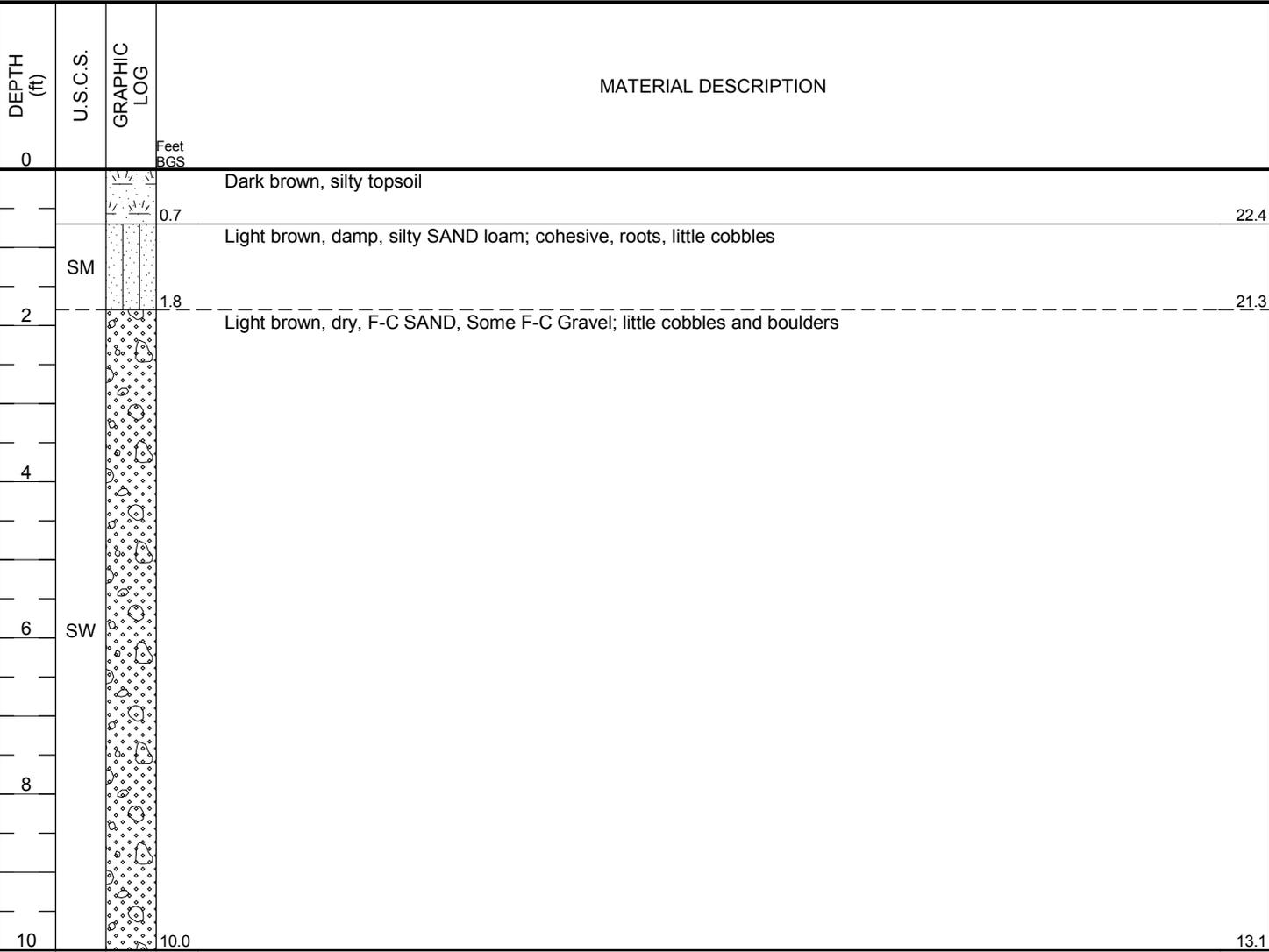


Woodard & Curran
 980 Washington St | Suite 325
 Dedham, MA 02026
 Telephone: 781.251.0200
 Fax: 781.251.0847

TEST PIT NUMBER TP-04

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \ICHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPIEXECUTION\GEO\TECHNICAL\SUBSURFACEBORING LOGS\OLDLYME_2013.GPJ

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



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-05

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \CHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WP\EXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLDLYME_2013.GPJ

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 | MATERIAL DESCRIPTION | |
|------------|---|----------|-------------|--|------|
| 0 | | | | Dark brown, damp, F SAND, Some Silt; roots | |
| 1.0 | | | | Light brown, damp, F SAND, Some Silt | 20.8 |
| 2 | Boulder noted at 1-2 ft depth in sidewall | SM | | | |
| | Orange mottling | | | | |
| 3.5 | | | | Visual confirmation of granitic rock surface | 18.3 |

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



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

TEST PIT NUMBER TP-07

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \ICHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\PIEXECUTION\GEO\TECHNICAL\SUBSURFACEBORING LOGS\OLDLYME_2013.GPJ

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

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

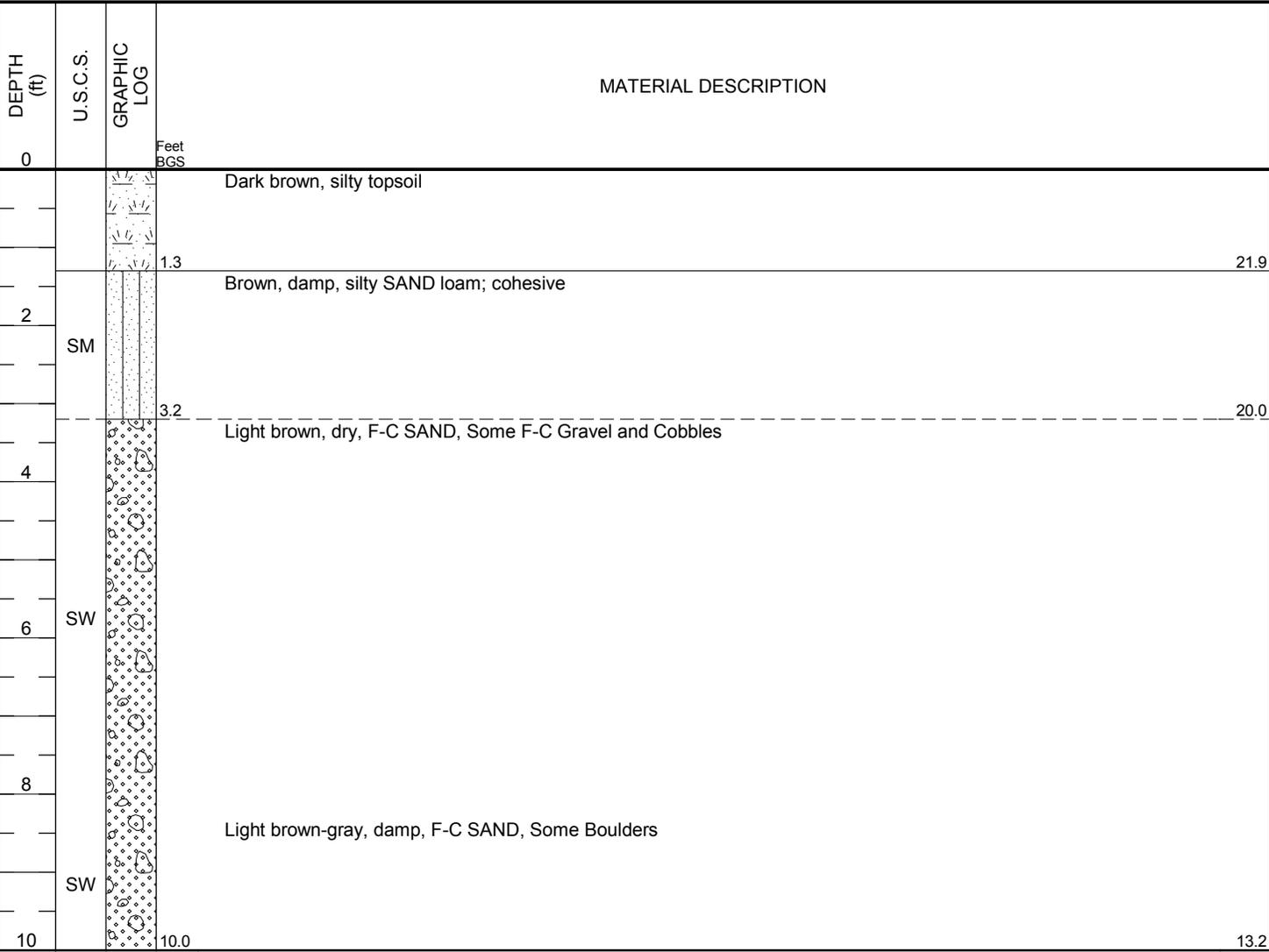
DATE STARTED 5/30/13 **COMPLETED** 5/30/13 **GROUND ELEVATION** 23.17 ft **TEST PIT SIZE** _____

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** ---



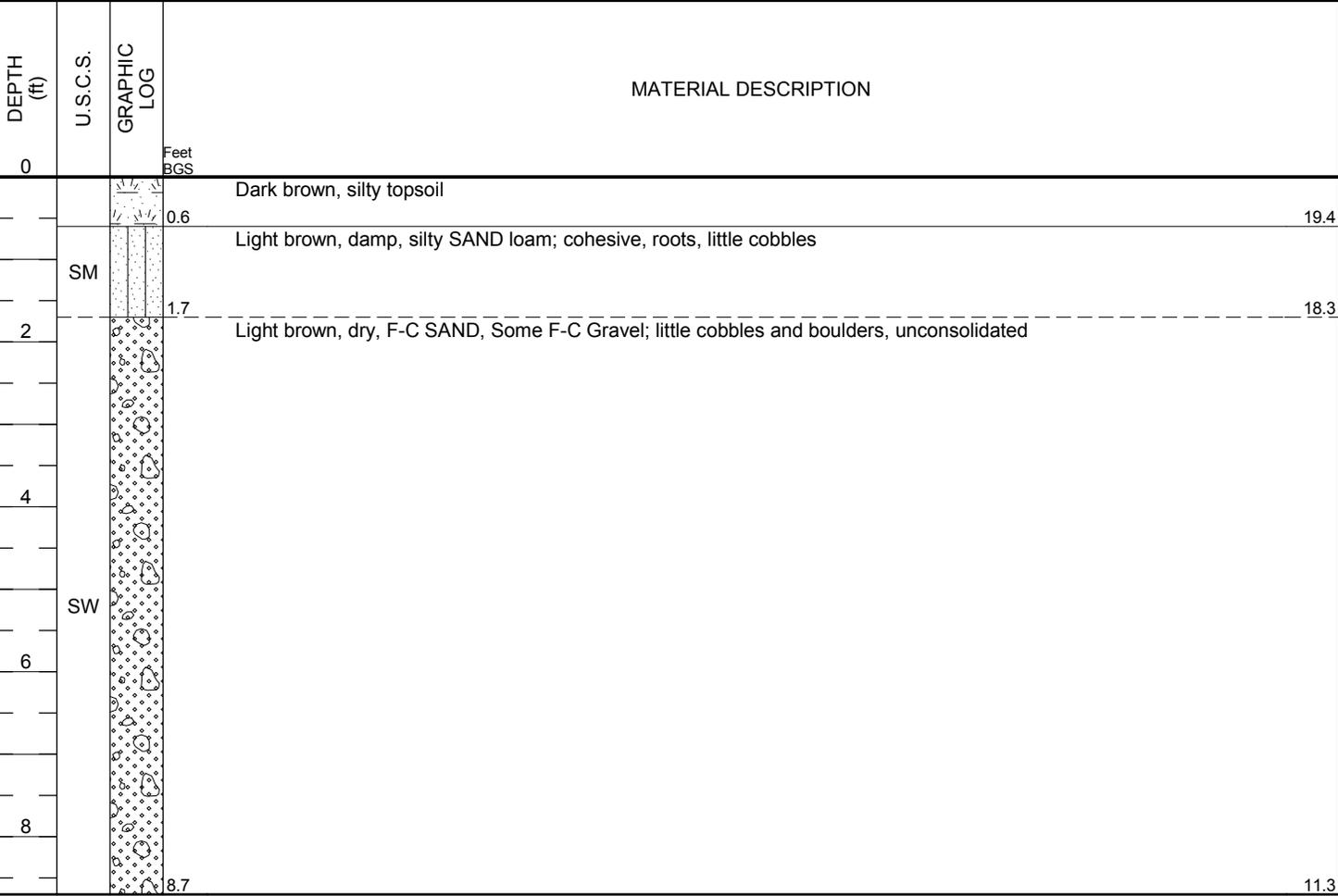


Woodard & Curran
 980 Washington St | Suite 325
 Dedham, MA 02026
 Telephone: 781.251.0200
 Fax: 781.251.0847

TEST PIT NUMBER TP-08

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \ICHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPEXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLDLYME_2013.GPJ

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



Bottom of test pit at 8.7 feet.



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

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \ICHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPIEXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLDLYME_2013.GPJ

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

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



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

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \\\CHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPEXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLDLYME_2013.GPJ

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

| DEPTH (ft) | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|-------------|----------|-------------|---|
| 0 | | | Feet BGS |
| 0 - 2 | | | Brown, dry, F-M SAND, Some Silt, little f. gravel and roots |
| 2 - 3.6 | | | Light brown, dry, F-C SAND, Little Silt and F Gravel, roots |
| 3.6 - 3.9 | MH | | Dark brown, damp, SILT, Some F SAND |
| 3.9 - 5.0 | SM | | Light brown, dry, F SAND, Some Silt, trace f. gravel |
| 5.0 - 6.0 | SP-SM | | Light brown, dry, F SAND, Little Silt and F Gravel |
| 6.0 - 8.0 | SW | | Light gray, dry, F-C SAND, Some F-C Gravel |
| 8.0 - 10.0 | SW-SM | | Dark brown, damp, F-M SAND, Little Silt and F Gravel; red/gray mottling, cohesive |
| 10.0 - 12.0 | SW | | Light gray, dry, F-C SAND, Little F Gravel |
| 12.0 - 14.0 | | | Dry fragments of gneissic rock |
| 14.0 - 16.0 | SW-SM | | Dark brown, damp, F-M SAND, Little Silt and F Gravel; red/gray mottling, cohesive |
| 16.0 - 18.0 | | | Brown, dry, weathered granitic rock |
| 18.0 - 20.0 | SW | | Light brown, dry, F-M SAND, Little F-C Gravel |
| 20.0 - 22.0 | | | Dry fragments of gneissic rock |

(Continued Next Page)



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

BORING NUMBER BH-2

PAGE 2 OF 2

CLIENT Town of Old Lyme, CT

PROJECT NAME Old Lyme Wastewater Management

PROJECT NUMBER 226617

PROJECT LOCATION Old Lyme, CT

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \\CHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WP\EXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLD LYME_2013.GPJ

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

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

16.2



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

BORING NUMBER BH-4

PAGE 1 OF 1

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \ICHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPIEXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLDLYME_2013.GPJ

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

| DEPTH (ft) | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | |
|------------|----------|-------------|---|----------|
| 0 | | | | Feet BGS |
| | | | Dark brown, damp, F SAND, Some Silt, trace f. gravel and roots | |
| 2 | | | Light brown, damp, F-M SAND, Little Silt, trace f. gravel and roots | 31.2 |
| | SP | | Rock fragments | |
| | | | Light brown, damp, F SAND, Little F Gravel, trace silt | |
| | SP | | Light gray, damp, F SAND, trace c. sand and roots | |
| 4 | | | 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 | | | 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 | | | |
| | | | 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.



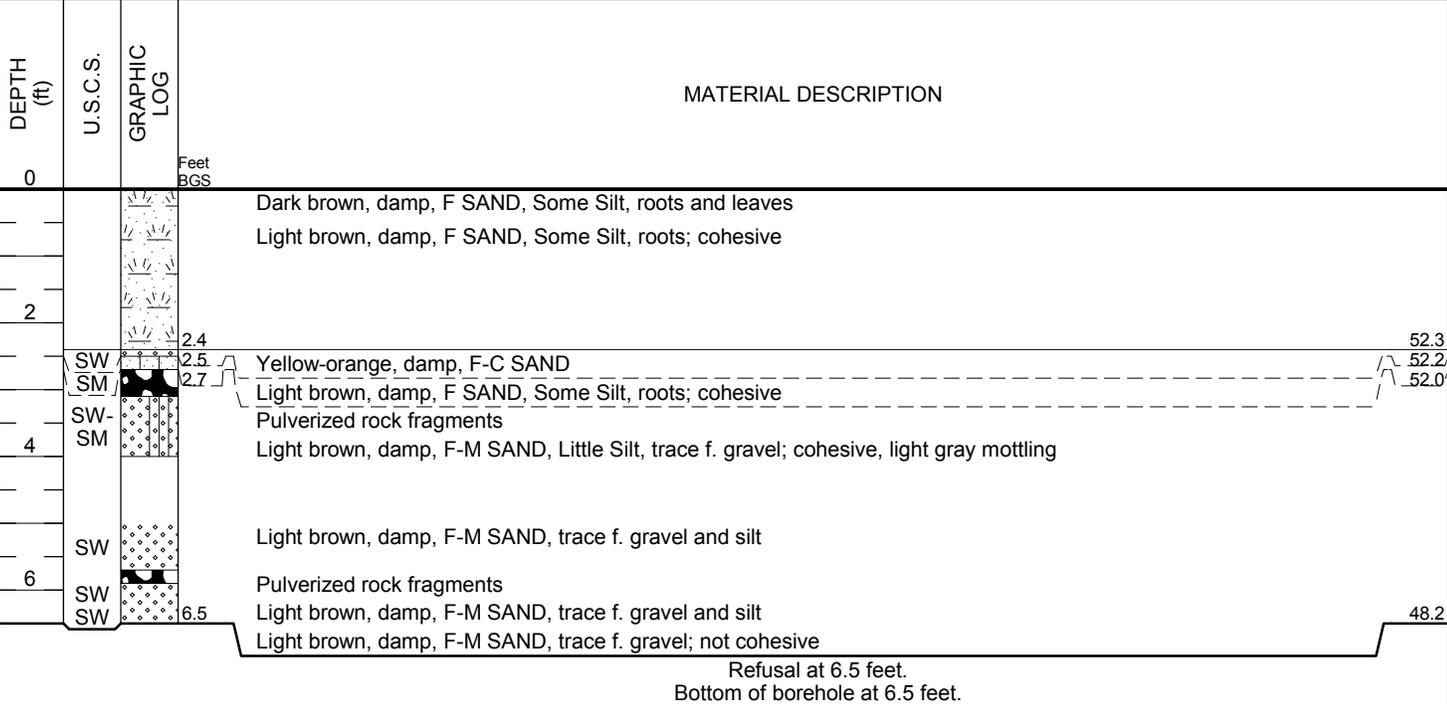
Woodard & Curran
 980 Washington St | Suite 325
 Dedham, MA 02026
 Telephone: 781.251.0200
 Fax: 781.251.0847

BORING NUMBER BH-5

PAGE 1 OF 1

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \CHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPIEXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLD LYME_2013.GPJ

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



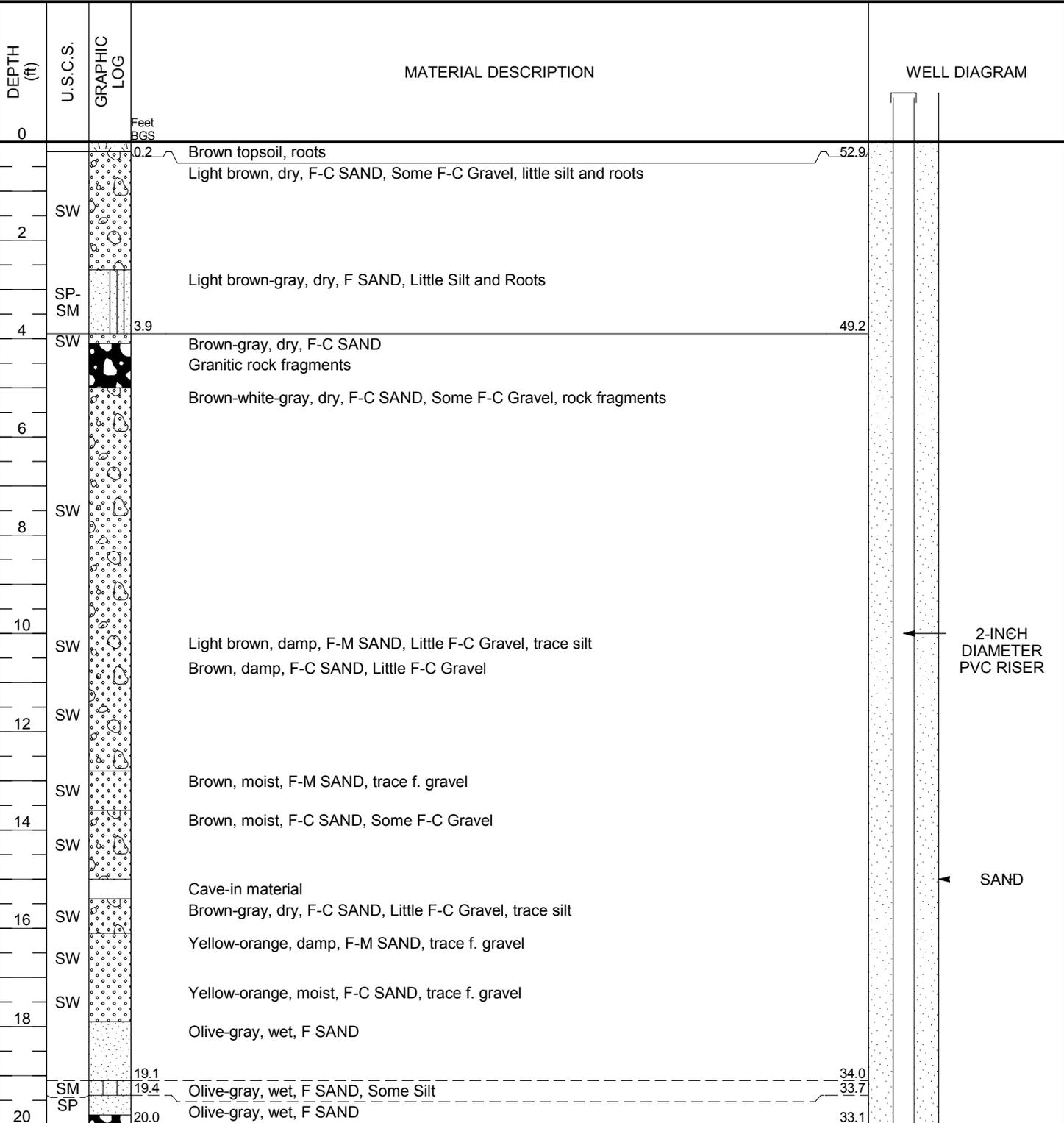


Woodard & Curran
 980 Washington St | Suite 325
 Dedham, MA 02026
 Telephone: 781.251.0200
 Fax: 781.251.0847

WELL NUMBER MW-3D

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \\\CHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPI\EXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLD LYME_2013.GPJ

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



(Continued Next Page)

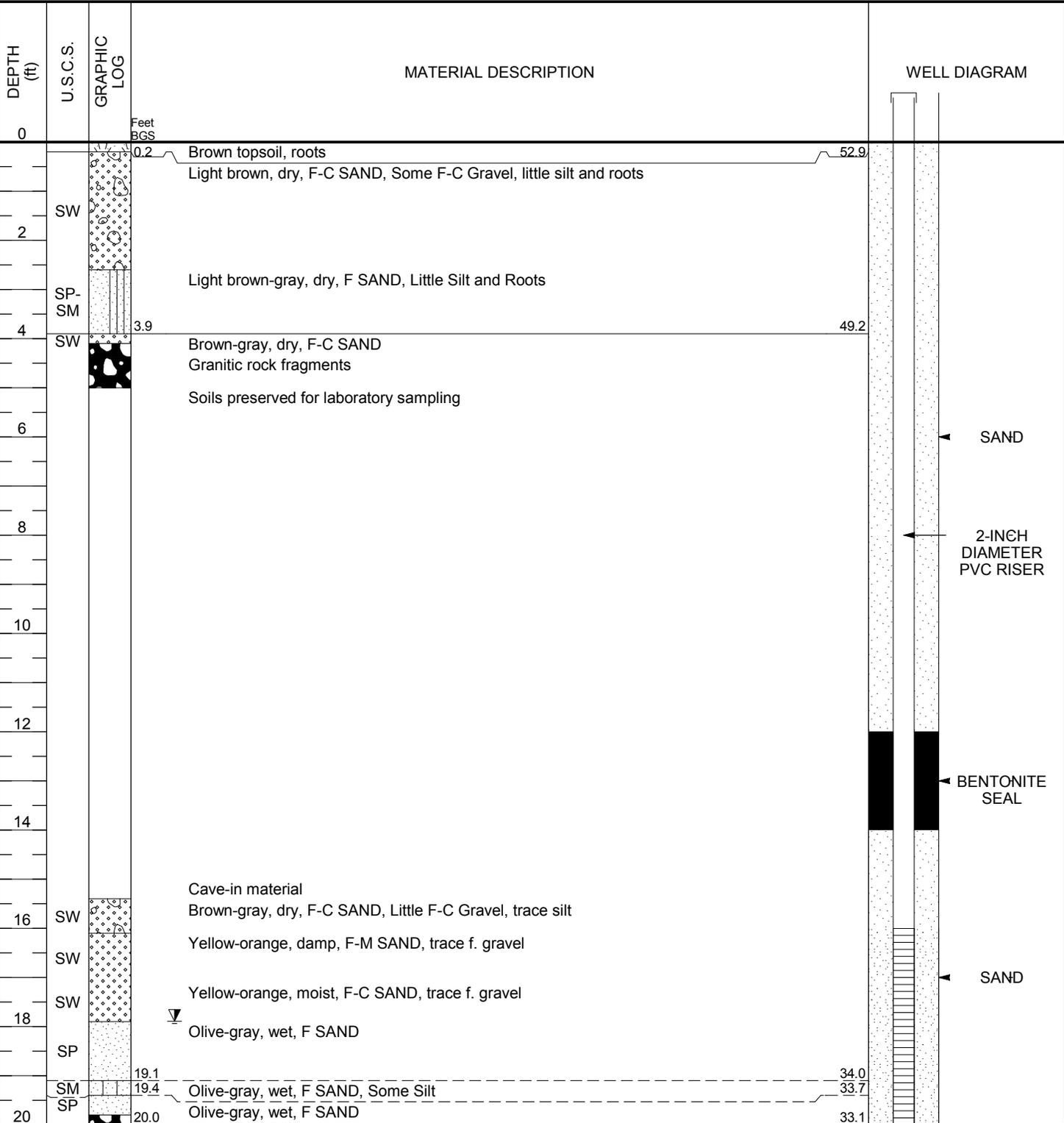


Woodard & Curran
 980 Washington St | Suite 325
 Dedham, MA 02026
 Telephone: 781.251.0200
 Fax: 781.251.0847

WELL NUMBER MW-3S

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \ICHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPI\EXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLD LYME_2013.GPJ

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



(Continued Next Page)

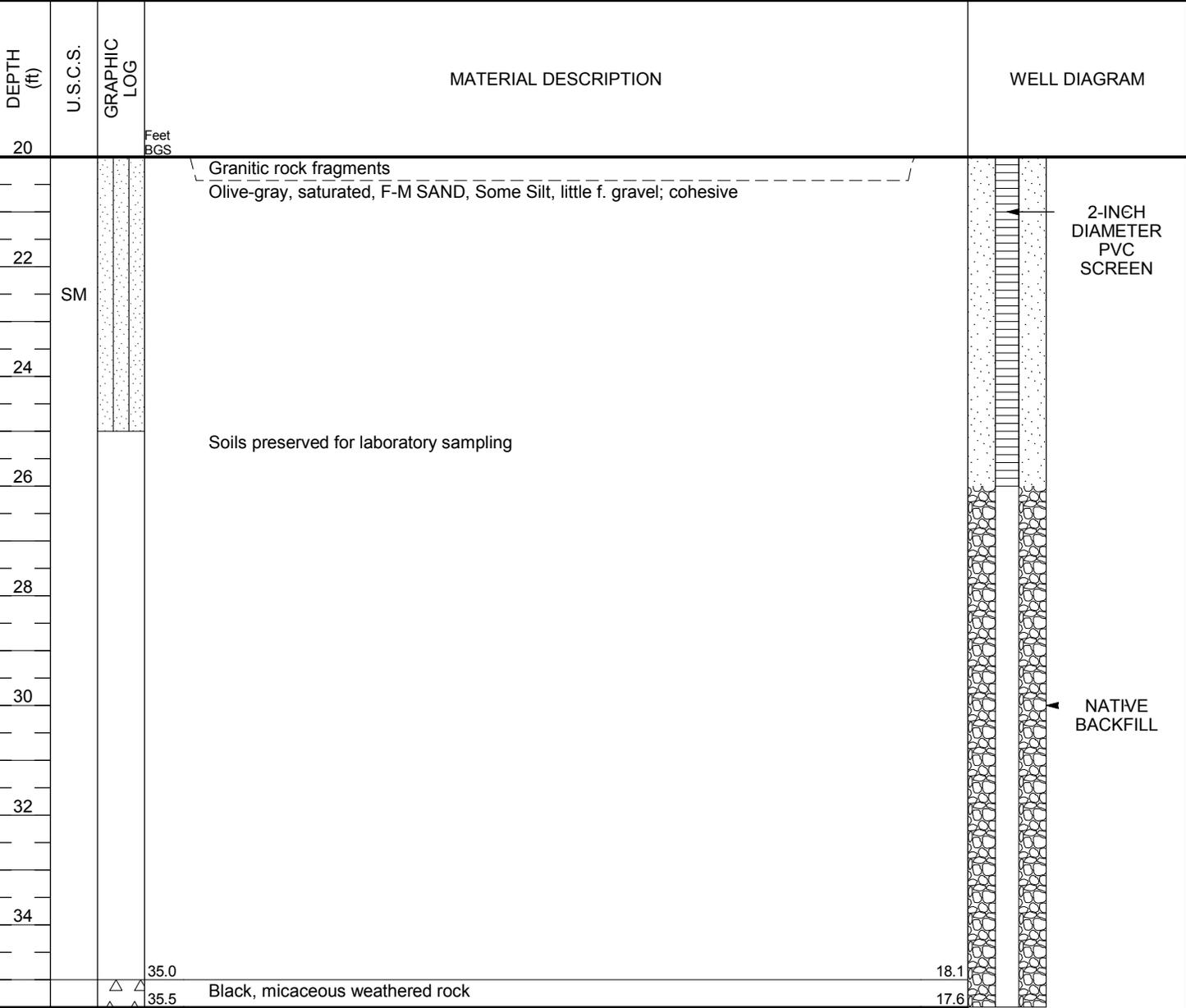


Woodard & Curran
 980 Washington St | Suite 325
 Dedham, MA 02026
 Telephone: 781.251.0200
 Fax: 781.251.0847

WELL NUMBER MW-3S

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \CHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPEXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLD LYME_2013.GPJ

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



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



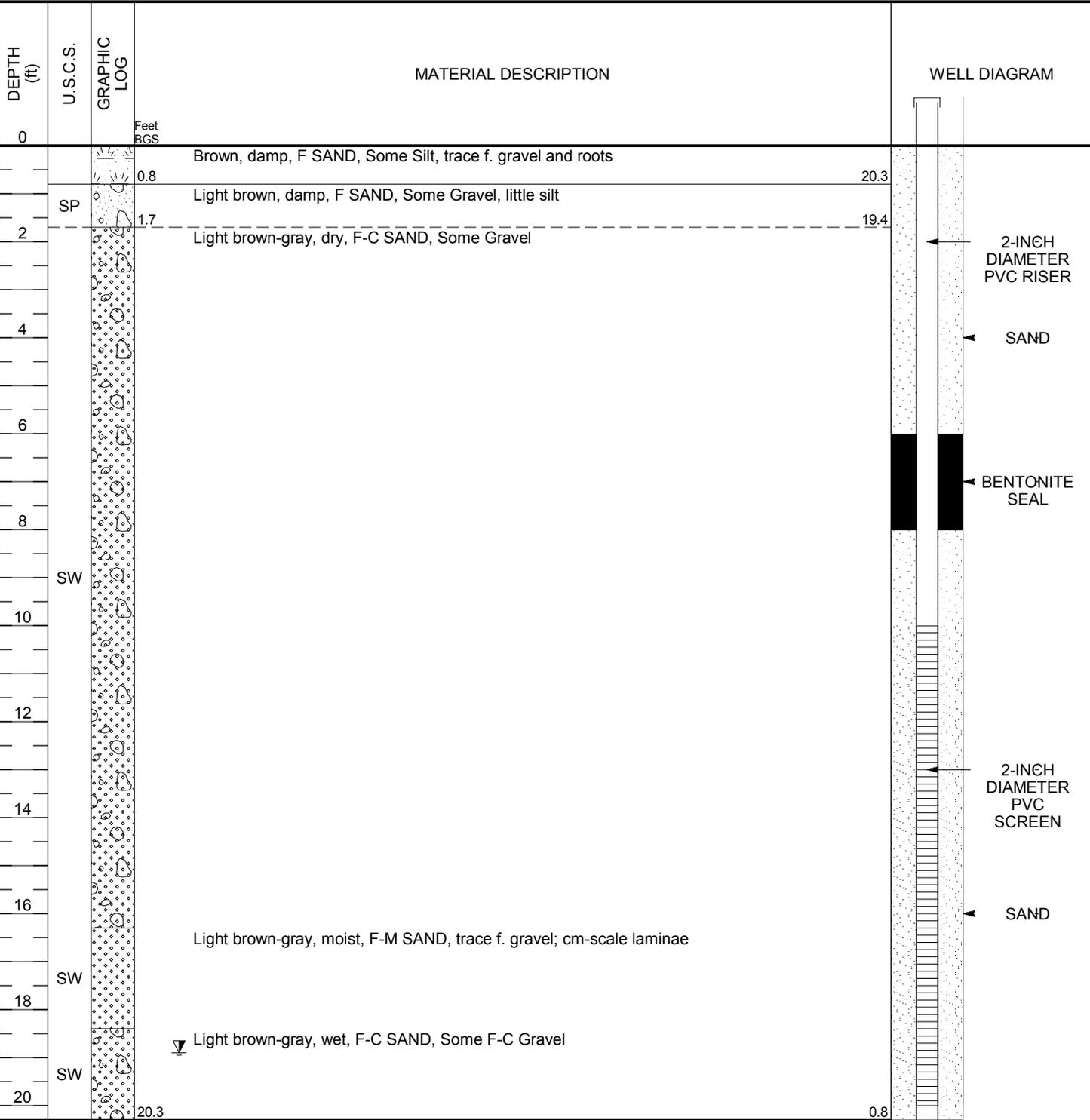
Woodard & Curran
 980 Washington St | Suite 325
 Dedham, MA 02026
 Telephone: 781.251.0200
 Fax: 781.251.0847

WELL NUMBER WC-1

PAGE 1 OF 1

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \ICHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPEXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLD LYME_2013.GPJ

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



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



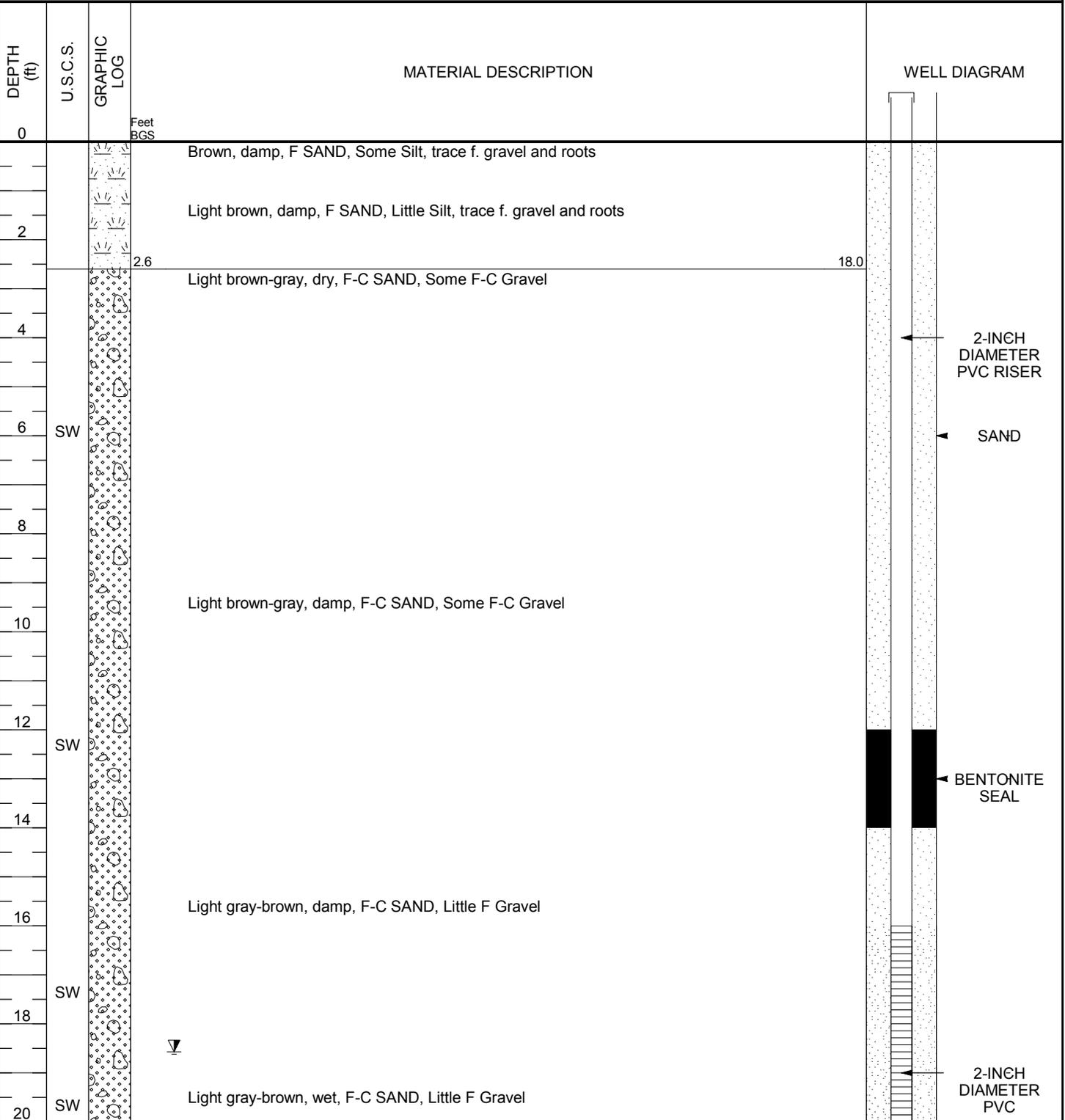
Woodard & Curran
 980 Washington St | Suite 325
 Dedham, MA 02026
 Telephone: 781.251.0200
 Fax: 781.251.0847

WELL NUMBER WC-2

PAGE 1 OF 2

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \CHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPEXECUTION\GEO\TECHNICAL\SUBSURFACEBORING LOGS\OLDLYME_2013.GPJ

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



(Continued Next Page)



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

WELL NUMBER WC-2

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \\CHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WP\EXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLD LYME_2013.GPJ

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 | MATERIAL DESCRIPTION | WELL DIAGRAM |
|------------|----------------------|---|--|
| 20 | | Light brown-gray, wet, F-C GRAVEL, Some F-C Sand | <p>SCREEN</p> <p>SAND</p> <p>NATIVE BACKFILL</p> |
| 22 | GW | | |
| 24 | | | |
| 26 | SW | Blue-gray, wet, F-M SAND, Little F Gravel, trace silt | |
| 26 | SW | Light brown-gray, wet, F-C SAND, Little F Gravel | |
| 28 | SP | Light brown-gray, wet, F SAND; inch-scale laminae | |
| 28 | SW | Light brown-gray, wet, F-C SAND, Little F Gravel | |
| 28 | SP | Light brown-gray, wet, F SAND; inch-scale laminae | |
| 30 | SW | Light brown-gray, wet, F-M SAND; inch-scale laminae | |
| 30 | SW | Light brown-gray, wet, F-C SAND | |

Bottom of borehole at 30.0 feet.

-9.5

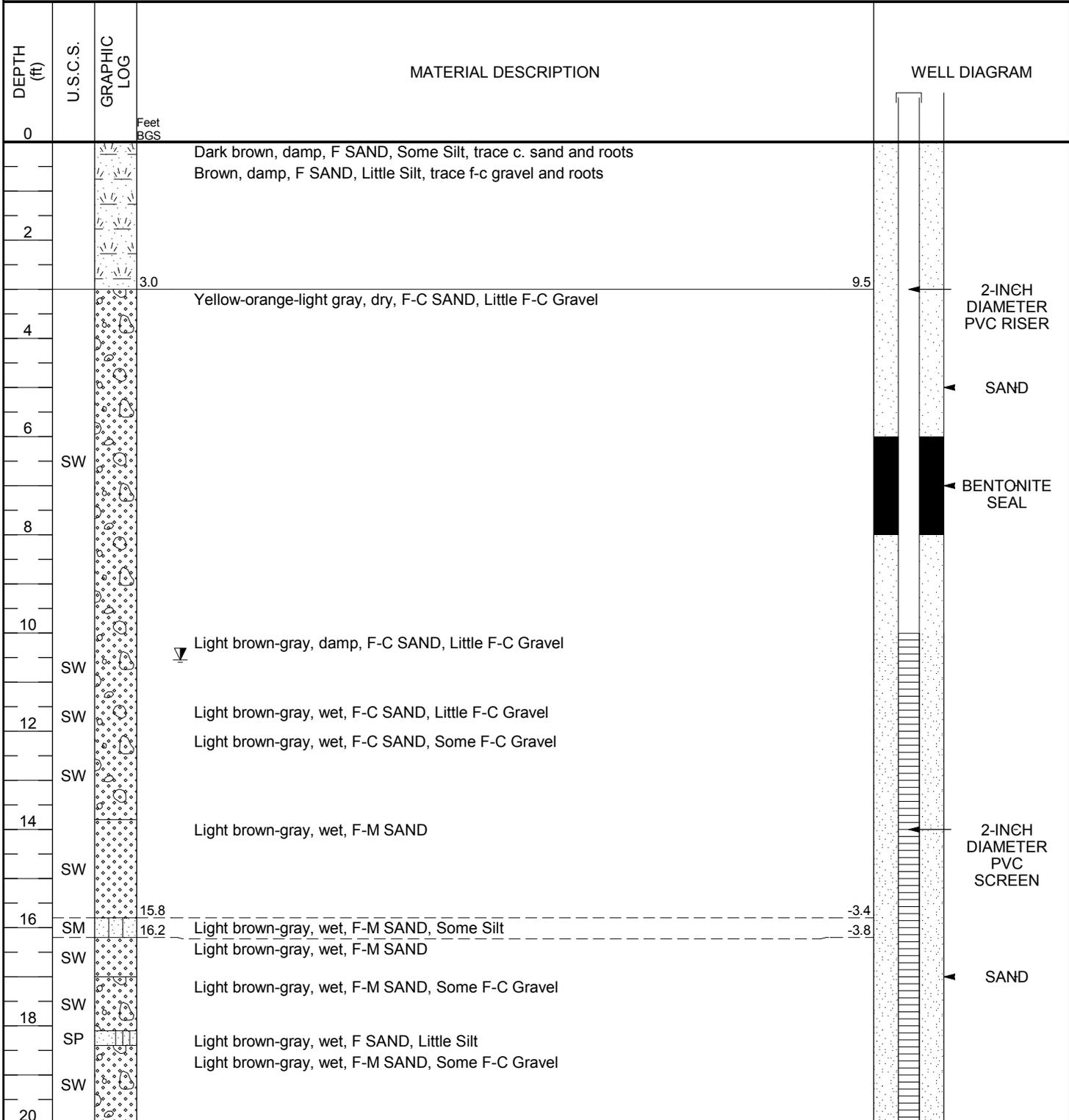


Woodard & Curran
 980 Washington St | Suite 325
 Dedham, MA 02026
 Telephone: 781.251.0200
 Fax: 781.251.0847

WELL NUMBER WC-3

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \\\CHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPEXECUTION\GEO\TECHNICAL\SUBSURFACEBORING LOGS\OLDLYME_2013.GPJ

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



(Continued Next Page)



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

WELL NUMBER WC-3

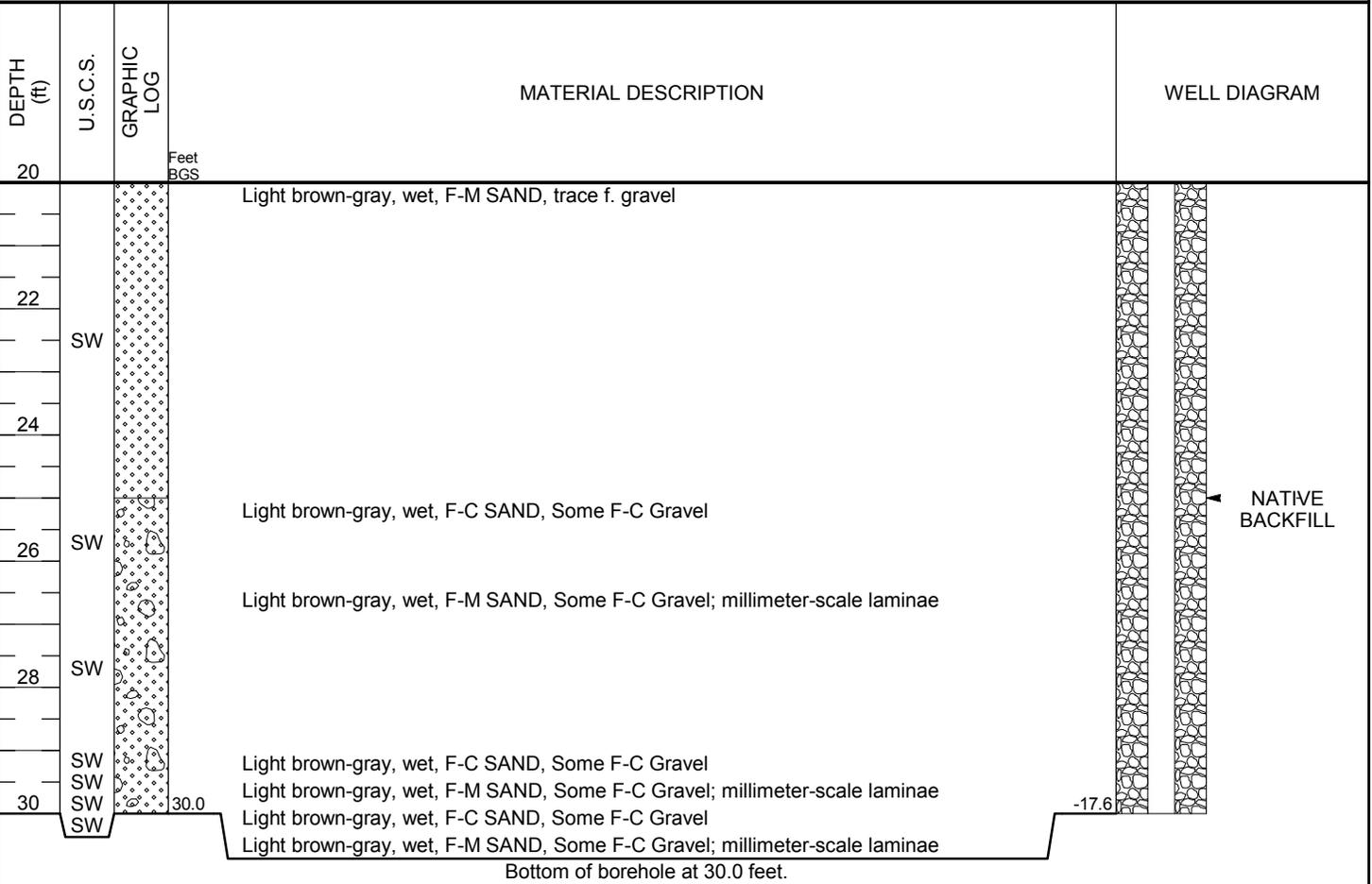
CLIENT Town of Old Lyme, CT

PROJECT NAME Old Lyme Wastewater Management

PROJECT NUMBER 226617

PROJECT LOCATION Old Lyme, CT

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \\CHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WP\EXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLD LYME_2013.GPJ

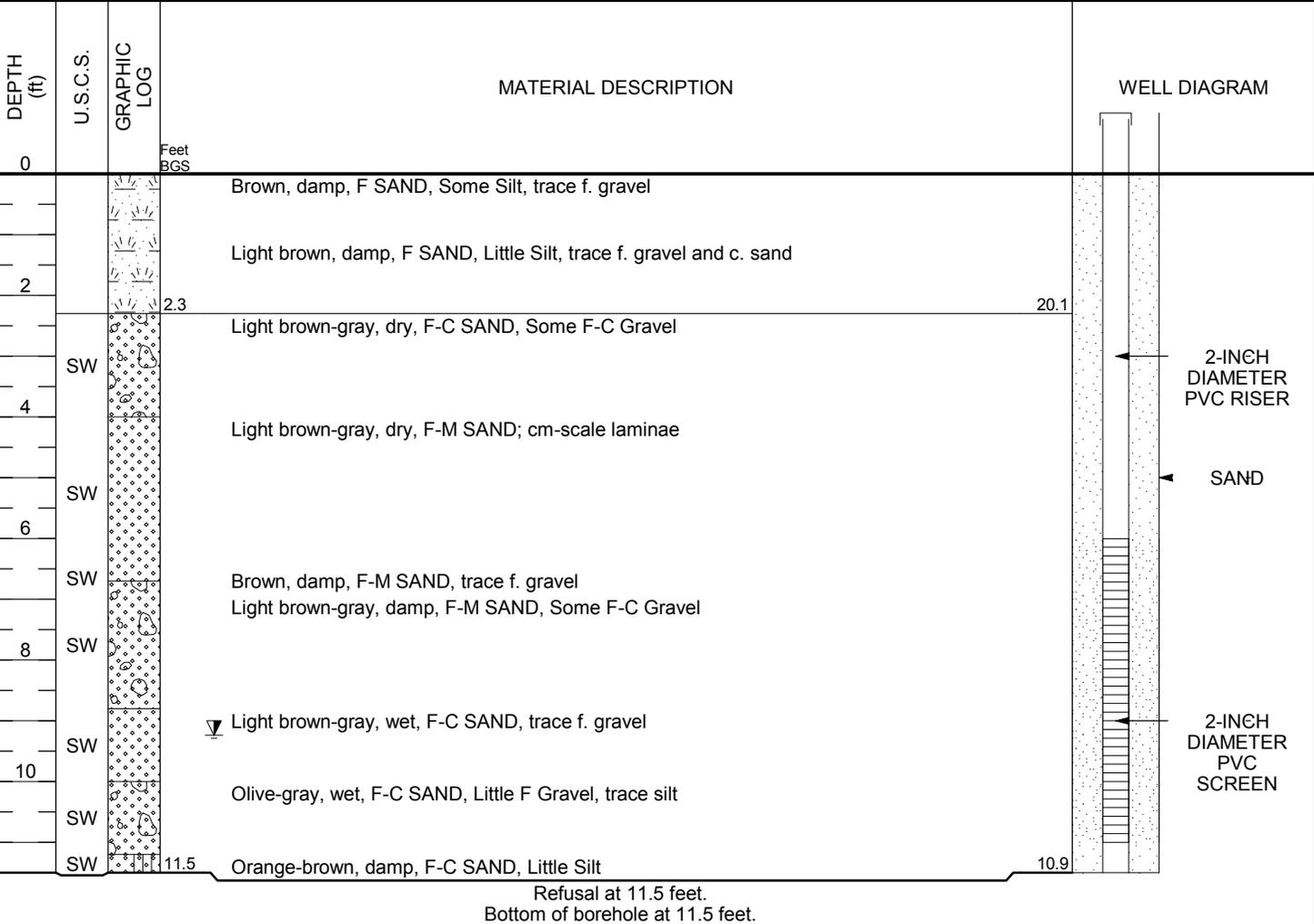




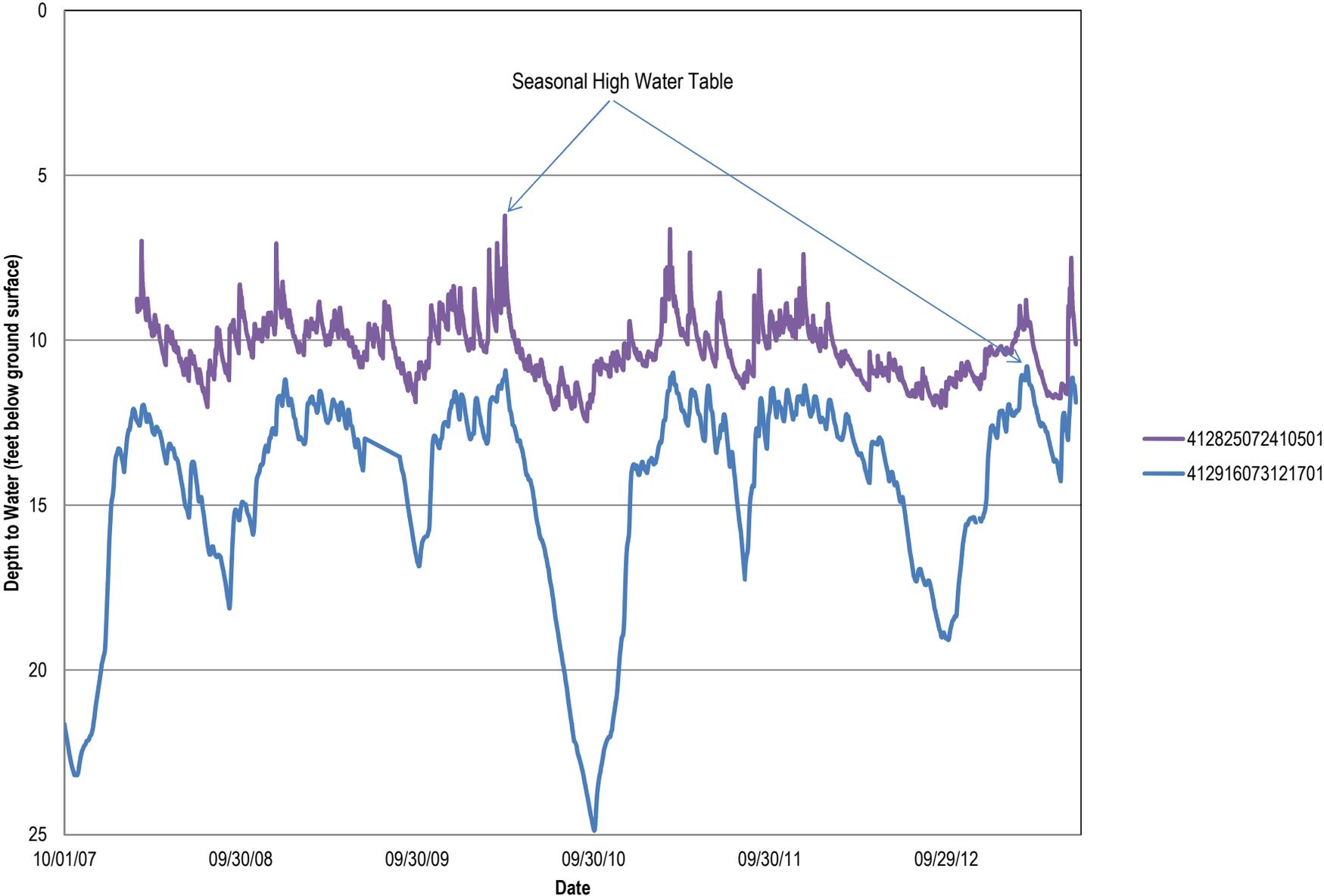
Woodard & Curran
 980 Washington St | Suite 325
 Dedham, MA 02026
 Telephone: 781.251.0200
 Fax: 781.251.0847

WOODARD & CURRAN STANDARD - WC STD.GDT - 9/5/13 10:24 - \ICHESHIRE\PROJECTS\226617 TOWN OF OLD LYME - WASTEWATER MANAGEMENT STUDY\WPI\EXECUTION\GEO\TECHNICAL\SUBSURFACE\BORING LOGS\OLD LYME_2013.GPJ

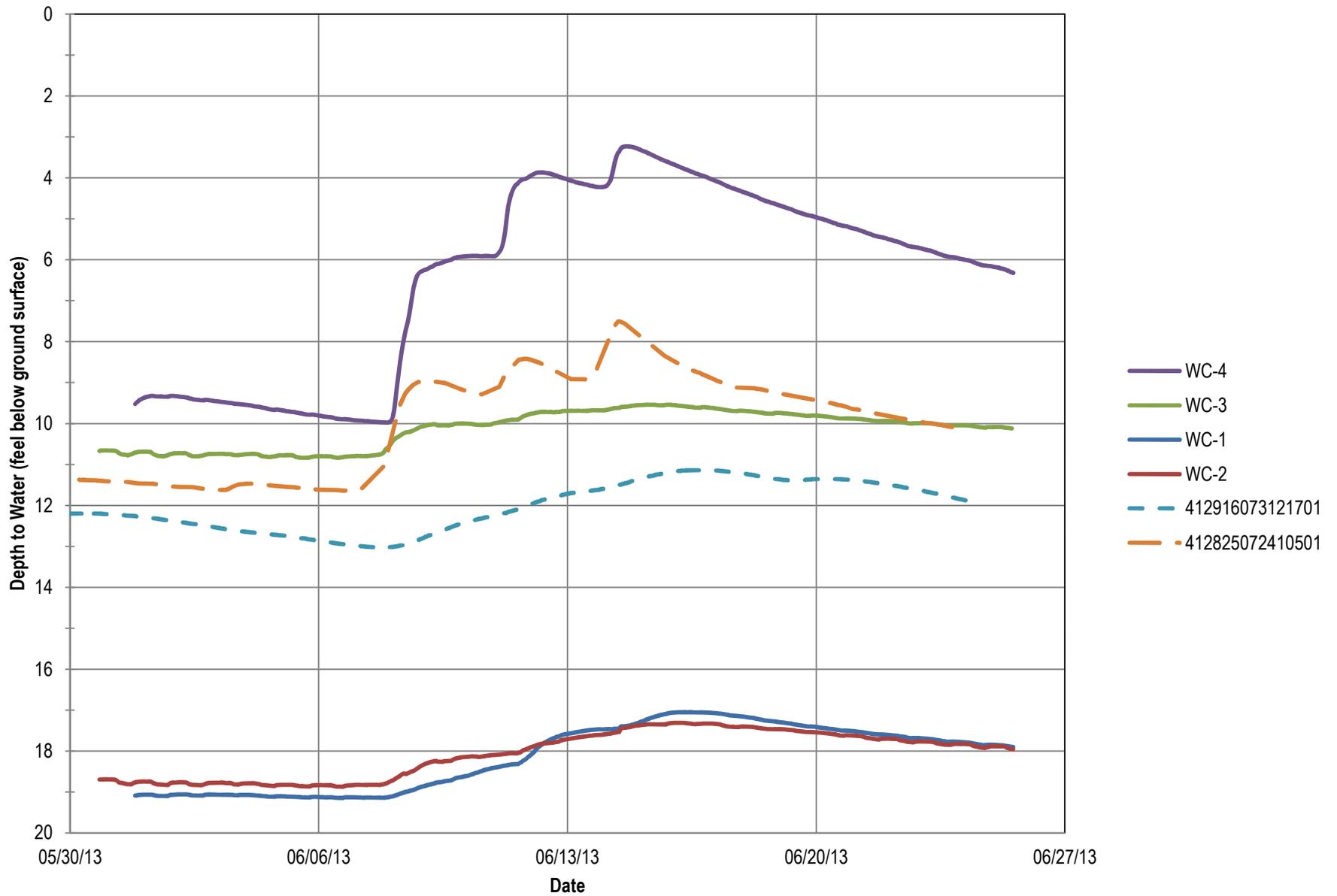
CLIENT Town of Old Lyme, CT **PROJECT NAME** Old Lyme Wastewater Management
PROJECT NUMBER 226617 **PROJECT LOCATION** Old Lyme, CT
DATE STARTED 5/22/13 **COMPLETED** 5/22/13 **GROUND ELEVATION** 22.35 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech **GROUND WATER LEVELS:**
DRILLING METHOD 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



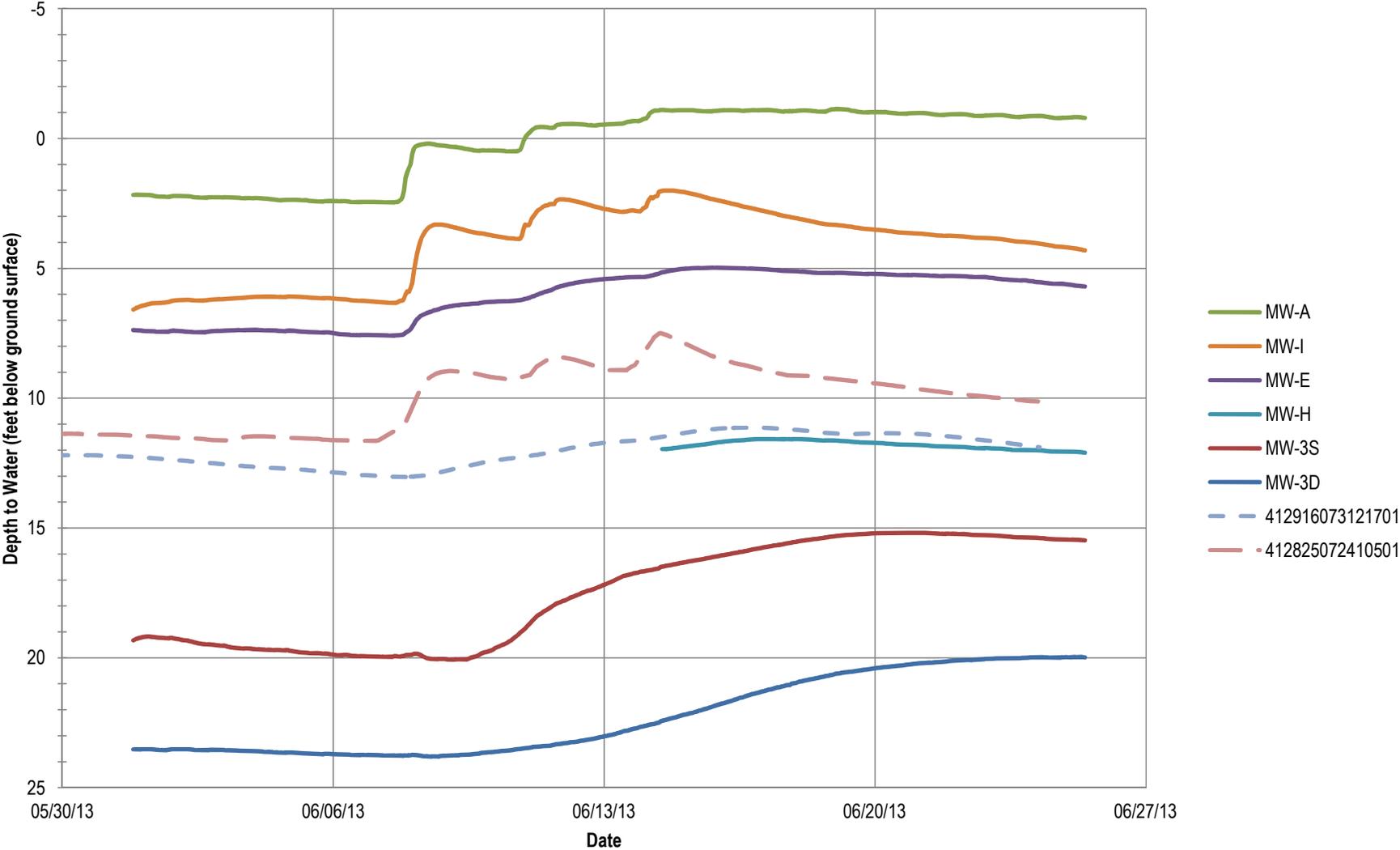
Appendix C.2: Depth to Groundwater - USGS Sentinel Wells



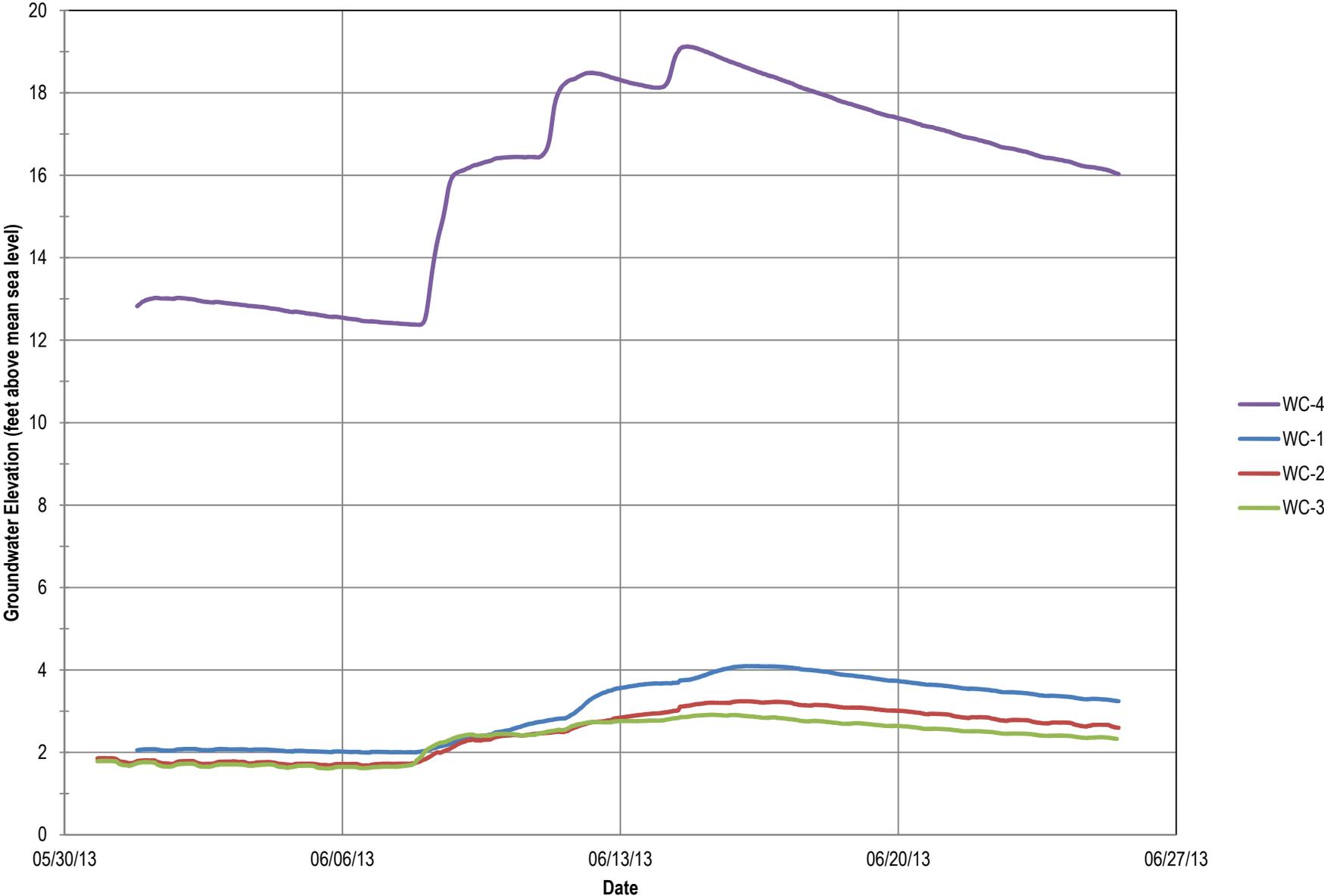
Appendix C.3: Depth to Groundwater - Cherrystone



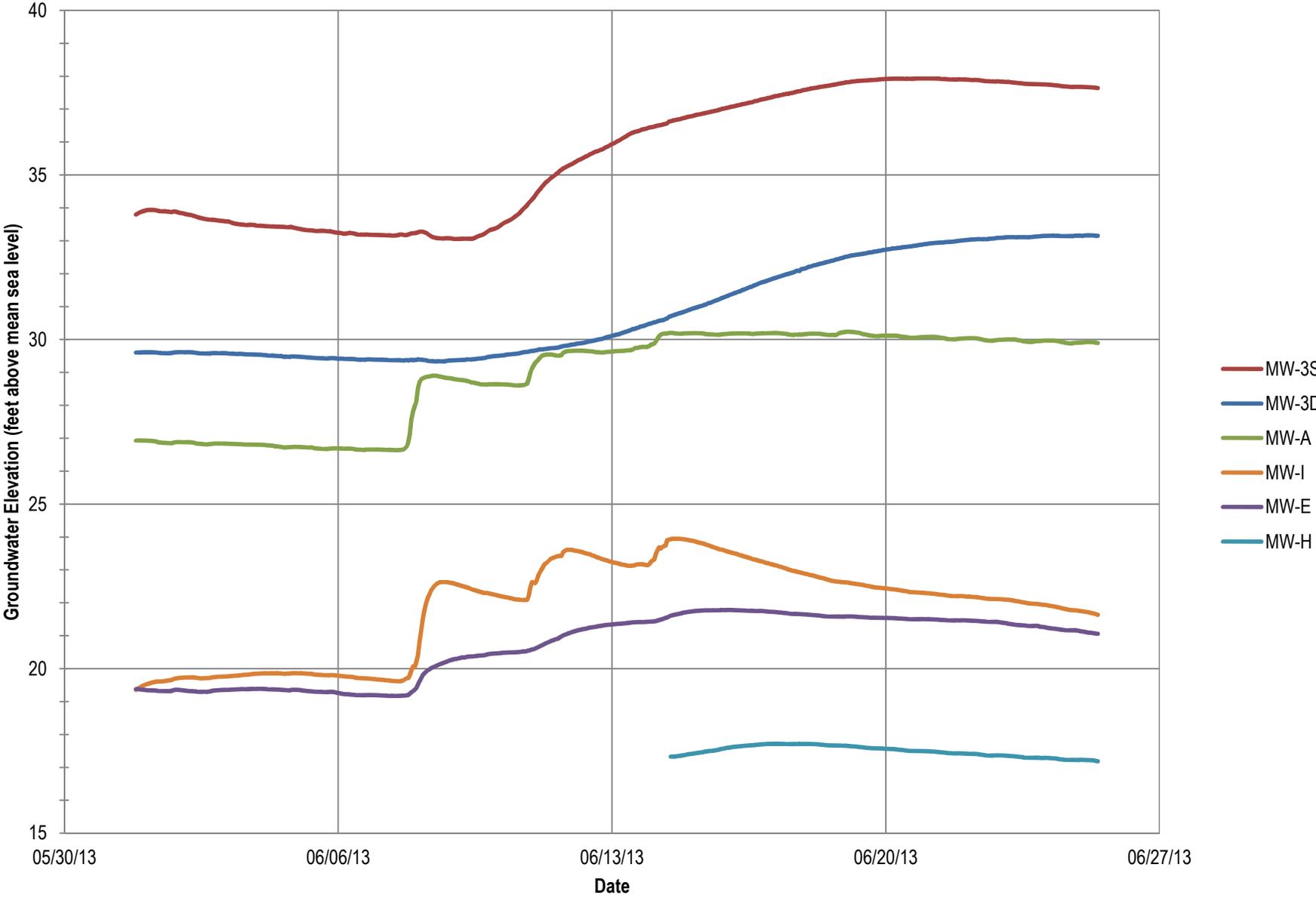
Appendix C.4: Depth to Groundwater - Black Hall



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 |
| <i>Total Flow = 87,600 gal/day</i> | |
| 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 |
| <i>Total Flow = 146,000 gal/day</i> | |
| 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 |
| <i>Total Flow = 219,000 gal/day</i> | |

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

APPENDIX D: GROUNDWATER QUALITY DATA FROM 2012 NLJ REPORT

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| HN-1-98 | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | Tl Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|------------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 6/25/1998 | 81 | 18 | 3.10 | 0.006 | 0.28 | 0.28 | 3.4 | 2 | 2 | 2 | nt |
| 9/23/1998 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 10/1/1998 | 154 | 16 | 4.90 | 0.005 | 0.10 | 0.05 | 5.0 | 2 | 2 | 2 | nt |
| 5/12/1999 | 197 | 20 | 10.00 | 0.005 | 0.43 | 0.05 | 10.4 | 0 | 2 | 2 | nt |
| 10/19/1999 | 184 | 18 | 11.00 | 0.005 | 0.10 | 0.07 | 11.1 | 0 | 2 | 0 | nt |
| 6/21/2000 | 209 | 32 | 4.60 | 0.005 | 2.80 | 0.05 | 7.4 | 0 | 2 | 0 | nt |
| 9/12/2000 | 173 | 23 | 3.20 | 0.005 | 2.40 | 0.05 | 5.6 | nt | 48 | 2 | nt |
| 4/25/2001 | 192 | 25 | 5.30 | 0.005 | 0.26 | 0.05 | 5.6 | nt | 2 | 2 | nt |
| 9/26/2001 | 150 | 17 | 4.80 | 0.010 | 0.43 | 0.03 | 5.2 | nt | 10 | 10 | nt |
| 5/30/2002 | 210 | 24 | 7.60 | 0.010 | 0.40 | 0.05 | 8.0 | nt | 10 | 10 | nt |
| 8/23/2002 | 190 | 22 | 6.30 | 0.010 | 0.72 | 0.25 | 7.0 | 10 | 10 | 30 | nt |
| 5/7/2003 | 210 | 33 | 5.50 | 0.010 | 0.54 | 0.07 | 6.1 | 30 | 10 | 10 | nt |
| 9/9/2003 | 130 | 17 | 4.10 | 0.010 | 0.27 | 0.02 | 4.4 | 60 | 60 | 20 | nt |
| 6/10/2004 | 190 | 27 | 4.90 | 0.020 | 0.48 | 0.10 | 5.4 | 10 | 10 | 10 | 10 |
| 8/17/2004 | 140 | 14 | 3.60 | 0.020 | 0.11 | 0.02 | 3.7 | 10 | 10 | 10 | nt |
| 5/10/2005 | 200 | 29 | 5.30 | 0.010 | 0.33 | 0.04 | 5.6 | 10 | 10 | 10 | nt |
| 9/14/2005 | 150 | 13 | 4.90 | 0.010 | 0.32 | 0.07 | 5.2 | 20 | 20 | 20 | 20 |
| 8/9/2006 | 150 | 13 | 5.90 | 0.010 | 0.99 | 0.10 | 6.9 | 20 | 20 | 20 | 20 |
| 5/8/2007 | 160 | 21 | 3.80 | 0.010 | 0.10 | 0.03 | 3.9 | 20 | 20 | 20 | 20 |
| 8/29/2007 | 130 | 15 | 2.70 | 0.010 | 0.56 | 0.02 | 3.3 | 10 | 10 | 10 | 10 |
| 4/16/2008 | 189 | 22 | 4.90 | 0.010 | 0.78 | 0.02 | 5.7 | 10 | 10 | 10 | 10 |
| 9/3/2008 | 170 | 17 | 6.50 | 0.010 | 0.73 | 0.06 | 7.2 | 10 | 10 | 10 | 10 |
| 5/19/2009 | nt | 20 | 4.60 | 0.010 | 0.83 | 0.12 | 5.4 | 10 | 10 | 10 | 10 |
| 8/28/2009 | 191 | 28 | 3.70 | 0.010 | 0.26 | 0.05 | 4.0 | 10 | 10 | 10 | 10 |
| 5/21/2010 | 172 | 18 | 8.00 | nt | 1.00 | 0.06 | 9.0 | 10 | 10 | 10 | 10 |
| 11/8/2011 | 161 | 19 | 7.80 | 0.010 | 0.60 | 0.02 | 8.4 | 10 | 10 | 10 | 10 |
| 6/19/2012 | 161 | 18.2 | 6.42 | 0.010 | 0.74 | 0.10 | 7.2 | 10 | 10 | 10 | 10 |
| Minimum | 81 | 13 | 2.70 | 0.005 | 0.10 | 0.02 | 3.3 | 0 | 2 | 0 | 10 |
| Maximum | 210 | 33 | 11.00 | 0.020 | 2.80 | 0.28 | 11.1 | 60 | 60 | 30 | 20 |
| Average | 170 | 21 | 5.52 | 0.009 | 0.64 | 0.07 | 6.2 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.



TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| HN-2-98 | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | TI Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|------------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 6/25/1998 | 97 | 25 | 2.40 | 0.010 | 0.84 | 0.28 | 3.3 | 2 | 10 | 2 | nt |
| 9/23/1998 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 10/1/1998 | 160 | 25 | 2.30 | 0.017 | 0.27 | 0.15 | 2.6 | 2 | 2 | 2 | nt |
| 5/12/1999 | 233 | 39 | 4.80 | 0.057 | 0.72 | 0.73 | 5.6 | 0 | 2 | 2 | nt |
| 10/19/1999 | 157 | 21 | 3.60 | 0.005 | 0.39 | 0.08 | 4.0 | 0 | 2 | 0 | nt |
| 6/21/2000 | 174 | 24 | 2.00 | 0.005 | 0.91 | 0.15 | 2.9 | 2 | 2 | 4 | nt |
| 9/12/2000 | 217 | 41 | 2.30 | 0.017 | 1.30 | 0.21 | 3.6 | nt | 2 | 2 | nt |
| 4/25/2001 | 187 | 27 | 2.40 | 0.022 | 0.60 | 0.09 | 3.0 | nt | 2 | 2 | nt |
| 9/26/2001 | 170 | 22 | 3.70 | 0.010 | 1.40 | 0.21 | 5.1 | nt | 10 | 10 | nt |
| 5/30/2002 | 150 | 16 | 5.10 | 0.010 | 0.44 | 0.33 | 5.6 | nt | 10 | 10 | nt |
| 8/23/2002 | 190 | 23 | 5.40 | 0.010 | 0.88 | 0.50 | 6.3 | 10 | 10 | 300 | nt |
| 5/7/2003 | 200 | 26 | 5.10 | 0.010 | 0.61 | 0.15 | 5.7 | 10 | 10 | 10 | nt |
| 9/9/2003 | 140 | 22 | 2.30 | 0.010 | 0.34 | 0.09 | 2.7 | 40 | 20 | 20 | nt |
| 6/10/2004 | 170 | 20 | 2.80 | 0.010 | 0.37 | 0.11 | 3.2 | 10 | 10 | 10 | 10 |
| 8/17/2004 | 150 | 14 | 2.60 | 0.010 | 0.24 | 0.06 | 2.9 | 10 | 10 | 10 | 10 |
| 5/10/2005 | 180 | 17 | 4.60 | 0.010 | 0.35 | 0.03 | 5.0 | 10 | 10 | 10 | nt |
| 9/13/2005 | 180 | 21 | 3.50 | 0.010 | 0.63 | 0.09 | 4.1 | 20 | 20 | 20 | 20 |
| 8/9/2006 | 170 | 19 | 3.00 | 0.010 | 0.72 | 0.04 | 3.7 | 20 | 20 | 20 | 20 |
| 5/8/2007 | 160 | 21 | 1.80 | 0.010 | 0.10 | 0.03 | 1.9 | 20 | 20 | 20 | 20 |
| 8/29/2007 | 150 | 15 | 1.70 | 0.010 | 0.28 | 0.02 | 2.0 | 10 | 10 | 10 | 10 |
| 4/16/2008 | 180 | 17 | 2.90 | 0.010 | 0.38 | 0.02 | 3.3 | 10 | 10 | 10 | 10 |
| 9/3/2008 | 199 | 19 | 6.20 | 0.010 | 0.42 | 0.04 | 6.6 | 10 | 10 | 10 | 10 |
| 5/19/2009 | nt | 19 | 5.00 | 0.010 | 0.71 | 0.10 | 5.7 | 10 | 10 | 10 | 10 |
| 8/28/2009 | 170 | 17 | 3.40 | 0.010 | 0.89 | 0.06 | 4.3 | 10 | 10 | 10 | 10 |
| 5/21/2010 | 161 | 18 | 3.30 | nt | 0.73 | 0.09 | 4.0 | 10 | 10 | 10 | 10 |
| 11/8/2011 | 147 | 19 | 3.30 | 0.010 | 0.81 | 0.10 | 4.1 | 10 | 10 | 10 | 10 |
| 6/19/2012 | 170 | 16 | 5.20 | 0.010 | 1.06 | 0.32 | 6.3 | 20 | 10 | 10 | 10 |
| Minimum | 97 | 14 | 1.70 | 0.005 | 0.10 | 0.02 | 1.9 | 0 | 2 | 0 | 10 |
| Maximum | 233 | 41 | 6.20 | 0.057 | 1.40 | 0.73 | 6.6 | 40 | 20 | 300 | 20 |
| Average | 170 | 22 | 3.49 | 0.013 | 0.63 | 0.16 | 4.1 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| HN-3-98 | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | Tl Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|------------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 6/25/1998 | 183 | 55 | 0.05 | 0.005 | 0.98 | 0.70 | 1.0 | 360 | 8 | 26 | nt |
| 9/23/1998 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 10/1/1998 | 324 | 66 | 0.01 | 0.019 | 1.60 | 0.94 | 1.6 | 6 | 2 | 2 | nt |
| 5/12/1999 | 285 | 58 | 0.01 | 0.006 | 1.30 | 0.87 | 1.3 | 0 | 2 | 2 | nt |
| 10/19/1999 | 172 | 27 | 0.05 | 0.005 | 3.80 | 0.18 | 3.9 | 57 | 4 | 20 | nt |
| 6/21/2000 | 218 | 44 | 0.15 | 0.006 | 2.40 | 0.41 | 2.6 | 580 | 2 | 8 | nt |
| 9/12/2000 | 309 | 80 | 0.05 | 0.012 | 1.60 | 0.34 | 1.7 | nt | 2 | 2 | nt |
| 4/25/2001 | 284 | 68 | 0.01 | 0.007 | 1.20 | 0.13 | 1.2 | nt | 2 | 2 | nt |
| 5/30/2002 | 250 | 43 | 0.19 | 0.010 | 0.86 | 0.15 | 1.1 | nt | 10 | 120 | nt |
| 8/23/2002 | 290 | 54 | 0.08 | 0.010 | 1.90 | 0.79 | 2.0 | 10 | 10 | 170 | nt |
| 5/7/2003 | 160 | 21 | 0.26 | 0.010 | 0.90 | 0.23 | 1.2 | 30 | 10 | 10 | nt |
| 9/9/2003 | 140 | 8 | 0.14 | 0.010 | 1.80 | 0.74 | 2.0 | 40 | 20 | 20 | nt |
| 6/10/2004 | 180 | 22 | 0.22 | 0.010 | 0.70 | 0.24 | 0.9 | 10 | 10 | 10 | 10 |
| 8/17/2004 | 130 | 10 | 1.30 | 0.010 | 0.48 | 0.11 | 1.8 | 100 | 10 | 10 | 10 |
| 5/10/2005 | 160 | 17 | 1.40 | 0.010 | 0.57 | 0.06 | 2.0 | 100 | 70 | 10 | nt |
| 9/14/2005 | 270 | 47 | 0.08 | 0.010 | 1.50 | 0.78 | 1.6 | 480 | 360 | 20 | 300 |
| 8/9/2006 | 190 | 22 | 0.06 | 0.010 | 1.30 | 0.46 | 1.4 | 320 | 40 | 20 | 20 |
| 5/8/2007 | 180 | 23 | 1.90 | 0.020 | 0.40 | 0.07 | 2.3 | 60 | 20 | 20 | 20 |
| 8/29/2007 | 250 | 27 | 0.04 | 0.010 | 2.70 | 1.40 | 2.7 | 10 | 10 | 640 | 10 |
| 4/16/2008 | 199 | 22 | 0.99 | 0.010 | 1.10 | 0.06 | 2.1 | 50 | 10 | 10 | 10 |
| 9/3/2008 | 234 | 20 | 0.22 | 0.010 | 1.90 | 0.84 | 2.1 | 20 | 10 | 10 | 10 |
| 5/19/2009 | nt | 14 | 2.00 | 0.010 | 1.70 | 0.22 | 3.7 | 10 | 10 | 10 | 10 |
| 8/28/2009 | 258 | 52 | 0.02 | 0.010 | 1.30 | 0.24 | 1.3 | 200 | 10 | 220 | 20 |
| 5/21/2010 | 130 | 8 | 3.80 | nt | 1.40 | 0.11 | 4.2 | 50 | 20 | 10 | 20 |
| 11/8/2011 | 1680 | 670 | 4.70 | 0.030 | 2.40 | 0.86 | 7.1 | 90 | 10 | 10 | 10 |
| 6/19/2012 | 628 | 144 | 0.99 | 0.010 | 3.33 | 0.77 | 4.3 | 100 | 40 | 100 | 30 |
| Minimum | 130 | 8 | 0.01 | 0.005 | 0.40 | 0.06 | 0.9 | 0 | 2 | 2 | 10 |
| Maximum | 1680 | 670 | 4.70 | 0.030 | 3.80 | 1.40 | 7.1 | 580 | 360 | 640 | 300 |
| Average | 296 | 65 | 0.75 | 0.011 | 1.56 | 0.47 | 2.3 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| HN-4 | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | TI Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|-----------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 9/8/2000 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 9/12/2000 | 157 | 29 | 1.40 | <i>0.005</i> | 1.40 | 0.06 | 2.8 | nt | 16 | 4 | nt |
| 4/25/2001 | 174 | 33 | 2.50 | <i>0.005</i> | 0.30 | <i>0.05</i> | 2.8 | nt | <i>2</i> | <i>2</i> | nt |
| 9/26/2001 | 50 | 4 | 0.87 | <i>0.010</i> | 0.17 | 0.05 | 1.1 | nt | 400 | <i>100</i> | nt |
| 5/30/2002 | 170 | 25 | 3.40 | <i>0.010</i> | 0.25 | 0.02 | 3.7 | nt | <i>10</i> | <i>10</i> | nt |
| 8/23/2002 | 180 | 30 | 3.90 | <i>0.010</i> | 0.85 | 0.31 | 4.8 | <i>10</i> | <i>10</i> | <i>10</i> | nt |
| 5/7/2003 | 210 | 46 | 2.20 | <i>0.010</i> | 0.39 | 0.09 | 2.6 | <i>10</i> | <i>10</i> | <i>10</i> | nt |
| 9/9/2003 | 150 | 31 | 1.50 | <i>0.010</i> | 0.45 | 0.04 | 2.0 | 280 | 40 | 120 | nt |
| 6/10/2004 | 220 | 43 | 2.70 | <i>0.010</i> | 0.44 | 0.08 | 3.2 | 10 | <i>10</i> | <i>10</i> | <i>10</i> |
| 8/17/2004 | 78 | 8 | 1.10 | 0.010 | 0.26 | 0.04 | 1.4 | 1200 | 400 | 700 | 500 |
| 5/10/2005 | 240 | 47 | 2.40 | <i>0.010</i> | 0.25 | <i>0.02</i> | 2.7 | <i>10</i> | <i>10</i> | <i>10</i> | nt |
| 9/14/2005 | 300 | 66 | 1.90 | <i>0.010</i> | 0.52 | 0.09 | 2.4 | 20 | <i>20</i> | 20 | 20 |
| 8/9/2006 | 220 | 45 | 1.90 | <i>0.010</i> | 0.50 | 0.05 | 2.4 | <i>1000</i> | <i>20</i> | 20 | <i>20</i> |
| 5/8/2007 | 220 | 42 | 1.50 | <i>0.010</i> | <i>0.10</i> | 0.04 | 1.6 | 40 | <i>20</i> | <i>20</i> | <i>20</i> |
| 8/29/2007 | 210 | 42 | 1.30 | <i>0.010</i> | 0.44 | 0.07 | 1.8 | 20 | <i>10</i> | <i>10</i> | <i>10</i> |
| 4/16/2008 | 212 | 41 | 1.30 | <i>0.010</i> | 1.50 | 0.06 | 2.8 | 30 | <i>10</i> | <i>10</i> | <i>10</i> |
| 9/3/2008 | 217 | 41 | 2.50 | <i>0.010</i> | 0.48 | 0.03 | 3.0 | 10 | <i>10</i> | <i>10</i> | <i>10</i> |
| 5/19/2009 | nt | 36 | 1.60 | <i>0.010</i> | 0.40 | 0.11 | 2.0 | <i>10</i> | 10 | <i>10</i> | <i>10</i> |
| 8/28/2009 | 267 | 61 | 0.80 | 0.020 | 0.77 | 0.05 | 1.6 | <i>10</i> | <i>10</i> | <i>10</i> | <i>10</i> |
| 5/21/2010 | 179.0 | 33 | 3.00 | nt | 0.86 | 0.06 | 3.9 | <i>10</i> | 10 | <i>10</i> | <i>10</i> |
| 11/8/2011 | 153.0 | 30 | 0.70 | <i>0.010</i> | 0.34 | <i>0.02</i> | 1.1 | 30 | <i>10</i> | <i>10</i> | <i>10</i> |
| 6/19/2012 | 264.0 | 65.9 | 1.03 | <i>0.010</i> | 0.42 | 0.10 | 1.46 | <i>10</i> | <i>10</i> | 10 | <i>10</i> |
| Minimum | 50 | 4 | 0.70 | <i>0.005</i> | 0.10 | <i>0.02</i> | 1.1 | <i>10</i> | <i>2</i> | <i>2</i> | <i>10</i> |
| Maximum | 300 | 66 | 3.90 | 0.020 | 1.50 | 0.31 | 4.8 | 1200 | 400 | 700 | 500 |
| Average | 194 | 38 | 1.88 | 0.010 | 0.53 | 0.07 | 2.4 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| HN-5D | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | TI Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|-----------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 9/8/2000 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 9/13/2000 | 195 | 21 | 3.30 | <i>0.005</i> | 1.30 | <i>0.05</i> | 4.6 | nt | 2 | 2 | nt |
| 4/25/2001 | 194 | 22 | 3.40 | <i>0.005</i> | 0.23 | <i>0.05</i> | 3.6 | nt | 2 | 2 | nt |
| 5/31/2002 | 220 | 28 | 6.90 | <i>0.010</i> | 0.24 | <i>0.02</i> | 7.2 | nt | 10 | 10 | nt |
| 8/23/2002 | 230 | 27 | 7.40 | <i>0.010</i> | 0.73 | 0.28 | 8.1 | 10 | 10 | 10 | nt |
| 5/7/2003 | 230 | 28 | 7.10 | <i>0.010</i> | 0.80 | 0.07 | 7.9 | 10 | 10 | 10 | nt |
| 9/9/2003 | 200 | 23 | 7.20 | <i>0.010</i> | 0.31 | 0.02 | 7.5 | 60 | 20 | 20 | nt |
| 6/10/2004 | 200 | 22 | 5.60 | <i>0.010</i> | 0.69 | 0.09 | 6.3 | 10 | 10 | 10 | 10 |
| 8/17/2004 | 210 | 21 | 6.10 | <i>0.010</i> | 0.36 | 0.06 | 6.5 | 10 | 10 | 10 | 10 |
| 5/10/2005 | 210 | 20 | 6.40 | <i>0.010</i> | 0.37 | 0.04 | 6.8 | 10 | 10 | 10 | nt |
| 9/14/2005 | 230 | 24 | 7.20 | 0.010 | 0.51 | 0.08 | 7.7 | 20 | 20 | 20 | 20 |
| 8/9/2006 | 230 | 22 | 7.70 | 0.010 | 0.16 | 0.05 | 7.9 | 20 | 20 | 20 | 20 |
| 5/8/2007 | 220 | 22 | 6.20 | <i>0.010</i> | <i>0.10</i> | 0.02 | 6.3 | 20 | 20 | 20 | 20 |
| 4/16/2008 | 197 | 22 | 3.40 | <i>0.010</i> | <i>0.10</i> | <i>0.02</i> | 3.5 | 10 | 10 | 10 | 10 |
| 9/3/2008 | 190 | 18 | 5.90 | <i>0.010</i> | 0.39 | 0.04 | 6.3 | 10 | 10 | 10 | 10 |
| 5/19/2009 | nt | 19 | 5.50 | <i>0.010</i> | 0.61 | 0.12 | 6.1 | 10 | 10 | 10 | 10 |
| 8/28/2009 | 199 | 21 | 6.40 | <i>0.010</i> | 0.19 | 0.04 | 6.6 | 10 | 10 | 10 | 10 |
| 5/21/2010 | 201 | 24 | 6.00 | nt | 0.98 | 0.06 | 7.0 | 10 | 10 | 10 | 10 |
| 11/8/2011 | 310 | 81 | 5.20 | <i>0.010</i> | 0.86 | 0.09 | 6.1 | 10 | 10 | 10 | 10 |
| 6/19/2012 | 254 | 42.2 | 5.55 | <i>0.010</i> | 0.65 | 0.05 | 6.2 | 10 | 10 | 10 | 10 |
| Minimum | 190 | 18 | 3.30 | <i>0.005</i> | 0.10 | <i>0.02</i> | 3.5 | 10 | 2 | 2 | 10 |
| Maximum | 310 | 81 | 7.70 | 0.010 | 1.30 | 0.28 | 8.1 | 60 | 20 | 20 | 20 |
| Average | 218 | 27 | 5.92 | 0.009 | 0.50 | 0.07 | 6.4 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| HN-5S | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | TI Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|-----------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 9/8/2000 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 9/13/2000 | 177 | 17 | 3.30 | 0.005 | 1.50 | 0.05 | 4.8 | nt | 2 | 2 | nt |
| 4/25/2001 | 180 | 22 | 2.70 | 0.005 | 0.54 | 0.05 | 3.2 | nt | 2 | 2 | nt |
| 5/31/2002 | 170 | 12 | 7.70 | 0.010 | 0.58 | 0.02 | 8.3 | nt | 10 | 10 | nt |
| 8/23/2002 | 170 | 18 | 6.40 | 0.010 | 0.63 | 0.25 | 7.0 | 10 | 10 | 10 | nt |
| 5/7/2003 | 200 | 29 | 5.60 | 0.010 | 0.53 | 0.09 | 6.1 | 10 | 10 | 10 | nt |
| 9/9/2003 | 150 | 10 | 5.40 | 0.010 | 0.30 | 0.03 | 5.7 | 75 | 20 | 20 | nt |
| 6/10/2004 | 210 | 20 | 7.80 | 0.010 | 1.00 | 0.11 | 8.8 | 10 | 10 | 10 | 10 |
| 8/17/2004 | 200 | 16 | 6.90 | 0.010 | 0.29 | 0.06 | 7.2 | 10 | 10 | 10 | 10 |
| 5/10/2005 | 210 | 22 | 7.00 | 0.010 | 0.42 | 0.04 | 7.4 | 10 | 10 | 10 | nt |
| 9/14/2005 | 220 | 16 | 7.20 | 0.010 | 0.63 | 0.07 | 7.8 | 20 | 20 | 20 | 20 |
| 8/9/2006 | 180 | 13 | 5.30 | 0.010 | 1.50 | 0.02 | 6.8 | 20 | 20 | 20 | 20 |
| 5/8/2007 | 170 | 18 | 3.40 | 0.010 | 0.10 | 0.04 | 3.5 | 20 | 20 | 20 | 20 |
| 4/16/2008 | 180 | 19 | 3.80 | 0.010 | 0.79 | 0.02 | 4.6 | 10 | 10 | 10 | 10 |
| 9/3/2008 | 215 | 17 | 10.00 | 0.010 | 0.60 | 0.07 | 10.6 | 10 | 10 | 10 | 10 |
| 5/19/2009 | nt | 21 | 6.60 | 0.010 | 0.91 | 0.12 | 7.5 | 10 | 10 | 10 | 10 |
| 8/28/2009 | 191 | 17 | 6.40 | 0.010 | 0.23 | 0.08 | 6.6 | 10 | 10 | 10 | 10 |
| 5/21/2010 | 193 | 22 | 6.10 | nt | 0.99 | 0.06 | 7.0 | 10 | 10 | 10 | 10 |
| 11/8/2011 | 1100 | 270 | 22.00 | 0.010 | 2.30 | 0.09 | 24.3 | 20 | 10 | 10 | 10 |
| 6/19/2012 | 226 | 26.8 | 9.13 | 0.010 | 0.87 | 0.04 | 10.0 | 10 | 10 | 10 | 10 |
| Minimum | 150 | 10 | 2.70 | 0.005 | 0.10 | 0.02 | 3.2 | 10 | 2 | 2 | 10 |
| Maximum | 1100 | 270 | 22.00 | 0.010 | 2.30 | 0.25 | 24.3 | 75 | 20 | 20 | 20 |
| Average | 241 | 32 | 6.99 | 0.009 | 0.77 | 0.07 | 7.8 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| HN-6 | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | TI Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|-----------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 9/8/2000 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 9/12/2000 | 220 | 43 | 2.40 | 0.005 | 1.50 | 0.07 | 3.9 | nt | 2 | 2 | nt |
| 4/25/2001 | 180 | 33 | 0.40 | 0.005 | 0.46 | 0.05 | 0.9 | nt | 2 | 2 | nt |
| 5/31/2002 | 240 | 51 | 1.00 | 0.010 | 0.38 | 0.03 | 1.4 | nt | 10 | 10 | nt |
| 8/23/2002 | 190 | 31 | 2.40 | 0.010 | 0.82 | 0.26 | 3.2 | 10 | 10 | 10 | nt |
| 5/7/2003 | 190 | 39 | 1.70 | 0.010 | 0.38 | 0.08 | 2.1 | 100 | 10 | 10 | nt |
| 9/9/2003 | 190 | 38 | 1.50 | 0.010 | 0.36 | 0.03 | 1.9 | 20 | 20 | 20 | nt |
| 6/10/2004 | 200 | 35 | 2.10 | 0.010 | 0.73 | 0.10 | 2.8 | 10 | 10 | 10 | 10 |
| 8/17/2004 | 210 | 37 | 1.80 | 0.010 | 0.31 | 0.07 | 2.1 | 10 | 10 | 10 | 10 |
| 5/10/2005 | 220 | 36 | 1.90 | 0.010 | 0.34 | 0.03 | 2.3 | 10 | 10 | 10 | nt |
| 9/14/2005 | 200 | 30 | 2.40 | 0.020 | 3.50 | 0.46 | 5.9 | 20 | 20 | 20 | 20 |
| 8/10/2006 | 210 | 30 | 3.20 | 0.010 | 0.54 | 0.04 | 3.8 | 20 | 20 | 20 | 20 |
| 5/8/2007 | 180 | 25 | 2.10 | 0.010 | 0.10 | 0.03 | 2.2 | 20 | 20 | 20 | 20 |
| 4/18/2008 | 153 | 25 | 0.72 | 0.010 | 0.34 | 0.04 | 1.1 | 10 | 10 | 10 | 10 |
| 9/3/2008 | 204 | 31 | 3.60 | 0.010 | 1.00 | 0.10 | 4.6 | 10 | 10 | 10 | 10 |
| 5/19/2009 | nt | 38 | 2.20 | 0.010 | 0.45 | 0.09 | 2.7 | 10 | 10 | 10 | 10 |
| 8/28/2009 | 255 | 49 | 1.80 | 0.020 | 0.43 | 0.06 | 2.3 | 10 | 10 | 10 | 10 |
| 5/21/2010 | 189 | 31 | 2.50 | nt | 0.54 | 0.05 | 3.0 | 10 | 10 | 10 | 10 |
| 11/9/2011 | 244 | 55 | 1.20 | 0.010 | 0.34 | 0.04 | 1.6 | 10 | 10 | 10 | 10 |
| 6/19/2012 | 200 | 34.9 | 2.03 | 0.010 | 0.34 | 0.06 | 2.4 | 10 | 10 | 10 | 10 |
| Minimum | 153 | 25 | 0.40 | 0.005 | 0.10 | 0.03 | 0.9 | 10 | 2 | 2 | 10 |
| Maximum | 255 | 55 | 3.60 | 0.020 | 3.50 | 0.46 | 5.9 | 100 | 20 | 20 | 20 |
| Average | 204 | 36 | 1.94 | 0.011 | 0.68 | 0.09 | 2.6 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| SV-1 | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | Tl Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|------------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 6/25/1998 | 125 | 26 | 2.90 | 0.015 | 0.42 | 0.14 | 3.3 | 10 | 20 | 0 | nt |
| 9/23/1998 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 10/1/1998 | 1770 | 43 | 3.20 | 0.005 | 0.23 | 0.05 | 3.4 | 2 | 2 | 2 | nt |
| 4/6/1999 | 198 | 33 | 4.00 | 0.005 | 0.01 | 0.05 | 4.0 | 0 | 2 | 2 | nt |
| 5/11/1999 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 10/19/1999 | 212 | 32 | 4.60 | 0.005 | 0.01 | 0.05 | 4.6 | 0 | 2 | 0 | nt |
| 6/21/2000 | 202 | 30 | 2.30 | 0.005 | 2.00 | 0.05 | 4.3 | 0 | 2 | 0 | nt |
| 9/8/2000 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 9/13/2000 | 274 | 52 | 2.70 | 0.005 | 2.00 | 0.05 | 4.7 | nt | 2 | 2 | nt |
| 5/4/2001 | 180 | 27 | 0.95 | 0.005 | 1.30 | 0.05 | 2.3 | nt | 4 | 4 | nt |
| 9/26/2001 | 280 | 51 | 4.00 | 0.010 | 0.39 | 0.11 | 4.4 | nt | 100 | 100 | nt |
| 5/31/2002 | 200 | 31 | 5.50 | 0.010 | 0.88 | 0.06 | 6.4 | nt | 10 | 10 | nt |
| 8/22/2002 | 260 | 44 | 4.70 | 0.010 | 0.85 | 0.14 | 5.6 | 10 | 10 | 40 | nt |
| 5/7/2003 | 210 | 33 | 5.00 | 0.010 | 1.90 | 0.18 | 6.9 | 10 | 10 | 10 | nt |
| 9/10/2003 | 260 | 43 | 3.20 | 0.010 | 0.43 | 0.05 | 3.6 | 80 | 20 | 40 | nt |
| 6/10/2004 | 230 | 39 | 3.70 | 0.010 | 0.74 | 0.12 | 4.5 | 10 | 10 | 10 | 10 |
| 8/17/2004 | 270 | 45 | 3.40 | 0.010 | 0.43 | 0.03 | 3.8 | 10 | 10 | 10 | nt |
| 5/11/2005 | 210 | 31 | 3.30 | 0.010 | 1.20 | 0.14 | 4.5 | 10 | 10 | 10 | nt |
| 9/13/2005 | 280 | 48 | 3.80 | 0.010 | 1.90 | 0.74 | 5.7 | 20 | 20 | 100 | 20 |
| 8/10/2006 | 240 | 37 | 2.80 | 0.010 | 0.67 | 0.06 | 3.5 | 20 | 20 | 20 | 20 |
| 5/9/2007 | 160 | 22 | 2.10 | 0.010 | 1.20 | 0.08 | 3.3 | 20 | 20 | 20 | 20 |
| 8/29/2007 | 220 | 36 | 2.00 | 0.010 | 0.49 | 0.04 | 2.5 | 10 | 10 | 10 | 10 |
| 4/17/2008 | 210 | 41 | 2.10 | 0.010 | 0.92 | 0.04 | 3.0 | 10 | 10 | 10 | 10 |
| 9/3/2008 | 251 | 41 | 4.90 | 0.010 | 0.94 | 0.05 | 5.9 | 10 | 10 | 10 | 10 |
| 5/21/2009 | nt | 29 | 3.10 | 0.010 | 1.10 | 0.08 | 4.2 | 10 | 10 | 10 | 10 |
| 8/18/2009 | 229 | 42 | 3.30 | 0.020 | 0.74 | 0.05 | 4.1 | 10 | 10 | 10 | 10 |
| 5/24/2010 | 214 | 36 | 3.60 | nt | 0.56 | 0.02 | 4.1 | 10 | 10 | 10 | 10 |
| 11/9/2011 | 345 | 55 | 2.50 | 0.010 | 0.54 | 0.04 | 3.1 | 10 | 10 | 10 | 10 |
| 6/19/2012 | 210 | 35 | 2.88 | 0.010 | 0.62 | 0.02 | 3.5 | 10 | 10 | 10 | 10 |
| Minimum | 125 | 22 | 0.95 | 0.005 | 0.01 | 0.02 | 2.3 | 0 | 2 | 0 | 10 |
| Maximum | 1770 | 55 | 5.50 | 0.020 | 2.00 | 0.74 | 6.9 | 80 | 100 | 100 | 20 |
| Average | 290 | 38 | 3.33 | 0.009 | 0.86 | 0.10 | 4.2 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| SV-2 | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | TI Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|------------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 6/25/1998 | 596 | 117 | 0.06 | 0.041 | 5.90 | 4.50 | 6.0 | 2 | 2 | 2 | nt |
| 9/23/1998 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 10/1/1998 | 254 | 450 | 0.01 | 0.005 | 3.70 | 4.20 | 3.7 | 18 | 20 | 2 | nt |
| 4/6/1999 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 5/12/1999 | 994 | 160 | 0.01 | 0.017 | 4.50 | 4.00 | 4.5 | 0 | 2 | 2 | nt |
| 10/19/1999 | 3140 | 900 | 0.04 | 0.017 | 9.60 | 5.80 | 9.7 | 0 | 2 | 0 | nt |
| 6/21/2000 | 875 | 120 | 0.01 | 0.011 | 4.30 | 2.50 | 4.3 | 9 | 2 | 0 | nt |
| 9/8/2000 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 9/13/2000 | 1970 | 460 | 0.01 | 0.019 | 10.00 | 5.50 | 10.0 | nt | 250 | 12 | nt |
| 5/4/2001 | 1300 | 220 | 0.01 | 0.045 | 7.50 | 4.40 | 7.6 | nt | 4 | 4 | nt |
| 9/26/2001 | 1200 | 190 | 0.18 | 0.010 | 7.80 | 4.20 | 8.0 | nt | 100 | 100 | nt |
| 5/31/2002 | 970 | 88 | 0.01 | 0.010 | 5.80 | 3.90 | 5.8 | nt | 10 | 160 | nt |
| 8/22/2002 | 1300 | 210 | 0.08 | 0.010 | 13.00 | 6.80 | 13.1 | 10 | 10 | 50 | nt |
| 5/7/2003 | 880 | 110 | 0.13 | 0.010 | 5.10 | 3.40 | 5.2 | 10 | 10 | 10 | nt |
| 9/9/2003 | 1000 | 180 | 0.05 | 0.010 | 7.80 | 4.90 | 7.9 | 20 | 20 | 20 | nt |
| 6/10/2004 | 1000 | 160 | 0.05 | 0.010 | 4.00 | 3.10 | 4.1 | 10 | 10 | 10 | 10 |
| 8/18/2004 | 1300 | 200 | 0.05 | 0.010 | 6.30 | 5.10 | 6.4 | 10 | 10 | 10 | nt |
| 5/11/2005 | 750 | 110 | 0.06 | 0.010 | 5.90 | 3.30 | 6.0 | 10 | 10 | 10 | nt |
| 9/13/2005 | 1100 | 130 | 0.05 | 0.010 | 9.40 | 7.20 | 9.5 | 20 | 20 | 20 | 20 |
| 8/10/2006 | 1700 | 330 | 0.05 | 0.010 | 7.60 | 5.10 | 7.7 | 20 | 20 | 20 | 20 |
| 5/8/2007 | 1100 | 220 | 0.01 | 0.090 | 4.10 | 2.90 | 4.2 | 20 | 20 | 20 | 20 |
| 8/29/2007 | 1200 | 200 | 0.03 | 0.012 | 8.90 | 6.90 | 8.9 | 10 | 10 | 10 | 10 |
| 4/16/2008 | 886 | 180 | 0.10 | 0.010 | 4.80 | 2.30 | 4.9 | 10 | 10 | 10 | 10 |
| 9/4/2008 | 1640 | 320 | 0.01 | 0.010 | 9.20 | 6.40 | 9.2 | 10 | 10 | 10 | 10 |
| 5/21/2009 | nt | 120 | 0.01 | 0.060 | 4.90 | 3.70 | 5.0 | 10 | 10 | 10 | 10 |
| 8/18/2009 | 1320 | 230 | 0.01 | 0.010 | 7.60 | 6.20 | 7.6 | 10 | 10 | 10 | 10 |
| 5/24/2010 | 783 | 110 | 0.01 | nt | 4.40 | 3.60 | 4.4 | 10 | 10 | 40 | 10 |
| 11/9/2011 | 1470 | 420 | 0.01 | 0.080 | 8.90 | 4.40 | 9.0 | 10 | 10 | 10 | 10 |
| 6/19/2012 | 1350 | 322 | 0.01 | 0.080 | 4.59 | 3.62 | 4.7 | 10 | 10 | 10 | 10 |
| Minimum | 254 | 88 | 0.01 | 0.005 | 3.70 | 2.30 | 3.7 | 0 | 2 | 0 | 10 |
| Maximum | 3140 | 900 | 0.18 | 0.090 | 13.00 | 7.20 | 13.1 | 20 | 250 | 160 | 20 |
| Average | 1203 | 241 | 0.04 | 0.024 | 6.75 | 4.54 | 6.8 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| SV-3 | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | Tl Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|-----------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 9/8/2000 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 9/13/2000 | 164 | 17 | 2.40 | 0.005 | 1.30 | 0.05 | 3.7 | nt | 2 | 2 | nt |
| 5/4/2001 | 150 | 17 | 0.43 | 0.050 | 1.60 | 0.05 | 2.1 | nt | 4 | 4 | nt |
| 9/26/2001 | 200 | 22 | 4.60 | 0.010 | 1.40 | 0.23 | 6.0 | nt | 100 | 100 | nt |
| 5/31/2002 | 160 | 20 | 6.50 | 0.010 | 1.00 | 0.06 | 7.5 | nt | 10 | 30 | nt |
| 8/22/2002 | 260 | 22 | 2.70 | 0.010 | 12.00 | 1.60 | 14.7 | 100 | 50 | 100 | nt |
| 5/7/2003 | 150 | 18 | 4.40 | 0.010 | 0.67 | 0.11 | 5.1 | 10 | 10 | 10 | nt |
| 9/10/2003 | 150 | 14 | 2.80 | 0.010 | 0.39 | 0.06 | 3.2 | 120 | 20 | 20 | nt |
| 6/10/2004 | 170 | 16 | 5.80 | 0.010 | 0.62 | 0.15 | 6.4 | 10 | 10 | 10 | 10 |
| Duplicate | 170 | 15 | 5.60 | 0.010 | 0.68 | 0.14 | 6.3 | 10 | 10 | 10 | 10 |
| 8/17/2004 | 170 | 16 | 4.90 | 0.010 | 0.44 | 0.08 | 5.4 | 10 | 10 | 10 | nt |
| 5/12/2005 | 170 | 18 | 4.60 | 0.010 | 0.48 | 0.05 | 5.1 | 10 | 10 | 10 | nt |
| 9/13/2005 | 240 | 22 | 2.50 | 0.020 | 2.20 | 0.76 | 4.7 | 20 | 20 | 40 | 20 |
| 8/9/2006 | 140 | 13 | 2.80 | 0.010 | 0.84 | 0.06 | 3.7 | 20 | 20 | 20 | 20 |
| 5/8/2007 | 130 | 12 | 2.80 | 0.010 | 0.10 | 0.03 | 2.9 | 20 | 20 | 20 | 20 |
| 8/29/2007 | 190 | 50 | 2.10 | 0.890 | 1.50 | 0.11 | 4.5 | 10 | 10 | 10 | 10 |
| 4/16/2008 | 144 | 13 | 4.20 | 0.020 | 1.30 | 0.10 | 5.5 | 10 | 10 | 10 | 10 |
| 9/3/2008 | 213 | 22 | 7.80 | 0.140 | 1.10 | 0.04 | 9.0 | 10 | 10 | 10 | 10 |
| 5/21/2009 | nt | 17 | 5.00 | 0.010 | 0.80 | 0.06 | 5.8 | 10 | 10 | 10 | 10 |
| 8/18/2009 | 156 | 14 | 4.50 | 0.030 | 0.63 | 0.07 | 5.2 | 10 | 10 | 10 | 10 |
| 5/24/2010 | 151 | 16 | 3.70 | nt | 0.41 | 0.02 | 4.1 | 10 | 10 | 10 | 10 |
| 11/9/2011 | 159 | 15 | 5.50 | 0.010 | 0.82 | 0.04 | 6.3 | 10 | 10 | 10 | 10 |
| 6/19/2012 | 162 | 17 | 3.97 | 0.010 | 0.76 | 0.02 | 4.7 | 10 | 10 | 10 | 10 |
| Minimum | 130 | 12 | 0.43 | 0.005 | 0.10 | 0.02 | 2.1 | 10 | 2 | 2 | 10 |
| Maximum | 260 | 50 | 7.80 | 0.890 | 12.00 | 1.60 | 14.7 | 120 | 100 | 100 | 20 |
| Average | 171 | 18 | 4.07 | 0.062 | 1.41 | 0.18 | 5.5 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| SV-4 | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | Tl Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|-----------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|------------------------------|------------------------|----------------------------|------------------------------|
| 9/8/2000 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 9/13/2000 | 478 | 52 | 0.01 | 0.005 | 12.00 | 9.80 | 12.0 | nt | 2 | 2 | nt |
| 5/4/2001 | 360 | 24 | 0.01 | 0.017 | 8.90 | 7.70 | 8.9 | nt | 4 | 4 | nt |
| 9/26/2001 | 320 | 46 | 0.18 | 0.010 | 11.00 | 10.00 | 11.2 | nt | 100 | 100 | nt |
| 5/31/2002 | 460 | 36 | 0.01 | 0.010 | 12.00 | 11.00 | 12.0 | nt | 10 | 450 | nt |
| 8/22/2002 | 460 | 38 | 0.08 | 0.010 | 1.70 | 1.20 | 1.8 | 10 | 10 | >600 | nt |
| 5/7/2003 | 410 | 27 | 0.28 | 0.010 | 11.00 | 9.40 | 11.3 | 10 | 10 | 10 | nt |
| 9/10/2003 | 500 | 34 | 0.05 | 0.010 | 11.00 | 10.00 | 11.1 | 100 | 20 | 20 | nt |
| 6/10/2004 | 460 | 24 | 0.05 | 0.010 | 8.30 | 7.60 | 8.4 | 10 | 10 | 10 | 10 |
| 8/17/2004 | 500 | 28 | 0.05 | 0.010 | 8.30 | 7.80 | 8.4 | 10 | 10 | 10 | 10 |
| 5/11/2005 | 330 | 10 | 0.05 | 0.010 | 6.60 | 5.90 | 6.7 | 10 | 10 | 10 | nt |
| 9/13/2005 | 420 | 29 | 0.06 | 0.010 | 11.00 | 10.00 | 11.1 | 20 | 20 | 20 | 20 |
| 8/9/2006 | 370 | 19 | 0.06 | 0.010 | 8.20 | 7.30 | 8.3 | 20 | 20 | 20 | 20 |
| 5/8/2007 | 340 | 17 | 0.01 | 0.040 | 7.00 | 6.00 | 7.1 | 20 | 20 | 20 | 20 |
| 8/29/2007 | 380 | 28 | 0.01 | 0.050 | 7.40 | 6.70 | 7.5 | 10 | 10 | 10 | 10 |
| 4/16/2008 | 231 | 15 | 0.03 | 0.010 | 6.50 | 5.60 | 6.5 | 10 | 10 | 10 | 10 |
| 9/4/2008 | 323 | 19 | 0.01 | 0.060 | 5.60 | 5.60 | 5.7 | 10 | 10 | 10 | 10 |
| 5/21/2009 | nt | 13 | 0.01 | 0.040 | 6.20 | 5.70 | 6.3 | 10 | 10 | 10 | 10 |
| 8/18/2009 | 265 | 17 | 0.01 | 0.080 | 6.00 | 5.00 | 6.1 | 10 | 10 | 10 | 10 |
| 5/24/2010 | 264 | 10 | 0.01 | nt | 5.00 | 4.70 | 5.0 | 10 | 10 | 10 | 10 |
| 11/9/2011 | 287 | 17 | 0.01 | 0.060 | 5.50 | 5.10 | 5.6 | 10 | 10 | 10 | 10 |
| 6/19/2012 | 476 | 100 | 0.01 | 0.060 | 5.97 | 5.55 | 6.0 | 10 | 10 | 10 | 10 |
| Minimum | 231 | 10 | 0.01 | 0.005 | 1.70 | 1.20 | 1.8 | 10 | 10 | 10 | 10 |
| Maximum | 500 | 100 | 0.28 | 0.080 | 12.00 | 11.00 | 12.0 | 100 | 100 | >600 | 20 |
| Average | 382 | 26 | 0.05 | 0.022 | 8.09 | 7.21 | 8.2 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| SV-6 | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | Tl Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|-----------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 9/8/2000 | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 9/13/2000 | 688 | 160 | 0.01 | 0.005 | 2.80 | 0.70 | 2.8 | nt | 2 | 16 | nt |
| 5/4/2001 | 580 | 110 | 0.01 | 0.005 | 2.00 | 0.77 | 2.0 | nt | 4 | 4 | nt |
| 9/26/2001 | 510 | 110 | 0.22 | 0.010 | 1.20 | 0.67 | 1.4 | nt | 100 | 100 | nt |
| 5/31/2002 | 540 | 100 | 0.01 | 0.010 | 2.00 | 1.30 | 2.0 | nt | 10 | 70 | nt |
| 8/22/2002 | 510 | 94 | 0.08 | 0.010 | 6.00 | 1.60 | 6.1 | 10 | 10 | >600 | nt |
| 5/7/2003 | 460 | 82 | 0.23 | 0.010 | 1.40 | 0.72 | 1.6 | 10 | 10 | 10 | nt |
| 9/9/2003 | 420 | 80 | 0.05 | 0.010 | 1.70 | 0.46 | 1.8 | 180 | 160 | 200 | nt |
| 6/10/2004 | 600 | 120 | 0.05 | 0.010 | 3.40 | 0.87 | 3.5 | 10 | 10 | 10 | 10 |
| 8/17/2004 | 460 | 80 | 0.05 | 0.010 | 1.40 | 0.54 | 1.5 | 200 | 1000 | 50 | nt |
| 5/11/2005 | 430 | 73 | 0.05 | 0.010 | 1.30 | 0.73 | 1.4 | 10 | 10 | 10 | nt |
| 9/13/2005 | 460 | 76 | 0.05 | 0.010 | 5.40 | 2.50 | 5.5 | 20 | 20 | 300 | 20 |
| 8/10/2006 | 490 | 86 | 0.05 | 0.010 | 3.90 | 0.71 | 4.0 | 20 | 20 | 20 | 20 |
| 5/9/2007 | 360 | 56 | 0.01 | 0.010 | 0.73 | 0.23 | 0.8 | 20 | 20 | 20 | 20 |
| 8/29/2007 | 370 | 63 | 0.01 | 0.010 | 1.00 | 0.34 | 1.0 | 60 | 50 | 10 | 60 |
| 4/17/2008 | 311 | 46 | 0.01 | 0.010 | 2.00 | 1.00 | 2.0 | 10 | 10 | 10 | 10 |
| 9/4/2008 | 361 | 57 | 0.01 | 0.010 | 2.20 | 0.40 | 2.2 | 40 | 10 | 10 | 10 |
| 5/21/2009 | nt | 55 | 0.01 | 0.010 | 1.70 | 0.92 | 1.7 | 300 | 40 | 20 | 300 |
| 8/18/2009 | 398 | 65 | 0.01 | 0.010 | 2.00 | 0.91 | 2.0 | 10 | 10 | 10 | 10 |
| 5/24/2010 | 356 | 59 | 0.01 | nt | 0.50 | 0.10 | 0.5 | 120 | 10 | 10 | 10 |
| 11/9/2011 | 350 | 63 | 0.01 | 0.010 | 0.61 | 0.19 | 0.6 | 50 | 10 | 10 | 10 |
| 6/19/2012 | 405 | 54 | 0.05 | 0.05 | 0.90 | 0.31 | 1.0 | 10 | 10 | 10 | 10 |
| Minimum | 311 | 46 | 0.01 | 0.005 | 0.50 | 0.10 | 0.5 | 10 | 10 | 10 | 10 |
| Maximum | 688 | 160 | 0.23 | 0.010 | 6.00 | 2.50 | 6.1 | 300 | 1000 | >600 | 20 |
| Average | 453 | 80 | 0.05 | 0.012 | 2.10 | 0.76 | 2.2 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| OC-1 | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | TI Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|-----------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 5/7/2003 | 280 | 20 | 0.45 | <i>0.010</i> | 9.40 | 8.40 | 9.9 | <i>10</i> | <i>10</i> | <i>10</i> | nt |
| 9/10/2003 | 360 | 34 | <i>0.05</i> | <i>0.010</i> | 8.40 | 7.60 | 8.5 | 80 | <i>20</i> | <i>20</i> | nt |
| 6/16/2004 | 260 | 19 | <i>0.05</i> | <i>0.010</i> | 6.10 | 5.60 | 6.2 | <i>10</i> | <i>10</i> | <i>10</i> | nt |
| 8/17/2004 | 370 | 29 | 0.20 | <i>0.010</i> | 7.90 | 7.20 | 8.1 | 210 | <i>10</i> | <i>10</i> | nt |
| 5/12/2005 | 240 | 17 | 0.12 | <i>0.010</i> | 6.00 | 5.10 | 6.1 | <i>10</i> | <i>10</i> | <i>10</i> | nt |
| 9/14/2005 | 310 | 25 | 0.09 | <i>0.010</i> | 2.60 | 2.20 | 2.7 | <i>20</i> | <i>20</i> | <i>20</i> | <i>20</i> |
| 8/15/2006 | 290 | 18 | <i>0.05</i> | <i>0.010</i> | 5.70 | 5.30 | 5.8 | 100 | <i>20</i> | <i>20</i> | <i>20</i> |
| 5/9/2007 | 270 | 23 | 0.02 | <i>0.010</i> | 6.10 | 6.00 | 6.1 | <i>20</i> | <i>20</i> | <i>20</i> | <i>20</i> |
| 4/17/2008 | 307 | 25 | <i>0.01</i> | <i>0.010</i> | 6.80 | 6.10 | 6.8 | <i>10</i> | <i>10</i> | <i>10</i> | <i>10</i> |
| 9/4/2008 | 238 | 17 | <i>0.01</i> | <i>0.010</i> | 6.20 | 4.10 | 6.2 | <i>10</i> | <i>10</i> | <i>10</i> | <i>10</i> |
| 5/21/2009 | nt | 16 | <i>0.01</i> | <i>0.010</i> | 3.90 | 3.60 | 3.9 | <i>10</i> | <i>10</i> | <i>10</i> | <i>10</i> |
| 8/19/2009 | 241 | 15 | <i>0.01</i> | <i>0.010</i> | 5.50 | 4.30 | 5.5 | <i>10</i> | <i>10</i> | <i>10</i> | <i>10</i> |
| 5/24/2010 | 198 | 12 | <i>0.01</i> | nt | 5.80 | 5.50 | 5.8 | <i>10</i> | <i>10</i> | <i>10</i> | <i>10</i> |
| 11/9/2011 | 433 | 21 | <i>0.01</i> | <i>0.010</i> | 10.00 | 9.20 | 10.0 | <i>10</i> | <i>10</i> | <i>10</i> | <i>10</i> |
| 6/20/2012 | 303 | 24.1 | <i>0.01</i> | <i>0.010</i> | 7.24 | 6.68 | 7.3 | <i>10</i> | <i>10</i> | <i>10</i> | <i>10</i> |
| Minimum | 198 | 12 | <i>0.01</i> | <i>0.010</i> | 2.60 | 2.20 | 2.7 | <i>20</i> | <i>10</i> | <i>10</i> | <i>20</i> |
| Maximum | 433 | 34 | 0.45 | 0.010 | 10.00 | 9.20 | 10.0 | 210 | <i>20</i> | <i>20</i> | <i>20</i> |
| Average | 293 | 21 | 0.07 | 0.010 | 6.51 | 5.79 | 6.6 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| OC-2 | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | Tl Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|-----------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 5/7/2003 | 230 | 25 | 5.40 | 0.370 | 30.00 | 5.10 | 35.8 | <i>10</i> | <i>10</i> | <i>10</i> | nt |
| 9/18/2003 | 230 | 23 | 5.10 | <i>0.010</i> | 2.10 | 1.40 | 7.2 | <i>20</i> | <i>20</i> | 20 | nt |
| 6/16/2004 | 220 | 24 | 5.60 | 0.010 | 1.30 | 1.10 | 6.9 | <i>10</i> | <i>10</i> | <i>10</i> | nt |
| 8/17/2004 | 230 | 23 | 5.00 | 0.050 | 1.60 | 1.00 | 6.7 | <i>10</i> | <i>10</i> | <i>10</i> | nt |
| 5/12/2005 | 230 | 24 | 5.90 | <i>0.010</i> | 2.30 | 1.10 | 8.2 | <i>10</i> | 10 | <i>10</i> | nt |
| 9/14/2005 | 210 | 22 | 2.00 | 0.020 | 2.90 | 1.10 | 4.9 | 20 | 20 | <i>20</i> | 20 |
| 8/15/2006 | 210 | 23 | 5.90 | 0.010 | 1.70 | 1.10 | 7.6 | 180 | <i>20</i> | 20 | <i>20</i> |
| 5/9/2007 | 220 | 28 | 5.30 | 0.100 | 0.72 | 0.68 | 6.1 | <i>20</i> | <i>20</i> | <i>20</i> | <i>20</i> |
| 4/17/2008 | 215 | 23 | 3.00 | 0.020 | 1.20 | 0.70 | 4.2 | <i>10</i> | <i>10</i> | <i>10</i> | <i>10</i> |
| 9/4/2008 | 218 | 22 | 6.60 | 0.030 | 2.00 | 0.82 | 8.6 | <i>10</i> | <i>10</i> | <i>10</i> | <i>10</i> |
| 5/21/2009 | nt | 22 | 6.10 | 0.020 | 1.50 | 0.80 | 7.6 | <i>10</i> | <i>10</i> | <i>10</i> | <i>10</i> |
| 8/19/2009 | 221 | 34 | 6.20 | 0.050 | 0.88 | 0.73 | 7.1 | 10 | 10 | 10 | <i>10</i> |
| 5/24/2010 | 221 | 26 | 6.50 | nt | 1.30 | 0.53 | 6.5 | >1000 | 240 | <i>10</i> | 200 |
| 11/9/2011 | 214 | 24 | 6.90 | 0.010 | 1.40 | 0.63 | 8.3 | <i>10</i> | <i>10</i> | <i>10</i> | <i>10</i> |
| 6/20/2012 | 217 | 25.5 | 6.14 | <i>0.010</i> | 1.05 | 0.55 | 7.2 | <i>10</i> | <i>10</i> | <i>10</i> | <i>10</i> |
| Minimum | 210 | 22 | 2.00 | <i>0.010</i> | 0.72 | 0.53 | 4.2 | <i>10</i> | <i>10</i> | <i>10</i> | <i>20</i> |
| Maximum | 230 | 34 | 6.90 | 0.370 | 30.00 | 5.10 | 35.8 | >1000 | 240 | 20 | 200 |
| Average | 220 | 25 | 5.44 | 0.051 | 3.46 | 1.16 | 8.9 | na | na | na | na |

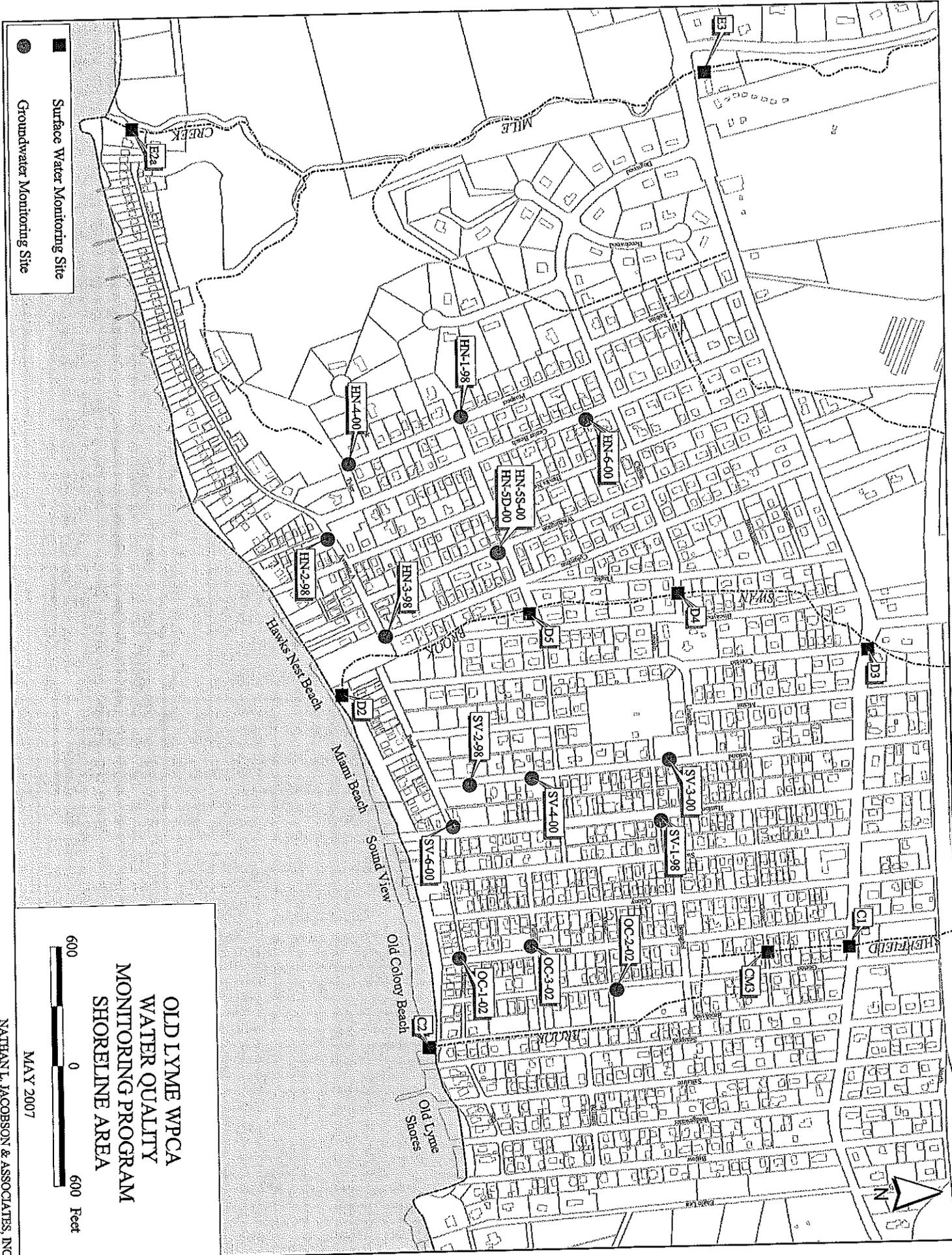
Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

| OC-3 | Spec Cond. umhos/cm | Chloride mg/l | Nitrate mg/l | Nitrite mg/l | TKN mg/l | Ammonia mg/l | Total Nitrogen mg/l | TI Coli. Bact #/100 ml | Fecal Coli #/100 ml | Fecal Strepto. #/100 ml | Escheri. Coli #/100 ml |
|-----------|------------------------|------------------|-----------------|-----------------|-------------|-----------------|------------------------|---------------------------|------------------------|----------------------------|---------------------------|
| 5/7/2003 | 110 | 6 | 0.39 | 0.010 | 0.65 | 0.30 | 1.1 | 10 | 10 | 10 | nt |
| 9/10/2003 | 170 | 5 | 0.05 | 0.010 | 0.75 | 0.32 | 0.8 | 120 | 20 | 20 | nt |
| 6/16/2004 | 170 | 5 | 0.08 | 0.010 | 1.60 | 0.26 | 1.7 | 10 | 10 | 10 | nt |
| 8/17/2004 | 300 | 7 | 0.80 | 0.040 | 0.69 | 0.24 | 1.5 | 1200 | >600 | 570 | nt |
| 5/12/2005 | 130 | 4 | 0.34 | 0.010 | 0.57 | 0.14 | 0.9 | 40 | 10 | 20 | nt |
| 9/14/2005 | 180 | 9 | 0.71 | 0.010 | 3.70 | 0.59 | 4.4 | 160 | 340 | 80 | 160 |
| 8/15/2006 | 170 | 10 | 1.50 | 0.020 | 0.25 | 0.19 | 1.8 | 240 | 20 | 20 | 20 |
| 5/9/2007 | 130 | 10 | 0.24 | 0.010 | 0.21 | 0.21 | 0.5 | 280 | 20 | 20 | 20 |
| 4/17/2008 | 117 | 8 | 0.16 | 0.010 | 0.99 | 0.14 | 1.2 | 80 | 10 | 10 | 10 |
| 9/4/2008 | 191 | 7 | 0.01 | 0.010 | 0.76 | 0.18 | 0.8 | 380 | 10 | 40 | 10 |
| 5/21/2009 | nt | 5 | 0.67 | 0.010 | 1.30 | 0.16 | 2.0 | 10 | 30 | 40 | 10 |
| 8/19/2009 | 185 | 15 | 0.82 | 0.010 | 0.32 | 0.20 | 1.2 | 40 | 60 | 50 | 40 |
| 5/24/2010 | 133 | 5.5 | 1.20 | nt | 0.45 | 0.06 | 0.5 | >1000 | 180 | 60 | 160 |
| 11/9/2011 | 352 | 88.0 | 0.27 | 0.010 | 1.40 | 0.08 | 1.7 | 90 | 10 | 10 | 10 |
| 6/20/2012 | 174 | 14.3 | 0.21 | 0.010 | 0.85 | 0.15 | 1.1 | 250 | 320 | 30 | 130 |
| Minimum | 110 | 4 | 0.01 | 0.010 | 0.21 | 0.06 | 0.5 | 10 | 10 | 10 | 20 |
| Maximum | 352 | 88 | 1.50 | 0.040 | 3.70 | 0.59 | 4.4 | 1200 | >600 | 570 | 160 |
| Average | 179 | 13 | 0.50 | 0.013 | 0.97 | 0.21 | 1.4 | na | na | na | na |

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.



 Surface Water Monitoring Site
 Groundwater Monitoring Site

600
 0
 600 Feet

**OLD LYME WPCA
 WATER QUALITY
 MONITORING PROGRAM
 SHORELINE AREA**

MAY 2007

NATHAN L. JACOBSON & ASSOCIATES, INC.

APPENDIX E: MARINE BACTERIAL COUNT DATA

| ACH NAME | DATE | CRITERIA/TEST | COL/100 ML |
|----------------------------|-----------|---------------|------------|
| White Sands (Marine Water) | 5/22/2014 | Enterococci | 24 |
| White Sands (Marine Water) | 5/28/2014 | Enterococci | 4 |
| White Sands (Marine Water) | 6/2/2014 | Enterococci | 4 |
| White Sands (Marine Water) | 6/10/2014 | Enterococci | 14 |
| White Sands (Marine Water) | 6/18/2014 | Enterococci | 0 |
| White Sands (Marine Water) | 6/24/2014 | Enterococci | 0 |
| White Sands (Marine Water) | 7/1/2014 | Enterococci | 0 |
| White Sands (Marine Water) | 7/9/2014 | Enterococci | 44 |
| White Sands (Marine Water) | 7/15/2014 | Enterococci | 40 |
| White Sands (Marine Water) | 7/21/2014 | Enterococci | 0 |
| White Sands (Marine Water) | 7/30/2014 | Enterococci | 0 |
| White Sands (Marine Water) | 8/5/2014 | Enterococci | 0 |
| White Sands (Marine Water) | 8/12/2014 | Enterococci | 0 |
| White Sands (Marine Water) | 8/18/2014 | Enterococci | 0 |
| White Sands (Marine Water) | 8/26/2014 | Enterococci | 6 |
| White Sands (Marine Water) | 9/3/2014 | Enterococci | 0 |
| White Sands (Marine Water) | 9/9/2014 | Enterococci | 0 |
| White Sands (Marine Water) | 9/17/2014 | Enterococci | 6 |
| | | | |
| | | | |
| Hawk's Nest (Marine Water) | 5/22/2014 | Enterococci | 12 |
| Hawk's Nest (Marine Water) | 5/28/2014 | Enterococci | 4 |
| Hawk's Nest (Marine Water) | 6/2/2014 | Enterococci | 6 |
| Hawk's Nest (Marine Water) | 6/10/2014 | Enterococci | 24 |
| Hawk's Nest (Marine Water) | 6/18/2014 | Enterococci | 2 |
| Hawk's Nest (Marine Water) | 6/24/2014 | Enterococci | 0 |
| Hawk's Nest (Marine Water) | 7/1/2014 | Enterococci | 4 |
| Hawk's Nest (Marine Water) | 7/9/2014 | Enterococci | 32 |
| Hawk's Nest (Marine Water) | 7/15/2014 | Enterococci | 16 |
| Hawk's Nest (Marine Water) | 7/21/2014 | Enterococci | 4 |
| Hawk's Nest (Marine Water) | 7/30/2014 | Enterococci | 0 |
| Hawk's Nest (Marine Water) | 8/5/2014 | Enterococci | 72 |
| Hawk's Nest (Marine Water) | 8/12/2014 | Enterococci | 0 |
| Hawk's Nest (Marine Water) | 8/18/2014 | Enterococci | 12 |
| Hawk's Nest (Marine Water) | 8/26/2014 | Enterococci | 4 |
| Hawk's Nest (Marine Water) | 9/3/2014 | Enterococci | 40 |
| Hawk's Nest (Marine Water) | 9/9/2014 | Enterococci | 46 |
| Hawk's Nest (Marine Water) | 9/17/2014 | Enterococci | 8 |
| | | | |
| | | | |

| | | | |
|----------------------------|-----------|-------------|-----|
| Sound View (Marine Water) | 5/22/2014 | Enterococci | 16 |
| Sound View (Marine Water) | 5/28/2014 | Enterococci | 12 |
| Sound View (Marine Water) | 6/2/2014 | Enterococci | 2 |
| Sound View (Marine Water) | 6/10/2014 | Enterococci | 24 |
| Sound View (Marine Water) | 6/18/2014 | Enterococci | 6 |
| Sound View (Marine Water) | 6/24/2014 | Enterococci | 2 |
| Sound View (Marine Water) | 7/1/2014 | Enterococci | 4 |
| Sound View (Marine Water) | 7/9/2014 | Enterococci | 20 |
| Sound View (Marine Water) | 7/15/2014 | Enterococci | 60 |
| Sound View (Marine Water) | 7/21/2014 | Enterococci | 0 |
| Sound View (Marine Water) | 7/30/2014 | Enterococci | 8 |
| Sound View (Marine Water) | 8/5/2014 | Enterococci | 8 |
| Sound View (Marine Water) | 8/12/2014 | Enterococci | 4 |
| Sound View (Marine Water) | 8/18/2014 | Enterococci | 0 |
| Sound View (Marine Water) | 8/26/2014 | Enterococci | 4 |
| Sound View (Marine Water) | 9/3/2014 | Enterococci | 0 |
| Sound View (Marine Water) | 9/9/2014 | Enterococci | 10 |
| Sound View (Marine Water) | 9/17/2014 | Enterococci | 0 |
| | | | |
| | | | |
| Point O' Woods | 5/22/2014 | Enterococci | 2 |
| Point O' Woods | 5/28/2014 | Enterococci | 2 |
| Point O' Woods | 6/2/2014 | Enterococci | 4 |
| Point O' Woods | 6/10/2014 | Enterococci | 2 |
| Point O' Woods | 6/18/2014 | Enterococci | 2 |
| Point O' Woods | 6/24/2014 | Enterococci | 18 |
| Point O' Woods | 7/1/2014 | Enterococci | 4 |
| Point O' Woods | 7/9/2014 | Enterococci | 24 |
| Point O' Woods | 7/15/2014 | Enterococci | 88 |
| Point O' Woods | 7/21/2014 | Enterococci | 16 |
| Point O' Woods | 7/30/2014 | Enterococci | 88 |
| Point O' Woods | 8/5/2014 | Enterococci | 12 |
| Point O' Woods | 8/12/2014 | Enterococci | 100 |
| Point O' Woods | 8/18/2014 | Enterococci | 0 |
| Point O' Woods | 8/26/2014 | Enterococci | 96 |
| Point O' Woods | 9/3/2014 | Enterococci | 24 |
| Point O' Woods | 9/9/2014 | Enterococci | 4 |
| Point O' Woods | 9/17/2014 | Enterococci | 0 |
| | | | |
| | | | |
| Miami Beach (Marine Water) | 5/22/2014 | Enterococci | 0 |
| Miami Beach (Marine Water) | 5/28/2014 | Enterococci | 18 |

| | | | |
|--------------------------------|-----------|-------------|-----|
| Miami Beach (Marine Water) | 6/2/2014 | Enterococci | 2 |
| Miami Beach (Marine Water) | 6/10/2014 | Enterococci | 40 |
| Miami Beach (Marine Water) | 6/24/2014 | Enterococci | 2 |
| Miami Beach (Marine Water) | 6/18/2014 | Enterococci | 16 |
| Miami Beach (Marine Water) | 7/1/2014 | Enterococci | 88 |
| Miami Beach (Marine Water) | 7/9/2014 | Enterococci | 36 |
| Miami Beach (Marine Water) | 7/15/2014 | Enterococci | 16 |
| Miami Beach (Marine Water) | 7/21/2014 | Enterococci | 8 |
| Miami Beach (Marine Water) | 7/30/2014 | Enterococci | 4 |
| Miami Beach (Marine Water) | 8/5/2014 | Enterococci | 100 |
| Miami Beach (Marine Water) | 8/12/2014 | Enterococci | 0 |
| Miami Beach (Marine Water) | 8/18/2014 | Enterococci | 0 |
| Miami Beach (Marine Water) | 8/26/2014 | Enterococci | 0 |
| Miami Beach (Marine Water) | 9/3/2014 | Enterococci | 0 |
| Miami Beach (Marine Water) | 9/9/2014 | Enterococci | 2 |
| Miami Beach (Marine Water) | 9/17/2014 | Enterococci | 4 |
| | | | |
| | | | |
| Old Colony (Marine Water) | 5/22/2014 | Enterococci | 22 |
| Old Colony (Marine Water) | 5/28/2014 | Enterococci | 6 |
| Old Colony (Marine Water) | 6/2/2014 | Enterococci | 2 |
| Old Colony (Marine Water) | 6/10/2014 | Enterococci | 34 |
| Old Colony (Marine Water) | 6/18/2014 | Enterococci | 6 |
| Old Colony (Marine Water) | 6/24/2014 | Enterococci | 8 |
| Old Colony (Marine Water) | 7/1/2014 | Enterococci | 4 |
| Old Colony (Marine Water) | 7/9/2014 | Enterococci | 32 |
| Old Colony (Marine Water) | 7/15/2014 | Enterococci | 16 |
| Old Colony (Marine Water) | 7/21/2014 | Enterococci | 0 |
| Old Colony (Marine Water) | 7/30/2014 | Enterococci | 0 |
| Old Colony (Marine Water) | 8/5/2014 | Enterococci | 8 |
| Old Colony (Marine Water) | 8/12/2014 | Enterococci | 4 |
| Old Colony (Marine Water) | 8/18/2014 | Enterococci | 0 |
| Old Colony (Marine Water) | 8/26/2014 | Enterococci | 0 |
| Old Colony (Marine Water) | 9/3/2014 | Enterococci | 2 |
| Old Colony (Marine Water) | 9/9/2014 | Enterococci | 2 |
| Old Colony (Marine Water) | 9/17/2014 | Enterococci | 0 |
| | | | |
| | | | |
| Old Lyme Shores (Marine Water) | 5/22/2014 | Enterococci | 22 |
| Old Lyme Shores (Marine Water) | 5/28/2014 | Enterococci | 24 |
| Old Lyme Shores (Marine Water) | 6/2/2014 | Enterococci | 6 |
| Old Lyme Shores (Marine Water) | 6/10/2014 | Enterococci | 16 |

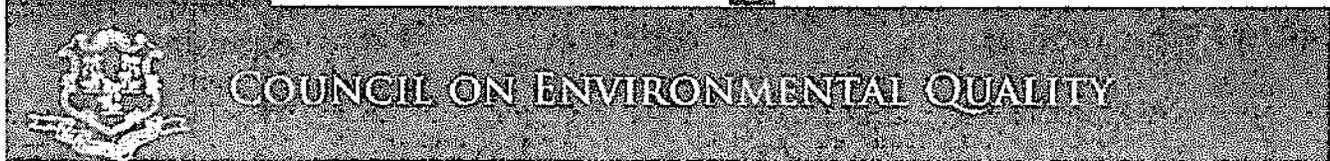
| | | | |
|--------------------------------|-----------|-------------|----|
| Old Lyme Shores (Marine Water) | 6/18/2014 | Enterococci | 2 |
| Old Lyme Shores (Marine Water) | 6/24/2014 | Enterococci | 0 |
| Old Lyme Shores (Marine Water) | 7/1/2014 | Enterococci | 0 |
| Old Lyme Shores (Marine Water) | 7/9/2014 | Enterococci | 8 |
| Old Lyme Shores (Marine Water) | 7/15/2014 | Enterococci | 0 |
| Old Lyme Shores (Marine Water) | 7/21/2014 | Enterococci | 8 |
| Old Lyme Shores (Marine Water) | 7/30/2014 | Enterococci | 80 |
| Old Lyme Shores (Marine Water) | 8/5/2014 | Enterococci | 8 |
| Old Lyme Shores (Marine Water) | 8/12/2014 | Enterococci | 0 |
| Old Lyme Shores (Marine Water) | 8/18/2014 | Enterococci | 4 |
| Old Lyme Shores (Marine Water) | 8/26/2014 | Enterococci | 2 |
| Old Lyme Shores (Marine Water) | 9/3/2014 | Enterococci | 4 |
| Old Lyme Shores (Marine Water) | 9/9/2014 | Enterococci | 6 |
| Old Lyme Shores (Marine Water) | 9/17/2014 | Enterococci | 0 |

MARINE WATER COMMENTS:

A concentration of enterococcal organisms less than or equal to 104 per 100ml is generally considered satisfactory for a single sample from a bathing area.

A single sample with a concentration of enterococcal organisms greater than 104 per 100 ml is in excess of that which is considered acceptable for bathing. (Reference CT Dept. of Health Services Guidelines)

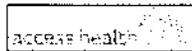
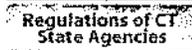
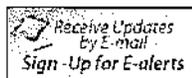
APPENDIX F: CEPA SCOPING NOTICE & COMMENT DOCUMENTS


[Home](#)
[About Us](#)
[Programs and Services](#)
[Publications](#)
[Contact Us](#)


Susan D. Merrow
Chair

[Environmental Monitor](#)
[Meeting Information](#)

- [Schedule](#)
- [Agenda](#)
- [Minutes](#)
- [Participation](#)
- [Internships](#)



Scoping Notice

[Browse CEQ Home](#) [Back](#) [Printable Version](#) [Text-Only](#) [Full-Screen](#) [Ask eMail](#)

Scoping Notice

Project Title: Old Lyme Coastal Wastewater Management Plan

Municipality where proposed project might be located: Old Lyme

Addresses of Possible Project Locations: Shoreline communities located south of and along Route 156 between White Sand Beach Association and Old Lyme Shores Beach Association, and the Route 156 corridor to East Lyme

Project Description: The Town of Old Lyme, and Old Lyme Shores, Old Colony Beach and Miami Beach Associations have conducted independent engineering studies showing that the prevalent conditions in the project area such as the age and location of existing onsite wastewater treatment systems, high density of development, lack of adequate space and overall challenging subsurface conditions, such as shallow groundwater, have rendered the onsite wastewater treatment systems economically and technically unfeasible for long term wastewater renovation. For this reason, the Town of Old Lyme is joining efforts with three chartered beach associations (Miami Beach, Old Colony Beach and Old Lyme Shores) to implement a holistic and long term solution that addresses identified wastewater management concerns within the boundaries of the described shoreline area.

The proposed solution would incorporate the installation of sanitary sewers within the following beach communities: White Sand Beach Association, Hawks Nest, Miami Beach Association, Sound View, Old Colony Beach Association and Old Lyme Shores Beach Association. It would also incorporate the installation of pump station(s) and transmission line to collect wastewater from the mentioned communities and transport it eastward along Route 156 to the town of East Lyme where it would be discharged into existing regional conveyance infrastructure for final treatment at the Piacenti Wastewater Treatment Facility in the City of New London. Once all connections into the proposed sanitary sewer system are completed, it is estimated that 1,350 existing dwelling units will be served by the proposed infrastructure generating approximately 300,000 gallons of wastewater on an average daily basis.

Project Maps: [Click here to view the areas to be sewered.](#)
[Click here to view the sewer route in Old Lyme.](#)
[Click here to view the existing conveyance system.](#)

Written comments from the public are welcomed and will be accepted until the close of business on August 22, 2014.

Any person can ask the sponsoring agency to hold a Public Scoping Meeting by sending such a request to the address below. If a meeting is requested by 25 or more individuals, or by an association that represents 25 or more members, the sponsoring agency shall schedule a Public Scoping Meeting. Such requests must be made by August 1, 2014.

Written comments and/or requests for a Public Scoping Meeting should be sent to:

Name: Carlos Esquerria
Agency: Department of Energy & Environmental Protection
 Bureau of Water Protection & Land Reuse
Address: 79 Elm Street
 Hartford, CT 06106-5127
Phone: 860-424-3756
Fax: 860-424-4067
E-Mail: carlos.esquerria@ct.gov

If you have questions about the public meeting, or other questions about the scoping for this project, contact Mr. Esquerria, as directed above.

The Connecticut Department of Energy and Environmental Protection is an Affirmative Action/Equal Opportunity Employer that is committed to complying with the requirements of the Americans with Disabilities Act. Any person with a disability who may need a communication aid or service may contact the

agency's ADA Coordinator at 860-424-3194 or at deep.hrmed@ct.gov. Any person with limited proficiency in English, who may need information in another language, may contact the agency's Title VI Coordinator at 860-424-3035 or at deep.aaooffice@ct.gov. ADA or Title VI discrimination complaints may be filed with DEEP's EEO Manager at (860) 424-3035 or at deep.aaooffice@ct.gov.

Content Last Modified on 7/16/2014 1:59:38 PM

[Edit This Page](#)

[Browse CEQ Home](#) [Back](#) [Printable Version](#) [Text-Only](#) [Full-Screen](#) [Ask eMail](#)

79 Elm Street Hartford, CT 06106 / Phone: 860-424-4000

[Home](#) | [CT.gov Home](#) | [Send Feedback](#) | [Logout](#) | [Update](#) | [Admin](#)
State of Connecticut [Disclaimer](#), [Privacy Policy](#), and [Web Site Accessibility Policy](#). Copyright © 2002-2014 State of Connecticut.



Dave Prickett

From: Esguerra, Carlos <Carlos.Esguerra@ct.gov>
Sent: Wednesday, August 27, 2014 8:10 AM
To: Dave Prickett; 'Kurt A. Mailman'
Cc: 'Jim Zanavich'; 'Kurt J Zemba RMB (kjrmb@msn.com)'; 'FRANK NOE (fnoe@freedomchoice.com)'; 'breemsnyder@oldlyme-ct.gov'; 'Paul J Rowean'; 'Douglas Whalen'; 'Scott Boulanger'; 'Gary@dditech.com'
Subject: CEPA comments
Attachments: David Potts.pdf; DPH.pdf; Old Lyme Coastal Wastewater Management Plan; FW: Projects Being Reviewed; OPM.pdf

Good morning everyone,

Attached are three comment letters and two internal DEEP emails that were received as a result of the initial CEPA scoping notice. Responses addressing these comments need to be incorporated in the planning report and final CEPA document.

Dave, I will coordinate with you and Kurt Mailman on the responses and updates to the report.

Thank you,

Carlos
CTDEEP
Municipal Facilities Section
860-424-3756
carlos.esguerra@ct.gov

From: Esguerra, Carlos
Sent: Tuesday, August 19, 2014 1:40 PM
To: 'Dave Prickett'; 'Kurt A. Mailman'
Cc: 'Jim Zanavich'; 'Kurt J Zemba RMB (kjrmb@msn.com)'; 'FRANK NOE (fnoe@freedomchoice.com)'; 'breemsnyder@oldlyme-ct.gov'; 'Paul J Rowean'; 'Douglas Whalen'; 'Scott Boulanger'; 'Gary@dditech.com'
Subject: David Potts comment letter

Good afternoon, Dave and Kurt,

The attached comment letter was received from Mr. David Potts on the proposed sewer extension project. I am forwarding this letter to you so that his comments can be documented and addressed in Town's report and associated CEPA documentation. Since DEEP is utilizing the town's scoping notice process to suffice MBA's CEPA requirements, Mr. Potts' comments will also pertain to the MBA study. Please review attached letter and I will be in touch regarding a coordinated response.

Thank you,

Carlos
CTDEEP
860-424-3756

Dave Prickett

From: Thomas, Eric <Eric.Thomas@ct.gov>
Sent: Wednesday, August 20, 2014 7:51 AM
To: Esguerra, Carlos
Subject: Old Lyme Coastal Wastewater Management Plan

Hi Carlos,

Upon reviewing the maps posted on the CEQ Environmental Monitor website, is that a new pump station proposed for the Niantic pump station location?

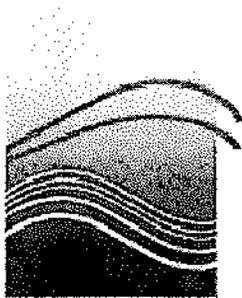
I am reviewing for the addition of a potential source of nutrients and pathogens in close proximity to the Niantic River, which is chronically assessed as impaired for Aquatic Life and for Recreation use. I would like to see what measures are to be included in the planning and post-construction O&M phases to monitor, detect and correct leaks through this pump station and transmission line crossing the Niantic River. Who would be responsible for the Niantic portion of this regional system?

I have a Niantic River Watershed Committee board meeting coming up and plan to share this information with the local committee (and town staff/commission representatives).

<http://www.ct.gov/ceq/lib/ceq/RegionalSewer.pdf>

Eric

Eric D. Thomas
Watershed Manager
Watershed and Nonpoint Source Management Program
Planning and Standards Division
Water Protection and Land Reuse
Connecticut Department of Energy and Environmental Protection
79 Elm Street, Hartford, CT 06106-5127
P: 860.424.3548 | F: 860.424.4055 | E: Eric.Thomas@ct.gov



Connecticut Department of

ENERGY &
ENVIRONMENTAL
PROTECTION

www.ct.gov/deep

*Conserving, improving and protecting our natural resources and environment;
Ensuring a clean, affordable, reliable, and sustainable energy supply.*

Dave Prickett

From: Esguerra, Carlos <Carlos.Esguerra@ct.gov>
Sent: Wednesday, August 20, 2014 10:51 AM
To: Greci, Dennis
Subject: FW: Projects Being Reviewed

Importance: Low

fyi

From: Balint, Marcy
Sent: Wednesday, August 20, 2014 10:11 AM
To: Fox, David
Cc: Esguerra, Carlos
Subject: RE: Projects Being Reviewed
Importance: Low

Hi, Dave,

Some general OLISP comments on OL project. Carlos E has been doing a great job keeping me up to date on OL Sewer project over time. I was not able to access the link and am now leaving on a long vacation so won't be able to respond by this Friday. (I return Sept 15th). OLISP is supportive of this project as a means to treat long-standing water quality issues consistent with our CCMA policies to reduce adverse impacts to WQ.

In terms of sewers and the CCMA notes " To disapprove extension of sewer and water services into developed and undeveloped beaches, barrier beaches and tidal wetlands except that, when necessary to abate existing sources of pollution, sewers that will accommodate existing uses with limited excess capacity may be used" (CGS Sec. 22a-92(b)(1)(B)).

Consistent with the above, Carlos and I have spoken about carefully implementing a growth management policy whereby lots that were not formerly approvable for septic would continue to not be eligible for sewer tie in, (or similar). Carlos understands this more and Dennis G first alerted to me this tool they have. Implementing this policy will be very important in this process. Perhaps Carlos can give you more information on this as required for your comprehensive review. In other words, CCMA is not looking to increase overall and sudden building in Coastal resource sensitive areas which are often flood prone as well. This seems especially important now in age of increased climate change threats and increased storm events. See www.ctclimatechange.com for more information regarding this.

.As an aside, we understand the town's concerns(over many years) regarding the need for growth management. One observation is that given the generally small lots in these beach areas, and existing zoning requirements, the town may wish to tighten their zoning to disallow significant housing expansions, which would help significantly to address their issues. I am not aware of them getting this zoning help but perhaps they are already thinking of this by now. I am available to brainstorm with the town or others as need be.

Hope this is useful.
Marcy Balint

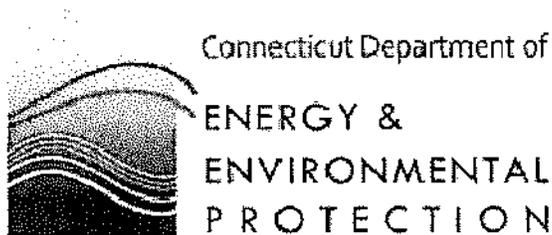
From: Fox, David
Sent: Wednesday, August 20, 2014 9:35 AM
To: Aarrestad, Peter; Appiefield, Dean; Babbidge, Tracy; Balint, Marcy; Barrett, Kevin; Bell, Robert E. (DEEP); Blais, Melissa; Blatt, David; Bolton, Yvonne; Bowe, Patrick; Brothers, Elizabeth; Caiola, Jeff; Chase, Cheryl; Christian, Art; Cimochoowski, John; Colon, Carmen; Creighton, James; Czapl, Kim; Czczotka, Jan; Dawley, Scott; DeCaprio, Mark; Decker, Melinda; DeRosa, Pat; Deshais, Janice; Dickson, Jenny; Duva, Diane; Emmerthal, Douglas; Farrell, Paul;

Firsick, Michael; Fitting, Corinne; Francis, Peter; Frigon, Gabrielle; Gaucher, John; Gephart, Steve; Giannotti, Laurie; Gilbert, Jacques; Gilmore, Robert; Girard, Robert; Gobin, Anne; Golembiewski, Brian; Gordon, Dahlia; Greci, Dennis; Hannon, Robert; Hart, Michael; Hudak, Kim; Hust, Robert; Hyatt, William; Inglese, Oswald; Isner, Robert; Jacobson, Rick; Johnson, Mark; Kaliszewski, Bob; Kallenberg, Kristal; Klee, Robert; Kozak, David; Lacas, Christine; LaFrance, Robert; Latham, Mark; Lee, Charles; Levere, Alan; Lugli, Nicole; Malik, Christopher; Mariani, Eleanor; Martin, Christopher; Mauger, Art; McCleary, Macky; McKay, Dawn; Monroe, Albert; Morgillo, Mary; Murphy, Brian; Murray, Nancy; Mysling, Donald; Whalen, Susan; Nosal, Thomas; Patel, Nisha; Pestana, Edith; Peterson, Susan; Pierce, Ellen; Pirolli, Ric; Ploch, Peter; Ringquist, David; RisCassi, Thomas; Robinson, Bradford; Robinson, Robert; Rose, Gary; Ruzicka, Denise; Saliby, Lori; Sarabia, Edward; Schain, Dennis; Schiavone, Joseph; Schnoor, Terri; Sherwin, Mary; Simpson, David; Stevens, Graham; Stratton, Jessie; Szymanski, Carol; Talbot, Tammy; Thomas, Eric; Thompson, Brian; Trella, Kim; Tyler, Tom; Warzecha, William; Williams, Neal; Wingfield, Betsey; Winther, Darcy; Zack, Peter

Subject: Projects Being Reviewed

See attached

David J. Fox
Senior Environmental Analyst
Office of Environmental Review
Connecticut Department of Energy and Environmental Protection
79 Elm Street, Hartford, CT 06106-5127
P: 860.424.4111 | E: david.fox@ct.gov



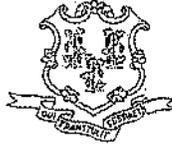
www.ct.gov/deep

*Conserving, improving and protecting our natural resources and environment;
Ensuring a clean, affordable, reliable, and sustainable energy supply.*

STATE OF CONNECTICUT

DEPARTMENT OF PUBLIC HEALTH

Jewel Mullen, M.D., M.P.H., M.P.A.
Commissioner



Dannel P. Malloy
Governor
Nancy Wyman
Lt. Governor

August 22, 2014

Carlos Esguerra
Bureau of Water Protection & Land Reuse
Department of Energy & Environmental Protection
79 Elm Street
Hartford, CT 06106-5127

Re: Old Lyme Coastal Wastewater Management Plan

Dear Mr. Esguerra:

The Department of Public Health (DPH) has reviewed the Notice of Scoping for the Old Lyme Coastal Waste Water Management Plan. The Town of Old Lyme is collaborating with three chartered beach associations (Miami Beach, Old Colony Beach and Old Lyme Shores) to implement a comprehensive, long term solution that addresses identified wastewater management concerns within the boundaries of the described shoreline area. The proposed solution would incorporate the installation of sanitary sewers within the following beach communities: White Sand Beach Association, Hawks Nest, Miami Beach Association, Sound View, Old Colony Beach Association and Old Lyme Shores Beach Association. It would also incorporate the installation of pump station(s) and transmission line to collect wastewater from the mentioned communities and transport it eastward along Route 156 to the town of East Lyme where it would be discharged into existing regional conveyance infrastructure for final treatment at the Piacenti Wastewater Treatment Facility in the City of New London.

It is not clear from the proposed solution whether the provision of sewers to the existing development is also intended to allow for induced growth of the residential and commercial uses within the project area. The majority of the buildings in the six beach communities that will benefit from public sewers are primarily seasonal cottages on small lots that cannot support code complying septic systems. Since the 1970s 19-13-B100 & B100a of the Regulations of CT State Agencies has prevented the cottages from being converted to year round. The regulations governing intensification of use activities in areas relying on septic systems ensures development does not expand beyond the capacity of the land to renovate and dispose of wastewater. The regulations often have significant impact in shoreline and lake area developments where there is significant development pressure; the regulations often serve as growth management.

The Old Lyme beach communities are located in environmentally sensitive areas that also face resiliency challenges associated with climate change. Recent revisions to the clean water state revolving fund statutes cite climate change in project funding considerations. It is recommended that induced growth controls be considered for state financing of this project so that it is clear that sewers are being introduced to provide a long term means of wastewater disposal for the beach communities, rather than a subsidization of a project for the benefit of property owners seeking to expand the use of their properties that are located in this sensitive shoreline area. The State of CT's Conservation and Development Plan includes policies about sewerage of areas to address health and safety concerns, and it notes such projects should be done at a scale that responds to existing needs to prevent more



Phone: (860) 509-7333 • Fax: (860) 509-7359 • VP: (860) 899-1611
410 Capitol Avenue, MS#51 WAT, P.O. Box 340308
Hartford, Connecticut 06134-0308
www.ct.gov/dph

Affirmative Action/Equal Opportunity Employer

extensive development. The Environmental Health Section is available to further discuss induced control measures, and sewer need assessments.

As the public sewer project moves ahead, all existing sewage disposal systems (septic systems, cesspools, holding tanks) must be located prior to commencement of construction. The Old Lyme Health Department maintains sewage disposal system records, including as-built record drawings that locate sewage systems relative to fixed reference points. Sewage system areas should be identified in the field, and care must be taken to ensure the systems aren't damaged by construction equipment/work since the systems will need to remain functional until the sewer system is operational.

Existing sewage disposal systems must also be formally abandoned once public sewers are operational. Sewage system abandonment must be completed in accordance with the provisions of Section II D of the Department's *Technical Standards for Subsurface Sewage Disposal Systems*. Abandonment of the sewage disposal systems must be approved by the Old Lyme Health Department, and abandonment records must be kept on file in accordance with the record keeping provisions of the Public Health Code.

Pursuant to Section 19-13-B51d of the Regulations of Connecticut State Agencies, the location of all wells in the area where sewers are to be installed need to be located to meet adequate separation distances between the wells and the lateral sewer connections to houses and sewer pipes/manholes in the roads. The Department is aware that many of the houses in the area to be served by sewers are supplied by the Connecticut Water Company; however there may be houses that retained their private wells for irrigation use. In situations when the minimal separation distance between future connections to sewer piping and any existing irrigation wells cannot be met, the well should be abandoned in accordance with the well abandonment procedures outlined in the Connecticut Well Drilling Code. Under the authority of Section 19a-36(d)(2), the Local Director of Health has authority to require abandonment of an irrigation well when there is an unacceptable risk of injury to the health or safety of persons using the water, to the general public, or to any public water supply. The Department recommends the existing construction of the well and the separation distance to existing and future sources of pollution be evaluated in the determination if irrigation well poses an unacceptable risk of injury to the health and safety of anybody using the water or to the public.

The proposed project area includes areas that are served by the following public water systems:

| Public Water System | PWSID Number | Administrative Contact | Phone Number |
|--|--------------|------------------------|--------------|
| Miami Beach Water Company | CT1051021 | Michael Girard | 860-434-7562 |
| Connecticut Water Company, Shoreline Region Sound View Water | CT1050732 | Robert F. Ross | 860-664-6120 |
| Connecticut Water Company, Shoreline Region, Point O Woods | CT1050752 | Robert F. Ross | 860-664-6120 |
| Old Lyme Pizza Palace | CT1050264 | Theodore Anastasiou | 860-434-1517 |
| South Shore Landing | CT1050344 | Kelly Angelini | 860-434-0222 |
| Camp Niantic by the Atlantic | CT0450024 | Carol Rice | 860-739-9308 |

There are numerous bedrock wells that supply water for the customers of these systems that are located within and near the area proposed to be sewerred and along the conveyance route. In order minimize the potential impacts to the purity and adequacy of these public drinking water supply wells, the Town of Old Lyme must locate the active and inactive public water supply wells for these systems and ensure that the sewer collection and conveyance system design is consistent with the applicable requirements of the Regulations of Connecticut State Agencies Section 19-13-B51d for the separating distances from systems for the disposal of sewage.

Mr. Esguerra
August 22, 2014
Page 3

The Notice of Scoping indicates that the area proposed to be sewerred will generate an average of 300,000 gallons of waste water per day. The basis for determining the average daily discharge should be clarified. The majority of the area proposed to be sewerred is also served by public water with water production and use data available. A review of DPH records indicates that this estimate is more consistent with maximum day demands that are currently experienced within the areas served by public water.

Installation of this sewage collection and conveyance system in the vicinity of the public water supply wells must adhere to the recommendations offered in the "General Construction Best Management Practices for Sites within a Public Drinking Water Supply Source Area" attached to this letter.

If you have any questions regarding these comments, please contact Bob Scully or Ryan Tetreault of the Environmental Health Section at 860-509-7296 or Eric McPhee of the Drinking Water Section at 860-509-7333.

Sincerely,



Ellen Blaschinski, RS, MBA
Public Health Branch Chief
Regulatory Services Branch

EB/sm
attachment

- c: Suzanne Blancaflor, MS, MPH ,Environmental Health Section
- Lori Mathieu, DPH Drinking Water Section
- Sonia Marino, Old Lyme Health Department
- Michael Girard, Miami Beach Water Company
- Robert F. Ross, Connecticut Water Company
- Theodore Anastasiou, Old Lyme Pizza Palace
- Kelly Angelini, South Shore Landing
- Carol Rice, Camp Niantic by the Atlantic
- David Radka, Connecticut Water Company



General Construction Best Management Practices for Sites within a Public Drinking Water Supply Area

DRINKING WATER SECTION • JULY 2014

Emergency Response Plan

A response plan should be written for actions to be taken for the containment of accidental fuel or chemical spills or the failure of temporary erosion and sedimentation controls that may occur during construction. Spill response equipment should be available on-site at all times along with personnel trained in the proper use of such equipment. A person or persons should be designated by the contractor for emergency response coordination on a 24/7 basis.

Vehicles and Machinery

Designate one area for auto parking, vehicle refueling and routine equipment maintenance. The designated area should be well away from exposed surfaces or storm drains. Methods and locations of refueling, servicing, and storage of vehicles and machinery should be addressed and included as notes on the final site plans. Minor servicing and refueling of machinery should be completed on a fueling pad with containment. All major equipment repairs must be made off site. Onsite fuel storage should be discouraged.

General Site Conditions

Keep pollutants off exposed surfaces. The burying of stumps or construction debris must not be allowed on the job site. Sediment fences and hay bales must be strategically placed, inspected and maintained to prevent sedimentation and erosion. Temporary storm water ponds and basins must be routinely inspected and maintained. If unexpected conditions occur, additional fences and hay bales should be available for use as needed to prevent runoff. Protect exposed stockpiles of soil to prevent runoff. Use as little water as possible for dust control. Clean up leaks, drips and other spills immediately to prevent or minimize soil contamination. Never hose down "dirty" pavement or surfaces where materials have spilled. Use dry cleanup methods whenever possible.

Hazardous Materials Storage

Paints, paint products and other hazardous materials should be removed from the site during non-work hours or otherwise stored in a secure area to prevent vandalism. Place covered trashcans and recycling receptacles around the site. Cover and maintain dumpsters, check frequently for leaks, and never clean a dumpster by hosing it down on site.

Sanitation

Make sure portable toilets are in good working order. Check frequently for leaks.

Notification

Notification of the project start date should be sent to the Public Water System as soon as it has been determined. Public Water System personnel should be granted daily site access to review compliance with site best management practices. The Public Water System, DPH Drinking Water Section (860-509-7333 OR after hours at 860-509-8000), and appropriate sections of the Department of Energy and Environmental Protection must be notified immediately of any chemical/fuel spill or any major failure of an erosion and sedimentation control at the construction site. Emergency telephone numbers and a statement identifying the construction site as a sensitive public water supply area should be posted where they are readily visible to contractors and other on-site personnel. A note should be added to the construction documents stating the sensitivity of the area.

DAVID A. POTTS
385 Roast Meat Hill Road
Killingworth, CT 06419

DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION
PLANNING & STATISTICS DIVISION
AUG 11 2014

August 8, 2014

Mr. Carlos Esguerra
Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse
79 Elm Street
Hartford, Connecticut 06106-5127

Re: Scoping Notice - Old Lyme Coastal Wastewater Management Plan

Dear Mr. Esguerra:

I have reviewed the above-referenced Department of Energy and Environmental Protection's ("DEEP") Scoping Notice for the Old Lyme Coastal Wastewater Management Plan. As stated in the Scoping Notice, the Town of Old Lyme and the Old Lyme Shores, Old Colony Beach and Miami Beach Associations have conducted independent engineering studies that conclude that on-site wastewater treatment systems are not a feasible solution for long-term wastewater renovation. We have reviewed these reports and have several concerns regarding the conclusions and the proposed solution of a centralized sanitary sewerage system, ultimately discharging to the wastewater treatment facility in New London.

By way of background, I am an environmental scientist and I have spent my professional career working in the field of soil and groundwater remediation and wastewater treatment. I am an avid outdoorsman and truly appreciate the need for, and the value of, clean water. I have lived on and around Long Island Sound for many years. As a result of my environmental expertise and involvement in the wastewater industry, I have been contacted by many people: environmentalists, local residents and even environmental regulators, who are concerned that the Old Lyme Coastal Wastewater Management Plan (the "Project") will set a dangerous precedent for Connecticut's shoreline and lake front communities. Based on the concerns that my friends and colleagues have raised, I am compelled to provide you with the following comments for your consideration.

First, with regard to public policy, the Project should be evaluated for consistency under the new State Plan of Conservation and Development (the "Plan") and the associated statutes. It is my understanding, and I have heard it often repeated, that the Plan does not allow an agency to provide funding for a growth related project unless the project is in a priority funding area. At a minimum there should be an explanation of how the use of Clean Water Funds for this Project is or is not "funding for a growth related project" and whether and how it can be

funded. If it can be funded in accordance with the Plan, then an explanation is due for how the funding of the Project is consistent with the following statements from the Plan:

- Cluster development techniques, when combined with properly installed and maintained decentralized water, wastewater and/or stormwater systems can accommodate growth without the need for publicly subsidized expansions of infrastructure.
- Rely upon the capacity of the land, to the extent possible, to provide drinking water and wastewater disposal needs beyond the limits of the existing service area. Support the introduction or expansion of public water and or sewer services or advanced wastewater treatment systems only when there is a demonstrated environmental, public health, public safety, economic, social or general welfare concern, and then introduce such services only at a scale which responds to the existing need without serving as an attraction to more extensive development.
- Minimize the siting of new infrastructure and development in coastal areas prone to erosion and inundation from sea level rise or storms, encourage the preservation of undeveloped areas into which coastal wetlands can migrate and undertake any development activities within coastal areas in an environmentally sensitive manner consistent with statutory goals and policies set forth in the Connecticut Coastal Management Act.

It would also be beneficial to the public to offer a detailed justification of the scoring of the Project for the Clean Water fund Priority List:

- 15 points -the Project is necessary for attainment of water quality standards where the impacted resource is a coastal area.
- 3 points - the Project will lower coliform bacteria levels in the waters of shellfish beds.
- 3 points -- the project will enhance existing swimming opportunities.
- 2 points -- the population served by the Project is less than 5,000.
- 6 points -- the Project will eliminate ponding of sewage from failing septic systems, backup of sewage into basements, or overflow of sewage in streets.

Second, with regard to science, I have previously reviewed the above-referenced engineering reports and based on the testing data included in those, it has never been clear to me that the results demonstrated that the wastewater from the beach communities is actually causing a pollution problem. Specifically, there is no conclusive proof that nitrogen from these neighborhoods is polluting Long Island Sound. In fact, the test data show that nitrogen levels in

groundwater are not significantly elevated. This may be the result of natural attenuation processes, dilution, and denitrification from organics in soils or a combination of these factors. Without a clearly understood or defined problem, it is premature to design a solution.

I believe that the reports overlook the latest science regarding the natural attenuation process for nitrogen and other pollutants from on-site systems. In particular, recent studies have shown that with conditions similar to those present in these communities, anaerobic ammonium oxidation can result in up to an 80 % reduction in nitrogen levels. These and other natural abilities of the site conditions to effectively renovate nitrogen are not described in any scientific detail in the engineering reports. The fact that the nitrogen levels in groundwater are not elevated is likely the result of these factors. It is not prudent to conclude that the existing balance of conditions that results in low nitrogen concentrations will be further improved by constructing sewers in these areas. Until the balanced site conditions are more clearly understood, any change could negatively upset this balance.

Further, the engineering studies have not adequately demonstrated that the proposed solution will actually reduce nutrient loading to Long Island Sound. Under the current conditions, the properties in the project area are largely occupied by seasonal homes. These properties cannot be expanded or converted to year-round use, unless the property owner can demonstrate that an on-site system could be constructed to meet the requirements of Section 19-13-B100a of the Department of Public Health regulations. Given that many of these properties cannot meet these standards, the communities maintain a mostly seasonal status, which significantly limits the annual nutrient loading. When the restrictions of the health code are removed through the construction of sanitary sewers, properties can more easily be expanded or converted to year-round use. This intensification can lead to unexpected secondary consequences effecting water quality. Increased impervious surfaces, increased use of fertilizers and winter road treatments contribute to increased surface water runoff that flows directly to receiving waters, without the benefit of treatment.

The unfortunate example of this condition is Lake Pocotopaug in East Hampton, Connecticut. Sewers were constructed in this seasonal lakeside community to solve a "community pollution problem." The sewers promoted a phase of rapid development and conversions to year-round use. Despite the replacement of the septic systems with sewers, the lake has had repeated problems with algal plumes and a sizeable fish kill. Studies of these problems strongly suggest that the cause is the increased nutrient loads in storm water from the developed shorelines of the lake. Certainly, with such a stark example, any studies should account for the substitution of nutrient loads from on-site wastewater systems with untreated flows of contaminated storm water.

Finally, the Clean Water Act requires that any waste treatment and management project undertaken with Federal or State financial assistance must be the waste treatment and management system that constitutes the most economical and cost effective project. While the engineering reports have purportedly analyzed the available alternatives and identified the most cost-effective solution, it is quite possible that the most cost-effective solution, natural

attenuation, already exists and any disruption of the existing conditions could lead to more pollution, not less. The sampling data contained in the above-referenced reports serve as a benchmark. If sewers were to be constructed and concentrations at the sampling locations increase, then it will be clear that DEEP's solution has caused the additional pollution.

As a final point, it is no surprise that the engineering reports identify sewers as the most cost-effective solution. I am not aware of any sanitary survey that has reached a different conclusion that has been initially accepted by the DEEP. The only exception that I am aware of is the Old Saybrook Decentralized project, but as you know, that has a history of its own.

Thank you for your consideration of these comments. If you have any questions, comments or suggestions, please feel free to contact me.

Sincerely,



David Potts
Environmental Scientist

Cc: Ms. Margaret Miner, Rivers Alliance of Connecticut
Ms. Sally Harold, The Nature Conservancy
Roger Reynolds, Esq., Connecticut Fund for the Environment/Save the Sound
Other Interested Parties



STATE OF CONNECTICUT

OFFICE OF POLICY AND MANAGEMENT
INTERGOVERNMENTAL POLICY DIVISION

August 22, 2014

Carlos Esguerra
Department of Energy & Environmental Protection
Bureau of Water Protection & Land Reuse
79 Elm Street
Hartford, CT 06106-5127

Re: Notice of Scoping:
Old Lyme Coastal Wastewater Management Plan

Dear Carlos:

The Office of Policy and Management (OPM) has reviewed the Notice of Scoping for the Old Lyme Coastal Wastewater Management Plan and submits the following comments:

- Old Lyme's 12/20/2013 Draft Coastal Wastewater Management Plan had recommended an approach other than that shown in the Notice of Scoping and described various environmental and financial advantages to that approach. There appeared to be strong local support for that approach, but minutes of the Old Lyme WPCA's 5/13/2014 meeting, available at http://www.oldlyme-ct.gov/Pages/OldLymeCT_WPCAMin/10482FFC7, mention feedback from DEEP that led to the town changing its approach. Please describe the rationale for the change in approach since December and what opportunity there was for public review and comment regarding that rationale and the resulting change. The circumstances would appear to call for a greater than usual level of detail in explaining the comparison of these alternatives and the ultimate decision.
- The project description and mapping provided in the Notice of Scoping do not show whether there is an expectation for expansion of sewer service outside of the highlighted neighborhoods. DEEP should clarify whether or not there are plans for any expansion of sewer service outside those areas and, if there might be such an expansion, DEEP's determination of the proposed action's consistency with the State Plan of Conservation & Development should also consider the consistency of such expansion.
- The WPCA's 7/8/2014 WPCA minutes, available at http://www.oldlyme-ct.gov/Pages/OldLymeCT_WPCAMin/104986C92, includes the following:

New Business

Sanitarian's Report

She has been in contact with the State's Drinking Water section and private wells department, as well as Ct Water Company, and will be scheduling a meeting so that the Town's water needs can be coordinated on a townwide basis. It is important to consider drinking water now in conjunction with the Wastewater project so cost efficiencies can be realized.

Any change in water service area beyond the sewer service area that is induced or stimulated by the proposed wastewater project must be considered as an indirect effect of the proposed action.

- Some dwellings in the area proposed to be served by sanitary sewers were heavily damaged by the state's recent tropical storms. Recognizing such threats, the 2011 CT Climate Change Preparedness Plan recommends the following best management practice:

Develop decision tools to evaluate replacement, modification, and design life for infrastructure

Decision support tools are needed for analysis of alternatives, trade-offs, costs and benefits of adaptation approaches. Technical support will be needed to develop decision tools that provide for consideration of economic, societal and environmental effects of climate change impacts and potential adaptation approaches. The decision tools should be created for engineers and planners to determine if replacement or modification of infrastructure is warranted and to guide selection of the most appropriate alternatives. The decision tools also will include information to determine the appropriate design life for future infrastructure components. For existing infrastructure, the vulnerability database should be used, in conjunction with these decision tools to assign priorities for action that could include re-engineering, relocation, and/or removal, based on social, economic and environmental considerations of the infrastructure value and cost/benefits of various actions.

What if anything has DEEP done to incorporate such an evaluation into its technical and financial review of the wastewater management plan, given the considerable cost and design life of the expected wastewater system?

Thank you for the opportunity to respond to this Notice of Scoping and please feel free to contact me if you have any questions.

Sincerely:



Bruce Wittchen
Office of Policy & Management
450 Capitol Ave, MS# 54ORG
Hartford, CT 06106
(860) 418-6323
bruce.wittchen@ct.gov