Draft Report to the Town of Ridgefield, Connecticut on the Phase 2 Wastewater Facilities Plan

February 2017

AECOM

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February 16, 2017

Water Pollution Control Authority
66 Prospect Street
Ridgefield, CT 06877
Attention: Ms. Amy Siebert, P.E., Chairperson

Subject: Phase 2 Wastewater Facilities Plan
Draft Report

Dear Authority Members:

In accordance with our Agreement, we are pleased to submit this draft Phase 2 Wastewater Facilities Plan for your review. This report addresses the following elements:

- Identify the current conditions of the Route 7 WWTF and South Street WWTF equipment, systems, and facilities.
- Project the design flows and loads to the Route 7 WWTF and South Street WWTF including:
  - Develop a plan for inflow reduction at the South Street WWTF
  - Project the design flows and loads if the Route 7 WWTF was decommissioned and the flows and loads from Sewer District No. 2 were combined with the flows and loads from Sewer District No. 1 and treated at the South Street WWTF.
- Identify effluent permit limits. This includes permit limits at each WWTF as well as the permit limits for treating the combined flows and loads from Sewer District No. 1 and Sewer District No. 2 at the South Street WWTF.
- Evaluate alternatives for various systems at both WWTFs to address the needs of the each WWTF for the 20 year planning period including estimated capital and life cycle costs.
- Recommend system and equipment upgrades at each WWTF for the 20 year planning period.
- Provide estimated costs for the recommended upgrades for each WWTF.
- Evaluate decommissioning of the Route 7 WWTF, conveyance of the Sewer District 2 flows and treating the combined Sewer District No. 1 and Sewer District No. 2 flow and loads at the South Street WWTF. Compare the Route 7 WWTF decommissioning alternative versus the alternative of upgrading and continuing the use of the Route 7 WWTF, including estimated capital and life cycle costs.
- Provide estimated costs for the recommended upgrades for Ridgefield’s Wastewater Treatment Facilities.

We would be pleased to discuss the report and any comments you may have. If you have any questions concerning this report, please feel free to call me at (978)-905-3158.

Very truly yours,

Jon R. Pearson
Vice President
AECOM, Inc.

JRP/jrp

Encl.

CC: Charles Fischer, Town Engineer
Michael Burke, SUEZ
Jeff Pennell, SUEZ

DRAFT REPORT TO THE TOWN OF RIDGEFIELD, CONNECTICUT
ON THE PHASE 2 WASTEWATER FACILITIES PLAN

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ACKNOWLEDGMENTS

We would like to acknowledge the invaluable assistance and cooperation of the staff of the Town of Ridgefield, Ridgefield Water Pollution Control Authority, and SUEZ. In particular, we extend our thanks to Ms. Dianna Van Ness, WPCA Administrator, Mr. Charles Fisher, Town Engineer; Mr. Jacob Muller, Assistant Town Engineer, Mr. Jorge Pereira, Retired WWTF Plant/Project Manager, and Mr. Jeff Pennell, WWTF Plant/Project Manager.

This Facilities Plan was prepared by Mr. Matthew Formica, Technical Manager, and Mr. Jon Pearson Project Manager and Vice President, under the direction of Mr. Donald Chelton, Vice President.

CHAPTER ONE
EXECUTIVE SUMMARY

INTRODUCTION

The Town of Ridgefield owns and operates two wastewater treatment facilities: the South Street Wastewater Treatment Facility (WWTF) which serves Sewer District No. 1 and the Route 7 WWTF which serves Sewer District No. 2. The Town has undertaken the preparation of this Phase 2 Facilities Plan as one step in planning for the upgrade of the existing WWWTF facilities to meet the future wastewater treatment needs.

The primary purpose of this Phase 2 Facilities Plan Report is to address the following:

- Identify the current conditions of the Route 7 WWTF and South Street WWTF equipment, systems, and facilities.
- Identify the design flows and loads to the Route 7 WWTF and South Street WWTF including:
    - Develop a plan for inflow reduction at the South Street WWTF
    - Identify the design flows and loads if the Route 7 WWTF was decommissioned and the flows and loads from Sewer District No. 2 were combined with the flows and loads from Sewer District No. 1 and treated at the South Street WWTF.
- Identify effluent permit limits. This includes permit limits at each WWTF as well as the permit limits for treating the combined flows and loads from Sewer District No. 1 and Sewer District No. 2 at the South Street WWTF.
- Evaluate alternatives for various systems at both WWTFs to address the needs of the each WWTF for the 20 year planning period including capital and life cycle costs.
- Recommend system and equipment upgrades at each WWTF for the 20 year planning period.
- Provide estimated costs for the recommended upgrades for each WWTF.
- Evaluate decommissioning of the Route 7 WWTF, conveyance of the Sewer District 2 flows and treating the combined Sewer District No. 1 and Sewer District No. 2 flow and loads at the South Street WWTF. Compare the Route 7 WWTF decommissioning alternative versus the alternative of upgrading and continuing the use of the Route 7 WWTF, including capital and life cycle costs.
- Provide estimated costs for the recommended upgrades for Ridgefield's Wastewater Treatment Facilities.

These items are described in more detail below and are presented in the subsequent report sections.

Report Format

The Phase 2 Facilities Plan Report is presented in eleven report chapters and eight appendices. The appendices include Technical Memorandums summarizing the field investigations conducted in the Sewer District No. 1 collection system to identify sources of system inflow, a Draft Inflow Control Plan to reduce Sewer District No. 1 inflow, permit related materials for both WWTFs, as well as a Technical Memorandum summarizing site condition assessment of both WWTFs.

CHAPTER ONE – EXECUTIVE SUMMARY

This chapter provides an overview of the Phase 2 Facilities Plan Report and its contents.

CHAPTER TWO – INTRODUCTION, PURPOSE AND SCOPE, AND BACKGROUND

This chapter presents background information and scope information related to the Phase 2 Facilities Plan study.

In addition this chapter presents a brief history of the Sewer Districts and WWTFs including history of the following:

- Sewer District No.1 Collection System (and its high flow Issues)
- South Street WWTF
- Sewer District No.2 Collection System
- Route 7 WWTF

CHAPTER THREE – SUMMARY OF PHASE 1 FACILITIES PLAN AND PEAK FLOW MANAGEMENT

This chapter presents a summary of the Phase 1 Facilities Plan results, a discussion on the peak flow management of Sewer District No. 1 originally performed in the Phase 1 Facilities Plan and updated in the Phase 2 Facilities Plan. These items are briefly discussed below.

Summary of Phase 1 Facilities Plan

Chapter Three summarizes the evaluations that were performed in the Phase 1 Facilities Plan. These items include the following:

- The influent flows and pollutant concentrations from July 2010 and June 2013 for both the Route 7 WWTF and the South Street WWTF were reviewed to determine the current flow and loading conditions to the WWTFs.

- The influent data from July 2010 to June 2013 for both the Route 7 WWTF and the South Street WWTF were compared to the original WWTF influent design flows and loads.

- The effluent data from July 2010 to June 2013 for both the Route 7 WWTF and the South Street WWTF were compared to the WWTF permit limits.

- The hydraulic and pollutant removal capacities of the WWTFs were evaluated under current conditions, design conditions, and increased flow and loading conditions to determine which unit processes are limiting each WWTF's overall capacity. After these capacity limitations were established, potential modifications to relieve these limitations were identified with consideration of the current and future permit limits at the WWTFs.

- Year 2035 average and peak flow conditions at each WWTF were projected. In addition the year 2035 average loading conditions at each WWTF were projected.

- Finally, the combined Year 2035 average flow and loading conditions of both Sewer District No.1 and Sewer District No. 2 being conveyed and treated at the South Street WWTF were projected.

Peak Flow Management

Chapter Three summarizes the existing peak flow conditions, describes recent and ongoing activities to manage the peak flows, and reviews alternatives for future peak flow management. These items are briefly discussed below.

Existing Conditions. Under normal conditions, the flow from Sewer District No. 1 is conveyed to the South Street WWTF Influent Building through a combination of a gravity sewer and an on-site submersible pump station (Influent Pump Station). During infrequent wet weather events, a portion of the South Street WWTF influent flow has been conveyed to the Influent Building through a trailer mounted pumping system that supplements the Influent Pump Station. The DEEP considers the use of the trailer mounted pumping system a bypass and the Town is required to file a bypass report each time this pumping system is used.

Recent Activities. Recognizing the impacts of the wet weather induced peak flows, the WPCA has initiated several projects to manage the peak flows. Recent efforts are described below.

I/I Investigations and Rehabilitation. In 2005 a cleaning and television inspection program of the collection system was initiated. As part of a five year cycle, approximately 20 percent of the collection system was cleaned and televised per year to locate leakage as well as structural defects in the system. In 2007 and 2008 an I/I analysis of Sewer Districts No.1 and No. 2 was performed incorporating rain gauging and flow monitoring and the review of TV inspection videos and reports of approximately 34,000 linear feet of sanitary sewers. Based on these analyses a February 2008 summary report presented a program to reduce I/I and improve system operation. In 2009, another approximate 4,000 linear feet of internal TV inspection data and 70 manhole inspections logs were analyzed. Based on these analyses a May 2009 summary report recommended a sewer pipeline and manhole rehabilitation project. This sewer rehabilitation work was completed in May 2010 and included the following:

- Chemical root control
- Joint testing and sealing
- Spot repairs
- Cured-in-place lining of mainline sewers
- Testing and sealing the connections of the mainline sewer service connections.

Phase 1 Wastewater Facilities Planning Efforts. Beginning in 2013, smoke testing, manhole inspections, and a collection system bottleneck evaluation were conducted in Sewer District No. 1. The smoke testing program located and documented a total of 78 inflow sources and 784 suspect inflow sources. The manhole inspections identified a total of 54 manholes requiring repair of defects and/or cleaning to remove sediment and debris accumulated on the bench or in the invert of the manhole. Based on this field work the following recommendations were made:

- Cap and redirect 45 direct inflow sources
- Rehabilitate 54 manholes
- Conduct further investigations including:
  - 556 manhole inspections
  - Inspection of 2 wastewater structures
  - Dyed water tracing of 20 indirect inflow sources
  - Dyed water testing of 160 suspect sources
  - House to house inspections of all buildings connected to the Sewer District No. 1 sanitary collection system to locate sump pumps connected to the sewer system.

Phase 2 Wastewater Facilities Planning Efforts. Beginning in 2015 the following field work was conducted:

- Dyed water testing – 160 suspect inflow sources (See Technical Memorandum No. 1 dated October 27, 2016 included as **Appendix A** to this report)
- Dyed water tracing – 20 identified inflow sources (Technical Memorandum No. 1 dated October 27, 2016 included as **Appendix A** to this report)
- CCTV of selected mainline and lateral sewers – approximately 3,000 linear feet (lf) of mainline sewer and 10 laterals (Technical Memorandum No. 2 dated November 17, 2016 included as **Appendix B** to this report)
- Manhole inspections – 470 manholes (approximately 80% of system) (Technical Memorandum No. 3 dated December 21, 2016 included as **Appendix C** to this report)
- House to house inspections – completed approximately 1,000 out of 1,200 attempted (83% of buildings in Sewer District 1) (Technical Memorandum No. 4 dated December 21, 2016 included as **Appendix D** to this report).

The findings and recommendations from these efforts are discussed in the Inflow Control Plan Reduction section below.

Quail Ridge Pump Station Relocation. As part of the Phase 1 Wastewater Facilities Plan an evaluation of the collection system bottlenecks and an updated pump station evaluation was conducted. This evaluation identified a hydraulic restriction in the area of the Quail Ridge Pump Station. In addition the Quail Ridge Pump Station is approximately 31 years old and is in need of replacement. As a result, a project was undertaken in response to replace and ultimately relocate the pump station to address the pump station condition as well as the collection system bottleneck. Two alternatives were evaluated; replacement of the pump station at its current location, or construction of a new pump station in the vicinity of the Goodwill trailer on South Street. Relocation of the pump station was recommended and the Town is moving forward with a project to relocate the Quail Ridge Pump Station.

Future Peak Flow Management. The year 2035 peak flow at the South Street WWTF was projected to be 6.3 MGD which exceeds the capacity of the WWTF. As discussed in Chapter Three, two alternatives were evaluated in order to eliminate or reduce the WWTF upgrade requirements to manage these peak flows. These include the following:

- Collection System Inflow Reduction Efforts
- Peak Flow Equalization at the South Street WWTF

Inflow Control Plan Recommendations. The Draft Inflow Control Plan was developed to assist the Town in prioritizing work to control inflow in Sewer District No. 1. The goal of the Inflow Control Plan is to remove at least 25% of the existing peak inflow, representing 1.0 MGD of inflow. As noted in Chapter Three, the DOT is planning on reconstructing Main Street which is to include drainage, sidewalks, catch basins, new pavement, and traffic flow improvements. This DOT project provides the Town with the opportunity to redirect some inflow sources in the area of construction such as roof downspouts, and other illegal connections from the sanitary sewer into a proper storm drain system. This opportunity has been incorporated into the Inflow Control Plan. In accordance with the Inflow Control Plan the following rehabilitation and follow up investigation efforts are recommended to be prioritized as follows:

Priority 1A. Redirect the 105 sump pumps identified through house to house building inspections and smoke testing (Table 4 of Draft Inflow Control Plan). The cost of removing the private inflow sources should be borne by the owner of the private property, therefore no cost has been estimated for this work.

Priority 1B. Conduct building inspections on Main Street to locate roof drains connected to the sanitary sewer system within the limits of the DOT Main Street Reconstruction project.

Priority 1C. Contact DOT to open a dialogue on integrating redirecting roof drain connections into the DOT Main Street Reconstruction project.

Priority 2. Eliminate the 44 private and five public inflow sources identified in Tables 2, 3, and 6 of the Draft Inflow Control Plan. The cost of removing the private inflow sources should be borne by the owner of the private property. The total estimated cost to remove the three direct public inflow sources (Table 3) and the two indirect public inflow sources (Table 6), including engineering and contingencies, is approximately $2,100, and $22,000 respectively.

Priority 3. Conduct the remaining portion of the 254 follow-up building inspections (Attachment A of Draft Inflow Control Plan), after Priority 1B is completed, to verify that there are no sources of inflow at these locations. It is anticipated that the follow-up building inspections would be conducted by Town staff, therefore no cost has been estimated for this work. Implement sump pump removal actions for any sump pumps found connected to the sewer system.

Priority 4. Locate and inspect the 84 manholes, identified in Attachment B of the Draft Inflow Control Plan, which were not inspected during prior investigations to further identify sources of leakage and to assess the physical condition of manholes in Sewer District No.1. It is anticipated that the Suez would uncover and inspect these manholes over time as part of system maintenance efforts, therefore no cost has been estimated for this work.

Priority 5. Initiate the design and construction of the rehabilitation of 32 manholes as identified in Table 5 of the Draft Inflow Control Plan. The total cost of manhole rehabilitation, including engineering and contingencies is approximately $175,000.

It is recommended that the Town continue the infiltration and inflow reduction efforts in the collection system tributary to the South Street WWTF in accordance with the recommendations from the Phase 1 facilities planning efforts and the Phase 2 facilities planning efforts and the resulting Draft Inflow Control Plan recommendations. The Draft Inflow Control Plan is included in **Appendix E**. If this program is not successful in reducing the I/I induced peak flow at the plant, flow equalization should be considered. The estimated total project cost for the flow equalization tank and ancillary systems is approximately $4,600,000, including engineering and contingencies.

CHAPTER FOUR – WASTEWATER TREATMENT FACILITIES EFFLUENT LIMITS, DESIGN CRITERIA, AND COST ESTIMATE BASIS

Chapter Four presents the existing permit limits for both the Route 7 WWTF and South Street WWTF, and also describes the anticipated future permit limits for both WWTFs as well as the future permit limits should the flows from both Sewer District No.1 and Sewer District No. 2 be conveyed for treatment at the South Street WWTF. In addition, the chapter presents design criteria used in the development and evaluation of the WWTF upgrade alternatives, and summarizes the basis for the estimated costs for WWTF upgrades.

WWTF Effluent Limits

Route 7 WWTF Effluent Limits. The current Route 7 WWTF effluent limits are presented in **Table 1-1**.

TABLE 1-1. CURRENT ROUTE 7 WWTF NPDES EFFLUENT PERMIT LIMITS

Effluent Parameter	Average Daily	Average Monthly	Maximum Daily	Instantaneous
Flow	0.12 MGD	n/a	n/a	n/a
BOD_5	n/a	20 mg/l	40 mg/l	n/a
TSS	n/a	20 mg/l	40 mg/l	n/a
Escherichia coli	n/a	n/a	n/a	410/100ml
Ammonia-Nitrogen				
June	n/a	6.7 mg/l	n/a	n/a
July – September	n/a	2.5 mg/l	n/a	n/a
October	n/a	4.4 mg/l	n/a	n/a
November-May	n/a	n/a	n/a	n/a
pH	n/a	n/a	n/a	6-9
Total Phosphorus Apr 1st to Oct 31st [1]	n/a	1.55 mg/l	3.11 mg/l	n/a

1. Total phosphorus average seasonal load limit of 1.0 lb/day = 1.0 mg/l at 0.12 MGD.

Route 7 WWTF Permit Impacts. The existing WWTF will not be able to meet the total phosphorus permit limits included in the NPDES permit. As a result, an upgrade to the Route 7 WWTF would be required to meet the total phosphorus limits. A description of the recommended upgrades to meet the phosphorus limits is included in Chapter Eight.

South Street WWTF Effluent Limits. The current South Street WWTF effluent limits are presented in **Table 1-2**. In addition, the WWTF must also comply with the target total nitrogen yearly average limit in the DEEP General Permit for Nitrogen Discharges. The 2016 effluent limit for the South Street WWTF was 29 lbs/day. At the annual average design flow of 1.0 MGD for the South Street WWTF this equates to an annual average total nitrogen concentration of 3.5 mg/l.

South Street WWTF Permit Impacts The existing WWTF will not be able to meet the total phosphorus permit limits included in the NPDES permit or the target total nitrogen limit in the General Permit for Nitrogen discharges. To meet the total phosphorus limits the installation of a tertiary phosphorus removal unit process will be required. A number of tertiary unit process alternatives were developed and evaluated to meet the new phosphorus limits. Descriptions and evaluations of these alternatives are included in Chapter Seven and the recommended process is included in Chapter Nine. To meet the total nitrogen target limits, the WWTF can either purchase nitrogen credits from the DEEP Nitrogen Credit Trading Program to comply with the effluent limit or provide upgrades to the WWTF to produce an effluent that meets the limit. A description and the evaluation of a number of process alternatives to reduce the total nitrogen in the WWTF to meet the effluent limit alone or supplemented by purchasing credits is included in Chapter Seven and the recommended treatment process is included in Chapter Nine.

Anticipated South Street WWTF Effluent Limits with Combined Sewer District No. 1 and Sewer District No. 2 Flows. The conveyance and treatment of the flows from both Sewer District 1 and Sewer District 2 at the South Street WWTF would require modifications to the South Street WWTF effluent limits. As part of the preparation of this report, discussions with DEEP representatives were held regarding the anticipated effluent limits. **Table 1-3** presents a summary of the anticipated effluent limits with the conveyance and treatment of flows from Sewer District No. 1 and Sewer District No. 2 at the South Street WWTF provided by the DEEP. In addition the South Street WWTF must also comply with the target total nitrogen yearly average limit based on the DEEP General Permit for Nitrogen Discharges. Based on input from DEEP, the annual average daily total nitrogen effluent limit for the South Street WWTF treating flows from both sewer districts would be 32 lbs/day. At the annual average design flow of 1.12 MGD for the South Street WWTF this equates to an annual average total nitrogen concentration of 3.4 mg/l.

TABLE 1-2. CURRENT SOUTH STREET WWTF NPDES EFFLUENT PERMIT LIMITS

Effluent Parameter	Average Daily	Average Monthly	Maximum Daily	Instantaneous
Flow	1.0 mgd	n/a	n/a	n/a
BOD_5 (Nov 1st to Mar 31st)	n/a	20 mg/l	40 mg/l	n/a
BOD_5 (Apr 1st to Oct 31st)	n/a	10 mg/l	20 mg/l	n/a
TSS (Nov 1st to Mar 31st)	n/a	20 mg/l	40 mg/l	n/a
TSS (Apr 1st to Oct 31st)	n/a	10 mg/l	20 mg/l	n/a
Escherichia coli [1]	n/a	n/a	n/a	410/100ml
Ammonia-Nitrogen				
April	n/a	7.3 mg/l	n/a	n/a
May	n/a	4.9 mg/l	n/a	n/a
June	n/a	2.3 mg/l	n/a	n/a
July – September	n/a	1.6 mg/l	n/a	n/a
October	n/a	2.7 mg/l	n/a	n/a
November-March	n/a	n/a mg/l	n/a	n/a
Dissolved Oxygen Apr 1st to Oct 31st	n/a	n/a	n/a	≥6.0 mg/l min.
pH	n/a	n/a	n/a	6-9
Total Phosphorus				
Nov 1st to Mar 31st	n/a	1.0 mg/l	2.0 mg/l	n/a
Apr 1st to Oct 31st [2]	n/a	0.16 mg/l	0.31 mg/l	n/a
Zinc [3]	n/a	0.25 kg/d	0.33 kg/d	n/a

1. The geometric mean of E. Coli bacteria during a calendar month from May 1st to September 30th shall not exceed 126/100ml.
2. Total phosphorus average seasonal load limit of 0.52 lb/day = 0.62 mg/l at 1.0 mgd.
3. Total zinc maximum day load limit of 0.33 kg/day = 0.087 mg/l at 1.0 mgd and 0.016 mg/l at peak flow of 5.3 mgd (see section below for peak flow projections)

South Street WWTF Permit Impacts The existing South Street WWTF will not be able to meet either the effluent total phosphorus limits or the total nitrogen limits when treating flows from both sewer districts. Descriptions and evaluations of alternatives to meet these limits are included in Chapter Seven and the recommended processes are included in Chapter Nine. In addition, the additional requirements and costs to convey and treat the additional flows and loads to meet the effluent limits for the combined flows from the two sewer districts at the South Street WWTF is included in Chapter Ten. Finally the recommended wastewater system upgrades for both sewer districts are summarized in Chapter Eleven.

Design Criteria

An array of design criteria have been established for use in the development and evaluation of the wastewater management alternatives for this Facilities Plan. These criteria include:

- A 20 year planning horizon (through 2035).
- Flows and loadings projections as established in the Phase 2 Facilities Plan for the Route 7 WWTF, the South Street WWTF treating flows from Sewer District No. 1 only, and the South Street WWTF treating flows from Sewer District No. 1 and Sewer District No. 2 . These flow and loading projections are presented in **Table 1-4**, **Table 1-5** and **Table 1-6**, respectively.
- Effluent quality requirements based on meeting or exceeding the existing and anticipated future effluent limits imposed by the DEEP through the NPDES permit process and the General Permit for Nitrogen Discharges through treatment alone or in connection with purchasing nitrogen credits.

TABLE 1-3. ANTICIPATED SOUTH STREET WWTF EFFLUENT PERMIT LIMITS WITH COMBINED SEWER DISTRICT NO. 1 AND SEWER DISTRICT NO. 2 FLOWS

Effluent Parameter	Average Daily	Average Monthly	Maximum Daily	Instantaneous
Flow	1.12 mgd	n/a	n/a	n/a
BOD_5 (Nov 1st to Mar 31st)	n/a	18 mg/l	40 mg/l	n/a
BOD_5 (Apr 1st to Oct 31st)	n/a	9 mg/l	20 mg/l	n/a
TSS (Nov 1st to Mar 31st)	n/a	18 mg/l	40 mg/l	n/a
TSS (Apr 1st to Oct 31st)	n/a	9 mg/l	20 mg/l	n/a
Escherichia coli [1]	n/a	n/a	n/a	410/100ml
Ammonia-Nitrogen				
April	n/a	6.5 mg/l	n/a	n/a
May	n/a	4.4 mg/l	n/a	n/a
June	n/a	2.1 mg/l	n/a	n/a
July – September	n/a	1.4 mg/l	n/a	n/a
October	n/a	2.4 mg/l	n/a	n/a
November-March	n/a	n/a mg/l	n/a	n/a
Dissolved Oxygen Apr 1st to Oct 31st	n/a	n/a	n/a	≥6.0 mg/l min.
pH	n/a	n/a	n/a	6-9
Total Phosphorus				
Nov 1st to Mar 31st	n/a	1.0 mg/l	2.0 mg/l	n/a
Apr 1st to Oct 31st [2]	n/a	0.16 mg/l	0.31 mg/l	n/a
Zinc	n/a	0.268 kg/d	0.355 kg/d	n/a

1. The geometric mean of E. Coli bacteria during a calendar month from May 1st to September 30th shall not exceed 126/100ml.
2. Total phosphorus average seasonal load limit of 0.52 lb/day = 0.055 mg/l at 1.12 mgd.
3. Total Zinc maximum day load limit of 0.33 kg/day = 0.084 mg/l at 1.12 mgd and 0.016 mg/l at peak flow of 6.0 mgd (see section below for peak flow projections).

TABLE 1-4. SEWER DISTRICT NO. 1 (SOUTH STREET WWTF) CURRENT AND PROJECTED YEAR 2035 WASTEWATER FLOWS AND LOADS

Constituent	2015 [1]	2035
Average Daily Flow, (MGD)	0.85	1.00
Peak Flow, (MGD)	5.32[2]	5.32[2]
BOD_5 (lb/day)	1,550	1,830
BOD_5 (mg/l)	219	219
TSS (lb/day)	1,643	1,940
TSS (mg/l)	233	233
TKN (lb/day)	176	210
TKN (mg/l)	24.8	25.2
Total Phosphorus (lb/day)	28.4	35.0
Total Phosphorus (mg/l)	4.0	4.2
Total Zinc (kg/day)	0.799	0.940
Total Zinc (mg/l)	0.248	0.248

1. Current concentration data was truncated to eliminate potentially unrepresentative date due to the potential impact of septage on the influent samples. See Chapter Three for more information.
2. Peak flow includes a reduction of 1.0 MGD due to inflow reduction or the construction of an equalization tank.

TABLE 1-5. SEWER DISTRICT NO. 2 (ROUTE 7 WWTF) CURRENT AND PROJECTED YEAR 2035 WASTEWATER FLOWS AND LOADS

Constituent [1]	2015	2035
Average Daily Flow, (MGD)	0.053	0.12
Peak Flow, (MGD)	0.36	0.72
BOD_5 (lb/day)	124	280
BOD_5 (mg/l)	280	280
TSS (lb/day)	102	230
TSS (mg/l)	226	230
TKN (lb/day)	15.6 [2]	33 [2]
TKN (mg/l)	33 [2]	33 [2]
Total Phosphorus (lb/day)	1.46	6.0 [2]
Total Phosphorus (mg/l)	3.3	6.0 [2]
Total Zinc (kg/day)	0.026	0.059
Total Zinc (mg/l)	0.128	0.128

1. All data is based on July 2010 to June 2013 with the exception of zinc data which was from Feb/Mar 2016
2. Assumed values based on medium/high strength wastewater.

TABLE 1-6. SEWER DISTRICT NO. 1 AND SEWER DISTRICT NO. 2 CURRENT AND PROJECTED YEAR 2035 WASTEWATER FLOWS AND LOADS

Constituent	2015	2035
Average Daily Flow, (MGD)	0.903	1.12
Peak Flow, (MGD)	6.24	6.00 [1]
BOD_5 (lb/day)	1,674	2,110
BOD_5 (mg/l)	222	226
TSS (lb/day)	1,745	2,170
TSS (mg/l)	232	232
TKN (lb/day)	192	234
TKN (mg/l)	25.4	25.1
Total Phosphorus (lb/day)	29.6	41
Total Phosphorus (mg/l)	4.0	4.4
Total Zinc (kg/day)	0.825	1.00
Total Zinc (mg/l)	0.241	0.236

1. Peak flow includes a reduction of 1.0 MGD due to inflow reduction or the construction of an equalization tank.

- Process sizing criteria based on industry standards including *TR-16, Guides for the Design of Wastewater Treatment Works* prepared by the New England Interstate Water Pollution Control Commission, *Manual of Practice (MOP) 8 – Design of Wastewater Treatment Plants* prepared by the Water Environment Federation, and *Wastewater Engineering – Treatment and Reuse* prepared by Metcalf & Eddy, Inc.
- Reliability and redundancy criteria were used to plan for the necessary maintenance and repair of equipment. Standby power has also been considered to maintain operation in the event of a failure of the primary utility power.

Basis for Cost Estimates

Chapter Four presents the basis for the cost estimates used in the Facilities Plan report. In summary the cost estimates for the alternatives in this Facilities Plan are based on the operation of the WWTFs at an annual average daily flow and load over the planning period. A linear flow and loading increase has been assumed for the 20 year planning period. These costs include estimated capital and operation and maintenance (O&M) costs.

Capital Costs. Capital costs were developed based on estimated construction costs for structures, process and auxiliary equipment, piping, instrumentation and controls. The estimated construction costs include the materials, labor, and equipment for installation, as well as contractor overhead and profit. The estimated construction costs were developed using 4th quarter 2016 dollars at an Engineering News Record construction cost index of 10442. In addition the capital cost estimates include a 30 percent final design allowance for the WWTF and Pump Station upgrades and a 20 percent final design allowance for force mains outside of the WWTF property (see Chapter Ten for Route 7 WWTF Decommissioning alternatives). To provide a total estimated capital cost, a 35 percent allowance for engineering and contingencies has been added to the base construction cost of each project element. Finally, the total estimated project costs have been escalated to the projected March 2020 midpoint of construction to give an estimated escalated total project cost.

The total estimated capital costs are preliminary planning level costs and have been developed based on a number of assumptions and may not represent the final project capital costs for the facilities once designed. The final costs could be higher or lower depending on what decisions are made during the design phase, how the final facilities are constructed, and when the final facilities are constructed.

O&M Costs. Operation and maintenance costs are the estimated costs to operate and maintain the facilities over the project planning period. The estimated O&M costs were based on power consumption, operation and maintenance labor, maintenance materials and 20 years of operation. Unit prices for power, chemicals, labor, and sludge disposal (as applicable) were escalated at 2.5 percent per year. The per pound cost for nitrogen credits (purchased and sold as applicable) were escalated at 3.0 percent per year.

Present Worth. The comparison of cost for different alternatives has been prepared on a present worth basis. The present worth for O&M costs are the annual O&M costs expressed as a present worth value in 4th quarter 2016 dollars. A discount rate of 4.0 percent was used to develop the present worth costs.

CHAPTER FIVE – EXISTING FACILITIES

In this chapter, the facilities at the Route 7 WWTF and the South Street WWTF were evaluated to identify their condition and the need for improvements or upgrades. The facilities were evaluated to assess their ability to provide continued service through the Facilities Plan design year of 2035. This section highlights the condition of the most significant unit processes and systems at the WWTFs (influent pumping, liquid process, residuals, ancillary systems, etc.).

This chapter concluded that a significant portion of the Route 7 WWTF systems and equipment date from the original 1985 construction and should be considered for replacement or upgrade due to physical conditions and the availability of spare parts. The Chapter also concluded that some of the South Street WWTF structures and equipment date from the original 1968 construction and should be considered for upgrade or replacement due to physical conditions. Some newer systems and equipment from the 1990 upgrade were also identified as needing replacement or upgrade due to concerns with their inability to provide service to the WWTF for the next 20 years, or the ability to improve energy efficiency and reduce maintenance.

The major Route 7 WWTF systems and equipment that should be considered for replacement and their respective issues are summarized in **Table 1-7**.

TABLE 1-7. ROUTE 7 WWTF SYSTEMS AND EQUIPMENT TO BE CONSIDERED FOR REPLACEMENT AND/OR UPGRADE

Facility System / Equipment	Issue(s)
Influent Pump Station	System from 1985, Existing Two Pumps Hydraulically Overload WWTF headworks.
Grit Chamber/Channel Grinder	Not Expected to Provide Reliable Service for 20 Years. Outdoor Location Concern with Wear and Odors, Removal of Material from Flow Preferable.
Primary Settling Tanks	Majority of System Components from 1985, Consider Covers for Odor and Debris Control. Effluent Troughs are a Hydraulic Restriction.
Equalization Tank	Equalization Functionality not Operable, System Components from 1985, Consider Covers for Odor and Debris Control.
Rotating Biological Contactors	All System Components 17 Years Old or More. Limited Tank Freeboard.
Secondary Settling Tanks	Majority of System Components from 1985, Consider Covers for Debris Control. Effluent Troughs are a Hydraulic Restriction.
UV Disinfection System	Not Expected to Provide Reliable Service for 20 Years. Hydraulic Limitation. Location Renders Plant Water System Unusable.
Plant Water Station	System from 1985, System Unusable Due to Upstream UV System.
Primary and Secondary Sludge and Scum Pumping Stations	System from 1985, Single Pump in Each Station (No Redundancy), Manual Wasting, Confined Space Access to Enter Stations.
Sludge Storage Tanks	System from 1985, Consider Proving Odor Control and Improvement for Truck Loading Operations.
Instrumentation and Control Systems	Control Systems Outdated, Limited Process Monitoring and Control.
Architectural Components	Many Tank Railing and Entrance Hatches Require Repairs and Upgrades. Control Building Needs Roof Replacement and Interior Upgrades.
Structural Components	Process Tanks and Slabs Require Crack Repairs and Sealing.
HVAC Systems	Majority of Equipment from 1985. Majority of Other Systems in Poor Condition.
Electrical Systems	Majority of System Components from 1985. Availability of Spare Parts.
Fuel Oil System	Not Expected to Provide Reliable Service for 20 Years.
Civil Site Components	Site Components in Poor Condition, No Potable Water on Site.
Hazardous Materials	Lead, Asbestos and PCB Materials Require Removal/Rehabilitation as part of an upgrade.

The major South Street WWTF systems and equipment that should be considered for replacement and their respective issues are summarized in **Table 1-8**.

TABLE 1-8. SOUTH STREET WWTF SYSTEMS AND EQUIPMENT TO BE CONSIDERED FOR REPLACEMENT AND/OR UPGRADE

Facility System / Equipment	Issue(s)
Influent Pump Station/Influent Distribution Box	Insufficient Capacity, Existing Pumps Not Expected to Provide Reliable Service for 20 Years, Odor Potential.
Septage Receiving	Spillage/Odors, Tanks Condition Unknown. Existing Pumps Not Expected to Provide Reliable Service for 20 Years. System requires Debris Removal from Both Tanks.
Influent Screening/Grit Chamber/Channel Grinder/Fine Screen	System Age and Condition, Majority from 1990, Hydraulic Capacity at High Flows. Fine Screen Cleaning is Manual, Odor Potential.
Aeration Distribution	Condition of Covers, Odor Potential.
Aeration Tanks/Aeration Systems	Insufficient and Inefficient Aeration Capacity, 1968 Tank Systems in Unusable Condition. No Dissolved Oxygen Control
Final Settling Tanks	Age of Mechanical Components, Concern of these Critical Process Components Lasting 20 More Years
Secondary (WAS/RAS/Scum) Pumps	System Age, Limited Control
Sand Filters	Age of Mechanical Components
Post Aeration	Age of Mechanical Components
Disinfection System	Age of Equipment, Availability of Spare Parts, Manual Lamp Cleaning, Lack of Redundant System Channel.
Waste Sludge Storage	Existing Tanks Unusable Due to Freezing and Odor Issues. Limited Operational Flexibility without Storage.
Sludge Thickening/Dewatering	System Age, System Operating at or Near Capacity, Odor Potential.
Thickened Sludge Storage	Limited Capacity Impact Operational Flexibility. Odor Potential. Truck Loading Pump Age, Location and Lack of Redundancy.
Ancillary Pumping Systems (Plant Water, Recycle Wet Well)	Polymer Systems Replacement Needed Due to Age.
Chemical Storage and Feed Facilities	Systems from 1990 Approach the End of Their Useful Life. Poor Access to Systems in Operations Building Basement
Instrumentation and Control Systems	Control Systems Outdated, Limited Process Monitoring and Control.
Architectural Components	Many Components in Poor Condition (Roofs, Damage Building Faces, Doors/Hardware, Corrosions Issues, Pealing Painting and Coatings), Extremely Limited Vehicle and Equipment Storage. Functional Upgrades to Administrative Areas Needed.
Structural Components	Significant Cracking and Deterioration in 1968 Process Tanks. Some Cracks in 1990 Tanks. Roof Cracking in Operations and Control Building.
HVAC Systems	Significant Equipment from 1990 and is in Poor Condition.
Electrical Systems	Majority of System Components from 1990. Availability of Spare Parts. Standby Generator Cannot Support Critical WWTF Processes.
Fuel Oil System	Not Expected to Provide Reliable Service for 20 Years.
Civil Site Components	Site Components in Poor Condition, Limited Vehicle Storage.
Hazardous Materials	Lead, Asbestos and PCB Materials Require Removal/Rehabilitation as part of an upgrade.

CHAPTER SIX – ROUTE 7 WWTF UPGRADE ALTERNATIVE EVALUATION

In Chapter Six alternatives were developed and evaluated for the most significant systems and unit processes at the Route 7 WWTF. These systems and unit processes include the following:

- Influent Pumping
- Headworks Facilities Including:
  - Screening
  - Grit Removal
- Equalization Tank
- UV Disinfection and Plant Water Systems
- Solids Pumping Upgrades

Chapter Six describes and evaluates the upgrade alternatives developed for these systems and unit processes. Included in Chapter Six are descriptions of the upgrade alternatives identification and screening processes, and descriptions of the alternatives identified as the most favorable to be evaluated in more detail. In some cases Chapter Six also summarizes of the advantages and disadvantages of the most favorable alternatives and presents their estimated capital costs. **Table 1-9** presents the alternatives that were evaluated for the systems and unit process noted above.

TABLE 1-9. ROUTE 7 WWTF SYSTEM AND UNIT PROCESS ALTERNATIVES EVALUATED

Facility System /Unit Process	Alternatives Evaluated
Influent Pumping	• Pump Station Replacement on the Existing Site • Pump Station Relocation Outside of the Existing WWTF
Headworks Facilities	
Screening	• Mechanically Cleaned Bar Screen • Rotating Channel Screen
Grit Removal	• Headworks with Enclosed Grit Removal • Headworks without Grit Removal • Headworks with Outdoor Grit Removal
Equalization Tank	• Flow Control Valve Equalization • Pumped Equalization
UV Disinfection and Plant Water Systems	• UV System Relocation and Reinstallation of the Plant Water System
Solids Pumping Station Upgrades	• Provide Pump and Valve Actuator Control at Grade • Relocate Pumps To Top Slab Enclosed In Weatherproof Enclosures • Relocate Pumps To Top Slab And Enclose In Precast Concrete Buildings • Provide New Access Stairs And Doors Into Existing Sludge Pumping Stations

CHAPTER SEVEN – SOUTH STREET WWTF UPGRADE ALTERNATIVE EVALUATION

In Chapter Seven alternatives were developed and evaluated for the two most significant systems and unit processes at the South Street WWTF. These systems and unit processes include the following:

- Septage Receiving Upgrades
- Nutrient Removal Upgrades, including:
  - Secondary Treatment Upgrades for Total Nitrogen and Phosphorus Removal

    - Tertiary Phosphorus Removal
    - Membrane Bioreactor
- Zinc Removal
- Aeration System Upgrades
- Solids Handling Upgrades

Chapter Seven describes and evaluates the upgrade alternatives developed for these systems and unit processes. Included in Chapter Seven are descriptions of the upgrade alternatives identification and screening processes, and descriptions of the alternatives identified as the most favorable to be evaluated in more detail. In some cases Chapter Seven also summarizes the advantages and disadvantages of the most favorable alternatives and presents their estimated costs. For some alternatives, these costs include estimated capital costs, operation and maintenance (O&M) costs, and 20-year life. **Table 1-10** presents the alternatives that were evaluated for the systems and unit process noted above.

TABLE 1-10. SOUTH STREET WWTF SYSTEM AND UNIT PROCESS ALTERNATIVES EVALUATED

Facility System /Unit Process	Alternatives Evaluated
Septage Receiving Upgrades	• Full Vactor Truck Sized Building • Partial Vactor Truck Sized Building
Nutrient Removal Upgrades	
Secondary Treatment for Total Nitrogen and Phosphorus Removal	• Biological Nitrogen Removal (with some chemical phosphorus removal): o Modified Ludzack-Ettinger process o 4-Stage Bardenpho process • Biological Nitrogen and Phosphorus Removal: o A2O process. o 5-Stage Bardenpho process.
Tertiary Phosphorus Removal	• Actiflo Process – Ballasted flocculation process • Blue PRO Process – Similar configuration to existing sand filters (single stage system) • Parkson Dynasand System Upgrade (two stage system)
Membrane Bioreactor Comparison	• Membrane Bioreactor • 4-Stage Bardepho Process and Blue PRO Process
Zinc Removal	• Tertiary Phosphorus Removal • pH Adjustments • Nanofiltration (NF) and Reverse Osmosis (RO) • Ion Exchange
Aeration System Upgrades	• Fine Bubble Diffused Air • Invent Mixer/Aerators • Aeration Control Systems o Dissolved Oxygen (DO) Control System o Ammonia Control Systems • Blowers o Positive Displacement (PD) Blowers o Hybrid Blowers

TABLE 1-10. SOUTH STREET WWTF SYSTEM AND UNIT PROCESS ALTERNATIVES EVALUATED (CONTINUED)

Facility System /Unit Process	Alternatives Evaluated
Solids Handling Technology Alternatives	
WAS Storage Alternatives	• Aerated Sludge Storage • Gravity Thickener (for thickening and storage)
Mechanical Sludge Thickening Only Alternatives	• Rotary Drum Thickener
Mechanical Sludge Thickening and Dewatering Alternatives	• Gravity Belt Thickener/Belt Filter Press • Centrifuge
Mechanical Sludge Thickening Only Alternatives	• Rotary Press
Combined Storage/ Thickening and Dewatering Solids Handling Alternatives	• Alternatives with Chemical Phosphorus Removal Liquid Processes • Alternatives with Biological Phosphorus Removal Liquid Processes

CHAPTER EIGHT – ROUTE 7 WWTF UPGRADE RECOMMENDATIONS

Facilities Plan Recommended Upgrades

Chapter Eight summarizes the draft recommended facilities upgrades and improvements for the Route 7 WWTF systems and unit processes as well as estimated capital costs. These recommended facilities upgrades are summarized in **Table 1-11**.

TABLE 1-11. ROUTE 7 WWTF RECOMMENDED UPGRADE ELEMENTS

Facility System /Unit Process	Recommended Upgrade
Liquid Processes	
Influent Pumping	• Replace the Pump Station at the Existing Location • Provide Three Pumps with VFDs • Provide New Generator
Preliminary Treatment	• Provide New Channel with Rotating Fine Screen with Washer/Compactor • Provide New Grit Removal System Components • Provide New 32 ft. x 40 ft. Headworks Building o Enclose New Preliminary Treatment Equipment o House New Alum Storage and Feed Systems for Phosphorus Removal o Provide Dedicated Electrical and Mechanical Rooms • Provide Odor Control for Building Process Areas
Primary Settling Tanks	• Replace all Mechanical Components • Provide Covers for Odor and Debris Control
Equalization Tank	• Replace all Mechanical Components • Provide Covers for Odor and Debris Control • Restore Equalization Functionality with Redundant Control Valve System

TABLE 1-11. ROUTE 7 WWTF RECOMMENDED UPGRADE ELEMENTS (CONTINUED)

Facility System /Unit Process	Recommended Upgrade
Liquid Processes	
Rotating Biological Contactors	• Replace Media, Drives and Covers • Lower Effluent Weir to Increase Freeboard
Final Settling Tanks	• Replace all Mechanical Components • Provide Covers for Odor and Debris Control
Total Phosphorous Removal	• Provide Alum Storage and Feed System, Associated Containment and Safety Systems, and Yard Piping • System to be Located in New Headworks Building (see above)
UV Disinfection	• Provide New Dual Channel UV Disinfection System • Construct New UV Building Adjacent to Plant Water Station/UV Disinfection Room. • Provide New Access Door to Plant Water Station/UV Disinfection Room.
Plant Water System	• Provide New Plant Water Pumps with VFDs • Replace Plant Water Yard Piping and Hydrants • Modify Plant Water Wet Well to Allow for Storage and Reuse of Plant Water
Solids Handling	
Primary and Secondary Sludge Pumping Systems	• Provide New Outside Stair Access with Building Enclosure for Primary Sludge Pump Station • Provide New Door from Existing Plant Water Station/UV Disinfection Room to Secondary Sludge Pump Station • Provide Two New Pumps, Three Motor Actuated Vales and Control Panel in Each Station
Sludge Storage and Hauling	• Replace All Existing Pumping and Aeration Components • Provide New Covers and Odor Control • Provide New Sludge Loading Pumps and an at Grade Truck Connection
Ancillary Systems	
Control, Software, Instrumentation and Communication Systems	• Provide WWTF SCADA System for: o System Monitoring and Alarm Call Out Functionality o Provide Select WWTF Process System Control • Replace Existing Instrumentation
Electrical and Emergency Power Systems	• Replace Entire WWTF Electrical Distribution System and Utility Transformer. • Installation of the Following New or Replacement Systems: o Fire Alarm System o Emergency and Exit Lights o Lightning Protection System o Site Security System o Power Monitoring System o Standby Generator and Fuel Oil Storage Tank o Energy Efficient (LED) Interior and Site Lighting Systems
Odor Control Systems	• Provide Ductwork, Fans and Carbon Adsorber for the Following Areas: • Headworks Building Process Area, Primary Settling Tanks, Equalization Tank • Sludge Storage Tanks
HVAC Systems	• Replace HVAC Systems in Control Building, Sludge Pump Station and Plant Water Station.

TABLE 1-11. ROUTE 7 WWTF RECOMMENDED UPGRADE ELEMENTS (CONTINUED)

Facility System /Unit Process	Recommended Upgrade
Support and Administrative Upgrade	
Control Building Architectural and Misc. Structural Upgrades	• Tank Railing Upgrades • Primary and Secondary Sludge Pump Station Hatches • Control Building Architectural Upgrades Including: o Replacement Control Building Metal Roof o Cosmetic Upgrades Including Painting, Ceiling Tile Replacement, Laboratory Furniture, Flooring, Etc. • Hazardous Material Removal and Remediation
Site Improvements	• Site Repaving and Curbing • Potable Water Service • Site Fencing Upgrade • Communication Conduit Between WWTF and Route 7 WWTF Pump Station

Facilities Plan Recommended Upgrades Estimated Capital Cost Summary

Table 1-12 presents a summary of the recommended upgrades for the Route 7 WWTF and the associated estimated capital costs. As indicated the total estimated capital costs for the recommended WWTF upgrades is $10,585,000.

TABLE 1-12. ROUTE 7 WWTF RECOMMENDED UPGRADES – ESTIMATED CAPITAL COST SUMMARY

Improvement / Upgrade Element	Estimated Cost
Liquid Processes	
Influent Pumping	$1,535,000
Preliminary Treatment	$1,345,000
Primary Settling Tanks	$415,000
Equalization Tank	$455,000
Rotating Biological Contactors	$860,000
Final Settling Tanks	$400,000
Total Phosphorous Removal	$135,000
UV Disinfection	$420,000
Plant Water System	$195,000
Solids Handling	
Primary and Secondary Sludge Pumping Systems	$485,000
Sludge Storage and Hauling	$275,000
Ancillary Systems	
Control, Software, Instrumentation and Communication Systems	$510,000
Electrical and Emergency Power Systems	$1,665,000
Odor Control Systems	$300,000
HVAC Systems	$140,000
Support and Administrative Upgrade	
Control Building Architectural and Misc. Structural Upgrades	$465,000
Site Improvements	$985,000
Total Costs	**$10,585,000**

CHAPTER NINE –SOUTH STREET WWTF UPGRADE RECOMMENDATIONS

Facilities Plan Recommended Upgrades

Chapter Nine summarizes the draft recommended facilities upgrades and improvements for the South Street WWTF systems and unit processes as well as estimated capital costs. These recommended facilities upgrades are summarized in **Table 1-13**.

TABLE 1-13. SOUTH STREET WWTF RECOMMENDED UPGRADE ELEMENTS

Facility System /Unit Process	Recommended Upgrade
Liquid Processes	
Influent Pump Station	• Provide a New Wet Well, Valve Vault and Conveyance Piping Next to Existing Pump Station • Provide Four Pumps with VFDs • Extend and Modify Influent Distribution Box
Septage Receiving	• Provide New Septage Receiving Building for Partial Enclosure of the Town's Vactor Truck • Ventilate Building to Odor Control System • Replace and Reconfigure Septage Tanks to Operate in Series • Replace Septage Pumps and Controls • Provide Discharge Piping to Solids Handling for Process Flexibility
Influent Building	• Provide Two Influent Screens with Common Conveyor and Washpress • Provide Screen Bypass Piping and Removable Manual Bar Rack • Replace all Mechanical Components of Grit Removal System • Provide Odor Control for Process Area
Total Nitrogen Removal – 4-Stage Bardenpho	• Provide Cover and Odor Control for Distribution Box No. 1 • Rehabilitate 1968 Aeration Tanks (concrete repair, railings, valves, weirs, etc). • Upgrade 1990 Aeration Tanks (new weir gates, minor concrete repairs). • Provide New and Modify Existing Aeration Tank Walls to Accommodate 4-Stage Bardenpho Process • Provide Fine Bubble Aeration System Aerobic Zones with Dissolved Oxygen Control System • Provide New Blower Building with Five Rotary Lobe Compressors (Hybrid Blowers) • Provide Mixers for Anoxic Zones • Provide Internal Recycle Pumps and Piping Systems • Provide Supplemental Carbon (Micro-C) Storage and Feed Systems. • Provide Ferric Chloride Chemical Storage and Feed Systems
Final Settling Tanks	• Replace all Mechanical Components
Tertiary Treatment – Blue PRO Process	• Provide 16 Blue PRO Filter Units, Including Two New Filter Cells to Be Located in the Existing Sand Filter Room. • Air Compressor with Air Dryer. • System Control Panel and Instrumentation • Ferric Chloride Storage and Feed Facilities (same as 4-Stage Bardenpho system) • Relocation of the existing UV disinfection, reaeration, and effluent flow measurement systems.

TABLE 1-13. SOUTH STREET WWTF RECOMMENDED UPGRADE ELEMENTS (CONTINUED)

Facility System /Unit Process	Recommended Upgrade
Liquid Processes	
UV Disinfection / Post Aeration / Maintenance Garage Facility	• Provide Two Channel UV Disinfection System • Provide New Post Aeration Tank and Aeration Systems (Blowers, Diffusers, Control, Etc,) • Provide New WWTF Flow Meter. • Provide New Building to House UV System, Post Aeration Support Systems, Maintenance Garage and New WWTF Switchgear.
Solids Handling	
WAS Storage	• Convert Existing Sludge Holding Tank No. 2 to New Aerated Sludge Storage Tank. • Provide Aluminum Plate Covers and Odor Control • Provide Aeration Diffusers and Aeration Blowers
Centrifuge Thickening	• Provide Thickening/Dewatering Centrifuge • Provide Polymer Blend and Feed Systems • Provide Two Centrifuge Sludge Feed Pumps. • Provide Odor Control for Dewatering Room and Sludge Truckway. • Provide New Garage (Dewatering operations will take the existing truckway/garage. See the UV Disinfection System above)
Thickened Sludge Storage	• Modify the Chemical Area In Operations Building Basement to a Thickened Sludge Storage Tank • Retain Existing Yard Storage Tank • Provide Submersible Mixers in Each Tank • Provide Two Truck Sludge Loading Pumps
Ancillary Systems	
Odor Control Systems	• Provide Ductwork, Fans and Carbon Adsorber for Following Areas: o Influent Pump Stations, Influent Building Process Area, Distribution Box No. 1 o Septage Receiving Building and Receiving Facilities o Aerate Waste Sludge Storage Tank o Sludge Process Areas in Operations Building o Existing Thickened Sludge Storage Tank
Ancillary Pumping Equipment	• Replacement of the Following Ancillary Pumping System o Waste Activated Sludge o Plant Water (Effluent Flushing Water Pumps) o Plant Recycle (Wet Well Pumps) o Return Activated Sludge o Scum Pump o Supernatant/Truck Loading Pump o Sump Pumps
Chemical Storage and Feed Systems	• Provide New Chemical Building in Area of Existing Sludge Holding Tank No. 3 to Contain the Following Storage and Feed Facilities: o Ferric Chloride o Supplemental Carbon (Micro-C) o Blue PRO Polymer o Sodium Hypochlorite • Provide Sodium Hydroxide Storage and Feed System in Influent Building

TABLE 1-13. SOUTH STREET WWTF RECOMMENDED UPGRADE ELEMENTS (CONTINUED)

Facility System /Unit Process	Recommended Upgrade
Ancillary Systems	
Electrical Systems	• Provide New Electrical Service and 1,000 kVA Transformer. • Provide New 1,600 amp 480 VAC Main Electrical Switchboard in New Main Electrical Room in UV Disinfection and Garage Building. • Replace Existing 800 amp Switchboard at the Operations Building. • Provide New Electrical Distribution Network, Duct Banks and Electrical Feeds to All Equipment. • Provide 600 kW Diesel Standby Generator and Fuel Oil Storage Tank
Instrumentation and Control Systems	• Provide WWTF SCADA System for: o System Monitoring and Alarm Call Out Functionality o Provide Select WWTF Process System Control • Replace Existing Instrumentation
HVAC	• Replace HVAC Systems in Influent Building, Control Building, and Operation Building • Replace Control Building, and Operation Building Boiler with Gas Fired Boilers • Provide Gas Utility Service to WWTF
Architectural and Structural Upgrade Recommendations	
Architectural and Structural Systems Upgrades	• Replace All Roofing Systems • Paint Interior Walls and Piping. • Repair Damaged Exterior Insulated Finish System (EIFS) building façade. • Upgrade Laboratory in Operations Building (Cabinetry, Countertops and Equipment). • Replace Damaged Doors and Hardware. • Repair Cracked and Delaminated Concrete Throughout Facility • Repair Concrete Roof Planks in Operations Building Filter Room
PCB / Lead / Asbestos Removal and Remediation	• Remove and Remediate Hazardous Materials
Site Improvements	• Site Repaving and Curbing • Landscape Restoration • Site Fencing Upgrade Including Motorized Entrance Gate

Facilities Plan Recommended Upgrades Estimated Capital Cost Summary

Table 1-14 presents a summary of the recommended upgrades for the South Street WWTF and the associated estimated capital costs. As indicated the total estimated capital costs for the recommended WWTF upgrades is $ 32,560,000.

TABLE 1-14. SOUTH STREET WWTF RECOMMENDED UPGRADES – ESTIMATED CAPITAL COST SUMMARY

Improvement / Upgrade Element	Estimated Cost
Liquid Process	
Influent Pump Station	$880,000
Septage Receiving	$1,045,000
Influent Building	$1,230,000
Total Nitrogen Removal – 4-Stage Bardenpho	$4,100,000
Final Settling Tanks	$895,000
Tertiary Treatment – Blue PRO Process	$3,010,000
UV Disinfection / Post Aeration / Maintenance Garage Facility	$3,310,000
Solids Handling	
WAS Storage / Centrifuge Thickening /Thickened Sludge Storage	$1,560,000
Ancillary Systems	
Odor Control Systems	$795,000
Ancillary Pumping Equipment	$955,000
Chemical Storage and Feed Systems	$2,185,000
Electrical Systems	$6,945,000
Instrumentation and Control Systems	$3,000,000
HVAC	$700,000
Architectural and Structural Upgrade Recommendations	
Architectural and Structural Systems Upgrades	$1,230,000
PCB / Lead / Asbestos Removal and Remediation	$290,000
Site Improvements	$430,000
Total Costs	**$32,560,000**

CHAPTER TEN - ROUTE 7 WWTF DECOMMISSIONING EVALUATIONS

In Chapter Ten an identification of the need and evaluation of alternatives to decommission the Route 7 WWTF and convey the Sewer District No. 2 flows and loads to either the South Street WWTF for treatment or to the Danbury sewer system for treatment at the Danbury WWTF is presented. Some of the alternative elements that were described and evaluated included:

- A New Route 7 Pump Station (to convey Sewer District No. 2 flows to another WWTF for treatment).
- Force Main Alternatives from Route 7 Pump Station to South Street WWTF including:
    - Route 35 Alternative. Reuse of the Existing Route 7 WWTF Force Main, Cross Country to Route 35 by the Water Tank, and South on Route 35 to the WWTF.
    - Local Road Route. Route 7, Haviland Road, Limekiln Road, Lee Road, Farmingville Road Route.
- Route 7 WWTF Decommissioning Needs.
- Additional South Street WWTF Upgrades to Accommodate the Sewer District No. 2 Flows and Loads.
- Force Main Route from Route 7 Pump Station to Danbury sanitary sewer system on Sugar Hollow Road.

These evaluations included estimated capital costs and a summary of advantages and disadvantages for the force main alternatives to the South Street WWTF.

Finally Two Alternative Comparisons were performed. These included:

- Comparing the Continued Operation of the Route 7 WWTF versus Decommissioning the Route 7 WWTF and Conveying and Treating the Sewer District No. 2 Flows at South Street WWTF.
- Comparing the Continued Operation of the Route 7 WWTF versus Decommissioning the Route 7 WWTF and Conveying and Treating the Sewer District No. 2 Flows at to the Danbury Sewer for Treatment of the Danbury WWTF.

These comparisons included summaries of the advantages and disadvantages of the alternatives and present their estimated capital costs.

For the comparison with the alternative of treating the Sewer District No. 2 flows at the South Street WWTF in addition estimated capital costs, the alternatives comparison also included operation and maintenance (O&M) costs, and 20-year life cycle costs. Finally for the same alternatives a coarse sensitivity analysis of the cost of the two alternatives was performed to identify the potential impact on the alternative costs if the Route 7 Pump Station and force main were not eligible for Clean Water Funding grant participation.

CHAPTER ELEVEN – RECOMMENDED PLAN

Chapter Eleven summarizes the recommended Wastewater Treatment Facilities Upgrades for the Route 7 WWTF and the South Street WWTF and provides estimated construction costs for the various project elements as well as a total estimated capital cost for the recommended upgrades.

In addition, it is recommended that the ongoing I/I Reduction Program discussed in Chapter Three continue to be implemented. The recommended Inflow Control Plan developed as part of the Phase 2 facilities planning efforts is summarized in this chapter.

Preliminary Recommended Wastewater Treatment Facilities Upgrades

Based on the evaluation performed in Chapter Ten, it is recommended that the Town decommission the Route 7 WWTF and construct a new Route 7 Pump Station and force main for conveyance of Sewer District No. 2 flows to the South Street WWTF for treatment. As a result of the increased flows and loads from Sewer District No. 2 being conveyed to the South Street WWTF, additional South Street WWTF upgrades will be required. The following is a brief summary of the recommended upgrades followed by a summary of the overall project costs.

Route 7 WWTF Decommissioning. It is recommended that the existing Route 7 WWTF be demolished and the area be restored for potential future use. It is assumed that the demolition and restoration would consist of the following:

- Removal of mechanical and electrical equipment
- Demolition of above grade structures
- Demolition of below ground structures to a depth of three feet below grade
- Provisions for water drainage of below ground tanks and structures
- Filling in of below ground tanks and structures
- Finish grading and restoration of decommissioned site.

There is the possibility to repurpose the site after the decommissioning of the WWTF including selling the land, providing green space or the installation of a solar panel system. Evaluation of options or estimates of revenue potential for repurposing of the site has not been included in the evaluation or estimated costs.

New Route 7 Pump Station and Force Main. It is recommended that a new Route 7 Pump Station be constructed at the location of the existing pump station to convey Sewer District No. 2 flows to the South Street WWTF. The preferred force main route has not been identified to date. However, for the purposes of presenting a total project cost for the recommended wastewater treatment facilities upgrade, the Route 7, Haviland Road, Limekiln Road, Lee Road, Farmingville Road force main "local" route has been assumed. It should be noted that this is the more costly of the two force main routes.

Additional South Street WWTF Upgrades to Accommodate the Sewer District 2 Flows and Loads. Additional upgrades to the South Street WWTF will be required and are recommended to accommodate the additional flow and pollutant loading from Sewer District No. 2. These upgrades include the following:

- Higher capacity influent pumps in the Influent Pump Station.
- Higher capacity aeration tank blowers and ancillary systems including a larger blower building.
- An additional Blue PRO filter cell with two filter manifolds and slightly larger ancillary facilities for tertiary phosphorus removal.
- Higher capacity UV disinfection system.

The majority of the other South Street WWTF recommended upgrades remain unchanged as summarized in **Table 1-13**.

Recommended Wastewater Treatment Facilities Upgrade Project Cost Summary

Table 1-15 presents a list summarizing the final recommended upgrades for the Ridgefield wastewater treatment systems. The total estimated capital cost for the recommended Ridgefield Wastewater Treatment Facilities Upgrade Project is $41,890,000.

The recommended wastewater treatment facilities upgrades are highlighted in **Figure 1-1**, **Figure 1-2**, and **Figure 1-3**, for the South Street WWTF, the Route 7 Pump Station, and the new Route 7 Pump Station to South Street WWTF force main, respectively.

In addition to the recommended wastewater treatment facilities upgrades, the ongoing Inflow Control Plan for Sewer District No. 1 discussed in Chapter Three is recommended to be implemented. The goal of the Inflow Control Plan is to remove at least 25% of the existing peak inflow, representing 1.0 MGD of inflow.

Facilities Plan Upgrade Program Implementation Approach and Schedule

It is recommended that the Wastewater Treatment Facilities Upgrade Project be designed and constructed as one construction contract package. This will require that all of the upgrades be financed at one time but will limit the overall time of construction and reduce the program costs. A preliminary recommended schedule for the Wastewater Treatment Facilities Upgrade Project has been developed. This schedule is shown in **Table 1-16.**

Recommended Upgrades - Estimated Grant and Loan Funding Cost Summary

A number of the recommended Wastewater Treatment Facilities Upgrade Project elements would qualify for different Clean Water Funding (CWF) grant programs. **Table 1-17** presents a cost summary of the different project elements, their estimated construction costs, the estimated CWF grant funding potential and the Town's share of the project costs. It is recommended that the Town pursue the available CWF funds to minimize the Town's share of the project costs.

It should be noted that the total estimated funding assistance costs are preliminary planning level costs and have been developed based on a number of assumptions and may not represent the final project capital costs or the final funding assistance for which the Town will qualify for or will be available for the

TABLE 1-15. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE PROJECT ESTIMATED CAPITAL COST SUMMARY

Improvement / Upgrade Element	Estimated Cost
SOUTH STREET WWTF UPGRADES	
Liquid Process	
Influent Pump Station	$905,000
Septage Receiving	$1,045,000
Influent Building	$1,230,000
Total Nitrogen Removal – 4-Stage Bardenpho	$4,165,000
Final Settling Tanks	$895,000
Tertiary Treatment – Blue PRO Process	$3,355,000
UV Disinfection / Post Aeration / Maintenance Garage Facility	$3,375,000
Solids Handling	
WAS Storage / Centrifuge Thickening /Thickened Sludge Storage	$1,560,000
Ancillary Systems	
Odor Control Systems	$795,000
Ancillary Pumping Equipment	$955,000
Chemical Storage and Feed Systems	$2,185,000
Electrical Systems	$6,975,000
Instrumentation and Control Systems	$3,000,000
HVAC	$700,000
Architectural and Structural Upgrade Recommendations	
Architectural and Structural Systems Upgrades	$1,230,000
PCB / Lead / Asbestos Removal and Remediation	$290,000
Site Improvements	$430,000
TOTAL SOUTH STREET WWTF UPGRADE COSTS	**$33,090,000**
NEW ROUTE 7 PUMP STATION	**$2,715,000**
FORCE MAIN TO SOUTH STREET WWTF	**$5,585,000**
ROUTE 7 WWTF DECOMMISSIONING	**$500,000**
TOTAL UPGRADE PROJECT CAPITAL COSTS	**$41,890,000**

TABLE 1-16. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE PROJECT SCHEDULE

Wastewater Treatment Facilities Upgrade Project Milestone	Milestone Date
Start Design	Spring 2017
Application for DEEP Project Funding	Spring 2017
WWTFs Upgrade Design Complete	Summer 2018
WWTFs Upgrade Town Funding Referendum	Fall 2018
Advertise Upgrade Project for Bid	Winter 2018/2019
Award Project and Begin Construction	Spring 2019
Complete Construction	Fall 2021
One Year Warranty Complete	Fall 2022

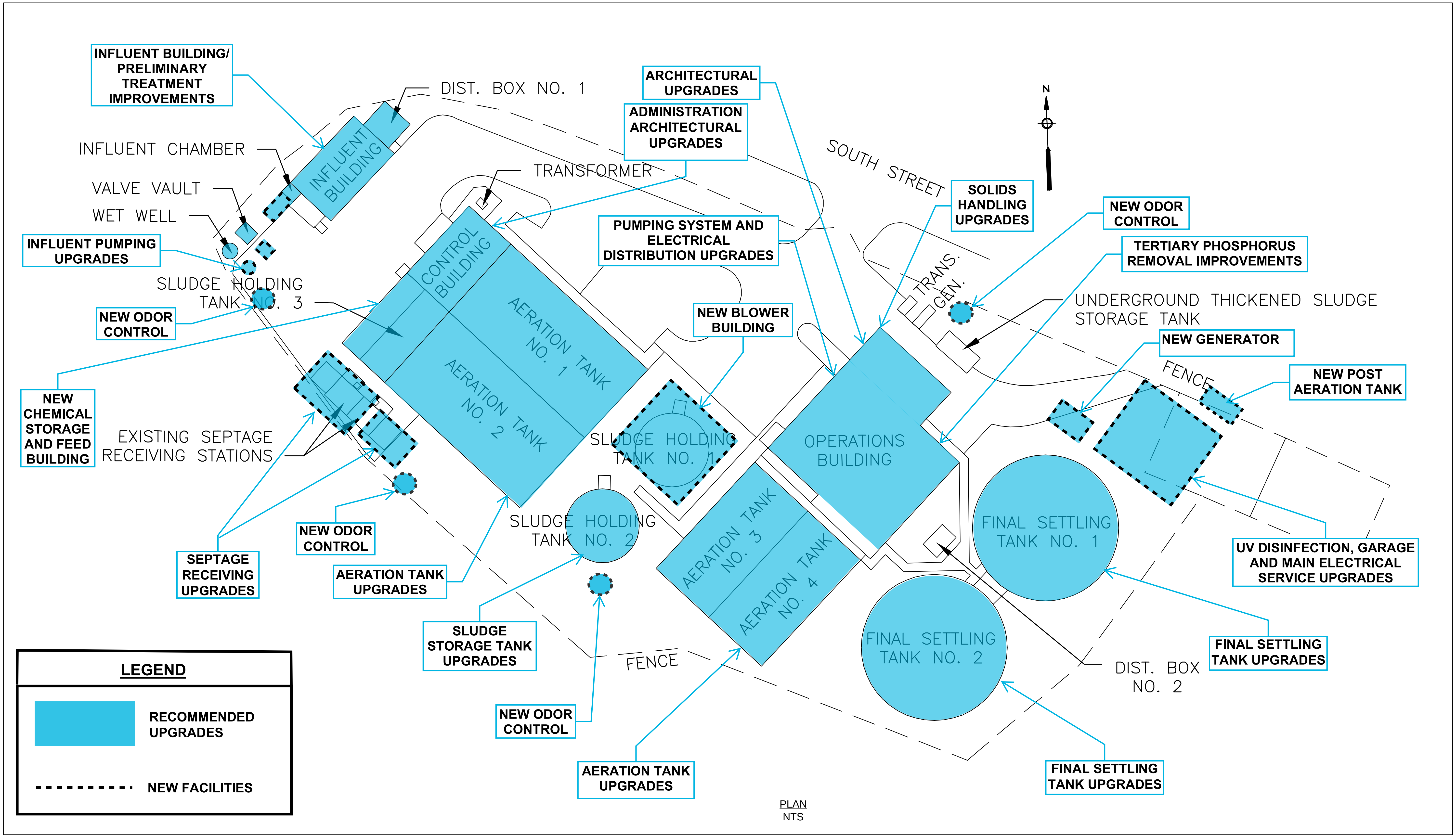


FIGURE 1-1
SOUTH STREET WWTF
RECOMMENDED UPGRADES SITE LAYOUT

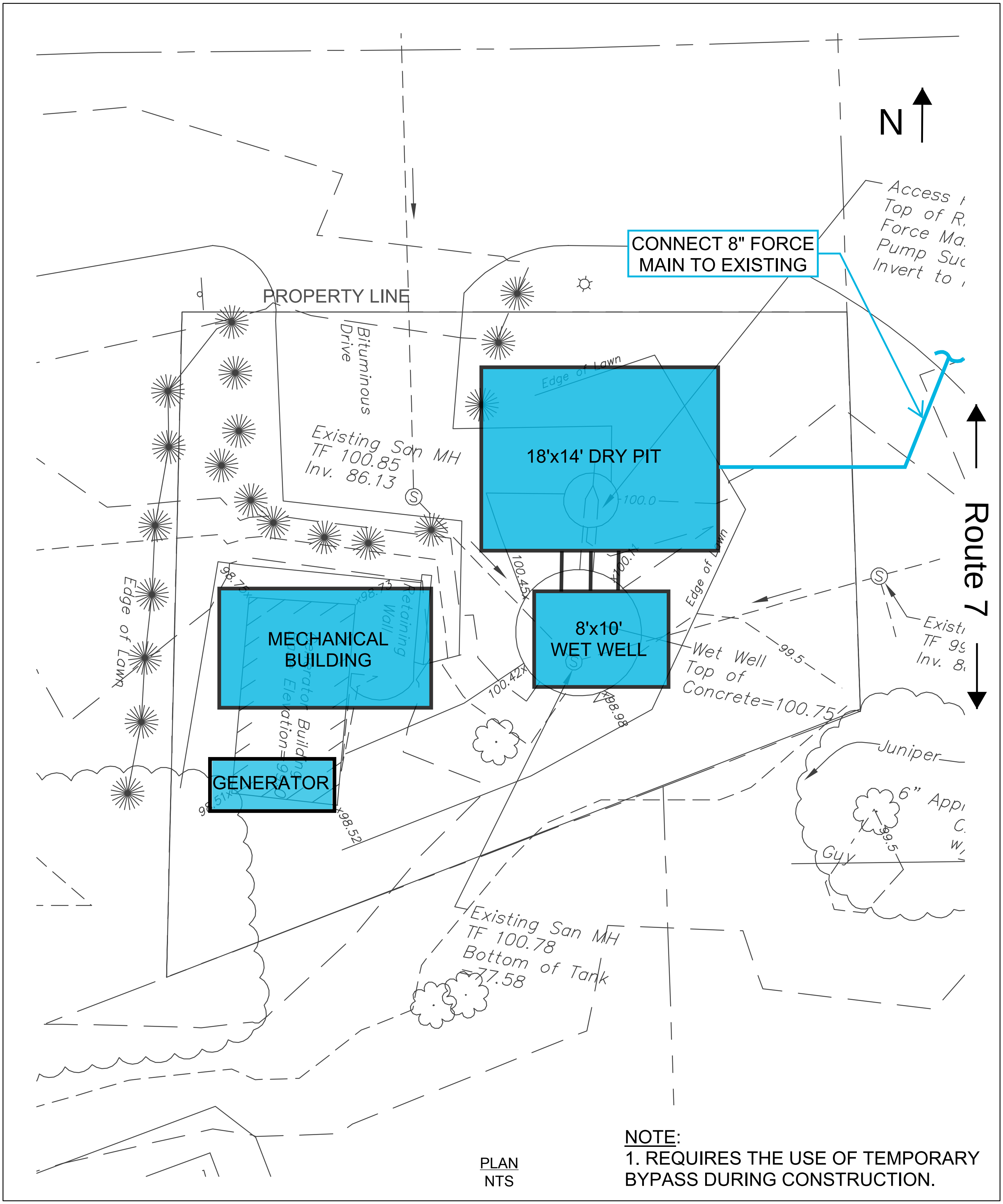
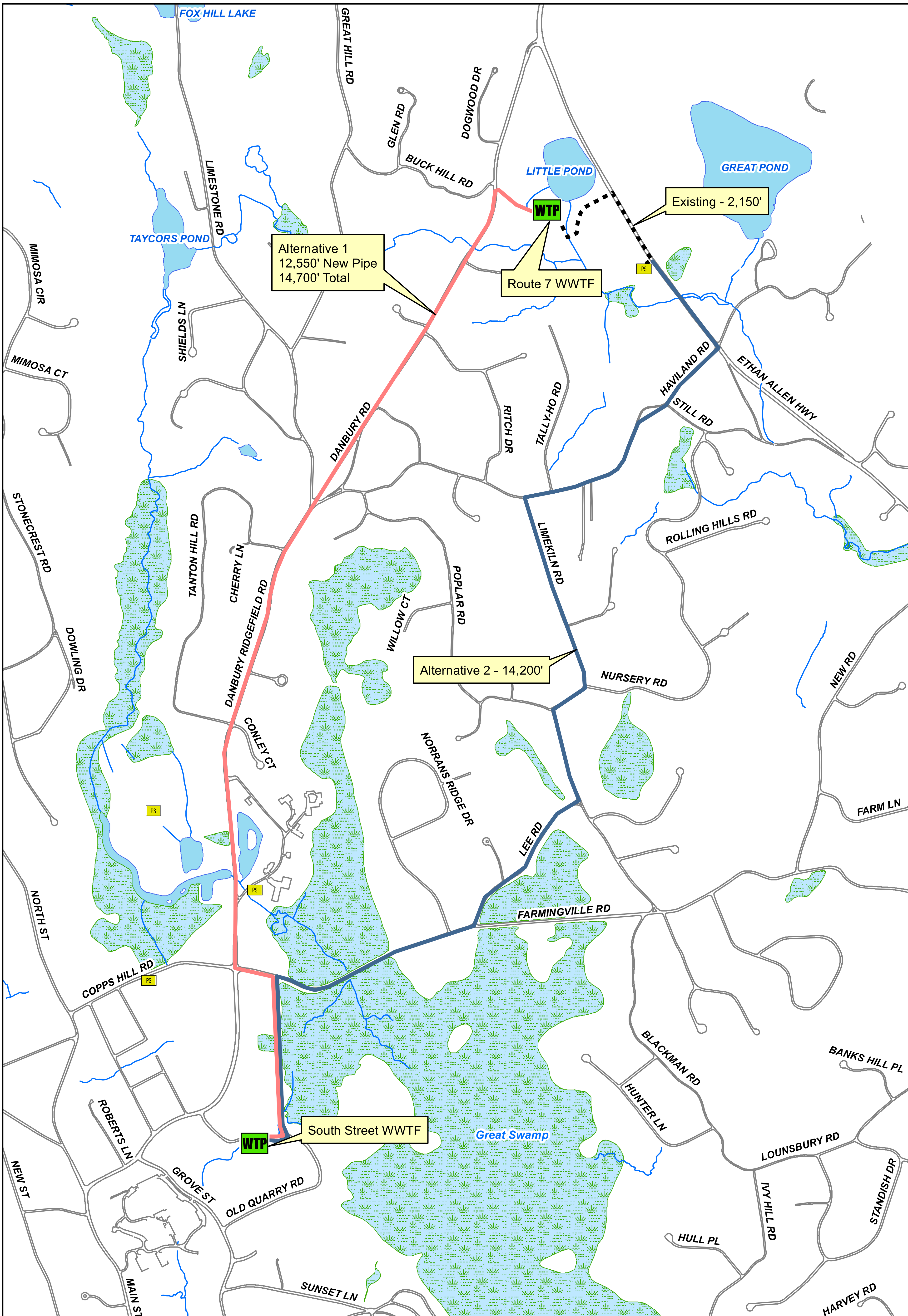


FIGURE 1-2
ROUTE 7 PUMP STATION TO SOUTH STREET WWTF

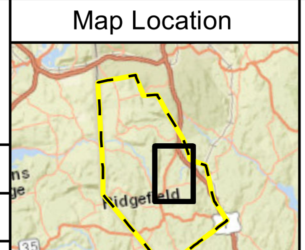


AECOM

Drawn: JM 1/9/2017

Approved: MR 1/9/2017

Map Location



Legend

WTP WWTP

PS Pump Station

Road Edge

Streams

Waterbodies

Swamps

Route 7 Force Main

Alternative 1

Alternative 2

Existing

0 200 400 800 Feet

N

FIGURE 1-3

ROUTE 7 DECOMMISIONING
PUMP TO SOUTH STREET
FORCE MAIN ALTERNATIVES

PHASE 2 WASTEWATER FACILITIES PLAN
RIDGEFIELD, CT

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TABLE 1-17. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE PROJECT - ESTIMATED GRANT FUNDING COST SUMMARY

Upgrade Component	Estimated Project Cost	20% Grant	30% Grant	50% Grant	Total Grant	Remaining Town Share [2]
South Street WWTF Upgrade						
Estimated TP Upgrade Costs	$4,870,000			$2,435,000	$2,435,000	$2,435,000
Estimated TN Upgrade Cost	$2,255,000		$677,000		$677,000	$1,578,500
Remaining WWTF Upgrade Cost	$25,965,000	$5,193,000			$5,193,000	$20,772,000
TOTAL SOUTH STREET WWTF UPGRADE COSTS	**$33,090,000**	**$5,193,000**	**$677,000**	**$2,435,000**	**$8,305,000**	**$24,785,000**
NEW ROUTE 7 PUMP STATION	**$2,715,000**	**$543,000**			**$543,000**	**$2,172,000**
Force Main to South Street WWTF						
Eligible Cost	$4,189,000	$838,000			$838,000	$3,351,000
Ineligible Cost [1]	$1,396,000					$1,396,000
FORCE MAIN TO SOUTH STREET WWTF	**$5,585,000**	**$838,000**			**$838,000**	**$4,747,000**
ROUTE 7 WWTF DECOMMISSIONING	**$500,000**	**$100,000**			**$100,000**	**$400,000**
TOTAL UPGRADE PROJECT ESTIMATED COSTS	**$41,890,000**	**$6,674,000**	**$677,000**	**$2,435,000**	**$9,786,000**	**$32,104,000**

1. Pavement restoration cost outside of the pipe trench width is ineligible for Clean Water Funding
2. The Town share of the project cost could be financed thought a combination of Clean Water Funding low interest loans for eligible cost and bonding or other Town originated funding mechanisms

facilities once designed. The final capital and financial assistance availability could be higher or lower depending on what decisions are made during the design phase, how the final facilities are constructed, and when the final facilities are constructed. In addition, the estimated funding assistance costs assume that the DEEP will have the resources available at the time to provide reimbursement and that their funding programs will not be modified in the future. Project element eligibility and financial assistance availability will need to be further developed and reviewed with input from the DEEP as the design proceeds and is completed.

Immediate Next Steps

To maintain the project schedule outlined in **Table 1-16** to meet the July 1, 2019 date to have executed a construction contract for the South Street WWTF Phosphorus upgrade to qualify for the DEEP 50% Phosphorus Grant program, there are several actions that are recommended to be taken as discussed below.

Submit Draft Phase 2 Wastewater Facilities Plan to DEEP. Once the WPCA has reviewed this draft report, and any necessary revisions are made to address comments from the WPCA, the draft report should be submitted to the DEEP for review. The DEEP currently notes the following on the DEEP website regarding submittal of documents related to the Clean Water Fund:

> "Due to resource constraints, municipalities should allocate a minimum of 90 calendar days from the date of submission to CT DEEP for the review and comment or approval of any document submitted related to the Clean Water Fund. These documents may include, but are not limited to, funding applications, engineering reports, plans and specifications, and professional services contracts. Implementation or execution of such documents without prior written approval by CT DEEP will result in loss of funding eligibility for the subject of the document. "

As a result of this schedule limitation for review of the report, and the need to move forward with initiating design by May 1, 2017, it is recommended that a review meeting with DEEP be held to review the Draft Phase 2 Wastewater Facilities Plan report findings. The meeting would be held to obtain DEEP's initial comments and reaction to the report in order to proceed with the development of the design scope in advance of receiving their formal comments.

Schedule a Public Hearing on the Recommended WWTFs Upgrade Project, Estimated Costs, and Schedule. The scope of work for the Phase 2 Wastewater Facilities Plan, and DEEP's regulations, require a public hearing be held prior to finalization of the Facilities Plan. Once the review meeting with the DEEP noted above is held, and DEEP's comments are obtained, the Public Hearing should be scheduled, publicized, and held. The WPCA may wish to have a meeting or meetings with the Board of Selectmen, Planning and Zoning, or other Town departments prior to the Public Hearing to inform Town boards about the details, need and costs for the WWTF Upgrade project. Once the Public Hearing is held, the draft report can be revised if needed to address feedback or revisions resulting from comments obtained at the hearing, and the Final Phase 1 and 2 Wastewater Facilities Plans can be issued.

Arrange for Funding for the WWTFs Upgrade Design and Initiate Design by May 1, 2017. As noted above, DEEP's review period for funding documents related to the Clean Water Fund is longer now than in the past due to resource constraints. As a result, the professional services contract for the design effort should be developed and executed once a meeting has been held to obtain DEEP's initial comments and reaction to the report in advance of receiving their formal comments. At the same time, the WPCA should take steps to budget for and secure the necessary funds for the design of the WWTFs upgrade.

> **Design Elements of Note.** Due to the specific permit requirements and the site conditions at the South Street WWTF there are a few unique elements of the design that are recommended. They are summarized below.

Stringent Total Phosphorus Requirements. As noted in Chapter Seven and Chapter Nine the target total phosphorus effluent concentration at the South Street WWTF for the year 2035 design flows are especially stringent (target total phosphorus concentration of 0.05 mg/l). It should be noted that the DEEP has approved a request by the Town to sole source Blue PRO for tertiary phosphorus removal at the South Street WWTF to meet the target total phosphorus concentration. While the Blue PRO system has other installations meeting the South Street WWTF target total phosphorus concentration, at these concentrations meeting the limit is very difficult and is affected by the speciation of phosphorus in the wastewater. In all wastewaters there is a portion of non-reactive phosphorus that will not be removed. During the Phase 2 Facilities Plan, Blue PRO performed some off site bench scale process testing of the South Street WWTF's secondary effluent, showing their ability to meet the target total phosphorus concentrations. However due to this limited data set and the low target concentration , it is recommended that performance of the technology be tested on a larger scale before proceeding with a full design. As an initial step in design it is recommended that this testing be performed on a pilot scale over a several week period to observe the Blue PRO system performance under varying flow and loading conditions. If the performance testing does not show the ability to meet the target effluent limits, the need to provide a second stage of Blue PRO filters or to utilize one of the other technologies (both tertiary phosphorus removal technologies and MBRs) will need to be reconsidered.

Site Constraints, Constructability and Plant Operations. The South Street WWTF site is extremely constrained. The site is only accessible from the two gates on South Street and a rear gate in the south east corner of the site from the Highway Department yard/parking area. In addition WWTF access roads are narrow and there is limited unused space on the site. The site will become even more constrained based on the recommended new facilities including; the partially enclosed septage receiving facility, the expanded influent box at the Influent Building, the Blower Building, the new generator and associated oil tank, the new odor control systems, the Post Aeration Tank and the UV Disinfection, Garage and Switchgear Building. In addition to the site constraints, the WWTF will need to be able to maintain operations throughout the upgrade construction while still meeting permit.

As a result, the design will need to address the site constraints and the need to maintain plant operations during construction. Constraints on the sequencing of work during construction will be evaluated and recommended during design to address these issues. Examples of these recommendations include:

- Sequencing of the work including the aeration tank work, the new UV disinfection and Post Aeration work (with demolition of the existing facilities, the new and existing filter cell modification work for the Blue PRO system), other system replacement components (pumps, final settling tank components), etc.
- Identifying wastewater unit process bypass requirements as needed.
- Specifying WWTF operations access requirements including those for staff, septage haulers, fuel and chemical deliveries, sludge hauling, etc.
- Identifying the needs for temporary facilities including staff facilities, temporary chemical feed systems (if necessary), temporary electrical systems, etc.

The design will also evaluate the staging area needs for the upgrade which will result in identifying areas for contractor trailers, worker parking, and equipment staging. Based in the site constraints it is likely that some of these areas will need to be located outside of the existing WWTF fence line.

Request Revised Compliance Schedules in Both NPDES Permits. Once DEEP's comments on the Draft Phase 2 Wastewater Facilities Plan report are obtained and the comments are addressed, the WPCA should request that the Compliance Schedules contained in the NPDES permits for both the

Route 7 WWTF and the South Street WWTF be revised to match the implementation schedule contained in the Final Phase 2 Wastewater Facilities Plan report.

CHAPTER TWO
INTRODUCTION, PURPOSE AND SCOPE, AND BACKGROUND

INTRODUCTION

The Town of Ridgefield owns and operates two wastewater treatment facilities (WWTFs) that serve two different sewer service areas: Sewer District No. 1 served by the South Street Wastewater Treatment Facility (WWTF), and Sewer District No. 2 served by the Route 7 Wastewater Treatment Facility. Both WWTFs are contract operated by Suez. The discharges of treated effluent from each WWTF are regulated by the Environmental Protection Agency (EPA) and the Connecticut Department of Energy and Environmental Protection (DEEP). A brief description of the history of existing wastewater collection and treatment facilities is presented in this chapter. Further discussion on managing peak flows is included in Chapter Three and detailed assessments of the condition of the unit processes, equipment, buildings and other ancillary facilities at the two WWTFs are included in Chapter Five.

PURPOSE AND SCOPE OF REPORT

The purpose of this Phase 2 Facilities Plan study is to review the existing conditions at the WWTFs to identify equipment, structures, and processes in need of an upgrade to provide future service, evaluate upgrade alternatives to treat the projected future flows and loads from Sewer District No. 1 and Sewer District No. 2 in the year 2035, and formulate an approach to upgrade the WWTFs to accommodate the future flows and loads. As part of this study, an evaluation of combining the treatment of the flow from both sewer districts at the South Street WWTF was considered. The scope of the report is outlined in detail in the engineering agreement between the Town of Ridgefield and AECOM, Inc. and is comprised of a series of eight major tasks summarized in **Table 2-1.**

BACKGROUND

Sewer District No. 1 Collection System

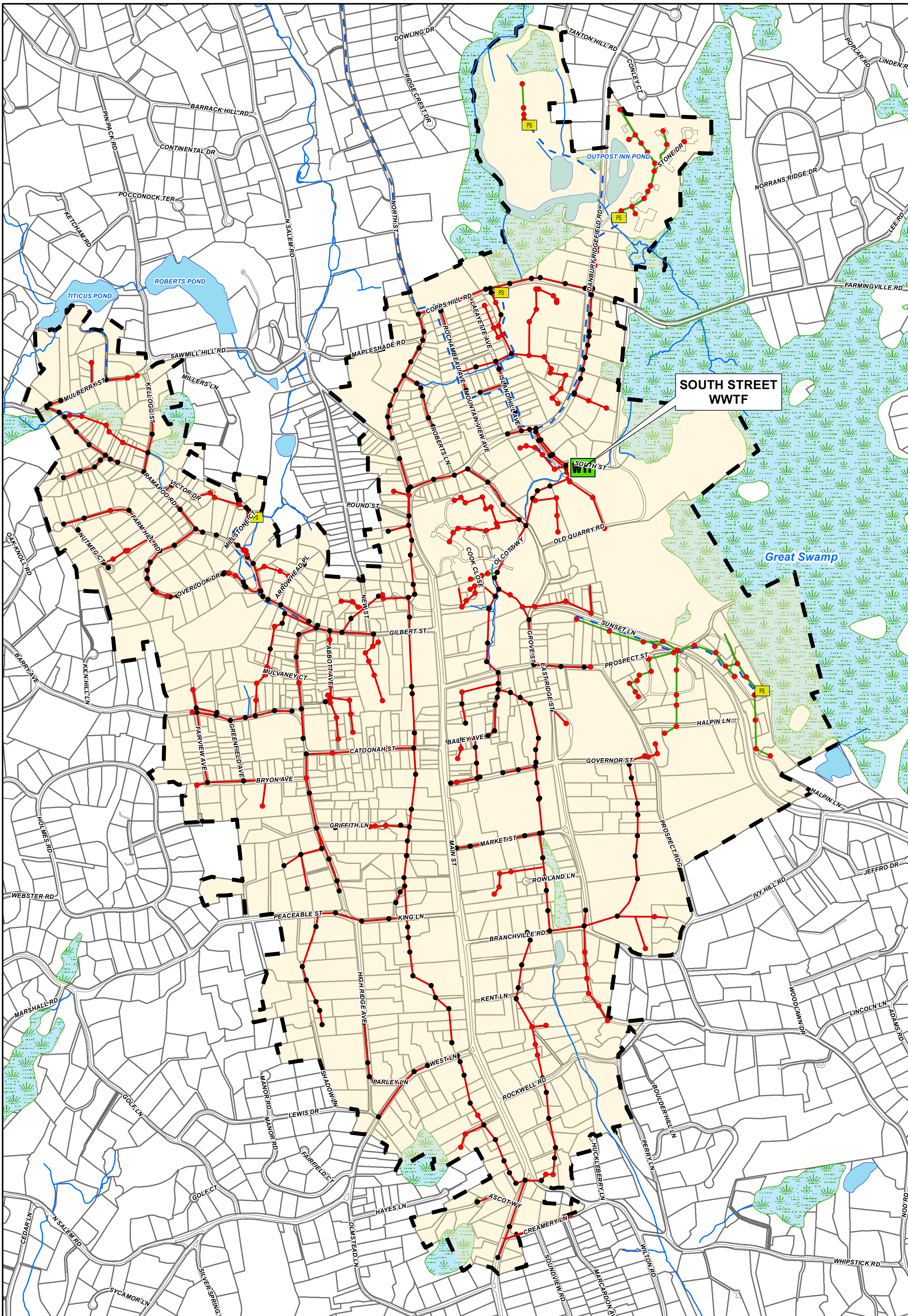
Sewer District No. 1 is the largest of the Town's sewer districts, serving downtown Ridgefield and the surrounding areas. Sewer District No. 1 includes a wastewater collection system that collects wastewater from approximately 1,230 acres which represents about 5.5 percent of the Town's area. The gravity sewer system consists of approximately 100,000 feet of sewers ranging in size from 6 inches to 18 inches in diameter, with approximately 1,760 billed service accounts. Most of the collection system conveys wastewater by gravity, but there are 6 pump stations (PS) in Sewer District No. 1 that lift the wastewater to higher elevations. There are also several small pump stations not operated by the WPCA (Recreation Center, Highway Department). Sewer District No. 1 also includes flow from Ridgefield's High School and Scott's Ridge Middle School which are pumped to the South Street WWTF. **Figure 2-1** shows the existing Sewer District No. 1 wastewater collection system. **Table 2-2** lists the pump stations in Sewer District No. 1 and key characteristics of each.

History. Much of the Sewer District No. 1 collection system dates from 1902 when a gravity sewer system consisting of vitrified clay pipes was constructed to service the "village" or central section of Town. The collection system has been expanded in stages over time since the construction of the original sewer system serving the village including sewers to handle the following locations:

- Fox Hill Condominiums
- Copps Hill and Peatt Park areas
- Ramapoo Road area
- High School and Scotts Ridge Middle School

TABLE 2-1. SCOPE OF WORK TASKS

Task	Description
1. Collection System Inflow Reduction Efforts	Locate, and develop a plan to remove, collection system inflow sources from Sewer District No. 1. The efforts include manhole inspections, a public education program, house to house inspections, and follow up inflow identification efforts for the Phase 2 Facilities Planning efforts including dyed watering tracing and flooding efforts in conjunction CCTV inspection, and select TV inspection. Prepare an Inflow Reduction Plan.
2. Evaluate Peak Flow Equalization at the South Street WWTF	Evaluate the use of peak flow equalization tank(s) at the South Street WWTF including conceptual sizing, site location, equipment needs identification, and estimated costs for implementation.
3. Investigate Future Effluent Limits	Identify potential future effluent limits, particularly nitrogen, phosphorus, and zinc that may be imposed on both WWTFs including if all flows are conveyed for treatment at the South Street WWTF through discussions with the DEEP.
4. Conduct WWTF Condition Assessment	Conduct a field assessment of the existing treatment facilities to review the existing facilities with the Town and Suez to gain both an understanding of the condition of the facilities and to identify equipment and structures in need of improvement or replacement at both WWTFs.
5. Identify Alternatives for Process and Facilities Upgrade	Identify alternatives for upgrading equipment, processes, and structures at the existing treatment facilities to treat the future flows and loadings to meet the effluent limits including those if all flows are conveyed for treatment at the South Street WWTF. Conduct an alternatives review workshop with the Town and Suez.
6. Develop and Evaluate Alternatives for Process and Facilities Upgrade	Develop and evaluate the upgrade alternatives based on their ability to meet the anticipated future effluent permit requirements and to address the upgrade of existing mechanical equipment, the ancillary equipment, and space needs of the facilities including those if all flows are conveyed for treatment at the South Street WWTF. The alternatives will be evaluated in terms of technical feasibility, capital and operating costs, and life-cycle costs. Conduct an alternatives evaluation workshop with the Town and Suez.
7. Prepare a Phase 2 Facilities Plan Report	Select a recommended plan to upgrade the treatment facilities based on an economic analysis, advantages and disadvantages, and Town and Suez preferences. Prepare a report that summarizes the recommended plan including cost and implementation considerations.
8. Prepare an Environmental Impact Evaluation	Prepare an Environmental Impact Evaluation (EIE) for the recommended facilities upgrades recommended in the Phase 2 Facilities Plan report. These EIE will not be included in Phase 2 Facilities Plan Report.

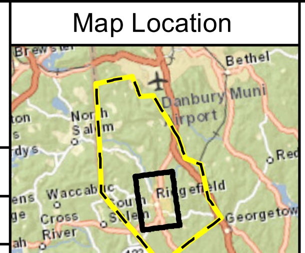


AECOM

Drawn: BC 4/23/2015

Approved: AA 4/23/2015

Map Location



Legend

WTF WWTF	Roads
PS Pump Station	Force Main
Manhole	Streams
Manhole - Not Field Located	Swamps
Municipal Sewer	Waterbodies
Private Sewer	Parcel Polygon

N

0 500 1,000 2,000 Feet

FIGURE 2-1

WASTEWATER COLLECTION SYSTEM
SEWER DISTRICT NO. 1

PHASE 2 WASTEWATER FACILITIES PLAN
RIDGEFIELD, CT

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TABLE 2-2. SEWER DISTRICT NO. 1 PUMP STATIONS

Pump Station Name	Pump Station Type	Pumping Capacity (Gallons per Minute)	Year of Construction or Last Upgrade
South Street WWTF Influent PS	Duplex Submersible	680	2007
Copps Hill PS	Duplex Submersible	650	2007
Middle School PS	Duplex, Two-Stage Submersible	280	2003
Quail Ridge PS	Duplex Prefabricated Dry Pit	100	1985
Fox Hill PS	Duplex Submersible	300	2005
Ramapoo Road (Millstone Court) PS	Duplex Submersible	220	1998

Additional details of the collection system history in these areas are described in more detail in the Phase 1 Wastewater Facilities Plan Report.

High Flow Issues. Due to the age of the collection system, Infiltration/Inflow (I/I) has historically been an issue at the South Street WWTF since the 1960s. I/I is extraneous groundwater and surface water that enters the sewer system, occupying capacity and potentially overloading the collection system. The Town has undertaken previous efforts to locate and remove I/I sources. An initial effort was undertaken in the 1960s with subsequent efforts undertaken in the mid 1980's with some sewer main lining and manhole sealing and repair performed.

In response to the unusually wet weather in late 2005 and early 2006, a district wide I/I analysis consisting of flow metering and television inspection of the Sewer District No. 1 sewers was completed in 2005-2009. This was followed by a sewer rehabilitation project in 2010 that used a variety of liner and repair methods to address defective and leaking pipes. In 2010, to address infrequent periods of high flows at the South Street WWTF Influent Pump Station, the Town installed a portable self-priming pump that starts automatically as a supplement to the influent pumps. Since the sewer rehabilitation work has been completed, the frequency of operation of this backup pumping system has been reduced, indicating the effectiveness in reducing I/I.

Additional details of the collection systems work related to high flow issues are described in more detail in the Phase 1 Wastewater Facilities Plan Report and in Chapter Three of this report.

South Street WWTF

From 1902 until 1973-74, collected wastewater in Sewer District No. 1 was treated using primary treatment and sand filtration at the location of the current WWTF on South Street. Treated effluent was discharged to the Great Swamp, which are the headwaters of the Norwalk River. The original primary treatment plant had an average daily flow capacity of 0.126 mgd.

The WWTF was upgraded and expanded both in the early 1970's and again in the early 1990s with the last upgrade providing an average daily flow capacity of 1.0 mgd. The WWTF system that exists today is a result of the early 1990s upgrade and expansion. **Figure 2-2** shows a site plan of the existing South Street WWTF, **Figure 2-3** presents a process flow diagram of the WWTF, and **Figure 2-4** shows aerial photographs of the existing WWTF.

The South Street WWTF uses a single stage nitrification activated sludge process to provide advanced treatment. The WWTF consists of the following processes:

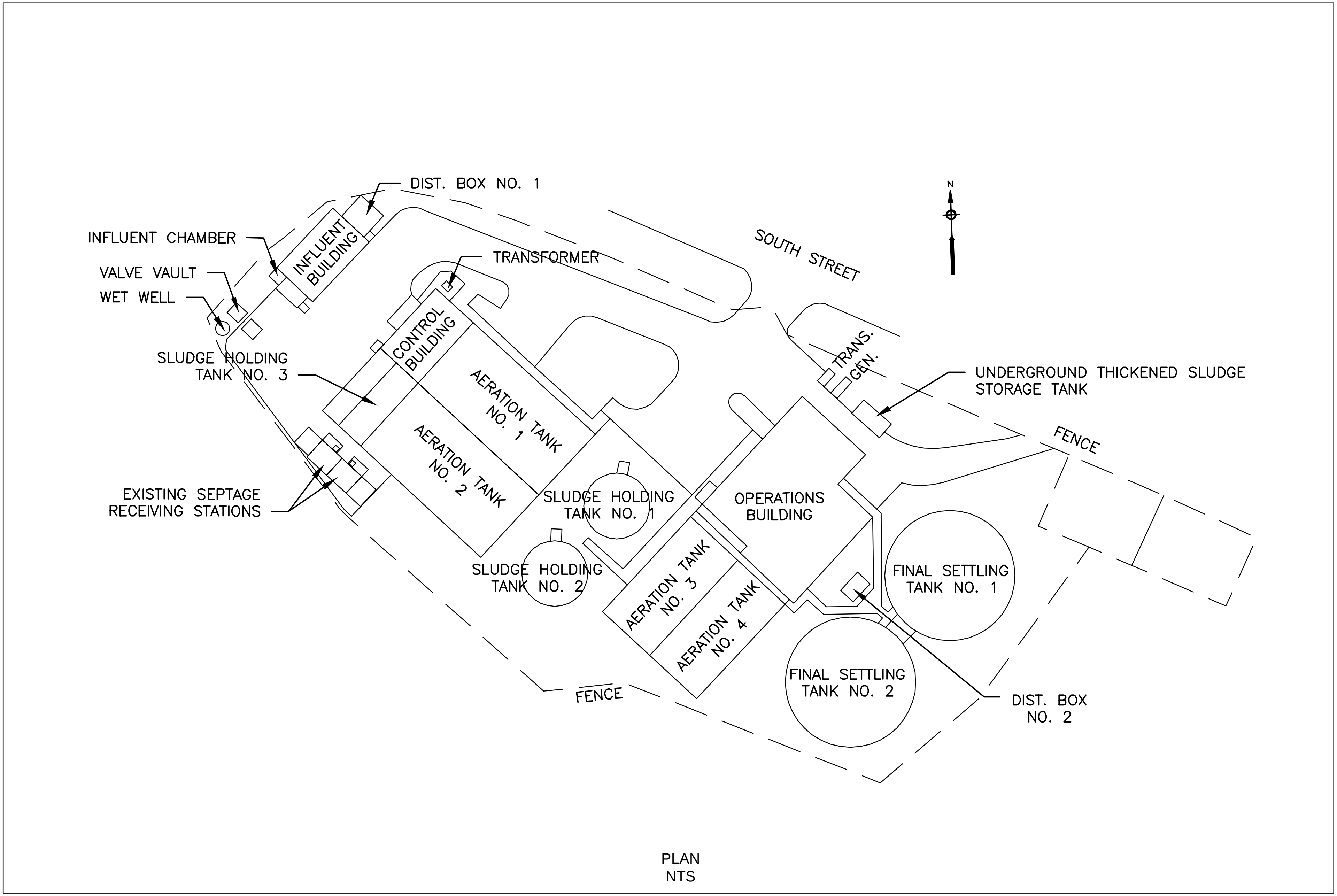
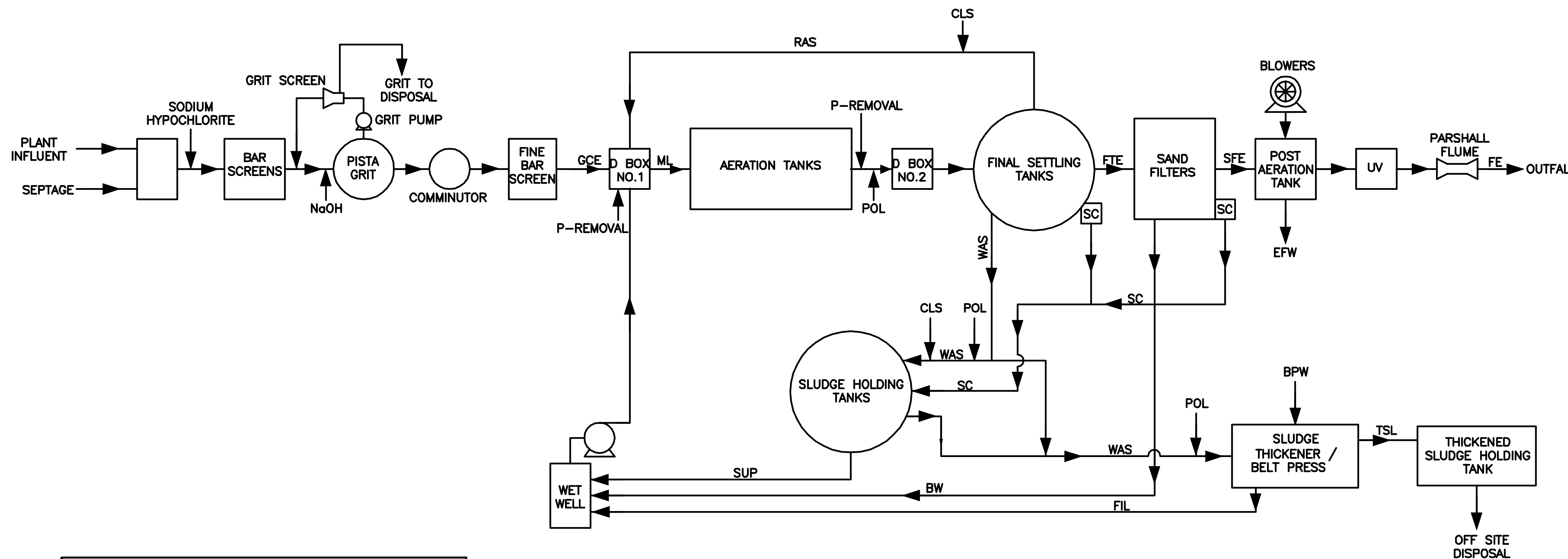


FIGURE 2-2
EXISTING SOUTH STREET WWTF
SITE LAYOUT



LEGEND	
FE	FINAL EFFLUENT
BW	BACKWASH
SC	SCUM
FIL	FILTRATE
POL	POLYMER
RAS	RETURN ACTIVATED SLUDGE
WAS	WASTE ACTIVATED SLUDGE
SUP	SUPERNATANT
GCE	GRIT CHAMBER EFFLUENT
ML	MIXED LIQUOR
FTE	FINAL SETTLING TANK EFFLUENT
SFE	SAND FILTER EFFLUENT
BPW	BELT PRESS WASH WATER
EFW	EFFLUENT FLUSHING WATER
CLS	CHLORINE SOLUTION
TSL	THICKENED SLUDGE
NAOH	SODIUM HYDROXIDE
P-REMOVAL	PHOSPHOROUS REMOVAL (ALUM)
POL	POLYMER

FIGURE 2-3
SOUTH STREET WWTF
PROCESS FLOW SCHEMATIC

Photographs from Bing Maps

Figure 2-4. South Street WWTF Aerial Photographs

- Gravity Influent and Influent Pump Station
- Influent Building for Preliminary Treatment
- Aeration Tanks
- Final Settling Tanks
- Sand Filters
- Post Aeration
- Ultraviolet (UV) Disinfection
- Gravity Belt Thickener/ Belt Filter Press Solids Handling
- Thickened Sludge Storage

The South Street WWTF in its current form has been in operation since 1992 with minor equipment replacements as needed to keep the many mechanical systems operating. Additional background information on the South Street WWTF history and systems are described in more detail in the Phase 1 Wastewater Facilities Plan Report.

Sewer District 2 Collection System

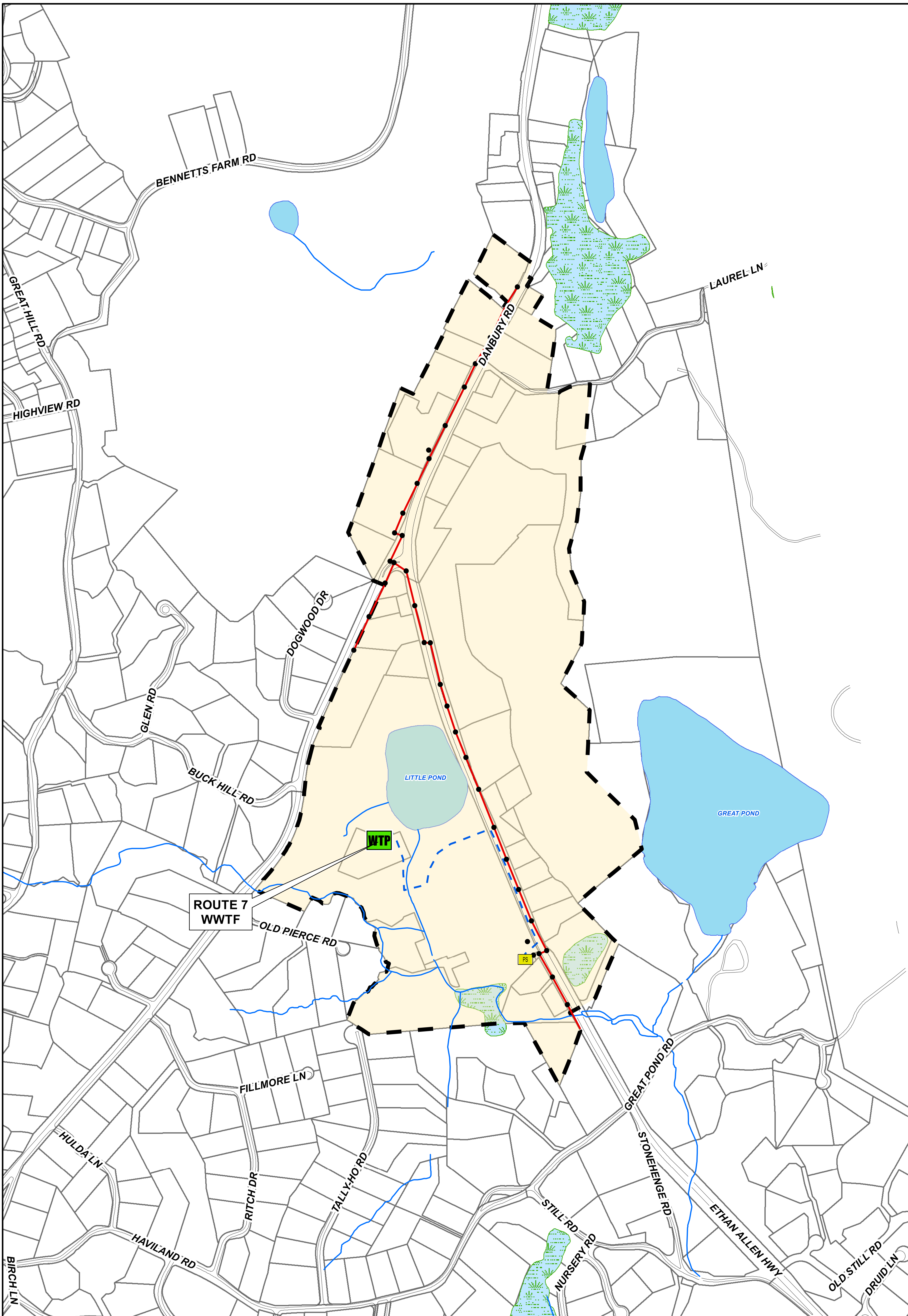
Sewer District No. 2 is located near the intersection of Route 35 and Route 7. **Figure 2-5** shows the extent of the collection system and service area for Sewer District No. 2. Sewer District No. 2 includes a wastewater collection system that collects wastewater from approximately 170 acres which represents less than 1 percent of the town's area. The gravity sewer system consists of approximately 6,300 feet of sewers ranging in size from eight inches to ten inches in diameter, with approximately 180 billed service accounts. Most of the collection system conveys wastewater by gravity to a single pump station near the Route 7 WWTF where the collected wastewater is pumped to the Route 7 WWTF. The Route 7 Pump Station houses duplex pumps in a prefabricated enclosure, and each pump has a capacity of 500 gallons per minute. This pump station has not been upgraded since it was constructed in 1985.

History. In 1978, the State of Connecticut issued the Town an order to abate pollution from failing on-site septic systems in the Route 7 and Route 35 area. At that time, the only wastewater treatment facility in this area was serving the Wells-Benrus (later Perkin-Elmer, now Ponds Edge Professional Park) facility. Other properties in this area were served by on-site septic systems. The Wells-Benrus WWTF was a 40,000 gallon per day extended aeration facility constructed in 1967. In 1979, in response to the State Order, a Facilities Plan was prepared by the Town for the Route 7 and Route 35 Area. Subsequent to the Facilities Plan, the collection system, Route 7 Pump Station, and the Route 7 WWTF were constructed. The old Wells-Benrus WWTF was then abandoned, and the Wells-Benrus facility was connected into the new Route 7 WWTF.

To fund the construction of the sewer system and the Route 7 WWTF, all of the parcels to be served formed the basis for Sewer District No. 2, and each parcel was allocated a flow allowance. The State paid 55 percent of the cost for the WWTF, as well as 30 percent of the cost of the collection system serving the area. The remaining costs were borne by the property owners of the parcels to be served by the system. Nearly all of the parcels in Sewer District No. 2 have since connected to the sewer system, although many of the parcels have not been developed at the density of development permitted by current zoning of the District. As a result, all of the current Route 7 WWTF capacity has been allocated to the existing users, with no capacity available for extension of the collection system. Additional details of the system history are described in more detail in the Phase 1 Wastewater Facilities Plan Report.

Route 7 WWTF

The Route 7 WWTF uses rotating biological contactors (RBCs) to provide advanced treatment and has an average daily flow capacity of 0.12 mgd. **Figure 2-6** shows a site plan of the existing Route 7 WWTF, **Figure 2-7** presents a process flow diagram of the WWTF, and **Figure 2-8** shows aerial photographs of the existing WWTF. All flow that enters the Route WWTF is pumped by the Route 7 pump station through an eight inch force main to the headworks of the WWTF. The WWTF consists of the following processes:



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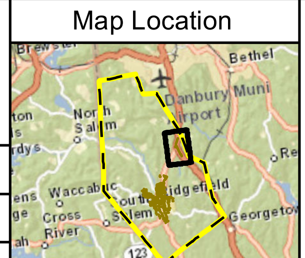
Approved: AA 4/23/2015

Map Location



Legend

WTP WWTF	Roads
PS Pump Station	Force Main
Manhole	Streams
Municipal Sewer	Swamps
	Waterbodies
	Parcel Polygon

0 300 600 1,200 Feet

N

FIGURE 2-5

WASTEWATER COLLECTION SYSTEM
SEWER DISTRICT NO. 2

PHASE 2 WASTEWATER FACILITIES PLAN
RIDGEFIELD, CT

G:\Projects\MUNI\60299267RID\Maps\Facilities Flow Report\Figure 2-5 - Existing Sewer District 2.mxd

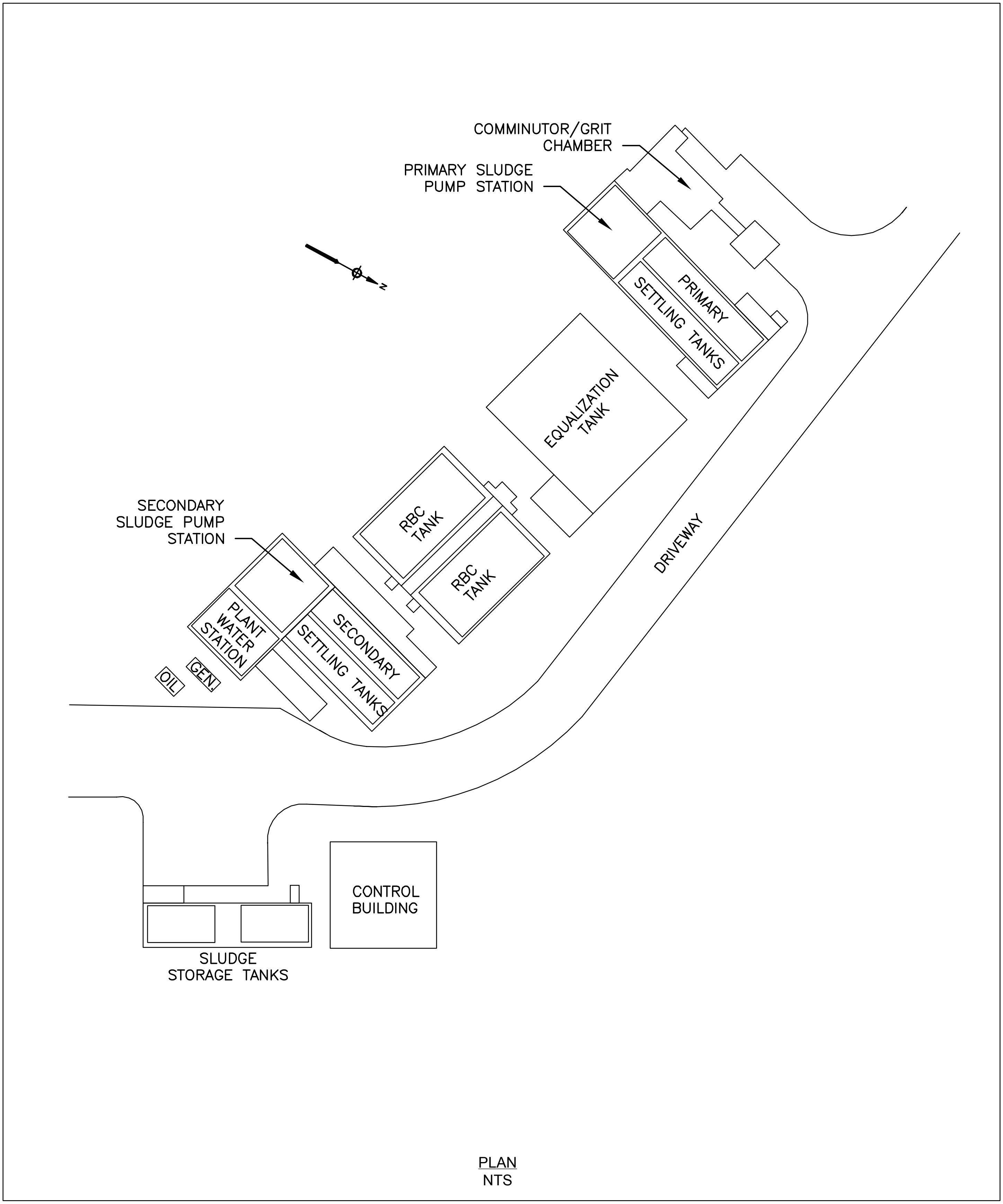
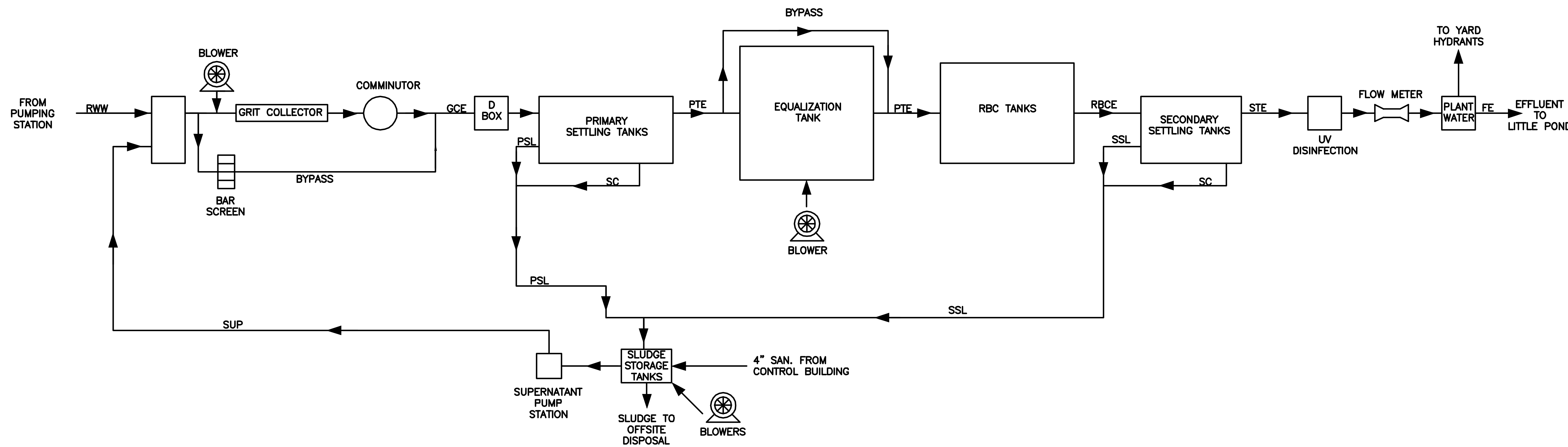


FIGURE 2-6
EXISTING ROUTE 7 WWTF
SITE LAYOUT



LEGEND	
RWW	RAW WASTEWATER
GCE	GRIT CHAMBER EFFLUENT
FE	FINAL EFFLUENT
PTE	PRIMARY SETTLING TANK EFFLUENT
STE	SECONDARY SETTLING TANK EFFLUENT
SC	SCUM
PSL	PRIMARY SLUDGE
SSL	SECONDARY SLUDGE
RBCE	ROTATING BIOLOGICAL CONTACTOR EFFLUENT
SUP	SUPERNATANT
SAN	SANITARY DRAIN

FIGURE 2-7
ROUTE 7 WWTF
PROCESS FLOW SCHEMATIC

Photographs from Bing Maps

Figure 2-8. Route 7 WWTF Aerial Photographs

- Headworks for Preliminary Treatment
- Primary Settling Tanks
- Flow Equalization Tank
- Rotating Biological Contactors (RBCs)
- Secondary Settling Tanks
- UV Disinfection
- Sludge Storage Tanks

The Route 7 WWTF in its current form has been in operation since 1985 with minor equipment replacements as needed to keep the many mechanical systems operating. In about the year 2000, the RBC units were replaced due to deterioration.

CHAPTER THREE
SUMMARY OF PHASE 1 FACILITIES PLAN AND PEAK FLOW MANAGEMENT

INTRODUCTION

To respond to the NPDES permit requirement that the Town prepare a plan to accommodate future flow increases at the South Street WWTF, the Town initiated preparation of this Facilities Plan. The Facilities Plan has been structured to address the planning issues in a two phased approach. In Phase 1, the Route 7 WWTF and the South Street WWTF existing flows and loads were reviewed and compared to their design conditions; the ability of the WWTFs to meet their permit limits were evaluated; the hydraulic and pollutant loading capacity of the existing WWTFs were analyzed; and the future flows and loads for the next 20 years under average day conditions were projected. These projections included flows and loads from each Sewer District being discharged to its current WWTF or the flows and loads of both Sewer Districts being discharged to the South Street WWTF. In addition the Scope of Work for the second phase of the Facilities Plan was developed based on the findings of the first phase.

The Phase 1 Facilities Plan Report was issued as a draft in April 2015 and was submitted to the DEEP for review. The relevant conclusions of the Phase 1 Facilities Plan are summarized in this chapter. More detailed information on the information presented below can be found in the Phase 1 Facilities Plan Report.

In addition this chapter presents the historical, Phase 1, and Phase 2 Facilities Planning efforts to investigate and control infiltration and inflow in both Sewer Districts with the majority of the efforts in Sewer District No. 1. Finally as a result of these efforts, this chapter presents peak flow management options to reduce peak flows to the South Street WWTF over the next 20 years.

ROUTE 7 WWTF PHASE 1 FACILITIES PLAN SUMMARY

Sewer District No. 2 Existing Flows and Loads

The existing influent flows and concentrations of wastewater constituents for the Route 7 WWTF for the period between July 1, 2010 and June 30, 2013 were reviewed and evaluated as well as the amount of infiltration and inflow in Sewer District No. 2. A summary of this review is below.

Infiltration and Inflow

Infiltration and inflow (I/I) were assessed using flows recorded at the WWTF and the Route 7 Pump Station data. Significant I/I was shown to be present in the Sewer District 2 collection system based on the flow records. **Table 3-1** presented a summary of the wastewater, infiltration, and inflow received at the Route 7 WWTF.

TABLE 3-1. ROUTE 7 WWTF CURRENT INFILTRATION AND INFLOW SUMMARY

Flow Component	Average Daily Flow (gpd)	Peaking Factor	Peak Flow (gpd)
Current Wastewater	33,000	3.0	99,000
Current Infiltration	21,000	1.79	37,600
Current Inflow	-	-	223,400
Total	54,000		360,000

Route 7 WWTF Influent Flows and Loads and Treatment Performance

The existing flows and concentrations of wastewater constituents for the Route 7 WWTF for the reporting period between July 1, 2010 and June 30, 2013 were evaluated. These included the wastewater constituent data for the WWTF's influent, primary effluent, and final effluent including annual average day and maximum month conditions. **Table 3-2** summarizes this data.

TABLE 3-2. ROUTE 7 WWTF FLOW AND LOADING SUMMARY (JULY 2010 TO JUNE 2013)

Parameter	Annual Average Day	Max Month Peaking Factor	Max Month[1]
Influent			
Flow (mgd)	0.053	1.49	0.079
TSS (mg/l)	226		199
TSS (lb/d)	102	1.28	131
BOD_5 (mg/l)	280		263
BOD_5 (lb/d)	124	1.40	173
Total Phosphorus (mg/l)	5.98		5.84
Total Phosphorus (lb/d)	2.71	1.42	3.85
Ortho-Phosphate (mg/l)	3.28		2.94
Ortho-Phosphate (lb/d)	1.46	1.33	1.94
Primary Effluent			
TSS (mg/l)	109		139
TSS (lb/d)	49.3	1.86	91.5
BOD_5 (mg/l)	180		182
BOD_5 (lb/d)	81.8	1.47	120
Ammonia Nitrogen (mg/l)	19.7		17.8
Ammonia Nitrogen (lb/d)	8.91	1.31	11.7
Final Effluent			
TSS (mg/l)	2.62		4.46
TSS (lb/d)	1.17	2.51	2.94
BOD_5 (mg/l)	4.20		5.42
BOD_5 (lb/d)	1.89	1.89	3.57
Ammonia Nitrogen (mg/l)	0.52		0.90
Ammonia Nitrogen (lb/d)	0.24	2.46	0.59
Total Phosphorus (mg/l)	5.09		5.00
Total Phosphorus (lb/d)	2.29	1.44	3.29
Ortho-Phosphate (mg/l)	4.05		3.79
Ortho-Phosphate (lb/d)	1.82	1.37	2.50

1. Due to the limited number of daily samples collected for analysis, the maximum month loading conditions were based on the 92nd percentile of all of the data while the maximum month concentration data was back calculated from the maximum month loading conditions and the maximum month flow.

Route 7 WWTF Design Flow and Loading, Effluent Concentration, and Permit Limit Comparison

As part of the facilities planning effort a comparison of the design flows and loads to the current conditions was performed as well as a comparison of the current effluent concentrations to the permit limits. These comparisons are presented in **Table 3-3.** For more detail information on these comparisons see the Phase 1 Wastewater Facilities Plan Report.

TABLE 3-3. ROUTE 7 WWTF DESIGN FLOW AND LOADING, EFFLUENT CONCENTRATION, AND PERMIT LIMIT COMPARISON (JULY 2010 TO JUNE 2013)

Element	Comparison to Design or Permit Limits
Flows	
Average Day Flow	Current flows are lower than design flows
Peak Hour Flow	Current flows are lower than design flows
Loads	
BOD	Current loads are lower than design loads
TSS	Current loads are lower than design loads
Permit Limits	
BOD	Effluent well below permit limits and meets 90% removal requirement
TSS	Effluent well below permit limits and meets 90% removal requirement
Ammonia	Effluent well below permit limits

Route 7 WWTF Capacity Evaluation

As part of the facilities planning effort a comparison of the hydraulic and pollutant removal capacities of the Route 7 WWTF under current conditions, design conditions, and increased flow and loading conditions was performed to determine which unit processes are limiting the WWTF's overall capacity. For the WWTF an opinion was offered on both its hydraulic capacity and pollutant removal capacity. After these capacity limitations were established, potential modifications to relieve these limitations were identified while considering the current and future permit limits at the WWTF.

Hydraulic Capacity. A summary of the hydraulic capacity evaluations are presented in **Table 3-4**, highlighting areas with the most significant capacity limitations. It should be noted that the hydraulic capacity of the rotating biological contactors and the UV disinfection system are indicated in the table as 0.0 mgd. This is the result of the weirs in both of these unit processes being located less than one foot below the top of the wall or structure therefore limiting the freeboard to less than 1 foot as required by TR-16, the design guidance document used by the CT DEEP to regulate WWTFs. For more detail information on these capacity evaluations see the Phase 1 Wastewater Facilities Plan Report.

TABLE 3-4. ROUTE 7 WWTF UNIT PROCESS HYDRAULIC CAPACITY WITH ONE UNIT OUT OF SERVICE

Treatment Unit	Unit Process Capacity	Comment
Primary Settling Tank Effluent Trough	Less than 0.30 mgd	
Rotating Biological Contactors	0.0 mgd [1]	RBC effluent weir is 6 inches below the top of tank
Secondary Settling Tank Effluent Trough	Less than 0.12 mgd	
UV Disinfection	0.0 mgd [1]	UV effluent weir is less than 12 inches below UV channel top

1. This structure has not been reported to have overtopped in the past and has been able to convey the flows recorded at the WWTF.

Pollutant Loading Capacity. A summary of the pollutant loading capacity evaluations are presented in **Table 3-5**, highlighting areas with the most significant capacity limitations. For more detail information on these capacity evaluations see the Phase 1 Wastewater Facilities Plan Report.

TABLE 3-5. ROUTE 7 WWTF UNIT PROCESS LOADING CAPACITY

Treatment Unit	Unit Process Capacity [1]	Limitation Comment
Grit Chamber	Peak Hour Flow - 0.58 mgd	Hydraulic Detention Time Limitation
UV Disinfection	Peak Hour Flow - 0.20 mgd	Capacity per information from the manufacturer

1. The loading was based on increasing flows at current WWTF influent concentrations.

Projected Year 2035 Flows and Loads

As summarized in the Phase 1 Report, the capacity of the existing Route 7 WWTF has been fully allocated to the existing parcels that comprise the district, and each parcel owner has purchased their share of the plant capacity. Since the capacity of the WWTF is fully allocated to the existing parcels in the District, the projected increase in the average daily flow and peak flow to the Route 7 WWTF would be from the development of undeveloped or underdeveloped parcels within the existing service area. No allowance for sewer extensions to serve parcels outside the existing sewer district has been included. Consequently, the projected future average daily flow for Sewer District 2 is the current plant capacity of 0.12 mgd and a peak flow capacity of 0.72 mgd. The projected year 2035 average day influent flows and loading to the Route 7 WWTF is summarized below in **Table 3-6**. For more detail information on these projected loadings see the Phase 1 Wastewater Facilities Plan Report.

TABLE 3-6. ROUTE 7 WWTF YEAR 2035 PROJECTED AVERAGE DAILY FLOW AND LOADS

Projected Average Daily Flow (mgd)	Projected Average Daily Load (lb./day)			
	BOD_5	TSS	TKN	TP
0.12	280	230	33	6.0

The projection of the 2035 loads from Sewer District No. 2 under peak flow conditions were not performed under the Phase 1 facilities planning effort, but were developed in Phase 2. Chapter Four presents the projected 2035 flows and loads from Sewer District No. 2 under peak flow conditions.

SOUTH STREET WWTF PHASE 1 FACILITIES PLAN SUMMARY

Sewer District No. 1 Existing Flows and Loads

The existing influent flows and concentrations of wastewater constituents for the South Street WWTF for the period between July 1, 2010 and June 30, 2013 were reviewed and evaluated as well as a review of the amount of infiltration and inflow in Sewer District No. 1. A summary of this review is below.

Infiltration and Inflow. Infiltration and inflow (I/I) for Sewer District 1 were assessed using flows recorded at the WWTF and pump station data throughout the collection system. Significant I/I was shown to be present in the Sewer District No. 1 collection system based on the flow records. **Table 3-7** presents a summary of the wastewater, infiltration, and inflow received at the South Street WWTF.

South Street WWTF Influent Flows and Loads and Treatment Performance

The existing flows and concentrations of wastewater constituents for the South Street WWTF for the reporting period between July 1, 2010 and June 30, 2013 were evaluated. These included the wastewater constituent data for the WWTF's influent and final effluent including annual average day and maximum month conditions. **Table 3-8** summarizes this data.

TABLE 3-7. SOUTH STREET WWTF CURRENT INFILTRATION AND INFLOW SUMMARY

Flow Component	Average Daily Flow (gpd)	Peaking Factor	Peak Flow (gpd)
Current Wastewater	592,000	2.8	1,658,000
Current Infiltration	201,000	1.81	363,000
Current Inflow	57,000	-	3,859,000
Total	850,000		5,880,000

TABLE 3-8. SOUTH STREET WWTF FLOW AND LOADING SUMMARY (JULY 2010 TO JUNE 2013)

Parameter	Annual Average Day	Max Month Peaking Factor	Max Month [1]
Influent			
Flow (mgd)	0.85	2.15	1.83
TSS (mg/l)	232		181
TSS (lb/d)	1,643	1.69	2,776
BOD_5 (mg/l)	219		158
BOD_5 (lb/d)	1,550	1.55	2,405
Total Kjeldahl Nitrogen (mg/l)	24.8		16.3
Total Kjeldahl Nitrogen (lb/d)	176	1.41	249
Total Phosphorus (mg/l)	4.0		3.1
Total Phosphorus (lb/d)	28.4	1.67	47.4
Zinc (kg/d)	0.799	1.81	1.446
Final Effluent			
TSS (mg/l)	2.1		2.3
TSS (lb/d)	14.8	2.34	34.7
BOD_5 (mg/l)	2.2		2.1
BOD_5 (lb/d)	15.3	2.14	32.7
Ammonia Nitrogen (mg/l)	0.5		1.0
Ammonia Nitrogen (lb/d)	3.8	3.87	14.7
Total Nitrogen (mg/l)	5.9		4.2
Total Nitrogen (lb/d)	40.7	1.58	64.3
Total Phosphorus (mg/l)	0.2		0.3
Total Phosphorus (lb/d)	1.4	3.29	4.6
Zinc (kg/d)	0.147	1.33	0.196

1. Due to the limited number of daily samples collected for analysis, the maximum month loading conditions were based on the 92^{nd} percentile of all of the data while the maximum month concentration data was back calculated from the maximum month loading conditions and the maximum month flow.

It should be noted that a preliminary analysis of influent concentration and loading data for the primary pollutants (BOD_5, TSS, Total Kjeldahl Nitrogen (TKN), and TP) showed a great deal of variability. This variability was believed to contain some unrepresentative data that was potentially attributed to the septage received at the WWTF and its impact on the influent composite samples. As a result, the data for the reporting period was truncated based on the review of plotted data histograms, engineering judgment, and textbook references. The truncated data is including in **Table 3-8**. For more detail information on the data truncation see the Phase 1 Wastewater Facilities Plan Report.

South Street WWTF Design Flow and Loading, Effluent Concentration, and Permit Limit Comparison

As part of the facilities planning effort a comparison of the design flows and loads to the current conditions was performed as well as a comparison of the current effluent concentrations to the permit limits. These comparisons are presented in **Table 3-9.** For more detail information on these comparisons see the Phase 1 Wastewater Facilities Plan Report.

TABLE 3-9. SOUTH STREET WWTF DESIGN FLOW AND LOADING, EFFLUENT CONCENTRATION, AND PERMIT LIMIT COMPARISON (JULY 2010 TO JUNE 2013)

Element	Comparison to Design or Permit Limits
Flows	
Average Day Flow	Current average flows exceeded 90% of design average flow 40% of the time. Overall average for period was 85% of design flow
Peak Hour Flow	Current peak flows have been higher than design flows 21 times during the reporting period
Loads	
BOD	Current loads are lower than design loads
TSS	Current loads are lower than design loads
TKN	Current loads are lower than design loads
Permit Limits	
BOD	Effluent well below permit limits and meets 85% removal requirement
TSS	Effluent well below permit limits and meets 85% removal requirement
Ammonia	Effluent well below permit limits
Total Phosphorus	Effluent well below the previous 1.0 mg/l average monthly permit limits
Zinc	Two average month and one maximum day effluent load exceedance during the reporting period. All occurred under high flow conditions due to wet weather.

South Street WWTF Capacity Evaluation

As part of the facilities planning effort, a comparison the hydraulic and pollutant removal capacities of the South WWTF under current conditions, design conditions, and increased flow and loading conditions was performed to determine which unit processes are limiting the WWTF's overall capacity For the WWTF an opinion was offered on both its hydraulic capacity and pollutant removal capacity. After these capacity limitations were established, potential modifications to relieve these limitations were identified while considering the current and future permit limits at the WWTFs.

Hydraulic Capacity. A summary of the hydraulic capacity evaluations are presented in **Table 3-10**, highlighting areas with the most significant capacity limitations. For more detail information on these capacity evaluations see the Phase 1 Wastewater Facilities Plan Report.

Pollutant Loading Capacity. A summary of the pollutant loading capacity evaluations are presented in **Table 3-11**, highlighting areas with the most significant capacity limitations. For more detail information on these capacity evaluations see the Phase 1 Wastewater Facilities Plan Report.

Projected Year 2035 Flows and Loads

As summarized in the Phase 1 Report, the projected future flows for Sewer District 1 were developed in a series of steps. First, flows resulting from new connections to the sewer system in the existing district were estimated. Next, flows resulting from potential redevelopment of existing sewered properties in Sewer District 1 based on current zoning designations were estimated. Lastly, data were reviewed to identify sewer needs areas where extension of the Sewer District 1 collection system to address pollution

TABLE 3-10. SOUTH STREET WWTF UNIT PROCESS HYDRAULIC CAPACITY WITH ONE UNIT OUT OF SERVICE

Treatment Unit	Unit Process Capacity	Comment
Plant Influent Chamber	Between 4.1 mgd and 4.5 mgd	
Influent Screen	Between 4.1 mgd and 4.5 mgd	
Sand Filter Effluent	0.85 mgd	Conservative downstream UV system model parameter indicated less than 3 inches between weir and downstream water surface.

TABLE 3-11. SOUTH STREET WWTF UNIT PROCESS LOADING CAPACITY

Treatment Unit	Unit Process Capacity	Limitation Comment
Grit Chamber	4.1 mgd	Based on vendor information. Grit capture reduced above 4.1 mgd
Aerators - Two Tanks in Service	Insufficient aeration capacity in 1st aerobic zone under current average day conditions	All zones in ATs No. 3 and No. 4 run in series
Aerators - Four Tanks in Service	Insufficient aeration capacity in 1st aerobic zone under current maximum month conditions	All zones in ATs No. 3 and No. 4 run in series and all zones in ATs No. 1 and No. 2 run in series

or health issues with the continued use of on-site septic system may be warranted in the future. The projected year 2035 average day influent flow and loading to the South Street WWTF is summarized below in **Table 3-12**. For more detail information on these projected loadings see the Phase 1 Wastewater Facilities Plan Report.

TABLE 3-12. SOUTH STREET WWTF YEAR 2035 PROJECTED AVERAGE DAILY FLOW AND LOADS

Projected Average Daily Flow (mgd)	Projected Average Daily Load (lb./day)			
	BOD_5	TSS	TKN	TP
1.00	1,830	1,940	210	35

As part of the Phase 1 facilities planning effort the peak flow from Sewer District No. 1 was projected. The projected year 2035 peak flow from Sewer District No. 1 is 6.3 mgd. The projection of the 2035 loads from Sewer District No. 1 under peak flow conditions were not performed under the Phase 1 facilities planning effort, but were developed in Phase 2. Chapter Four presents the projected 2035 flows and loads from Sewer District No. 1 under peak flow conditions.

COMBINED SEWER DISTRICT FLOWS TO SOUTH STREET WWTF

As part of the Phase 2 Facilities Planning effort an evaluation of decommissioning the Route 7 WWTF was performed. In order to decommission the Route 7 WWTF, the flows from Sewer District 2 would need to be conveyed to and treated at the South Street WWTF. As such the combined Sewer District 1 and Sewer District 2 flows and loads to the South Street WWTF needed to be identified. To estimate these flows and loads the individual flows and loads were added together for Sewer District 1 and Sewer District 2. These combined flows and loads under average day condition were evaluated in the Phase 1 facilities planning effort. A summary of these combined flows and loads are presented in **Table 3-13.** For more detailed information on these projected loadings refer to the Phase 1 Wastewater Facilities Plan Report.

TABLE 3-13. YEAR 2035 PROJECTED COMBINED AVERAGE FLOW AND LOADS

Flow Component	Projected Average Daily Flow (mgd)	Projected Average Daily Load (lb./day)			
		BOD_5	TSS	TKN	TP
Sewer District No. 1	1.00	1,830	1,940	210	35
Sewer District No. 2	0.12	280	230	33	6
Combined	1.12	2,110	2,170	243	41

The projection of the year 2035 flows and loads from both Sewer District No. 1 and Sewer District No. 2 under peak flow conditions was not performed under the Phase 1 facilities planning effort, but was developed in Phase 2. Chapter Four presents the projected year 2035 flows and loads from Sewer District No. 1 and Sewer District No. 2 under peak flow conditions.

SEWER DISTRICT NO. 1 PEAK FLOW MANAGEMENT

During wet periods of the year when the groundwater level is elevated and large storm events occur, average and peak influent flows at the South Street WWTF increase significantly. These periods typically occur in the spring, and to a lesser extent, in the fall. The flow increases are a result of both increased infiltration of groundwater into the collection system, and more significantly, an increase in inflow of surface water and stormwater into the sanitary collection system. These flows which elevated the six month moving average of the plant average daily flow to exceed 90% of the design flow and was, in part, a reason the facilities planning effort was initiated. In addition these flow increases have exceeded the capacity of the South Street WWTF Influent Pump Station, although infrequently.

This section reviews existing peak flow conditions, describes recent and ongoing activities to manage the peak flows, and reviews alternatives for future peak flow management.

Existing Conditions

Under normal conditions, the flow from Sewer District No. 1 is conveyed to the South Street WWTF Influent Building through a combination of gravity sewers and an on-site submersible pump station (Influent Pump Station). During infrequent wet weather events, a portion of the South Street WWTF influent flow has been conveyed to the Influent Building through a trailer mounted pumping system that supplements the Influent Pump Station. The CT DEEP considers the use of the trailer mounted pumping system a bypass and the Town is required to file a bypass report each time this pumping system is used.

Recent Activities

Recognizing the impacts of the wet weather induced peak flows, the Water Pollution Control Association (WPCA) initiated several projects to manage peak flows. These include

- Infiltration/Inflow (I/I) Investigations and Rehabilitation Efforts
- Phase 1 Wastewater Facilities Planning Efforts
- Phase 2 Wastewater Facilities Planning Efforts
- Quail Ridge Pump Station Relocation

These efforts are described below.

Infiltration/Inflow (I/I) Investigations and Rehabilitation Efforts. In 2005, as part of the services under the wastewater operational services contract with Aquarion Operating Services (now SUEZ), cleaning and television inspection program of the collection system was initiated. As part of a five year cycle, approximately 20 percent of the collection system was cleaned and televised per year to locate leakage as well as structural defects in the system.

In 2007 and 2008, AECOM conducted an I/I analysis of Sewer Districts No.1 and No. 2. The analysis incorporated rain gauging and flow monitoring at seven locations for seven weeks and the review of TV inspection videos and reports of approximately 34,000 linear feet of sanitary sewers. As a result of these efforts a program to reduce I/I and improve system operation was presented in a February 2008 summary report.

In 2009, AECOM reviewed another approximately 4,000 linear feet of internal TV inspection data collected in 2009 as well as logs of 70 manhole inspections collected in 2008. Recommendations of sewer pipeline and manhole rehabilitation for these efforts were presented in the May 2009 summary report. Based on the recommendations of the 2008 and 2009 reports, construction documents were developed for sewer rehabilitation and bid as the Infiltration/Inflow Rehabilitation Project, Contract 09-1. The sewer rehabilitation work included the following:

- Chemical root control
- Joint testing and sealing
- Spot repairs
- Cured-in-place lining of mainline sewers
- Testing and sealing the connections of the mainline sewer service connections

The sewer rehabilitation project was completed in May 2010.

Phase 1 Wastewater Facilities Planning Efforts. Beginning in 2013, as part of the Phase 1 wastewater facilities planning efforts, smoke testing, manhole inspections, and a collection system bottleneck evaluation were conducted in Sewer District No. 1. The smoke testing program located and documented a total of 78 inflow sources and 784 suspected inflow sources. Through the manhole inspections, a total of 54 manholes were identified for repair of defects and/or cleaning to remove sediment and debris accumulated on the bench or in the invert of the manhole. Based on this field work the following recommendations were made:

- Cap and redirect 45 direct inflow sources
- Rehabilitate 54 manholes
- Conduct further investigations including:
    - 556 manhole inspections
    - Inspection of 2 wastewater structures
    - Dyed water tracing of 20 indirect inflow sources
    - Dyed water testing of 160 suspected sources
    - Closed circuit television inspection of selected mainline and lateral sewers
    - House to house inspections of all buildings connected to the Sewer District No. 1 sanitary collection system to locate sump pumps connected to the sewer system.

Phase 2 Wastewater Facilities Planning Efforts. Beginning in 2015, as part of the Phase 2 wastewater facilities planning efforts, the following field work was conducted:

- Dyed water testing – 160 suspected inflow sources (refer to Technical Memorandum No. 1 dated October 27, 2016 included as **Appendix A** to this report)
- Dyed water tracing – 20 identified inflow sources (refer to Technical Memorandum No. 1 dated October 27, 2016 included as **Appendix A** to this report)

- CCTV of selected mainline and lateral sewers – approximately 3,000 linear feet of mainline sewer and 10 laterals (refer to Technical Memorandum No. 2 dated November 17, 2016 included as **Appendix B** to this report)
- Manhole inspections – 470 manholes (approximately 80% of system) (refer to Technical Memorandum No. 3 dated December 21, 2016 included as **Appendix C** to this report)
- House to house inspections – completed approximately 1,000 out of 1,200 attempted inspections (83% of buildings in Sewer District 1) (Technical Memorandum No. 4 dated December 21, 2016 included as **Appendix D** to this report).

The findings and recommendation from these efforts are discussed in the Inflow Control Plan section below.

Quail Ridge Pump Station Relocation. As part of the Phase 1 Wastewater Facilities Plan, an evaluation of the collection system bottlenecks and an updated pump station evaluation was conducted. This evaluation identified a hydraulic restriction in the collection system, downstream of the Quail Ridge Pump Station. In addition, the Quail Ridge Pump Station is approximately 31 years old and is in need of upgrade or replacement. The existing concrete wet well was identified as having an inadequate working volume for the projected design flows. The pumping equipment was also identified as having reached the end of its design life and was in need of replacement to meet the design flows.

As a result, a project was undertaken to replace and ultimately relocate the pump station to address the pump station condition as well as the collection system bottleneck. As an initial step in the project, an evaluation of the feasibility of relocating the Quail Ridge Pump Station was conducted. Two alternatives were evaluated; replacement of the pump station at its current location, or construction of a new pump station in the vicinity of the Goodwill trailer on South Street. Benefits to relocating the pump station included a lower total dynamic head which translates into lower operating costs and diverting flows from the portion of the collection system identified as being overburdened. Relocation of the pump station also provides the opportunity to eliminate the existing Department of Public Works (DPW) Pump Station by intercepting flows from the municipal buildings, which currently discharge to it, and redirecting them to the new pump station. The Town is moving forward with a project to relocate the Quail Ridge Pump Station.

Future Peak Flow Management

As previously noted in this chapter, the year 2035 peak flow at the South Street WWTF was projected to be 6.3 mgd. This estimate was developed by adding the estimated existing peak flow of 5.9 mgd to the projected additional future peak flow of 0.4 mgd. See the Phase 1 Wastewater Facilities Plan Report for more information of the peak flow projection. It should be noted that the existing peak flows at the WWTF have exceeded the plant design capacity of 4.1 mgd 21 times between July 2010 and June 2013. In order to eliminate or reduce the WWTF upgrade requirements to manage these peak flows, two alternatives have been evaluated which include the following:

- Collection system inflow reduction efforts
- Peak flow equalization at the South Street WWTF.

In accordance with the recommendations in the Phase 1 Wastewater Facilities Plan, the Town is actively working on implementation of efforts to reduce peak inflow at the South Street WWTF. As the I/I identification and rehabilitation program is ongoing, and recognizing that the amount of leakage that can be reduced is highly dependent upon the sources and locations of the defects in the collection system, the degree of I/I reduction that can ultimately be achieved through system rehabilitation is uncertain. To provide a basis for comparing the benefits of continued efforts of an I/I reduction program to the approach of constructing flow equalization facilities, a flow equalization alternative was developed. The inflow reduction and flow equalization alternatives are described below.

Inflow Control Plan. An Inflow Control Plan has been developed to assist the Town in prioritizing work to control inflow in Sewer District No. 1. A Draft Inflow Control Plan is included as **Appendix E**. The goal of the Inflow Control Plan is to remove at least 25% of the existing peak inflow, representing 1.0 mgd of inflow. The Inflow Control Plan provides a list of inflow sources and recommends an educational public outreach program to garner support, additional basement inspections, and removal of inflow sources.

As noted previously, a number of field investigations identified numerous inflow sources. Going forward, it is recommended that the Town continue to focus on identification and removal of private inflow sources. Additional private inflow sources would be identified through follow-up house to house building inspections assisted by an educational public outreach program.

During the Phase 2 house to house inspections, a total of 254 buildings were identified for follow-up inspections to verify that no inflow sources exist at these locations. A list of the buildings identified for follow-up inspection is included in Attachment A to the Draft Inflow Control Plan in **Appendix E**. It should be noted that the Connecticut Department of Transportation (DOT) is planning reconstruction of Main Street from Governor Street to the Public Library at 472 Main Street. It is recommended that the Town inspect the 254 buildings within the limits of the Main Street reconstruction project to locate any roof drains connected to the sewer system first and incorporate redirection of these inflow sources into the Main Street Reconstruction project.

A public outreach program is recommended to encourage voluntary participation in the inflow control plan. The key to public support is to convince the sewer user that the redirection of illegal connections is in their best interest. Various methods and media can be used for public outreach efforts. The use of printed ads in local newspapers, local access cable television programming, website links, and public meetings are common outreach approaches. It is recommended that the public outreach program be initiated by the mailing of an educational brochure to all sewer users in Sewer District No. 1. A draft of a suggested educational brochure is included in Attachment C to the Draft Inflow Control Plan. The brochure includes a general description of I/I sources and requests residents to call the WPCA if an inflow source is known to exist on their property.

As part of the continued sump pump identification and removal process, once a new sump pump has been identified through the educational public outreach program, a limited basement inspection is recommended. Until such time that the 254 follow-up building inspections have been conducted, the Town would rely on property owners identifying that they have a sump pump connected to the sanitary sewer system and notifying the WPCA. When this type of notification occurs, it is recommended that a limited basement inspection be performed to allow the Town to confirm the current discharge location of the sump pump, and provide input to an acceptable alternative discharge location. A suggested basement inspection form is included in Attachment D to the Draft Inflow Control Plan.

Once an illegal connection (ex. sump pump connected to sewer), has been identified and confirmed, the WPCA should issue a letter to the property owner requesting the disconnection of the illegal connection. If an illegal connection is not removed within a specified time period, the Town may consider assessing a penalty, added to the sewer bill, until the disconnection has been made.

There are three typical options for removing sump pumps connected to the sanitary sewer system. They include:

- Redirect flow to a drywell
- Redirect flow to an outlet at existing ground level (overland flow)
- Redirect flow to connect to an existing drainage system

For general guidance, typical details showing various sump pump redirection alternatives are included in Attachment E to the Draft Inflow Control Plan included in **Appendix E**.

Inflow Control Plan Priority List. As previously noted, the goal of the Inflow Control Plan is to reduce at least 25% of the existing peak inflow, representing 1.0 mgd of inflow. Accordingly, rehabilitation and further investigation efforts are recommended to be prioritized as follows:

Priority 1A. Redirect the 105 sump pumps identified through house to house building inspections and smoke testing (Table 4 of Draft Inflow Control Plan). The WPCA is requiring private property owners with illegal inflow sources to fund removing these private inflow sources, therefore no cost has been estimated for this work. There will cost to the WPCA for administering and tracking inflow source removals.

Priority 1B. Conduct building inspections for roof drains connected to the sewer system on Main Street within the limits of the DOT Main Street Reconstruction project.

Priority 1C. Contact DOT to open a dialogue on integrating sump pump and roof drain connections into the DOT Main Street Reconstruction project.

Priority 2. Eliminate the 44 private and five public inflow sources identified in Tables 2, 3, and 6 of the Draft Inflow Control Plan. As noted above, the WPCA's policy is that the cost of removing the private inflow sources is borne by the owner of the private property. The total estimated cost to remove the three direct public inflow sources (Table 3) and the two indirect public inflow sources (Table 6), including engineering and contingencies, is approximately $2,100, and $22,000 respectively.

Priority 3. Conduct the remaining portion of the 254 follow-up building inspections (Attachment A of Draft Inflow Control Plan), after Priority 1B is completed, to verify that there are no sources of inflow at these locations. It is anticipated that the follow-up building inspections would be conducted by Town staff, therefore no cost has been estimated for this work. Implement sump pump removal actions for any sump pumps found connected to the sewer system.

Priority 4. Locate and inspect the 84 manholes, identified in Attachment B of the Draft Inflow Control Plan, which were not inspected during prior investigations to further identify sources of leakage and to assess the physical condition of manholes in Sewer District No.1. It is anticipated that Suez would uncover and inspect these manholes over time as part of system maintenance efforts, therefore no cost has been estimated for this work.

Priority 5. Initiate the design and construction of the rehabilitation of 32 manholes as identified in Table 5 of the Draft Inflow Control Plan. The total cost of manhole rehabilitation, including engineering and contingencies, is approximately $175,000.

It is anticipated that completing the Priority 1A, 1B, 1C, 2, and 3 actions will reduce inflow by the target level of 1.0 mgd. However it is recommended that Priority 4 and 5 should also be implemented whether the 1.0 mgd reduction is or is not achieved by the higher priority actions.

An essential part of the recommended Inflow Control Plan is the inclusion of a public education outreach program and additional basement inspections as noted above. It is also recommended that the Town track the removal of I/I from its system on a subarea by subarea basis. To facilitate this process, a computer spreadsheet or database should be developed to track steps taken to contact owners of sump pumps or other inflow sources required to be removed. Depending on the nature and extent of I/I removal work, it may be warranted to conduct post-construction flow monitoring as a means of documenting the I/I quantity removed from the system. However, the scope of, and need for, a monitoring program should be determined by the WPCA on a case by case basis. The South Street WWTF flows should continue to be monitored as the WPCA currently does to assess changes in flows resulting from I/I reduction, and confirm that the 1.0 mgd inflow removal target has been achieved. If the target inflow reduction is not achieved, the need for further I/I removal, or the implementation of flow equalization should be assessed.

Flow Equalization. As an alternative to reducing inflow to reduce peak flow, a flow equalization tank could be constructed. A description of a flow equalization system and its estimated costs are below.

Flow Equalization System Descriptions. Providing flow equalization to the South Street WWTF would require constructing a tank or tanks to receive diverted peak flows that exceed either the WWTF hydraulic capacity or a target peak flow. For the purposes of this evaluation the flow equalization would involve diverting influent flows at the South Street WWTF greater than 5.3 MGD from the Influent Box adjacent to the Influent Building and temporarily storing excess peak flows in a new equalization tank. Diverted flows up to one (1) million gallons would be stored or equalized temporarily until the peak flows subside. Once there is capacity available at the WWTF to treat the diverted flows, the stored or equalized flow would be returned to the Influent Box adjacent to the WWTF Influent Building for treatment. To provide flow equalization a number of facilities would need to be constructed. These facilities are shown schematically in **Figure 3-1** and are described below.

To divert the peak flows a new equalization flow diversion box (EQ diversion box) would be constructed as an expansion to the influent box adjacent to the Influent Building. Note that to address other hydraulic capacity issues the influent box is being recommended for expansion as part of the Phase 2 Facilities Planning efforts with or without the inclusion of any flow equalization at the South Street WWTF. See Chapter Nine for additional information. For the purposes of peak flow diversion and flow equalization, the expanded influent/EQ diversion box would include an adjustable flow diversion weir gate that would allow flows in excess of the 5.3 MGD to be diverted to a new equalization tank by gravity through an eight inch pipe approximately 500 feet in length. The new equalization tank would be located to the south of the Final Settling Tanks, occupying a portion of the existing Highway Department yard. The equalization tank would be constructed below grade to allow for vehicular traffic to pass or park over the tank and around the existing Highway Department garage. The tank would likely need to be constructed with rock anchors to prevent flotation of the tank under high ground water conditions as the tank needs to be kept empty. The proposed location of the flow equalization tank is depicted in **Figure 3-2**.

To provide the required one million gallons of storage volume, the equalization tank would be approximately 170 feet long, 40 feet wide, and have a sidewater depth of 20 feet. The tank would be provided with coarse bubble diffusers and blowers to mix and aerate the tank contents to reduce potential odors. The aeration system would start automatically once the water elevation (depth) in the tank reaches an adjustable set point and would operate until the water elevation drops below another adjustable set point. Washdown of the tank would be required after an equalization event to reduce the potential for odors. The existing effluent flushing water system would be extended to the equalization tank to provide washdown water through hose gates and hoses provided at numerous locations around the tank. Exposed effluent flushing water piping would need to be heat traced.

An equalization tank pump station would be constructed adjacent to the equalization tank to pump the tank contents back to the influent/EQ diversion box adjacent to the Influent Building when WWTF capacity becomes available after a wet weather event. This facility would be a submersible pump station equipped with three 250 gallons per minute (gpm) variable frequency drive (VFD) driven pumps, with two operating pumps and the third serving as a redundant spare. This submersible equalization pump station would be approximately 8 feet by 10 feet and 25 feet deep. It would be connected to the equalization tank, with an eight inch diameter pipe. The equalized flow would discharge from the pump station via a six inch return force main,

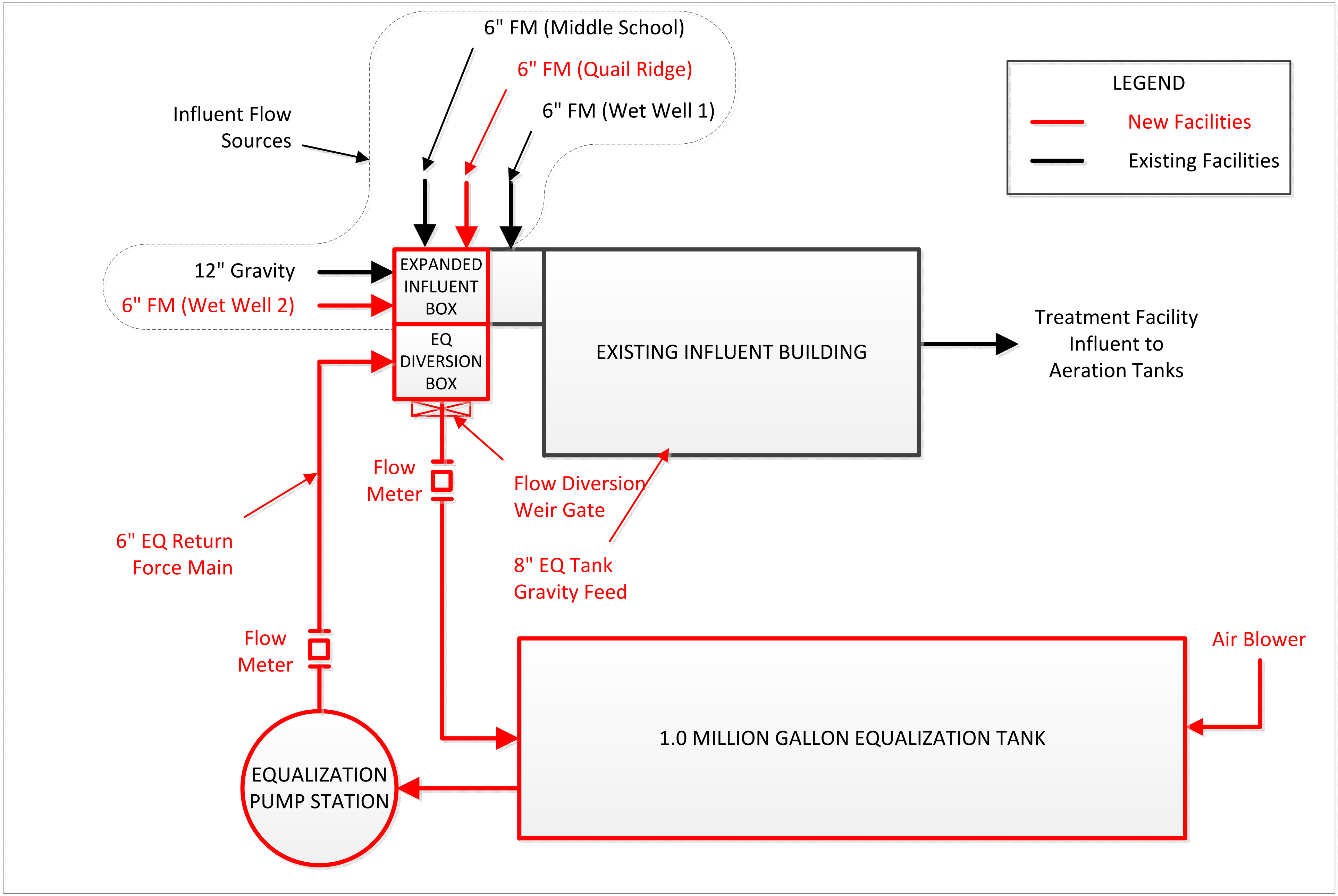


FIGURE 3-1
SOUTH STREET WWTF FLOW EQUALIZATION TANK SCHEMATIC

PLAN
NTS

Image Courtesy of Google Earth

FIGURE 3-2
SOUTH STREET WWTF
EQUALIZATION TANK LOCATION

approximately 500 feet in length, to the influent/EQ diversion box upstream of the Influent Building.

The water level in the influent/EQ diversion box, equalization tank and equalization pump station would be monitored, displayed, and potentially controlled by the WWTF SCADA system. On high level in the equalization tank, the flow diversion weir gate at the influent/EQ diversion box would be closed to prevent overfilling of the equalization tank. In addition, flows to the equalization tank and flow from the equalization tank pump station would be monitored, recorded, and displayed in the WWTF SCADA system for trending and control. The rate of return flow from the equalization tank would be metered and controlled through a rate controller. Standby power would be provided to the influent flow diversion weir gate and the equalization pump station through the WWTF standby generator.

Flow Equalization System Estimated Cost. The estimated cost for the construction of the flow equalization tank and its ancillary systems is approximately $4,600,000, including engineering and contingencies. The cost for this work includes the following items and systems:

- Equalization tank (including rock anchors)
- Ancillary systems, including
  - Mixing system (mechanical aerators or coarse bubble diffusers)
  - Electrical work
  - Control system
  - Washdown water
- Equalization pump station
- Equalization feed and return piping

Conclusion. Comparing the inflow reduction cost with flow equalization costs, it is apparent that inflow reduction is the least cost approach to reducing peak flows at the South Street WWTF from Sewer District No. 1. Construction of a flow equalization tank could be considered if the Inflow Control Plan does not reduce peak flows by the one million gallon per day target under peak flow conditions.

CHAPTER FOUR
WASTEWATER TREATMENT FACILITIES EFFLUENT LIMITS, DESIGN CRITERIA, AND COST ESTIMATE BASIS

Discharges of treated effluent from the Route 7 WWTF to the Norwalk River and the South Street WWTF to the Great Swamp are regulated by their National Pollutant Discharge Elimination System (NPDES) permits. These permits are issued to the Town by the Connecticut Department of Energy and Environmental Protection (DEEP). This chapter reviews the existing permit limits for the Route 7 WWTF and the South Street WWTF and describes the anticipated future permit limits at the South Street WWTF if the flows from Sewer District No. 1 and Sewer District No. 2 were treated at the South Street WWTF. In addition, this chapter presents the design criteria used in the development and evaluation of plant upgrade alternatives in the Phase 2 Facilities Planning effort, and summarizes the basis for the estimated costs for plant upgrades.

ROUTE 7 WWTF EFFLUENT LIMITS

The current NPDES permit for the Route 7 WWTF was issued by the DEEP on September 17, 2014. A copy of the permit is included in **Appendix F**. The permit contains a number of requirements that the Town must comply with through the operation and maintenance of the WWTF. NPDES permits are issued for a five year period, and the current permit is due to expire on September 17, 2019. As required by the permit, the Town must reapply for their permit 180 days in advance of the expiration of the existing permit. Until the DEEP issues a new permit, the existing permit remains in effect. **Table 4-1** presents a summary of the different parameters and limits contained in the Route 7 WWTF permit.

TABLE 4-1. CURRENT ROUTE 7 WWTF NPDES EFFLUENT PERMIT LIMITS

Effluent Parameter	Average Daily	Average Monthly	Maximum Daily	Instantaneous
Flow	0.12 mgd	n/a	n/a	n/a
BOD_5	n/a	20 mg/l	40 mg/l	n/a
TSS	n/a	20 mg/l	40 mg/l	n/a
Escherichia coli	n/a	n/a	n/a	410/100ml
Ammonia-Nitrogen				
June	n/a	6.7 mg/l	n/a	n/a
July – September	n/a	2.5 mg/l	n/a	n/a
October	n/a	4.4 mg/l	n/a	n/a
November-May	n/a	n/a	n/a	n/a
pH	n/a	n/a	n/a	6-9
Total Phosphorus Apr 1st to Oct 31st [1]	n/a	1.55 mg/l	3.11 mg/l	n/a

1. Total phosphorus average seasonal load limit of 1.0 lb/day = 1.0 mg/l at 0.12 mgd.

The Route 7 WWTF does not have a total nitrogen limit as part of the DEEP General Permit for Nitrogen Discharges due to the small average day design flow. The Route 7 WWTF NPDES permit also contains a compliance schedule for meeting the phosphorus. **Table 4-2** summarizes the milestones in the permit. This schedule may need to be revised depending on the final plan for upgrades to both the Route 7 WWTF upgrade and the South Street WWTF upgrade.

Permit Impact on Route 7 WWTF

The existing WWTF will not be able to meet the total phosphorus permit limits included in the NPDES permit without an upgrade. A description of the recommended upgrades to meet the phosphorus limits is included in Chapter Eight.

TABLE 4-2. CURRENT ROUTE 7 WWTF NPDES EFFLUENT PERMIT LIMITS

Constituent / Compliance Element	Days from Permit Issuance (other)	Date
Permit Issued	-	9/18/2014
Total Phosphorus		
Phase 1 Facility Plan (FP) Report	240	5/16/2015
Engineering Report (Phase 2 FP) Recommended Upgrades to Comply with Limits	730	9/17/16
Contract Documents for Compliance Upgrade	180 (upon DEEP approval of Report)	TBD
Compliance Upgrade Completed	1,800	8/23/19

SOUTH STREET WWTF PERMIT EFFLUENT LIMITS

The current NPDES permit for the South Street WWTF was issued by the DEEP on September 29, 2015. A copy of the permit is included in **Appendix G**. The permit contains a number of requirements that the Town must comply with through the operation and maintenance of the WWTF. NPDES permits are issued for a five year period, and the current permit is due to expire on September 29, 2020. As required by the permit, the Town must reapply for their permit 180 days in advance of the expiration of the existing permit. Until the DEEP issues a new permit, the existing permit remains in effect. **Table 4-3** presents a summary of the different parameters and limits contained in the South Street WWTF permit.

The South Street WWTF NPDES permit also contains a compliance schedule for meeting the zinc and phosphorus limits. **Table 4-4** summarizes the milestones in the permit. This is an aggressive schedule and may need to be revised depending on the final plan for the South Street WWTF upgrade and the Route 7 WWTF upgrade.

In addition to the specific NPDES permit issued for the South Street WWTF, the WWTF must also comply with the DEEP General Permit for Nitrogen Discharges. This general permit contains yearly mass based effluent limits on total nitrogen which are based on the annual average daily total nitrogen discharged in pounds per day. Total nitrogen limits for 79 municipal treatment plants in the state 1.0 mgd or larger are contained in the permit. As noted above, the Route 7 WWTF is not included in the general permit. The general permit was renewed effective January 1, 2016 expiring in December, 2018. The 2016 effluent limit for the South Street WWTF was 29 lbs/day. At the annual average design flow of 1.0 mgd for the South Street WWTF this equates to an annual average total nitrogen concentration of 3.5 mg/l.

Permit Impacts on South Street WWTF

Phosphorus. The existing WWTF will not be able to meet the total phosphorus permit limits included in the NPDES permit without the installation of a tertiary phosphorus removal unit process. A number of tertiary unit process alternatives were developed and evaluated to meet the new phosphorus limits. Descriptions and evaluations of these alternatives are included in Chapter Seven and the recommended process is included in Chapter Nine.

Nitrogen. The existing WWTF also will not be able to meet the total nitrogen permit limits included in the DEEP General Permit for Nitrogen Discharges without either purchasing nitrogen credits from the DEEP Nitrogen Credit Trading Program to comply with the effluent limit or providing upgrades the WWTF to produce an effluent that meets the limit. A description and the evaluation of a number of process alternates to reduce the total nitrogen in the WWTF to meet the effluent limit alone or supplemented by purchasing credits is included in Chapter Seven and the recommended process is included in Chapter Nine.

TABLE 4-3. CURRENT SOUTH STREET WWTF NPDES EFFLUENT PERMIT LIMITS

Effluent Parameter	Average Daily	Average Monthly	Maximum Daily	Instantaneous
Flow	1.0 mgd	n/a	n/a	n/a
BOD_5 (Nov 1st to Mar 31st)	n/a	20 mg/l	40 mg/l	n/a
BOD_5 (Apr 1st to Oct 31st)	n/a	10 mg/l	20 mg/l	n/a
TSS (Nov 1st to Mar 31st)	n/a	20 mg/l	40 mg/l	n/a
TSS (Apr 1st to Oct 31st)	n/a	10 mg/l	20 mg/l	n/a
Escherichia coli [1]	n/a	n/a	n/a	410/100ml
Ammonia-Nitrogen				
April	n/a	7.3 mg/l	n/a	n/a
May	n/a	4.9 mg/l	n/a	n/a
June	n/a	2.3 mg/l	n/a	n/a
July – September	n/a	1.6 mg/l	n/a	n/a
October	n/a	2.7 mg/l	n/a	n/a
November-March	n/a	n/a mg/l	n/a	n/a
Dissolved Oxygen Apr 1st to Oct 31st	n/a	n/a	n/a	$\geq$6.0 mg/l min.
pH	n/a	n/a	n/a	6-9
Total Phosphorus				
Nov 1st to Mar 31st	n/a	1.0 mg/l	2.0 mg/l	n/a
Apr 1st to Oct 31st [2]	n/a	0.16 mg/l	0.31 mg/l	n/a
Zinc [3]	n/a	0.25 kg/d	0.33 kg/d	n/a

1. The geometric mean of E. Coli bacteria during a calendar month from May 1st to September 30th shall not exceed 126/100ml.
2. Total phosphorus average seasonal load limit of 0.52 lb/day = 0.62 mg/l at 1.0 mgd.
3. Total zinc maximum day load limit of 0.33 kg/day = 0.087 mg/l at 1.0 mgd and 0.016 mg/l at peak flow of 5.3 mgd (see section below for peak flow projections)

TABLE 4-4. SOUTH STREET WWTF NPDES PERMIT MILESTONE SUMMARY

Constituent / Compliance Element	Days from Permit Issuance (other)	Date
Permit Issued	-	9/30/2015
Zinc		
Engineering Report (Phase 2 FP) Recommended Upgrades to Comply with Limits	390	10/24/2016
Contract Documents for Compliance Upgrade	426 (upon DEEP approval of Report)	TBD
Compliance Upgrade Completed	1820	9/23/2020
Total Phosphorus		
Engineering Report (Phase 2 FP) Recommended Upgrades to Comply with Limits	390	10/24/2016
Contract Documents for Compliance Upgrade	426 (upon DEEP approval of Report)	TBD
Compliance Upgrade Completed	1820	9/23/2020

ANTICIPATED SOUTH STREET WWTF EFFLUENT LIMITS WITH COMBINED SEWER DISTRICT NO. 1 AND SEWER DISTRICT NO. 2 FLOWS

As part of the Phase 2 facilities planning effort, an evaluation of the potential to decommission the Route 7 WWTF and convey the Sewer District No. 2 flows to the South Street WWTF for treatment was conducted. A description of this evaluation is included in Chapter Ten. The conveyance and treatment of the flows from both Sewer District 1 and Sewer District 2 at the South Street WWTF would require modifications to the South Street WWTF effluent limits

As part of the preparation of this report, a number of meetings and discussions with DEEP representatives were held regarding anticipated effluent limits that may be imposed on the WWTF with the treatment of both Sewer District No. 1 and No. 2 flows. **Table 4-5** presents a summary of the anticipated effluent limits with the conveyance and treatment of flows from Sewer District No. 1 and Sewer District No. 2 to the South Street WWTF provided by the DEEP.

TABLE 4-5. ANTICIPATED SOUTH STREET WWTF EFFLUENT PERMIT LIMITS WITH COMBINED SEWER DISTRICT NO. 1 AND SEWER DISTRICT NO. 2 FLOWS

Effluent Parameter	Average Daily	Average Monthly	Maximum Daily	Instantaneous
Flow	1.12 mgd	n/a	n/a	n/a
BOD_5 (Nov 1st to Mar 31st)	n/a	18 mg/l	40 mg/l	n/a
BOD_5 (Apr 1st to Oct 31st)	n/a	9 mg/l	20 mg/l	n/a
TSS (Nov 1st to Mar 31st)	n/a	18 mg/l	40 mg/l	n/a
TSS (Apr 1st to Oct 31st)	n/a	9 mg/l	20 mg/l	n/a
Escherichia coli [1]	n/a	n/a	n/a	410/100ml
Ammonia-Nitrogen				
April	n/a	6.5 mg/l	n/a	n/a
May	n/a	4.4 mg/l	n/a	n/a
June	n/a	2.1 mg/l	n/a	n/a
July – September	n/a	1.4 mg/l	n/a	n/a
October	n/a	2.4 mg/l	n/a	n/a
November-March	n/a	n/a mg/l	n/a	n/a
Dissolved Oxygen Apr 1st to Oct 31st	n/a	n/a	n/a	≥6.0 mg/l min.
pH	n/a	n/a	n/a	6-9
Total Phosphorus				
Nov 1st to Mar 31st	n/a	1.0 mg/l	2.0 mg/l	n/a
Apr 1st to Oct 31st [2]	n/a	0.16 mg/l	0.31 mg/l	n/a
Zinc	n/a	0.268 kg/d	0.355 kg/d	n/a

1. The geometric mean of E. Coli bacteria during a calendar month from May 1st to September 30th shall not exceed 126/100ml.
2. Total phosphorus average seasonal load limit of 0.52 lb/day = 0.055 mg/l at 1.12 mgd.
3. Total Zinc maximum day load limit of 0.33 kg/day = 0.084 mg/l at 1.12 mgd and 0.016 mg/l at peak flow of 6.0 mgd (see section below for peak flow projections).

Based on discussions with DEEP, the South Street WWTF would be able to receive a modification to the total nitrogen load in the DEEP General Permit for Nitrogen Discharges with both sewer district flows being conveyed to and treated at the South Street WWTF. Based on input from DEEP, the annual average daily total nitrogen effluent limit for the South Street WWTF treating flows from both sewer districts would be 32 lbs/day. At the annual average design flow of 1.12 mgd for the South Street WWTF this equates to an annual average total nitrogen concentration of 3.4 mg/l, slightly lower than the total nitrogen concentration for Sewer District No. 1 flows only.

Permit Impact on South Street WWTF

Similar to the discussion on the South Street WWTF treating Sewer District No. 1 flows only, the WWTF will not be able to meet either the effluent total phosphorus limits or the total nitrogen limits treating flows from both sewer districts. Descriptions and evaluations of alternatives to meet these limits are included in Chapter Seven and the recommended processes are included in Chapter Nine. In addition, the additional requirements and costs to convey and treat the additional flows and loads to meet the effluent limits for the combined flows from the two sewer districts at the South Street WWTF are included in Chapter Ten. Finally the recommended wastewater system upgrades for both sewer districts are summarized in Chapter Eleven.

DESIGN CRITERIA

Design criteria have been established for use in the development and evaluation of the wastewater management alternatives for this Facilities Plan. These criteria are described below.

Planning Horizon

The planning horizon was based on a 20 year planning period with current or baseline year being 2015 which was used in the Phase 1 Facilities Plan to evaluate existing flow and loading conditions in the two sewer districts and to project flows to the year 2035. In addition the 20 year planning period has been used to assess the condition of the facilities and systems at both WWTFs to determine if the discrete systems will be able to provide service to for the planning period. Finally, the 20 year planning period was used to compare upgrade alternatives as it related to the development of operation and maintenance costs and present worth costs

Flows and Loadings

The current average and peak conditions flow and loads and the projected 2035 average flows and loads for Sewer District No. 1 and Sewer District No. 2 are summarized in Chapter Three, and discussed in detail in the Phase 1 Facilities Plan report. This section further summarizes the projected 2035 flows and loads from the two sewer districts to their respective WWTFs under peak flow conditions. In addition this section summarizes the current and projected year 2035 flow and loading projections for the alternative where the Route 7 WWTF is decommissioned and all of the flows and loads from Sewer District No. 1 and Sewer District No. 2 are conveyed to and treated at the South Street WWTF. The current average and peak conditions flow and loads and the projected year 2035 flow and loads under peak and average flow conditions are for Sewer District No. 1, Sewer District No. 2 and the combined Sewer Districts are summarized in **Table 4-6**, **Table 4-7**, and **Table 4-8** respectively. As noted in Chapter Three, the projected peak flows at the South Street WWTF have been reduced by 1.0 million gallons per day due to the inflow reduction plan or if need be the future construction of an onsite equalization tank. These reduced peak flow values are indicated in **Table 4-6** and **Table 4-8**.

Effluent Quality Requirements

Wastewater treatment alternatives were developed to provide a level of treatment that meets the existing and anticipated future effluent limits imposed by the DEEP through the NPDES permit process as noted in the section above as well as to meet the DEEP General Permit for Nitrogen Discharges through treatment alone or in connection with purchasing nitrogen credits.

Process Sizing Criteria

In developing and sizing wastewater treatment alternative processes, the primary sizing criteria used were contained in *TR-16, Guides for the Design of Wastewater Treatment Works* prepared by the New England Interstate Water Pollution Control Commission. These criteria specify design loading rates and operating parameters for unit treatment processes. Examples include clarifier overflow rates, aeration

TABLE 4-6. SEWER DISTRICT NO. 1 (SOUTH STREET WWTF) CURRENT AND PROJECTED YEAR 2035 WASTEWATER FLOWS AND LOADS

Constituent	2015 [1]	2035
Average Daily Flow, (mgd)	0.85	1.00
Peak Flow, (mgd)	5.32[2]	5.32[2]
BOD_5 (lb/day)	1,550	1,830
BOD_5 (mg/l)	219	219
TSS (lb/day)	1,643	1,940
TSS (mg/l)	233	233
TKN (lb/day)	176	210
TKN (mg/l)	24.8	25.2
Total Phosphorus (lb/day)	28.4	35.0
Total Phosphorus (mg/l)	4.0	4.2
Total Zinc (kg/day)	0.799	0.940
Total Zinc (mg/l)	0.248	0.248

1. Current concertation data was truncated to eliminate potentially unrepresentative date due to the potential impact of septage on the influent samples. See Chapter Three for more information.
2. Peak flow includes a reduction of 1.0 mgd due to inflow reduction or the construction of an equalization tank.

TABLE 4-7. SEWER DISTRICT NO. 2 (ROUTE 7 WWTF) CURRENT AND PROJECTED YEAR 2035 WASTEWATER FLOWS AND LOADS

Constituent [1]	2015	2035
Average Daily Flow, (mgd)	0.053	0.12
Peak Flow, (mgd)	0.36	0.72
BOD_5 (lb/day)	124	280
BOD_5 (mg/l)	280	280
TSS (lb/day)	102	230
TSS (mg/l)	226	230
TKN (lb/day)	15.6 [2]	33 [2]
TKN (mg/l)	33 [2]	33 [2]
Total Phosphorus (lb/day)	1.46	6.0 [2]
Total Phosphorus (mg/l)	3.3	6.0 [2]
Total Zinc (kg/day)	0.026	0.059
Total Zinc (mg/l)	0.128	0.128

1. All data is based on July 2010 to June 2013 with the exception of zinc data which was from Feb/Mar 2016
2. Assumed values based on medium/high strength wastewater (M&E Text 5th Ed.).

TABLE 4-8. SEWER DISTRICT NO. 1 AND SEWER DISTRICT NO. 2 COMBINED CURRENT AND PROJECTED YEAR 2035 WASTEWATER FLOWS AND LOADS

Constituent	2015	2035
Average Daily Flow, (mgd)	0.903	1.12
Peak Flow, (mgd)	5.68 [1]	6.00 [1]
BOD_5 (lb/day)	1,674	2,110
BOD_5 (mg/l)	222	226
TSS (lb/day)	1,745	2,170
TSS (mg/l)	232	232
TKN (lb/day)	192	234
TKN (mg/l)	25.4	25.1
Total Phosphorus (lb/day)	29.6	41
Total Phosphorus (mg/l)	4.0	4.4
Total Zinc (kg/day)	0.825	1.00
Total Zinc (mg/l)	0.241	0.236

1. Peak flow includes a reduction of 1.0 mgd due to inflow reduction or the construction of an equalization tank.

basin mixed liquor concentrations, disinfection contact time, and filter loading rates. These criteria were also used in the Phase 1 Facilities Plan in evaluating the capacity of the existing plant. Other criteria used include the *Manual of Practice (MOP) 8 – Design of Wastewater Treatment Plants* prepared by the Water Environment Federation, and *Wastewater Engineering – Treatment and Reuse* prepared by Metcalf & Eddy, Inc.

Reliability/Redundancy Criteria

Wastewater treatment systems by design inherently involve extensive use of mechanical and electrical equipment. To plan for the necessary maintenance and repair of this equipment, redundancy is provided. The amount of redundancy for a system or component depends on how critical that system or component is for plant operation. For most equipment, multiple units are provided. For the liquid process systems, the tankage and equipment is sized to effectively convey the peak flow with one unit out of service with some level of treatment. For wastewater pumping systems, the pumping facilities must be capable of pumping the peak flow with the largest unit out of service. Solids handling systems are typically provided in multiple units and sized to handle the maximum month loadings. For the South Street WWTF, a single mechanical new sludge thickening/dewatering unit has been assumed with the existing sludge gravity belt thickener and belt filter press dewatering unit retained as a spare. In addition provisions for sludge storage will be provided.

Standby power should be provided to maintain operation in the event of a failure of the primary utility power. Standby power facilities are provided to meet EPA's Class I reliability requirements, together with the NPDES permit requirements to provide a minimum of primary treatment and disinfection, with the added demand of keeping the biological process viable during a prolonged power outage.

BASIS FOR COST ESTIMATES

Cost estimates for the alternatives in this Facilities Plan are based on the operation of the WWTFs at an annual average daily flow and load over the planning period. A linear flow and loading increase has been assumed for the 20 year planning period. These costs include capital and operation and maintenance (O&M) costs.

Capital Costs

Capital costs include estimated construction costs for structures, process and auxiliary equipment, piping, instrumentation and controls. The estimated base construction costs include the materials, labor, and equipment for installation as well as a mark up for contractor overhead and profit. The construction costs were developed using 4th quarter 2016 dollars at an Engineering News Record construction cost index of 10442. In addition the capital cost estimates include a 30 percent final design allowance for the WWTF and Pump Stations upgrades and a 20 percent final design allowance for force mains outside of the WWTF property (see Chapter Ten for Route 7 WWTF Decommissioning alternatives). To provide a total estimated capital cost, a 35 percent allowance for engineering and contingencies has been added to the base construction cost of each project element. Finally, the total estimated project costs have been escalated at 3.0 percent per year to the projected March 2020 midpoint of construction to give an estimated escalated total project cost.

The total estimated capital costs are preliminary planning level costs and have been developed based on a number of assumptions and may not represent the final project capital costs for the facilities once designed. The final costs could be higher or lower depending on what decisions are made during the design phase, how the final facilities are constructed, and when the final facilities are constructed.

O&M Costs

Operation and maintenance costs are the estimated costs to operate and maintain the facilities over the project planning period. The estimated O&M costs were based on power consumption, operation and maintenance labor (developed based on *The Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants* prepared in November 2008 by the New England Interstate Water Pollution Control Commission (NEIWPCC)), maintenance materials and 20 years of operation. Unit prices for power, chemicals, labor, and sludge disposal (as applicable) were escalated at 2.5 percent per year. The per pound cost for nitrogen credits (purchased and sold as applicable) were escalated at 3.0 percent per year.

Present Worth

The comparison of cost for different alternatives has been prepared on a present worth basis. The present worth for O&M costs are the annual O&M costs expressed as a present worth value in 4th quarter 2016 dollars. A discount rate of 4.0 percent was used to develop the present worth costs.

CHAPTER FIVE
EXISTING FACILITIES

GENERAL

The Town of Ridgefield's two wastewater treatment facilities (WWTFs), the Route 7 WWTF and the South Street WWTF, were assessed to identify their present conditions and their need for improvements or upgrades. The facilities were evaluated to assess their ability to provide continued service through the Facilities Plan design year of 2035. This chapter describes the most significant unit processes and systems at the Route 7 WWTF and South Street WWTF and their ability to provide service through the year 2035. An architectural and engineering (AE) evaluation of the two WWTFs was also conducted on a discipline specific basis (architectural, mechanical, etc.). These evaluations are documented in a memorandum titled *"Town of Ridgefield, CT Phase 2 Wastewater Facilities Plan – WWTF Condition Assessments (March 2016)"* included as **Appendix H**. Portions of these evaluations for each WWTF are described in this chapter as appropriate to the unit processes and systems.

ROUTE 7 WWTF INTRODUCTION

Figure 2-6 presents the existing layout of the Route 7 WWTF site and identifies the major plant unit processes and facilities. In addition, a process flow schematic illustrating the existing liquid and residuals unit processes for the Route 7 WWTF is presented in **Figure 2-7**. These processes are described in the sections below.

ROUTE 7 WWTF LIQUID PROCESSES

Influent Pump Station

The Route 7 Pump Station receives wastewater from Sewer District 2 and conveys it to the Route 7 WWTF. Sewer District 2 is located near the intersection of Route 35 and Route 7 and collects wastewater from approximately 170 acres, which represents less than one percent of the town's area. The gravity sewer system consists of approximately 6,300 linear feet of sewers ranging in size from 8 inches to 10 inches in diameter. The Route 7 Pump Station is located in the south east corner of the parking lot adjacent to the Route 7 WWTF site. The design criteria for the Route 7 Pump Station are presented in **Table 5-1.**

TABLE 5-1. ROUTE 7 INFLUENT PUMP STATION DATA

Parameter	Value
Wetwell	1
Diameter, ft	8
Valve Vault	
Diameter, ft	8
Influent Pumps	2
Type Capacity, gpm Motor	Non-Clog Submersible 500 @ 70 ft TDH 15

The pump station is supported by a 60 kW standby diesel emergency generator with a fuel oil day tank and fiberglass enclosure. A subsurface fuel oil tank and the generator are located partially below ground. The pump station was constructed in the mid 1980's. Due to the age of the equipment, replacement of the pump station, including the wet well, valve vault and standby emergency generator should be considered. Alternatives include locating the pump station in the same location or relocating it if constructability is an issue. The new pump station should also include a magnetic flow meter for recording the influent flow and flow pacing of the total phosphorus removal chemical feed system.

Preliminary Treatment

The Route 7 Pump Station conveys flow to the Route 7 WWTF influent channel and headworks for preliminary treatment. The current configuration of the influent channel only allows for one pump to be operational at the pump station, as the influent channel overflows when the second pump is turned on. A new equipment configuration should be evaluated to handle the flows conveyed by the influent pumps. The headworks systems at the Route 7 WWTF are located outside. These systems include an influent box, aerated grit chamber, and channel grinder. There is also a bypass channel, which contains a manually cleaned bar rack. The grit chamber is shown in **Figure 5-1.**

FIGURE 5-1. ROUTE 7 WWTF GRIT CHAMBER

The grit chamber has a capacity of 0.75 million gallons per day (MGD) and consists of an aerated chamber and a grit screw. The grit screw operates on a timer. Operations staff noted that they may only remove one to two barrels of grit per year and little grit is observed in the primary settling tanks. The design criteria for the aerated grit chamber are presented in **Table 5-2.**

TABLE 5-2. ROUTE 7 WWTF AERATED GRIT CHAMBER DATA

Parameter	Value
Grit Chamber	1
Dimensions	
Length, ft	12.66
Width, ft	2.5
Average Depth, ft	5.05
Volume, ft^3	160
Volume, gallons	1,197
Grit Collector	1
Screw Conveyor	1
Motor Size, HP	1
Aeration Blowers	1
Type	Positive Displacement Rotary Lobe
Motor Size, HP	0.78
Capacity, CFM	11 @14.4 psi

The channel grinder was installed two to three years ago to replace an existing comminutor.

The headworks equipment is functional; however, due to the age of the equipment (with the exception of the grinder) and the fact that it is located outside, the equipment is approaching the end of its serviceable life and should be considered for replacement. It is also recommended that any new headworks equipment be enclosed to provide protection from the elements and to contain odors. Odor control should be considered, as well as providing screening of the influent flow versus grinding.

Primary Settling Tanks

Flow from the headworks is directed to two primary rectangular settling tanks with slotted pipe scum removal. The design criteria for the primary settling tanks are summarized in **Table 5-3**. The sludge collection chain and flights in the tanks were replaced five years ago; however, the drives and scum skimmer pipes were not replaced are still original from the 1985 plant construction. Full replacement of the sludge collection mechanism, launders, weir and scum collection equipment should be considered.

TABLE 5-3. ROUTE 7 WWTF PRIMARY SETTLING TANK DATA

Parameter	Value
Primary Settling Tanks	2
Type	Rectangular
Dimensions (each)	
Length, ft	32
Width, ft	7
Depth, ft	8
Surface area, ft^2	224
Volume, gallons	13,405
Overflow rate, gpd/ft^2	
Average Flow (0.05 MGD)	118
Peak Hourly Flow (0.36 MGD)	804
Detention Time (hours)	
Average Flow (0.05 MGD)	12.14
Peak Hourly Flow (0.36 MGD)	1.79

The primary settling tank effluent troughs have hydraulic limitations and alternatives to relieve them should be considered.

Equalization Tank

Following the primary settling tanks, flow is directed to the equalization tank. The equalization tank is shown in **Figure 5-2.** The design criteria for the equalization tank are outlined in **Table 5-4**. The equalization tank provides little to no flow equalization and it operates in a flow through mode. The existing flow control valves and lower tank discharge piping are not operational. As a result, flow exits the tank through an overflow pipe at the top of the tank. The tank is aerated with coarse bubble aeration diffusers and a single positive displacement blower. The aeration diffusers and blower are approaching the end of their serviceable life and should be considered for replacement.

While in the current operating mode the equalization tank provides no flow equalization, it does provide some loading equalization and the aeration may provide some benefit. The reestablishment of the full functionality of the equalization tank is recommended, as well as the replacement of the aeration system. The equalization tank overflow pipe has a hydraulic limitation and alternatives to relieve it should be considered.

FIGURE 5-2. ROUTE 7 WWTF EQUALIZATION TANK

TABLE 5-4. ROUTE 7 WWTF EQUALIZATION TANK DATA

Parameter	Value
Equalization Tank	1
Dimensions	
Length, ft	32.3
Width, ft	28
Depth, ft	8.25
Aeration Blower	1
Type	Positive Displacement Rotary Lobe
Motor Size, HP	1.9
Capacity, CFM	65 @14.4 psi

Rotating Biological Contactors

Two rotating biological contactors (RBCs) are located downstream of the equalization tank. The design criteria for the RBCs are summarized in **Table 5-5**. The existing media and shafts on the RBCs were replaced in the year 2000. The bearing and drives on RBC No. 1 were replaced recently, but RBC No. 2 has its original equipment. The fiberglass covers are original. Operations staff built enclosures around the drive units to prevent freezing and icing during winter months. Both RBC units should be considered for full replacement of their media, drives, shafts, and covers.

TABLE 5-5. ROUTE 7 WWTF ROTATING BIOLOGICAL CONTACTOR DATA

Parameter	Value
Rotating Biological Contactors	2
Dimensions (each)	
Diameter, ft	12
Length, ft	25
Total Area, ft^2	200,000
Hydraulic Loading Capacity (gpd/ ft^2)	
Average Flow (0.05 MGD)	0.27
Peak Hourly Flow (0.36 MGD)	1.5

The freeboard between the water surface and the top of the tank is less than the one foot required by TR-16. Alternatives should be considered to address the limited freeboard.

Secondary Settling Tanks

Flow from the RBCs is directed to two secondary rectangular settling tanks with slotted pipe scum removal. The design criteria for the secondary settling tanks are summarized in **Table 5-6**. The sludge collection chain and flights in the tanks were replaced five years ago; however, the drives and scum skimmer pipes were not replaced and are still original from the 1985 plant construction. Full replacement of the sludge collection mechanism, launders, weir and scum collection equipment should be considered.

TABLE 5-6. ROUTE 7 WWTF SECONDARY SETTLING TANK DATA

Parameter	Value
Secondary Settling Tanks	2
Type	Rectangular
Dimensions (each)	
Length, ft	28
Width, ft	7
Depth, ft	7
Surface area, ft^2	196
Volume, gallons	10,263
Overflow rate, gpd/ft^2	
Average Flow (0.05 MGD)	135
Peak Hourly Flow (0.36 MGD)	918
Detention Time (hours)	
Average Flow (0.05 MGD)	9.29
Peak Hourly Flow (0.36 MGD)	1.37

The final settling tank effluent troughs have hydraulic limitations and alternatives to relieve them should be considered.

UV Disinfection

Ultraviolet (UV) disinfection is used to disinfect the secondary settling tank effluent. The UV disinfection system consists of a single open channel Trojan 3,000 PTP unit that was installed within the last 10 years. The UV Disinfection System is shown in **Figure 5-3.** The design criteria for the UV disinfection system are summarized in **Table 5-7**. The UV system is not expected to provide reliable service for the next 20 years and should be considered for replacement.

FIGURE 5-3. ROUTE 7 WWTF UV DISINFECTION SYSTEM

TABLE 5-7. ULTRAVIOLET DISINFECTION SYSTEM DATA

Parameter	Value
UV Channels	1
Dimensions	
Length, in	96
Width, in	12
Depth, in	9
Banks per Channel	1
Modules per Bank	4
Lamps per Module	2

The UV system requires labor intensive manual cleaning including the operators having to remove the bulb racks frequently and wipe them down with a harsh chemical cleaning solution. Installation of an automatically cleaned system should be considered to avoid this hazardous cleaning process. There is currently no operating eyewash station at the UV disinfection system and a station is recommended if manual bulb cleaning is continued. The UV system also does not have the capacity to handle the design peak flow and maintain the recommended one foot of freeboard. Should the system be replaced, installation of a system with a higher flow capacity is recommended. If the system is not replaced, alternatives should be considered to address the system's hydraulic limitations.

Plant Water System

The use of the existing plant water system was discontinued with the installation of the open channel UV system and a local well provides limited non-potable water for the plant. The original plant water pumping system was installed adjacent to the plant water wet well. The installation of a new plant water system should be considered to facilitate maintenance operations and allow for wash down of all structures, equipment, and systems at the WWTF.

ROUTE 7 WWTF SOLIDS HANDLING PROCESSES

Sludge Pumping

Each set of primary and secondary settling tanks is served by a single 30 gpm sludge and scum plunger pump. Sludge wasting is performed manually. These pumps are located in the Primary Sludge Pump Station and Secondary Sludge Pump Station, which have nearly identical layouts. One of the sludge pump stations is shown in **Figure 5-4.** The design criteria for the sludge pumps are summarized in **Table 5-8**. The two pumps are well beyond their expected serviceable life and should each be considered for replacement with two pumps in each pump station to provide redundancy.

FIGURE 5-4. ROUTE 7 WWTF SLUDGE PUMPING STATION

TABLE 5-8. ROUTE 7 WWTF PRIMARY AND SECONDARY SLUDGE AND SCUM PUMP DATA

Parameter	Value
Sludge and Scum Pumps	2
Type	Simplex Plunger
Capacity, gpm	30 @ 5 ft TDH
Motor, HP	1

The pumps are located in below grade valve vaults that require the operators to enter a confined space for access. Consideration should be given to allow operation of the pumps at grade without entering the confined space valve vaults.

Sludge Storage

The Route 7 WWTF has two aerated sludge storage tanks for primary and secondary sludge storage prior to the sludge being hauled off-site. The sludge storage tanks are shown in **Figure 5-5.** The design criteria for the sludge storage tanks are summarized in **Table 5-9**. The aeration system is only operated one day prior to liquid sludge being removed from the tanks for offsite disposal. Due to its age, replacement of the aeration system should be considered. Sludge is hauled offsite one or two times per month and thickening is not required. Hauling currently requires the use of a vacuum truck with access at the top of the tank. Improvements to truck loading operations, including the installation of a pump out system or the installation of a truck connection at grade, should be considered. During filling of the sludge storage tanks from the sludge pumping stations, there is only a local alarm on the tank level sensing system that sounds and can be difficult to hear. Improvements to tank level monitoring should be considered.

FIGURE 5-5. ROUTE 7 WWTF SLUDGE STORAGE TANKS

TABLE 5-9. SLUDGE STORAGE TANK DATA

Parameter	Value
Sludge Storage Tanks	2
Dimensions (each)	
Length, ft	15
Width, ft	8.5
Depth, ft	14
Volume, gallons	11,445
Sludge Storage Tank Blowers	2
Type	Positive Displacement Rotary Lobe
Motor Size, HP	1.9
Capacity, CFM	65 @ 14.4 psia
Supernatant Pump	1
Motor size, HP	1
Capacity, gpm	50 @45-50 ft TDH

The tanks have a supernatant decant pump to pump supernatant back to the WWTF headworks to allow thickening of the sludge. The existing supernatant pump is a residential grade ¼ horsepower sump pump that is not adequate for the service for which it is currently used. Replacement of the supernatant pump and piping to the headworks should be considered.

ROUTE 7 WWTF ANCILLARY FACILITIES

Instrumentation and Control Systems

The Route 7 WWTF is not staffed full time and is periodically visited for routine operations. The Route 7 WWTF currently has no local or remote alarms should any mechanical equipment fail. As part of the National Pollutant Discharge Elimination System (NPDES) permits for the WWTF, reports of plant operating data are required to be submitted to the CT DEEP. Currently, with no automated data collection system, those reports are generated manually.

The WWTF's single flow meter is an ultrasonic level element and weir system located in the effluent flushing water pump station. It outputs a signal to the effluent chart recorder in the first floor of the Control Building.

Due to its age, the limited instrumentation at this facility is not expected to provide reliable service in the future. Providing WWTF system monitoring as well as local and remote alarm capability should be considered.

Architectural Components

Several of the tanks at the Route 7 WWTF, including the grit chamber, primary settling tanks, equalization tank, and secondary settling tanks, have spalling and/or cracked concrete in many locations at the guardrail bases. The guardrails, which are in good condition, have been modified with plastic netting covers in order to prevent leaves from accumulating in the tanks. The hatches to the primary and secondary sludge stations are in poor condition. The roof of the Control Building is deteriorating and at the end of its serviceable life.

Due to the age and existing conditions, upgrades to the WWTF railings and hatches and installation of covers on some of the process tanks should be considered. It is recommended that the roof of the control building be replaced, and upgrades to the laboratory space, including painting and replacing ceiling tiles, laboratory furniture, lighting, and flooring, be considered.

Structural Components

As discussed with the architectural components, the exposed concrete on the majority of the process tanks are showing cracking, particularly around the guardrail posts. The Control Building does not appear to require structural repair. Sealing of the guardrail posts and crack and surface repair of the tanks and slabs throughout the site should be considered.

HVAC Systems

In general, the HVAC equipment and systems at the Route 7 WWTF are in poor condition and many are past their expected service life. Most of the rooms have no ventilation and either corroded heaters or no heat. Temporary heaters, dehumidifiers and portable air conditioning units have been provided in some areas. Upgrades to the HVAC systems in the primary and secondary sludge pumping stations, plant water station and UV disinfection area, and the Control Building area including the laboratory, the electrical room, and the storage room should be considered.

Electrical Systems

The Route 7 WWTF main electrical distribution equipment was installed in the mid-1980s, and is currently obsolete and past its service life. As a result, newly produced spare parts are no longer readily available and there is limited manufacturer support for maintenance and repair. The WWTF main electrical distribution panel (MDP) is rated for 400 amps, 208 VAC and it may not have the capacity to support a facility upgrade.

As part of a WWTF upgrade, consideration should be given to the following:

- Removing and replacing the facility's electrical distribution system in its entirety.
- Replacing the existing utility transformer with new a transformer with rated KVA matching any future facility upgrade.
- Replacing the standby generator
- Replacing the WWTF lighting systems with energy efficient type lighting (LED).
- Providing the WWTF with the following new systems:
    a. Fire alarm system.
    b. Emergency and exit lights.
    c. Lightning protection system.
    d. Security system.
    e. Power monitoring system.
- Performing electrical short circuit and coordination studies and providing all new electrical equipment with arc flash labels in accordance with the requirement of the NEC, NFPA-70E and IEEE 1584.
- Protecting the electrical systems from flood damage.

Fuel Oil Systems

There is a single fuel storage tank at the WWTF to serve the standby generator. It is in a 500 gallon above ground "Convault" concrete storage tank. Due to its age, this tank should be considered for replacement with any future upgrade to provide reliable service to the WWTF for the next 20 years.

Civil/Site Components

The site lighting, paving and curbing, and fence are in poor condition and should be considered for replacement.

There is no potable water at the plant because the well that is used for the plant water system is reported to be heavily laden with iron and does not provide adequate pressure for use in the facility. Connecting the Route 7 WWTF to the Town water supply should be considered. Potable water would be required for emergency showers and eyewash stations.

Resiliency

Upgrades to the WWTF should take into consideration resiliency issues specifically those to address flooding potential as well as backup power. TR-16 recommends that the critical equipment, which includes conveyance and treatment system components, be able to maintain flow as well as primary treatment and disinfection during flood events. As a result, this requires protection of these systems as well as other support systems which include electrical distribution, standby power systems, as well as instrumentation and control systems. The design flood elevation recommended by TR-16 is three feet above the 100 year flood elevation for critical equipment and two feet above the 100 flood elevation for non-critical equipment. The 100 year flood elevations should be based on the most recent information from the Federal Emergency Management Agency (FEMA). The current 100 year flood elevation at the Route 7 WWTF is 491 (referenced to the National Geodetic Vertical Datum (NGVD) 1988), and the entire WWTF site is above this elevation. In fact the entire WWTF site is above the 500 year flood level. The first floor elevation of the Control Building of elevation 503.0 NGVD 1929 (or ~ 502.1 NGVD 1988) is greater than 3 feet above the 100 year flood elevation, however the lower floor of the building, at elevation 493.0 (or ~ 492.1 NGVD 1988), is less than 3 feet above the 100 year flood evaluation. Addressing this constraint will need to be considered in alternatives where the Control Building is upgraded and reused.

Backup power recommendations from TR-16 include providing backup power with sufficiency capacity for critical WWTF systems as well as providing sufficient fuel storage for the backup power systems to run 48 hour at peak flow conditions and 96 hours at average conditions. The existing standby generator is also located well above the 100 year flood elevation. Resiliency elements should be considered with any Route 7 WWTF upgrades.

Tank Covers and Odor Control Upgrades

Tank covers should be considered to help control odors, to keep leaves out of the tanks, and to reduce algal growth. The following tanks should be considered for covers for odor and/or leaf control: existing headworks (if not enclosed in a building), primary settling tanks, equalization tank, secondary settling tanks and sludge storage tanks.

Hazardous Materials

As part of the existing conditions evaluation, a hazardous materials survey was performed at the Route 7 WWTF to help identify areas where lead paint, asbestos, and PCBs containing building materials are or may be present. The investigations were performed by HYGENIX, Inc. from Stamford, CT. On-site lead analysis was performed using an X-ray fluorescence analyzer. For asbestos, samples of suspect building materials were collected and tested by an off-site laboratory. Finally, for building materials suspected of containing PCBs either chip samples, bulk samples or wipe samples were collected and tested by an off-site laboratory.

The purpose of the survey was not to completely evaluate all building materials on site but to get a representative sample collection from different suspected hazardous building materials that were readily accessible and did not impact the building material functionality (for example the roof). The survey results are to be used as a baseline for future investigation and to allow for a preliminary estimate of cost to remove and remediate these materials during a WWTF upgrade project. **Table 5-10** presents a summary of the hazardous materials positively identified or assumed at the WWTF from the survey.

TABLE 5-10. ROUTE 7 WWTF HAZARDOUS MATERIALS SURVEY FINDINGS

Hazardous Material	Location	Description	Comments
Lead			
	Plant Water Station	Metal Pipe	
	Control Building	Yellow Stair Paint Metal Desks Metal Fume Hood	
Asbestos			
	Control Building	Lab Hood	
	Building Foundations	Mastic	Assumed [1]
PCBs			
	Grit Chamber	Green Air Piping Paint	

1. Area could not be accessed for sampling

SOUTH STREET WWTF INTRODUCTION

Figure 2-2 presents the existing layout of the South Street WWTF site and identifies the major plant unit processes and facilities. In addition, a process flow schematic illustrating the existing liquid and residuals unit processes for the South Street WWTF is presented in **Figure 2-3**. These processes are described in the sections below.

SOUTH STREET WWTF LIQUID PROCESSES

Influent Conveyance

Under normal conditions, the flow from the Town's Sewer District No. 1 is conveyed to the South Street WWTF Influent Building through a combination of a gravity sewer and an on-site submersible pump station (Influent Pump Station). Sewer District 1 is the largest of the Town's sewer districts, serving downtown Ridgefield and the surrounding areas. Sewer District No. 1 collects wastewater from approximately 1,230 acres, which represents about 5.5 percent of the Town's area. The gravity sewer system consists of approximately 100,000 feet of sewers ranging in size from 6 inches to 18 inches, with approximately 1,760 billed service accounts. The Influent Pump Station design criteria are summarized in **Table 5-11.**

TABLE 5-11. SOUTH STREET WWTF INFLUENT PUMP STATION DATA

Parameter	Value
Wetwell	1
Diameter, ft	8
Valve Vault	
Length, ft Width, ft	6 6
Influent Pumps	2
Type Capacity, gpm Motor	Recessed Impeller Submersible 680 @ 15 ft TDH 10

During infrequent wet weather events, a portion of the South Street WWTF influent flow has been conveyed to the Influent Building through a trailer mounted pumping system that supplements the Influent Pump Station. The DEEP considers the use of the trailer mounted pumping system a bypass and the Town is required to file a bypass report each time this pumping system is used. As a result, it is recommended that alternatives be considered to eliminate the use of this trailer mounted pumping system. Also during wet weather events, it has been reported that the influent box at the Influent Building has a high water surface elevation is very turbulent, and is believed to limit hydraulic capacity. It is recommended that alternatives be considered to reconfigure this box.

Septage Receiving

The septage receiving station accepts septage from the unsewered population of the Town of Ridgefield. The septage receiving station is located west of the Control Building and consists of an unloading area, storage tanks, and pumping facilities with only manual screening. The septage receiving area is shown in **Figure 5-6.** The design criteria for the septage receiving station are summarized in **Table 5-12** below.

FIGURE 5-6. SOUTH STREET WWTF SEPTAGE RECEIVING AREA

TABLE 5-12. SOUTH STREET WWTF SEPTAGE RECEIVING STATION DATA

Parameter	Value
Septage Tanks	2
Dimensions (each)	
Length, ft	16
Width, ft	10
Depth, ft	7
Effective Storage, ft	4
Capacity (each), gallons	4,800
Septage Transfer Pumps	2
Type	Submersible Chopper
Capacity (each), gpm	200 @ 15 ft TDH
Motor, HP	1.5

The septage trucks park alongside the septage receiving station and septage is unloaded from the trucks. The station is designed for unloading one truck at a time. The septage flows through a coarse screening grate directly into one of two septage holding tanks. The effective storage between the tank float switches is 4 ft. with the switches located 2 ft. and 6 ft. above the base of the tank, respectively. There is also a high water alarm at 7 ft. above the base of the tank.

Stored septage is periodically transferred directly to the South Street WWTF Influent Building by two septage transfer pumps, one located in each septage tank. These pumps were installed in 1987 as a part of a septage handling upgrade. The pumps can be accessed through a hatch on top of each septage holding tank for maintenance. Debris is removed from the tanks a few times per year by a contract tank cleaner (McVac).

Consideration should be given to updating the septage area to reduce the pump out of debris and providing it with odor control.

Preliminary Treatment

All equipment providing preliminary treatment of raw wastewater is located in the Influent Room of the Influent Building. The Influent Room of the Influent Building is shown in **Figure 5-7.** The design criteria for the preliminary treatment equipment are summarized in **Table 5-13**.

FIGURE 5-7. SOUTH STREET WWTF INFLUENT BUILDING

TABLE 5-13. SOUTH STREET WWTF PRELIMINARY TREATMENT EQUIPMENT DATA

Parameter	Value
Mechanical Bar Screen	**1**
Drive, HP	0.5
Capacity, MGD	4.1
Opening Size, in	1
Vortex Grit Removal System	**1**
Grit Pump	1
Type	Vertical, close-coupled, vacuum primed with curved vane flow inducer
Capacity, gpm	175 @ 41.2 ft TDH
Motor, HP	7.5
Screen	1/16-in stainless steel wedge wire
Manually Cleaned Fine Screen	**1**
Opening Size, in	3/8

Two parallel channels are located immediately downstream of the influent box. One channel contains a mechanically operated bar screen and the second contains a manually cleaned bar rack intended for use during bypass of the mechanically operated screen. The screens remove coarse material, such as cans, rags, paper, etc. from the raw wastewater. The mechanically cleaned screen system can be hydraulically overloaded during high influent flows. Due to its age it should be considered for replacement.

After the bar screens, wastewater flows through the grit removal system. The system is a vortex Pista grit removal system manufactured by Smith & Loveless and consists of a grit collection chamber and hopper, rotating paddle, grit removal pump, and grit dewatering screen. The mechanical components of the grit removal system are at the end of their serviceable life and should be considered for replacement.

Following the grit removal system is a channel grinder, which cuts and shears remaining solids. The channel grinder was recently installed by Suez to replace a failed comminutor. A manually cleaned fine bar screen is located in the channel following the channel grinder. The screen system gets overloaded during high influent flows.

Hydraulic limitations exist in the various components of the WWTF's preliminary treatment. Due to the age of much of the equipment and the hydraulic restrictions of the preliminary treatment system, new configurations of the preliminary treatment and new equipment should be considered. With improved initial screening, the manual fine screen would not be needed and should be considered for removal.

Secondary Treatment Process

The secondary treatment process at the WWTF consist of two sets of aeration tanks, aeration equipment, final settling tanks, distribution boxes, return and waste activated sludge pumps and scum pumps. These items are described below.

Aeration Distribution. The aeration tank distribution box (Distribution Box No. 1) is located adjacent to the Influent Building and receives the WWTF influent flow as well as the return activated sludge from the secondary process. This box directs flow to Aeration Tanks Nos. 1 & 2 and/or Aeration Tanks Nos. 3 & 4. It has plywood covers to contain odors. Consideration should be given to replacing the covers with hinged plate covers and providing a connection to odor control.

Aeration Tanks. There are two sets of aeration tanks at the South Street WWTF. Aeration Tanks Nos. 1 & 2, located further north were constructed during the original 1968 WWTF project. Aeration Tanks Nos. 3 & 4, located further south were constructed during the 1990 upgrade. The 1990 Aeration Tanks is shown in **Figure 5-8. Table 5-14** presents summary information for the aeration tanks and aeration systems.

FIGURE 5-8. SOUTH STREET WWTF 1990 AERATION TANKS

In the 1990 upgrade Aeration Tanks No. 1 and No. 2 and Aeration Tanks No. 3 and No. 4 were configured to run as two sets of tanks in parallel with the influent flow and RAS split between to the two set of tanks in Distribution Box No. 1. Each aeration tank No. 1 though No. 4 has two zones per tank (example Aeration Tank No. 1 contains zones 1A and 1B). Each set of two aeration tanks can be run be in two configurations as follow:

- Each aeration tank (two zones per tank or 4 zones per set) run in series (example flow from 3A to 3B and from 4A to 4B) known as "2-in series"
- Each aeration tank set run in series through all four zones of that set (example flow from 3B, 3A to 4A to 4B) known as "4-in series".

The ability to provide cyclic aeration in 3 of the 4 zones in each of the aeration tanks was provided to allow some level of denitrification in the tanks for the removal of total nitrogen. This was the first WWTF in Connecticut to implement this process.

TABLE 5-14. SOUTH STREET WWTF AERATION TANK AND AERATION SYSTEM DATA

Parameter	Value
Aeration Tank 1 & 2	**1**
Aeration Zones per Tank	2
Dimensions (per zone)	
Length, ft	42
Width, ft	42
Sidewater Depth, ft	10.39
Capacity (each zone), gallons	137,000
Mechanical Aerators (Aeration Tank No. 1)	2
Two speed motor, HP	25/18.75
Mechanical Aerators (Aeration Tank No. 2)	2
Single speed motor, HP	15
Aeration Tanks 3 & 4	**2**
Aeration Zones per Tank	2
Dimensions (per zone)	
Length, ft	32
Width, ft	32
Sidewater Depth, ft	15
Capacity (each zone), gallons	114,900
Mechanical Aerators	4
Two speed motor, HP	20/15

The WWTF currently operates on Aerations Tank No. 3 and No. 4 in the" 4-in series mode" with cyclic aeration provided to the first zone (3B). In this configuration, the WWTF is not able to meet the target total nitrogen effluent limit from the CT DEEP Nitrogen General Permit. Aeration Tanks No. 1 and No. 2 are not currently operable due to the condition of the mechanical components from the original 1968 construction. Due to the inability to run Aeration Tanks No. 1 and No. 2 the WWTF is at or approaching capacity for the current WWTF loadings with only Aeration Tanks No. 3 and No. 4 available. As a result consideration should be given to upgrading Aeration Tanks No. 1 and 2 to make them operable as well as modify the configuration of all of the aeration tanks to improve the ability of the WWTF remove total nitrogen.

Aeration Systems. The contents of each aeration tank are to be aerated and mixed by mechanical aerators, one in each of the eight aeration tank zones. The surface aerators in the 1990s tanks appear in good working order; however they are inefficient and are not expected to provide reliable service for the next 20 years and should be considered for replacement. The surface aerators in the 1968 tanks are inoperable and should be considered for replacement. Replacement of the aeration systems should consider systems with improved energy efficiency (fine bubble, high efficiency blowers, etc.)

Final Settling Tanks and Sludge and Scum Pumping. The WWTF has two circular final settling tanks constructed as part of the 1990s upgrade for separation of solids in the aeration tank mixed liquor. The final settling tanks are shown in **Figure 5-9.** The design criteria of these tanks and associated pumping systems are summarized in **Table 5-15**. The settling tank drive units and internal sludge and scum collection equipment are approaching the end of their serviceable life. As a result, replacement of the settling tank drive units, sludge collection equipment, weirs, and baffles should be considered.

Return activated sludge (RAS) is pumped from the collection hopper at the center of each settling tank to Distribution Box No. 1. There are three return sludge pumps located in the pump gallery in the Operations Building basement (two pumps in service and one standby). Each pump is equipped with a variable speed drive, which allows adjustment of discharge flow from 200 gpm at 9.6 feet TDH to 660 gpm at 31.4 feet TDH for each pump.

FIGURE 5-9. SOUTH STREET WWTF FINAL SETTLING TANKS

TABLE 5-15. SOUTH STREET WWTF FINAL SETTLING TANK DATA

Parameter	Value
Final Settling Tanks	**2**
Type	Circular
Dimensions (each)	
Diameter, ft	65
Sidewater Depth, ft	13
Surface Area, ft^2	3,317
Volume (each), gallons	322,500
Overflow rate, gpd/ft^2	
Average flow (0.85 MGD)	128
Peak hourly flow (5.88 MGD)	886
Detention Time, hours	
Average flow (0.85 MGD)	18.21
Peak hourly flow (5.88 MGD)	2.63
RAS Pumps	**3**
Pumps in service	2
Type	Horizontal non-clog centrifugal
Capacity, gpm	660 @ 31.4 ft TDH
WAS Pumps	**2**
WAS Pump No. 1	1
Type	Recessed Impeller
Capacity, gpm	100 @ 16.6 ft TDH
WAS Pump No. 2	1
Type	Recessed Impeller
Capacity, gpm	100 @ 2.9 ft TDH
Scum Pump	
Type	Simplex plunger
Capacity, gpm	90 @ 101 ft TDH

Waste activated sludge (WAS) is pumped from the final settling tanks by using one of two waste sludge pumps or the belt filter press feed pump. Note that the belt filter press feed pump is discussed in the solids handling section. The WAS can be directed to the sludge holding tanks, the gravity belt thickener/belt filter press or to truck loading for offsite disposal. The typical operation is to pump sludge to the gravity belt thickener/belt filter press

Scum from each final settling tank is conveyed into a trough and flows to the scum box located between the two settling tanks. Scum from the settling tank scum box is then conveyed by gravity to another scum box located in the basement of the Operations Building. Scum and water are collected and stored in the in the Operations Building scum box until pumping is required, at which point scum can be pumped by the scum pump located in the pump gallery to Sludge Holding Tank No. 3 or to truck loading for off-site disposal or pumped to the gravity belt thickener/belt filter press.

Based on the age of the RAS, WAS and scum pumps, it is not believed that they will be able to provide reliable service for the next 20 years. As a result, these pumps should be considered for replacement.

Sand Filters

Following the activated sludge process, final settling tank effluent is conveyed to the sand filters. The sand filters are continuously backwashing, upflow filters manufactured by Parkson under the trade name “Dynasand”. The filter system consists of filter cells, filter modules, one compressor, one air dryer, electrical and pneumatic controls. The design criteria for the sand filters are outlined in **Table 5-16**.

TABLE 5-16. SOUTH STREET WWTF SAND FILTER DATA

Parameter	Value
Sand Filter Cells	**6**
Filters Per Cell	2
Dimensions (each cell)	
Average Depth, ft	17.5
Media Depth, ft	3.3
Width, ft	8.17
Length, ft	14.17
Area, ft^2	116
Cells Online	6
Maximum Surface Area Online, ft^2	969
Loading Rate, gpm/ft^2	
Average Flow	0.9
Peak Hourly Flow	5.9

There are six concrete filter cells with each containing two fiberglass filter modules, for a total of 12 filter modules. A concrete influent channel is located upstream and north of the filter cells and an effluent channel is located downstream and south of the filter cells. On top of each of the 12 filter modules is a central compartment/washer that is used to remove solids from the filter medium to recycle the clean sand media continuously to the top of the sand bed. The airlift, which brings dirty sand from the bottom of the bed to the central compartment washer, is supplied by an air compressor located in the Blower Room of the Operations Building. Six control panels, one for each filter cell, are located next to the cells.

The mechanical components and controls of the sand filters are at the end of their serviceable life. As a result, these systems should be considered for replacement.

Post Aeration

The post aeration process adds oxygen to the sand filter effluent by diffusing air to raise the dissolved oxygen concentration in the water. This system consists of a post aeration tank, blowers, diffusers, piping, and related equipment. The design criteria for the post aeration tank and equipment are summarized in **Table 5-17**. Two post aeration blowers supply air to the diffusers located in the post aeration tank. One blower is a standby blower. The blowers are located in the Blower Room of the Operations Building. Due to the age of the equipment, they should be considered for replacement.

TABLE 5-17. SOUTH STREET WWTF POST AERATION SYSTEM DATA

Parameter	Value
Post Aeration Tank	1
Dimensions	
Length, ft	14
Width, ft	8
Sidewater Depth, ft	15
Volume, gallons	12,600
Aeration Blowers	2
Type	Rotary Lobe Positive Displacement
Units in Operation/Standby	1/1
Rated Capacity, ACFM	95/244 @ 6.2/6.5 psig
Motor, HP	10

UV Disinfection

The ultraviolet disinfection system follows the post aeration system and is located just prior to flow measurement in the Parshall Flume. The system is operated seasonally per the WWTF's NPDES permit. The UV system is a Trojan UV 3000 system with two UV lamp banks. Each bank contains 11 modules, each module contains eight bulbs (lamps). The UV system is shown in **Figure 5-10.** The design criteria for the UV system are summarized in **Table 5-18**. An automatic downstream water level controller keeps the water at the required elevation.

FIGURE 5-10. SOUTH STREET WWTF UV DISINFECTION SYSTEM

TABLE 5-18. SOUTH STREET WWTF ULTRAVIOLET DISINFECTION SYSTEM DATA

Parameter	Value
UV Channels	1
Dimensions	
Length, ft	36
Width, ft	4
Depth, ft	3.5
Banks per Channel	2
Modules per Bank	11
Lamps per Module	8

The UV system operation is automatic; however, manual cleaning of the lamps is required. It should be noted that Trojan is discontinuing the manufacture of spare parts for this system. Due to the age of the equipment and the lack of availability of spare parts, the UV system should be considered for replacement. Replacement of this system with an automatically cleaned system is recommended to reduce the manual cleaning of the UV lamps. Installation of a UV intensity meter should be considered to facilitate addressing the DEEP reporting requirements.

SOUTH STREET WWTF SOLIDS HANDLING PROCESSES

Sludge Storage

As part of the 1990s upgrade the WWTF was provided with the ability to store sludge in three sludge holding tanks. The intent of these tanks was to store waste sludge and scum until the WWTF operations staff was ready to send this material to the belt press/thickener for processing. Sludge Holding Tanks No. 1 and No. 2 were provided by converting the original final settling tanks from the 1968 construction into aerated sludge storage tanks. These tanks are 30 ft. diameter circular tanks that were provided with the ability to aerate them with blowers and coarse bubble diffuser systems. The two sludge mixing blowers are located in the Blower Room on the first floor of the Operations Building. Sludge Holding Tanks No. 1 and 2 are also serviced by a single supernatant pump. This pump allows for the removal of the tank supernatant for discharge to the plant recycle wet well which can be used to increase the solids concentration in these tanks. In addition this supernatant pump is also used and known as the truck loading pump. When used as the loading pump it conveys sludge from the thickened sludge storage tank to trucks for off-site sludge disposal. Sludge Holding Tank No. 3 was the original sludge holding tank from the 1968 construction located adjacent to the 1968 Aeration Tanks and Control Building. This tank was provided with top mounted mechanical mixer aerators. All three tanks are open to the atmosphere. The design criteria for the sludge holding tanks are summarized in **Table 5-19** below.

TABLE 5-19. SOUTH STREET WWTF SLUDGE STORAGE TANK DATA

Parameter	Value
Sludge Holding Tanks No. 1 & No. 2	2
Dimensions (each)	
Diameter, ft	30
Sidewater Depth, ft	8
Aeration	
Type	Coarse bubble
Blowers	2
Type	Rotary, positive displacement, belt-driven
Capacity (each), acfm	238[1]
Supernatant Pump	
Type	Duplex Plunger
Capacity, gpm @ TDH	180 @ 39 ft.
Motor, HP	5
Sludge Holding Tank No. 3	1
Dimensions	
Length, ft	29.25
Width, ft	24
Depth, ft	15
Aeration	
Type	Mechanical mixer/aerator

1. PSI rating of blower unknown

Subsequent to the 1990s upgrade, these tanks were used sparingly due to problems associated with odors and freezing. Shortly thereafter the use of these tanks was discontinued. While not currently used, consideration should be given to rehabilitation or retrofitting some or all of these tanks as part of a future upgrade to increase the flexibility of the solids handling process at the WWTF.

Solids Thickening and Dewatering

The existing sludge thickening and dewatering system consists of a sludge gravity belt thickener/belt filter press that is operated in thickening mode. The belt thickener/press is an Ashbrook-Simon-Hartley Klampress Size I and is located on the second floor of the Operations Building in the Sludge Dewatering Room. The belt thickener/press is shown in **Figure 5-11.** The belt thickener press is fed by a single belt filter press feed pump in the Operations Building basement. The design criteria for the belt thickener/press and feed pump are summarized in **Table 5-20**. Thickened sludge is stored in the thickened sludge storage tank.

The belt thickener/press is approaching the end of its serviceable life and is operating at or near capacity. Alternatives should be considered for its replacement, including upgrades for thickening, dewatering, or both thickening and dewatering.

FIGURE 5-11. SOUTH STREET WWTF SLUDGE BELT THICKENER /PRESS

TABLE 5-20. SOUTH STREET WWTF SLUDGE BELT THICKENER / PRESS DATA

Parameter	Value
Thickener /Press	
Number of Units	1
Belt Width, meters	1
Hydraulic Throughput Rate, gpm	0 - 70
Sludge Feed Concentration, %TS	0.75-3.0
Thickened Sludge Concentration, %TS	≥ 5
Dewatered Sludge Concentration, %TS	≥ 17
Feed Pump	
Units	1
Type	Simplex Plunger
Capacity, gpm @ TDH	120 @ 44 ft
Motor, HP	5

Thickened/Dewatered Solids Storage and Disposal

A 10,000 gallon thickened sludge holding tank is located east of the Operations Building. It stores sludge that has been processed by the belt thickener prior to being hauled off site. **Table 5-21** presents the thickened sludge holding tank data.

TABLE 5-21. SOUTH STREET WWTF THICKENED SLUDGE HOLDING TANK DATA

Parameter	Value
Thickened Sludge Holding Tank	1
Approximate Dimensions	
Length, ft	20
Width, ft	10
Sidewater Depth, ft	7

Gravity discharge from the belt thickener to the thickened sludge holding tank should normally be adequate for sludge transfer; however, if gravity feeding is not sufficient, there is a progressive cavity pump located in the Sludge Dewatering Room that is used to pump thickened sludge to the Thickened Sludge Holding Tank. Sludge from the Thickened Sludge Holding Tank is conveyed to trucks for off-site disposal using the truck loading pump in the Operations Building basement. This pump can also be used as and is known as the supernatant pump. This pump is described in more detail in the waste sludge storage section above. When used as the loading pump it conveys sludge from the thickened sludge holding tank to trucks for off-site sludge disposal. If desired, dewatered sludge can be discharged to the Truck Loading Room below the Sludge Dewatering Room for off-site disposal via dump truck or sludge container.

The WWTF staff has reported that this thickened sludge storage tank is a choke point in the solids handling process. In the summer months, with the receipt of more septage and the increased biological activity in the WWTF, the thickened sludge holding tank often needs to be pumped out every day. Also at times when off site sludge hauling has been limited, the lack of storage volume has resulted in the WWTF having to stop their solids processing until the tank can be emptied. Consideration should be given to increasing the thickened sludge storage volume as well as replacing the truck loading pump due to its age and relocating it closer to the thickened sludge storage tank.

SOUTH STREET WWTF ANCILLARY FACILITIES

Ancillary Pumping Systems

Plant Water Pumps. A plant water system is installed throughout the facility and is used for flushing pipes, cleaning, and yard hydrants. Effluent water is withdrawn from the Post Aeration Tank by Plant Water Pumps No. 1 and No. 2, located in the Pump Gallery of the Operations Building. The design criteria for the plant water pumps are summarized in **Table 5-22.** Operations staff has reported that the pump runs constantly, and should be considered for replacement.

TABLE 5-22. SOUTH STREET WWTF PLANT WATER PUMP DATA

Parameter	Value
Plant Water Pumps	2
Plant Water Pump No. 1	1
Type	Centrifugal
Capacity, gpm	@___ ft TDH [1]
Motor, HP	30
Plant Water Pump No. 2	1
Type	Centrifugal
Capacity, gpm	240 @ 170 ft TDH
Motor, HP	15

1. Unknown capacity. Pump from original 1968 WWTF Construction.

Wet Well Pumps. The wet well pumps return internal recycle flows received at the recycle wet well in the Operations Building to Distribution Box No. 1. The sources of flow into the wetwell include filtration backwash, belt press/thickener filtrate, belt press/thickener wash water, supernatant from the sludge holding tanks, and sump pump discharges in the Operations Building. The design criteria for the wet well pumps are summarized in **Table 5-23.** Due to the age of these pumps they should be considered for replacement.

TABLE 5-23. SOUTH STREET WWTF WET WELL PUMP DATA

Parameter	Value
Wet Well Recycle Pumps	2
Type	Horizontal non-clog centrifugal
Capacity, gpm	415 @ 25.8 ft TDH
Motor, HP	5

Chemical Storage and Feed Systems
Four chemical systems are provided at the South Street WWTF which include the following:

- Sodium hypochlorite
- Sodium hydroxide
- Phosphorus removal chemical (alum)
- Polymer.

These systems are described below.

Sodium Hypochlorite. The sodium hypochlorite system has four feed points for odor control and for process control. The feed points are the influent channel prior to coarse screening, the waste activated sludge (WAS) discharge piping prior to the sludge holding tank, the return activated sludge (RAS) pump discharge piping, and the thickened sludge storage feed line. The sodium hypochlorite feed pump and storage tanks are located in the Chlorinator Room of the Control Building. Sodium hypochlorite can be added to the influent channel, waste sludge, and thickened sludge storage tank for odor control and can be added to the return sludge for sludge bulking control.

Sodium Hydroxide. Sodium hydroxide can be provided to maintain alkalinity in the wastewater, as biological nitrification in the activated sludge system consumes alkalinity. Sodium hydroxide addition can be provided to increase the buffering capacity during the nitrification process, as well as to maintain an optimum pH level. The feed points are located in the influent channel following the grit filtrate recycle and influent sampling just prior to the Pista-Grit chamber.

Phosphorous Removal Chemical. Aluminum sulfate (alum) or ferric chloride (ferrous sulfate) may be added for the removal of phosphorus. The feed points include the WWTF influent at Distribution Box No. 1 and to the mixed liquor just upstream of Distribution Box No. 2 (upstream of the Final Settling Tanks). Currently, alum is being added to Distribution Box No. 2 for phosphorous removal. There are two phosphorus removal chemical feed pumps and two 4,000 gallon liquid phosphorus removal chemical storage tanks located in the eastern side of the Operations Building basement. The two storage tanks are loaded through 3-inch PVC lines from the Truck Loading Room in the Operations Building.

Polymer. Two polymer mixing and aging tanks and two polymer feed pumps are located on the first floor of the Operations Building. The polymer systems allow polymer to be added to the sludge feed to the belt thickener, the sludge holding tanks, or upstream of Distribution Box No. 2 to enhance final settling.

All of the chemical feed and storage facilities were installed as part of the 1990 upgrade and are approaching the end of their useful life. Replacement of these feed and storage facilities should be considered. In addition, the access to the phosphorus removal storage and feed facilities in the basement of the Operations Building is difficult for the WWTF operators. Alternate locations for these systems should be considered.

Instrumentation and Control Systems

The South Street WWTF is staffed Monday through Saturday from 7:00 a.m. to 3:00 p.m. and Sunday from 8:00 a.m. to 10:00 a.m. In the event of an issue with the critical equipment at the South Street WWTF, alarms are activated in a local centralized panel at the WWTF. During unstaffed hours, alarms (including fire alarms) are conveyed using auto-dialers via dial-up telephone lines to an offsite alarm monitoring service (Simplex).

The South Street WWTF operates its equipment and systems both manually and with some automated processes. The automated processes include the UV disinfection process (operated based on flow), the upflow sand filters (manufacturer provided controls), and the belt filter press (a local control panel controls the press, the sludge feed rate, and polymer addition). The WWTF has no local or remote instrumentation control panels (ICPs) or SCADA control. Equipment status is indicated locally, run-time meters are located at the Motor Control Centers, and alarms are hard wired and indicated on the alarm annunciator panel.

As part of the National Pollutant Discharge Elimination System (NPDES) permit for the WWTF, reports providing plant operating data are required to be submitted to the DEEP. Currently, without an automated data collection system, those reports are generated by manual data collection and entry.

The WWTF measures flow at a single location. Flow is measured by a parshall flume located downstream of the UV disinfection system.

Due to its age, the limited instrumentation and control system at the WWTF are not expected to provide reliable service in the future. Providing a plant wide SCADA system for monitoring and control as well as local and remote alarms of a number of the WWTF systems should be considered.

Architectural Components

Many of the architectural features of the buildings at the facility are in poor condition, including damaged building faces, damaged doors and associated hardware, roof leaks, corrosion, and paint/coating peeling in process areas. In addition, there is extremely limited space available for vehicle and equipment storage and maintenance. **Table 5-24** summarizes architectural component upgrades that should be considered.

Structural Components

Aeration Tanks No. 1 and No. 2 were constructed in 1968. They are currently unused and exhibit significant cracking and deterioration. Aeration Tanks No. 3 and No. 4 were constructed in 1990 and show some wall cracking. The final settling tanks are mostly buried, but the exposed concrete appears to be in good condition. The roofs on both the Control Building and Operations Building show signs of cracking. The concrete located in the Operations Building basement pump gallery does not appear to have any structural issues, but some water infiltration is coming from underground conduits that supply the wiring for the building.

The significant cracks in Aeration Tanks No. 1 and No. 2 should be repaired if they are to be used in the future and the minor cracks in Aeration Tanks 3 and 4 should be repaired. The roofs of the Control Building Influent Building and Operations Building should also be considered for repair and replacement and the leaks in the Operations Basement sealed.

HVAC Systems

In general, the HVAC equipment and systems at the WWTF are in fair to poor condition and are not expected to provide reliable service to the WWTF over the next 20 years. Much of the equipment is corroded, not functional, missing, or near the end of its service life. Upgrades to the HVAC systems in the Headworks Building, Control Building, and Operations Building should be considered.

TABLE 5-24. SOUTH STREET WWTF ARCHITECTURAL COMPONENT UPGRADES TO BE CONSIDERED

South Street WWTF Building	Architectural Component Upgrades to be Considered
Influent Building	• Repair EIFS [(1)] exterior • Replace exterior doors and their hardware • Recoat interior paint • Repair or replace corroded metal components and install protective coatings • Repair or replace roof
Control/Maintenance Building	• Replace adjoining tank and exterior guardrails • Replace storefront glass • Replace exterior doors • Repaint interior upper level • Repair or replace roof • Utilize basement for storage • Modify building to be dedicated administration space with ADA improvements
Operations Building	• Repair (as needed) exterior EIFS • Replace exterior doors and their hardware • Repaint or recoat interior process areas • Repair or replace roof • Improve ADA accessibility • Functional upgrades to Laboratory, Control Room, Break Room
Vehicle Maintenance Garage	• New space for vehicle and equipment storage and maintenance

1. EFIS – Exterior Finish Insulation System

Electrical Systems

The main electrical distribution equipment at the WWTF was provided in the 1990s upgrade, and is obsolete and past its service life. Newly produced spare parts are no longer readily available and there is limited manufacturer support for maintenance and repair. The WWTF facility main distribution panel (MDP) is rated for 800 amps and it may not have the capacity to support a facility upgrade. The WWTF main electrical system is located on the second floor of the Operations Building and is not readily accessible, which could be an issue to access during building fire. The WWTF has limited standby power backup capacity and cannot support the WWTF's critical process loads.

Electrical upgrades that should be considered include:

- Replace the facility electrical distribution system in its entirety
- Provide a new electrical system in the new electrical room located at grade with outside door access and in dedicated, air conditioned, environmentally controlled space, and away from process equipment
- Replace the standby generator(s) in outdoor, weatherproof, sound attenuated enclosure(s)
- Consider the use of a natural gas powered generator
- Replace the existing utility transformer
- Replace the lighting systems with energy efficient lighting (LED)
- Replace the fire alarm system
- Provide new emergency and exit lights
- Provide a lightning protection system

- Provide a new phone, paging, and security system including remote opening and closing of an actuated WWTF main entrance gate
- Provide a power monitoring system
- Perform electrical short circuit and coordination studies and provide all new electrical equipment with arc flash labels in accordance with the requirement of the NEC, NFPA-70E and IEEE 1584

Fuel Oil Systems

The fuel oil systems at the WWTF consist of two underground fuel storage tanks and fuel oil piping, valves, and pump. There is a 5,000 gallon storage tank located to the north of the Operations Building, and a 3,000 gallon tank located to the south of the Influent Building. Due to the age of the fuel oil systems, they should be considered for replacement. Consideration should be given to replacing the heating system at the plant with natural gas as a gas main was recently installed on South Street.

Civil/Site Components

The site lighting, paving, curbing, and fence are in poor condition and should be considered for replacement.

The current configuration of the plant has little room for vehicle and equipment storage and maintenance. The sludge loading truckway currently serves as the main storage area, and consideration should be given to constructing a second garage, as maintenance to the fleet vehicles is done at the facility.

Resiliency

Upgrades to the WWTF should take into consideration resiliency issues specifically those to address flooding potential as well as backup power. TR-16 recommends that the critical equipment, which includes conveyance and treatment system components, be able to maintain flow as well as primary treatment and disinfection during flood events. As a result, this requires protection of these systems as well as other support systems which include electrical distribution, standby power systems, as well as instrumentation and control systems. The design flood elevation recommended by TR-16 is three feet above the 100 year flood elevation for critical equipment and two feet above the 100 flood elevation for non-critical equipment. The 100 year flood elevations should be based on the most recent information from the Federal Emergency Management Agency (FEMA).). The current 100 year flood elevation at the South Street WWTF is 577 (referenced to the National Geodetic Vertical Datum (NGVD) 1988), and the entire WWTF site is above this elevation. In fact the entire WWTF site is above the 500 year flood level. The first floor elevation of 598.0 NGVD 1929 (or ~597.1 1988 NGVD) of lowest building on the site, the Operations Building, is greater than 3 feet above the 100 year flood elevation, so no additional flood protection will be needed if this building is upgrade. The other WWTF buildings are all at higher elevations than the Operations Building.

Backup power recommendations from TR-16 include providing backup power with sufficiency capacity for critical WWTF systems as well as providing sufficient fuel storage for the backup power systems to run 48 hour at peak flow conditions and 96 hours at average conditions. The lower of the two existing generators at the WWTF (one near the Operations Building and one near the Control Building) is on a concrete pad at approximately elevation 598.0 NGVD 1929 (or ~597.1 1988 NGVD), so it is also well above the 100 year flood level. Resiliency elements should be considered with any South Street WWTF upgrades.

Odor Control Upgrades

Odor control should be considered for areas/unit processes that have the potential of releasing fugitive odors that may have an impact on neighboring properties/facilities. The following WWTF area/unit processes should be considered to be provided with odor control: influent pump station, Influent Building process area, Distribution Box No. 1, septage facilities, sludge thickening/dewatering areas, and the Thicken Sludge Storage Tank.

Hazardous Materials

As part of the existing conditions evaluation, a hazardous materials survey was performed at the Route 7 WWTF to help identify areas where lead paint, asbestos, and PCBs containing building materials are or may be present. The investigations were performed by HYGENIX, Inc. from Stamford, CT. On-site lead analysis was performed using an X-ray fluorescence analyzer. For asbestos, samples of suspect building materials were collected and tested by an off-site laboratory. Finally, for building materials suspected of containing PCBs either chip samples, bulk samples or wipe samples were collected and tested by an off-site laboratory.

The purpose of the survey was not to completely evaluate all building materials on site but to get a representative sample collection from different suspected hazardous building materials that were readily accessible and did not impact the building material functionality (example roof). The survey results are to be used a based line for future investigation and to allow for a preliminary estimate of cost to remove and remediate these materials during a WWTF upgrade project. **Table 5-25** presents a summary of the hazardous materials positively identified or assumed at the WWTF from the survey.

TABLE 5-25. SOUTH STREET WWTF HAZARDOUS MATERIALS SURVEY FINDINGS

Hazardous Material	Location	Description	Comments
Lead			
	Control Building	Metal Fire Protection Pipe Metal Windows	
	Operations Building	Exterior Metal Pipe Interior Fire Protection Pipe Metal Desks Metal Fume Hood	
Asbestos			
	Control Building	Floor & Tile Mastic Gasket Insulation Some1968 Window Caulk Some1968 Window Glazing Foundation Mastic	 Also contains PCBs Also contains PCBs Assumed [1]
	Operations Building	EFIS Moisture Barrier Foundation Mastic	 Assumed [1]
	Influent Building	EFIS Moisture Barrier Foundation Mastic	Assumed [1] Assumed [1]
PCBs			
	Control Building Exterior	1968 Window Caulk 1968 Window Glazing	
	Control Building Interior	1968 Window Caulk 1st Floor Ceiling and Wall Paint Stair Tread and Riser Paint Basement Ceiling and Wall Paint Boiler Room Door Frame Paint Basement Process Piping Paint and Insulation.	
	Operations Building	Side Walk Caulk	

1. Area could not be accessed for sampling.

CHAPTER SIX
ROUTE 7 WWTF UPGRADE ALTERNATIVE EVALUATION

In Chapter Five, the existing facilities at the Route 7 WWTF were described and assessed to identify their condition and need for improvements or upgrades. The facilities were evaluated to determine if they would be able to provide continued service through the Facilities Plan design year of 2035. A number of WWTF systems and unit processes were identified as requiring upgrades and/or improvements.

For a number of systems and unit processes multiple alternatives were evaluated. The systems and unit process that had these multiple alternatives are as follows:

- Influent Pumping
- Headworks Facilities Including:
  - Screening
  - Grit Removal
- Equalization Tank
- UV Disinfection and Plant Water Systems
- Solids Pumping Upgrades

This chapter will describe and evaluate the upgrade alternatives developed for the systems and unit processes noted above. This chapter summarizes alternatives identified, screened, and the evaluations performed on various WWTF systems. For many of these systems the evaluations were qualitative based on engineering judgment and experience. However, for a number of systems with more complicated alternatives, the evaluations were both qualitative and quantitative including summaries of the advantages and disadvantages of the alternatives, as well as a comparison of estimated capital costs, including allowances for electrical and instrumentation and control upgrades to support the alternatives. Note that these evaluations did not include operation and maintenance costs.

INFLUENT CONVEYANCE

Introduction

As noted in Chapter Five, the Route 7 Pump Station is approximately 30 years old and contains most of its original equipment. The existing pump station has reached the end of its service life and full replacement of all systems is recommended. Operations staff have also noted that discharge surge issues occur when two pumps are run simultaneously, causing the influent box at the Route 7 WWTF Headworks to overtop.

Approach

The current average daily and peak flows at the pump station are approximately 54,000 gpd and 357,000 gpd respectively (38 gpm and 250 gpm). The year 2035 projected average daily and peak flows for the pump station are 120,000 gpd and 720,000 gpd respectively (85 gpm and 500 gpm). The new pump station design would accommodate this range in flows. It is recommended that the pumps be provided with variable frequency drives (VFDs) to reduce flow surges currently experienced at the Route 7 WWTF and to address the projected range in flows. It is recommended that in lieu of providing two large pumps each sized for 500 gpm, three smaller pumps each sized to accommodate half of the design flow (250 gpm) be provided. It is anticipated that one pump would be adequate to keep up with pump station demand the majority of the time and two pumps would be required to convey peak wastewater flows. The third pump would serve as a standby. It is also recommended to provide a communication between the PS and the Route 7 WWTF SCADA system for monitoring, control and alarms. To provide communication between the WWTF and the pump station, a new communication conduit has been assumed. Other communication alternatives such as wireless or radio based technologies could be considered in design.

The SCADA system would be capable of alternating the operating pumps to provide reliability, as well as the ability to measure and record flow from a flow meter installed on the pump station discharge.

The existing Route 7 pump station force main runs from the pump station directly to the Route 7 WWTF and is an 8-inch diameter ductile iron pipe, and is approximately 2,150 feet long. The elevation rise from the wet well to the force main discharge is approximately 50 feet. The energy losses due to friction at the design pumping rate combined with the static head energy losses at this pump station would result in a total dynamic head of approximately 75 feet with the existing 8-inch force main.

Alternatives Evaluated

Two pump station alternatives were considered for the replacement of the existing pump station including:

- Pump Station Replacement on the Existing Site
- Pump Station Relocation Outside of the Existing WWTF Fence

Pump Station Replacement on the Existing Site. The replacement of the Route 7 Pump Station at the existing site was evaluated. In order to rebuild at this site, it would be necessary to utilize bypass pumping during the pump station reconstruction to allow for demolition of the existing pump station and construction of the replacement pump station in the same location. The bypass pumps would be connected into the existing 8" cement lined ductile iron force main in the vicinity of the site. The bypass system would include electrically powered primary bypass pumps and diesel powered backup pump(s). The existing wet well, valve vault and generator building / enclosure would be demolished after the bypass has been established to allow for construction of the new pumping station. The layout of the replacement pump station at the existing site is shown in **Figure 6-1**. The replacement pump station would be of similar depth of the existing pump station and the pumps would connect to and reuse the existing force main for conveyance of flow to the WWTF.

Pump Station Relocation Outside of the Existing WWTF Fence. The relocation of the Route 7 pump station would allow for some of the headworks facilities for the WWTF to be located at the bottom of the hill. In this alternative, some of the headworks equipment would be located at the new pump station and would include screening of the wastewater before pumping to the WWTF. The relocated headworks would be enclosed within a new building that would also be designed to house chemical storage and feed systems for phosphorous removal. Relocation of the pump station would require the installation of approximately 1,500 linear feet of gravity sewer to convey flow between the existing PS location and the new PS location. This would require a new easement through the existing parking lot and access road between the existing pump station and the WWTF. The installation of the gravity sewer would increase the new pump station depth by approximately 10 feet versus replacement of the existing pump station at the existing PS. The addition of a screen for preliminary treatment at this location would also increase the depth of the station to approximately 30' below grade. This depth would increase the pump station cost and would make removing screenings from below grade difficult. As a result, the increased costs for providing the new gravity sewer and deeper pump station at a new location versus the smaller additional costs of the extended construction bypass systems for replacing the PS at the existing location; the alternative to relocate the PS was eliminated from consideration.

Based on the summary of alternatives above, replacing the pump station at the existing location is recommended. See Chapter Nine for additional information on this pump station, including the estimated costs.

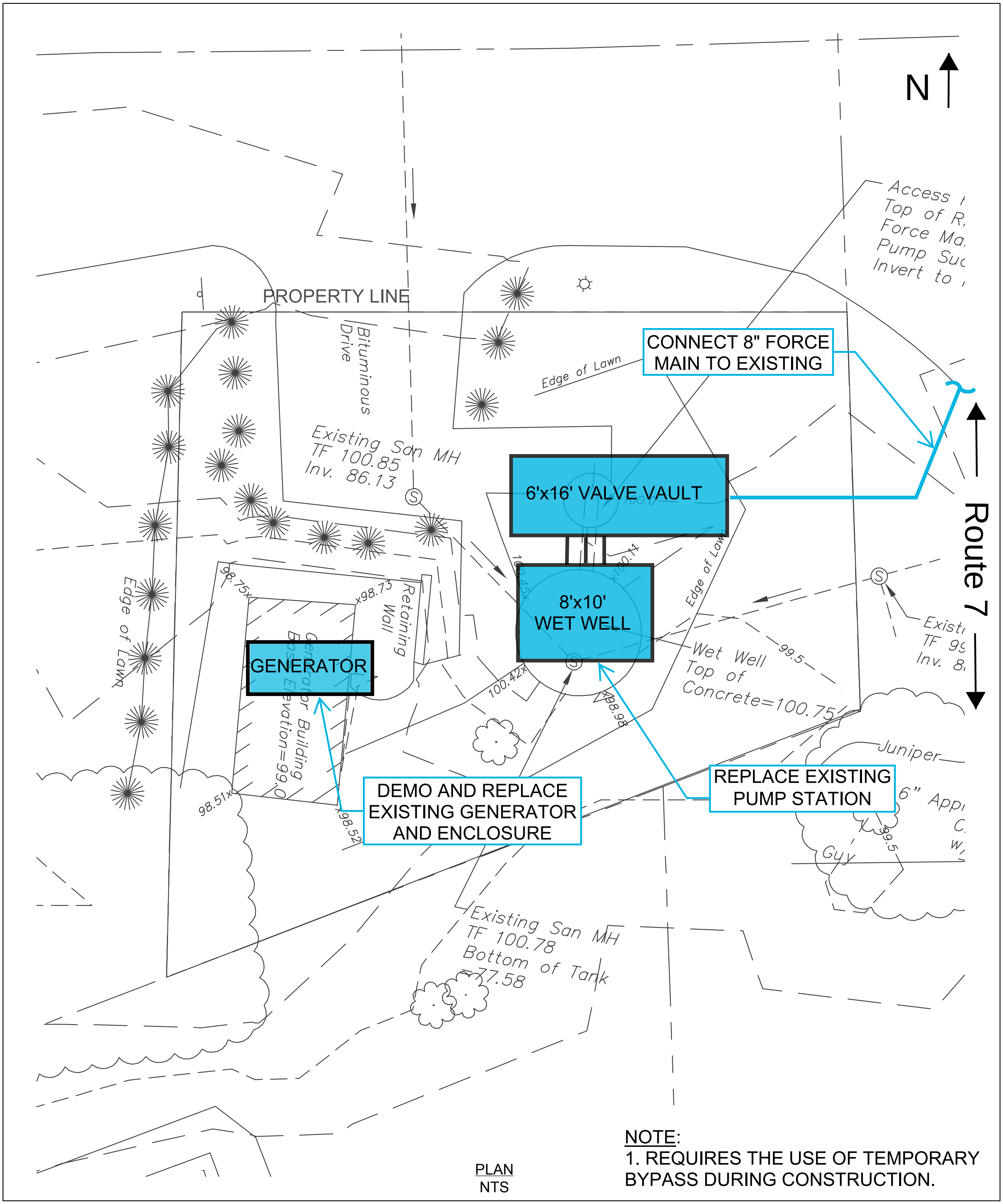


FIGURE 6-1
ROUTE 7 WWTF
REPLACEMENT PUMP STATION

HEADWORKS

Introduction

As noted in Chapter 5 the equipment in the Headworks has reached the end of its service life and is in need of replacement. The existing headworks facility is located at the top of the hill and is open to the environment. Rehabilitation of the existing headworks facility was evaluated. To minimize odors and to protect the equipment from the elements it is recommended that the headworks equipment be located within a new structure. Per TR-16, *Guides for the Design of Wastewater Treatment Works*, the addition of a screening system upstream of the existing aerated grit chamber is recommended. With the implementation of screening, it is recommended that the existing channel grinder be removed. The evaluations included alternatives for different types of screens and the rehabilitation or discontinuation of grit removal. These items are discussed in the section below.

Approach

A new Headworks Building would be located at the top of the hill adjacent to the existing headworks structures. This building would be sized to accommodate screening and grit removal systems (if grit removal is recommended to be continued). In addition, to minimize the need to construct an additional building, chemical storage and feed equipment for total phosphorous removal, and space for auxiliary electrical and mechanical equipment would also be provided in this building. The chemical area would be sized to accommodate two alum feed pumps as well as two 250 gallon alum storage totes.

A second alternative would be to discontinue the use of a grit removal system at the WWTF. During site visits conducted by the design team, operators noted that little to no grit is collected and removed from the WWTF. The headworks alternatives layouts have been evaluated both with and without grit removal, including reducing the size of the proposed Headworks Building.

In addition to the mechanical equipment being past its service life, the existing influent channel is prone to overtopping when both pumps at the Route 7 PS are operating. This issue will be addressed as described in the Pump Station section above. In addition, the alternatives also addressed the hydraulic limitations noted in the Phase 1 Facility Plan that are summarized in Chapter Three.

Screening Alternatives

Two screen types were evaluated for use at the WWTF and are described below:

- Mechanically cleaned bar screen
- Rotating channel screen

Mechanically Cleaned Bar Screen. A mechanically cleaned bar screen was considered for installation at the headworks facility. The bar screen is oriented vertically and installed in the influent channel to intercept influent material on the bars. **Figure 6-2** shows a photograph of an installed unit. The bars, which can be provided in various sizes and bar spacing, are cleaned by a mechanical rake that removes screenings periodically either when the head loss in the channel reaches a set point or on a timer. Due to the nature of the long vertical opening between the bars, some larger material can pass through the bars if in the right orientation. If a grinder was desired for the collected screenings, the mechanically cleaned screen would require a separate grinder. If washing and compacting of the screenings was desired to remove some of the offensive organic material from the screenings, a separate screenings washer/compactor would be required. The additional cost and maintenance associated with multiple pieces of equipment made the bar screen less suited for this application.

FIGURE 6-2. MECHANICALLY CLEANED BAR SCREEN

Rotating Channel Screen. The rotating drum screen was considered for installation at the Headworks Building. This screen would be installed in the influent channel on an angle to intercept material on the screen. The screen portion consists of a perforated metal drum that with a screenings collection auger to remove material from the drum. Screened material is collected within the screen drum while flow passes through the drum to the downstream processes. See **Figure 6-3** for an illustration of a rotating channel screen. These perforated plates come in a number of sizes and often have better removal efficiency and higher headloss versus bar screens. The collected screenings are then moved to a center screw and transferred up the shaft through a washing and compaction zone to remove some of the offensive organic material. The screen can either be equipped with an automatic bagger, or a dumpster can be placed below to collect screenings. This type of screen may require operators to manually remove large debris from the waste stream, as it cannot be transferred up the center screw for disposal or a channel grinder may be installed upstream of the screen in the influent channel. As all influent flow to the WWTF is pumped, large debris would not be able to make it through the pump station, making this type of screen well suited for the application. All desired functions can be provided in a single compact unit, including grinding, screening, washing and compacting. As a result, a drum screen is recommended for installation at the Route 7 WWTF headworks.

Grit Removal Alternatives

Three grit removal alternatives for the Route 7 WWTF headworks were evaluated, including:

- Headworks with Enclosed Grit Removal
- Headworks without Grit Removal
- Headworks with Outdoor Grit Removal

For the purposes of the evaluation, a rotating channel screen with an upstream grinder and integrated screening washer/compactor has been included in each alternative.

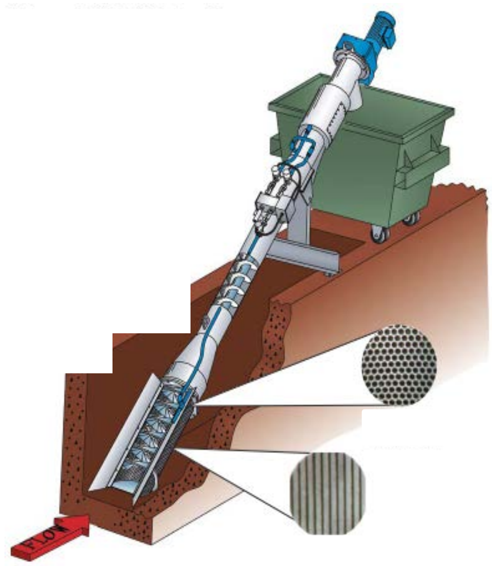


FIGURE 6-3. ROTATING CHANNEL SCREEN

Headworks with Enclosed Grit Removal. For this alternative, the inclusion of a new screening system in the Headworks Building with grit removal would require the installation of a new channel upstream and adjacent to the existing aerated grit chamber to accommodate the screen. The existing aerated grit chamber would be upgraded with new air diffusers, a new blower and a new grit removal screw. A layout of this headworks alternative with grit removal is shown in **Figure 6-4**. As described above, the new Headworks Building would be sized to accommodate space and the screening system, grit chamber, chemical storage and feed systems for total phosphorous removal, as well as space for auxiliary electrical and mechanical equipment. The size of the headworks building for this alternative would be approximately 40-feet long by 32-feet wide. The headworks process area would be approximately 40-feet long by 20-feet wide. The chemical storage area will include space for two chemical totes, metering pumps, and an emergency eyewash station, and will be approximately 20-feet long by 12-feet wide. The remaining area would house auxiliary electrical and mechanical equipment.

Headworks without Grit Removal. For this alternative, the existing grit chamber would be removed and the channel would be reconfigured for installation of the screening system recommended in the previous section. Historically, the existing grit removal equipment has removed little to no grit, as the Sewer District No. 2 system is relatively new with minimal infiltration issues that typically cause the addition of inorganic material to wastewater flows. In addition, the original primary sludge pumping systems has not experienced excessive wear issues, indicating that little grit is passing through the existing grit chamber. This alternative would also include an area for chemical storage and feed systems and auxiliary mechanical and electrical spaces described earlier in this section. The exclusion of a grit removal system would allow the new headworks building to be reduced in size by approximately 5 feet in width to approximate dimensions of 40-feet long by 27-feet wide. **Figure 6-5** shows a layout of this alternative.

Headworks with Outdoor Grit Removal. For this alternative, the inclusion of a new screening system and upgraded grit removal system would be provided. The new screening system would be installed within a new Headworks Building, but the grit removal equipment would be located outside of the building. Similar to the alternative of headworks without grit removal, this would reduce the size of the building by approximately 5 feet. However, to provide access to the influent screening channel and grit chamber, this layout would increase the required distance between the screen channel and grit removal channel than if both were located within the building for construction of the wall. This additional distance between the screening channel and grit chamber will require locating the new building farther up the hill. This location has more exposed rock at grade and would be expected to increase construction costs and offset potential savings from the smaller building. As such, this alternative was eliminated from consideration.

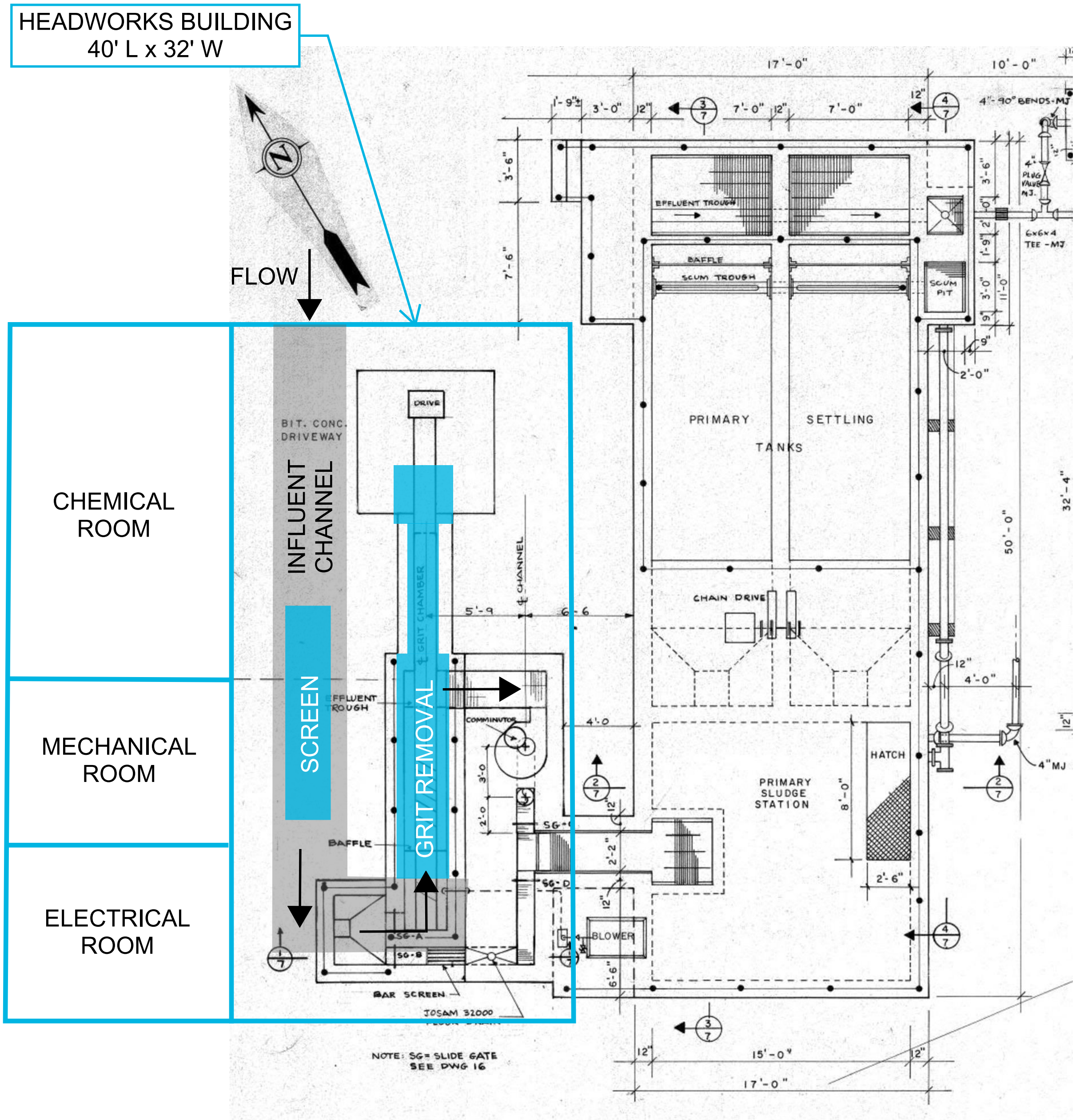


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FIGURE 6-4
ROUTE 7 WWTF
HEADWORKS WITH ENCLOSED
GRIT REMOVAL

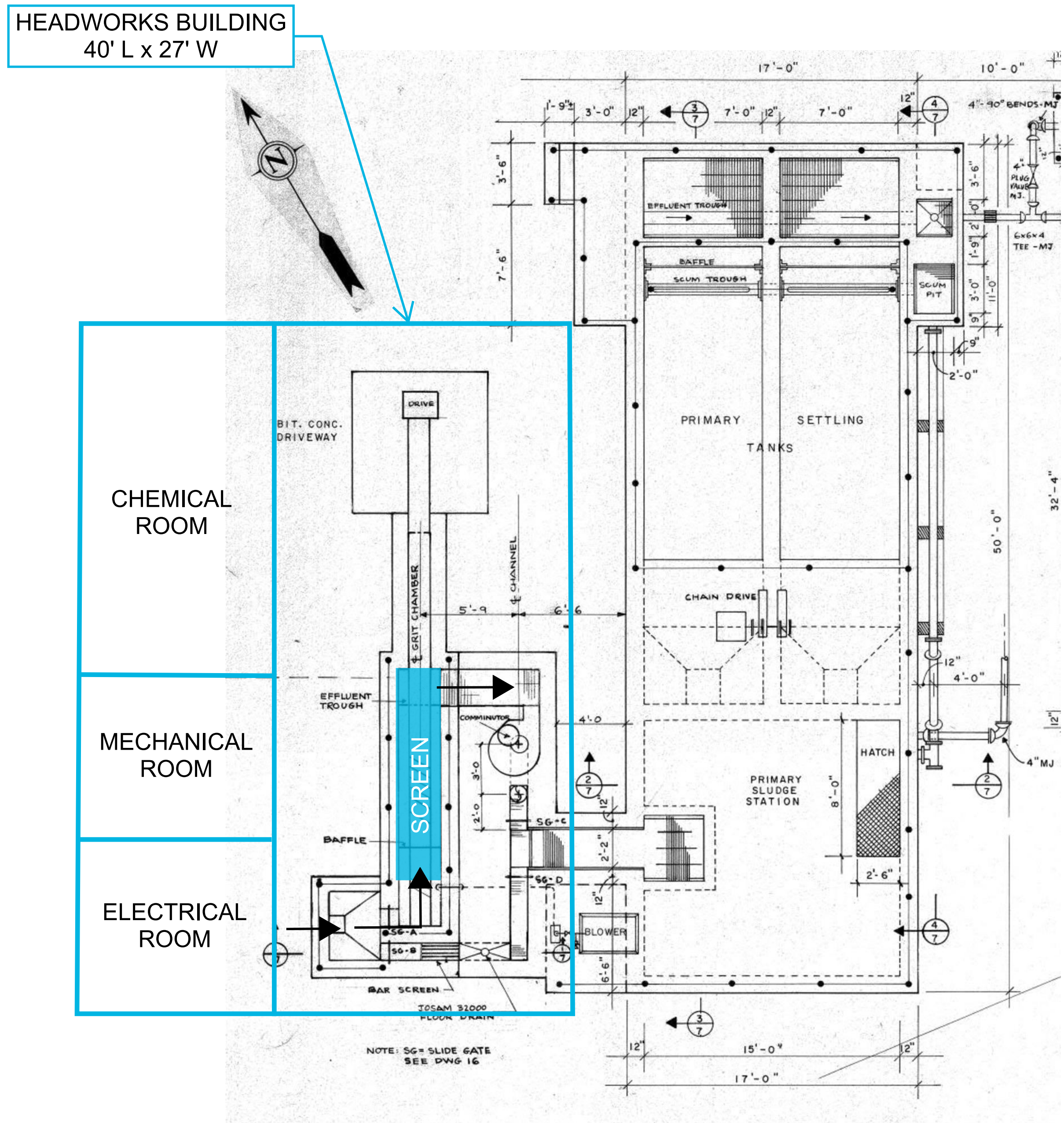

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FIGURE 6-5
ROUTE 7 WWTF
HEADWORKS WITHOUT
GRIT REMOVAL

Headworks Alternatives Estimated Costs

Estimated capital costs for the first two grit removal alternatives are summarized in **Table 6-1**. These alternatives include a Headworks Building to house the headworks equipment, as described in the alternative descriptions, chemical feed and storage equipment for phosphorus removal, and space for ancillary electrical and mechanical equipment.

TABLE 6-1. ROUTE 7 WWTF HEADWORKS ALTERNATIVE COSTS

Alternative	Capital Cost
Headworks with Grit Removal	**$1,345,000**
Headworks without Grit Removal	**$1,050,000**

EQUALIZATION TANK

Introduction

The equalization (EQ) tank is located between the primary settling tanks and the rotating biological contactors (RBCs). The EQ tank currently operates in a flow through mode, providing little to no flow equalization due to the existing flow control valve being non-operational. The existing flow control valve was reportedly undersized and quickly became clogged, rendering it inoperable. It has been recommended that the equalization function be restored as part of a WWTF upgrade. In addition, the aeration system and blower require replacement due to their age and condition. The tank should also be equipped with a means for routing flow around the tank.

Approach

The new equalization control system would be provided to attenuate the peak flow conveyed to the rotating biological contactors to 300,000 gallons per day or less per the original WWTF design.

Alternatives

Two alternatives were evaluated for the restoration of the equalization function, including:

- Flow Control Valve Equalization
- Pumped Equalization

These alternatives are discussed below.

Flow Control Valve Equalization. This alternative would include the use of an automatically actuated flow control valve control to modulate the flow exiting the tank. The existing valve was undersized and has not been operational for some time. To address the existing undersized flow control valve, the use of a larger flow control valve (4-inch diameter) is recommended. The valve operation would be controlled by the WWTF SCADA system based on the water level in the tank, and the tank's influent flow rate, as measured by an upstream flow meter.

During periods peak flows less than 300,000 gpd (during the initial years after a WWTF upgrade), the tank would operate in a flow through configuration (i.e. flow out of an outlet pipe at the top of the tank or other location). The WWTF SCADA system would monitor the influent flow to the WWTF over a rolling 24 hour period. As the influent peak flows increase above 300,000 gpd, (over the design life of the WWTF upgrade) the EQ functionality would be initiated. Due to the larger valve size, the control valve would operate on a timer (i.e. one minute open, five minutes closed) to prevent clogging of the valve as well as to limit the downstream flow. Once the peak flow event has passed, the tank would return to running in flow through mode as initiated by the WWTF staff. The basis of the logic for control of the valve is the equalization tank level. Under normal conditions, a specific tank level is targeted by adjusting the frequency and duration that the valve is opened. At a low tank level, or when the influent flow is below the minimum set point the valve will not open or will open for a limited period of time each hour. As the flow increases and when the tank level is above the set point the valve will open at greater frequencies and for greater durations until it reaches its maximum daily flow of 300,000 gpd. This control scheme will minimize the number of times that the valve opens and closes, increasing the valve service life. It is recommended that a redundant valve also be installed as well as providing improved access to the valves.

Pumped Equalization. The control of the equalization tank using a pump is the second alternative for equalization control. This alternative includes the use of a pump to control the flow exiting the equalization tank. The pump would be sized and operated to convey a maximum of 300,000 gpd to the RBCs. Due to the hydraulic conditions at the WWTF (i.e. pumping downhill), a pumped equalization system will require the use of a positive displacement type pump to prevent forward flow. These pumps are typically more costly than centrifugal type pumps. The pumps would be equipped with variable frequency drives (VFDs) to accommodate the range in flows. The pump discharge would be controlled via the WWTF SCADA system based on the tank water level and the influent flow rate based on an upstream flow meter.

During periods peak flows less than 300,000 gpd (during the initial years after a WWTF upgrade), the tank would operate in a flow through configuration (i.e. flow over an outlet pipe at the top of the tank or other location). As the influent peak flows increase above 300,000 gpd, (over the design life of the WWTF upgrade) the EQ functionality would be initiated. The basis of the logic for control of the pump(s) is the equalization tank level. Under normal conditions, a specific tank level is targeted by adjusting the speed of the equalization pumps. At a low tank level, or when the influent flow is below the minimum set point the pumps will shut off or will operate for a limited period of time each hour. As the flow increases and when the tank level is above the set point the pump speed will increase until it reaches its maximum daily flow of 300,000 gpd. This control scheme will minimize the run time on the pumps, limiting wear and energy consumption.

Based on the alternatives evaluated above, the use of a flow control valve to control the equalization tank is recommended due to increased capital and operations and maintenance costs of the pumped system alternative. See Chapter Nine for additional information on the equalization tank, including the estimated costs.

UV DISINFECTION AND PLANT WATER SYSTEM

Introduction

The existing UV system is located in a partially below grade room adjacent to the Secondary Sludge Pump Station. The existing system consists of a single stainless steel open channel, with two banks of UV bulbs in series. As described in Chapter Five, the existing ultraviolet (UV) disinfection system is not expected to provide reliable service for the next 20 years and is therefore recommended for replacement. The existing system is not capable of handling the design peak flow while maintaining the TR-16 recommended one foot of freeboard. The existing open channel UV system also prevents the use of the existing plant water wet well and plant water system. Plant Water Station functionality is recommended to be reinstated at the WWTF. In addition, the WWTF staff has requested that UV redundancy be provided with a two channel system to provide improved maintenance and reliability. UV system upgrade recommendations also included mechanical cleaning, flow pacing and system instrumentation and alarms. It was recommended that the replacement of the UV disinfection system in its existing location be evaluated, as well as relocating the system in conjunction with the plant water system.

Approach

The two channel UV system prevents the system from being installed in the existing location due to lack of available space, requiring the UV disinfection system be relocated. As a result, alternatives for relocating the UV system were evaluated.

UV System Relocation. The use of an open channel system with the existing UV system location rendered the plant water system inoperable, as the original hydraulic grade line needed for the plant water system was dependent on a closed UV system that could be surcharged.

An alternative that would allow for the relocation of the new UV system and would allow for the existing plant water wet well to be placed into service was identified. The new two channel UV system could be located directly upstream of its current location just downstream of the secondary settling tanks with a water level controller at an elevation where its water surface is not impacted by the Plant Water Station Wet Well water surface elevation. This would require that a new UV Building be constructed adjacent to the existing Plant Water Station and secondary settling tanks, in the location of the existing stairs to the UV Room and Plant Water Station. A layout of this alternative is shown on **Figure 6-6**. The existing stairs and door to the Plant Water Station would be demolished and the entrance relocated to the west side of the Plant Water Station. The new building would be sized to accommodate the dual channel UV system, as well as the electrical equipment and control panel associated with the UV system.

A flow meter would be installed downstream of the UV system prior to entering the Plant Water Wet Well. This flow meter will allow for flow pacing of the UV system, as well as serve to provide metering for control of the equalization tank and any chemical dosing downstream of the EQ Tank.

The new UV system location will allow for the existing Plant Water Wet Well functionality to be reinstated providing a source of wash down water at the plant to service the yard hydrants as well as the recommended screening system. Two new plant water pumps would be provided in the existing Plant Water Station. These pumps would be provided with variable frequency drives. The pumps would be relocated from their original location to allow for egress through the relocated door, as shown on **Figure 6-7**. It is also recommended that the existing plant water yard piping and hose gates be replaced as they are not expected to provide reliable service for the next 20 years.

Based on the alternatives evaluated above, relocating the UV system and reinstating the existing plant water station is recommended. See Chapter Nine for additional information on the UV Building, UV system and refurbished plant water system, including the estimated costs.

PRIMARY AND SECONDARY SLUDGE PUMPING STATIONS

Introduction

As noted in Chapter Five, the existing primary and secondary sludge pump stations are located in below grade vaults which are confined spaces. The existing sludge pumps are in need of replacement due to their age. Each vault is equipped with hatches and a single ship's ladder for entry into the station. WWTF staff is required to enter the vaults daily on weekdays to operate the sludge pumps and valves to waste sludge and scum from the two primary settling tanks and the two secondary settling tanks. To improve worker safety, pump station upgrades to reduce the need for entry into the vaults are recommended.

Approach

Alternatives for providing control of the pumps and the valves to each of the settling tanks and scum pits from grade and relocation of those systems to above grade have been developed and evaluated for improving access to the vaults. In addition, the existing pumping stations each utilize a single pump for each set of settling tanks. It is recommended that a second redundant pump be installed. Finally, based

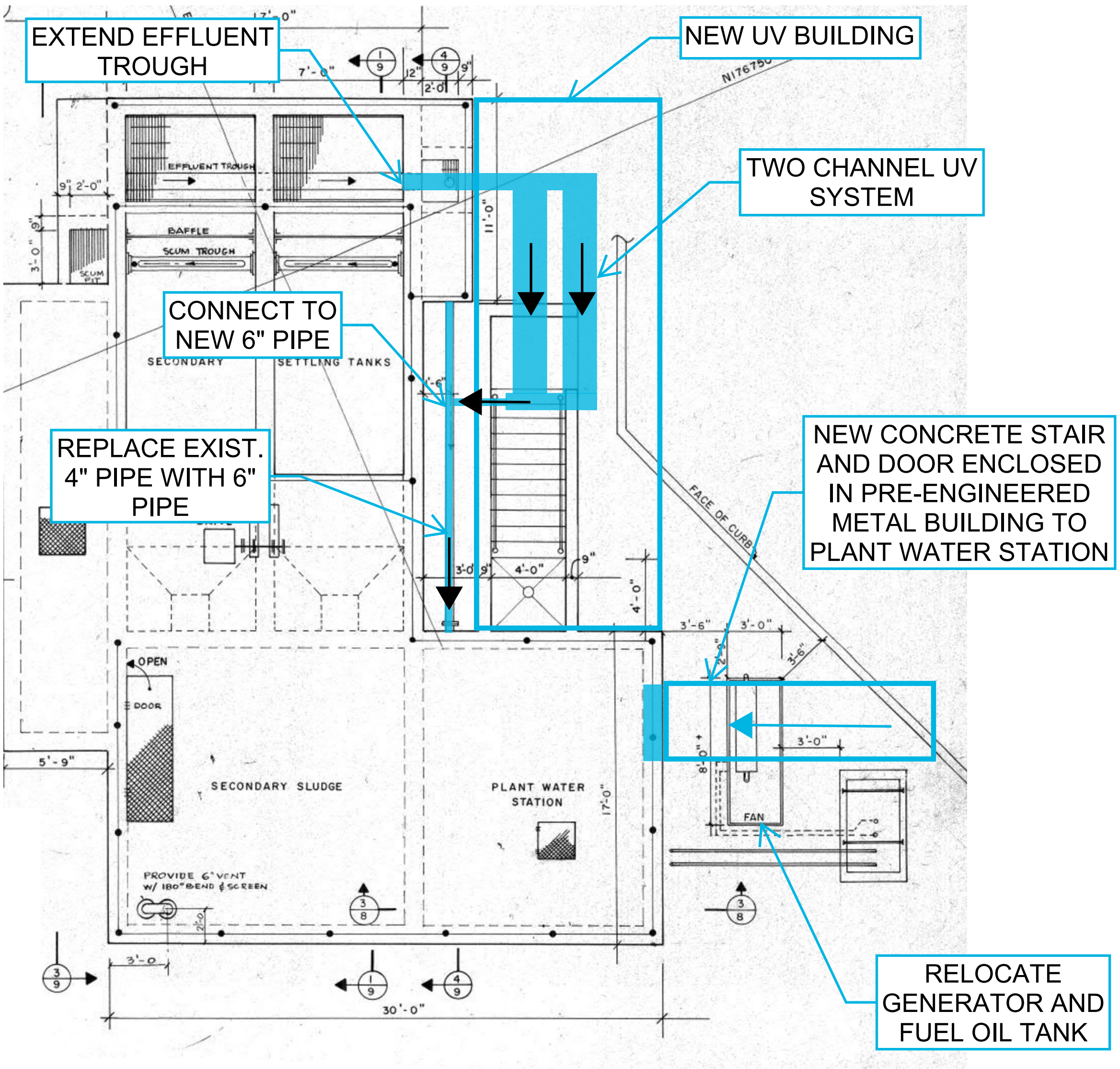

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FIGURE 6-6
ROUTE 7 WWTF
UV DISINFECTION SYSTEM RELOCATION

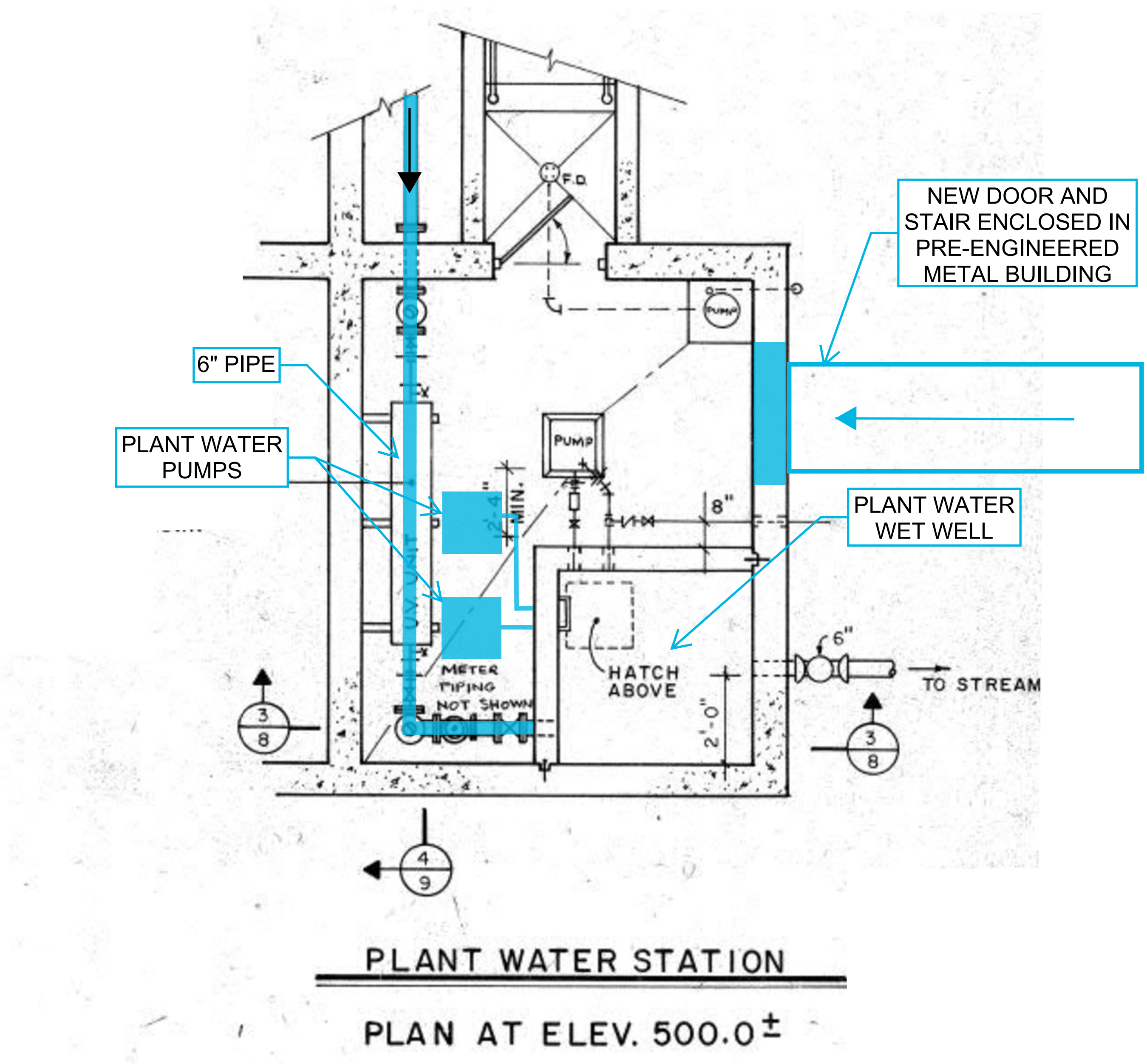

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FIGURE 6-7
ROUTE 7 WWTF
PLANT WATER STATION MODIFICATIONS

on the elevation of the settling tanks, their pumps and the sludge storage tanks, sludge can inadvertently be discharged from the settling tanks if the pumps are off and the tank valves are open. As a result, it is recommended to install positive displacement pumps, such as hose pumps. This type of pump will prevent undesired discharge from the pumps as they discharge to a lower elevation.

Primary and Secondary Sludge Pumping Station Alternatives

Four alternatives were evaluated to improve operator safety and to minimize the need for confined space entry into the below grade Primary and Secondary Sludge Pump Stations, including:

- Provide Pump and Valve Actuator Control at Grade
- Relocate Pumps To Top Slab Enclosed In Weatherproof Enclosures
- Relocate Pumps To Top Slab And Enclose In Precast Concrete Buildings
- Provide New Access Stairs And Doors Into Existing Sludge Pumping Stations

All alternatives were evaluated to provide two new sludge pumps, one operating and one standby. These alternatives are discussed below.

Provide Pump and Valve Actuator Control at Grade. This alternative would provide two replacement sludge pumps installed within each vault with three electric valve actuators on the suction lines to each settling tank and scum pit for each set of settling tanks. A control panel for the operation of the pumps and valves would be provided at grade at each pump station to allow WWTF staff to waste from either settling tank or the scum pit. **Figure 6-8** shows the new pump and piping configuration. Under this alternative, WWTF staff would then only need to enter the station vaults periodically for routine maintenance on the pumps, valves, and valve actuators or to manually activate isolation valves to switch between the operational and standby pumps. The stations could be visually inspected from grade through the existing hatches without the need for regular entry. This option would also require minor modifications to the existing piping and top slabs. Under this alternative with the pumps remaining at the lower level, it is recommended that a hoisting device, such as a portable davit crane be provided for each pump station to allow operations staff to move replacement parts and equipment in and out of the below grade vaults.

Relocate Pumps to Top Slab In Weatherproof Enclosures. This alternative would provide two new sludge pumps on the top slab of each of the sludge pump stations at grade. This alternative would further minimize the need for entries into the below grade vault, as all valves would either be located or actuated from the top slab. To protect the equipment, the pumps and any grade level valves would be located in heated and ventilated weatherproof enclosures. WWTF staff would then only need to enter the station vaults periodically for routine maintenance on any below grade valves and valve actuators. The stations could be visually inspected from grade through the existing hatches without the need for regular entry. This option would also require minor modifications to the existing piping and top slabs.

Relocate Pumps to Top Slab In Precast Concrete Buildings. This alternative would be to provide two new sludge pumps and valves on the top slab of each of the sludge pump stations at grade enclosed within a precast concrete building. This alternative would further minimize the need for entries into the below grade vault, as all valves would either be located or actuated from the top slab. Due to the weight of the new structure, the building would need to sit over the vault walls. The building would be larger than necessary to house the pumps, increasing operation costs for heating and ventilation. The valves and pumps would be controlled from a control panel located within the building, minimizing the need for access into the vaults for maintenance on the valves and actuators.

Provide New Access Stairs and Doors to the Below Grade Vaults. This alternative would provide access to the below grade vaults through new stairs and access doors. For both the primary and secondary sludge pumping stations, two replacement pumps and electric valve actuators on the three suction lines from each of the settling tanks and the scum pits would be provided in the vaults. A control panel would be provided in the vault for the operation of the pumps and the actuated valves. A new concrete stair would be constructed adjacent to the Primary Sludge Pump Station on the downhill side.

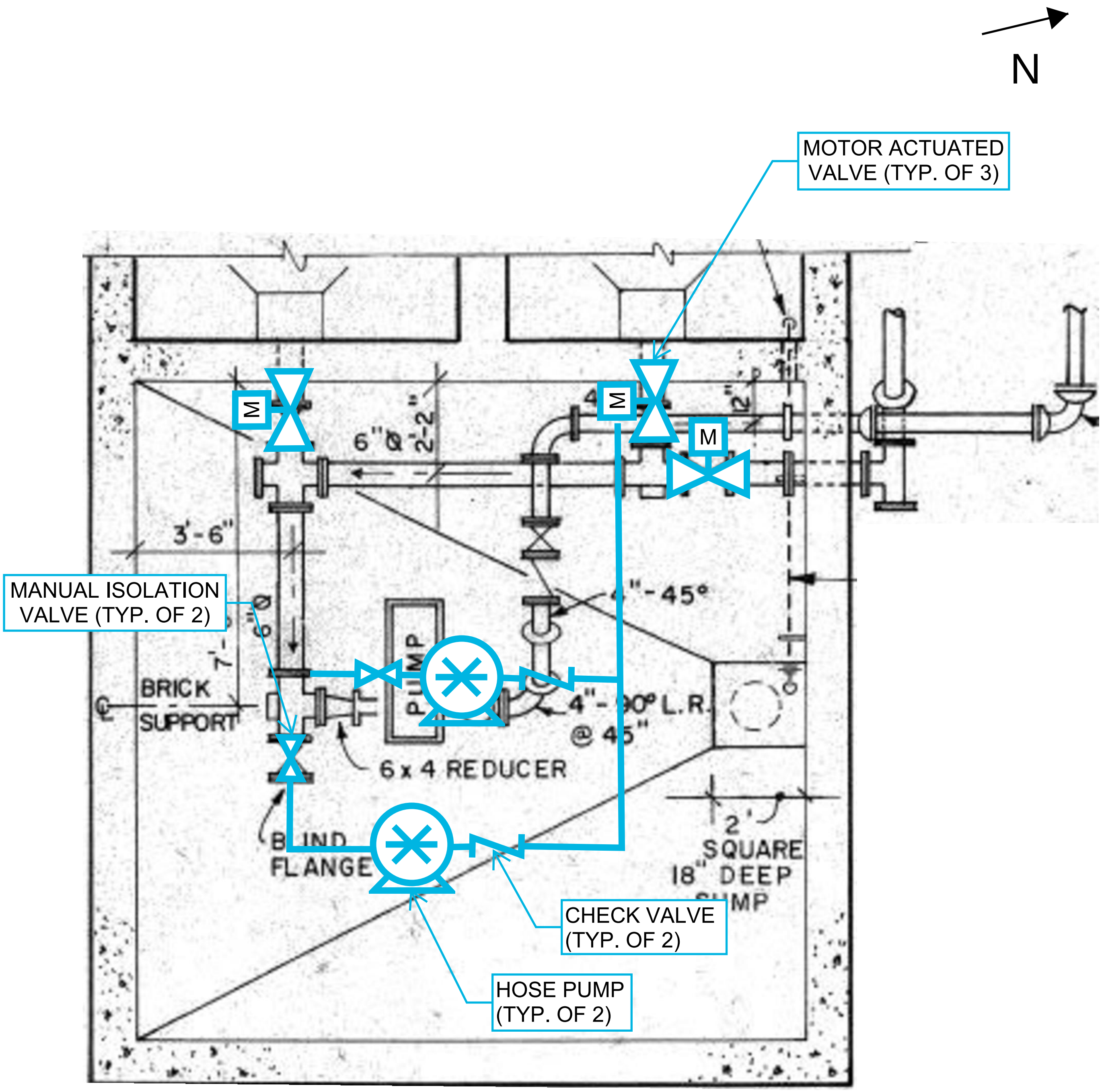

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FIGURE 6-8
ROUTE 7 WWTF
PRIMARY AND SECONDARY SLUDGE
PUMPING STATION PIPING MODIFICATIONS

The stair would provide access to the pumps and valves without the need for entry by the ship's ladder and hatch. The Secondary Sludge Pumping Station would be accessed through a new door installed through the wall of the Plant Water Station. The relocation of the UV system will allow for access to be provided in the location of the existing UV system. The new door and stair into the Plant Water Station is necessary with or without the implementation of this option, and is shown earlier in this Chapter on **Figure 6-7**. The layout for the new stair and entrance to the primary and secondary sludge pumping stations is shown in **Figure 6-9**. Under this alternative with the pumps remaining at the lower level, it is recommended that a hoisting device, such as a portable davit crane be provided for each pump station to allow operations staff to move replacement parts and equipment in and out of the below grade vaults.

Estimated Costs

Estimated capital costs for the primary and secondary sludge pumping stations as described above are summarized in **Table 6-2**. Each of the alternatives include two new positive displacement sludge pumps and electrically actuated valves to switch between settling tanks and scum pits.

TABLE 6-2. ROUTE 7 WWTF PRIMARY AND SECONDARY SLUDGE PUMPING STATION ALTERNATIVE COSTS

Alternative	Capital Cost
Sludge Pumps in Existing Vault	**$420,000**
Sludge Pumps Relocated to Top Slab in Weatherproof Enclosure	**$465,000**
Sludge Pumps Relocated to Top Slab in Precast Concrete Building	**$605,000**
Provide New Access Stairs and Doors to Below Grade Vaults	**$485,000**

Based on the alternatives evaluated above, the addition of stairs and entrance doors into the primary and secondary sludge pumping stations is recommended. See Chapter Nine for additional information on the sludge pumping stations, including the estimated costs.

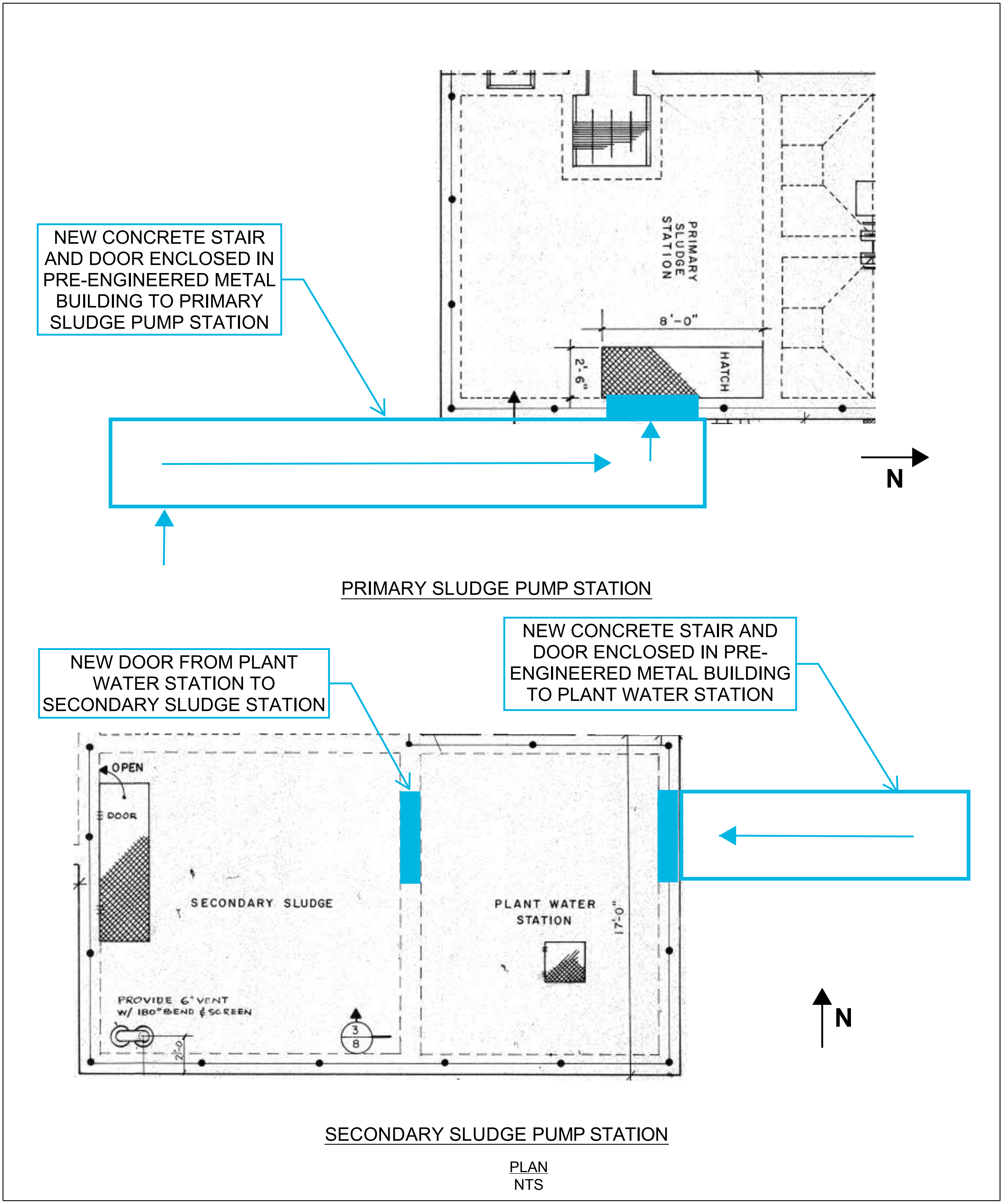


FIGURE 6-9
ROUTE 7 WWTF
PRIMARY AND SECONDARY SLUDGE PUMPING STATION STAIR AND DOOR ACCESS MODIFICATIONS

CHAPTER SEVEN
SOUTH STREET WWTF UPGRADE ALTERNATIVES EVALUATION

In Chapter Five, the existing facilities at the South Street WWTF were described and assessed to identify their condition and need for improvements or upgrades. The facilities were evaluated to determine if they would be able to provide continued service through the Facilities Plan design year of 2035. A number of WWTF systems and unit processes were identified as requiring upgrades and/or improvements.
For a number of systems and unit processes multiple alternatives were evaluated. The systems and unit process that had these multiple alternatives are as follows:

- Septage Receiving Upgrades
- Nutrient Removal Upgrades, including:
  - Secondary Treatment Upgrades for Total Nitrogen and Phosphorus Removal
  - Tertiary Phosphorus Removal
  - Membrane Bioreactor
- Zinc Removal
- Aeration System Upgrades
- Solids Handling Upgrades

This chapter will describe and evaluate the upgrade alternatives developed for the various systems and unit processes noted above. Included in this chapter are descriptions of the upgrade alternatives identified, screened and the evaluations performed for the different alternatives. For a number of the unit processes/systems evaluated, summaries of the advantages and disadvantages of the difference alternative are presented. Also included in this chapter are estimated costs for a number of the alternatives. These include estimated capital costs and in some cases operation and maintenance (O&M) costs and 20-year life cycle costs. Note these estimated capital costs and as a result the estimated 20 year life cycle costs (as applicable) include estimated costs for electric and instrumentation and control upgrades to support the alternatives. See Chapter Four for the basis of the cost estimates provided

It should be noted that all of the liquid and solids process alternatives evaluations and related costs were based on the influent flows and loads described in Chapter Four with the South Street WWTF treating all of the flows and loads from both Sewer District No. 1 and Sewer District No. 2. While these flows and loads are approximately 10% greater than the Sewer District No. 1 flows alone, the costs presented in this Chapter are for the purposes of evaluating comparative costs for the different alternatives. A comparison of the costs and upgrades to treat the Sewer District 1 flows only versus treating the flow from both Sewer District No. 1 and Sewer District No. 2 is presented and discussed in Chapter Ten.

SEPTAGE RECEIVING UPGRADES

Introduction/Background

The South Street WWTF currently accepts septage collected from the unsewered population of the Town. As described in Chapter Five, the existing septage receiving mechanical equipment has reached the end of its service life and is in need of replacement. In addition, the two existing septage storage tanks are in need of repair or replacement and it is also recommended that the septage receiving facility be connected to odor control to reduce odor impacts on nearby development.

Approach

The existing septage receiving facility consists of an at grade manual bar rack with septage discharged by gravity to the grate from the septage trucks. The use of a packaged septage receiving station was initially explored, but based on discussions with the WPCA and SUEZ operations staff it was recommended to retain a similar manual screening system at the receiving facility. The WPCA also indicated that the new system should accommodate the dumping of the Town's Vactor truck with its lift body in the raised position. It was also recommended that the two septage holding tanks be configured to operate in series to allow for settling to occur and to limit wear on the septage pumping equipment by removing rocks and large debris ahead of the pumps. Lastly, to provide odor control it was recommended that a building enclosure be provided with connection to an odor control system. As a result of these requirements, two alternatives were evaluated for the septage receiving station upgrades, including:

- Full Vactor Truck Sized Building
- Partial Vactor Truck Sized Building

Both alternatives are described below. It should be noted that both alternatives include the full replacement of the existing below grade concrete septage tanks, as well as the septage transfer pumps. The septage pumps would then convey septage to the Influent Building for treatment in the liquid process, or convey septage directly to the aerated sludge storage tank for treatment in the solids handling process described later in this chapter. In addition, both buildings would be constructed of lightweight construction and would be provided with two rollup doors to allow for vehicles to drive through the garage allowing for improved site access.

Septage Receiving Station Upgrade Alternatives

Full Vactor Truck Sized Building. This alternative would include the construction of a building that would allow the Town's Vactor truck to pull entirely into the building and allow the doors to close to contain odors. The overall building dimensions would be approximately 25 feet wide and 55 feet long. The clear height within the building would be approximately 25 feet to accommodate the raised lift body of the Vactor truck. The Vactor truck or septage trucks would discharge Vactor operations collected material or septage directly into Tank No. 2. Septage would then flow into Tank No. 1 that would contain the pumps. The building would be connected to a dedicated carbon odor control system. The carbon odor control system for this building would be larger than the Partial Vactor Truck Sized Building as the volume of air to be treated is larger. This alternative is depicted in **Figure 7-1**.

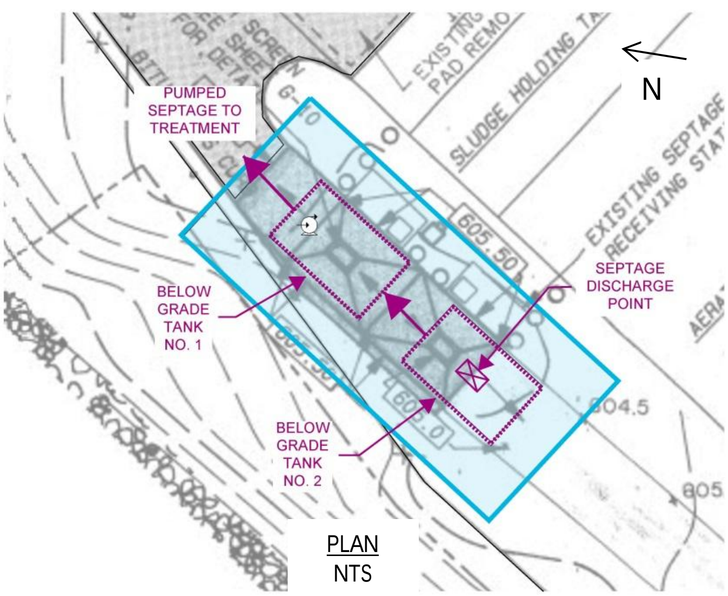


FIGURE 7-1. SEPTAGE RECEIVING - FULL VACTOR TRUCK SIZED BUILDING

Partial Vactor Truck Sized Building. The Partial Vactor Truck Sized Building alternative would include the construction of a building that would allow for vehicles to be partially enclosed when offloading septage or material from the Town's Vactor truck. The overall building dimensions would be 25 feet wide by 30 feet long. The clear height would be 25 feet similar to the first alternative. Septage or material collected from the Vactor truck operation would be offloaded into Tank No. 1 and would then flow into Tank No. 2 which would contain the transfer pumps. The building would be connected to a dedicated odor control system and would be sized smaller than the first alternative due to the reduced the volume of air to be treated. The Partial Vactor Truck Sized Building alternative is depicted in **Figure 7-2**.

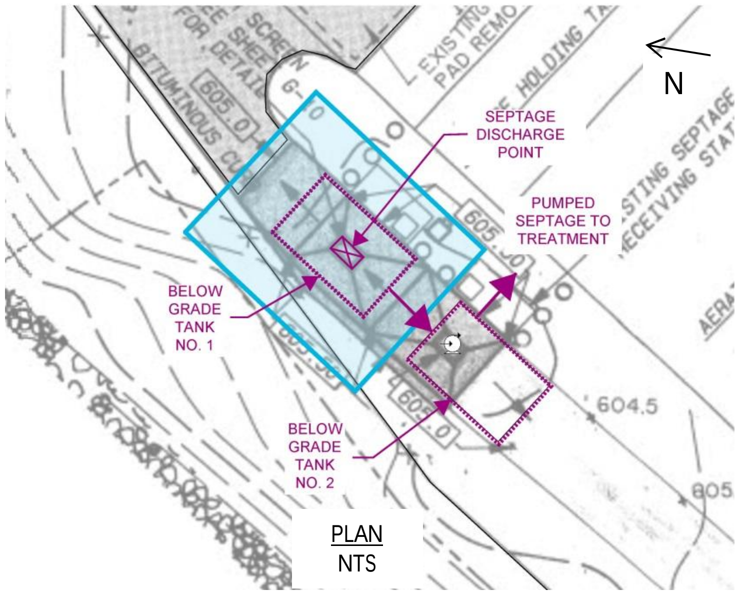


FIGURE 7-2. SEPTAGE RECEIVING - PARTIAL VACTOR TRUCK SIZED BUILDING

Estimated Costs

The estimated capital costs for the Septage Receiving Station improvement alternatives are presented in **Table 7-1**.

TABLE 7-1. SEPTAGE RECEIVING STATION UPGRADE ALTERNATIVES CAPITAL COSTS

Alternative	Capital Cost
Full Vactor Truck Sized Building	**$1,610,000**
Partial Vactor Truck Sized Building	**$1,045,000**

NUTRIENT REMOVAL

Introduction/Background

The South Street WWTF effluent nitrogen target limits and required phosphorus permit limits are described in Chapter Four. As noted in Chapter Five, the current secondary and tertiary processes at the South Street WWTF are unable to meet the target nitrogen effluent limits and the required phosphorus effluent limits at the WWTF. As a result a number of secondary treatment process alternatives and tertiary treatment process alternatives were evaluated in order to meet these target and required limits. They are as follows and will be presented below:

- Secondary Treatment Processes Alternatives for Total Nitrogen and Total Phosphorus Removal
- Tertiary Phosphorus Removal Alternatives
- Membrane Bioreactors

Existing System Upgrade Needs

It should be noted that for all of the secondary treatment alternative process evaluated both sets of aeration tanks (ATs No. 1 and No. 2 constructed in 1968 and ATs No. 3 and No. 4 constructed in 1990) would be required. In addition the existing final settling tanks would be used and no additional settling tankage would be required.

As described in Chapter Five due the age and condition of the aeration tanks, some structural and mechanical upgrades would be required for the each set of aeration tanks. These modifications are described in more detail below for each secondary treatment process alternative.

Also as described in Chapter Five, due to the age and condition of the existing surface aerators on both sets of aeration tanks, it is recommended that a complete aeration upgrade be provided. As a result the existing aeration system was not considered a limiting factor in the process evaluation. For the purposes of evaluating the secondary treatment process alternatives it was assumed that each alternative would employ a fine bubble diffused air system with high efficiency blowers. Aeration system upgrade evaluations are discussed later in this chapter.

Finally, as described in Chapter Five, the return sludge pumping system is not expected to provide reliable service for the next 20 years. As a result the return sludge pumping system is recommended for a full upgrade and was not considered a limiting factor in the process evaluation.

Permit Requirements

As discussed in Chapter Four, the WWTF has a target total nitrogen load of 29 lbs/day as contained the CT DEEP Nitrogen General Permit. Based on follow up discussions with the DEEP the total nitrogen target load in the WWTF is expected to be 32 lbs/day. As a result the evaluation of alternatives described below is based on achieving the target annual average total nitrogen limit of 32 lbs/day at the year 2035 projected flows. At the projected average daily flow of 1.12 mgd (combined flow of Sewer District No. 1 and Sewer District No. 2) this corresponds to an average annual effluent total nitrogen concentration limit of 3.4 mg/l. The WWTF can achieve the permitted annual total nitrogen load by either treatment or through the purchasing of nitrogen credits under the Nitrogen Trading Program. As a result, two secondary process alternatives were evaluated that could achieve the permitted total nitrogen limit through treatment and two secondary process alternative were evaluated that could reduce the total nitrogen in the effluent but required the purchase of nitrogen credits to meet the permitted total nitrogen limit

As discussed in Chapter Four, more stringent effluent total phosphorus limits are included in the most recent NPDES permit. As a result, the evaluation of alternatives described below is based on achieving the permitted seasonal average total phosphorus limit of 0.52 lbs/day (April 1 to October 31) at the year 2035 projected flows. At the projected average daily flow of 1.12 mgd (combined flow of Sewer District No. 1 and Sewer District No. 2) this corresponds to an average seasonal effluent phosphorus concentration limit of 0.055 mg/l.

For additional details related to the proposed total phosphorus and total nitrogen effluent limits see Chapter Four and Appendix C.

SECONDARY TREATMENT UPGRADES FOR TOTAL NITROGEN AND TOTAL PHOSPHORUS REMOVAL

Based on the target total nitrogen limit provided by the DEEP for the treatment of Sewer District No. 1 and Sewer District No. 2 flows, modifications to the existing secondary process will be required. An evaluation of activated sludge process alternatives to meet or exceed the target limits was performed. The evaluation was conducted through the use of a BioWin wastewater process model. This model was developed, calibrated and validated during Phase 1 of the Facilities Planning effort. Please see the Phase 1 Facilities Plan Report for additional information on this process model. In addition, the removal of some phosphorus was evaluated in conjunction with the total nitrogen removal alternatives in the secondary process (either chemically or biologically). These evaluations are discussed below. However, in order to set up the discussion of the process alternatives, the following background information is presented:

- General Biological Nitrogen Removal
- General Phosphorus Removal Including:
  - Biological Phosphorus Removal
  - Chemical Phosphorus Removal

General Biological Nitrogen Removal

The primary function of an activated sludge process is to removal organic material (BOD) in the wastewater. However an activated sludge process can also be enhanced to provide the removal of nitrogen. In an activated sludge process that is configured to remove nitrogen, this nitrogen removal occurs in two steps.

In the first step the ammonia (NH_3) in the wastewater is nitrified in the presence of oxygen and is converted to nitrite (NO_2) and subsequently to nitrate (NO_3). This conversion is driven by the presence of nitrosomonas and nitrobacter bacteria. In order for these microorganisms to out compete the other microorganisms in an activated sludge process, the organic material in the wastewater must first be reduced.

In the second step the nitrogen in the wastewater in the form of nitrate (NO_3) is denitrified or converted to nitrogen gas (N_2) and it is removed from the system to the atmosphere. This denitrification occurs under anoxic (low oxygen) conditions (dissolved oxygen conditions below 0.1 mg/l). There are a number of bacteria that can reduce nitrate to nitrogen gas. In the absence of oxygen, these bacteria can use the oxygen in nitrate and nitrite, along with soluble biodegradable organic material, for cell reproduction. This soluble organic material can be provided in the influent wastewater to the activated sludge process or through the use of supplemental carbon such as methanol or glycol based products.

For most activated sludge processes designed to remove total nitrogen, there are anoxic tanks followed by one or more aerobic tanks. The ammonia nitrogen (NH_3) in the incoming wastewater passes through the anoxic tanks and is then nitrified in the aerobic tanks. The resulting nitrate (NO_3) generated in the aerobic tanks from the nitrification process is then recycled to the upfront anoxic tanks. In the anoxic tanks the recycled nitrate (NO_3) is denitrified to nitrogen gas (N_2) using some of the soluble organic material in the WWTF influent entering the anoxic tanks. The ability to remove nitrogen as a whole is dependent on tanks sizes/configuration, activated sludge concentrations, internal recycle rates, and the ratios of different organic and nitrogen species in the wastewater.

General Phosphorus Removal

Phosphorus is essential for the growth of algae and other biological organisms. Because of noxious algal blooms that occur in surface waters, there is interest in reducing the amount of phosphorus that enters surface waters from WWTFs. Total phosphorus is the total of all forms of phosphorus in the wastewater. The typical forms of phosphorus that are found in wastewater are orthophosphate, polyphosphate and organic phosphate. Orthophosphates are available for biological metabolism and can be precipitated with metal salts. Polyphosphates are slowly hydrolyzed in wastewater and revert to orthophosphate forms. The organic phosphate is typically organically bound phosphorus and is found in the organic matter in the wastewater.

It should be noted that the existing secondary process and tertiary sand filters with chemical addition at the South Street WWTF will not be able to meet the new effluent phosphorus limits required at the WWTF. The secondary process will, however, remove some of the phosphorus in the influent wastewater through the growth and reproduction of the biomass in the aeration tanks and through the removal of this biomass in the waste activated sludge. The removal of additional phosphorus in the secondary process can be further enhanced through biological or chemical methods. The intent of these enhancements is to remove sufficient phosphorus in the secondary process to allow for improved effluent concentration and operating performance of a subsequent tertiary phosphorus removal process. Both enhanced secondary biological and chemical phosphorus removal processes are briefly discussed below.

Biological Phosphorus Removal. Biological phosphorus removal is typically achieved by providing for the selective growth of phosphorus accumulating organisms (PAOs) in an activated sludge process and subsequently removing these organisms in the waste sludge. More specifically, environmental conditions are created in a secondary process that allow for the growth and proliferation of PAOs. Under the right conditions, these PAOs will uptake a higher percent of phosphorus into their cell mass than the typical activated sludge microbial population (5-7% vs. 2-3%). These PAOs and the phosphorus associated with them are then removed from the activated sludge through the normal settling and waste activated sludge removal processes.

The conditions required for biological phosphorus removal include an initial anaerobic zone (selector) that is provided with volatile fatty acids (VFAs). This selector is subsequently followed by an aerobic zone(s). The anaerobic zone provides conditions that allow the PAOs to release phosphorus, uptake VFAs, and produce polyhydroxybutyrate (PHB) storage products. Subsequently when these PAOs are subjected to aerobic conditions, they will uptake and store the ortho-phosphate in the wastewater in their PHBs. These subsequent aerobic conditions are needed to allow this “luxury” or enhanced uptake of the ortho-phosphorus from the wastewater into the cell mass of the PAOs. In Ridgefield, this would require using the existing aeration tank zones or modifying the existing aeration tank zones to provide these conditions.

As noted above, anaerobic conditions will cause the release of phosphorus from the PAOs. Therefore it is extremely important that once these PAOs are removed from the activated sludge process (via the waste sludge) that they are not again subjected to anaerobic conditions. If they are subjected to anaerobic conditions, they will release the phosphorus that they have taken up. This released phosphorus will then be recycled back to the liquid process through the sludge handling liquid recycle streams. Therefore, it is recommend that the biological phosphorus removal sludge WAS thickening and dewatering processes and storage tanks remain aerobic. This can be provided through the use of short detention times for the thickening and dewatering processes and by aerating sludge storage tanks.

For the purposes of providing both biological nitrogen and biological phosphorus removal in secondary process at the South Street WWTF a number of configurations and their expected performance expected performance based on using the existing process tanks (both with minor and significant modifications) are described at the end of this section.

Chemical Phosphorus Removal. In chemical phosphorus removal, phosphorus is removed from the liquid process by precipitating soluble ortho-phosphates out of the wastewater (as is currently being performed at the WWTF). Metal salts are typically used to form these precipitates. These insoluble metal-phosphates are then removed from the wastewater through solids separation processes (typically settling or filtration). Chemicals that are typically used for the precipitation of phosphorus include aluminum salts and iron salts. The dosing location for the chemical can be before or after secondary processes and at one or more locations. All dosing locations require a solids separation step downstream of the dosing location.

Chemical storage and feed systems are required for chemical phosphorus removal. This would require the upgrade of the existing systems or the construction of new systems for this purpose. These systems should be enclosed in a building and would consist of chemical storage tanks and feed pumps, as well as other ancillary equipment such as an exterior chemical fill station and dosing control systems. Metal salt addition is typically flow paced to minimize chemical usage. The required chemical storage and feed systems are described in Chapter Nine.

In addition to the bulk wastewater process flow dosing, it is recommend that the ability to dose plant recycles be considered as part of chemical phosphorus removal. Recycle streams often contain high concentrations of phosphorus that can be easily removed through chemical dosing. The dosing of recycle flows typically results in an overall reduction in chemical used for phosphorus removal. The WWTF recycle streams that should be considered for chemical dosing include the solids thickener/dewatering recycle streams. The quantity and nature of these recycle streams will be dependent upon the WWTF's solids handling approach going forward.

For the purposes of providing both biological nitrogen and chemical phosphorus removal in secondary process at the South Street WWTF a number of configurations and their expected performance based on using the existing process tanks (both with minor and significant modifications) at the South Street WWTF are described below.

Secondary Treatment Process Alternatives

The secondary process alternatives that were evaluated utilizing the existing aeration tanks included the following:

- Biological Nitrogen Removal (with some chemical phosphorus removal):
  - Modified Ludzack-Ettinger process
  - 4-Stage Bardenpho process

- Biological Nitrogen and Phosphorus Removal:
  - A2O process.
  - 5-Stage Bardenpho process.

These processes, the upgrades or new facilities that are required to employ them and their ability to meet the target total nitrogen and total phosphorus effluent limits are described below.

Modified Ludzack-Ettinger Process. In addition to the removal of organic material (BOD), the Modified Ludzack-Ettinger (MLE) Process is designed to increase the removal of total nitrogen. This is accomplished by providing a number of tanks in series under anoxic and then aerobic conditions. For the South Street WWTF the four zone aeration tanks from both 1968 (Aeration Tanks No. 1 and No. 2) and 1990 (Aeration Tank No. 3 and No. 4) would maintain their existing zones (no wall relocations). Both sets of aeration tanks would be run in parallel with the four zones in each set of tanks run in series. For each set of tanks the first zone would be anoxic followed by three zones run under aerobic conditions. An internal recycle pumping system would be provided to convey flow from the last aerobic zone to the anoxic zone. See **Figure 7-3** for a process flow diagram of the MLE process and **Figure 7-4** the South Street WWTF aeration tank configuration for the MLE process. The process layout would be similar for both sets of aeration tanks with the exception of the influent flow path to each set of tanks (as noted in the figure) due to the existing aeration tanks influent configuration.

Items that would be required to provide the MLE process for the aeration tanks at South Street WWTF include the following:

- Rehabilitation of the 1968 aeration tanks (significant concrete repair, new railings, new valves, new weirs, etc.).
- Minor improvements to the 1990 aeration tanks (new weir gates, minor concrete repairs).

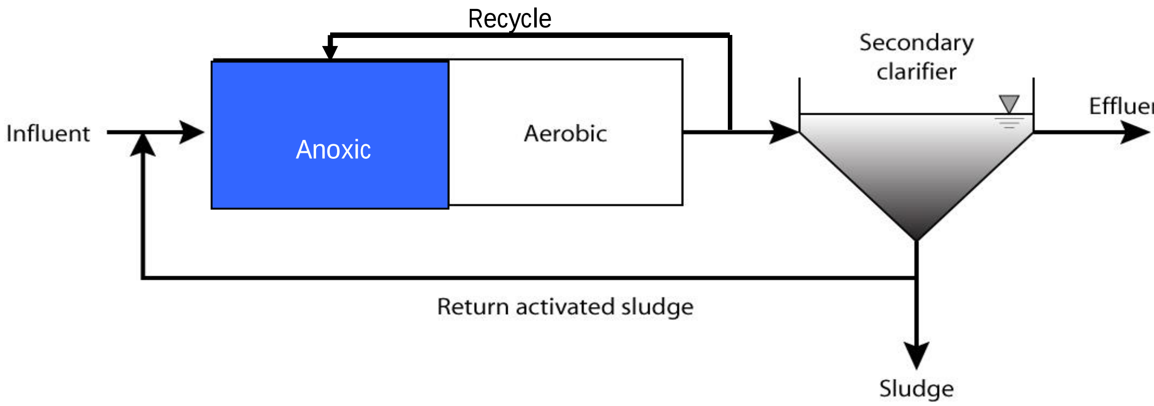
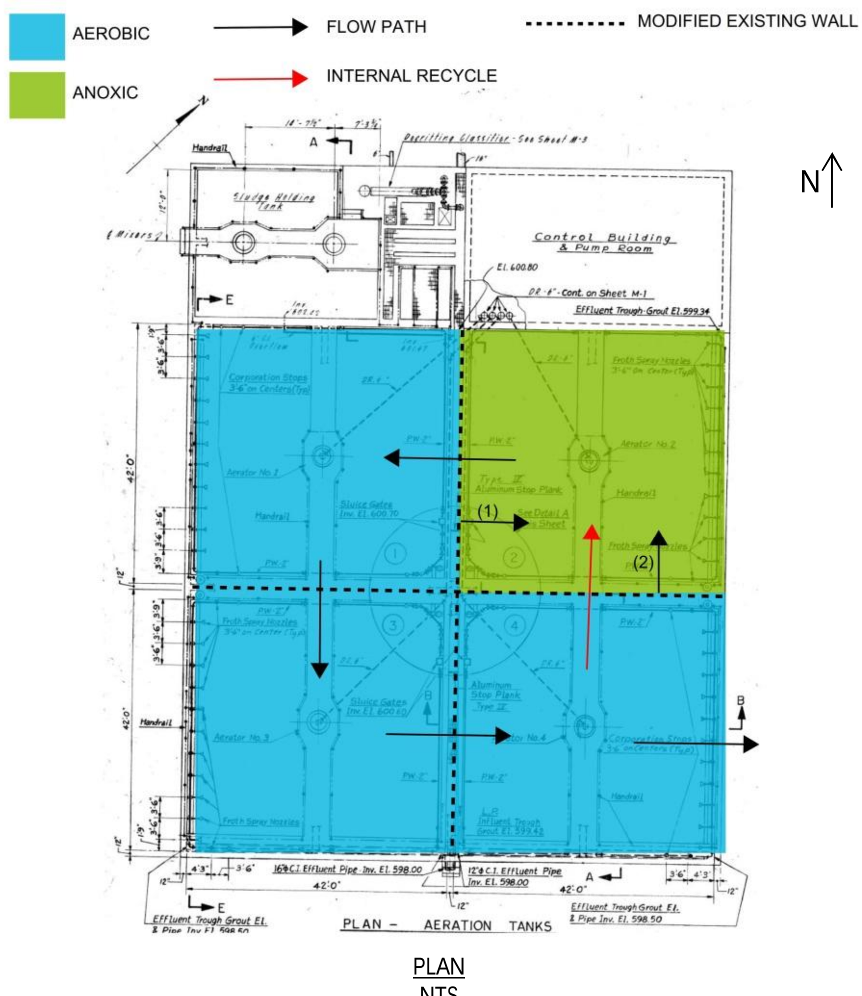


FIGURE 7-3. MODIFIED LUDZACK-ETTINGER (MLE) PROCESS FLOW DIAGRAM



NOTES:
(1) AERATION TANK 1&2 (1968) INFLUENT FLOW PATH
(2) AERATION TANK 3&4 (1990) INFLUENT FLOW PATH

FIGURE 7-4. SOUTH STREET WWTF AERATION TANK MLE PROCESS CONFIGURATION

- New aeration system for the aerobic zones (three zones per set of aeration tanks) including aeration supply and control systems.
- Mixers for anoxic zones (one zone per set of aeration tanks).
- Internal recycle pumping and piping systems.
- Chemical phosphorus removal chemical storage and feed facilities.

A summary of the predicted effluent performance of the MLE process at the South Street WWTF will be discussed later in this section.

4-Stage Bardenpho. Similar to the MLE process for removing removal of organic material (BOD) and some total nitrogen, the 4-Stage Bardenpho process is designed to increase the removal of total nitrogen. Like the MLE process, this is done by providing a number of tanks in series under anoxic and then aerobic conditions. Unlike the MLE process, the 4-Stage Bardenpho process at the South Street WWTF would require wall modifications to the four zone aeration tanks from both 1968 (Aeration Tanks No. 1 and No. 2) and 1990 (Aeration Tank No. 3 and No. 4). These modifications are required to improve the process performance by providing unique residence time of the wastewater in each zone to increase nitrogen removal.

Both sets of aeration tanks would be run in parallel with the four zones in each set of tanks run in series. For each set of tanks the first zone would be anoxic followed by an aerobic zone, a second anoxic zone and a final reaeration zone. An internal recycle pumping system would be provided to convey flow from the first aerobic zone to the first anoxic zone. The second anoxic zone would also require the addition of a supplemental carbon source (Micro-C is recommended due to the limited space and the flammability concerns with methanol at the WWTF) to achieve the target effluent total nitrogen concentration of approximately 3.0 mg/l. See **Figure 7-5** for a process flow diagram of the 4-Stage Bardenpho process and **Figure 7-6** for the South Street WWTF aeration tank configuration for the 4-Stage Bardenpho process. **Figure 7-6** shows the proposed new walls within the aeration tank and the existing walls in the aeration tanks that would need to be modified or removed to allow for the passage of flow and the reconfiguration of the zone sizes in the tanks. The process layout would be similar for both sets of aeration tanks with the exception of the influent flow path to each set of tanks (as noted in the figure) due to the existing aeration tanks influent configuration.

Items that would be required to provide the 4-Stage Bardenpho process for the aeration tanks at South Street WWTF include the following:

- Rehabilitation of the 1968 aeration tanks (significant concrete repair, new railings, new valves, new weirs, etc.).
- Minor improvements to the 1990 aeration tanks (new weir gates, minor concrete repairs).
- New walls and modification to existing walls in the 1968 and 1990 aeration tanks.
- New aeration system for the aerobic zones (two zones per set of aeration tanks) includes aeration supply and control systems.
- Mixers for anoxic zones (two zones per set of aeration tanks).
- Internal recycle pumping and piping systems.
- Supplemental carbon (Micro C) storage and feed facility.
- Chemical phosphorus removal chemical storage and feed facilities.

A summary of the predicted effluent performance of the 4-Stage Bardenpho process at the South Street WWTF will be discussed later in this section.

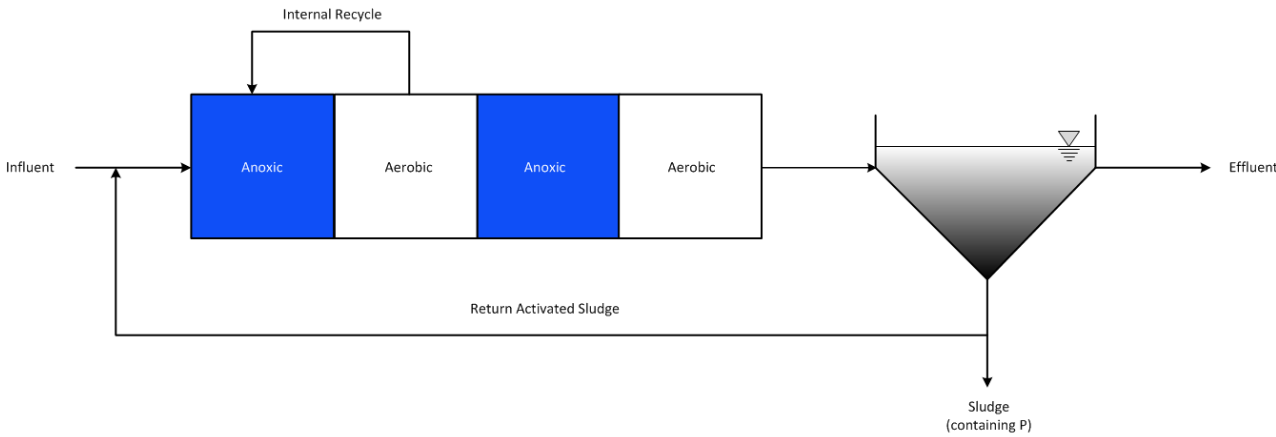
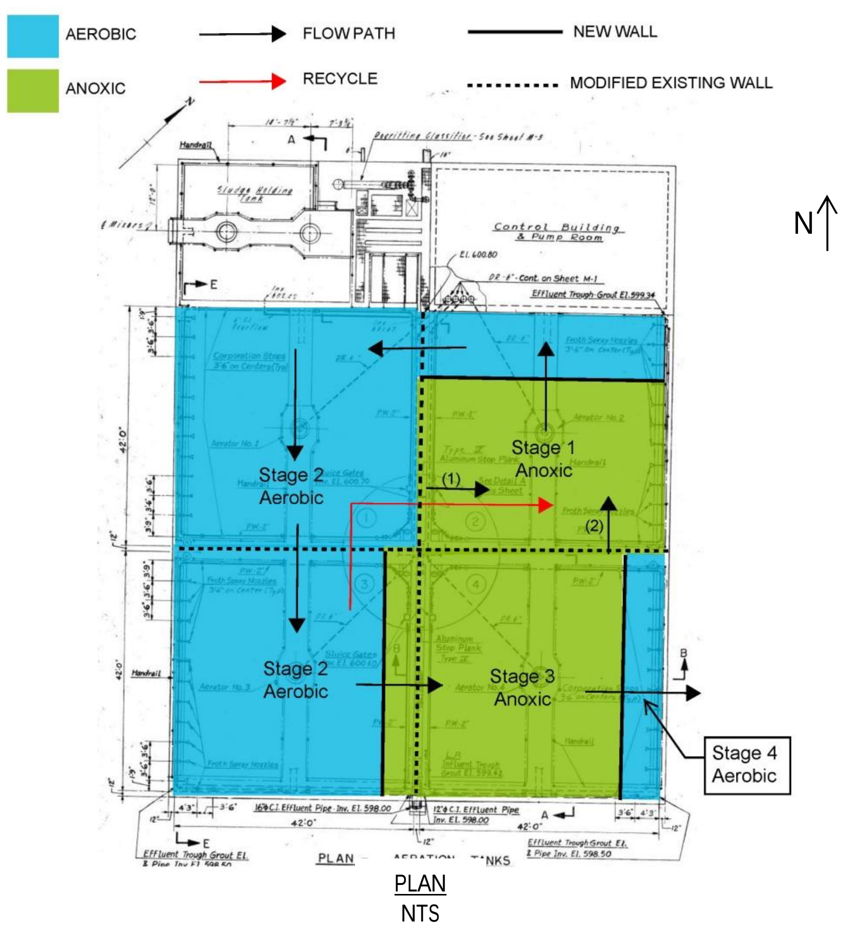


FIGURE 7-5. 4-STAGE BARDENPHO PROCESS FLOW DIAGRAM



NOTES:
(1) AERATION TANK 1&2 (1968) INFLUENT FLOW PATH
(2) AERATION TANK 3&4 (1990) INFLUENT FLOW PATH

FIGURE 7-6. SOUTH STREET WWTF AERATION TANK 4-STAGE BARDENPHO PROCESS CONFIGURATION

A2O Process. The A20 process is similar to the MLE process in that in addition to the removal of organic material (BOD), the process is designed for the removal of total nitrogen through the use of anoxic and aerobic zones in series. Where it differs is the inclusion of an upstream anaerobic zone (selector) to enhance phosphorus removal biologically. For the South Street WWTF the four zone aeration tanks from both 1968 (Aeration Tanks No. 1 and No. 2) and 1990 (Aeration Tank No. 3 and No. 4) would maintain the existing zones (no wall relocations). Both sets of aeration tanks would be run in parallel with the four zones in each set of tanks run in series. For each set of tanks, the first zone would be anaerobic followed by a single anoxic zone and two aerobic zones. Similar to the MLE process, an internal recycle pumping system would be provided to convey flow from the last aerobic zone to the anoxic zone. See **Figure 7-7** for a process flow diagram of the A2O process and **Figure 7-8** for the South Street WWTF aeration tank configuration for the A2O process. The process layout would be similar for both sets of aeration tanks with the exception of the influent flow path to each set of tanks (as noted in the figure) due to the existing aeration tank influent configuration.

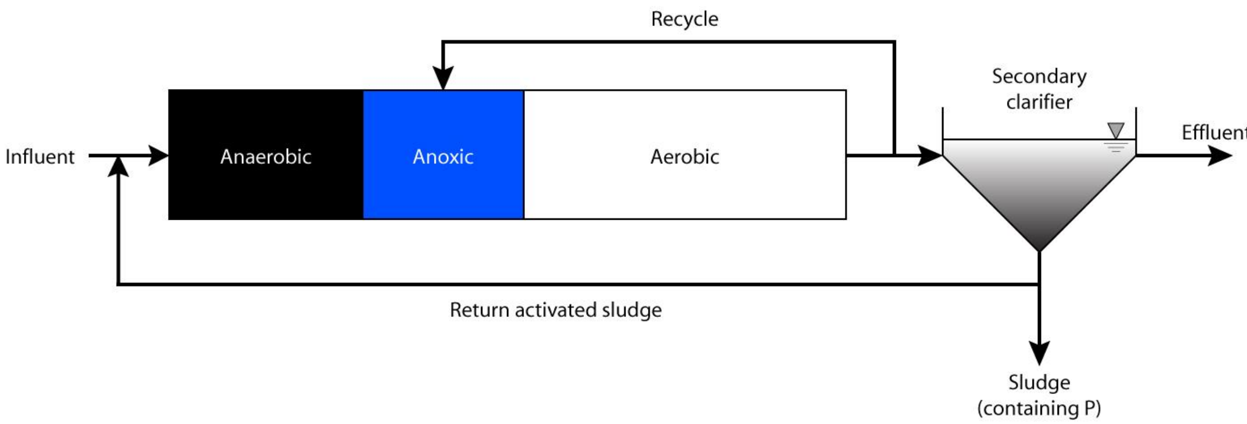


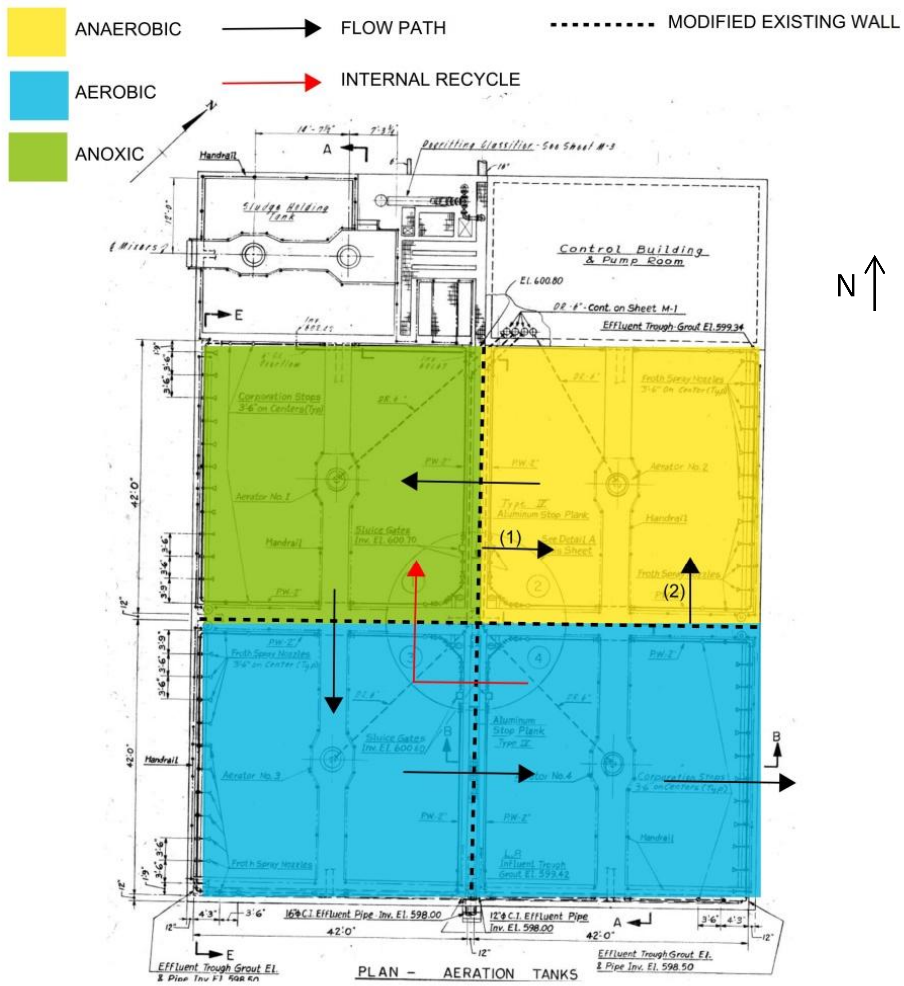
FIGURE 7-7. A2O PROCESS FLOW DIAGRAM

Items that would be required to provide the A2O process for the aeration tanks at South Street WWTF include the following:

- Rehabilitation of the 1968 aeration tanks (significant concrete repair, new railings, new valves, new weirs, etc.).
- Minor improvements to the 1990 aeration tanks (new weir gates, minor concrete repairs).
- New aeration system for the aerobic zones (three zones per set of aeration tanks) including aeration supply and control systems.
- Mixers for the anaerobic zones (one zone per set of aeration tanks)
- Mixers for anoxic zones (one zone per set of aeration tanks)
- Internal recycle pumping and piping systems.
- A means to provide aerated sludge storage to prevent phosphorus release from the waste sludge.

A summary of the predicted effluent performance of the A2O process at the South Street WWTF will be discussion later in this section.

5-Stage Bardenpho. The 5-Stage Bardenpho process is similar to the 4-Stage Bardenpho for removal of organic material (BOD) and some total nitrogen. Similar to the A2O process an anaerobic zone (selector) is added upstream of the first anoxic zone to enhance the removal of phosphorus biologically. The 5-Stage Bardenpho process at the South Street WWTF would require wall modifications for the four zone aeration tanks from both 1968 (Aeration Tanks No. 1 and No. 2) and 1990 (Aeration Tank No. 3 and No. 4) to provide five zones. These modifications are required to add a fifth zone and to improve the process performance by providing unique residence time of the wastewater in each zone to increase nitrogen removal and phosphorus removal.



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NOTES:
(1) AERATION TANK 1&2 (1968) INFLUENT FLOW PATH
(2) AERATION TANK 3&4 (1990) INFLUENT FLOW PATH

FIGURE 7-8. SOUTH STREET WWTF AERATION TANK A2O PROCESS CONFIGURATION

Both sets of aeration tanks would be run in parallel with the five zones in each set of tanks run in series. For each set of tanks the first zone would be an anaerobic zone, followed by an anoxic zone, an aerobic zone, a second anoxic zone, and a final reaeration zone. An internal recycle pumping system would be provided to convey flow from the first aerobic zone to the first anoxic zone. The second anoxic zone would also require the addition of a supplemental carbon source (Micro-C is recommended due to the limited space and flammability concerns at the WWTF) to achieve the target effluent total nitrogen concentration of approximately 3.0 mg/l. See **Figure 7-9** for a process flow diagram of the 5-Stage Bardenpho process and **Figure 7-10** for the South Street WWTF aeration tank configuration for the 5-Stage Bardenpho process. **Figure 7-10** shows the proposed new walls within the aeration tank and the existing walls in the aeration tanks that would need to be modified or removed to allow for the passage of flow and the reconfiguration of the zone sizes in the tanks. The process layout would be similar for both sets of aeration tanks with the exception of the influent flow path to each set of tanks (as noted in the figure) due to the existing aeration tank influent configuration.

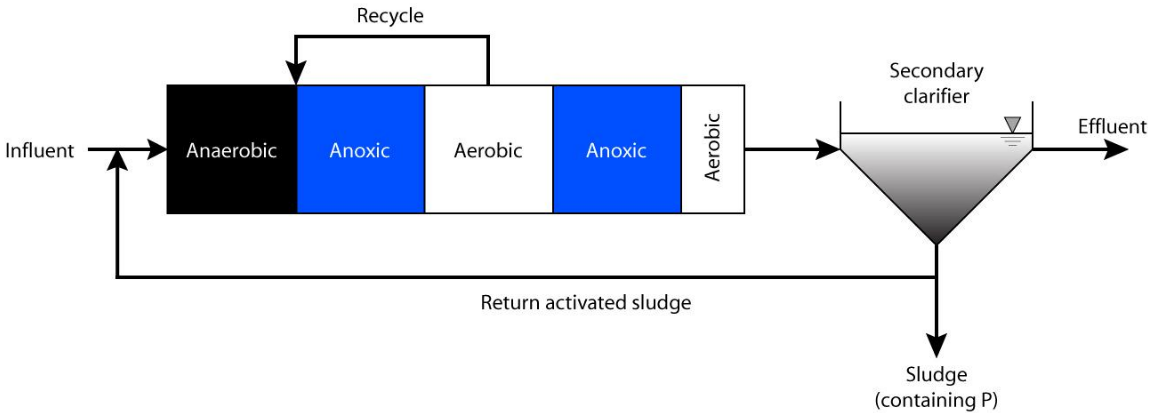
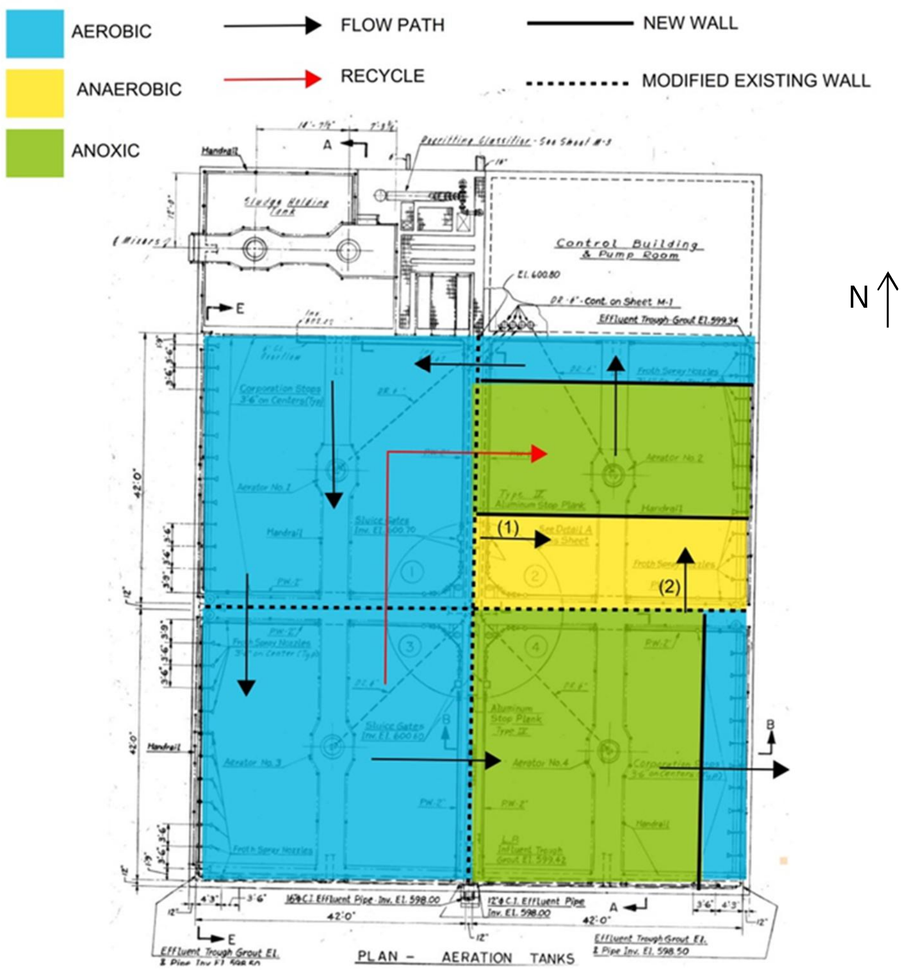


FIGURE 7-9. 5-STAGE BARDENPHO PROCESS FLOW DIAGRAM



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NOTES:
(1) AERATION TANK 1&2 (1968) INFLUENT FLOW PATH
(2) AERATION TANK 3&4 (1990) INFLUENT FLOW PATH

FIGURE 7-10. SOUTH STREET WWTF AERATION TANK 5-STAGE BARDENPHO PROCESS CONFIGURATION

Items that would be required to provide the 5-Stage Bardenpho process for the aeration tanks at South Street WWTF include the following:

- Rehabilitation of the 1968 aeration tanks (significant concrete repair, new railings, new valves, new weirs, etc.).
- Minor improvements to the 1990 aeration tanks (new weir gates, minor concrete repairs).
- New walls and modification to exiting walls in the 1968 and 1990 aeration tanks.
- New aeration system for the aerobic zones (two zones per set of aeration tanks) including aeration supply and control systems.
- Mixers for the anaerobic zones (one zone per set of aeration tanks).
- Mixers for anoxic zones (two zones per set of aeration tanks).
- Internal recycle pumping and piping systems.
- Supplemental carbon (Micro - C) storage and feed facility.
- A means to provide aerated sludge storage to prevent phosphorus release from the waste sludge.

A summary of the predicted effluent performance of the 5-Stage Bardenpho process at the South Street WWTF will be discussed later in this section.

Secondary Process Alternatives Effluent Performance Comparison

The following is a summary of the performance of the various aeration tank processes as it relates to effluent total nitrogen, effluent total phosphorus and chemical use. For the purposes of the evaluation it was assumed that processes used fine bubble diffusers and high efficiency hybrid rotary lobe compressor style blowers for aeration and submersible mixers for maintaining the mixed liquor in suspension for non-aerated zones. An evaluation of standard positive displacement blowers, fine bubble diffusers, and “Invent” style mixer aerators related to the systems assumed above is presented later in this Chapter. Also for the purposes of this evaluation it was assumed that the mixed liquor internal recycle for each of the process was 200% of the WWTF forward flow. This internal recycle flow rate will be evaluated in more detail during design of the recommended alternative.

For each of the processes the target total phosphorus was 0.33 mg/l or less. As a result, alum addition was included in the alternatives that were not able to reduce the phosphorus levels biologically to those levels. Alum doses were selected to achieve a TP effluent between 0.25 mg/l and 0.35 mg/l. Alum was used for the purposes of this evaluation as it is the current coagulant employed by the WWTF. Alternative coagulants may be evaluated during design. It should be noted that even if a biological phosphorus removal process was employed the construction of alum storage and feed facilities would be recommended for this system. The secondary process would allow for some operational flexibility and to assist in the removal of phosphorus if there was a biological process upset.

Table 7-2 below summarizes the predicted model performance of the various secondary processes as it relates to effluent total nitrogen, effluent total phosphorus, and chemical use. The information presented in the table is based on maximum month year 2035 loadings to the WWTF and minimum wastewater temperature of 12^{o}C with the exception of the chemical usage which is based on annual average flow.

The MLE and the A2O process are not able to meet the target total nitrogen limit of 3.0 mg/l, and would require the purchase of nitrogen credits to meet the General Nitrogen Permit limits. Should a numerical limit for total nitrogen (TN) be given in the future, modifications to the process would be required to convert to a 4- or 5-Stage Bardenpho process. This conversion would require wall relocation, carbon addition and may need to be done at a time when the ability to construct the project may be more difficult due to increased flow/loads at the WWTF versus current conditions

TABLE 7-2. ACTIVATED SLUDGE PROCESS ALTERNATIVES PERFORMANCE

Process Alternative	TN, mg/l	TP, mg/l	Alum Added, gpd[1]	Micro-C Added, gpd[1]
MLE (with alum addition)	4.77	0.25	28.5	-
A2O (with alum addition)	5.03	0.33	9.5	-
4-Stage Bardenpho	3.0	1.95	-	20
4-Stage Bardenpho (with alum addition)	3.0	0.25	32.5	20
5-Stage Bardenpho	2.7	0.76	-	20
5-Stage bardenpho (with alum addition)	2.7	0.31	11.5	20

Notes: 1. Based on annual average flow.

Secondary Treatment Alternatives Estimated Costs

Estimated capital costs, operation and maintenance costs, and life cycle costs for the secondary process upgrade alternatives are summarized in **Table 7-3**. For all of the alternatives it was assumed that fine bubble aeration with hybrid rotary lobe compressor style blowers and submersible mixers would be used to provide process air and mixing.

TABLE 7-3. SECONDARY PROCESS UPGRADE ALTERNATIVES ESTIMATED COSTS

	Process Alternatives			
Costs	**MLE**	**A2O**	**4 Stage Bardenpho**	**5 Stage Bardenpho**
Total Capital Cost	$4,095,000	$4,230,000	$4,670,000	$4,765,000
20-Year Present Worth O&M Costs	$4,900,000	$5,900,000	$4,700,000	$5,200,000
Total 20-Year Present Worth	**$8,995,000**	**$10,130,000**	**$9,370,000**	**$9,965,000**

The estimated capital costs were based on the estimated construction costs which include material and installation costs of the aeration and mixing systems, the internal recycle pumping systems, supplemental carbon addition storage and feed systems if applicable. In addition, the capital cost includes the costs to provide structural upgrades the 1968 aeration tanks to allow them to provide reliable service for the next 20 years as well as any wall relocations and tank upgrades/modifications required by each specific process in each set of aeration tanks. The costs of the alum addition storage and feed system are not included in these costs as they would be common to all alternatives (even as a backup system for the A2O and 5-Stage Bardenpho processes) and there may be the opportunity to provide a common coagulant (alum) storage and feed system with a tertiary phosphorus removal system which will be addressed later in this chapter.

A design allowance as well as engineering and construction contingencies has been added to the base construction cost of each project element to provide a total estimated capital cost. Estimated O&M costs included costs for electrical use, chemicals, operation and maintenance labor, annual parts replacement costs, and the cost or revenue from the purchase or sale of nitrogen credits. See Chapter Four for additional information related to the basis of the cost estimates

Alternative Advantages and Disadvantages

Each of the secondary process alternatives has advantages and disadvantages associated with its implementation and operation. **Table 7-4** summarizes the advantages and disadvantages of the different processes alternatives for the South Street WWTF.

TERTIARY PHOSPHORUS REMOVAL

In order to meet the required effluent total phosphorus limits in the NPDES permit as noted in Chapter Four, a tertiary chemical addition and solids removal process will be required at the WWTF. It is assumed that chemical addition upstream in the WWTF (aeration distribution box, aeration tank effluent) alone or in conjunction with a biological phosphorus removal secondary process will still be required in addition to the selected tertiary process alternatives described below. As noted in the secondary treatment process alternatives comparison the target feed concentration for the tertiary phosphorus removal process is 0.33 mg/l or less.

The total phosphorus removal technologies that were evaluated downstream of the upgraded secondary treatment process include the following:

- Actiflo Process – Ballasted flocculation process
- Blue PRO Process – Similar configuration to existing sand filters (will need a single stage system)
- Parkson Dynasand System Upgrade (will need a two stage system)

These processes and the upgrades or new facilities that are required to employ them are described below.

Actiflo Process

Description. The Actiflo system is a compact clarification system that utilizes microsand as a seed for floc formation. The microsand promotes the formation of large, stable, high-density flocs that have considerably higher settling velocities than conventional flocs. The higher settling velocities allow for significantly higher settling tank overflow rates, which allow for a reduced process volume and system footprint. **Figure 7-11** shows a process flow schematic of the Actiflo process.

The Actiflo sytem consists of a coagulation tank, maturation tank, and a settling tank with lamella tube settlers. For this application of the Actiflo process, effluent from the final settling tanks would be directed to the Actiflo tanks. Prior to entering the system, alum would be added to the wastewater to generate chemical phosphorus flocs. The wastewater would then flow into the coagulation tanks, where polymer is added and the flocs are impregnated by the dense microsand that is continuously reinjected into the tank. Following the coagulation tanks are the maturation tanks where flocs grow and mature. These flocs are then separated and removed in the settling tanks and the clarified water exits the system. The sludge from the lamella settlers is pumped to hydrocyclones at the coagulation tanks to be separated from the microsand, and the clean microsand is returned to the injection tank. The waste sludge from the Actiflo process would flow by gravity to the recycle wet well in the Operations Building basement, where it would be conveyed back to the head of the WWTF.

TABLE 7-4. SECONDARY PROCESS UPGRADE ALTERNATIVES ADVANTAGES AND DISADVANTAGES

Technology	Advantages	Disadvantages
MLE	• No wall relocation (ease of construction) • Ease of operation • No carbon addition required (capital and O&M) • Lowest cost • Can use gravity thickener for sludge storage if desired • Can use rotary press for dewatering if put in gravity thickener	• Cannot meet target total nitrogen limit (would have to purchase nitrogen credits) • No enhanced biological TP removal • Additional construction required in the future if numerical TN limits were imposed
4-Stage Bardenpho	• Can meet the target total nitrogen limit (no need to purchase credits and would not be impacted by conversion of permit to numerical limits) • Can use gravity thickener for sludge storage if desired • Can use rotary press for dewatering if put in gravity thickener	• Higher cost • Requires wall relocations • Requires supplemental carbon (capital and O&M) • No enhanced biological TP removal
A2O	• No wall relocation (ease of construction / reduced cost) • No carbon addition required (capital and O&M) • Flexibility to switch to MLE in winter to improve nitrification in cold weather when out of seasonal P limit • Lowest cost Bio-P removal • Can remove TP to approximately 0.6 mg/l without alum (reduction in chemical use)	• Biological P removal can be subject to process upsets • Cannot meet target total nitrogen limit (would have to purchase nitrogen credits) • Additional construction would be required in the future if numerical TN limits were imposed • Requires aerated solids handling
5-Stage Bardenpho	• Can meet the target total nitrogen limit (no need to purchase credits and would not be impacted by potential conversion of permit to numerical limits) • Can remove TP to approximately 0.7 mg/l without alum (reduction in chemical use)	• Higher cost • Biological P removal can be subject to process upsets • Requires wall relocations • Requires supplemental carbon (capital and O&M) • Requires aerated solids handling

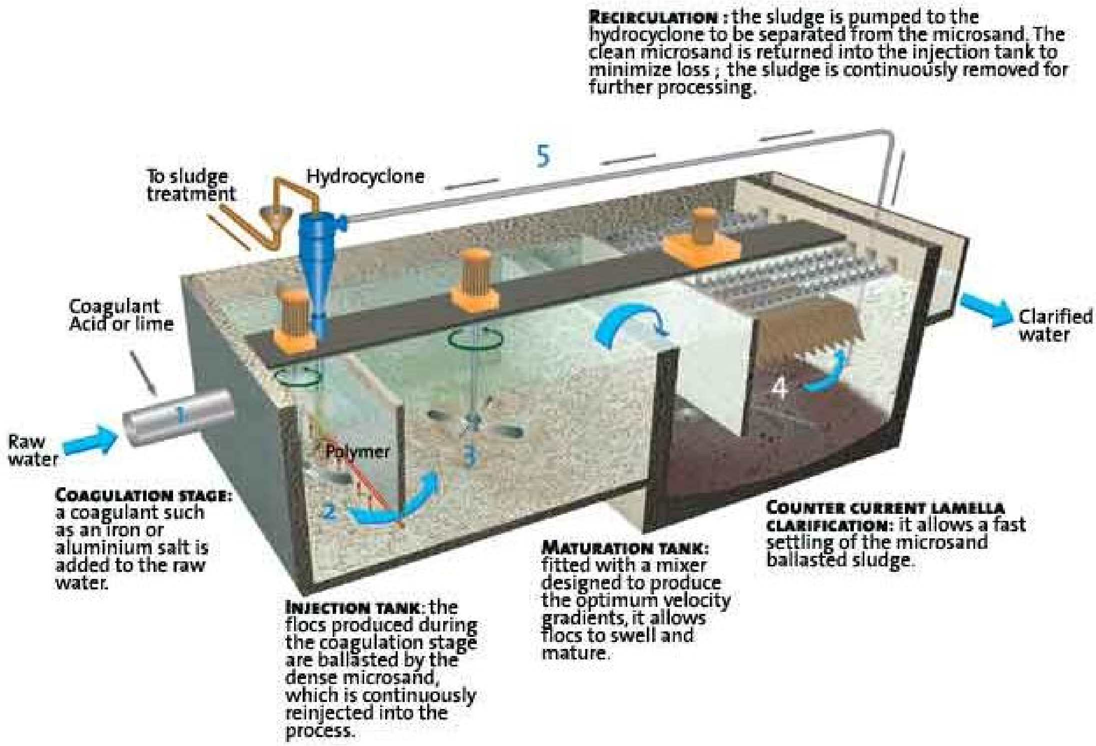


FIGURE 7-11. ACTIFLO PROCESS FLOW SCHEMATIC

For the application at the South Street WWTF, the manufacturer recommends installing two Actiflo trains, each with a capacity of 3.0 MGD, for a total capacity of 6.0 MGD. One train would be capable of handling the projected average daily flow, and both trains would operate during peak flows. The Actiflo system would be installed at the location of the existing Dynasand filter cells. **Figure 7-12** shows the proposed process layout. Installation would require the demolition of the existing filter cells and relocation of the ultraviolet (UV) disinfection system, post aeration tank, and Parshall flume. The components that would be required for the installation of the Actiflo system at the South Street WWTF are listed below.

System Components. The following system components are required with the Actiflo system:

- Two process trains each with:
  - One coagulation tank
  - One maturation tank
  - One settling tank
- Upstream flash mixer for alum dispersion
- Coagulation tank mixers (2)
- Maturation tanks mixers, anti-vortex baffle sets, weir wall stilling baffles (2)
- Settling tank scraper assemblies and drives (2)
- Lamella tubes and support equipment sets (2)
- Effluent collection troughs and supports (2)
- Micro-sand recirculation pumps, valves, and appurtenances (4)
- Hydrocyclones and appurtenances (4)
- Coagulant storage and feed system

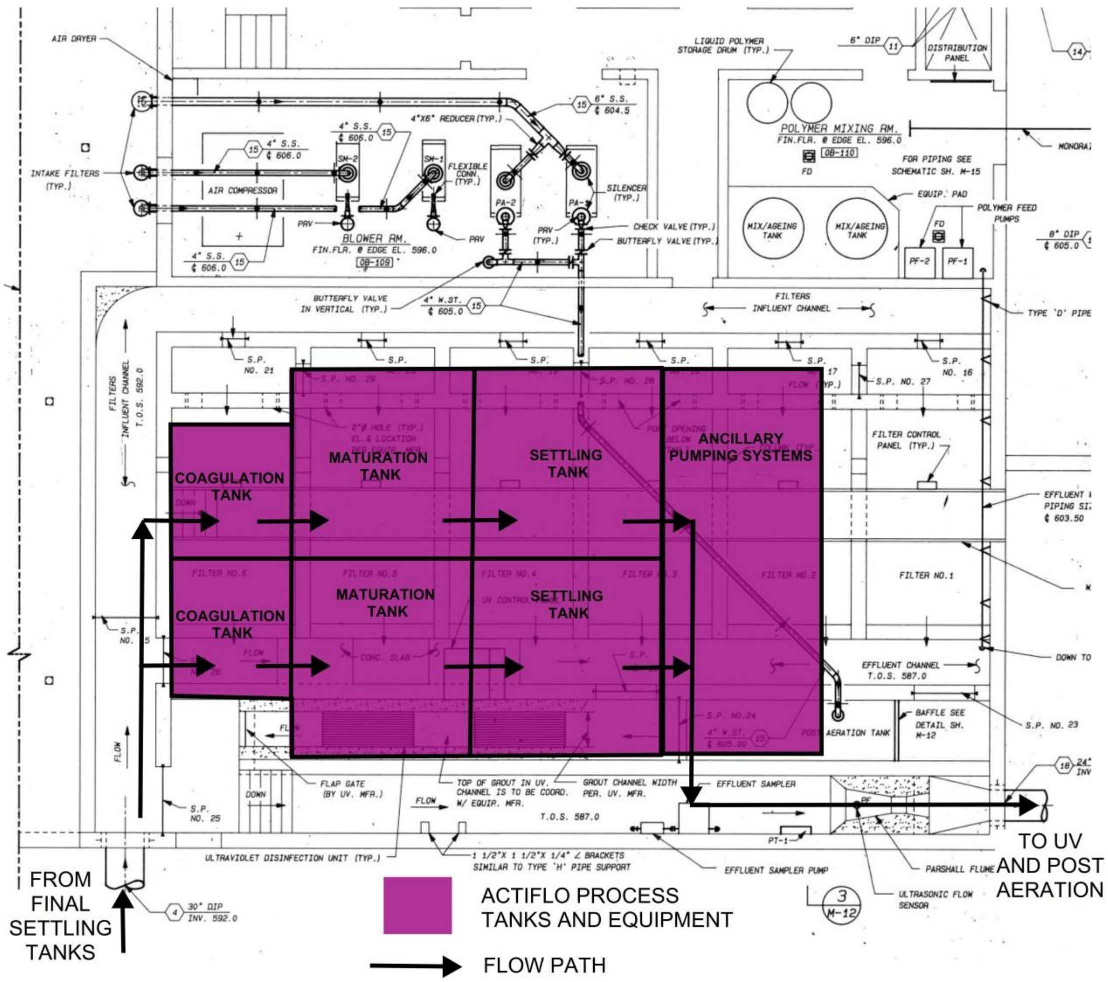


FIGURE 7-12. ACTIFLO ALTERNATIVE PROCESS LAYOUT

- Polymer storage and feed system
- Flow meters
- Pressure sensors
- Turbidimeters
- pH Sensors
- Control panels

Blue PRO Process

Description. The Blue PRO process consists of continuous backwashed gravity sand filters with reactive filtration. Influent to the unit flows downward through the central feed chamber and is distributed into the bottom of the sand bed through a series of radial arms. The influent then flows upward through the downward moving media. The media in the Blue PRO system has an adsorptive surface created by continuous regeneration hydrous ferric oxide (HFO) that forms on the surface of sand media. As the influent flows upward, phosphorus from the influent wastewater is adsorbed within the filter media, and organic and inorganic material is captured by the sand. The cleaned filtrate continues to move upward and exits at the top of the filter, over the filtrate weir, and exits the system. See **Figure 7-13** for a process flow schematic of a Blue PRO filter unit.

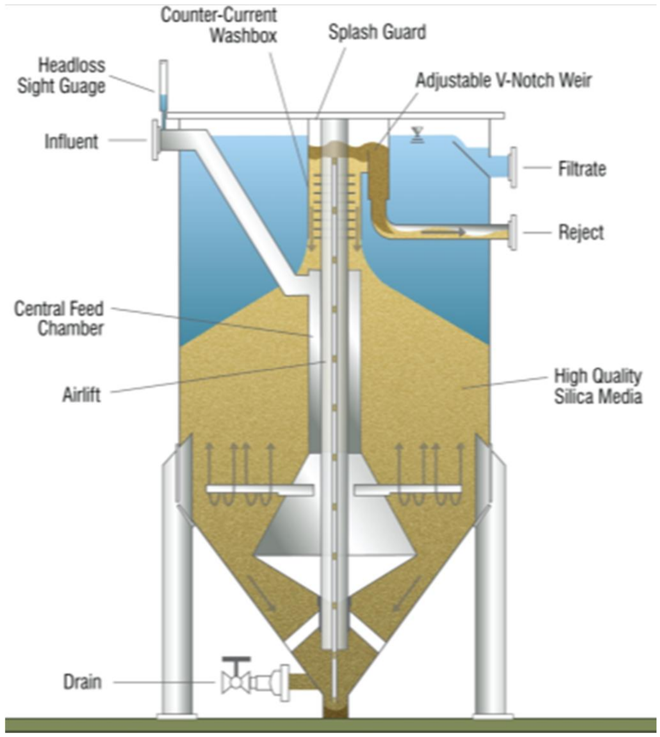


FIGURE 7-13. BLUE PRO FILTER UNIT PROCESS FLOW SCHEMATIC

The sand bed containing adsorbed phosphorus and captured solids is drawn downward into the center of the filter where the airlift pipe is located. A small volume of compressed air is introduced at the bottom of the airlift, drawing the sand into the airlift pipe. The sand is scoured within the airlift pipe, which dislodges any solid particles and iron and phosphorus that are attached to the sand grains. The dirty slurry is conveyed to the top of the airlift and into the reject compartment. From the reject compartment, the “cleaned” sand falls into the sand washer, and the lighter reject solids are carried over the reject weirs and out the reject pipe. The reject, or backwash waste, from the Blue PRO process would flow by gravity to the recycle wet well in the Operations Building basement, where it would be conveyed back to the head of the WWTF.

The Blue PRO system, while operating as a continuously backwashing sand filter, differentiates itself from other similar sand filters for phosphorus removal by utilizing adsorption of phosphorus onto the media versus solids separation of a previously formed and flocculated phosphorus precipitate. The sand media is coated with hydrous ferric oxide, allowing for improved adsorption of phosphorous and phosphorous containing solids. While the Actiflo and Dynasand tertiary processes allow for flexibility between the use of alum or ferric chloride as a coagulant, the Blue PRO process requires the use of ferric chloride for continuous regeneration of the adsorptive capacity of the media. The Blue PRO system would also require the addition of polymer for improved zinc.

For the application at the South Street WWTF, the Blue PRO system would be installed at the location of the existing Dynasand filter cells. Twelve (12) of the sixteen (16) required Blue PRO filter units would be retrofitted in the six existing Dynasand filter cells (two units per cell). The remaining four filter units would be located at the south end of the Operations Building in two new cells adjacent to the existing filter cells. **Figure 7-14** shows the proposed configuration. The UV system, post aeration tank, and Parshall flume would be relocated. The components that would be required for the installation of the Blue PRO system at the South Street WWTF are listed below.

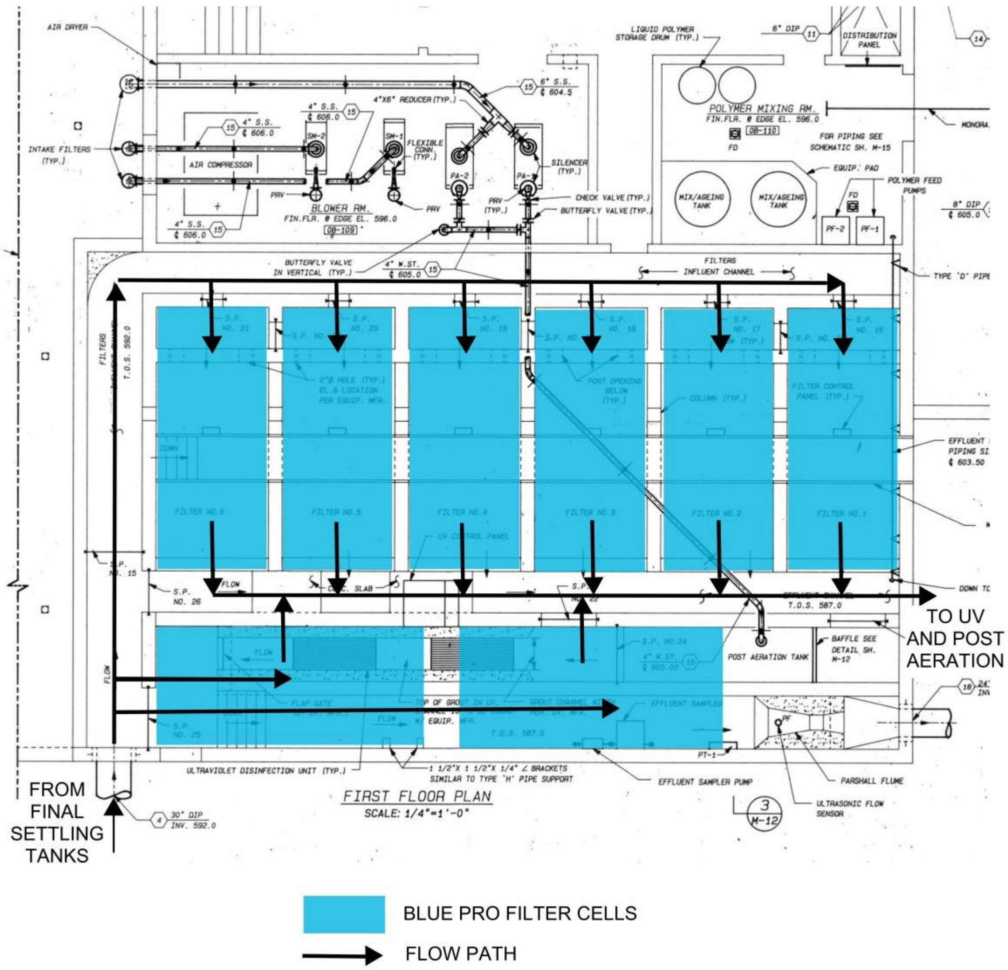


FIGURE 7-14. BLUE PRO ALTERNATIVE PROCESS LAYOUT

System Components. The following system components are required with the Blue PRO system:

- 16 Blue PRO filter units, including two new filter cells, and associated influent and effluent channels
- Air compressor package with air dryer
- Ferric chloride storage and feed system
- Polymer storage and feed system
- Headloss gauges
- Float switches
- Flow meters
- Control panels

It should be noted that this technology also has the ability to denitrify to provide total nitrogen removal. This ability comes with a number of limitations which include the following:

- A second stage of filters is required.
- The filter bed depth increase from 60 inches to 80 inches
- The surface loading rate needs to be reduced from approximately 5.0 gpm/ft^2 to 1.5 gpm/ft^2, significantly increasing the number of filters required.
- The feed needs to be completely nitrified and have a nitrate concertation of 15 mg/l or less.

Given these limitations the implementation of this technology for nitrogen removal was not considered.

Dynasand Process

Description. The Dynasand process is a continuously backwashing upflow sand filtration process. Influent to the unit flows downward through an annular section. The influent feed is introduced into the bottom of the sand bed through a series of feed radials that are open at the bottom. As the influent flows upward through the downward moving sand bed, organic and inorganic material is captured by the sand. The cleaned filtrate continues to move upward and exits at the top of the filter, over the filtrate weir, and exits the system. See **Figure 7-15** for a process flow schematic of a Dynasand filter unit.

The sand bed containing captured solids is drawn downward into the center of the filter where the airlift pipe is located. A small volume of compressed air is introduced at the bottom of the airlift, drawing the sand into the airlift pipe. The sand is scoured within the airlift pipe, which dislodges any solid particles that are attached to the sand grains. The dirty slurry is conveyed to the top of the airlift and into the reject compartment. From the reject compartment, the “cleaned” sand falls into the sand washer, and the lighter reject solids are carried over the reject weirs and out the reject pipe. The reject, or backwash waste, from the Dynasand process would flow by gravity to the recycle wet well in the Operations Building basement, where it would be recycled back to the head of the WWTF.

In the South Street WWTF application, ferric chloride or alum would be added upstream of the filters in order to allow precipitation of metal phosphate in the filter cells, thereby removing phosphorus from the wastewater. In order to meet the required total phosphorus limits at the WWTF, a two-stage Dynasand filter system would be required. The first stage filters would use a larger sand grain size and would primarily provide total suspended solids removal. The second stage would act as a polishing filter, utilizing a smaller sand size and provide higher phosphorus removal performance.

For the application of Dynasand at the South Street WWTF, the existing six (6) Dynasand filter cells (with two filter units in each cell) would be retrofitted with new Stage Two equipment and an additional eight (8) filter cells would be required to accommodate four (4) new filter units to handle future projected flows. The new Stage Two filter cells would be installed at the south end of the Operations Building adjacent to the existing filter cells. The UV system, post aeration tank, and Parshall flume would be relocated. For Stage One, twenty (20) new Dynasand filter cells would be constructed to the west of the Final Settling Tanks, and a new pump station would be constructed to pump the Final Setting Tank effluent to the Stage One filter cells. Effluent from the Stage One filters would flow by gravity to the Stage Two filters. **Figure 7-16** shows the proposed location of the Stage One filter cells and pump station, and **Figure 7-17** shows the proposed configuration of the Stage Two filter cells within the Operations Building. The components that would be required for the installation of the two stage Dynasand system at the South Street WWTF are listed below.

System Components. The following system components are required with the Dynasand system:

- Pump station to pump Final Settling Tank effluent to Dynasand Stage One filter units
- Twenty (20) Stage One Dynasand filter units and associated influent and effluent channels
- Twenty (20) Stage Two Dynasand filter units and associated influent and effluent channels
- Air compressor package with dryer
- Headloss gauges

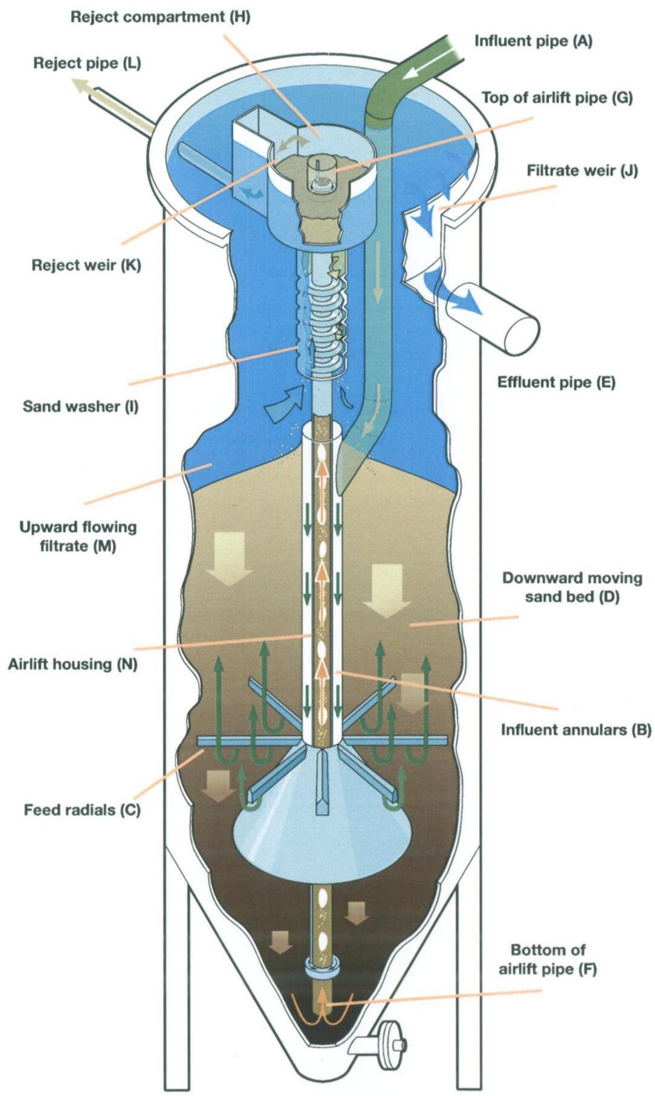


FIGURE 7-15. DYNASAND FILTER UNIT PROCESS FLOW SCHEMATIC

- Float switches
- Flow meters
- Control panels

It should be noted that this technology also has the ability to denitrify to provide total nitrogen removal. This ability comes with a number of limitations which include the following:

- A second stage of filters is still required.
- The feed needs to be completely nitrified and have a nitrate concentration of 15 mg/l or less.

Given these limitations the implementation of this technology for nitrogen removal was not considered.

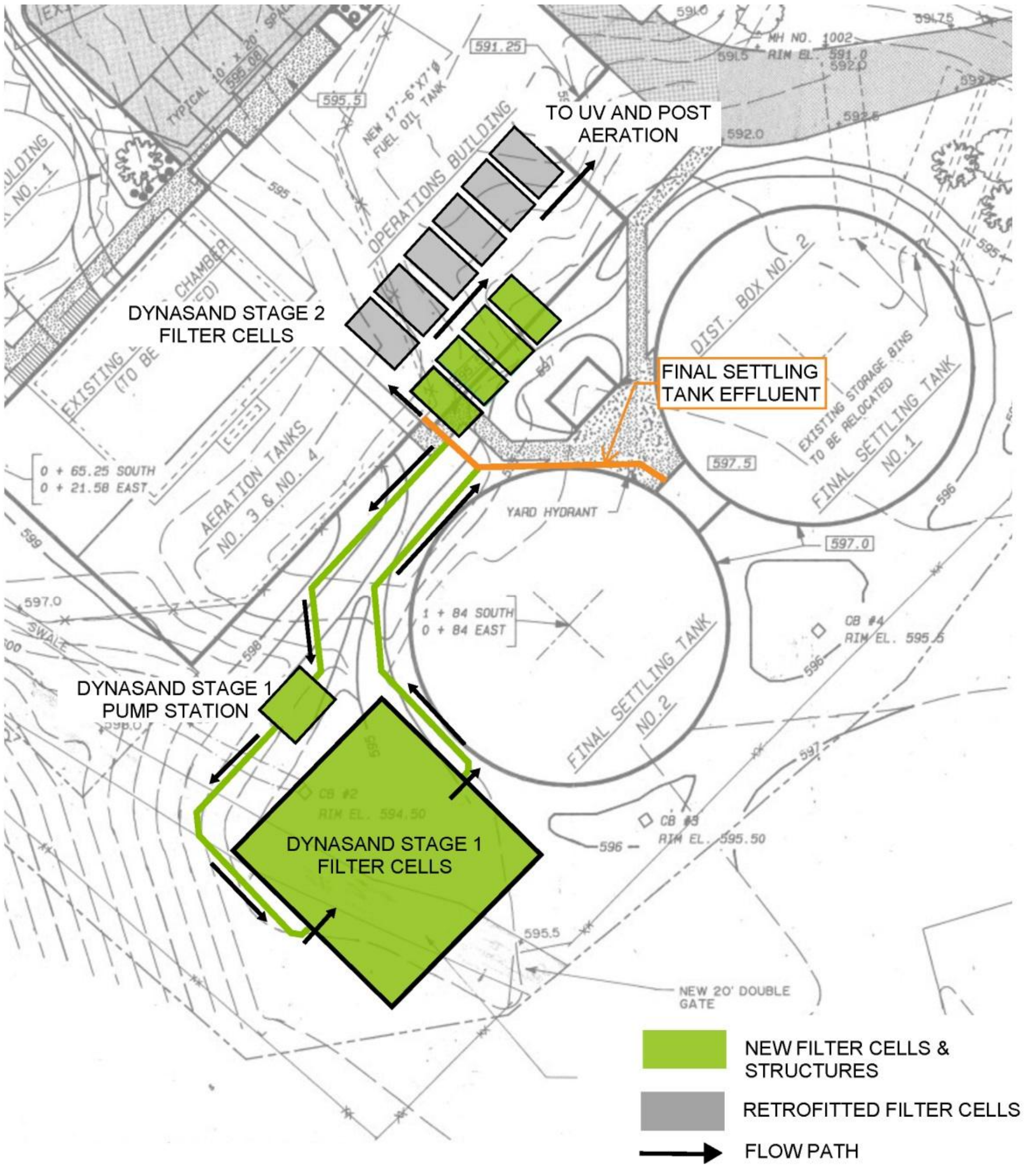


FIGURE 7-16. DYNASAND ALTERNATIVE STAGE ONE PROCESS LAYOUT

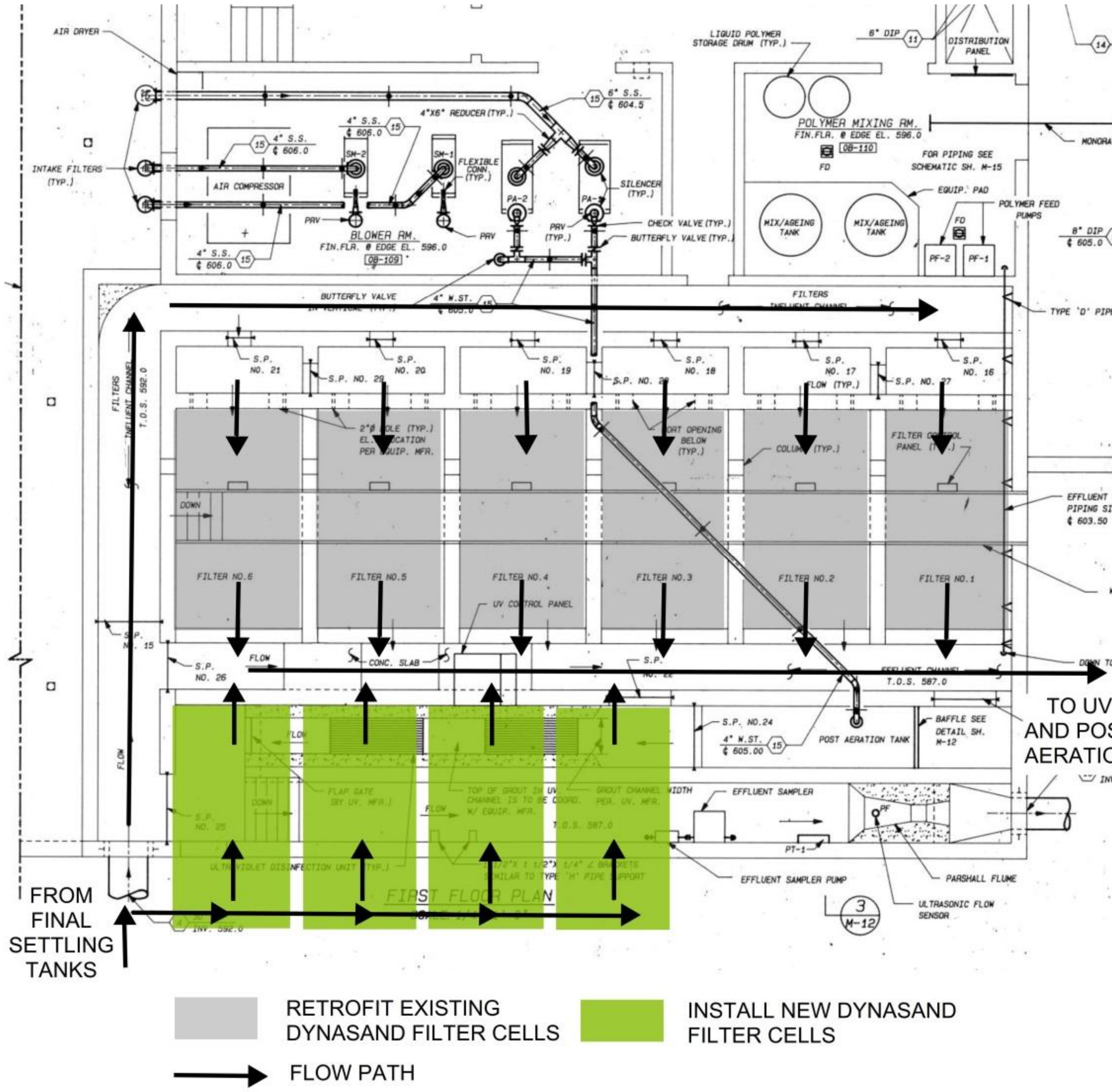


FIGURE 7-17. DYNASAND ALTERNATIVE STAGE TWO PROCESS LAYOUT

Tertiary Phosphorus Removal Process Alternatives Estimated Costs

Estimated capital costs, operation and maintenance costs, and life cycle costs for the tertiary phosphorus removal process alternatives are summarized in **Table 7-5**.

The estimated capital costs were based on the estimated construction costs which include material and installation costs of the vendor provided tertiary phosphorus removal systems and equipment, including modifications of the existing sand filter cells, the construction of new process tankage/filter cells, pump stations (as applicable), electrical and control system component and upgrades.

A design allowance as well as engineering and construction contingencies has been added to the base construction cost of each project element to provide a total estimated capital cost. Estimated O&M costs included costs for electrical use, chemicals, operation and maintenance labor, annual parts replacement costs, and addition solids handling costs from the tertiary processes. See Chapter Four for additional information related to the basis of the cost estimates.

TABLE 7-5. TERTIARY PHOSPHORUS REMOVAL PROCESS ALTERNATIVES ESTIMATED COSTS

	Process Alternatives		
Costs	Actiflo	Blue PRO	Dynasand
Total Capital Cost	$6,360,000	$3,770,000	$9,570,000
20 Year Present Worth O&M Costs	$2,700,000	$1,300,000	$3,900,000
Total 20 Year Present Worth	**$9,060,000**	**$5,070,000**	**$13,470,000**

Alternative Advantages and Disadvantages

Each of the tertiary phosphorus removal alternatives has advantages and disadvantages associated with its implementation and operation. **Table 7-6** summarizes the advantages and disadvantages of the different processes alternatives for the South Street WWTF.

TABLE 7-6. TERTIARY PHOSPHORUS REMOVAL PROCESS UPGRADE ALTERNATIVES ADVANTAGES AND DISADVANTAGES

Technology	Advantages	Disadvantages
Actiflo	• Alum or ferric can be used as coagulant • Technology can be retrofitted into existing filter room	• Higher capital cost • Higher operating costs • More complex technology • New tankage required • Requires polymer (additional storage and feed system) • Does not have installation with total phosphorus limit as low as Ridgefield
Blue PRO	• Lowest capital cost • Lowest operating costs • Technology can be retrofitted into existing filter room • Simple technology • Similar technology as existing filters at WWTF • Has other installations meeting the Ridgefield total phosphorus limit	• Requires the use of ferric chloride (which would require additional chemical storage and feed system if WWTF wants to maintain the use of alum in the secondary process) • Few installations with total phosphorous limits as low as Ridgefield
Dynasand	• Alum or ferric can be used as coagulant • Simple technology • Same technology as existing filters at WWTF • Has a number of installations meeting or exceeding the Ridgefield total phosphorus limit	• Highest capital cost • Highest operating cost • Requires additional Stage 2 filters (requires expanding the existing filter room footprint) • Requires separate Stage 1 filters, associated pump station, and yard piping in order to meet phosphorus limit

MEMBRANE BIOREACTOR (MBR)

Description

Another process that was evaluated for nitrogen and phosphorus removal at the South Street WWTF was the membrane bioreactor. This technology uses an activated sludge process with membrane filters (either hollow fiber or flat plate membranes) to provide the separation of solids in the mixed liquor. An advantage of this system is that there are no settling tanks required as the membranes provide the solids separation. Another advantage is that the mixed liquor concentrations can be increased up to 10,000 mg/l versus the 4,000 – 5,000 mg/l maximum mixed liquor concentration in a conventional activated sludge process with settling tanks. Similar to the secondary treatment process alternatives discussed previously in this section, MBRs can be configured to remove total nitrogen and total phosphorus. The total nitrogen in an MBR would be removed biologically while the total phosphorus removal can be achieved either through the use of chemical addition or a combination of biological removal and chemical addition. One advantage of an MBR for an application like the South Street WWTF is its ability to remove phosphorus to levels low enough that it would eliminate the need for a tertiary phosphorus removal system.

A conceptual evaluation of an MBR system at the WWTF was conducted with two MBR system manufacturers. The MBR systems evaluated were able to achieve effluent limits of less than 3.0 mg/l of total nitrogen and 0.05 mg/l of total phosphorus.

A conceptual layout of the MBR process at the South Street WWTF is shown in **Figure 7-18**. The system is comprised of the two sets of aeration tanks run in parallel. For each set of aeration tanks the flow starts in an anoxic zone followed by an aerobic zone, a post anoxic zone, and finally by an aerated membrane zone. Supplemental carbon would be added to the post anoxic zone to facilitate denitrification and alum (or another coagulant) would be provided just upstream on the membrane tank to precipitate phosphorus for total phosphorus removal. There are a number of other ancillary systems required by the MBR which would be housed inside a building to be located between the two sets of aeration tanks. These ancillary equipment systems are as follows:

- Membrane tank blowers and diffuser systems (separate from the process diffusers and blowers for the upstream aerobic tank zones).
- Permeate pumps to pull effluent through the membranes and to convey the permeate to the downstream processes.
- Membrane cleaning systems (sodium hypochlorite and citric acid).
- Membrane backpulse (backwash) system to maintain membrane flux.
- Various field instruments and control systems for the MBR process and ancillary systems.

MBR Alternative Estimated Cost Comparison

A comparative capital cost and O&M cost estimate were developed for the MBR alternative. This evaluation compared the MBR versus the combined 4-Stage Bardenpho process that provided the same total nitrogen removal and the Blue PRO tertiary phosphorus removal process that provided the same total phosphorus removal. For the purposes of comparison, both the common and different unique process components between the MBR alternative and the 4-Stage Bardenpho/Blue PRO alternative were identified. These are described below.

Common MBR Alternative and 4-Stage Bardenpho/Blue PRO Alternative Components. Since this was a comparative cost evaluation a number of common components were developed for both alternatives. As they were common elements they were assumed to have the same relative costs. These common elements are as follows:

FIGURE 7-18. MEMBRANE BIOREACTOR ALTERNATIVE PROCESS LAYOUT

- Aeration tank upgrades and wall relocations. For both technologies similar tank upgrades would be required and the same number of walls would need to be relocated.
- Aeration tanks fine bubble diffusers, blowers, mixer, return sludge, and internal recycle pumps. These elements are similar for both alternatives.
- UV disinfection system and Post Aeration equipment. The equipment for the alternatives would be similar, however, a new UV Disinfection / Post Aeration Building is a unique component of the 4-Stage Bardenpho/Blue PRO alternative while the MBR could use the existing UV disinfection and Post Aeration system location.
- Chemical feed and storage facilities for phosphorus removal chemical and for supplemental carbon addition. These elements are similar for both alternatives.

Unique MBR Alternative and 4-Stage Bardenpho/Blue PRO Alternative Components. A number of components were identified for the MBR and 4-Stage Bardenpho/Blue PRO alternatives that are unique to each alternative. These unique components were identified to allow for the comparative cost evaluation for each alternative. These unique components by alternative are as following:

MBR Alternative Specific Components

- Membrane Bioreactor equipment including:
  - Membranes
  - Permeate pumping system
  - Membrane air scour blowers
  - Backpulse (backwash) system
  - Membrane cleaning systems
  - Electrical and control equipment
- Ancillary Equipment Building (approximately 50 ft. x 60 ft.)
- Demolition of Sludge Holding Tank No. 2 to accommodate the new ancillary equipment building
- A 2 mm band screen upgrade (screen and channel modifications versus the proposed ¼ inch influent screening upgrade)

4-Stage Bardenpho/Blue PRO Alternative Specific Components

- Final settling tank mechanical sludge collection mechanisms upgrade items. This item is not required for the MBR as the membranes provide the mixed liquor solids separation.
- New UV Disinfection / Post Aeration Building. System equipment is similar for both alternatives.
- Blue PRO system components including installation as well as modifications to existing and construction of new filter cells.

Cost Comparison. Comparative capital costs, operation and maintenance costs, and life cycle costs for the MBR alternative and the 4-stage Bardenpho / Blue PRO tertiary phosphorus removal process alternatives were developed based on the unique process components described above. **Table 7-7** presents summary of the comparative costs of these two alternatives.

TABLE 7-7. 4-STAGE BARDENPHO / BLUE PRO ALTERNATIVE VERSUS MEMBRANE BIOREACTOR COMPARATIVE COSTS

Alternative	Capital Cost ($)	20 Year Present Worth O&M Cost ($)	20 Year Life Total Present Worth Cost ($)
4- Stage Bardenpho and Blue PRO Processes	$7,865,000	$6,200,000	**$14,065,000**
Membrane Bioreactor	$11,065,000	$7,800,000	**18,865,000**

The findings of the evaluation are as follows:

- The capital cost of the MBR alternative is approximately $3.2 million greater than the 4-Stage Bardenpho/Blue PRO alternative.
- The 20 year present worth O&M costs of the MBR alternative are approximately $1.6 million greater than the 4-Stage Bardenpho/Blue PRO alternative.
- The 20 year total present worth cost of the MBR alternative is approximately $4.8 million greater than the 4-Stage Bardenpho/Blue PRO alternative.

As a result of these significantly higher costs, the MBR alternative was eliminated from consideration.

ZINC REMOVAL

The South Street WWTF effluent zinc permit limits are described in Chapter Four. All of the zinc limits for the WWTF are mass based rather than concentration based like most of the permitted effluent constituents. The average monthly zinc effluent limit is 0.25 kg/day and the daily zinc effluent limit is 0.33 kg/day. At projected design flows of 1.12 mgd average day and 6.0 mgd peak hour, the mass limit equates to WWTF effluent zinc concentrations of 0.059 mg/l average day and a 0.015 mg/l peak hour. As noted in Chapter Four, the current secondary and tertiary processes at the South Street WWTF are unable to meet the zinc effluent limits at the WWTF under all conditions.

Zinc Removal from Tertiary Phosphorus Removal

The tertiary phosphorus removal technology alternatives previously described in this Chapter all require chemical addition (coagulants and or polymers) and solids removal to achieve phosphorus removal. These chemicals are the same chemicals that would typically be used to precipitate zinc. Through discussions, supplier experience at other WWTFs, and some jar testing at the South Street WWTF, two of three suppliers noted that their equipment and its required chemical addition will remove some zinc. These suppliers estimate that zinc removal may be between 0% and 30%. It should be noted that none of the suppliers believe they will be able to achieve the effluent peak flow zinc concentration of 0.015 mg/l.

pH Adjustments to Improve Removal

A common method of improving the removal of zinc is to adjust the wastewater pH to help remove more dissolved zinc with the addition of coagulants and/or polymers. The feasibility of this solution was investigated to meet the required South Street zinc effluent concentration limits as noted above. **Figure 7-19** shows a typical metal hydroxide solubility curve, presenting the solubility of common heavy metal ions and their respective solubility versus pH. This figure shows that zinc can be optimally removed (has the lowest solubility) at a pH of approximately 10.1. Please note that this curve represents an ideal clean water scenario and that actual results will vary significantly depending upon competing reactions and other wastewater constituents such as chelating agents that may inhibit metals removal.

Based on this figure, it is not believed that an adjustment of the pH in the wastewater at South Street WWTF and the addition of coagulants/polymers will be able to achieve the effluent peak flow zinc concentrations noted above due to solubility limitations of zinc even at optimal pH conditions. As shown in the figure, the minimum solubility of zinc even at the optimal pH is about 0.1 mg/l or 100 ug/l which is substantially higher than the maximum day limit of 0.015 mg/l at peak hour flow conditions. It should be noted that a number of the tertiary phosphorus removal technology suppliers had noted that this solubility issue was a concern to them and they did not think that pH adjustments would significantly increase their zinc removal through their processes.

Alternate Approaches to Removing Zinc

Based on the discussion with the tertiary phosphorus removal suppliers, and the solubility limitation of zinc as noted above, there are few other alternatives to meet the zinc effluent limits required at the WWTF. Two alternatives explored to be installed downstream of the tertiary phosphorus removal system to meet the zinc limits are Nano Filtration (NF)/ Reverse Osmosis (RO) filtration and ion exchange. It should be noted that both of these alternatives have limited municipal wastewater installations as zinc removal to this extremely low level is an unusual requirement. These technology alternatives are discussed below.

Nanofiltration (NF) and Reverse Osmosis (RO). In discussions with an NF/RO manufacturer, few alternatives exist to achieve the zinc limits required at peak flows (with the tertiary phosphorus removal effluent as their feed).

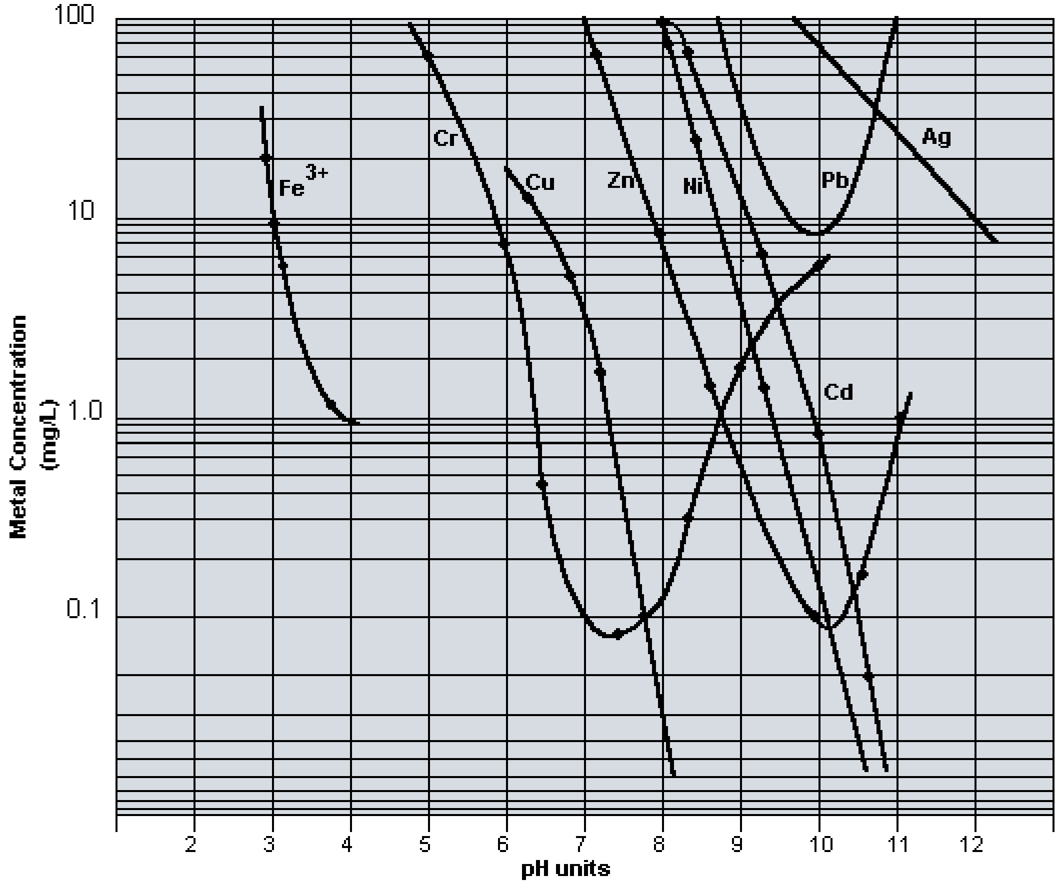


FIGURE 7-19. METAL HYDROXIDE SOLUBILITY CURVE

Alternative one includes the installation of an NF/RO system downstream of the tertiary phosphorus removal system. Although it is estimated that a NF/RO system would produce the required effluent zinc concentrations, the percent recovery of this system is estimated to be about 75%. The recovery of the system is the amount of product produced per amount of feed applied. So in this case, for every 1.0 mgd treated by the system, 0.75 mgd would be effluent (filtrate) and 0.25 mgd would be residuals which include the brine (retentate), contaminated backwash, and membrane cleaning chemicals. These residuals would need to be disposed of offsite or evaporated. This option was not believed to be feasible due to the large quantity of residuals.

A second option would be to install a micro filtration (MF) membrane system between the tertiary phosphorus removal system effluent and the NF/RO system. With this configuration it was estimated that the system recovery may improve to approximately 90%. Again, this is not considered feasible due to the large volume of residuals. It should be noted that a membrane system supplier has also indicated that that this configuration would not be cost competitive with an ion exchange system.

Ion Exchange. In discussions with several ion exchange resin and system suppliers, they believe that they would be able to achieve the zinc limits required at peak flows using the effluent from the tertiary phosphorus removal process. Based on supplier input, it is estimated that the recovery of the system would be approximately 99% or 10,000 gallons per day of “regenerate” at 1.0 mgd of WWTF flow. Coarse planning level costs were developed for an ion exchange system to treat the peak flows at the South Street WWTF to meet the required mass effluent zinc limits. The estimated capital cost for a weak acid cationic ion exchange system (which has a good selectivity for zinc) including the resin columns, the resin, housing the system in a building, and ancillary systems (chemical storage and feed systems, regenerate storage, instrumentation, pumping, electrical, etc.) is on the order of $20M - $25M. These costs do not include the cost for operations. Many operating costs are not identifiable without specific testing of the water (including regeneration frequency, resin replacement frequency, chemical use, power and labor). However, a coarse operating cost estimate for disposal of the regenerate was prepared. Based on a 99% recovery and an estimated residual volume of 10,000 gallons per day, it is estimated that the disposal cost of the regenerate would be approximately $300,000 per year.

Conclusion/Summary. Based the information presented above it appears that only ion exchange has the potential to meet the required effluent zinc limits required at peak flows for the South Street WWTF. This installation of an ion exchange system would result in significant capital and operating cost for the Town. The expenditure of these high costs would potentially allow the Town to meet a mass zinc limit that has only been a problem under peak flow conditions (three times in the last six years) with effluent zinc concentrations less than the 66 ug/l instream acute and chronic zinc limit that the mass limits are based on.

AERATION SYSTEMS

Introduction

As noted previously in this Chapter and described in Chapter Five, due to the age and condition of the existing surface aerators on both sets of aeration tanks, it is recommended that a complete aeration upgrade be provided. As a result two aeration technologies were evaluated which include:

- Fine Bubble Diffused Air
- Invent Mixer/Aerators

These alternatives, their system components, and new facilities that are required to employ them are described below.

Fine Bubble Diffused Air

In fine bubble diffused air systems, oxygen is transferred in aeration basins by diffusion of oxygen from bubbles to the mixed liquor. Fine bubbles are generated by passing blower supplied air through diffusers. Diffusers come in a number of styles (tubes, discs, panels, etc.) and material types (ceramic, plastic, rubber, etc.). The diffusers are mounted on the aeration tank bottom in a grid pattern. See **Figure 7-20** below for some photographs of a membrane diffuser and the grid layout. Often the number of diffusers is tapered (more in the upfront basins and less in the downstream basins) to match the supplied airflow to the in-tank oxygen demand. In addition to the diffusers, the fine bubble diffused air system for the South Street WWTF would include air distribution piping and valves, blowers (and appurtenances), and a control system.

The diffusers evaluated for this alternative were the membrane disc style. Other styles of diffusers may be evaluated during design. The required number and size of the diffusers needed to meet the oxygen and mixing requirements in the aerobic basins was determined by calculated basin specific Actual Oxygen Requirements (AORs), vendor reported and industry standard alpha and beta values, and vendor assisted diffuser grid layouts. In order to address the 2035 design flows and pollutant loads, it is necessary to use both the original 1968 aeration tanks, as well as the 1990 aeration tanks. The tanks will be configured in a parallel setup splitting the influent flow between each set of aeration tanks. The 1968 tanks have a larger footprint, but a shorter sidewater depth of approximately 10 feet. The 1990s tanks have a smaller footprint and sidewater depth of approximately 15 feet. Due to the different operating water levels of each set of tanks, it is recommended to provide isolated blowers for each set of tanks.

FIGURE 7-20. FINE BUBBLE AIR - MEMBRANE DIFFUSER AND MEMBRANE GRID INSTALLATION

Invent Mixer/Aerators

The Invent Mixer/Aerator is an aeration technology that can provide aeration and mixing or mixing only. In this system oxygen is transferred to the aeration basins by diffusion of oxygen from bubbles to the mixed liquor. The system consists of a vertical top mounted mechanical hyperboloid shaped mixer. A coarse bubble sparger ring is located on the tank bottom below the mixer. Blower provided air is passed through the sparger ring producing coarse bubbles. These coarse bubbles are then sheered into fine bubbles by the sheer vanes located on the mixer. These fine bubbles are then transported outwards and distributed through the basins. See **Figure 7-21** below a photograph and a process schematic of the Invent mixer/aerator technology.

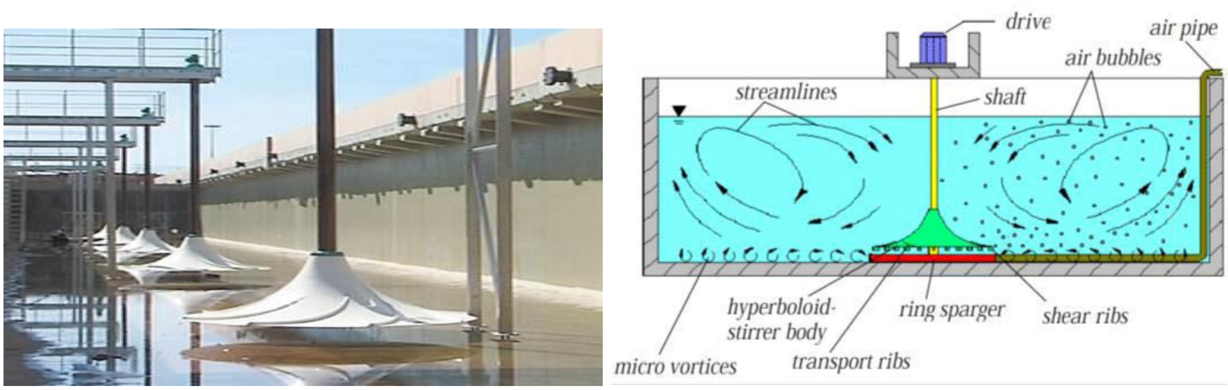


FIGURE 7-21. INVENT MIXER/AERATOR - INSTALLATION AND PROCESS SCHEMATIC

Similar to diffused air systems, the oxygen transfer provided by the aerator/mixers is tapered to match the in-tank oxygen demand. The required mixer/aerator sizes for the different basins to meet the basin specific oxygen and mixing requirements was determined by the calculated basin specific Actual Oxygen Requirements, vendor reported and industry standard alpha and beta values, and vendor assisted aerator/mixer sizing. It should be noted that multiple aerator/mixers are required in all of the aeration basins to meet the projected oxygen requirements. In addition, the Invent mixer/aerator air system for the South Street WWTF would include air distribution piping and valves, blowers (and appurtenances), and a control system.

Mixer/aerators would be mounted in either the existing mechanical aerator platforms or in new platforms depending on the aeration tank liquid process alternative selected and any new walls based on zone configuration requirements. The existing platforms will likely require modifications to accept the mixer/aerators.

Estimated Costs

While both fine bubble diffused air systems and Invent mixer/aerators will meet the aeration goals of the South Street WWTF for all liquid process alternatives, both the capital and electrical operating costs vary significantly between the two technologies. A cursory review of these costs for all nutrient removal processes was performed to determine if a detailed analysis of each technology was warranted. The capital costs for the supply and installation of Invent style mixer/aeration system was between 30% and 40% higher than those for fine bubble diffused aeration system. The electrical operating costs for the Invent style mixer/aeration system were either the same cost to approximately 40% more expensive than fine bubble diffused aeration system. Based on this cursory review, the use of Invent mixer/aerator system was eliminated from consideration and a fine bubble aeration system is recommended for the aeration tanks at the WWTF.

Ancillary System/Equipment Requirements

In addition to the fine bubble diffused air system components and the mixer/aerators system, a number of ancillary systems and equipment are recommended for both alternatives. These ancillary systems and equipment include the following:

- Aeration Control Systems
- Blowers

These ancillary systems and equipment as well as the new facilities that are required to employ them are described below.

Aeration Control Systems. In order to control the amount of air that is provided to the aerobic stages of the aeration tanks, an aeration control system is recommended. These systems are intended to indirectly match the oxygen demand in the aeration tank mixed liquor in the each of the different aerobic zones based on the varying carbon oxidation and nitrification requirements of the WWTF influent and the plant recycle streams. Aeration system control alternatives evaluated can be classified into two categories as follows:

- Dissolved Oxygen (DO) Control System
- Ammonia Control Systems

A description of the systems, their components, control approach and advantages and disadvantages are described below.

Direct Feedback Dissolved Oxygen Control System. In a DO control system the aeration system output is adjusted by the measured DO in the aeration tanks to increase or decrease the air supplied to match a target DO set point. In this case, the measured DO controls the aeration output as a "direct feedback" to the control system.

The control of this system would be provided by a dedicated control panel or through a central WWTF supervisory control and data acquisition (SCADA) system. DO probes would be installed in a number of the aerobic aeration basins (number to be determined during design) to measure the DO concentration of the mixed liquor. These measurements would be provided to the control system. The DO control system would adjust the motor operated valves on the feed piping to the diffusers or sparger rings on the invent mixer/aerator to match a control system DO set point. As a result of these the DO control system valve adjustments, the aeration system (piping, etc.) pressure will change. The system pressure would be controlled independently of the DO control system by the blower control system. The blower control system will maintain a system pressure set point by adjusting the number of on-line blowers and individual blower outputs. The set points for DO as well as system pressure would be operator adjustable.

The advantages of these systems include their simplicity; the need for a single type of field instrument (DO probe) and the fact that they are the most commonly used type of aeration control systems at WWTFs.

The disadvantages of these system include that may not be the most energy efficient systems for aeration control due to the fact that the system cannot respond quickly to changes in influent pollutant loading concentration (ex. ammonia) or prevent over aeration to meet a target in tank pollutant loading concentration (ex. ammonia) to ensure complete pollutant removal (ex. nitrification).

Ammonia (NH_3) Control System. In an ammonia control system the aeration system output is adjusted by the ammonia measured in the aeration tanks and can directly or indirectly increase or decrease the air supplied to match a target ammonia set point. These systems can be configured in multiple configurations:

- Direct Feedback Ammonia Control
- Direct Feedback Ammonia and DO Cascade Control
- Feed Forward Ammonia Control

A brief summary of each configuration is provided below.

Direct Feedback Ammonia Control. In a direct feedback ammonia control system, a number of ammonia analyzers are installed in the aeration tanks (number to be determined during design) to measure the ammonia concentration of the mixed liquor. These measurements would be provided to the control system. Similar to the DO control system, the ammonia control system would adjust the motor operated valves on the feed piping to the aeration system to match a control system ammonia set point. Again similar to the DO control system the system pressure would be controlled independently by the blower control system to maintain system pressure.

The advantages of this type of system are their simplicity and the need for a single type of field instrument (NH_4 probe). In addition the system has the potential to reduce energy use since it can respond quickly to changes in ammonia concentration and prevent over aeration to meet a target in tank ammonia concentration while still ensuring complete nitrification

The disadvantages of this type of system are a slightly higher cost and the fact that this type of system is infrequently used at WWTFs. In addition, since the DO is not monitored or controlled, the system operation can cause DO levels to be higher or lower than desired. Preventing higher than desired DO concentration is important for processes trying to remove total nitrogen to prevent carry over of high DO concentrations from the aerobic zones which will negatively impact the denitrification in the downstream anoxic zones.

Direct Feedback Ammonia and DO Cascade Control. In a direct feedback ammonia and DO cascade control system, both ammonia and DO probes are installed in the process tanks and monitored by the control system. The measured ammonia is compared to the ammonia set point and calculates a DO set point which is transmitted to the DO controller. The DO controller then compares the measured DO with the calculated DO set point and then calculates the required air flow and transmits that signal to the air flow controller.

The advantages of this type of system are that the system can respond quickly to changes in ammonia concentration. This system can also prevent over aeration to meet a target in tank ammonia concentration while still ensuring complete nitrification, prevent the issue with higher or lower than desired DO concentration, and has the potential to reduce energy use.

The disadvantages of this type of system are higher costs due to the need to install both DO and ammonia probes in the tanks and the fact that this type of system in infrequently used at WWTFs.

In addition, there is a high level of complexity in tuning and operating the ammonia and DO controllers as they have a tendency to have issues with control as the ammonia concentration and DO concentrations change at different rates in the aeration tanks.

Feed Forward Ammonia Control. In a feed forward ammonia control system the aeration control is based on the upstream ammonia concentration. An ammonia probe (and sometimes a COD probe) is used to measure the ammonia concentration and transmit it to a controller. This concentration along with other measured parameters (COD, flow, etc.) is input into a model to predict the aeration rate and control the aeration output of the system. The ability to reduce energy costs is only as good as the predictive model being used. The installation of DO probes in the aeration tanks is often suggested for monitoring and feedback from an effluent ammonia sensor is also recommended to correct for errors in the model.

The advantages of this type of system are that the system can respond quickly to changes in ammonia concentration. This system can also prevent over aeration to meet a target in tank ammonia concentration while still ensuring complete nitrification, prevent the issue with higher or lower than desired DO concentration, and has the potential to reduce energy use.

The disadvantages of this type of system are higher costs due to the need to install a number of different types of field instruments and the fact that this type of system in infrequently used at WWTFs. In addition, this system requires the development and adjustment of a predictive aeration model to operate the system.

Blowers. Blowers are required to provide compressed air to the fine bubble diffusers or the mixer/aerators. Due to significant differences in the sidewater depth of these tanks it is recommended that five blowers be provided to serve both sets of aeration tanks, with two larger blowers dedicated to the 1968 tanks and two smaller blowers dedicated to the 1990 tanks. A fifth blower would be provided as a "swing" blower that can be used to feed either set of tanks. The swing blower would be sized to match the larger blowers. All blowers would be housed in a new common Blower Building at the location of the existing Sludge Storage Tank No. 1. See **Figure 7-22** for a site layout of the proposed Blower Building.

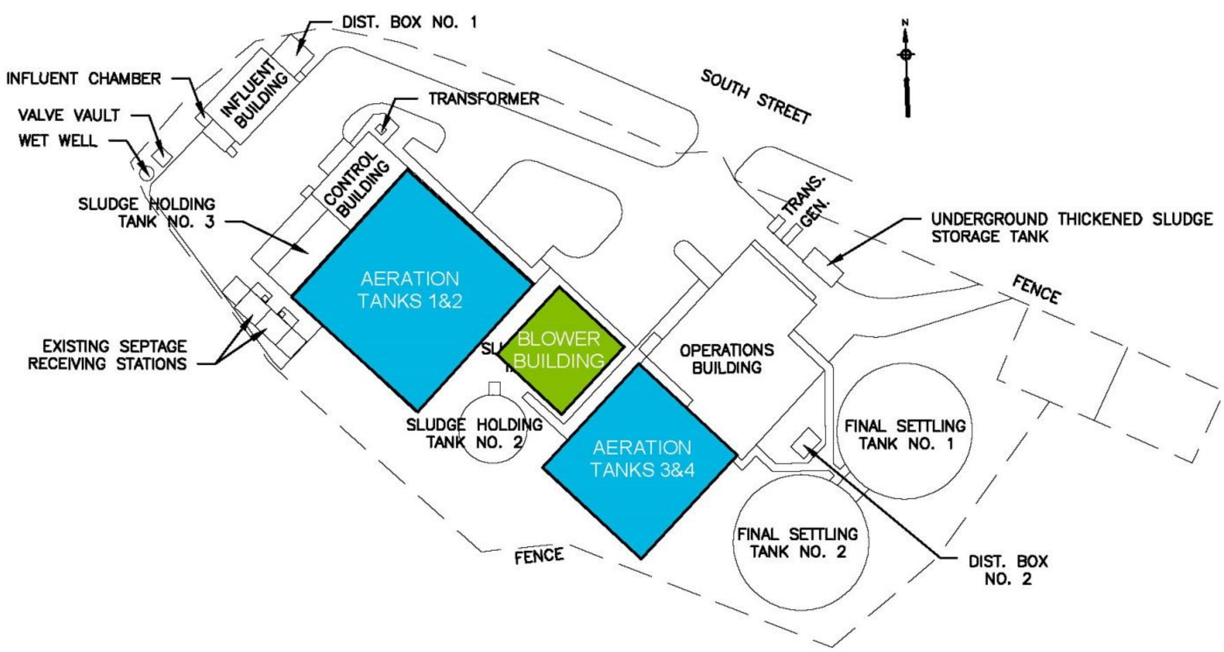


FIGURE 7-22. PROPOSED BLOWER BUILDING SITE LOCATION

Blower Technologies. Two types of blower technologies were considered for the aeration systems at the South Street WWTF which are as follows:

- Positive displacement (PD) blowers
- Hybrid blowers.

The following is a description of these blower technologies, their energy efficiencies, and the recommended blower technology for the South Street WWTF.

Positive Displacement Blowers. Positive displacement blowers (or rotary lobe blowers) have been used for wastewater applications since the 1960s and have been known to perform well over changing operating conditions. These blowers cause movement of air by trapping a fixed volume of influent air, then displacing that volume through the blower discharge. The blower consists of two rotors rotating in opposite directions in order to draw air into the blower and discharge pressurized air into the system. This type of blower is a proven technology in wastewater treatment and has the lowest capital cost, but is not as energy efficient as newer technologies, such as the hybrid blower described below. PD blowers can be controlled using variable frequency drives (VFDs) to provide excellent turndown ratios as wastewater flows and pollutant loads fluctuate. While the units provide for high turndown ratios, the decreased rotor speed also significantly reduces energy efficiency.

Hybrid Blowers. Hybrid blowers (or rotary lobe compressors) are a relatively recent advance in blower technology that provides energy efficiency comparable to turbo blowers with the flexibility of PD technology. These blowers use a low pressure screw rotor to move air. These blowers offer similar turndown capability to PD blowers, while using up to 30% less energy than PD blowers. In addition, energy savings are realized across the full range of air flows. Limitations for hybrid type blowers include a higher capital cost and a lower efficiency than PD blowers at very low pressures. It is assumed that the hybrid style blower can provide an additional 10-15 percent efficiency savings over the range of anticipated operating conditions. Based on the additional anticipated efficiency, the capital cost for the hybrid blowers may be recovered in approximately 7-9 years due to operational savings.

SOLIDS HANDLING

Introduction

The solids handling processes currently used at the South Street WWTF include the following:

- Gravity belt thickening of WAS directly from the Final Settling Tanks
- Storage of thickened WAS in the below grade thickened sludge storage tank
- Hauling and disposal of thickened WAS

The South Street WWTF currently processes solids directly from the final settling tanks and employs the thickening portion only of a dual zone belt filter press, which is capable of both gravity belt thickening and dewatering. There are three waste sludge holding tanks on site that are currently unused due to odor and freezing issues in the years after their initial installation. The solids in the sand filter backwash are discharged to the recycle wet well in the Operations Building and is conveyed back to the head of the WWTF. The existing solids handling processes and the condition of the associated equipment and systems are described in Chapter Five.

The WWTF staff identified a number of operational issues and desired evaluations associated with the solids handing processes. These include:

- The desire to have flexibility to either thicken or dewater WWTF solids to allow them to react to future disposal cost market conditions.
- The need for new garage and workshop space should the existing truckway in the Operations Building be occupied by dewatered cake storage.
- The need for improved waste sludge storage as the only usable storage is in the Final Settling Tanks.
- The desire to limit dewatering options for 5 hours per day, for a total of 30 hours a week.
- The need for additional thickened sludge storage as the existing storage has limited WWTF operations, and flexibility during holiday weekends or when off site trucking is unavailable for a day.

This section will describe alternatives to address the operational issues associated with the current solids handling processes, the method used to identify and screen various solids handling process alternatives to address the operational issues, and the evaluation of solids handling upgrade alternatives.

Approach

A preliminary identification of alternatives was conducted to address the WWTF operational issues associated with solids handling noted above. The solids handing unit process were broken down into major categories for evaluation which include:

- WAS Storage Alternatives
- Mechanical Sludge Thickening Only Alternatives
- Mechanical Sludge Thickening and Dewatering Alternatives
- Mechanical Sludge Dewatering Only Alternatives

Alternatives for each solids handling unit process category were then developed and evaluated. These solids handling alternatives were evaluated to account for varying liquid treatment process alternatives, specifically the type of phosphorous removal employed in the secondary treatment process. For example the analysis varied the quantity of sludge being processed, with additional sludge being processed for chemical phosphorus removal (due to the additional solids generated) versus biological phosphorus removal. In addition the type of phosphorus removal (biological or chemical) in the secondary treatment process also impacted the suitability of the solid handling process alternatives. As an example, biological phosphorous removal processes require the aerobic condition for solids handling. Biological phosphorous removal sludge that is not aerated will release phosphorous into the WWTF recycle stream. This phosphorous would then be returned to the head of the plant and will significantly reduce the removal of phosphorus in the solids processing, while increasing the influent phosphorus loading. For the evaluation, an aerated sludge storage tank was required for secondary processes for all biological phosphorus removal alternatives. On the other hand, a gravity thickener was assumed for secondary processes that used chemical phosphorus removal.

The section below will provide descriptions of the alternatives identified and evaluated for each of solids handling categories noted above include summaries of the advantages and disadvantages of the process alternatives. Following that, combinations of waste sludge storage alternatives and mechanical thickening and dewatering alternatives for both chemical and biological removal secondary processes will be presented and evaluated including their estimated costs

Waste Sludge Storage Alternatives

The two waste sludge storage alternatives that were evaluated were:

- Aerated Sludge Storage
- Gravity Thickener (for thickening and storage)

In both alternatives, the existing Sludge Holding Tank No. 2 would be used and converted to either an upgraded aerated sludge storage tank or to a gravity thickener. The original 1968 settling tanks were converted to aerated sludge storage holding tanks during the 1990 WWTF upgrade and expansion. These tanks were configured to draw air from the existing blowers in the Operations Building and were provided with existing air piping connected to each tank. The reuse of Sludge Holding Tank No. 2 as either an aerated sludge storage tank or a gravity thickener will allow for the beneficial reuse of this tank as well as some of the existing interconnecting aeration and sludge piping to the operations building.

Aerated Sludge Storage. As discussed above, aerated sludge storage will be required for solids processing if biological phosphorous removal is used. To provide an aerated sludge storage tank, Sludge Holding Tank No. 2 would be provided with the following:

- Aluminum Cover system
- Odor Control system
- New Aeration Diffusers
- New Aeration Blowers (either dedicated or in conjunction with new aeration tank blowers)

Gravity Thickener. The use of a gravity thickener for WAS storage would be expected to provide a thickened sludge concentration between 2-3%. This concentration is significantly less than other mechanical thickening processes (discussed in this section below). As a result, subsequent sludge mechanical thickening/dewatering would be required. Conventional gravity thickeners consist of a circular concrete tank with sloped bottom and rotating scraper (similar in design to a circular sedimentation tank) and are a common sludge thickening method. Sludge is fed into a center feed well and is allowed to settle and compact. The rotating truss mechanism creates thickening channels in the sludge, allowing water to escape via the gravity overflow. To provide a gravity thickener, existing Sludge Holding Tank No. 2 would be provided with the following:

- Gravity Thickener Mechanism
- Dilution Water Pumps (for sludge freshening)
- Odor Control system
- Dome Cover
- Gas Monitoring

Waste Sludge Storage Comparison. A summary of the advantages and disadvantages of the aerated sludge storage and gravity thickener alternative to provide storage of waste sludge at the WWTF are presented in **Table 7-8**.

Mechanical Sludge Thickening Only Alternatives

Only one alternative for sludge thickening only was identified and evaluated. This alternative was as follows:

- Rotary Drum Thickener

This alternative is described below:

Rotary Drum Thickener. The rotary drum thickener (RDT) also called a rotary screen thickener, consists of a flocculation tank, and the drum area, consisting of internal rotating cylindrical screens, and an internal rotating screw for conveying thickened sludge out of the drum. The feed WAS is dosed with polymer, is conditioned in a flocculation tank, and then enters the drum. The water (or filtrate) removed from the sludge in the RDT unit is drained through the openings in the rotating drum screen and conveyed to an underdrain for recycling back to the head of the WWTF. At the South Street WWTF, the filtrate would be

TABLE 7-8. WASTE SLUDGE STORAGE ALTERNATIVES ADVANTAGES AND DISADVANTAGES

Technology	Advantages	Disadvantages
Aerated Sludge Storage	• Existing sludge storage tanks already set up for aerated sludge holding (replace blowers and diffusers) • Aeration provides "freshening" of sludge which will reduce odors	• Does not provide any thickening • Higher energy usage
Gravity Thickener	• Provides pre-thickening while providing storage • Only mechanical equipment is required (beneficial use of old storage tank)	• Requires additional electrical equipment and modifications for drive units • May require dilution water to reduce septicity (additional plant recycle)

conveyed to the recycle wet well in the Operations Building. The thickened sludge would be conveyed to thickened sludge storage. Some RDT configurations have inclined drums to facilitate the thickening process while others have drums in the horizontal orientation.

RDTs can achieve thickened solids concentrations between 4 and 9 percent. The RDT performance is polymer and feed solids concentration dependent. For the purposes of the Facilities Plan evaluation, a dosage of 10 lbs/ton with liquid polymer has been assumed. Field jar testing is recommended to determine the effectiveness and dosage of various polymer types. The selection of a liquid or dry polymer feed system should be evaluated in more detail during design. Components and ancillary systems that would be required for an RDT installation at South Street include:

- Rotary drum thickener
- Flocculation tank
- Polymer blend and feed system

A process schematic and some photographs of typical RDT installations are depicted in **Figure 7-23.**

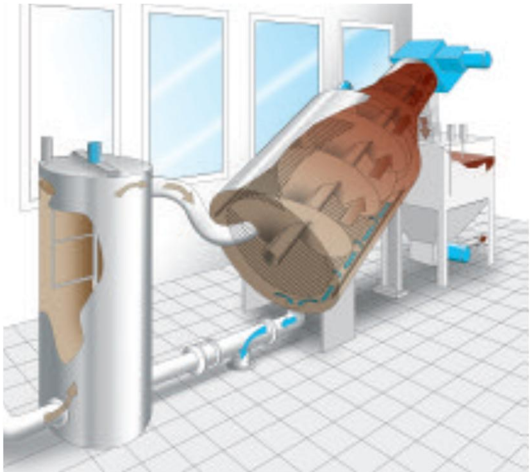
At the South Street WWTF, a single RDT would be provided and located in the existing Belt Press Room. The RDT installation could be constructed with the existing GBT/BFP in the room, allowing solids processing to continue during construction. This alternative would also allow for use of the existing GBT/BFP as a back up to the RDT if needed. Odor control would be provided to the room to improve the environmental condition and to help address potential odor issues.

Mechanical Sludge Thickening and Dewatering Alternatives

Two alternatives that have the ability to both thicken and dewater sludge were identified and evaluated. These alternatives are as follows:

- Gravity Belt Thickener/Belt Filter Press
- Centrifuge

These alternatives are described below.



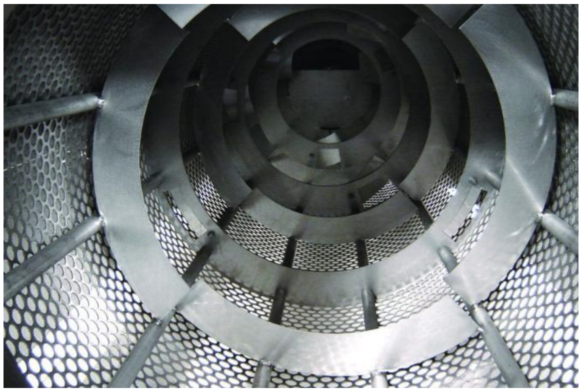


FIGURE 7-23 ROTARY DRUM THICKENER PROCESS SCHEMATIC AND PHOTOGRAPHS

Gravity Belt Thickener/Belt Filter Press. Gravity belt thickeners (GBT) and belt filter presses (BFP) can be individual mechanical sludge thickening and dewatering technologies or as in the case of the existing unit at South Street, these technologies can be combined into a single machine (GBT/BFP) to provide thickening or dewatering. The plant currently uses a single 1.0 meter GBT/BFP for sludge processing. The existing GBT/BFP is only run to thicken sludge in the gravity zone as the facility hauls liquid sludge as opposed to dewatering.

Gravity belt thickeners/belt filter presses are a continuously fed solids thickening and dewatering device that use the principals of chemical conditioning, gravity drainage, and mechanically applied pressure to thicken and dewater sludge, respectively. A GBT/BFP machine can be divided into three zones:

- Gravity zone, where free water is drained by gravity through a porous belt.
- Low pressure (Wedge) zone, where the solids are prepared for pressure application.
- High pressure zone, where increasing pressure is applied to the conditioned solids as it moves through a series of rollers.

The gravity zone of the unit consists of a belt driven by a variable speed motor over rollers. The sludge is furrowed by a number of plow blades and rakes that create channels allowing for the water (filtrate) to escape. In the low pressure zone, solids are discharged from the gravity deck onto a lower belt that begins to compress solids between the gravity deck, removing additional water. In the high pressure zone, mechanical pressure is applied to sludge sandwiched between two tensioned belts, by passing those belts through varying diameter rollers. Thickened sludge leaving the gravity zone is approximately 5-6% solids and requires the use of approximately 8-10 lb./ton dry solids of polymer. Dewatered sludge leaving the dewatering zone is approximately 16-18% solids and requires approximately 8-10 lb//ton dry solids of polymer. **Figure 7-24** shows a process schematic of a conventional gravity belt thickener / belt filter press.

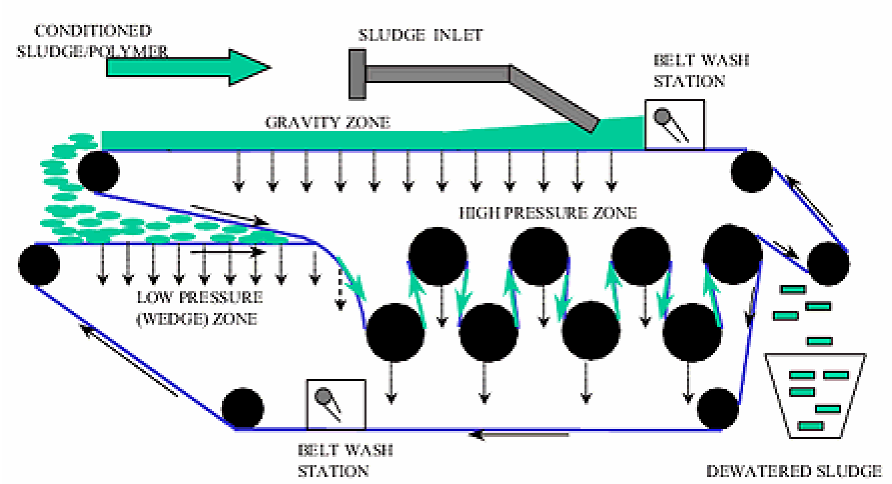


FIGURE 7-24. GRAVITY BELT THICKENER / BELT FILTER PRESS SCHEMATIC

Components and ancillary systems that would be required for a GBT/BFP installation at South Street include:

- GBT/BFP
- Polymer blend and feed system
- Washwater pumps
- Garage for sludge cake containers/truck (for dewatering alternative)

At the South Street WWTF, a single new GBT/BFP would be located in the existing Belt Filter Press room on the second floor of the Operations Building. Filtrate would be discharged to the recycle wet well in the Operations Building. The room would be upgraded with odor control and additional ventilation to improve the environmental conditions and to help address potential odor issues. It should also be noted that the existing belt filter press would need to be dismantled prior to installation of the new belt filter press as currently available units are larger than the existing and would not fit in the room without the removal of the old unit. The demolition of the existing GBT/BFP prior to its replacement would require the hauling of unthickened liquid sludge or provision for temporary thickening during the construction period.

Centrifuge. Centrifuges can be used for either sludge thickening or sludge thickening and dewatering. A solid-bowl centrifuge is commonly used for sludge thickening or thickening and dewatering which consists of a long bowl that is mounted horizontally and tapered at one end. The feed sludge is conditioned with polymer prior to being introduced into the unit. Typical polymer usage for the centrifuge is 15-30 lb./ton dry solids. Feed sludge is introduced continuously into the unit's spinning bowl and the solids concentrate along the perimeter of the spinning bowl. The water removed from the sludge (centrate) exits the spinning bowl and is conveyed to plant recycle stream. At the South Street WWTF, the centrate would discharge to the recycle wet well in the Operations Building. An internal helical scroll, spinning at a slightly different speed than the bowl, moves the accumulated sludge toward the tapered end of the centrifuge unit. In this tapered area additional solids concentration occurs as the solids back up behind the lip at the discharge end of the unit. The conical-shaped bowl helps lift solids out of the liquid allowing them to dry on an inclined surface before being discharged. The thickened or dewatered sludge is discharged through a chute located at the bottom of the unit. Typical solids concentration of centrifuge thickened sludge is approximately 6% solids, while centrifuge dewatered sludge concentrations are approximately 16-25% solids. The thickened or dewatered sludge would then be conveyed to thickened sludge storage or dewatered sludge storage.

Components of a centrifuge installation at South Street would include:

- Centrifuge
- Polymer blend and feed system
- Garage (for dewatering alternative)

Figure 7-25 presents an installation photograph and a process schematic of the sludge thickening and dewatering centrifuge.

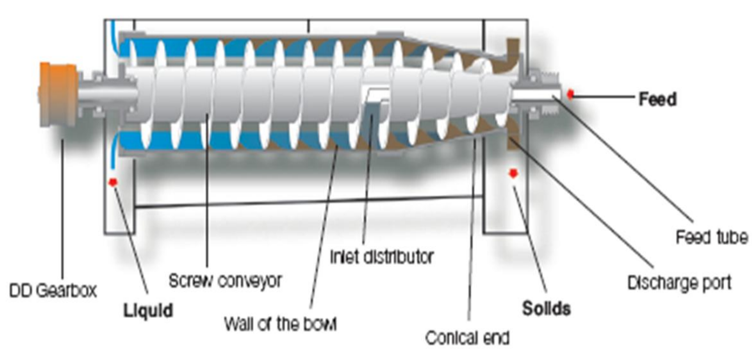


FIGURE 7-25. THICKENING AND DEWATERING CENTRIFUGE INSTALLATION PHOTO AND PROCESS SCHEMATIC

At the South Street WWTF, a single centrifuge would be installed in the Belt Filter Press Room on the second floor of the Operations Building. The installation of a centrifuge could be constructed with the existing GBT/BFP in the room, allowing solids processing to continue during construction. This alternative would also allow for use of the existing GBT/BFP as a back up to the centrifuge if needed. The room would be upgraded with odor control and additional ventilation to improve the environmental conditions and to help address potential odor issues.

Mechanical Sludge Dewatering Only Alternatives

A single alternative for sludge dewatering only was identified and evaluated. This alternative was as follows:

- Rotary Press

This alternative is described below:

Rotary Press. A rotary press is a slow speed enclosed unit with a steel housing that operates with stainless steel channels that rotate at slow speed. The sludge feed is treated with a polymer injected upstream of the rotary press unit in a flocculator with a mechanical mixer. Flocculated sludge is then fed into a rectangular channel of the press and rotates between two parallel revolving stainless steel screens. The sludge is dewatered as it advances within the channel and removed water (filtrate) passes through the screens. At the South Street WWTF, the filtrate would be conveyed to the recycle wet well in the Operations Building. The frictional force of the slow moving screens and an actively controlled outlet restriction help dewater the sludge before extrusion from the machine to dewatered sludge storage. Each channel is cleaned-in-place with spray water valves.

The South Street facility does not utilize primary clarifiers, and only dewaters waste activated sludge. While the manufacturers state that the rotary press is capable of dewatering pure waste activated sludge, experience has shown that this process functions better when blended or pre-thickened sludges are dewatered. For the purposes of this evaluation, it is assumed that this technology is only applicable if the feed sludge has been pre-thickened in a gravity thickener. Typical solids concentrations for dewatered WAS is approximately 13-18%, with polymer consumption of approximately 20-35 lb./ton dry solids. Components and ancillary systems that would be required for a rotary press installation at South Street include:

- Rotary Press
- Polymer blend and feed system
- Flocculation tank
- Air compressor
- Garage for sludge cake containers/truck

Figure 7-26 presents a typical installation photo and process schematic of a rotary press.

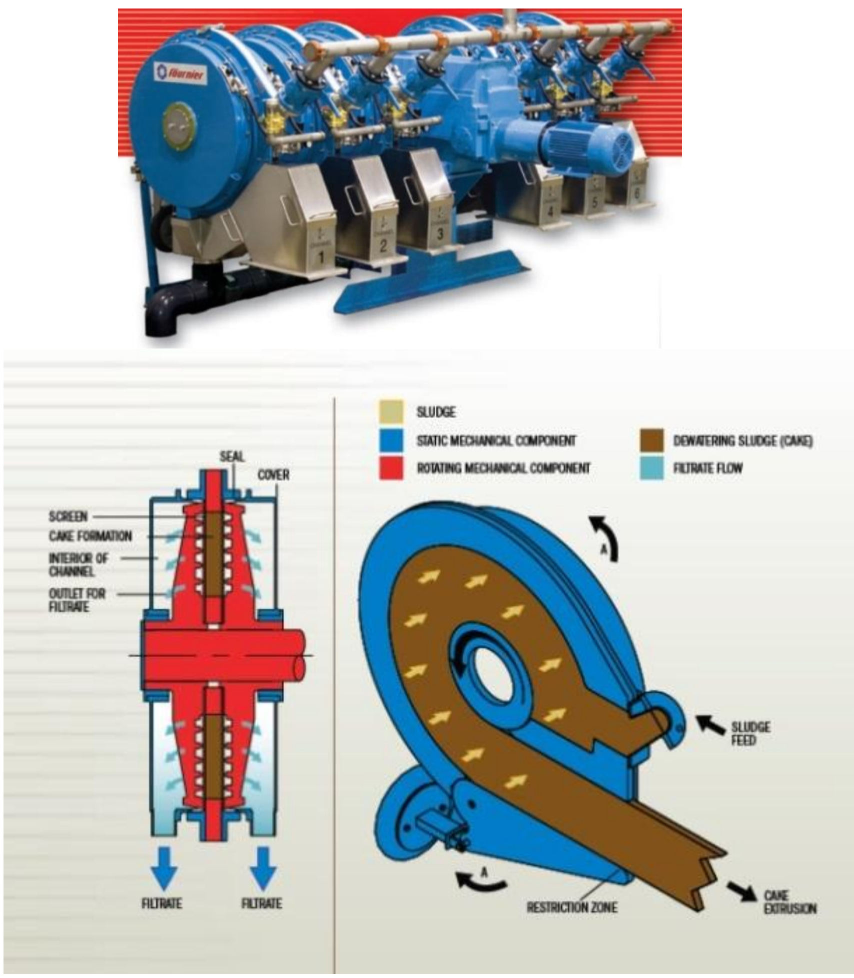


FIGURE 7-26. ROTARY PRESS INSTALLATION PHOTO AND PROCESS SCHEMATIC

At the South Street WWTF, a single four (4) channel rotary press would be installed in the Belt Filter Press Room on the second floor of the Operations Building. The installation of a rotary press could be constructed with the existing GBT/BFP in the room, allowing solids processing to continue during construction. This alternative would also allow for use of the existing GBT/BFP as a back up to the centrifuge if needed. The room would be upgraded with odor control and additional ventilation to improve the environmental conditions and to help address potential odor issues

Mechanical Sludge Thickening and Dewatering Comparison

Summaries of the advantages and disadvantages of the different mechanical sludge thinning and dewatering technology alternatives are presented below as is relates to the South Street WWTF. The summaries are divided into two categories. **Table 7- 9** presents the advantages and disadvantages of the mechanical sludge thickening technology alternatives and **Table 7- 10** presents the advantages and disadvantages of the mechanical sludge dewatering technology alternatives.

Combined Solids Handling Alternatives

A noted previously in this section, combinations of waste sludge storage alternatives and mechanical thickening and dewatering alternatives for both chemical and biological removal secondary processes were evaluated. This section will described these combined alternatives and present their estimated costs.

For the purposes of evaluation and presenting the combined alternatives, two categories of combined solids handling alteratives developed based on the type of phosphorus removal that is employed in the WWTF's secondary liquid processes. The two solids handling process categories are as follows:

- Solids Handling Alternatives with Chemical Phosphorus Removal Liquid Processes
- Solids Handling Alternatives with Biological Phosphorus Removal Liquid Processes

The solids handling process categories were looked at separately to account for differences in the sludge quantity generated by the WWTF's secondary liquid process and the need to keep biological phosphorus removal sludges aerobic. These differences include the following:

- Waste Sludge Quantity. For the purposes of the evaluation it was assumed that the quantity of waste sludge generated for the chemical phosphorus alternative is 15% greater than the quantity waste sludge generated for the biological phosphorus removal alternatives.

- Waste Sludge Storage Alternative. For each solids handling process category the existing sludge Holding Tank No. 2 will be modified. For the chemical phosphorus removal alternatives it is assumed that the existing tank will be converted into a gravity thickener. For the biological phosphorus removal alternatives it is assumed that the existing tank will be rehabilitated into a new aerated waste sludge storage tank.

The combined alternatives for waste sludge storage, thickening and dewatering alternatives are presented in **Figure 7-27** through **Figure 7-30**. **Figure 7-27** and **Figure 7-28** present the thickening and dewatering alternatives for chemical phosphorous removal processes respectively, while **Figure 7-29** and **Figure 7-30** present waste sludge storage, thickening and dewatering alternatives for biological removal processes, respectively. These alternatives are presented below.

TABLE 7-9. MECHANICAL SLUDGE THICKENING ALTERNATIVES ADVANTAGES AND DISADVANTAGES

Technology	Advantages	Disadvantages
Rotary Drum Thickener	• Lowest capital cost • Lowest operating cost • Enclosed process • Can help with odors • Improved operator safety • Can be run automated/unattended • Can be constructed while maintaining existing sludge processing	• Does not provide process flexibility for changes between thickening and dewatering • High polymer consumption
Gravity Belt Thickener / Belt Filter Press	• Process flexibility allows thickening or dewatering • Operator familiarity	• Odor concerns • Reduced operator safety • Operator intensive (no unattended operation) • Solids handling room will need modifications to fit new unit (larger footprint) • Highest polymer consumption • Cannot be constructed while maintaining operation of existing BFP • Highest operating cost • Highest capital cost
Centrifuge	• Process flexibility allows thickening or dewatering • Lowest polymer consumption • Can be constructed while maintaining existing sludge processing • Enclosed process • Can help with odors • Improved operator safety	• High capital cost • High operating cost • Processed sludge is typically more odorous than other mechanical thickening options • Bowl resurfacing performed offsite (no backup thickening unit)

TABLE 7-10. MECHANICAL SLUDGE DEWATERING ALTERNATIVES ADVANTAGES AND DISADVANTAGES

Technology	Advantages	Disadvantages
Gravity Belt Thickener / Belt Filter Press	• Process flexibility allows thickening or dewatering • Operator familiarity • Lowest polymer consumption	• Odor concerns • Reduced operator safety • Highest operating cost • Lowest cake concentration; higher disposal costs • Highest capital cost • Operator intensive (no unattended operation) • Solids handling room will need modifications to fit new unit (larger footprint) • Highest polymer consumption • Cannot be constructed while maintaining operation of existing BFP • Requires the construction of a new garage
Centrifuge	• Process flexibility allows thickening or dewatering • Enclosed process • Can help with odors • Improved operator safety • Highest cake concentration, lowest disposal costs • Average polymer consumption • Can be constructed while maintaining existing belt filter press operation	• High capital cost • High yearly O&M costs • Operator intensive (no unattended operation) • Processed sludge is typically more odorous than other mechanical dewatering options • Requires the construction of a new garage • Bowl resurfacing performed offsite (no backup dewatering unit)
Rotary Press	• Can be run automated/unattended • Enclosed process • Can help with odors • Improved operator safety • Slow speed, modular unit • Can be constructed while maintaining existing sludge processing • Low energy use	• High capital cost • Dewatering performance lower for WAS dewatering • Lower cake concentration, higher disposal costs • Highest polymer consumption • Requires the construction of a new garage

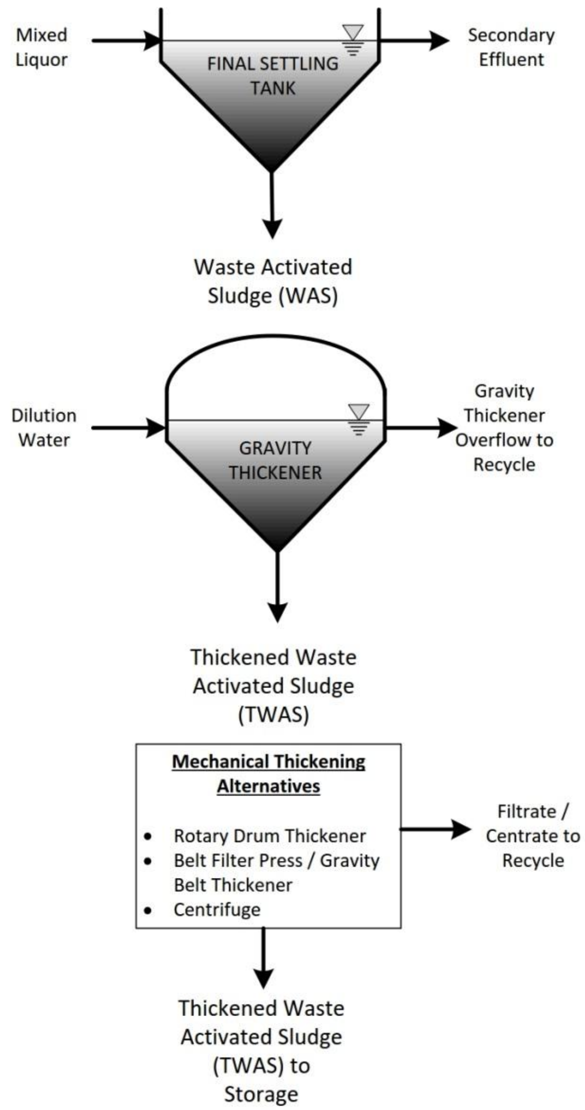


FIGURE 7-27. CHEMICAL PHOSPHORUS REMOVAL SLUDGE THICKENING SOLIDS HANDLING ALTERNATIVES

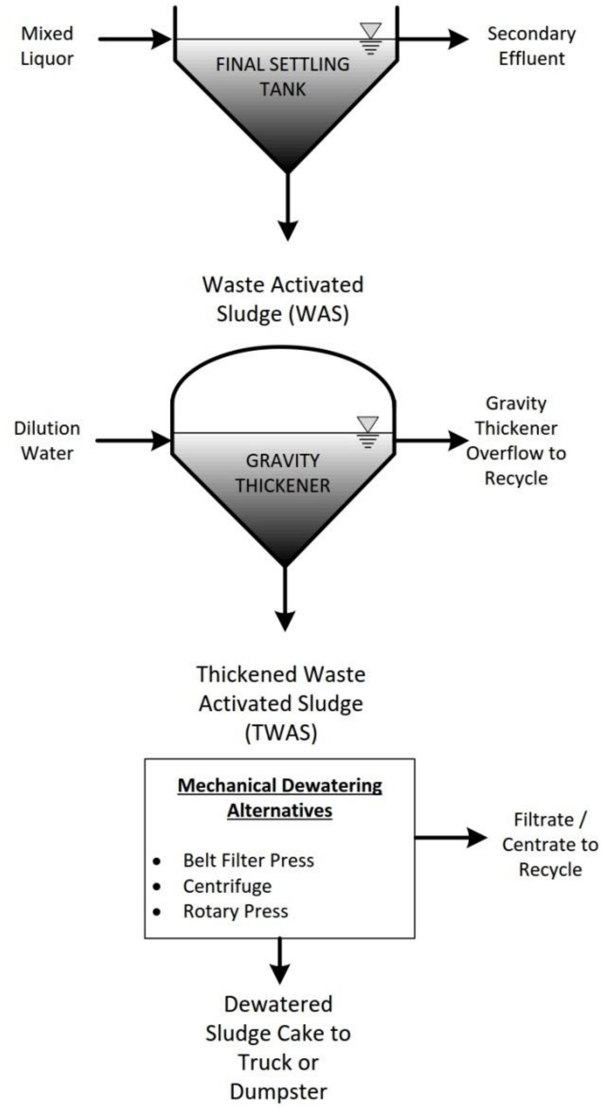


FIGURE 7-28. CHEMICAL PHOSPHORUS REMOVAL SLUDGE DEWATERING SOLIDS HANDLING ALTERNATIVES

Solids Handling Alternatives with Chemical Phosphorus Removal Estimated Costs. Estimated capital costs, operation and maintenance costs, and life cycle costs for the chemical phosphorus removal solids handing alternatives with thickening and dewatering are summarized in **Table 7-11.** The solids handling alternatives with chemical phosphorus removal are presented below and have been broken down into the sludge thickening alternatives as previously shown in **Figure 7-27** and the sludge dewatering alternatives as previously shown in **Figure 7-28.**

The estimated capital costs were based on the estimated construction costs which include material and installation costs of the gravity thickener for WAS sludge storage and thickening as well as the various applicable mechanical sludge thickening/dewatering alternatives and their required ancillary equipment/systems as previously described in this section. Dewatering alternatives also included the

TABLE 7-11. CHEMICAL PHOSPHOROUS REMOVAL COMBINED SLUDGE THICKENING AND DEWATERING ALTERNATIVES ESTIMATED COSTS

Alternative	Capital Cost ($)	20 Year Present Worth O&M Cost ($)	20 Year Life Total Present Worth Cost ($)
THICKENING			
Rotary Drum Thickener	$2,300,000	$1,900,000	**$4,200,000**
Gravity Belt Thickener / Belt Filter Press	$2,735,000	$3,100,000	**$5,835,000**
Centrifuge	$2,910,000	$2,400,000	**$5,310,000**
DEWATERING			
Gravity Belt Thickener / Belt Filter Press	$3,455,000	$3,300,000	**$6,755,000**
Centrifuge	$3,270,000	$2,400,000	**$5,670,000**
Rotary Press	$2,990,000	$2,300,000	**$5,290,000**

construction cost of a new garage and maintenance area. A design allowance as well as engineering and construction contingencies has been added to the base construction cost of each project element to provide a total estimated capital cost. Estimated O&M costs included costs for electrical use, chemicals, operation and maintenance labor, and annual parts replacement costs. See Chapter Four for more information on the basis of the cost estimates.

Solids Handling Alternatives with Biological Phosphorous Removal Estimated Costs. Estimated capital costs, operation and maintenance costs, and life cycle costs for the biological phosphorus removal solids handing alternatives with thickening and dewatering are summarized in **Table 7-12.** The solids handling alternatives with biological phosphorus removal are presented below and have been broken down into the sludge thickening alternatives as previously shown in **Figure 7-29** and the sludge dewatering alternatives as previously shown in **Figure 7-30.**

TABLE 7-12. BIOLOGICAL PHOSPHOROUS REMOVAL COMBINED SLUDGE HANDLING ALTERNATIVES ESTIMATED COSTS

Alternative	Capital Cost ($)	20 Year Present Worth O&M Cost ($)	20 Year Life Total Present Worth Cost ($)
THICKENING			
Rotary Drum Thickener	$2,160,000	$1,900,000	**$4,060,000**
Gravity Belt Thickener / Belt Filter Press	$2,770,000	$3,000,000	**$5,770,000**
Centrifuge	$2,035,000	$2,500,000	**$4,535,000**
DEWATERING			
Gravity Belt Thickener / Belt Filter Press	$3,315,000	$3,200,000	**$6,515,000**
Centrifuge	$3,130,000	$2,400,000	**$5,430,000**

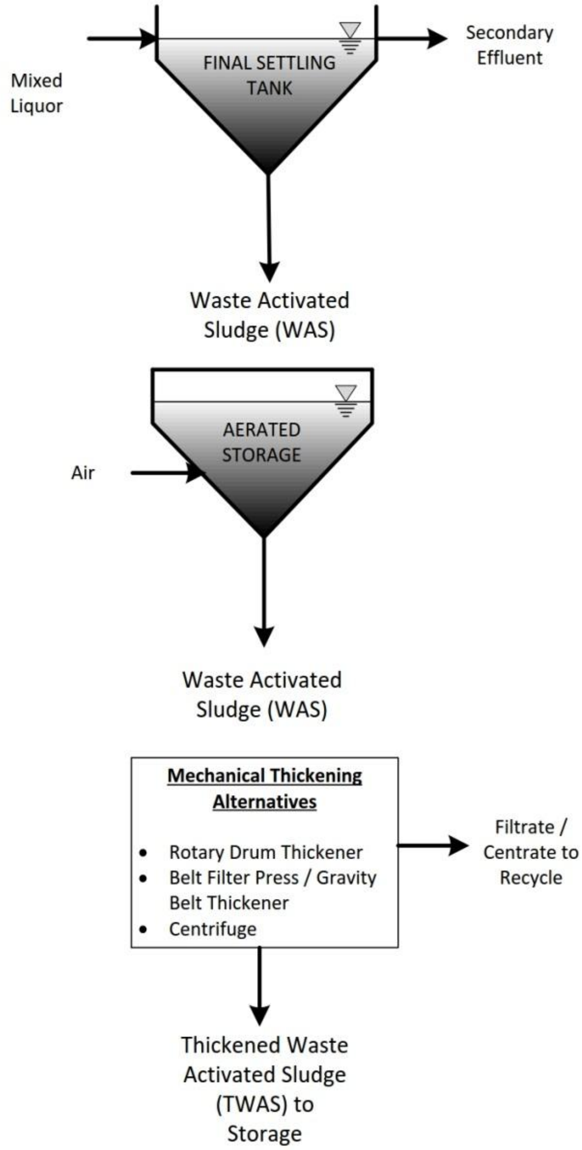


FIGURE 7-29. BIOLOGICAL PHOSPHORUS REMOVAL SLUDGE THICKENING SOLIDS HANDLING ALTERNATIVES

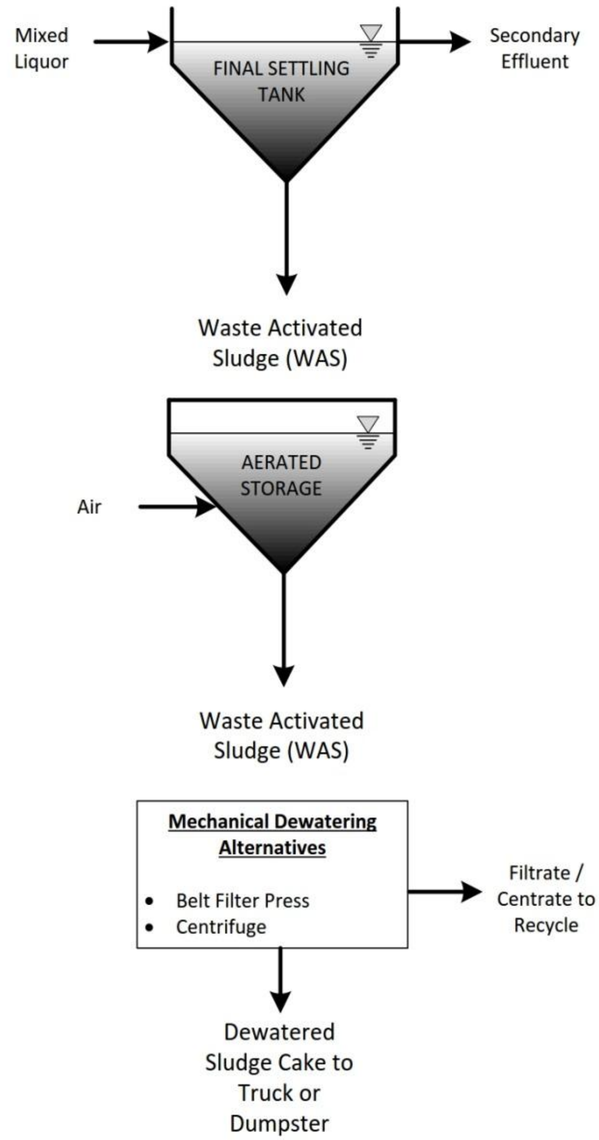


FIGURE 7-30. BIOLOGICAL PHOSPHORUS REMOVAL SLUDGE DEWATERING SOLIDS HANDLING ALTERNATIVES

The estimated capital costs were based on the estimated construction costs which include material and installation costs of the aerated sludge storage tank for WAS sludge storage as well as the various applicable mechanical sludge thickening/dewatering alternatives and their required ancillary equipment/systems as previously described in this section. Dewatering alternatives also included the construction cost of a new garage and maintenance area. A design allowance as well as engineering and construction contingencies has been added to the base construction cost of each project element to provide a total estimated capital cost. Estimated O&M costs included costs for electrical use, chemicals, operation and maintenance labor, and annual parts replacement costs. See Chapter Four for more information on the basis of the cost estimates.

CHAPTER EIGHT
ROUTE 7 WWTF UPGRADE RECOMMENDATIONS

In Chapter Five, the existing facilities at the Route 7 WWTF were evaluated. The facilities were evaluated to determine if they would be able to provide continued service through the Facilities Plan design year of 2035. As a result of these evaluations, a number of WWTF systems and unit process were identified as requiring upgrade and/or improvements. As appropriate, for some WWTF systems and unit processes, alternatives were developed and evaluated, as described in Chapter Six. These Route 7 WWTF systems and unit processes include the following:

- Liquid Processes including:
    - Influent Pumping
    - Preliminary Treatment
    - Primary Settling Tanks
    - Equalization Tank
    - Rotating Biological Contactors
    - Secondary Settling Tanks
    - Total Phosphorus Removal
    - UV Disinfection
    - Plant Water System
- Solids Handling including:
    - Primary and Secondary Sludge Pumping Systems
    - Sludge Storage and Hauling
- Ancillary Systems including
    - Control, Software, Instrumentation and Communication Systems
    - Electrical and Emergency Power Systems
    - Odor Control Systems
    - HVAC Systems
- Architectural and Structural Upgrades
    - Control Building Architectural Upgrades
    - Structural Upgrades
    - Hazardous Materials Removal and Remediation
- Energy Efficiency Upgrades
- Site Improvements
    - Site Security And Fencing
    - Paving
    - Potable Water Connection to Aquarion Water

This Chapter summarizes the recommended facilities upgrades and improvements for these systems and unit processes and provides estimated construction cost for the various project elements as well as a total estimated capital cost for the recommended upgrades. The major recommended facility plan upgrades are highlighted in **Figure 8-1.**

LIQUID PROCESS RECOMMENDATIONS

Influent Pumping

As noted in Chapter Five, the existing Route 7 Pump Station has reached the end of its service life and is recommended for replacement. Alternatives for replacement of the pump station were evaluated in Chapter Six. As a result of the evaluated alternatives, it is recommended that the pump station be replaced on the existing pump station site. The pump station will include a new wet well, new valve vault and three new pumps provided with variable frequency drives (two operational and one standby) to handle the design peak flow of 720,000 gpd. In addition, the existing standby emergency power system will be replaced. The existing ductile iron force main between the pump station and the Route 7 WWTF

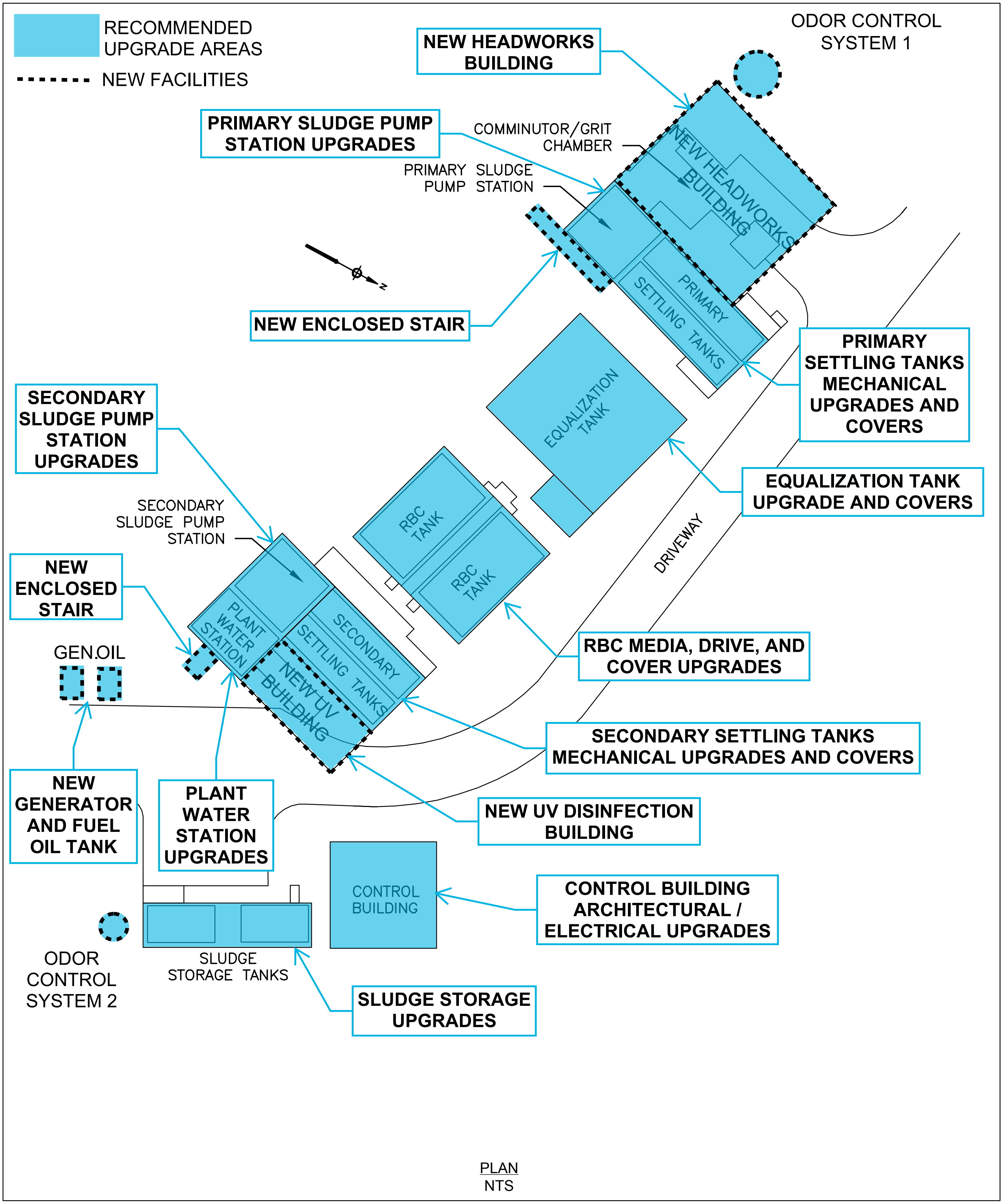


FIGURE 8-1
ROUTE 7 WWTF
RECOMMENDED UPGRADES
SITE LAYOUT

will be retained. The pump station will be provided with a flow meter on the discharge that will also be used for control of the equalization tank. The pump station level, pump status and flow meter will be connected to the WWTF SCADA system via a communications conduit to monitor and record system status and to provide alarm functionality.

Cost Summary. The estimated capital cost to replace the pump station at the existing site is $1,535,000. Note the cost to provide the communications conduit is included in the site improvement recommendations and the cost to provide the SCADA system is included in the instrumentation and control systems recommendations discussed later in this Chapter.

Preliminary Treatment

A number of preliminary treatment alternatives which included variations in influent screening and grit removal and their associated costs were described in Chapter Six. Based on an evaluation of those alternatives it is recommended that the new preliminary treatment upgrades at the WWTF include the following:

- A rotating fine channel screening system with an integral screenings washer and compactor and installed in a new channel adjacent to the existing headworks structure. Consideration should be given to providing a channel grinder upstream of the screen which will be evaluated during design.
- New grit removal equipment including a new grit screen, aeration diffuser and a new grit blower.
- The screening system and grit removal system will be enclosed within a new Headworks Building.
- The Headworks will also house new alum storage and feed systems, chemical containment and safety eyewash/shower systems for chemical phosphorus removal, and include dedicated electrical and mechanical spaces. The overall dimensions of the recommended Headworks Building are approximately 32 feet by 40 feet.
- The preliminary treatment (screening/grit removal) area of the Headwork Building is recommended to be ventilated to an exterior odor control system. The odor control systems for the Route 7 WWTF are discussed in more detail later in this Chapter.

Cost Summary. The estimated capital cost to upgrade the headworks facility, including the addition of a fine channel screen, grit removal upgrades and new building is $1,345,000. The costs associated with the chemical feed system and odor control are presented in other sections later in this Chapter.

Primary Settling Tanks

As described in Chapter Five, the existing primary settling tank equipment has reached the end of its service life and is recommended for replacement. This equipment includes the sludge collection mechanisms and drives, effluent launders, weir and scum collection equipment. It is also recommended that the primary settling tanks be provided with aluminum plate covers to address odors and wind-blown debris concerns. The covered tanks will have hydrogen sulfide resistant coating installed on the concrete walls to three feet below the water line to minimize corrosion of the interior concrete. The covered tanks are also recommended to be connected to an odor control system which is described later in this Chapter. Finally, to provide the DEEP required 0.25-foot of freeboard between the effluent weir and the water surface in the effluent trough under design peak flow conditions, it is recommended to increase the size of the effluent piping from six-inches to eight-inches.

Cost Summary. The estimated capital cost to upgrade the primary settling tanks is $415,000.

Equalization Tank

As described in Chapter Five, the existing equalization tank does not currently have flow equalization functionality and operates in a flow through mode. The existing blower and diffused air system have reached the end of their service life and are recommended for replacement.

The restoration of the equalization function through the use of a SCADA controlled electrically actuated flow control valve is recommended, including a redundant valve and improved access to the valves. This system will also require that the water level in the tank be monitored by the WWTF SCADA system. In addition, it is recommended that an aluminum plate cover be provided to contain odors and be connected to an odor control system. The odor control system is described later in this Chapter.

Cost Summary. The estimated capital cost for the upgrade of the equalization tank, including replacement of the positive displacement blower and diffusers, restoration of the equalization functionality with new flow control valves and SCADA control logic, and installation of a cover is $455,000.

Rotating Biological Contactors

As described in Chapter Five, the existing rotating biological contactors (RBC) have reached the end of their service life and are recommended for replacement. It is recommended that new media, drives, shafts and separate covers for both the media and drives be provided. It is also recommended to lower the RBC effluent weir to meet the DEEP required one foot of freeboard between the water surface and top of concrete.

Cost Summary. The estimated capital cost to upgrade the rotating biological contactors is $860,000.

Secondary Settling Tanks

As described in Chapter Five, the existing secondary settling tank equipment has reached the end of its service life and is recommended for replacement. This equipment includes the sludge collection mechanisms and drives, effluent launders, weir and scum collection equipment. To address the accumulation of wind-blown debris and leaves in the tanks, it is also recommended that an aluminum plate cover be provided over the secondary settling tanks. These tanks are not recommended to be connected to an odor control system. Finally, to provide the DEEP required 0.25-foot of freeboard between the effluent weir and the water surface in the effluent trough under design peak flow conditions, it is recommended to increase the size of the effluent piping from four-inches to six-inches.

Cost Summary. The estimated capital cost to upgrade the secondary settling tanks is $400,000.

Total Phosphorus Removal

To address the WWTF's new NPDES permit limit for total phosphorus, it is recommended that a chemical phosphorus removal process be employed. The recommended chemical phosphorus removal process would include a chemical storage and feed room located in the new Headworks Building. The system would include provision to store two-270 gallon totes of alum in the building with containment provisions. Redundant chemical metering pumps would also be provided as will safety eyewash and shower. Chemical dosing locations would be provided upstream of the primary settling tanks, as well as upstream of the secondary settling tanks. Yard piping between the Headworks Building and dosing locations would be provided. The recommended total phosphorus removal dosing locations are shown in **Figure 8-2.**

Cost Summary. The estimated capital cost to provide a chemical phosphorus removal system, including the chemical storage and feed equipment, safety eyewash and shower and chemical feed piping is $135,000. This does not include the cost of the building, which is included in the costs for the preliminary treatment.

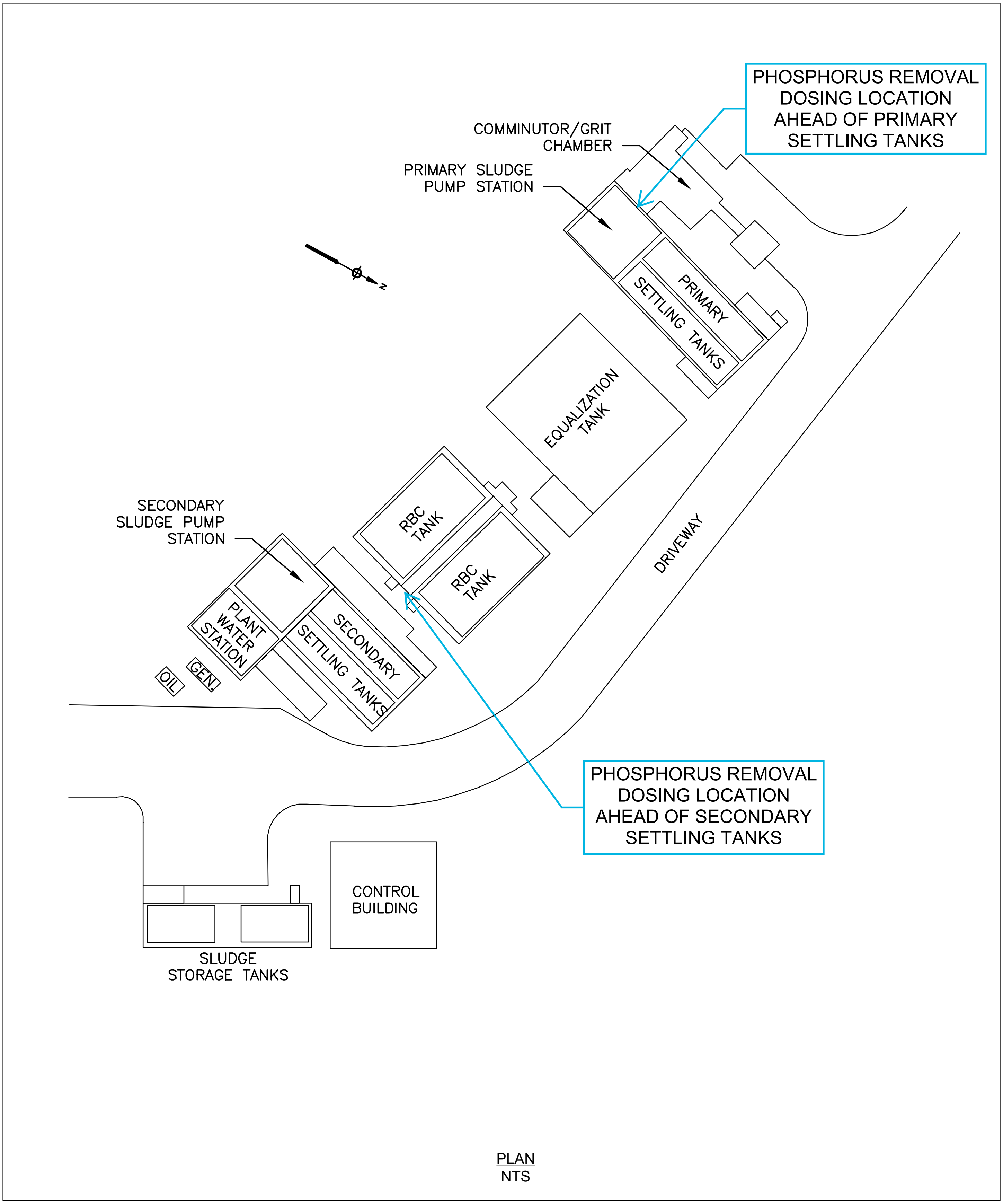


FIGURE 8-2
ROUTE 7 WWTF
RECOMMENDED TOTAL PHOSPHORUS
REMOVAL CHEMICAL DOSING LOCATIONS

UV Disinfection

As described in Chapter Five, the existing UV disinfection system has reached the end of its service life and spare parts are no longer available. A new UV disinfection system with two channels, each with a single bank of UV modules is recommended. To provide a dual channel UV system, the relocation of the UV disinfection system is required. A new UV Building is recommended to be constructed adjacent to the secondary settling tanks and the existing Plant Water Station/UV Disinfection Room. The UV system elevation and resulting hydraulic grade line through the UV system would be raised from the existing system. This higher HGL would allow for the reuse of the currently unused Plant Water Wet Well, described below. A UV intensity meter is recommended to be provided to aid in DEEP reporting, as well as a downstream flow meter for flow pacing of the UV system and other WWTF systems.

Cost Summary. The estimated capital cost to provide a new building and UV disinfection system is $420,000.

Plant Water System

As described in Chapter Six and above, the relocation of the UV disinfection system will allow for the currently unused Plant Water Wet Well to be reused as intended to provide effluent flushing water. Two new plant water pumps, one operational and one standby are recommended to be provided in the existing Plant Water Station/UV Room. Variable frequency drives are recommended to be provided on these pumps to accommodate the range of required plant water flows. The existing ultrasonic level element located in the Plant Water Wet Well would be removed and modifications to the wet well would be provided to allow for storage without impacting upstream processes. A new magnetic flow meter would be provided and located upstream of the Plant Water Station. It is also recommended to replace the existing plant water piping and yard hydrants as they are not currently in service and not expected to provide reliable service over the design period.

Cost Summary. The estimated capital cost to restore the plant water system and provide new room access due to the installation of the new adjacent UV Building is $195,000.

SOLIDS HANDLING PROCESS RECOMMENDATIONS

Primary and Secondary Sludge Pumping Systems

As described in Chapter Five, the existing sludge pumping station equipment has reached the end of its service life. The existing sludge pump stations are housed in below grade vaults that are classified as confined spaces and have poor access of only a ship’s ladder for access from the top slab. Four alternatives were presented in Chapter Six. As a result of the evaluation performed, it is recommended that new stair and access door alternative be implemented.

It is recommended that the primary sludge pump station would be accessed through a new stair running adjacent to the existing sludge pump station on the downhill side. The stair would be constructed of concrete and be enclosed within a pre-engineered metal building enclosure. The secondary sludge pump station would be accessed through the plant water station. A new stair and doorway is already recommended to be constructed for entrance into the plant water station as the existing stair and door would be demolished for the relocation of the UV system, as described earlier in this chapter. A new door would then be cut through the wall in the plant water station for entry into the secondary sludge pumping station. The pumps and valves would be controlled from a new control panel within each pump station.

Cost Summary. The estimated capital cost to upgrade the primary and secondary sludge pumping stations, including new access stairways and doors is $485,000.

Sludge Storage and Hauling

As noted in Chapter Five, the two existing sludge storage tanks are located adjacent to the Control Building. These tanks are located above grade, and have a staircase that provides access to the truck connection located on top of the structure. To improve operator safety and sludge removal operations, the installation of a truck connection located at grade to eliminate the need for carrying the hoses up the stairs and maneuvering around the railings is recommended. The inclusion of a sludge loading pump is also recommended to eliminate the need for a vacuum truck for sludge removal from the facility. The sludge loading pumps would be submersible solids handling chopper pumps located within each storage tank. A new discharge header would be provided that would connect to the new at grade truck connection. It is also recommended that instrumentation be provided to allow operators to monitor the level of the sludge holding tank at the pump stations. Finally, the existing sludge storage tanks are served by a diffused air mixing system, including diffusers and a positive displacement blower as well as a supernatant pump to send flow back to the headworks. These systems have reached the end of their service life and are recommended for replacement. It is also recommended that the existing storage tank covers be replaced and the tanks be provided with odor control.

Cost Summary. The estimated capital cost to upgrade the existing sludge storage tanks, including the cost for replacement covers, sludge loading pumps, supernatant pumps, interior tank coating, a new diffused air systems and blower and an at grade truck connection is $275,000. The cost for the recommended odor control system is described later in this Chapter.

ANCILLARY SYSTEMS RECOMMENDATIONS

In addition to the major system upgrades described above, several other ancillary systems and items have been evaluated for upgrade. These systems include the following:

- Control, Software, Instrumentation and Communication Systems
- Electrical and Emergency Power Systems
- Odor Control Systems
- HVAC Systems

Instrumentation and Control Systems

As described in Chapter Five, the WWTF has minimal instrumentation and control and is not currently served by an instrumentation and control system. Due to its age, the limited instrumentation at this facility is not expected to provide reliable service in the future and is recommended for replacement.

The installation of an instrumentation and control system is recommended for the facility. An industry standard supervisory control and data acquisition (SCADA) system is recommended. At a minimum this SCADA system should allow for monitoring and alarm functionality of the major WWTF systems and the Route 7 Pump Station with control provided to some specific equipment. A new telecommunication conduit would be provided from Route 7 to the WWTF in the same trench as the potable water connection described later in this Chapter. This conduit would also house wiring to connect the Route 7 Influent Pump Station to the WWTF SCADA system.

Monitoring recommendations include the following including the installation of field instrumentation as necessary:

- Route 7 Pump Station equipment status and run time and wet well levels
- Influent and effluent flow
- Status and run time for mechanical equipment
- Tank levels for the equalization tank, UV system, Plant Water Wet Well, sludge storage tank, and fuel oil storage

- Power status (utility vs. standby generator)
- UV disinfection system intensity
- Control Building temperature

Systems that are recommended to be provided with local and remote alarms include:

- Route 7 Pump Station equipment failure and high wet well levels
- Critical (high) tank levels in the equalization tank; sludge storage tanks, and UV system
- Safety alarms including (chemical feed eyewash/shower activation, headworks gas detection, operator emergency push buttons, fire alarms)
- Main power failure status (utility vs. standby generator)
- Building flood
- Low Control Building temperature

Systems that are recommended to be provided with SCADA system control include:

- Route 7 Pump Station operations
- Chemical dosing
- Equalization Tank operation
- UV disinfection flow pacing

Note the monitoring, alarm and control of the Route 7 Pump Station equipment/systems will require the installation of direct communication between the pump station and the Route 7 WWTF. This connection connectivity could be provided through a hard wired connection between the two facilities or through radio or cellular communication methods. These methods will be examined in more detail in design. For the purposes of the facility planning effort it is assumed that the connection is hard wired.

Cost Summary. The estimated capital cost for the implementation of the recommended plant SCADA system and field instrumentation is $510,000. As previously noted the cost to provide the communications conduit between the Route 7 Pump Station and the WWTF is including in the site improvement recommendations discussed later in this Chapter.

Electrical and Emergency Power Systems

As described in Chapter Five, the majority of the electrical systems and equipment are from the original WWTF construction 32 year ago. This equipment has reached the end of its service life and is recommended for full replacement. Also due to the relatively simple nature of the WWTF, a number of electrical systems typical for modern treatment facilities were not included in the original construction. As a result the following items are recommended for replacement to be included in an upgrade:

- Replace entire WWTF electrical distribution system
- Replace existing utility transformer.
- Installation of the following new or replacement systems:
    - Fire alarm system
    - Emergency and exit lights
    - Lightning protection system
    - Site security system
    - Power monitoring system
    - Standby generator and fuel oil storage tank
    - Interior and site lighting systems with energy efficient type lighting (LED)
- Performing electrical short circuit and coordination studies and providing all new electrical equipment with arc flash labels in accordance with the requirement of the NEC, NFPA-70E and IEEE 1584

Cost Summary. The estimated capital cost for the upgrade of the entire Route 7 WWTF electrical distribution and ancillary systems is $1,665,000.

Odor Control Systems

The inclusion of tank covers at various locations is recommended to reduce the escape of odors from the WWTF, especially with the potential for construction near the WWTF. Activated carbon adsorber systems are recommended to be used for odor control with multi speed odor control fans and ductwork conveying odorous air from the collection areas to the adsorbers.

Four WWTF areas are recommended to have conveyance and treatment of odorous air. These areas include:

- Screening and grit removal areas of new Headworks Building
- Primary Settling Tanks
- Equalization Tank
- Sludge Storage Tanks

To minimize the amount of conveyance ductwork and the number of odor control systems required, two systems are recommended. One system will be located at the top of the hill and serve the Headworks Building, Primary Settling Tanks and Equalization Tank. The second system will be at the bottom of the hill and serve the Sludge Storage Tanks. These systems are depicted on **Figure 8-3**.

Cost Summary. The estimated capital cost for the two odor control systems, including the carbon adsorbers, fans and conveyance ductwork is $300,000.

HVAC Systems

As noted in Chapter Five, all HVAC equipment was installed under the original 1984 construction contract and has reached the end of its service life. The equipment is recommended for replacement in order to serve the HVAC needs of the WWTF for the next 20 years. Energy efficient HVAC equipment is recommended when replacing equipment. The areas of the WWTF that require HVAC equipment upgrades include:

- Primary Sludge Pump Station
- Secondary Sludge Pump Station
- Plant Water Station
- Control Building

Cost Summary. The estimated capital cost for the replacement of existing HVAC equipment is $140,000. This cost includes the replacement of all existing equipment. The pricing for HVAC equipment for new structures, such as the Headworks Building and UV Building, is included in the cost of the building presented earlier in this Chapter.

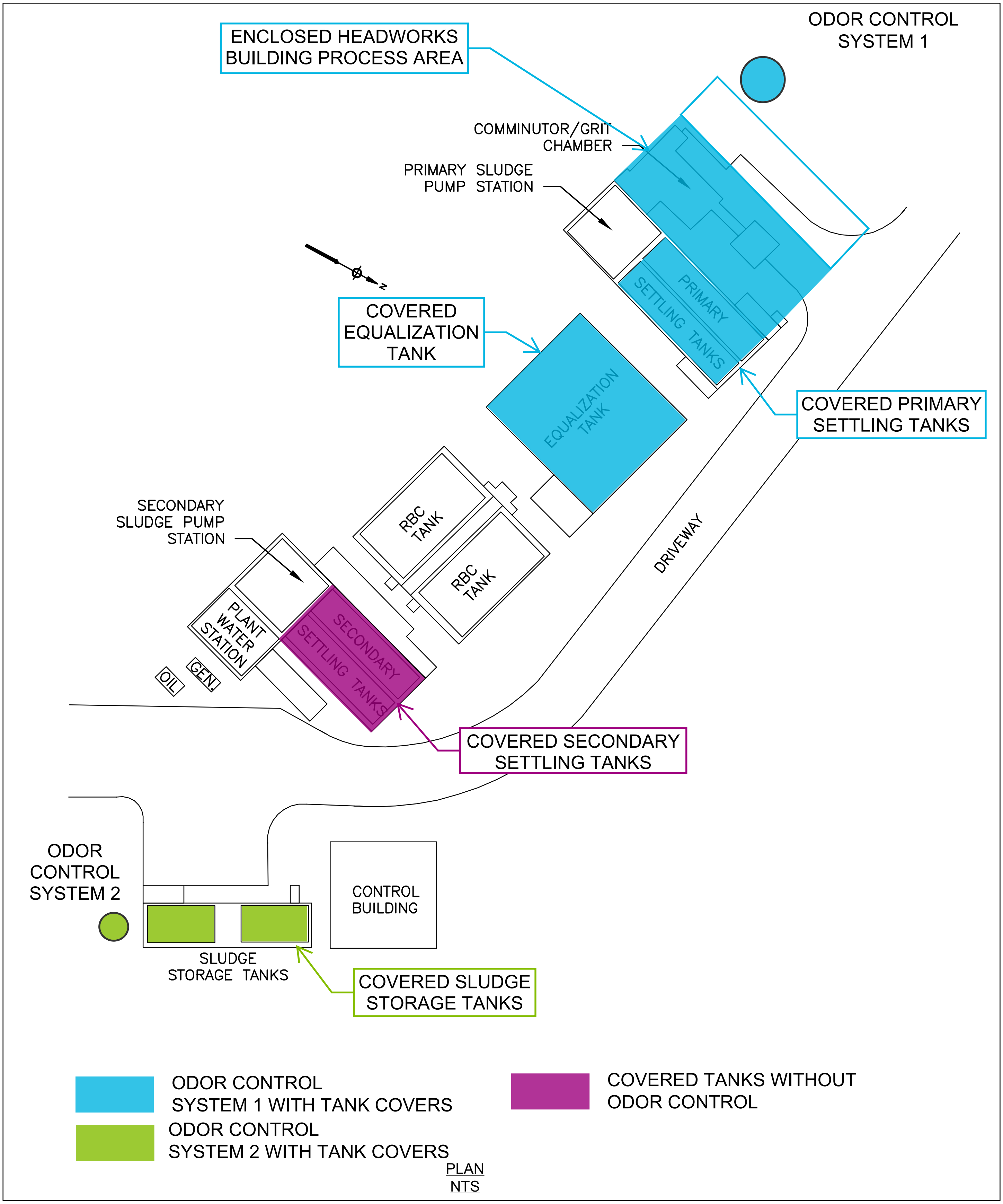


FIGURE 8-3
ROUTE 7 WWTF
RECOMMENDED ODOR CONTROL
SYSTEMS AND TANK COVERS

ARCHITECTURAL AND STRUCTURAL UPGRADE RECOMMENDATIONS

Architectural and Miscellaneous Structural Upgrades

As noted in Chapter Five, a number of architectural components were identified and are recommended to be upgraded. These components include:

- Tank railings
- Primary and Secondary Sludge Pump Station hatches
- Control Building architectural upgrades

The recommended Control Building architectural upgrades include:

- Replacement of metal roof
- Cosmetic upgrades, including painting, ceiling tile replacement, lighting, laboratory furniture, flooring, etc.

As discussed in Chapter Five, the exposed concrete on the majority of the process tanks are showing cracking, particularly around the guardrail posts. Sealing of the guardrail posts concurrent with replacement of the guardrails, as well as crack and surface repair of the tanks and slabs throughout the site is recommended.

Hazardous Materials Removal and Remediation

A summary of the hazardous materials (lead, asbestos and PCBs) identified through an on-site survey at the Route 7 WWTF is presented in Chapter Five. It is recommended that these materials be removed and remediated as required by federal and state law. Additional samples may be required to confirm the presence of the hazardous materials that have been assumed in some building materials and will be impacted during construction (ex. foundation mastic).

Cost Summary. The cost for the upgrade of existing tank railings and replacement hatches has been included in the cost estimates of the respective unit processes, as appropriate. The estimated capital cost for the remaining architectural and miscellaneous structural upgrades at the Route 7 WWTF including the removal and remediation of hazardous materials is $465,000.

ENERGY EFFICIENCY UPGRADES

Upgrades to the WWTF should consider the inclusion of energy efficient components where their long term benefits outweigh the additional capital costs associated with these components. Once the recommended facilities plan upgrade items (systems/building) are finalized, the ability to include energy efficient items/enhancements should be examined in more detail during design. Systems that are recommended to be reviewed as it relates to energy efficiency include:

- Electrical systems including the use of:
    - Variable speed motors
    - High efficiency motors/drives
- Instrumentation and control systems (SCADA) to reduce energy use.
- High efficiency HVAC systems.

After review of these energy efficiency items in design, recommended energy efficiency items will be presented in a preliminary design report.

SITE IMPROVEMENT RECOMMENDATIONS

As noted in Chapter Five, the site lighting, paving, curbing and perimeter fence are in poor condition. These items are recommended for replacement. It is also recommended to provide a motor operated access gate at the WWTF. Also, no potable water exists at the plant because the well that is used for the potable water system is heavily laden with iron and does not provide adequate pressure for use in the facility. Connecting the Route 7 WWTF to the Town water supply is recommended as potable water would be required for emergency showers and eyewash stations. Finally to provide communication connectivity between the Route 7 Pump and the WWTF the installation of a communication conduit is recommended as it can be installed in the same trench excavation as the potable water line.

Cost Summary. The estimated capital cost for miscellaneous site improvement work, piping, communications conduit and upgrades described above is $985,000.

RESILIENCY

In order to address resiliency at the WWTF a number of items are recommended. As noted in Chapter Five, the resiliency issues that are recommended to be addressed by TR-16 relate to flooding potential as well as backup power. The recommendation to provide a new standby generator has been addressed in the Electrical and Emergency Power Systems section above. The new generator and fuel oil system are recommended to be sized, at a minimum, based on critical WWTF system electrical load needs and the specified fuel oil storage days as defined in TR-16.

To address the potential flooding issues, the current FEMA flood map in the area of the Route 7 WWTF was reviewed. Based on this review, it was discovered that the existing electrical room in the Control Building basement, which contains major components of the WWTFs electrical distribution system, does not meet the TR-16 recommended elevation of three feet above the 100 year flood elevation. As a result, it is recommended that the new electrical distribution equipment be provided in a new electrical room on the first floor of the Control Building. This location would allow this critical equipment to be located above the recommended flood elevation requirement. This floor room would also contain the WWTF's SCADA system to protect its components as well. As a result of the recommendation to relocate the electrical equipment and electrical room, the first floor of the Control Building will need to be reconfigured. Please see **Figure 8-4** for the recommended revised layout of the Control Building first floor to accommodate the new electrical room.

Costs. There are costs associated with providing the new standby generator and fuel oil systems as well as the reconfiguration of the first floor of the Control Building. These costs have been included in the costs previously presented for the electrical and emergency power systems recommendations and the architectural and structural upgrade recommendations, respectively.

TOTAL ESTIMATED UPGRADE CAPITAL COST

Table 8-1 presents a summary list of the final recommended upgrades for the Route 7 WWTF based on input from the WPCA and SUEZ at the two workshops. As a result of the decisions and direction provided by the WPCA, the total estimated capital cost for the upgrade recommendations at the Route 7 WWTF is $10,585,000.

The total estimated capital costs are preliminary planning level costs and have been developed based on a number of assumptions and may not represent the final project capital costs for the facilities once designed. The final costs could be higher or lower depending on what decisions are made during the design phase, how the final facilities are constructed, and when the final facilities are constructed.

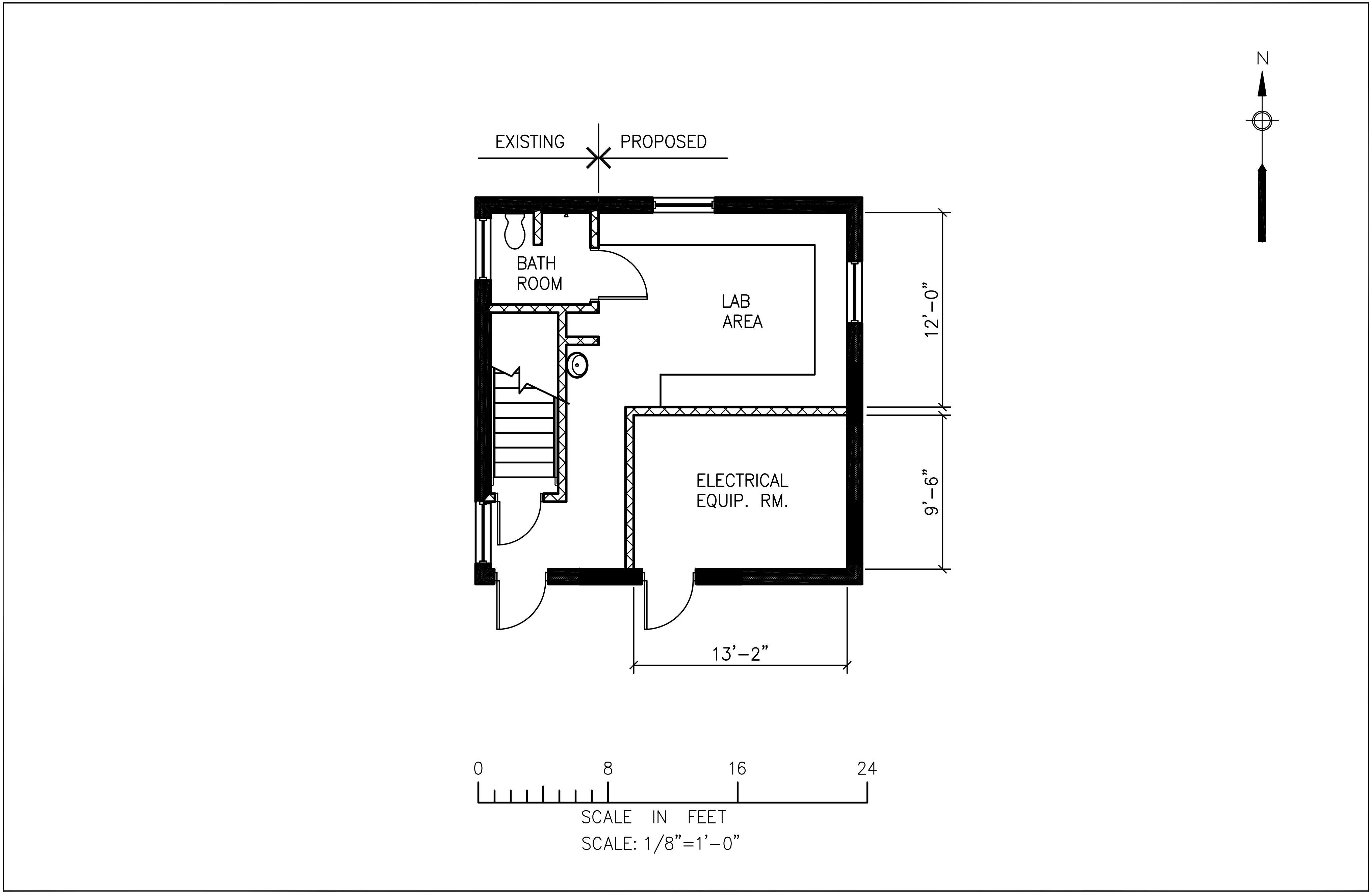


FIGURE 8-4
ROUTE 7 WWTF
RECOMMENDED MODIFIED CONTROL BUILDING
FIRST FLOOR LAYOUT

TABLE 8-1. ROUTE 7 WWTF RECOMMENDED UPGRADES – ESTIMATED CAPITAL COST SUMMARY

Improvement / Upgrade Element	Estimated Cost
Liquid Processes	
Influent Pumping	$1,535,000
Preliminary Treatment	$1,345,000
Primary Settling Tanks	$415,000
Equalization Tank	$455,000
Rotating Biological Contactors	$860,000
Final Settling Tanks	$400,000
Total Phosphorous Removal	$135,000
UV Disinfection	$420,000
Plant Water System	$195,000
Solids Handling	
Primary and Secondary Sludge Pumping Systems	$485,000
Sludge Storage and Hauling	$275,000
Ancillary Systems	
Control, Software, Instrumentation and Communication Systems	$510,000
Electrical and Emergency Power Systems	$1,665,000
Odor Control Systems	$300,000
HVAC Systems	$140,000
Support and Administrative Upgrade	
Control Building Architectural and Misc. Structural Upgrades	$465,000
Site Improvements	$985,000
Total Costs	**$10,585,000**

CHAPTER NINE
SOUTH STREET WWTF UPGRADE RECOMMENDATIONS

In Chapter Five, the existing facilities at the South Street WWTF were evaluated. The facilities were evaluated to determine if they would be able to provide continued service through the Facilities Plan design year of 2035. As a result of these evaluations, a number of WWTF systems and unit process were identified as requiring upgrade and/or improvements. For the most significant WWTF systems and unit processes, alternatives were developed and evaluated, as described in Chapter Seven. The South Street systems and unit processes include the following:

- Liquid Process Recommendations
    - Influent Conveyance
    - Septage Receiving
    - Preliminary Treatment and Influent Building
    - Secondary Nitrogen Removal Treatment Process
    - Final Settling Tanks
    - Tertiary Phosphorus Removal
    - Zinc Removal
    - UV Disinfection, Post Aeration and Maintenance Garage
- Solids Handling Process Recommendations
    - Sludge Storage
    - Solids Thickening and Dewatering
    - Thickened/Dewatered Solids Storage and Disposal
- Ancillary Facilities and System Recommendations
    - Odor Control Systems
    - Ancillary Pumping Systems
    - Chemical Storage and Feed Systems
    - Electrical Systems
    - Instrumentation and Control Systems
    - HVAC Systems
- Architectural and Structural Component Upgrade Recommendations
    - Architectural Upgrades
    - Structural Upgrade
    - Hazardous Materials Removal / Remediation
- Energy Efficiency Upgrades
    - General
    - Solar Panels
- Site Improvement Recommendations

This Chapter summarizes the recommended facilities upgrades and improvements for these systems and unit processes and provides estimated construction cost for the various project elements as well as a total estimated capital cost for the recommended upgrades. The major recommended facility plan upgrades are highlighted in **Figure 9-1**.

It should be noted that all of the liquid and solids process unit process recommendations and related costs presented in this Chapter were based on the influent flows and loads described in Chapter Four with the South Street WWTF treating flow from Sewer District No. 1 only. A comparison of the costs and upgrades to treat the Sewer District No. 1 flows only versus treating the flow from both Sewer District 1 and Sewer District No. 2 will be presented and discussed in Chapter Ten. See Chapter Four for the basis of the cost estimates provided below.

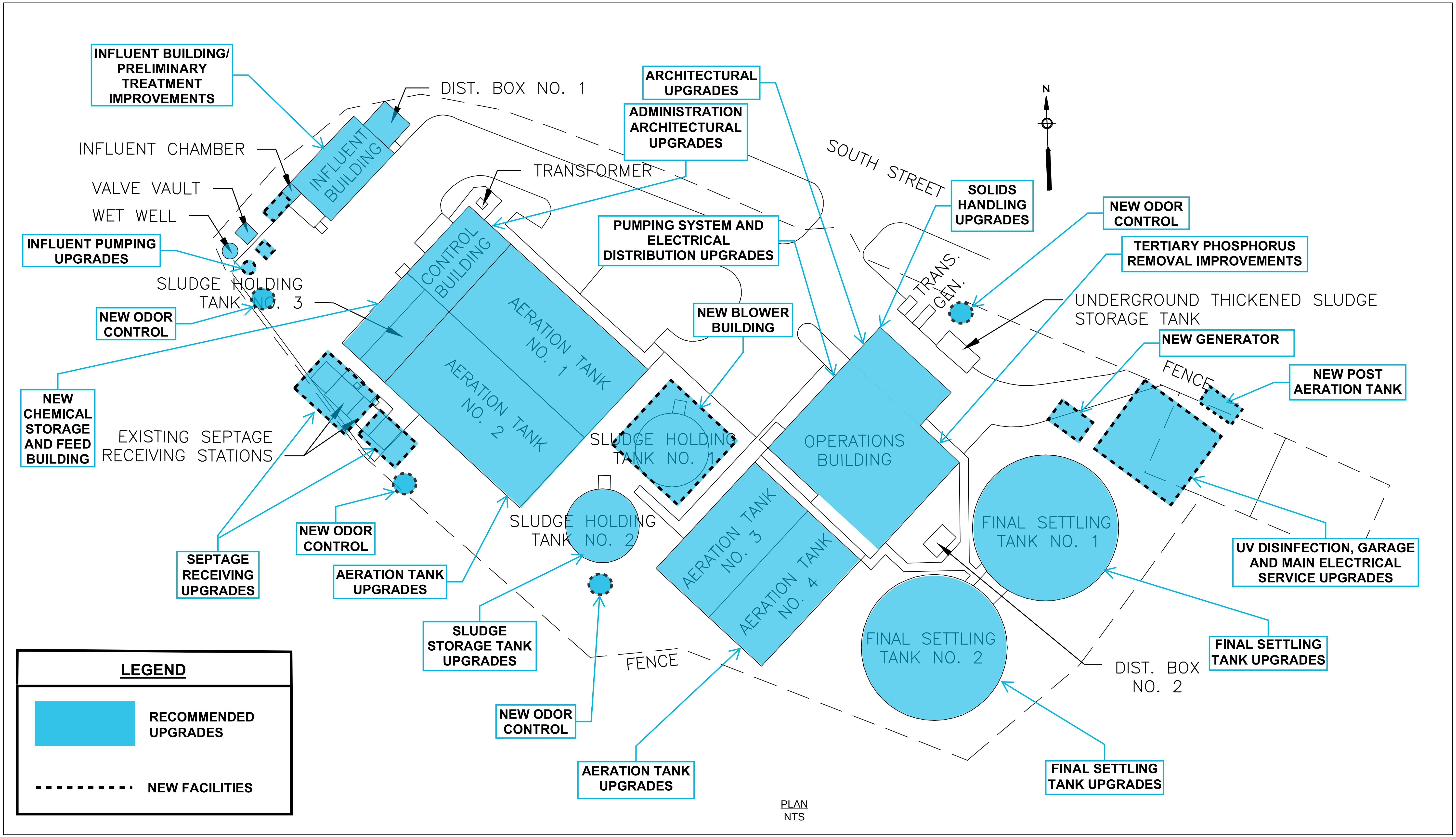


FIGURE 9-1
SOUTH STREET WWTF
RECOMMENDED UPGRADES SITE LAYOUT

LIQUID PROCESS RECOMMENDATIONS

Influent Conveyance

The existing influent pump station was constructed in 2007, replacing the original pump station constructed during the 1990 plant upgrade and expansion. The pump station consists of a single PVC lined 8-foot diameter wet well, and adjacent valve vault. The station contains two recessed impeller submersible pumps with a capacity of 680 gpm rated at 15 feet TDH. As discussed in Chapter Five, infrequent wet weather events have caused the system to back up, requiring the use of a trailer mounted jockey pump to be used to convey flow into the plant and prevent upstream backups in the collection system. As noted in Chapter Five, it was recommended that alternatives be considered to eliminate the use of the trailer mounted system. In additional all alternatives were evaluated to convey the year 2035 design flows specified in Chapter Four. These alternatives include and are discussed below:

- Install larger pumps in existing wet well
- Construct new wet well with additional pumps
- Reconfigure existing influent piping

Install Larger Pumps in Existing Wet Well. Due to the existing pump station limited years of service, it was desirable to leave the existing PVC lined wet well in place. In order to address the large range between average and future design peak flows while using the existing wet well, the replacement of the existing pumps is necessary. In order to address the large flow range, it is recommended to have three pumps operating to handle the peak instantaneous flow (2 operating and 1 spare). The existing 8 foot diameter wet well can only accommodate two pumps; therefore the alternative to use the existing wet well was not feasible.

Construct a New Wet Well. In order to reuse the existing influent pump station wet well, it is recommended that a new 8-foot diameter wet well be installed adjacent to the existing wet well. The new wet well would be connected to the existing wet well via a pipe at the invert, allowing the two wet wells to be filled and drawn down simultaneously. Four new submersible pumps would be provided, with two installed in each wet well. It is recommended that the two existing 680 gpm pumps be replaced in kind to address the low range of the anticipated design flow range. In addition, two 1,650 gpm pumps would be installed to address the high range of the design flows. The station design would require the use of both 680 gpm pumps, and a single 1,650 gpm pump to convey the peak hour design flow (or both large pumps without the smaller pumps). The final configuration of the pumps (i.e. which pumps are installed in each wet well and their control) will be determined during design. Alternatives were evaluated to convey the flow from the new valve vault to the Influent Building. These included keeping the piping as 6-inch diameter, and increasing the size of the pipe to address the higher peak design flow. The existing 6-inch diameter pipe would cause high velocity concerns at the peak flows, while a new larger pipe would be problematic for the minimum flows. As a result, it is recommended that the new wet well and valve vault be connected directly to the expanded Influent Building Influent Box, as described later in this Section. The recommended layout of the influent pump station modifications is depicted in **Figure 9-2**.

Reconfigure Piping Upstream of Influent Building. It was thought that the reconfiguration of some of the influent piping upstream of the Influent Building could help solve the influent conveyance limitations. Alternatives for reconfiguring the piping upstream of the influent box, included removing the gravity line from influent box which conveys flow from the downtown village area, as well addressing the limits of the influent box were evaluated. As a result of the evaluation, it is recommended to leave the existing gravity line in the existing influent box as it will minimize pumping costs during average and low flows that occur the majority of the time. The reconfiguration of the force mains from the two wet wells was also evaluated as described above, and is not recommended.

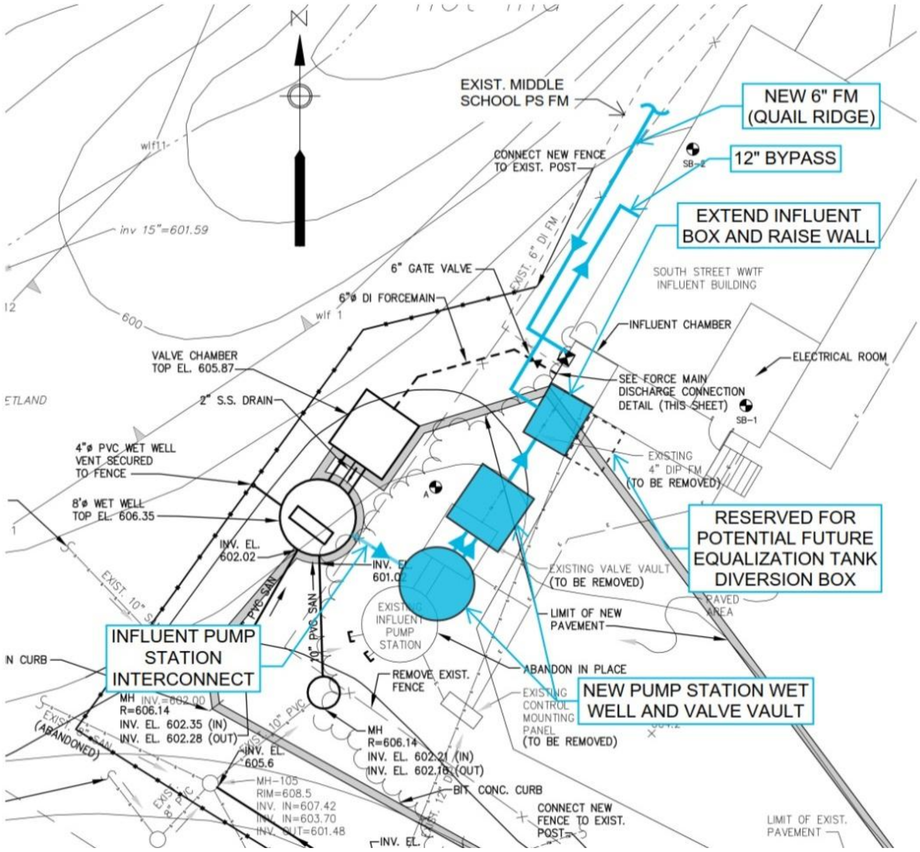


FIGURE 9-2. RECOMMENDED INFLUENT PUMP STATION AND INFLUENT BUILDING BOX LAYOUT

Cost Summary. The estimated capital cost to upgrade the influent pump station equipment, provide a new wet well, valve vault, conveyance piping, and extended and modified influent distribution box is $880,000.

Septage Receiving

As described in Chapter Five, the existing septage receiving station is located in the back of the facility and includes a manual rack and open discharge of septage to the ground, which is then directed to either of the tanks. The existing septage holding tanks are also noted to be structurally deteriorating. Depending upon condition, it is recommended that these tanks either be repaired or replaced. In order to minimize the need to clean out settled material from the septage and to reduce the wear on the septage transfer pumps it is recommended that the septage received at the WWTF tanks be conveyed through septage tanks in series. Due to their age, it is also recommended that the septage transfer pumps be replaced and updated tank level instrumentation and pumping control systems be provided. In addition, it is also recommended to provide new piping to direct septage directly to solids processing to provide operational flexibility, as well as replacing the piping to the Influent Building.

It is also recommended that a new septage building be provided to allow for partial enclosure of the septage trucks and the Town's Vactor truck to contain odors. The building will include a manual floor grate and floor rack allowing for septage haulers to discharge septage to the floor of the building. Vehicles will back into the building through an approximately 12' wide by 25' high opening to accommodate the Town's Vactor truck, allowing it to discharge material from the vehicle's tank in the raised position. The building ventilation will be exhausted to a carbon adsorber odor control system. The WWTF odor control systems are discussed later in this Chapter.

Cost Summary. The estimated capital cost to provide a new septage receiving building and the septage handling modifications described above is $1,045,000.

Preliminary Treatment and Influent Building

As noted in Chapter Five, the preliminary treatment systems in the Influent Building include a mechanically cleaned bar rack, a vortex grit removal system, a new channel grinder and a manually cleaned fine bar screen. A number of issues associated with these systems were identified including the following:

- The mechanically cleaned bar rack and mechanical components of the vortex grit removal system are at the end of their service life and are recommended for replacement
- The manually cleaned fine screen is labor intensive
- Under current conditions hydraulic limitations exist in the various preliminary treatment systems

The following are the recommendations to upgrade the systems to provide reliable preliminary treatment at the current and year 2035 design flows.

Influent Distribution Box No. 1. Operators have indicated that the existing influent box adjacent to the Influent Building is insufficiently sized for the influent plant flow during wet weather events causing turbulent flow conditions and is also believed to limit hydraulic capacity. In addition, a number of new connections to the Influent Building are required, including:

- New Wet Well
- Quail Ridge Pump Station
- Equalization Tank
- Screenings Bypass

Due to constraints related to constructability and the need to accommodate existing and new piping, increasing the size of the influent box is recommended. It is also recommended that the walls of the influent box be raised to account for the increase in the design peak flow and to also address the hydraulic issues in the influent box. **Figure 9-2** presents the recommended layout of the expanded influent box and the new and existing piping connections to that box for flow conveyance.

Influent Screening. The existing influent bar screen is recommended to be replaced due to its age. Replacing the bar screen with either a rotating drum screen or a mechanically cleaned bar screen were evaluated. Due to the length of the rotating drum screens, significant concrete channel modifications would be required. A mechanically cleaned bar screen does not require the same level of modification and is therefore recommended. To eliminate the need for a downstream fine screen and the downstream channel grinder a ¼ inch mechanically cleaned bar screen is recommended. At this screen opening size and to address the year 2035 design peak hour flow, it will be necessary to provide a second mechanically cleaned screening system as a single channel system does not have adequate capacity. It is recommended that the second screen system be installed in the existing screening bypass channel that has a manual bar rack. As a result, a new screening system bypass will be required. This is described later in this section.

In addition to the screens it is recommend that a screenings washpress be provided to wash and compact the collected screenings to reduce the screenings organic content, volume and odors. It is recommended that a single washer/compactor would be provided to process screenings from both screens. Material from each screen would discharge to a conveyor that transfers screenings to the washer compactor or directly to screenings receptacle (trash can, wheeled cart, etc.) if the washpress was out of service. Under normal operation treated screenings from the wash press would be discharged to a bagging system or wheeled cart or dumpster for final disposal.

As noted above, with the second screen now occupying the existing screen bypass channel a new screening system bypass is required. A new bypass channel (and manual bar rack) could be located inside of the Influent Building but would require extensive concrete modification. As a result, it is recommended to construct the new bypass on the outside of the building. The bypass would consist of a 12-inch ductile iron pipe connected to the influent box with upstream and downstream flow isolation valves. The pipe would be attached to and run along the north exterior wall of the Influent Building and convey bypass flow (if needed) to the existing channel inside of the building downstream of the new mechanically cleaned screens. Downstream of where the bypass flow returns to the existing channel, a removable manually cleaned bar rack would be provided that can be installed or removed with the operation of the bypass and to remove large debris from the influent flow when one or more mechanically cleaned screens is out of service. Due to the elevation of the influent channel, this pipe would be located above grade. As a result, the bypass pipe is recommended to be provided with a flushing connection and drain piping to allow for the pipe to be cleaned and emptied after being taken out of service. The drain piping would connect to the one of the upstream wet wells and include isolation valves.

Finally, in order to allow for the TR-16 required 12 inches of freeboard under year 2035 projected peak flow conditions, it is recommended that the channel on the upside of the screen and in the upstream influent box be raised. The recommended layout of the Influent Building, including the two new screens, the screenings conveyor and washpress and the new bypass pipe and manual bar rack are shown in **Figure 9-3.**

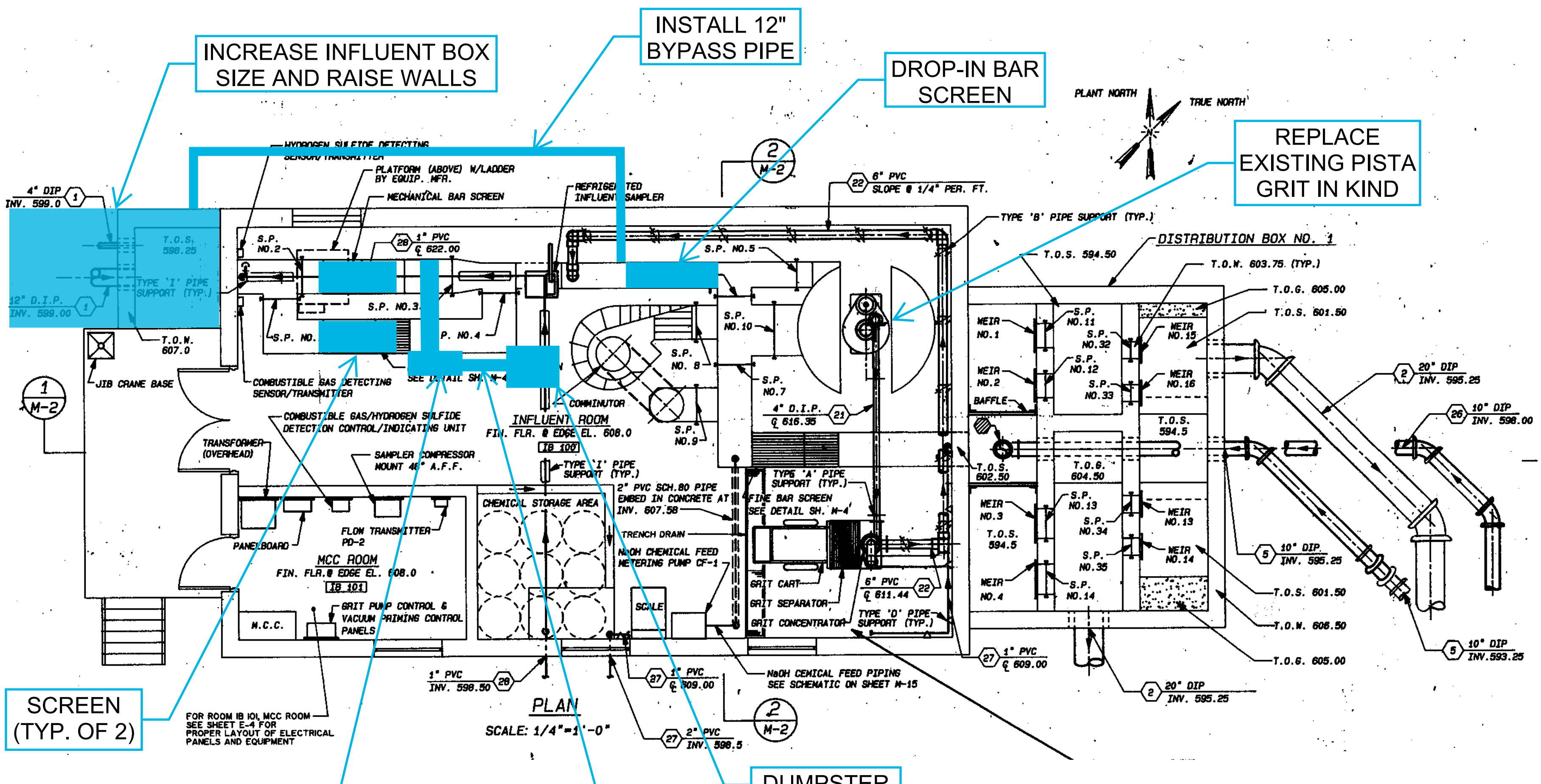
Grit Removal. The existing vortex grit removal system is recommended to be replaced due to its age. The equipment to be replaced includes the vortex grit chamber drive unit, the grit slurry pump and the grit classifier. The increase in design peak flow was also considered when sizing replacement equipment. In order to address the year 2035 design peak flow, the existing vortex grit chamber would need to be enlarged, requiring significant modifications to the existing channel and concrete removal. In discussion with the vendor, it has been determined that the replacement unit of the same size can hydraulically handle the peak flow, yet the grit removal efficiency will decrease during peak flow events. Due to the limited expected frequency of these high flows and to reduce the project cost, it is recommended that the existing unit be replaced in kind understanding that under peak flow conditions, a small amount of grit may not be captured.

Odor Control. Based on the nature of the influent wastewater and the materials being removed by preliminary treatment, odor control of the process area of the Influent Building is recommended. Odor control for different areas at the WWTF will be discussed later in this Chapter.

Cost Summary. The capital cost for the modifications to the preliminary treatment process including the new screens, conveyor, wash press, screen bypass piping and grit removal system upgrades as described above is estimated to be $1,230,000.

Secondary Nitrogen Removal Treatment Process

Aeration Distribution. As described in Chapter Five, the existing aeration distribution box (Distribution Box No. 1) located adjacent to the Influent Building is currently covered with plywood to contain odors. It is recommended that aluminum plate covers be added to this tank to contain odors, improve durability, and increase operator safety. To improve the lifespan of the concrete in the tank, it is recommended that the exposed concrete from the top of the wall to two feet below the water line be coated with a hydrogen sulfide resistant coating. It is also recommended that this structure be ventilated through the recommended Influent Building odor control system. Odor control for different areas of the WWTF are described together later in this Chapter. The distribution box receives flow from influent building, as well as the return activated sludge (RAS) flow from the secondary treatment process. It is recommended that a submersible mixer be provided in the distribution box to improve the mixing of the influent flow with the RAS prior to distribution to the two sets of aeration tanks.



PLAN
NTS

FIGURE 9-3
SOUTH STREET WWTF
RECOMMENDED INFLUENT BUILDING LAYOUT

Aeration Tank Nutrient Removal Process. As noted in Chapter Four and Chapter Seven, based on the target total nitrogen limits in the CT General Permit for Nitrogen Discharges modifications to the existing secondary process will be required to meet the limits or to reduce the quantity of nitrogen credits purchased. As a result a number of total nitrogen removal alternatives were evaluated in order to meet the target total nitrogen limits completely through process modifications or by a combination of process modifications and purchasing nitrogen credits. In addition the removal of some phosphorus (down to 0.33 mg/l or less) was evaluated in conjunction with the total nitrogen removal alternatives in the secondary process (either chemically or biologically).

As a result of the evaluations, it is recommended that the WWTF employ a 4-Stage Bardenpho process in the existing aeration tanks with chemical phosphorus removal. To implement this process in the existing aeration tank the following upgrades and modifications will be required:

- Rehabilitation of the 1968 aeration tanks (significant concrete repair, new railings, new valves, new weirs, etc.).
- Minor improvements to the 1990 aeration tanks (new weir gates, minor concrete repairs).
- New walls and modification to exiting walls in the 1968 and 1990 aeration tanks
- New aeration system for the aerobic zones (two zones per set of aeration tanks) include aeration supply and dissolved oxygen control systems.
    - Based in the evaluation of alternatives in Chapter Five it is recommended that fine bubble diffused air systems fed by new high efficiency rotary lobe compressors (hybrid blowers) housed in a new Blower Building located between the two sets of aeration tanks.
- Mixers for anoxic zones (two zones per set of aeration tanks).
- Internal recycle pumping and piping systems.
- Supplemental carbon (Micro-C) storage and feed facility. The WWTF chemical facilities are described in more detail later in this chapter.
- Chemical phosphorus removal chemical storage and feed facilities. The WWTF chemical facilities are described in more detail later in this chapter.

The aeration tank configuration, process flow diagram and site layout showing the new Blower Building are shown in **Figure 7-5, Figure 7-6, and Figure 7-22**, respectively**.**

This alternative was recommended as it had the lowest operation and maintenance cost and relatively low 20 year present worth cost. Other advantages of the 4-Stage Bardenpho process alternative include the following:

- The process can meet the target total nitrogen limit which:
    - Eliminates the need for the WWTF to purchase nitrogen credits
    - Reduces the future impact and potential need for a future upgrade if the WWTF's total nitrogen permit is converted to numerical limits
- Simpler process to operate for phosphorus than biological processes.
- Allows for more flexibility in solids handling.

Cost Summary. The estimated capital cost to provide aeration distribution tank modification and a 4-Stage Bardenpho process in the two sets of aeration tanks as described above is $4,100,000

Final Settling Tanks

As described in Chapter Five, the existing final settling tank equipment has reached the end of its service life and is recommended for replacement, including the sludge collection mechanism and drive unit, effluent launders, weir and scum collection equipment.

Cost Summary. The estimated capital cost to upgrade the final settling tanks is $895,000.

Tertiary Phosphorus Removal

As noted in Chapter Four the new effluent total phosphorus limits in the NPDES permit will require the installation of tertiary chemical addition and solids removal process at the WWTF. As a result, a number of tertiary phosphorus removal alternatives were evaluated to achieve a 0.05 mg/l seasonal average total phosphorus concentration. These alternatives are presented in Chapter Seven. As a result of the evaluations, it is recommended that the WWTF employ the Blue PRO process for tertiary phosphorus removal.

To implement this process the following upgrades and modification would be required.

- 16 Blue PRO filter units, including two new filter cells, and associated influent and effluent channels to be located in the existing sand filter room.
- Air compressor package with air dryer.
- Various instrumentation including:
    - Headloss gauges
    - Float switches
    - Flow meters
- Control panels
- Chemical phosphorus removal chemical storage and feed facilities (these would be the same facilities used for chemical phosphorus removal in the secondary process). The WWTF chemical facilities are described in more detail later in this chapter.
- Relocation of the existing UV disinfection, reaeration, and effluent flow measurement systems

The Blue PRO process layout at the South Street WWTF is shown in **Figure 7-14.**

This alternative was recommended as it had the lowest capital costs, lowest operation and maintenance cost, and lowest 20 year present worth cost. Other advantages of the Blue PRO process alternative include the following:

- Technology can be retrofitted into existing filter room
- Simple technology
- Similar technology as existing filters at WWTF
- Has other installations meeting the South Street WWTF target total phosphorus concentration

As noted above the Blue PRO system has other installations meeting the South Street WWTF target total phosphorus concentration. During the facilities planning effort, Blue PRO performed some off site bench scale process testing of the WWTF's secondary effluent showing their ability to meet the target total phosphorus concentrations. However, the target total phosphorus effluent limits are especially stringent at the WWTF (target TP concentration of 0.05 mg/l). At these concentrations, meeting the limit is very difficult and is affected by the speciation of phosphorus in the wastewater. In all wastewaters there is a portion of non-reactive phosphorus that will not be removed. As a result of this it is recommended that on site performance testing be performed as an initial step in design to confirm that the target effluent phosphorus concentration can be achieved by this technology at a larger scale on the South Street final settling tank effluent. It is recommended that this testing be performed on a pilot scale over a several week period to observe the system performance under varying flow and loading conditions. If the performance testing does not show the ability to meet the target effluent limits the need to provide a second stage of Blue PRO filters or to utilize one of the other technologies (both tertiary phosphorus removal technologies and MBRs) will need to be considered.

Cost Summary. The estimated capital cost to implement the BluePRO filtration system is $3,010,000. The cost does not include chemical feed systems or the relocation of the UV disinfection system and the post aeration tank which are described later in this section.

Zinc Removal

An evaluation of the alternatives to remove zinc at the WWTF was presented in Chapter Seven. Based on that evaluation it is expected that the Blue PRO tertiary phosphorus removal process will remove some zinc. It is estimated that the zinc removal will be between 0% and 30%. However, even at this removal, the WWTF would not be able to meet the required effluent peak flow zinc concentration of 0.015 mg/l. As discussed in Chapter Seven, it appears that only an ion exchange process has the potential to meet the required effluent zinc limits required at peak flows for the South Street WWTF. Installation of an ion exchange system would result in significant capital ($20 MM - $25MM) and operating cost. It should be noted that this costly ion exchange system would potentially allow the Town to meet a mass zinc limit under peak flows that has only been a problem under peak flow conditions three times in the last six years. On these three occurrences the effluent zinc concentrations were less than the instream acute and chronic zinc concentration limit of 66 ug/l (or 0.066 mg/l) that the mass limits are based on and were not believed to have had a negative impact on the receiving waters. It is recommended that the Town delay any additional zinc removal upgrades at the WWTF (ion exchange or other) until the zinc removal performance of the full scale Blue PRO system can be evaluated once it is operational.

UV Disinfection, Post Aeration and Maintenance Garage

As noted in the Tertiary Phosphorus Removal section, the recommended Blue PRO filter system will require the relocation of the UV system and post aeration tank as the existing location will be used for the installation of additional Blue PRO filter cells for phosphorus removal. As described in Chapter Five, the existing UV system includes a single channel with two banks of UV lamp modules in series for redundancy. It is recommended that the new UV system be provided with redundancy with two separate channels, each with one bank of modules to allow for operational flexibility and the ability to take a channel out of service during the disinfection season. It is recommended that a new UV system be located in a new building in the vicinity of the existing Town vehicle impound area. The post aeration tank is also recommended to be located adjacent to the UV building.

To convey the effluent flow from the recommended Blue PRO filter system to the relocated UV disinfection system, new 24" ductile iron piping would be provided. A new 24" final effluent pipe would also be installed across South Street and connect into the existing manhole on the far side of the road. The new UV Disinfection Building is also recommended to include a new maintenance garage so the existing garage in the Operations Building may be used for future dewatered sludge storage. The building would also include dedicated mechanical space for two (2) new post aeration blowers as well as space for a new main electrical room for the installation of a new WWTF main electrical switchgear and associated power distribution equipment.

The UV Disinfection, Switchgear and Garage Building dimensions would be approximately 45 feet long and 40 feet wide. The garage portion of the building would be approximately 45 feet long by 20 feet wide. The garage clear height is estimated to be 20 feet high to accommodate a vehicle lift for sewer department vehicle maintenance. As the garage would be used for maintenance purposes, an oil water separator and associated drain piping would be installed. The oil water separator would discharge to the existing process drain system in the Operations Building. See **Figure 9-4** for a recommended layout of the new UV Disinfection, Switchgear and Garage Building and Post Aeration Tank.

Cost Summary. The estimated capital cost for the construction of the new UV Disinfection, Switchgear and Garage Building and Post Aeration Tank is $3,310,000.

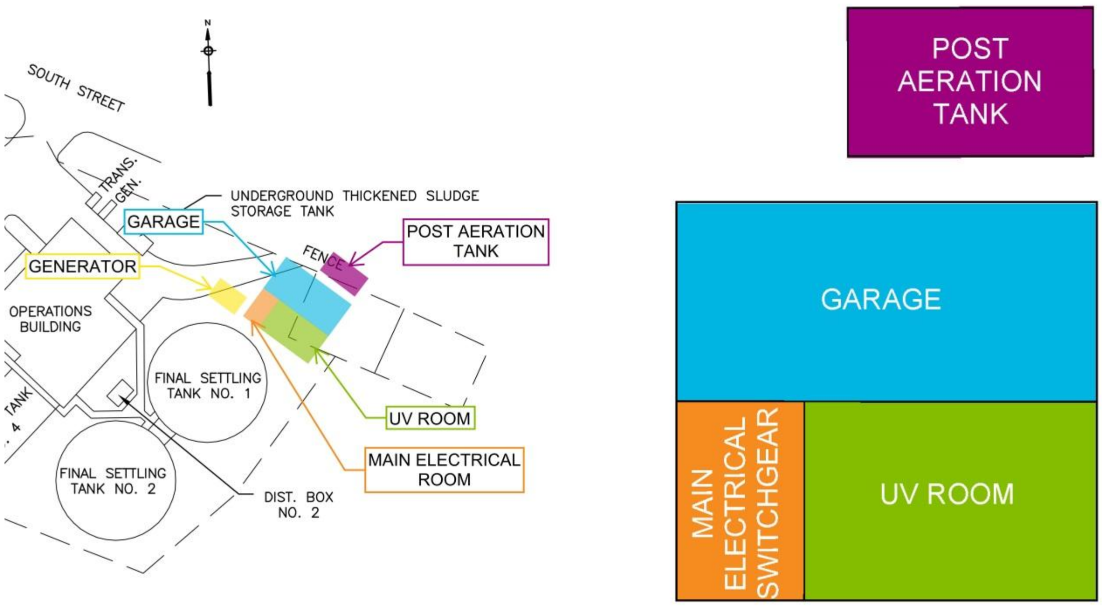


FIGURE 9-4. RECOMMENDED UV DISINFECTION, SWITCHGEAR AND GARAGE BUILDING AND POST AERATION TANK LAYOUT

SOLIDS HANDLING RECOMMENDATIONS

Waste Activated Sludge Storage

As noted in Chapter Seven, to address the existing WAS storage limitations at the facility both the use of a gravity thickener and an aerated sludge storage tank were evaluated. Based on the evaluation it is recommended that an aerated sludge storage tank be provided by modifying the existing Sludge Holding Tank No. 2. Modifications to the existing Sludge Holding Tank No. 2 to provide an aerated sludge storage tank include installation of:

- Aluminum plate covers
- Odor control system
- New aeration diffusers
- New aeration blowers (either dedicated or in conjunction with new aeration tank blowers)

This alternative was recommended due it having the lowest capital costs, lowest operation and maintenance cost and lowest 20 year present worth cost (versus a gravity thickener). Other advantages of the aerated sludge storage tank versus using a gravity thickener for sludge storage include the following:

- Technology does not require dilution water for sludge freshening which would result in a significant recycle flow to the headworks of the WWTF.
- The existing sludge storage tanks can easily be upgraded with new blowers and diffusers
- The odor control requirements of the aerated sludge storage tank are less than the gravity thickener.
- It is a simpler process to operate for sludge storage.

Due to the location of the new Blower Building (associated with the aeration tank upgrade) some of the existing yard piping associated with the old sludge holding tank being repurposed to the new waste sludge storage tank (sludge feed and suction piping, air piping, etc.) will require relocation or replacement.

Solids Thickening and Dewatering

As described in Chapter Seven, the existing gravity belt thickener/belt filter press is in need of replacement. A number of mechanical thickening and dewatering alternative were evaluated including an assessment of their capital, O&M and life cycle costs. As a result of the evaluation the installation of a centrifuge which will allow both thickening and dewatering is recommended. To implement this process the following systems and modification are recommended:

- A thickening and dewatering centrifuge to be located in the Operations Building Sludge Dewatering (and Thickening) Room.
- Centrifuge discharge configured to allow discharge to thickened sludge to the thickened sludge storage tanks or sludge cake to trucks or containers in the sludge loading truckway.
- Polymer blend and feed system.
- New centrifuge sludge feed pumps (one duty one standby).
- Odor control for the Sludge Dewatering Room and Sludge Loading Truckway.
- A new garage as dewatering operations will take the existing truckway/garage in the Operations Building for sludge loading.

See **Figure 9-5** for a recommended layout of the Sludge Thickening/Dewatering Room with the new centrifuge.

This alternative was recommended due it having the lowest capital costs, lowest operation and maintenance cost and lowest 20 year present worth cost of the technologies that could provide both sludge thickening and dewatering. This flexibility is important as it will allow the WWTF to react to the sludge disposal market condition in the future.

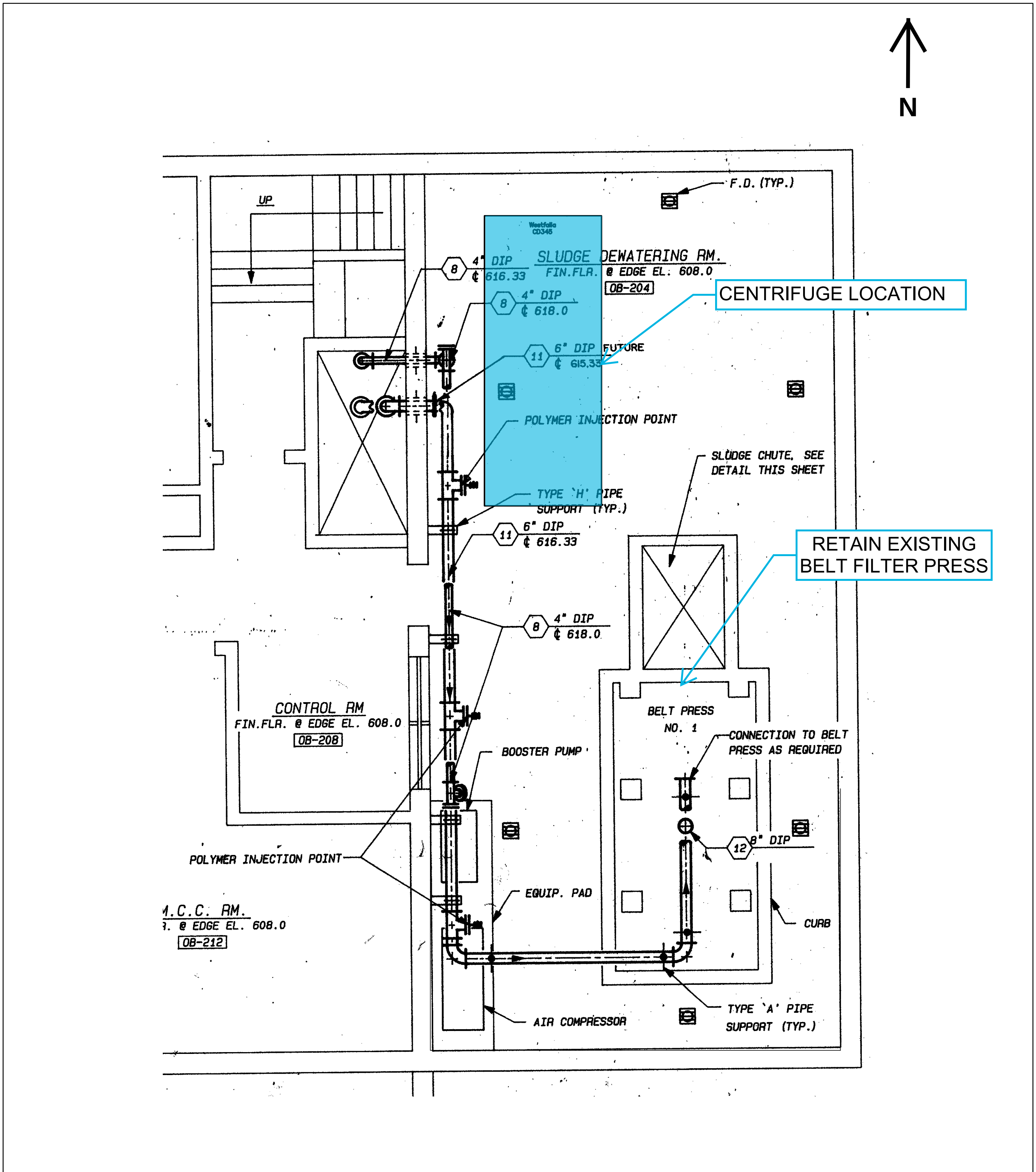
Other advantages of a centrifuge alternative for thickening and dewatering include the following:

- Enclosed process which can:
  - Reduce odors.
  - Improve operator safety.
- In thickening mode has the lowest polymer consumption
- In dewatering mode can produce the highest cake concentration
- Can be constructed while maintaining the existing gravity belt thickener/belt filter press operation

Based on the evaluation in Chapter Seven and based on current market conditions it is recommended that the centrifuge operate in a thickening mode and that thickened liquid sludge be hauled off site for disposal. In the future if market conditions favor dewatering it is recommended that the WWTF install a multi drop dewatered sludge cake conveyor in the sludge loading truckway. This conveyor will improve the distribution of sludge cake in sludge trucks or containers loading. Finally as part of this alternative, it is recommended that the existing gravity belt thickener/belt filter press not be demolished and remain as a backup system to the new centrifuge.

Thickened and Dewatered Sludge Storage

As noted in Chapter Five, the existing below grade thickened sludge storage tank limits the WWTFs ability to process sludge due to its limited storage volume. To address the limited thickened sludge storage at the facility, it is recommended that the existing chemical storage area located below the solids loading truckway in the Operations Building basement be converted into a 29,000 gallon thickened sludge



PLAN
NTS

FIGURE 9-5
SOUTH STREET WWTF
RECOMMENDED SLUDGE
THICKENING / DEWATERING
ROOM LAYOUT

storage tank. The new thickened sludge storage tank will require relocation of the chemical area. As noted in Chapter Five these chemical storage and feed facilities in the Operations Building are approaching the end of their useful life and their location in the basement of the Operations Building is difficult from an operation and access stand point. The new chemical storage and feed facilities will be discussed later in this chapter.

The existing below grade thickened sludge storage tank in the yard adjacent to the truckway of the Operations Building will be retained. Each thickened sludge tank will be provided with a submersible mixer to homogenize the sludge prior to truck loading. Thickened sludge is loaded into trucks via the existing belt filter press feed pump. Valves are configured to allow for the pump to pull suction from both the Sludge Holding Tanks Nos. 1 and 2, and from the thickened sludge storage tank adjacent to the truckway. This single pump will be replaced with two new pumps, one operating and one redundant. Odor control for both thickened sludge storage tanks is also recommended.

Cost Summary. The estimated capital cost to upgrade the solids handling process, including upgrades to the existing Sludge Holding Tank No. 2 to provide an aerated sludge storage tank, a thickening and dewatering centrifuge, new polymer systems, new centrifuge feed pumps, and conversion of the old chemical area to a thickened sludge storage tank and upgrades to the existing thickened sludge storage tank is $1,560,000. The cost of installing a new maintenance garage to address the lack of storage for future dewatering is included in the UV Disinfection / Maintenance Garage building cost presented earlier in this Chapter. The cost of odor control systems noted above are discussed later in this Chapter.

ANCILLARY FACILITIES AND SYSTEMS RECOMMENDATIONS

Odor Control Systems

As described in this chapter, odor control is recommended to be provided for several areas of the South Street WWTF. These areas include the Influent Pump Stations, Influent Building, Septage Receiving Building and holding tanks, aerated sludge storage tank, existing Sludge Thickening and Dewatering Room, Sludge Loading Truckway, and the existing and new thickened sludge storage tanks. Where these areas are in close proximity to each other and their operations (intermittent or continuous) are similar, these areas are recommended to be served by common odor control systems. The layout of the recommended WWTF odor control systems is shown in **Figure 9-6**. **Table 9-1** presents the recommended odor control systems to be provided, their areas served, the system type, and the design capacity.

TABLE 9-1. SOUTH STREET WWTF ODOR CONTROL SYSTEM RECOMMENDATIONS

Odor Control System	Facilities Served	Recommended Unit Type	Design Throughput (SCFM)
No. 1	Influent Building Influent Room, Influent Box, Distribution Box No. 1, Influent PS wet wells	Deep Bed Activated Carbon Adsorber	3,500 CFM
No. 2	Septage Receiving Building, septage holding tanks	Radial Flow Activated Carbon Adsorber	2,500 CFM
No. 3	Aerated Waste Sludge Storage	Wet Drum Scrubber	750 CFM
No. 4	Operations Building Sludge Thickening/Dewatering Room, new thickened sludge storage tank, Sludge Loading Room	Radial Flow Activated Carbon Adsorber	5,500 CFM
No. 5	Existing Thickened Sludge Storage Tank (in yard)	Wet Drum Scrubber	100 CFM

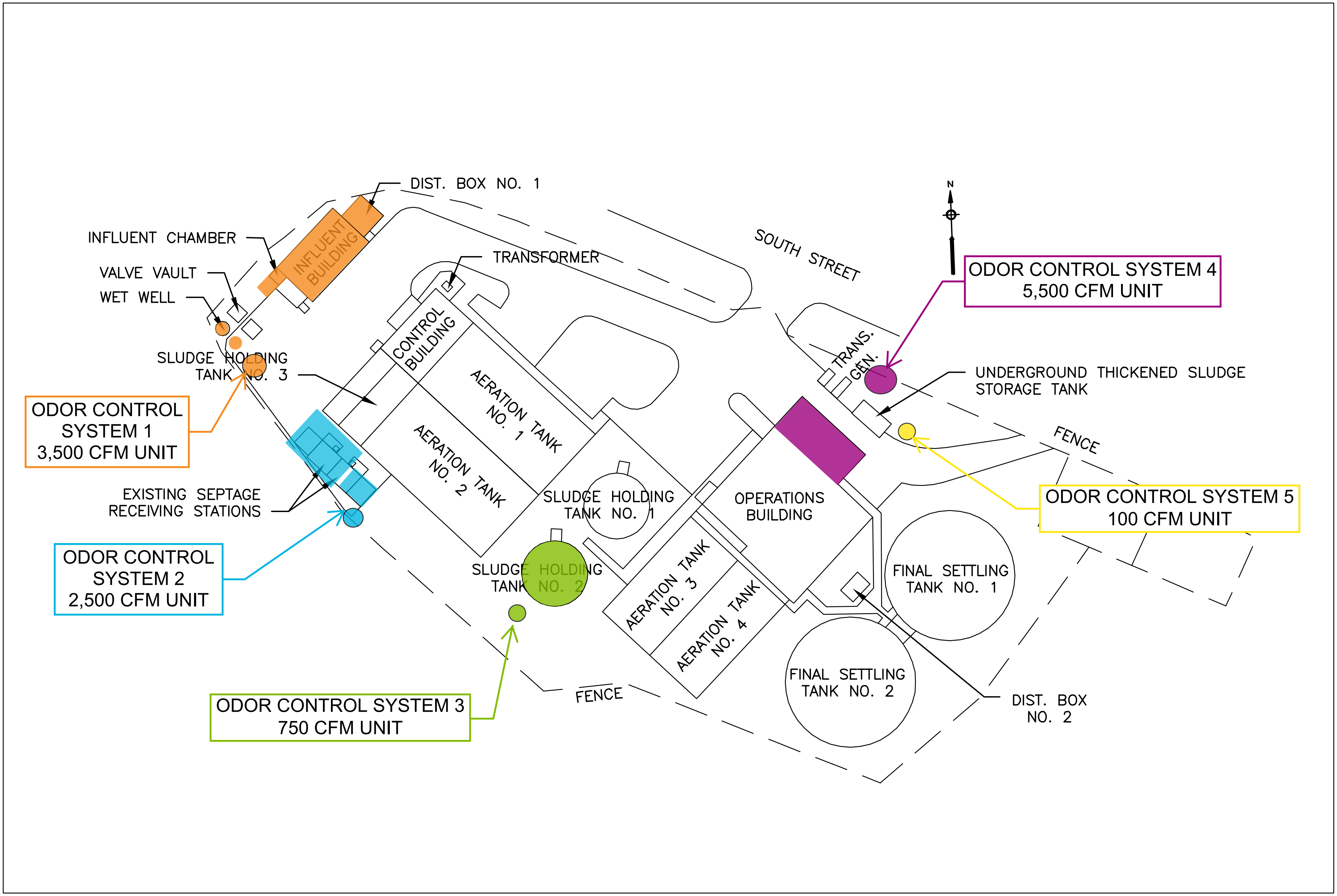


FIGURE 9-6
SOUTH STREET WWTF
RECOMMENDED ODOR CONTROL SYSTEMS

Cost Summary. The estimated capital cost for the implementation of the recommended odor control systems is $795,000.

Ancillary Pumping Systems

As described in Chapter Five, there are a number of existing ancillary pumping systems. These systems include:

- Waste Activated Sludge
- Plant Water (Effluent Flushing Water Pumps)
- Plant Recycle (Wet Well Pumps)
- Return Activated Sludge
- Scum Pump
- Supernatant/Truck Loading Pump
- Sump Pumps

The following is a summary of these systems.

All existing ancillary pumping systems at the WWTF have reached the end of their service life. As a result, it is recommended that all ancillary pumping systems be replaced to provide reliable service over the next twenty years. All new pumps are recommended to be provided with variable frequency drives to reduce energy use and to provide operational flexibility. The waste activated sludge pumps, plant water pumps (effluent flushing water pumps), plant recycle pumps (wet well pumps), scum pump, supernatant pump and sump pumps are recommended to be replaced in kind. The return activated sludge pumps will be sized to accommodate the increased flows to the WWTF and the TR-16 requirement to provide 100% of maximum month flow. The following is a summary of the pumps recommended for replacement:

- Waste Activated Sludge Pumps – two (2) centrifugal end suction (3.0 HP)
- Plant Water Pumps– two (2) centrifugal end suction (1 - 15 HP and 1 - 30 HP)
- Plant Recycle Pumps – three (3) centrifugal end suction (7.5 HP)
- Scum Pump – one (1) horizontally mounted plunger pump (5 HP)
- Supernatant/Truck Loading Pump - one (1) horizontally mounted plunger pump (5 HP)
- Sump Pumps – three (3) submersible solids handling pumps (1 HP)
- Return Activated Sludge Pumps – three (3) centrifugal end suction chopper (15 HP)

Cost Summary. The estimated cost for the replacement of the ancillary pumping systems described above is $955,000.

Chemical Storage and Feed Systems

As described in Chapter Five, the existing phosphorus removal chemical storage and feed system has reached the end of its service life and is located in the Basement of the Operations Building with poor system access. In addition, the existing sodium hypochlorite and sodium hydroxide systems in the Influent Building have also reached the end of their service lives. Finally, the sludge dewatering polymer system has also reached the end of its service life and is recommended for replacement. Based on the recommended liquid process alternatives discussed previously in this Chapter, a number of new chemical storage and feed systems are also required. The Blue PRO system requires the use of ferric chloride for phosphorus removal. This ferric system would also be used to dose ferric chloride to Distribution Box No. 2 upstream of the final settling tanks for partial total phosphorus removal upstream of the Blue PRO system. The Blue PRO system also requires the use of polymer for improved zinc removal. The implementation of the 4-Stage Bardenpho process for nitrogen removal will require the addition of a carbon source to the second anoxic zone. While methanol is commonly used for this application, due to setback requirements and safety concerns, it is recommended that Micro-C, (a proprietary carbon source) be implemented for carbon supplementation at the South Street WWTF. As noted earlier, the Belt Filter

Press polymer system for solids handling is recommended for replacement. This system is covered in the Solids Handling Section of this Chapter.

The existing location of the phosphorus removal chemical storage and feed systems has been recommended to be converted into a new thickened sludge storage tank and relocation of the chemical feed system is required. It is therefore recommended that a new chemical storage and feed building be constructed in the location of Sludge Storage Tank No. 3, in the location of the 1968 headworks area adjacent to the existing Control Building. The existing glass storefront storage area of the Control Building would be demolished to allow a new chemical storage area to be constructed in its place. The new chemical storage tanks, including the ferric chloride, Micro-C, the Blue PRO polymer system and the sodium hypochlorite feed system would be located within this structure. The new building would be approximately 42 feet by 24 feet. The proposed 6,000 gallon ferric chloride and Micro-C tanks will be depressed within the existing sludge storage tank to minimize concrete and excavation costs to meet the necessary containment volume. Three redundant chemical feed pumps would be provided for the ferric chloride system, including one for dosing at Distribution Box No. 2, one for the Blue PRO system and a spare that could be used for either dosing location. The Micro-C system will be provided with two dedicated feed pumps, one for each set of aeration tanks, as well as a third redundant feed pump that would be configured to feed either set of aeration tanks.

The sodium hypochlorite system is anticipated to be a tote based system with feed pumps for dosing chemical for odor and process control.

The sodium hydroxide feed system is used to provide alkalinity to the plant influent in the Influent Building. The sodium hydroxide system is recommended to include storage space and containment pallets for two (2) 55-gallon drums and two (2) chemical feed pumps. The recommended location of the Chemical Storage and Feed Building is shown on **Figure 9-7**

Cost Summary. The estimated capital cost for the new chemical storage building, chemical storage and feed systems as noted above is estimated to be $2,185,000. The cost of the polymer system for the recommended centrifuge is included in the solids handling Section of this Chapter.

Electrical Systems

As described in Chapter Five, the existing electrical distribution system and equipment has reached the end of its service life. In addition, the existing electrical equipment is not adequately sized to treat the projected flows over the 20 year design period. The recommended electrical upgrades for the South Street WWTF include:

- Provide new electrical service and 1,000 kVA transformer.
- Provide new 1,600 amp 480 VAC main electrical switchboard at new main electrical room in UV Disinfection and Garage Building.
- Replace existing 800 amp switchboard at the Operations Building.
- Provide new electrical distribution network, duct banks and electrical feeds to all existing and new equipment.
- Provide new 600 kW diesel fired standby emergency generator.

Cost Summary. The estimated capital cost to upgrade the existing electrical system is $6,945,000.

Instrumentation and Control Systems

As described in Chapter Five, the WWTF has limited instrumentation and control with the exception of some manufactured provided controls for certain unit processes and is not currently served by a centralized instrumentation and control system. Due to its age, the limited instrumentation at this facility is not expected to provide reliable service in the future and is recommended for replacement.

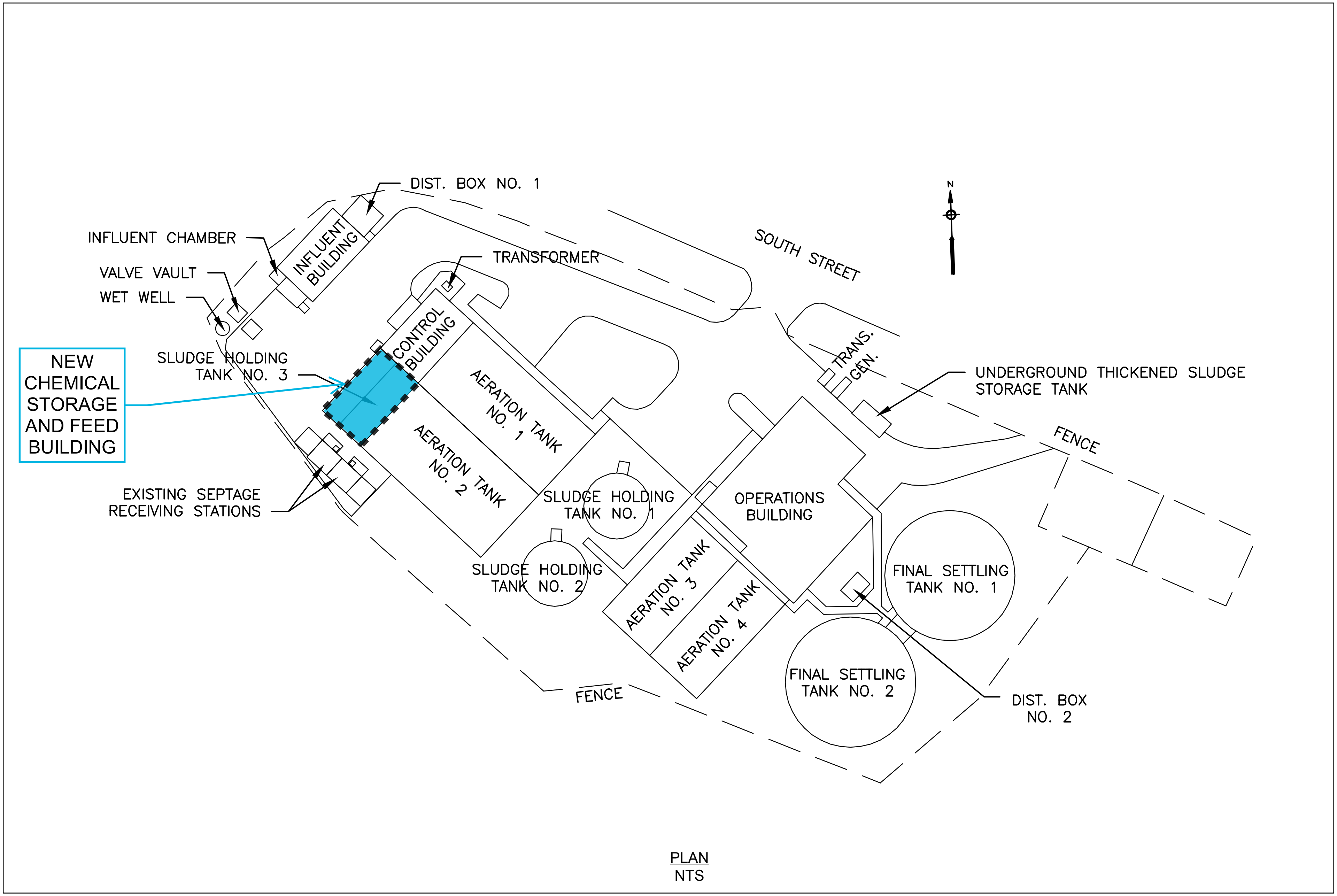


FIGURE 9-7
SOUTH STREET WWTF
RECOMMENDED CHEMICAL
STORAGE AND FEED BUILDING
LOCATION

The installation of an instrumentation and control system is recommended for the facility. An industry standard supervisory control and data acquisition (SCADA) system is recommended. At a minimum this SCADA system should allow for monitoring and alarm functionality of the major WWTF systems with control provided to some specific equipment. The system should also be provided with a historian for data tracking, trend monitoring and report generation.

Monitoring recommendations include the following including the installation of field instrumentation as necessary:

- Influent Pump Station equipment status and run time and wet well levels
- Status and run time for mechanical equipment
- Aeration Tank dissolved oxygen and aeration header pressure
- Tank/channel levels in the Preliminary treatment systems, septage tanks, Distribution Box No. 1, UV system, WWTF Recycle Wet Well, sludge storage tanks, fuel oil and chemical storage tanks
- Aeration Tank dissolved oxygen.
- Multichannel online phosphate analyzer
- UV Disinfection system intensity
- Post Aeration dissolved oxygen
- Process flows (plant flow, RAS, WAS, septage)
- Power status (utility vs. standby generator)
- Building temperatures

Systems that are recommended to be provided with local and remote alarms include:

- Influent Pump Station equipment and high wet well levels
- Influent Building preliminary treatment system equipment
- Aeration Tank mixers and blowers
- Blue PRO system
- Chemical feed pumps
- UV Disinfection system
- Post-Aeration system
- Critical high tank/channel levels in the Influent Building and sludge storage tanks
- Safety alarms including chemical feed eyewash/shower activation, Influent Building gas detection, operator emergency push buttons, fire alarms
  Main power failure status (utility vs. standby generator)
- Low building temperatures

Systems that are recommended to be provided with SCADA system control include:

- Influent Pump Station operations
- Septage Pumping
- Chemical Dosing
- Aeration tank dissolved oxygen
- UV Disinfection flow pacing
- Post Aeration dissolved oxygen
- RAS flow pacing
- Automatic WAS wasting
- Recycle wet well operations
- Plant water pump operations

Cost Summary. The estimated capital cost for the implementation of the recommended plant SCADA system and field instrumentation is $3,000,000.

HVAC Upgrades

As noted in Chapter Five, the existing HVAC systems at the WWTF are not expected to provide reliable service for the next 20 years and it is recommended that the HVAC systems in the Influent Building, Control Building, and Operations Building be replaced. It is recommended that the existing boilers in the Operations Building and Control Building be replaced with natural gas fired boilers of the same size.

Fuel Oil Systems. As noted in Chapter Five, the fuel oil system at the WWTF consists of two underground fuel storage tanks and fuel oil piping that serve the Operations Building and Influent Building. Due to the age of the fuel oil system, it is not anticipated that it will provide reliable service for the next 20 years. Instead of replacing the fuel oil system in kind, it is recommended that the South Street WWTF connect to natural gas service and replace all fueled equipment. It is recommended that the standby generator be replaced with a diesel power generator and dedicated above grade fuel storage tank as natural gas generators are not available at the recommended size.

Cost Summary. The estimated capital cost for HVAC upgrades at the South Street WWTF is $700,000. The estimated capital cost includes the conversion of the existing Control Building into dedicated administrative and storage space. The estimated capital cost also includes connection to the natural gas utility, as well as replacement of all existing air handling and miscellaneous HVAC equipment. These costs do not include the HVAC systems in the new buildings (Blower Building, Septage Building and UV Disinfection / Garage) as the HVAC costs have been included in the new building estimated costs.

Based on correspondence with Eversource, the estimated customer contribution for the connection of the site to the Eversource natural gas supply in South Street would be approximately $40,000. This cost is included in the estimated capital cost above.

ARCHITECTURAL AND STRUCTURAL UPGRADE RECOMMENDATIONS

Architectural Upgrades

As noted in Chapter Five, the South Street WWTF lacks adequate administrative and storage space. To address this issue, it is recommended that the existing Control Building be updated to provide new office and storage space. The recommended layout is depicted in **Figure 9-8**.

It is also recommended that the existing ballasted roofing systems on the Influent Building, Control Building and Operations Buildings be replaced as they have reached the end of their service life. These roofs are recommended to be replaced in kind, with minor repairs required to the underlying precast concrete planks below the Operations Building lower roof of the Filter Room.

In addition, the following additional architectural upgrades are recommended:

- Paint all interior walls and piping.
- Repair damaged Exterior Insulated Finish System (EIFS) building façade.
- Upgrade of the existing laboratory in the Operations Building with new cabinetry, countertops and equipment.
- Replacement of existing damaged doors.

Structural Upgrades

As noted in Chapter Five, there are locations throughout the WWTF that show cracked and delaminated concrete. In addition, the replacement of the existing roofs at the Influent Building, Control Building and Operations Buildings will require that each building be evaluated to meet current building codes. Due to the construction of the existing roofs, it will likely be necessary to provide modifications to bring the roofs into compliance with current building codes.

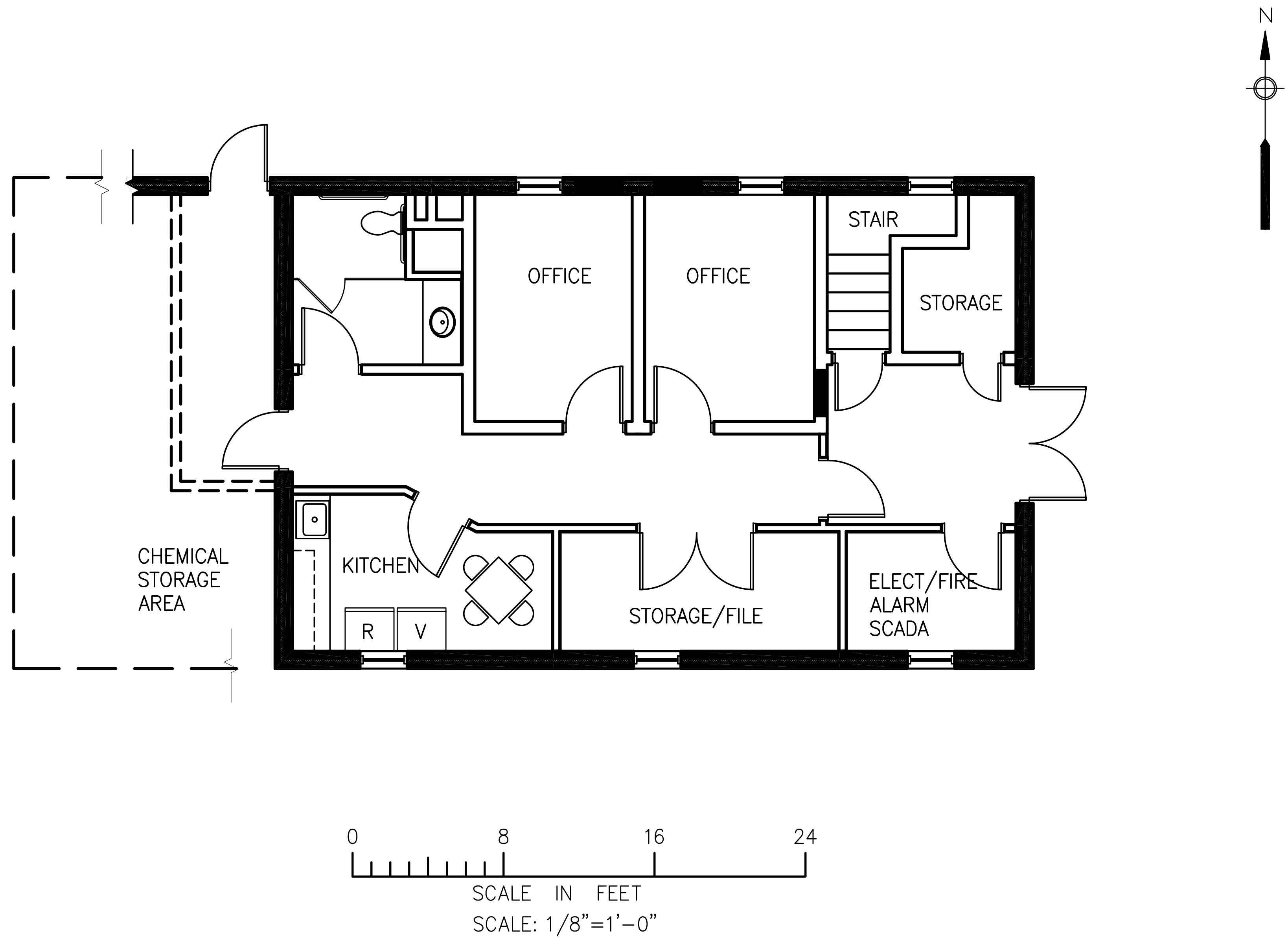


FIGURE 9-8
SOUTH STREET WWTF
RECOMMENDED MODIFIED CONTROL BUILDING
FIRST FLOOR LAYOUT

Cost Summary. The estimated capital cost for architectural and structural upgrades at the South Street WWTF is $1,230,000. The estimated capital cost includes removal of the non-functioning equipment, the conversion of the existing Control Building into dedicated administrative and storage space, including new access doors, painting and new windows.

Hazardous Materials Removal and Remediation

A summary of the hazardous materials (lead, asbestos and PCBs) identified through an on-site survey at the South Street WWTF are summarized on Chapter Five. It is recommended that these materials be removed and remediated as required by federal and state law. Additional samples may be required to confirm the presence of the hazardous materials that have been assumed in some building materials that will be impacted during construction (ex. foundation mastic) and to assess the extent if any of the PCB containing building materials have had PCB contamination migrate into the adjacent masonry materials (ex. PCB window caulk migrating into the exterior building brick).

Cost Summary. The estimated cost for the remediation of PCBs, lead and asbestos located in the existing buildings based on preliminary sampling performed during the Phase 2 Facilities Planning efforts is $290,000.

ENERGY EFFICIENCY UPGRADES

General

Upgrades to the WWTF should consider the inclusion of energy efficient components where their long term benefits outweigh the additional capital costs associated with these components. Once the recommended facilities plan upgrade items (systems/building) are finalized, the ability to include energy efficient items/enhancements should be examined in more detail during design. Systems that are recommended to be reviewed as it relates to energy efficiently include:

- Electrical systems including the use of:
  - Variable speed motors
  - High efficiency motors/drives
- Instrumentation and control systems (SCADA) to reduce energy use.
- High efficiency HVAC systems including:
  - Plant Effluent Heat Pump Systems (ex. potentially to be used to heat the new septage receiving facility)
  - Solar walls for energy efficiency for existing and new structures.

Energy incentive funding from Eversource may be available for some of these upgrades. The potential for energy incentive funding should be reviewed during design. After review of these energy efficiency items and the potential energy incentive funding available, recommended energy efficiency items will be presented in a preliminary design report.

Solar Panels

The Town has expressed interest in solar panels for reducing the cost of power used at the WWTF. Solar panel systems can be configured in many different ways with varying complexity depending on the installation location, the economic payback, and the ultimate use of the power. For example, the panels can be the fixed mount type or tracking type (which will move the panels to track the movement of the sun). The tracking types are available in both single axis and dual axis type. There are also three types of inverters that can be used for converting the panel generated DC current into usable AC current. These inverter types are categorized as central inverters, string inverters, and micro inverters. The tie in of the solar system to the WWTF electrical distribution system can also be configured in different ways. The systems can be tied in to the main electrical distribution switchgear or it can be tied into an electrical sub distribution component (motor control centers). Finally, if the solar system is large enough, net metering or the ability to sell electricity back to the grid could be considered. Net metering could be considered if the potential generated solar power is large enough to result in excess power. However it is believed that the ability to generate enough power to warrant net metering is unlikely at the South Street WWTF.

Due to the high capital expenditure to provide solar panels and their ancillary systems, many municipalities have looked into solar power purchase agreements. Under these agreements a third party solar provider will essentially lease the roof or yard space and install and maintain a solar panel system at no cost to the Town. In return, the solar provider will sell the power generated by the solar panel system to the Town at a reduced cost through a power purchase agreement. These leases are typically 20 years in duration at which point the solar panels and their ancillary system are turned over to the Town. These solar power purchase agreements typically come with the requirement that any roof mounted units be installed on new roofs. It should be noted that based on the recommendations of the Facilities Plan that the WWTF will have new roofs on all buildings after the upgrade. While there are advantages and disadvantage to these power purchase agreements, the advantage of no initial capital outlay by the Town is attractive. However, one potentially significant disadvantage of the purchase power agreements is the potential loss of a 20% Clean Water Funding (CWF) grant from the DEEP for the solar panels. The DEEP has indicated that if a solar project element was part of a comprehensive WWTF upgrade project and the system was deemed cost effective, then it would be eligible for a 20% CWF grant.

Based on complexity of the different types of solar systems and components, the means to procure solar systems, the solar system costs and the potential available grant funding, it is recommended that during design the Town discuss and assess if and how they would like to proceed with the design and procurement of a solar system for the WWTF. As noted above, the solar panel system design and procurement could be implemented as part of a comprehensive WWTF upgrade project or as a separate follow up project, or through a power purchase agreement after the WWTF has been upgraded. In either case it is recommended that the electrical upgrade at the WWTF be designed with some flexibility to accommodate a solar panel system in the future.

SITE IMPROVEMENT RECOMMENDATIONS

The existing pavement at the site has reached the end of its service life. Coupled with its age and the recommended WWTF upgrades construction, it is recommended that all paved surfaces and curbing at the plant be replaced at the end of construction with new pavement along with landscaping restoration. In addition, portions of the perimeter fence are from the original 1968 construction. As a result, it is recommended that the perimeter security fence be replaced. Finally, the addition of a motor operated vehicle entrance gate is recommended to allow for site access via access card or remote entry from the WWTF control room.

Cost Summary. The estimated cost for the general civil site upgrades as described above is $430,000. The cost for the civil site work associated with all new buildings has been included in those sections as described earlier in this Chapter.

RESILIENCY

In order to address resiliency at the WWTF a number of items are recommended. As noted in Chapter Five, the resiliency issues that are recommended to be addressed by TR-16 relate to flooding potential as well as backup power. The recommendation to provide a new standby generator has been addressed in the Electrical and Emergency Power Systems section above. The new generator and fuel oil system are recommended to be sized, at a minimum, based on critical WWTF system electrical load needs and the specified fuel oil storage days as defined in TR-16.

To address the potential flooding issues, the FEMA flood map in the area of the Route South Street WWTF was reviewed. Based on this review, the all buildings at the WWTF are above the TR-16 recommended elevation of three feet above the 100 year flood elevation. As a result, no specific elements to address flooding as it relates to these requirements are recommended.

Costs. There are costs associated with providing the new standby generator and fuel oil systems for the WWTF. These costs have been included in the costs previously presented for the electrical and fuel oil system recommendations, respectively.

TOTAL ESTIMATED UPGRADE CAPITAL COST

Table 9-2 presents a summary list of the final recommended upgrades for the South Street WWTF based on input from the WPCA and SUEZ at the recommendations workshop. The total estimated capital cost for the upgrade recommendations at the South Street WWTF to treat flows from Sewer District No. 1 is $32,560,000.

TABLE 9-2. SOUTH STREET FINAL RECOMMENDED WWTF UPGRADES-ESTIMATED CAPITAL COST SUMMARY

Improvement / Upgrade Element	Estimated Cost
Liquid Process	
Influent Pump Station	$880,000
Septage Receiving	$1,045,000
Influent Building	$1,230,000
Total Nitrogen Removal – 4-Stage Bardenpho	$4,100,000
Final Settling Tanks	$895,000
Tertiary Treatment – Blue PRO Process	$3,010,000
UV Disinfection / Post Aeration / Maintenance Garage Facility	$3,310,000
Solids Handling	
WAS Storage / Centrifuge Thickening /Thickened Sludge Storage	$1,560,000
Ancillary Systems	
Odor Control Systems	$795,000
Ancillary Pumping Equipment	$955,000
Chemical Storage and Feed Systems	$2,185,000
Electrical Systems	$6,945,000
Instrumentation and Control Systems	$3,000,000
HVAC	$700,000
Architectural and Structural Upgrade Recommendations	
Architectural and Structural Systems Upgrades	$1,230,000
PCB / Lead / Asbestos Removal and Remediation	$290,000
Site Improvements	$430,000
Total Costs	**$32,560,000**

The total estimated capital costs are preliminary planning level costs and have been developed based on a number of assumptions and may not represent the final project capital costs for the facilities once designed. The final costs could be higher or lower depending on what decisions are made during the design phase, how the final facilities are constructed, and when the final facilities are constructed.

CHAPTER TEN
ROUTE 7 WWTF DECOMMISSIONING EVALUATIONS

The previous chapters have identified alternatives, recommended upgrades, and costs should both the Route 7 WWTF and the South Street WWTF continue to independently treat flows and loads from Sewer District No. 2 and Sewer District No. 1, respectively. This Chapter presents an evaluation of alternatives to decommission the Route 7 WWTF and convey the Sewer District No. 2 flows and loads to either the South Street WWTF for treatment or to the Danbury sewer system for treatment at the Danbury WWTF. This chapter includes discussion of the following items:

- Combined South Street WWTF Flows, Loads and, Effluent Limits
- Route 7 Pump Station
- Force Main Alternatives to South Street WWTF
- Route 7 WWTF Decommissioning
- Additional South Street WWTF Upgrades to Accommodate the Sewer District No. 2 Flows and Loads
- Route 7 WWTF Decommissioning and Conveyance to South Street WWTF Alternatives Evaluation
- Route 7 WWTF Decommissioning and Conveyance to Danbury's Sewer System Alternative Evaluation

These items are presented below.

COMBINED SOUTH STREET WWTF FLOWS, LOADS, AND EFFLUENT LIMITS

The current and projected year 2035 flows and loads from each sewer district are presented in detail in Chapter Four. For the Route 7 WWTF decommissioning alternatives, it is assumed that the new pump station and force main would be required to convey the current and projected the average and peak day flows to an alternate location. Bringing the additional flows and loads from Sewer District No. 2 to the South Street WWTF will increase the South Street WWTF's influent flows and loads. Chapter Four presents a summary of the current and projected year 2035 flows and loads for the combined sewer districts at the South Street WWTF.

Bringing the additional flows and loads for Sewer District No. 2 to the South Street WWTF will also have an impact on the South Street WWTF's NPDES effluent permit limits and the target total nitrogen effluent load in the Connecticut General Permit for Nitrogen Discharges. Due to anti-backsliding permit provisions and the fact that a number of the effluent limits at the South Street WWTF are mass based, this will require that the WWTF treat additional flows and loads and produce an effluent of higher quality. A summary of the anticipated required effluent limits at the South Street WWTF when treating the flows and loads from both Sewer District No. 1 and Sewer District 2 are summarized in Chapter Four. In order to treat the additional flows to a higher quality, additional upgrade modifications will be required at the South Street WWTF compared to those to treat the Sewer District No. 1 flows only as presented in Chapter Nine. These additional upgrades are summarized later in this chapter.

ROUTE 7 PUMP STATION

Description

To convey flow from Sewer District No. 2, a new pump station is recommended to be constructed on the site of the existing Route 7 Influent Pump Station. The Route 7 Pump Station would be constructed in a similar manner to the construction of the Route 7 Influent Pump Station (for pumping to the Route 7 WWTF) summarized in Chapter Six and Chapter Eight, including the use of a bypass pumping system to convey flow through the existing force main to the Route 7 WWTF during construction of the pump station and force main which is described later in this chapter.

For conveyance of flows to the South Street WWTF, the pump station will be sized for a total flow of 500 gallons per minute (gpm), with pumps rated at 205 feet total dynamic head (TDH). Similar to the Route 7 WWTF Influent Pump Station (summarized in Chapter Six and Chapter Eight), it is recommended that three pumps, each sized for half of the total design flow be provided. The third pump would serve as a redundant spare. The pumps would be required to serve relatively low flow with high head conditions. As a result, it is recommended that a staged pumping system be provided to increase the efficiency of the new pump station. The new Route 7 staged pump station would include three submersible solids handling pumps rated for 250 gpm at approximately 105’ TDH. The submersible pumps would discharge to three dry pit submersible pumps located in an adjacent below grade vault. The dry pit submersible pumps would be rated at 250 gpm at approximately 100’ TDH and discharge to a conveyance force main. It should be noted that the Middle School Pump Station, which was installed in 2003, had similar design conditions and uses the same staged pumping configuration.

In addition to the pumping systems, a standby generator is recommended to be installed to provide backup power to the pump station in the event of loss of utility power. Also due to the length of the force main and the expected residence time of the wastewater in the force main it is also recommended that a potassium permanganate system be provided for hydrogen sulfide and corrosion control. This system would be housed in a new building at the pump station site and include chemical drum storage and feed systems including chemical feed pumps and control systems, chemical containment, and safety eyewash/shower systems. The recommended layout of the Route 7 Pump Station is shown in **Figure 10-1**. The pump station for the alternative of conveyance of flow to Danbury would be similar and is discussed later in this chapter.

Estimated Cost

The estimated capital cost to construct the new Route 7 Pump Staton for conveyance of Sewer District No. 2 flows to the South Street WWTF as described above is $2,715,000.

FORCE MAIN ALTERNATIVES TO SOUTH STREET WWTF

Alternatives

Two force main alternatives between the new Route 7 Pump Station to the South Street WWTF were developed and evaluated. The force main alternatives are as follows:

- Alternative 1 – Existing Route 7 WWTF Force Main, Cross Country by the Water Tank, Route 35 Route “Route 35 Route”
- Alternative 2 - Route 7, Haviland Road, Limekiln Road, Lee Road, Farmingville Road Route “Local Road Route”

The force main alternatives are shown on **Figure 10-2** and described in **Table 10-1**. It should be noted that Alternative 1 assumes that the existing Route 7 force main that conveys flow from the Route 7 WWTF Influent Pump Station to the Route 7 WWTF is reused. The existing force main was installed at the same time as the Route 7 WWTF and the Route 7 WWTF Influent pump station in the mid-1980s. The force main is an 8-inch diameter cement lined ductile iron pipe, approximately 2,150 linear feet in length. The reuse of the existing force main versus providing new pipe along this existing route will be evaluated during design.

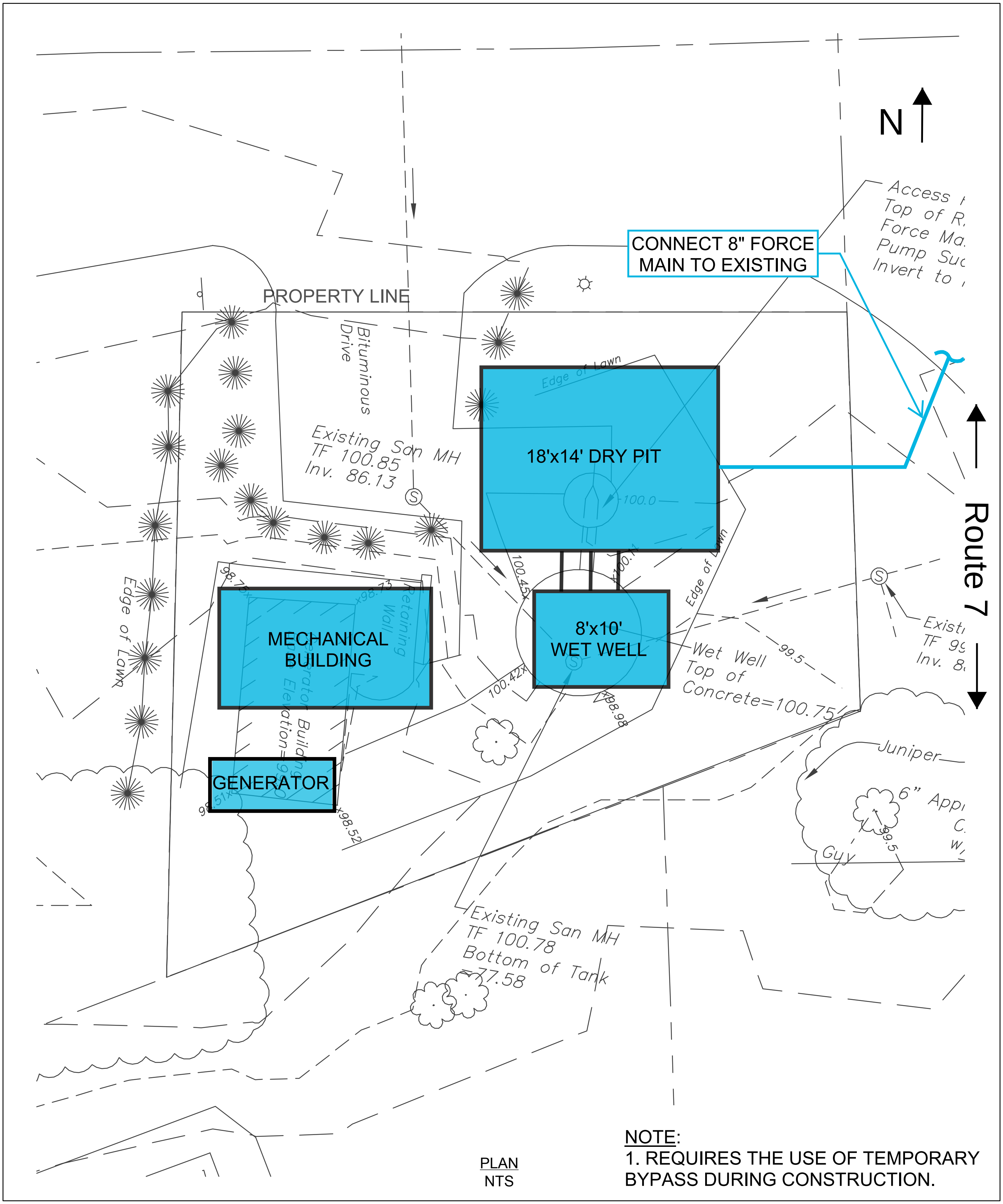
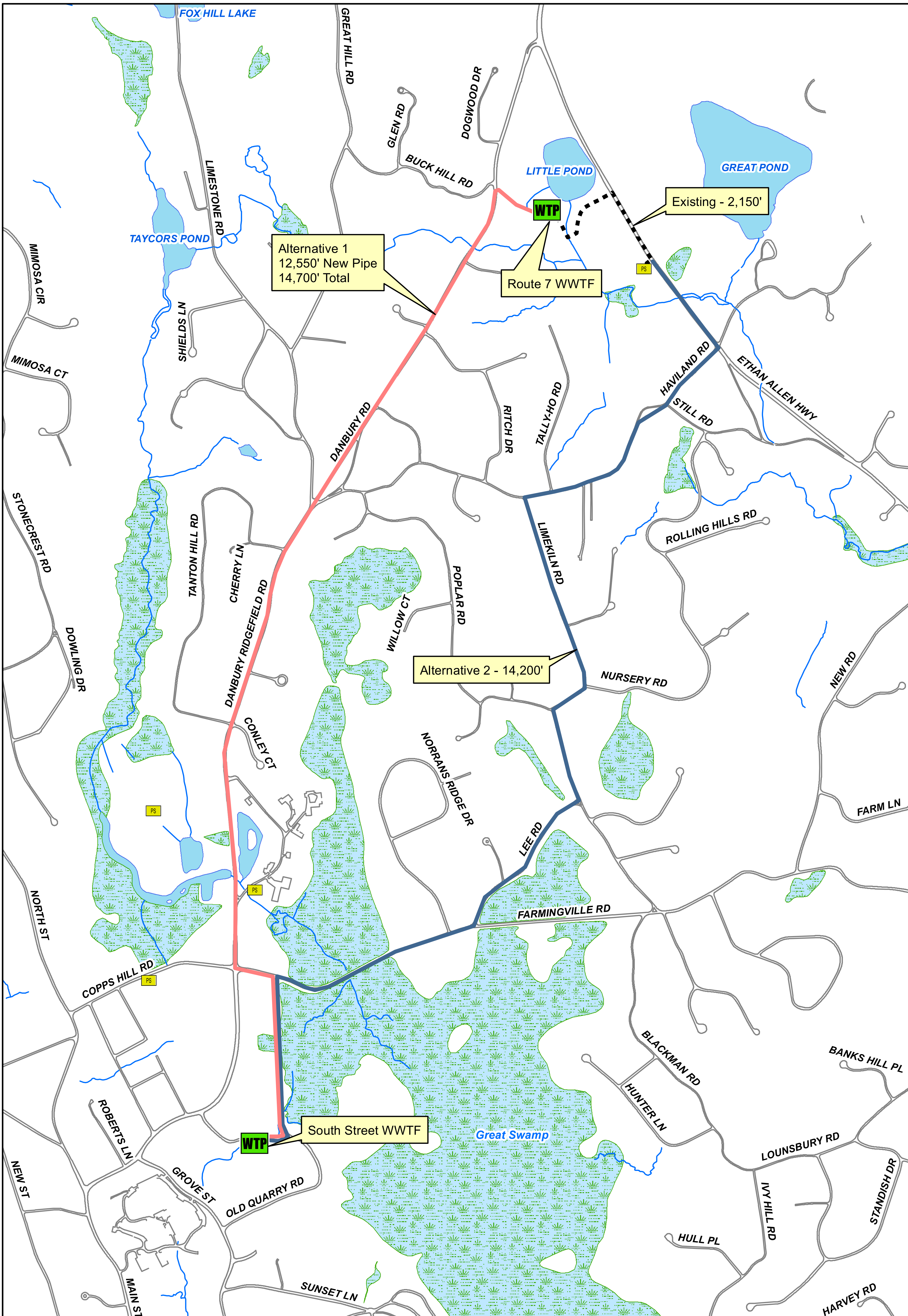


FIGURE 10-1
ROUTE 7 PUMP STATION TO SOUTH STREET WWTF



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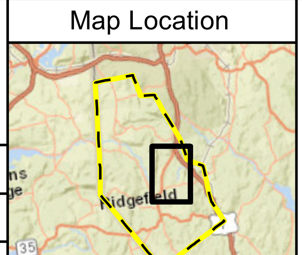
Drawn: JM 1/9/2017

Approved: MR 1/9/2017

Map Location



Legend

- WTP WWTP
- PS Pump Station
- Road Edge
- Streams
- Waterbodies
- Swamps

Route 7 Force Main
- Alternative 1
- Alternative 2
- Existing

0 200 400 800 Feet

N

FIGURE 10-2

ROUTE 7 DECOMMISIONING
PUMP TO SOUTH STREET
FORCE MAIN ALTERNATIVES

PHASE 2 WASTEWATER FACILITIES PLAN
RIDGEFIELD, CT

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TABLE 10-1. FORCE MAIN ALTERNATIVES TO SOUTH STREET WWTF SUMMARY

Alternative	Route Description	Total Force Main Length	New Pipe Length
1	Existing Route 7 WWTF Force Main, Cross Country by the Water Tank, to Route 35	14,700	12,550
2	Route 7, Haviland Road, Limekiln Road, Lee Road, Farmingville Road, to Route 35	14,200	14,200

Estimated Costs

The estimated capital costs for the force main alternatives between the Route 7 Pump Station and the South Street WWTF are as summarized in **Table 10-2**. These estimated costs include the pipe installation, trench and estimated rock excavation, bridge crossings, pavement restoration (full road width for local roads and half road width for state roads), police, and traffic control.

TABLE 10-2. FORCE MAIN ALTERNATIVES TO SOUTH STREET WWTF CAPITAL COSTS

Alternative	Capital Cost
Existing Route 7 WWTF Force Main, Cross Country by the Water Tank, to Route 35	$4,595,000
Route 7, Haviland Road, Limekiln Road, Lee Road, to Farmingville Road	$5,585,000

Alternative Advantages and Disadvantages

Each of the force main alternatives between the Route 7 Pump Station and the South Street WWTF has advantages and disadvantages associated with its implementation. **Table 10-3** summarizes the advantages and disadvantages of the different force main alternatives.

ROUTE 7 WWTF DECOMMISSIONING

Description

Should Sewer District No. 2 flows and loads be conveyed to the South Street WWTF (or Danbury sewer system) it is recommended that the Route 7 WWTF be decommissioned to reduce the risk of material contamination, liability issues related to worker or trespassers being injured on the site, and to allow for the potential repurposing of the site for another use. As a result, it is recommended that the existing buildings, tanks, and other facilities at the WWTF be demolished and the area be restored. It is recommended that the demolition and restoration consist of the following:

- Removal of mechanical and electrical equipment
- Demolition of above grade structures
- Demolition of below ground structures to a depths of three feet below grade
- Provisions for water drainage of below ground tanks and structures
- Filling in of below ground tanks and structures
- Finish grading and restoration of decommissioned site

TABLE 10-3. FORCE MAIN ALTERNATIVES TO SOUTH STREET WWTF ADVANTAGES AND DISADVANTAGES

Pipeline Route Alternative	Advantages	Disadvantages
Existing Route 7 WWTF Force Main, Cross Country by the Water Tank, to Route 35	• Shorter new pipe length • Lower capital cost • Less construction in residential neighborhoods	• Construction along major traffic route • Slightly higher operating costs • Approximately 2,150 ft of pipe (reused) will be 30 years old. • Likely more utility conflicts along route • May require easement through water tank property
Route 7, Haviland Road, Limekiln Road, Lee Road, Farmingville Road	• Construction not along a major traffic route • Slightly lower operating costs • Entire pipeline will be new • Likely fewer utility conflicts along route • Entire pipeline within public roadway	• Longer new pipe length (14,200 ft.) • Higher capital cost • More construction in residential neighborhoods

After demolition, there is the possibility to repurpose the site. Potential options for repurposing the site include selling the land, providing green space, or the installation of a solar panel system. An evaluation for repurposing of the site has not been performed as part of this Facilities Plan.

Estimated Cost

The estimated capital costs to decommission, demolish, and restore of the Route 7 WWTF site as noted above is $500,000. Evaluation of the potential for or estimates of revenue from repurposing the site has not been included in the evaluation or estimated costs.

ADDITIONAL SOUTH STREET WWTF UPGRADES TO ACCOMMODATE SEWER DISTRICT NO. 2 FLOWS AND LOADS

In order to accommodate the Sewer District No. 2 flows and loads at the South Street WWTF and to meet the anticipated more stringent effluent permit limits, upgrades to the South Street WWTF would be required. These upgrades are in addition to those recommended for the South Street WWTF for Sewer District No.1 flows only presented in Chapter Nine. These upgrades include the following:

- Higher capacity influent pumps in the Influent Pump Station
- Higher capacity aeration tank blowers and ancillary systems including a larger Blower Building.
- An additional tertiary phosphorus removal Blue PRO filter cell with two filter manifolds and slightly larger ancillary facilities for tertiary phosphorus removal.
- Higher capacity UV disinfection system.

The majority of the other recommended South Street WWTF upgrades summarized in Chapter Nine remain unchanged.

Estimated Cost

The estimated capital costs for the additional upgrades to accommodate the Sewer District No. 2 flows and loads at the South Street WWTF in addition to those presented in Chapter Nine as noted above is $530,000.

ROUTE 7 WWTF DECOMMISSIONING AND CONVEYANCE TO SOUTH STREET WWTF ALTERNATIVES EVALUATION

The section below presents an evaluation of decommissioning the Route 7 WWTF and conveying the Sewer District No. 2 flows to the South Street WWTF versus maintaining independent treatment at the two Ridgefield WWTFs. As summary of the two alternatives evaluated is as follows:

- Continuing to treat the flows and loads from Sewer District No. 1 and Sewer District No. 2 at the South Street WWTF and Route 7 WWTFs independently.
- Decommissioning the Route 7 WWTF including:
    - Demolition and decommissioning of the Route 7 WWTF.
    - Construction of a new Route 7 Pump Station.
    - Construction of a new force main between the Route 7 Pump Station and the South Street WWTF.
    - Additional upgrades the South Street WWTF to accommodate the Sewer District No. 2 flows and loads.

Estimated Costs

A comparison of the estimated capital costs, operation and maintenance costs, and life cycle costs for the decommissioning alternatives noted above was performed. A summary of the development of these alternatives is summarized below.

Capital Cost. Comparative capital costs of the two alternatives were developed. The comparative capital cost include the cost to upgrade the Route 7 WWTF (per the recommendations indicated in Chapter Eight) versus the costs to demolish and decommission the Route 7 WWTF, construct a new Route 7 Pump Station, construct a force main between the Route 7 Pump Station and the South Street WWTF, and the additional costs for the upgrades at the South Street WWTF to accommodate the Sewer District No. 2 flows and loads. For the purposes of the evaluation of the Route 7, Haviland Road, Limekiln Road, Lee Road, Farmingville Road force main route has been assumed. It should be noted that this is the more costly of the two force main routes.

Comparative Operation and Maintenance Costs. Comparative operation and maintenance costs for the two decommissioning alternatives were developed. These costs included estimates of a number of operation and maintenance cost elements related to the different alternatives which are summarized in **Table 10-4**. The comparative operation and maintenance costs were assumed to be the additional costs to treat the average daily flows and loads of both sewer districts. These average day conditions included annual flow and loading increases between the current year condition and the projected year 2035 conditions over the 20 year evaluation period.

Alternatives Cost Comparison. Estimated capital costs, operation and maintenance costs, and life cycle costs for the Route 7 WWTF decommissioning alternatives are summarized in **Table 10-5**.

In addition to the estimated costs summarized in **Table 10-5,** an evaluation of the estimated costs of both alternatives was performed to determine the potential impact on the ability to receive funding assistance to reduce the capital cost for the different alternates' project elements, specifically funding assistance from the CT DEEP Clean Water Fund in grants. More detailed information as it relates to the Clean Water Fund grant and loan program is included in Chapter Eleven. Two project components that are unusual as they relate to their ability to qualify for funding through the Clean Water Fund are the Route 7 Pump Station and force main under the alternative to decommission the Route 7 WWTF. A brief discussion of the Route 7 Pump Station and force main funding eligibility is below.

TABLE 10-4. ROUTE 7 WWTF DECOMMISSIONING ALTERNATIVES COMPARATIVE OPERATION AND MAINTENANCE COST ELEMENTS SUMMARY

Cost Components	Route 7 WWTF and South Street WWTF Separate Cost Elements	Decommission Route 7 WWTF, Convey and Treat All Flows at South Street WWTF Cost Elements
Electrical Costs	Route 7 WWTF and Route 7 WWTF Influent Pump Station Operation Costs	New Route 7 Pump Station, Force Main Corrosion Control, and Additional South Street WWTF Treatment Operation Costs
Labor and Maintenance Costs	Route 7 WWTF and Route 7 WWTF Influent Pump Station Operation Costs	New Route 7 Pump Station Costs
Chemical Costs	Route 7 WWTF Phosphorus Removal Costs	Force Main Corrosion Control and Additional South Street WWTF Treatment Operation Costs
Parts and Replacement Cost	Route 7 WWTF and Route 7 WWTF Influent Pump Station Costs	New Route 7 Pump Station Costs
Laboratory and Permit Costs	Route 7 WWTF Monitoring and DEEP Permit Costs	NA

TABLE 10-5 – ROUTE 7 WWTF DECOMMISSIONING ALTERNATIVES ESTIMATED COSTS

Cost Element	Route 7 WWTF and South Street WWTF Separate	Decommission Route 7 WWTF, Convey and Treat All Flows at South Street WWTF
Capital Costs		-
Route 7 WWTF Upgrade	$10,585,000	-
New Route 7 Pump Station	-	$2,715,000
Force Main to South Street WWTF [1]	-	$5,585,000
Additional South Street WWTF Upgrades to Accommodate Sewer District 2 Flows and Loads	-	$530,000
Demolish / Decommission Route 7 WWTF	-	$500,000
Total Capital Cost	**$10,585,000**	**$9,330,000**
Comparative Yearly O&M Cost	**$160,000**	**$25,000**
Comparative 20 Year Present Worth O&M Cost	**$2,160,000**	**$340,000**
Comparative 20 Year Total Present Worth Cost	***$12,745,000***	***$9,670,000***

1 - Assumes the Route 7, Haviland Road, Limekiln Road, Lee Road, Farmingville Road force main route.

Route 7 Pump Station and Force Main Funding Eligibility. Typically collection system improvement projects (pump stations and force mains) do not qualify for grant funding through the Connecticut Clean Water Fund (CWF) but do qualify for low interest loans on the eligible project costs. Given the unique situation of these project elements as it relates to the combining two WWTFs it was believed that these elements may qualify for CWF grant assistance. It is our opinion that these project elements can be viewed as treatment elements as they are an alternative to upgrading the Route 7 WWTF and will result in improved treatment of the wastewater from Sewer District No. 2 as the South Street WWTF and will produce an effluent of higher quality. Based on discussions with the DEEP, indication was given that the Route 7 Pump Station and force main would qualify for a 20% water pollution control project grant for eligible costs. However, for the purposes of a sensitivity analysis the alternative project costs was evaluated assuming the new pump station and force main were not eligible for any grant funding as described below.

For the two alternatives presented in **Table 10-5**, the difference in the comparative 20 year present worth cost is approximately $3.1 million. A coarse sensitivity analysis of the cost of the two alternatives was performed to identify the potential impact on the alternative costs if the Route 7 Pump Station and force main were not eligible for Clean Water Funding grants. This coarse sensitivity analysis was based on the following assumptions:

- All of the components of the Route 7 WWTF upgrade would receive a 20% CWF grant (best case scenario).
- The alternative for decommissioning the Route 7 WWTF, and conveying and treating all flows at the South Street WWTF would receive no CWF grant funding (worst case scenario).

Under these assumptions the $10.6 million estimated upgrade cost for Route 7 WWTF would receive a 20% grant of $2.1 million. This would reduce the 20 year present worth cost for this alternative from $12.75 million to approximately $10.65 million. For the alternative to decommission the Route 7 WWTF and convey and treat all flows at the South Street WWTF it was assumed that it would receive no grant funding. As a result the 20 year present worth coast would remain unchanged at approximately $9.67 million.

Conclusion. The sensitivity analysis shows that even under the best and worst case funding scenarios for the two alternatives as described above, the alternative to decommission the Route 7 WWTF and convey and treat all flows at the South Street WWTF is the least costly alternative.

Alternative Advantages and Disadvantages

The alternatives decommissioning the Route 7 WWTF described above each have advantages and disadvantages. **Table 10-6** summarizes the advantages and disadvantages of these decommissioning alternatives.

CONVEY SEWER DISTRICT NO. 2 FLOWS TO DANBURY

As part of the Phase 2 Facilities Plan effort, an evaluation of an alternative to decommission the Route 7 WWTF and convey the flows to the Danbury sewer system for treatment at the Danbury WWTF was performed. This alternative would require a new pump station at the existing Route 7 Pump Station location and a force main to the Danbury sewer system. The following is a summary of the evaluation.

Danbury WWTF Upgrade

The City of Danbury is currently in the final stage of completing their facilities plan to upgrade their WWTF and is about to start the design of the recommended upgrades. The design is for a WWTF with an average daily flow of 11.54 mgd with new processes to meet an effluent total phosphorus concentration of

TABLE 10-6. ROUTE 7 WWTF DECOMMISSIONING ALTERNATIVES ADVANTAGES AND DISADVANTAGES

Route 7 WWTF Decommissioning Alternative	Advantages	Disadvantages
Decommission Route 7 WWTF, Convey and Treat All Flows at South Street WWTF	• Lower capital cost • Lower operating costs • May allow for the sale or repurposing of the Route 7 WWTF property. • Consolidates all WWTF operations to one facility • Force main has a service life of 50 years[1]	• Loss of Route 7 WWTF NPDES Permit (may preclude future use of WWTF if needed) • Reduction in South Street WWTF future capacity • Future growth to either Sewer District could require costly process upgrade to South Street WWTF • Issues with new force main construction (traffic, neighbors, etc)
Keep Route 7 WWTF and South Street WWTF Separate	• Maintains Rt. 7 WWTF NPDES permit. • Can more readily accommodate future growth in either Sewer District • Reserves some capacity at the South Street WWTF without the need for a costly process upgrade • Eliminates issues with new force main construction (traffic, disruption, etc.)	• Higher capital cost • Higher operating costs • Need to operate and manage two WWTFs • Route 7 WWTF will require another upgrade in 20 years to replace mechanical/electrical components

1. Presented force main route is the “Local Road” route with all new construction. If the “Route 35” route is used the existing Route 7 WWTF force main may be reused and will have a reduced service life. The reuse of the existing force main under the “Route 35” route should be evaluated during design.

0.077 mg/l. Based on discussion with the Danbury Director of Public Utilities, it is believed that the Danbury WWTF could accept the 120,000 gpd design average daily flow from Sewer District No. 2. If Ridgefield wanted to pursue this option, they would need to do so almost immediately as Danbury's engineering consultant is about to start the upgrade design. In addition, Danbury is under the same funding schedule as Ridgefield to have a signed construction contract by July 1, 2019 to be eligible for DEEP's 50% phosphorus grant. Danbury had previously sent Ridgefield information on the cost of the Danbury WWTF upgrade and for the existing Ridgefield flow allocation of 140,000 gpd. The 140,000 gpd consists of 120,000 for Boehringer- Ingelheim (a pharmaceutical industry that straddles the Town line) and 20,000 gpd for the Turner Hill District (Sewer District No. 3). The 140,000 gpd is approximately 1.21% of the Danbury WWTF upgrade design flow. With the available grants, the WWTF upgrade cost for Danbury and the communities they serve is approximately $67.8 MM. As a result of the inter-municipal agreement with Danbury, Ridgefield's portion of the Danbury WWTF upgrade is estimated at approximately $820,000.

For the concept of decommissioning the Route 7 WWTF and conveying the 120,000 gpd Sewer District No. 2 flow to Danbury, Ridgefield would again need to pay for their share of the Danbury WWTF upgrade. Using the same design flow proportion, the 120,000 gpd would represent 1.04% of the 11.54 mgd design flow which would equate to approximately $705,000 of the non-grant funded Danbury WWTF upgrade costs.

Alternative Description

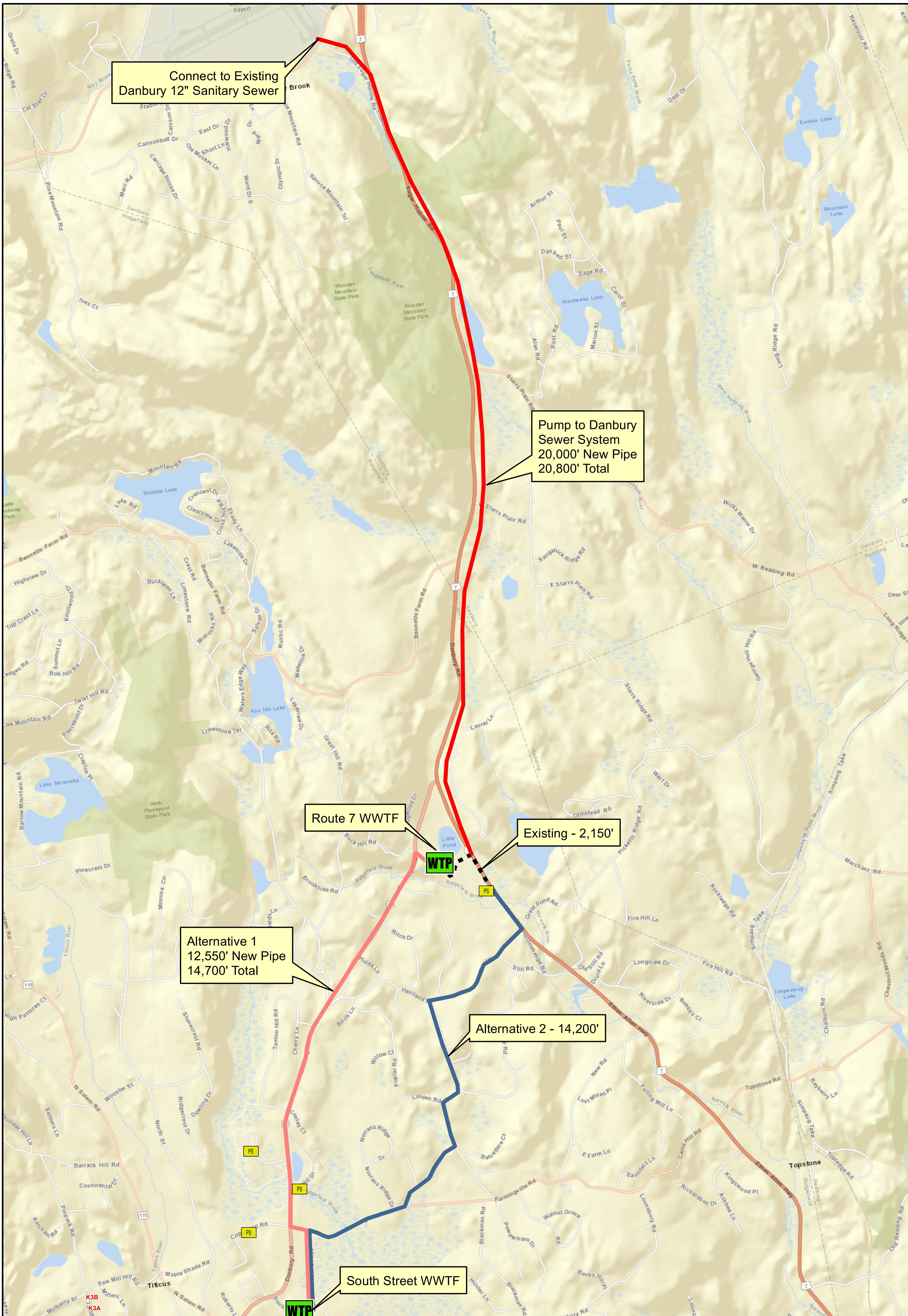
Based on discussions with Danbury, it was noted that the closest location to the Route 7 WWTF where Danbury has sewer service available is a 12" sewer on Sugar Hollow Road at the easterly end of the runway at Danbury Airport. The most direct force main route between the two points is in the road shoulder along Route 7. See **Figure 10-3** for a recommended force main route from the Route 7 Pump Station to the 12" sewer on Sugar Hollow road. The length of this force main is approximately 4.8 miles.

It should be noted that this entire stretch of Route 7 was recently reconstructed by the Connecticut DOT. In addition, the section of the force main route near the airport is constructed on an elevated concrete slab to avoid filling the underlying wetlands. The installation of a force main beneath the slab would be a costly project. For the purposes of this evaluation, it was assumed that approximately 2,600 linear feet of the force main would need to be directionally drilled beneath the wetlands to avoid supporting the force main from the concrete slab.

As noted in previous section, the distance between the Route 7 Pump Station and the South Street WWTF is approximately 2.7 miles. As noted above, the distance to the Sugar Hill Road 12 inch sewer in Danbury is 4.8 miles. This pipeline alternative is almost twice as long and will increase both the capital cost and pumping costs of conveying flows to the Danbury sewer system versus conveying the flows to the South Street WWTF, and increase the potential for odor release at the force main discharge due to the extended detention time.

State Conservation and Development Policy Issues

It should be noted that a portion of the area that the Danbury force main would run through is a public water supply area (Saugatuck Reservoir watershed.) As part of a proposed development requesting extension of sewer service from Sewer District No. 2 in the late 1990s, the DEP noted that among other concerns that the proposed sewer extension was also in this public supply watershed. As a result, the project was not looked upon favorably by DEP when reviewing the project against the Conservation and Development (C & D) Plan Policies for Connecticut. The alternative to convey the Sewer District No. 2 flows via a force main to Danbury along Route 7 and as described above would also likely be viewed unfavorably by the DEEP for a similar reason.



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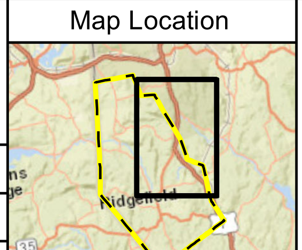
Map Location



Legend

WTP WWTP

PS Pump Station

Route 7 Force Main

Alternative 1

Alternative 2

Existing

0 500 1,000 2,000 Feet

N

FIGURE 10-3

ROUTE 7 DECOMMISIONING
PUMP TO DANBURY
FORCE MAIN

PHASE 2 WASTEWATER FACILITIES PLAN
RIDGEFIELD, CT

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Comparative Capital Costs

The estimated capital costs for the alternatives of Route 7 WWTF decommissioning, conveying and treating of the Sewer District No. 2 flows at either the Danbury WWTF or the South Street WWTF are summarized in **Table 10-7.** For the purposes of comparison, the estimated costs for the new Route 7 Pump Station to convey flows to Danbury is assumed to be the same as the pump station to the South Street WWTF even though the cost would likely be higher due to the increased force main length.

TABLE 10-7 – ROUTE 7 WWTF DECOMMISSIONING DANBURY ALTERNATIVE CAPITAL COST COMPARISON

Cost Element	Decommission the Route 7 WWTF and Treat all flow at Danbury WWTF	Decommission the Route 7 WWTF and Treat all flow at South Street WWTF
New Route 7 Pump Station	$2,715,000	$2,715,000
Force Main to Sugar Road Danbury	$8,305,000	-
Force Main to South Street WWTF [1]	-	$5,585,000
Additional South Street WWTF Upgrades to Accommodate Sewer District 2 Flows and Loads	-	$530,000
Demolish / Decommission Route 7 WWTF	$500,000	$500,000
120,000 gpd Portion of Danbury WWTF Upgrade Cost	$705,000	-
Total Capital Cost	**$12,225,000**	**$9,330,000**

1 – Assumes the Route 7, Haviland Road, Limekiln Road, Lee Road, Farmingville Road force main route

Alternative Advantages and Disadvantages

The alternatives for decommissioning the Route 7 WWTF and pumping the Sewer District No. 2 flows to either the Danbury sewer system or directly to the South Street WWTF have advantages and disadvantages. **Table 10-8** summarizes the advantages and disadvantages of these decommissioning alternatives.

TABLE 10-8. ROUTE 7 WWTF DECOMMISSIONING DANBURY SEWER SYSTEM AND SOUTH STREET WWTF CONVEYANCE ALTERNATIVES ADVANTAGES AND DISADVANTAGES

Route 7 WWTF Decommissioning Alternative	Advantages	Disadvantages
Decommission Route 7 WWTF / Pump Flow to Danbury Sewer System	• Reduces the flow and loads to be treated at South Street WWTF • Reserves some future capacity at the South Street WWTF without the need for a costly process upgrade (membrane treatment) • Reduced issues with new force main construction in Ridgefield (traffic, disruption, etc.) as most of the force main is in Danbury	• Higher capital cost • Proposed force main route through public water supply watershed • Potential future costs for treatment at the Danbury WWTF • Require new inter-municipal agreement with Danbury • Longer Force Main ~4.8 miles • Ridgefield does not control the upgrade and operation of the Danbury facilities
Decommission Route 7 WWTF / Pump Flow to South Street WWTF	• Lower capital cost • Lower operating costs • New inter-municipal agreement with Danbury not required. • Shorter Force Main ~2.7 miles • Ridgefield controls the upgrades and operation of the required facilities	• Reduction in South Street WWTF future capacity • Future growth to either Sewer District would require costly process upgrade to South Street WWTF • Issues with new force main construction (traffic, disruption, etc.)

CHAPTER ELEVEN
RECOMMENDED PLAN

In Chapter Eight and Chapter Nine, recommendations were made for upgrades of the Route 7 WWTF and the South Street WWTF, respectively to provide continued service through the planning period. These chapters summarized the recommended upgrades and improvements for the two WWTFs' systems and unit processes and provided estimated construction costs for the various project elements as well as a total estimated capital cost for the recommended upgrades. In Chapter Ten, an evaluation of decommissioning the Route 7 WWTF and conveying flow to another WWTF for treatment versus continuing to provide treatment of the flows from Sewer District No. 1 and Sewer District No. 2 independently at the South Street WWTF and Route 7 WWTF, respectively, was performed. This included the evaluation of a new Route 7 Pump Station and a new force main to convey the Sewer District No. 2 flow to the South Street WWTF as well as identifying the additional upgrade needs at the South Street WWTF to accommodate and treat the additional Sewer District No. 2 flows and loads. The evaluation included the development of comparative 20 year present worth costs for the decommissioning versus non decommissioning alternatives and a summary of the advantages and disadvantages for each alternative.

This chapter summarizes the recommended Wastewater Treatment Facilities Upgrades for the Route 7 WWTF and the South Street WWTF and provides estimated construction costs for the various project elements as well as a total estimated capital cost for the recommended upgrades.

In addition, it is recommended that the ongoing I/I Reduction Program discussed in Chapter Three continue to be implemented as part of the Wastewater Treatment Facilities Upgrade Project. The recommended Inflow Control Plan developed as part of the Phase 2 facilities planning efforts is summarized in this chapter.

PRELIMINARY RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADES

Based on the evaluation presented in Chapter Ten, it is recommended that the Town decommission the Route 7 WWTF and construct and new Route 7 Pump Station and force main for conveyance of Sewer District No. 2 flows to the South Street WWTF for treatment. As a result of the increased flows and loads from Sewer District No. 2 being conveyed to the South Street WWTF, additional South Street WWTF upgrades will be required.

The recommended facilities and system upgrades are described in more detail in Chapter Ten. The following is a brief summary of the recommended upgrades followed by a summary of the overall project costs.

Route 7 WWTF Decommissioning

As noted in Chapter Ten, it is recommended that the existing Route 7 WWTF be demolished and the area be restored for potential future use. It is assumed that the demolition and restoration would consist of the following:

- Removal of mechanical and electrical equipment
- Demolition of above grade structures
- Demolition of below ground structures to a depth of three feet below grade
- Provisions for water drainage of below ground tanks and structures
- Filling in of below ground tanks and structures
- Finish grading and restoration of decommissioned site.

As noted in Chapter Ten, there is the possibility to repurpose the site after the decommissioning of the WWTF. Potential repurposing options include selling the land, providing green space, or the installation of a solar panel system. Evaluation of options or estimates of revenue potential for repurposing of the site has not been included in the evaluation or estimated costs.

Cost Summary. The estimated capital costs to provide decommissioning including demolition and restoration of the Route 7 WWTF site as noted above is $500,000.

New Route 7 Pump Station and Force Main

As noted in Chapter Ten, it is recommended that a new Route 7 Pump Station be constructed at the location of the existing pump station to convey Sewer District No. 2 flows to the South Street WWTF. The preferred force main route has not been identified to date. However, for the purposes of presenting a total project cost for the recommended wastewater treatment facilities upgrade, the Route 7, Haviland Road, Limekiln Road, Lee Road, Farmingville Road force main "local" route has been assumed. It should be noted that this is the more costly of the two force main routes.

Cost Summary. The estimated capital cost to provide a new Route 7 Pump Station and force main to the South Street WWTF via the local road force main route is $8,300,000.

Additional South Street WWTF Upgrades to Accommodate the Sewer District 2 Flows and Loads

As noted in Chapter Ten, additional upgrades to the South Street WWTF will be required to accommodate the additional flow and pollutant loading from Sewer District No. 2. These upgrades include the following:

- Higher capacity influent pumps in the Influent Pump Station.
- Higher capacity aeration tank blowers and ancillary systems including a larger blower building.
- An additional Blue PRO filter cell with two filter manifolds and slightly larger ancillary facilities for tertiary phosphorus removal.
- Higher capacity UV disinfection system.
- Additional electrical distribution costs associated with the items above.

The majority of the other South Street WWTF upgrades remain unchanged.

Cost Summary. The estimated capital costs for the additional upgrades to accommodate the Sewer District 2 flows and loads at the South Street WWTF above those presented in Chapter Nine and as noted above is $530,000. The total cost for the South Street WWTF upgrades including these additional costs are presented in the recommended wastewater treatment facilities upgrade project costs discussed below.

RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE PROJECT COST SUMMARY

Table 11-1 presents a list summarizing the final recommended upgrades for the Ridgefield wastewater treatment facilities. The upgrades include the following:

- Upgrades of the South Street WWTF to treat the combined flows and loads from Sewer District No. 1 and Sewer District No. 2 to meet the effluent requirements at those combined flows.
- A new Route 7 pump station to convey Sewer District No. 2 flows to the South Street WWTF.
- A new force main to convey Sewer District No. 2 flows to the South Street WWTF. The recommended force main route is the Route 7, Haviland Road, Limekiln Road, Lee Road, Farmingville Road route.
- Demolition and decommissioning of the Route 7 WWTF.

TABLE 11-1. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADES- ESTIMATED CAPITAL COST SUMMARY

Improvement / Upgrade Element	Estimated Cost
SOUTH STREET WWTF UPGRADES	
Liquid Process	
Influent Pump Station	$905,000
Septage Receiving	$1,045,000
Influent Building	$1,230,000
Total Nitrogen Removal – 4-Stage Bardenpho	$4,165,000
Final Settling Tanks	$895,000
Tertiary Treatment – Blue PRO Process	$3,355,000
UV Disinfection / Post Aeration / Maintenance Garage Facility	$3,375,000
Solids Handling	
WAS Storage / Centrifuge Thickening /Thickened Sludge Storage	$1,560,000
Ancillary Systems	
Odor Control Systems	$795,000
Ancillary Pumping Equipment	$955,000
Chemical Storage and Feed Systems	$2,185,000
Electrical Systems	$6,975,000
Instrumentation and Control Systems	$3,000,000
HVAC	$700,000
Architectural and Structural Upgrade Recommendations	
Architectural and Structural Systems Upgrades	$1,230,000
PCB / Lead / Asbestos Removal and Remediation	$290,000
Site Improvements	$430,000
TOTAL SOUTH STREET WWTF UPGRADE COSTS	**$33,090,000**
NEW ROUTE 7 PUMP STATION	**$2,715,000**
FORCE MAIN TO SOUTH STREET WWTF	**$5,585,000**
ROUTE 7 WWTF DECOMMISSIONING	**$500,000**
TOTAL UPGRADE CAPITAL COSTS	**$41,890,000**

The total estimated capital cost for the recommended Ridgefield wastewater treatment facilities upgrade as described above is $41,890,000.

The total estimated capital costs are preliminary planning level costs and have been developed based on a number of assumptions and may not represent the final project capital costs for the facilities once designed. The final costs could be higher or lower depending on what decisions are made during the design phase, how the final facilities are constructed, and when the final facilities are constructed. See Chapter Four for the basis of the cost estimates.

The recommended wastewater treatment facilities upgrades are highlighted in **Figure 11-1**, **Figure 11-2**, and **Figure 11-3**, for the South Street WWTF, the Route 7 Pump Station, and the new Route 7 Pump Station to South Street WWTF force main, respectively.

PEAK FLOW MANAGEMENT AND INFLOW REDUCTION PLAN

As noted in Chapter Three, the projected future year 2035 peak flow to the South Street WWTF from Sewer District No. 1 is projected to be 6.3 mgd. The peak flow management goal for Sewer District No. 1 is to reduce the peak inflow to the WWTF by 1.0 mgd to a total flow of 5.3 mgd. With the

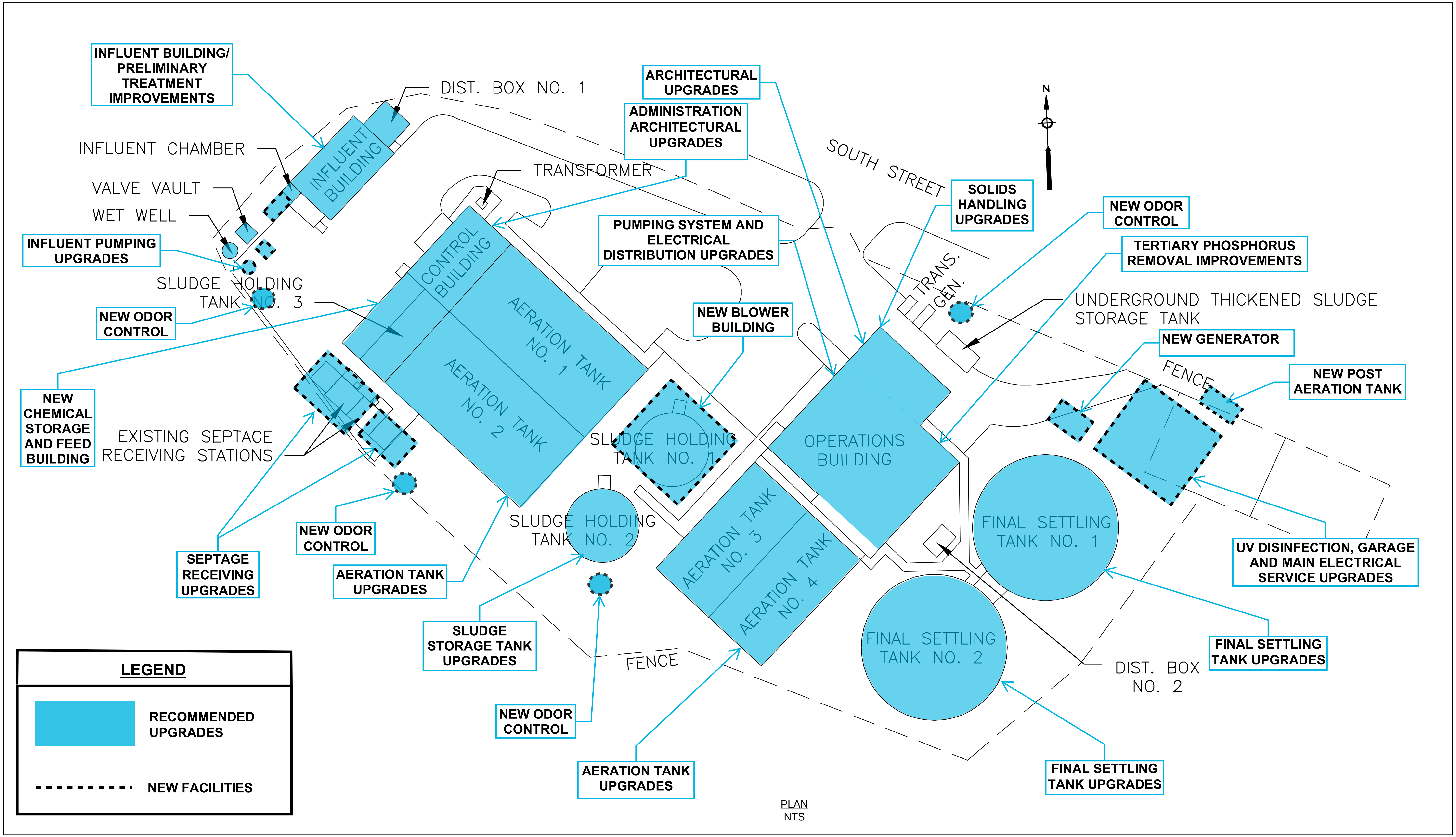


FIGURE 11-1
SOUTH STREET WWTF
RECOMMENDED UPGRADES SITE LAYOUT

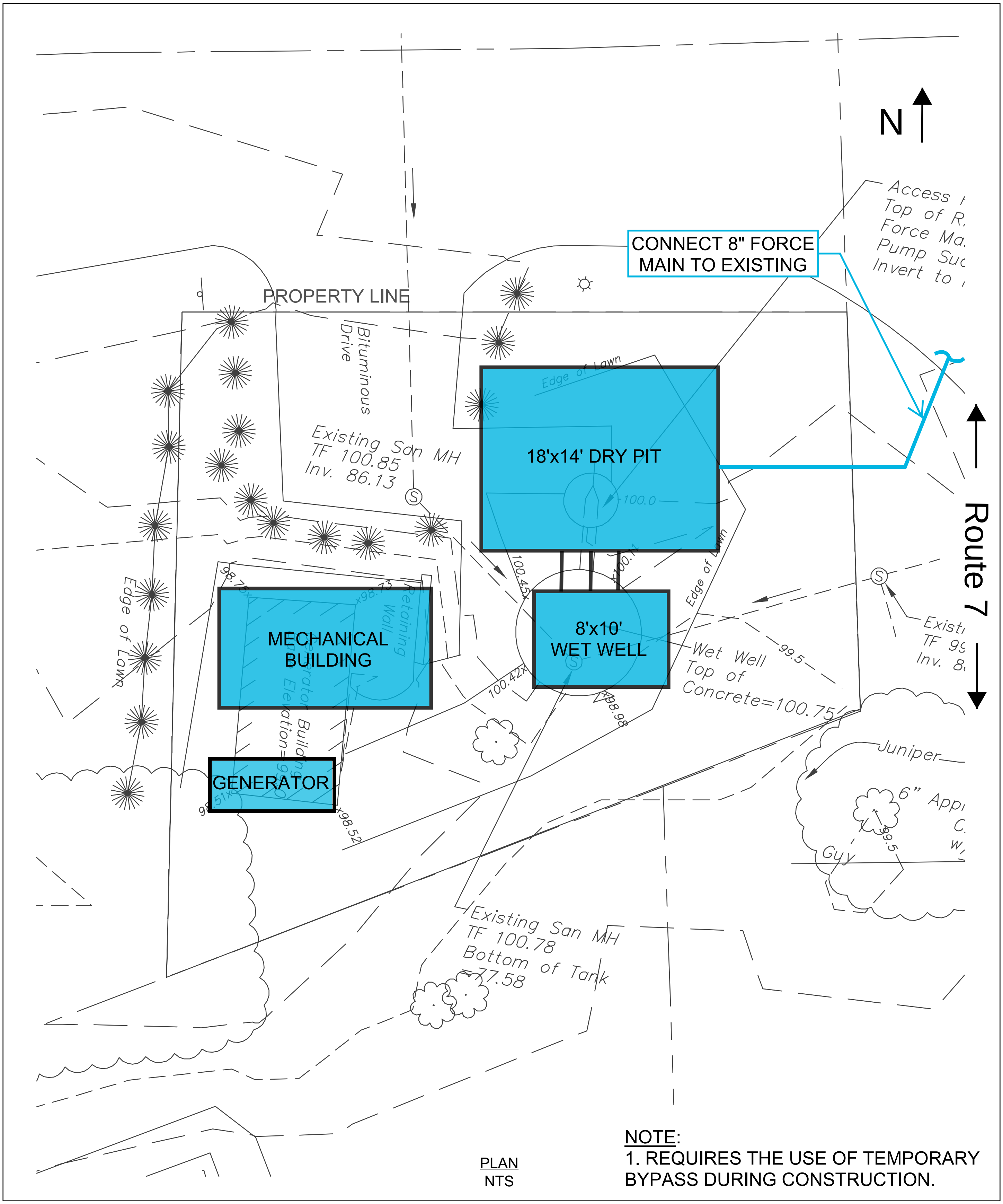
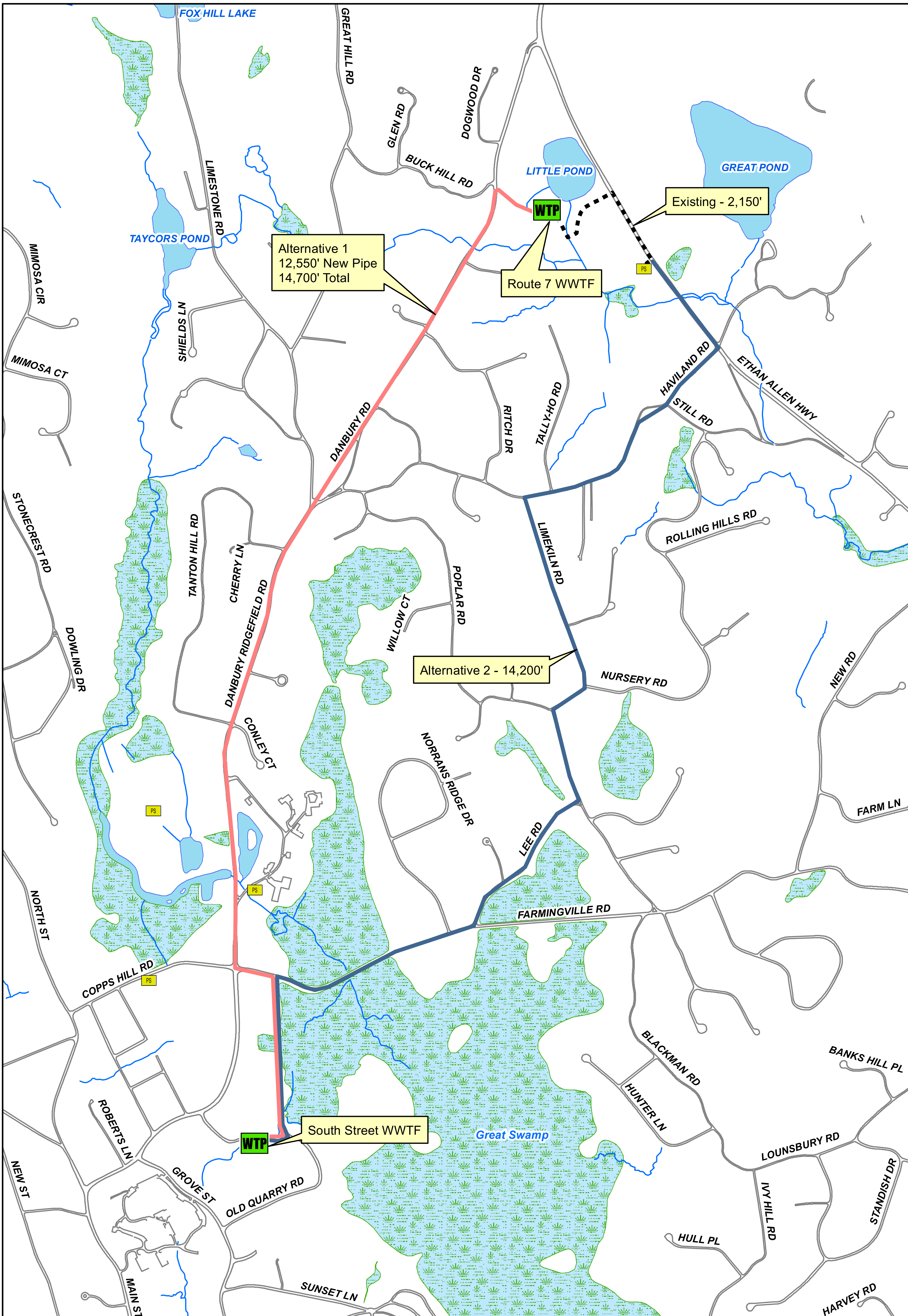


FIGURE 11-2
ROUTE 7 PUMP STATION TO SOUTH STREET WWTF

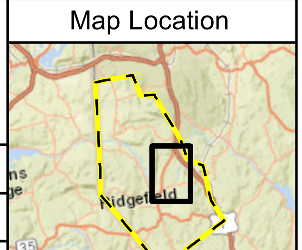


AECOM

Drawn: JM 1/9/2017

Approved: MR 1/9/2017

Map Location



Legend

- WTP WWTP
- PS Pump Station
- Road Edge
- Streams
- Waterbodies
- Swamps

Route 7 Force Main

- Alternative 1
- Alternative 2
- Existing

0 200 400 800 Feet

N

FIGURE 11-3

ROUTE 7 DECOMMISIONING
PUMP TO SOUTH STREET
FORCE MAIN ALTERNATIVES

PHASE 2 WASTEWATER FACILITIES PLAN
RIDGEFIELD, CT

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recommendation to decommission the Route 7 WWTF and convey and treat both Sewer District No. 1 and Sewer District No. 2 flows at the South Street WWTF, the projected year 2035 peak flow at the WWTF is 7.0 mgd. The goal to reduce the peak inflow to the WWTF by 1.0 mgd still applies. As a result the goal is to reduce the future peak flow at the South Street WWTF from 7.0 mgd to 6.0 mgd.

As discussed in Chapter Three, in order to eliminate or reduce the WWTF upgrade requirements to manage these peak flows two alternatives were evaluated. These include the following:

- Collection System Inflow Reduction Efforts
- Peak Flow Equalization at the South Street WWTF

Inflow Control Plan Recommendations

The Draft Inflow Control Plan was developed to assist the Town in prioritizing work to control inflow in Sewer District No. 1. The goal of the Inflow Control Plan is to remove at least 25% of the existing peak inflow, representing 1.0 mgd of inflow. The Inflow Control Plan provides a list of inflow sources and recommends an educational public outreach program to garner support, recommends additional basement inspections, and the removal of inflow sources.

As noted in Chapter Three, the DOT is planning on reconstructing Main Street which is to include drainage, sidewalks, catch basins, new pavement, and traffic flow improvements. This DOT project provides the Town with the opportunity to redirect some inflow sources in the area of construction such as sump pumps, roof downspouts, and other illegal connections from the sanitary sewer into a proper storm drain system. This opportunity has been incorporated into the Inflow Control Plan. IN accordance with the Inflow Control Plan the following rehabilitation and follow up investigation efforts are recommended to be prioritized as follows:

Priority 1A. Redirect the 105 sump pumps identified through house to house building inspections and smoke testing (Table 4 of Draft Inflow Control Plan). The cost of removing the private inflow sources should be borne by the owner of the private property, therefore no cost has been estimated for this work.

Priority 1B. Conduct building inspections on Main Street to locate roof drains connected to the sanitary sewer system within the limits of the DOT Main Street Reconstruction project.

Priority 1C. Contact DOT to open a dialogue on integrating redirecting roof drain connections into the DOT Main Street Reconstruction project.

Priority 2. Eliminate the 44 private and five public inflow sources identified in Tables 2, 3, and 6 of the Draft Inflow Control Plan. The cost of removing the private inflow sources should be borne by the owner of the private property. The total estimated cost to remove the three direct public inflow sources (Table 3) and the two indirect public inflow sources (Table 6), including engineering and contingencies, is approximately $2,100, and $22,000 respectively.

Priority 3. Conduct the remaining portion of the 254 follow-up building inspections (Attachment A of Draft Inflow Control Plan), after Priority 1B is completed, to verify that there are no sources of inflow at these locations. It is anticipated that the follow-up building inspections would be conducted by Town staff, therefore no cost has been estimated for this work. Implement sump pump removal actions for any sump pumps found connected to the sewer system.

Priority 4. Locate and inspect the 84 manholes, identified in Attachment B of the Draft Inflow Control Plan, which were not inspected during prior investigations to further identify sources of leakage and to assess the physical condition of manholes in Sewer District No.1. It is anticipated that the SUEZ would uncover and inspect these manholes over time as part of system maintenance efforts, therefore no cost has been estimated for this work.

Priority 5. Initiate the design and construction of the rehabilitation of 32 manholes as identified in Table 5 of the Draft Inflow Control Plan. The total cost of manhole rehabilitation, including engineering and contingencies is approximately $175,000.

It is anticipated that completing the Priority 1A, 1B, 1C, 2, and 3 actions will reduce inflow by the target level of 1.0 mgd. However it is recommended that Priority 4 and 5 should also be implemented whether the 1.0 mgd reduction is or is not achieved by the higher priority actions.

It is recommended that the Town continue the infiltration and inflow reduction efforts in the Sewer District No. 1 collection system in accordance with the recommendations from the Phase 1 facilities planning efforts and the Phase 2 facilities planning efforts and the resulting Draft Inflow Control Plan recommendations. The Draft Flow Control Plan is included in **Appendix E**. If this program is not successful in reducing the I/I induced peak flow at the plant, flow equalization should be considered. The estimated total project cost for the flow equalization tank and ancillary systems is approximately $4,600,000, including engineering and contingencies. While construction of the flow equalization system would reduce the peak flow that the plant would be required to treat, it must be recognized that these facilities would be unused more that 99 percent of the time based on the frequency of the extreme peak flows in the last few years. The flow equalization system would only provide a benefit to the WWTF operation under the extreme peak flow conditions. Conversely, if the infiltration and inflow (I/I) is removed from the collection system, there is a benefit in improved WWTF performance on a daily basis and reduced operation costs from removal of the extraneous flows. The benefit of reducing the peak flow through I/I removal is realized in nearly every storm event throughout the year, not in just the very significant storms. Given the magnitude of the cost, the required land area for implementing flow equalization, and the very infrequent usage of the flow equalization system, it is recommended that the Town continue to focus efforts on removing I/I in the collection system as recommended in the Inflow Control Plan.

The recommended Inflow Control Plan should also include a public education outreach program and additional basement inspections as noted above. It is also recommended that the Town track the removal of I/I from its system on a subarea by subarea basis. To facilitate this process, a computer spreadsheet or database should be developed to track steps taken to contact owners of sump pumps or other inflow sources required to be removed. Depending on the nature and extent of I/I removal work, it may be warranted to conduct post-construction flow monitoring as a means of documenting the I/I quantity removed from the system. However, the scope of and need for a monitoring program should be determined by the WPCA on a case by case basis. The South Street WWTF flows should continue to be monitored as the WPCA currently does to assess changes in flows resulting from I/I reduction, and confirm that the 1.0 mgd inflow removal target has been achieved. If the target inflow reduction is not achieved the implementation of flow equalization should be assessed.

RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADES DESIGN CRITERIA

A summary of the design criteria for the recommended wastewater treatment facilities upgrades was developed. **Table 11-2,** which is included at the end of this chapter, presents the design criteria for the most significant process systems and equipment recommended. As applicable, loading design criteria is provided for different flow and loading conditions for both the current year 2015 and the design year 2035, respectively.

WASTEWATER TREATMENT FACILITIES UPGRADE PROJECT IMPLEMENTATION APPROACH AND SCHEDULE

Based on discussions with the WPCA, it is recommended that the wastewater treatment facilities upgrade project be designed and constructed as one construction contract package. One major advantages to this approach is that the total time that the upgrades are under construction will be reduced, therefore reducing the disruption to the normal operations at the South Street WWTF. The other major advantage is that the total cost for all of the upgrades will be reduced due to the economies of scale of having all of the design, bidding, and construction efforts under once contract by one engineer and one contractor. The one major disadvantage of this approach is that the entire cost of all of the upgrades will need to be financed at one time. A recommended schedule for the Wastewater Treatment Facilities Upgrade Project has been developed. This schedule is shown in **Table 11-3.**

TABLE 11-3. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE PROJECT SCHEDULE

Wastewater Treatment Facilities Upgrade Project Milestone	Milestone Date
Start Design	Spring 2017
Application for DEEP Project Funding	Spring 2017
WWTFs Upgrade Design Complete	Summer 2018
WWTFs Upgrade Town Funding Referendum	Fall 2018
Advertise Upgrade Project for Bid	Winter 2018/2019
Award Project and Begin Construction	Spring 2019
Complete Construction	Fall 2021
One Year Warranty Complete	Fall 2022

It should be noted that the recommended schedule presented above is aggressive. This aggressive schedule is recommended in order for the Town to qualify for a 50% grant from the State Clean Water Fund (CWF) on the phosphorus removal elements. To be eligible for this grant, one of the requirements is that a construction contract be executed by the Town for the work by July 1, 2019. More information on this grant is discussed in the next section. It should be highlighted that maintaining the recommended schedule will required timely actions and decisions by the WPCA as the project proceeds.

WASTEWATER TREATMENT FACILITIES UPGRADE PROJECT FUNDING

In order to minimize the wastewater treatment facilities upgrade project costs, it is recommended that the Town apply for outside grant and low interest loan funding assistance. The two most frequently used funding sources for wastewater projects are the Connecticut Clean Water Fund (CWF) and the United States Department of Agriculture and Rural Development (USDA) Rural Development Water & Waste Disposal Loan & Grant Program. These two funding programs as they relate to the recommended Wastewater Treatment Facilities Upgrade Project are described below.

Connecticut Clean Water Fund

The Clean Water Fund (CWF) is the mechanism through which CT DEEP provides financial assistance to municipalities for projects addressing wastewater needs. The program provides assistance through a series of grants and low interest loans. Not all project costs are eligible for funding. The percent of the project construction costs (which include engineering and contingency costs) that receive grants versus loans is project dependent. As summary of the factors that are used to determine the grant and loan funding are described below.

Phosphorus Removal. Through the CWF program, eligible WWTF project costs associated with phosphorus removal qualify for a 30% grant and the balance of the eligible project cost qualify for a low interest loan. However, Public Act 16-57 an Act Concerning Phosphorus Reduction Reimbursements to Municipalities" dated May 26, 2016 provides that municipalities that have entered into a construction contract prior to July 1, 2019 and have permit limits that specify phosphorus removal to a level at or below 0.31 mg/l average month total phosphorus effluent limit are eligible for a project grant of 50% of the eligible total phosphorus removal cost. The balance of the eligible project costs would be eligible for a low interest loan. The South Street WWTF permit limits satisfy the permit limit eligibility requirements. As a result, the eligible recommended upgrades to remove phosphorus at the South Street WWTF would qualify for the 50% grant provided that a construction contract is executed by the Town by July 1, 2019. This is a competitive grant program with eleven WWTFs statewide that qualify for this funding program competing for available funds.

Nitrogen Removal. Through the CWF program eligible WWTF project costs associated with Biological Nitrogen Removal (BNR) qualify for a 30% grant and the balance of the eligible project costs qualify for a low interest loan. As a result, the eligible recommended upgrades to remove nitrogen at the South Street WWTF would qualify for a 30% grant.

WWTF Treatment Plant Upgrades. Through the CWF program, eligible costs for most water pollution control projects (WWTF projects) qualify for a 20% grant and the balance of the eligible project costs qualify for a low interest loan. As a result, the eligible recommended upgrades to South Street WWTF not associated with the phosphorus removal elements or nitrogen removal element would qualify for a 20% grant.

Route 7 Pump Station and Force Main. Typically collection system improvement projects (pump stations and force mains) only qualify for low interest loans through the CWF program. However, based on discussions with the DEEP it was indicated that the Route 7 Pump Station and force main would qualify for the 20% water pollution control project grant for eligible costs. These project elements qualify for a 20% grant since they can be viewed as treatment elements due to the fact that they are an alternative to upgrading the Route 7 WWTF and would result in improved treatment of the wastewater from Sewer District No. 2 as the South Street WWTF would produce an effluent of higher quality.

Project Specific Grants. It is also possible that the Town's legislative delegation may be successful in securing special project funding appropriations. The Town previously secured funds in this manner. The Ramapoo Road Sewer Project was funded by a $3 million special grant.

USDA Water & Waste Disposal Loan & Grant Program

USDA Rural Development provides grants and loans for municipal wastewater projects provided that the municipalities meet their requirements. The municipality needs to have a population less than 10,000 people and also needs to have a median household income less than 100 percent of the non-metropolitan median household state income. The Town does not meet either of these requirements based on the Town's population and median income. As a result it is not recommended that this funding assistance program be pursued.

Recommended Upgrades - Estimated Grant and Loan Funding Cost Summary

Based on the funding programs described above a number of the recommended wastewater treatment facilities upgrade project elements would qualify for the different Clean Water Funding grant programs. **Table 11-4** presents a cost summary of the different project elements, their estimated construction costs, the estimated CWF grant funding potential, and the Town's share of the project costs.

TABLE 11-4. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE PROJECT - ESTIMATED GRANT FUNDING COST SUMMARY

Upgrade Component	Estimated Project Cost	20% Grant	30% Grant	50% Grant	Total Grant	Remaining Town Share [2]
South Street WWTF Upgrade						
Estimated Total Phosphorus Upgrade Costs	$4,870,000			$2,435,000	$2,435,000	$2,435,000
Estimated Total Nitrogen Upgrade Cost	$2,255,000		$677,000		$677,000	$1,578,500
Remaining WWTF Upgrade Cost	$25,965,000	$5,193,000			$5,193,000	$20,772,000
TOTAL SOUTH STREET WWTF UPGRADE COSTS	**$33,090,000**	**$5,193,000**	**$677,000**	**$2,435,000**	**$8,305,000**	**$24,785,000**
NEW ROUTE 7 PUMP STATION	**$2,715,000**	**$543,000**			**$543,000**	**$2,172,000**
Force Main to South Street WWTF						
Eligible Cost	$4,189,000	$838,000			$838,000	$3,351,000
Ineligible Cost [1]	$1,396,000					$1,396,000
FORCE MAIN TO SOUTH STREET WWTF	**$5,585,000**	**$838,000**			**$838,000**	**$4,747,000**
ROUTE 7 WWTF DECOMMISSIONING	**$500,000**	**$100,000**			**$100,000**	**$400,000**
TOTAL UPGRADE PROJECT ESTIMATED CAPITAL COSTS	**$41,890,000**	**$6,674,000**	**$677,000**	**$2,435,000**	**$9,786,000**	**$32,104,000**

1. Pavement restoration cost outside of the pipe trench width is ineligible for Clean Water Funding
2. The Town share of the project costs could be financed through a combination of Clean Water Fund low interest loans for eligible costs and bonding or other Town originated funding mechanisms

It should be noted that the total estimated funding assistance costs are preliminary planning level costs and have been developed based on a number of assumptions and may not represent the final project capital costs or the final funding assistance will qualify or will be available for the facilities once designed. The final capital and financial assistance availability could be higher or lower depending on what decisions are made during the design phase, how the final facilities are constructed, and when the final facilities are constructed. In addition, the estimated funding assistance costs assume that the DEEP will have the resources available at the time to provide reimbursement and that their funding programs will not be modified in the future. Project element eligibility and financial assistance availability will need to be further developed and reviewed with input from the DEEP as the design proceeds and is completed.

IMMEDIATE NEXT STEPS

To maintain the project schedule outlined in **Table 11-3** to meet the July 1, 2019 date to have executed a construction contract for the South Street WWTF Phosphorus upgrade t qualify for the DEEP 50% Phosphorus Grant program, there are several actions that are recommended to be taken as discussed below.

Submit Draft Phase 2 Wastewater Facilities Plan to DEEP

Once the WPCA has reviewed this draft report, and any necessary revisions are made to address comments from the WPCA, the draft report should be submitted to the DEEP for review. The DEEP currently notes the following on the DEEP website regarding submittal of documents related to the Clean Water Fund:

> "Due to resource constraints, municipalities should allocate a minimum of 90 calendar days from the date of submission to CT DEEP for the review and comment or approval of any document submitted related to the Clean Water Fund. These documents may include, but are not limited to, funding applications, engineering reports, plans and specifications, and professional services contracts. Implementation or execution of such documents without prior written approval by CT DEEP will result in loss of funding eligibility for the subject of the document. "

As a result of this schedule limitation for review of the report, and the need to move forward with initiating design by May 1, 2017, it is recommended that a review meeting with DEEP be held to review the Draft Phase 2 Wastewater Facilities Plan report findings. The meeting would be held to obtain DEEP's initial comments and reaction to the report in order to proceed with the development of the design scope in advance of receiving their formal comments.

Schedule a Public Hearing on the Recommended WWTFs Upgrade Project, Estimated Costs, and Schedule

The scope of work for the Phase 2 Wastewater Facilities Plan, and DEEP's regulations, require a public hearing be held prior to finalization of the Facilities Plan. Once the review meeting with the DEEP noted above is held, and DEEP's comments are obtained, the Public Hearing should be scheduled, publicized, and held. The WPCA may wish to have a meeting or meetings with the Board of Selectmen, Planning and Zoning, or other Town departments prior to the Public Hearing to inform Town boards about the details, need and costs for the WWTF Upgrade project. Once the Public Hearing is held, the draft report can be revised if needed to address feedback or revisions resulting from comments obtained at the hearing, and the Final Phase 1 and 2 Wastewater Facilities Plans can be issued.

Arrange for Funding for the WWTFs Upgrade Design and Initiate Design by May 1, 2017

As noted above, DEEP's review period for funding documents related to the Clean Water Fund is longer now than in the past due to resource constraints. As a result, the professional services contract for the design effort should be developed and executed once a meeting has been held to obtain DEEP's initial comments and reaction to the report in advance of receiving their formal comments. At the same time, the WPCA should take steps to budget for and secure the necessary funds for the design of the WWTFs upgrade.

Design Elements of Note. Due to the specific permit requirements and the site conditions at the South Street WWTF there are a few unique elements of the design that are recommended. They are summarized below.

Stringent Total Phosphorus Requirements. As noted in Chapter Seven and Chapter Nine the target total phosphorus effluent concentration at the South Street WWTF for the year 2035 design flows are especially stringent (target total phosphorus concentration of 0.05 mg/l). It should be noted that the DEEP has approved a request by the Town to sole source Blue PRO for tertiary phosphorus removal at the South Street WWTF to meet the target total phosphorus concentration. While the Blue PRO system has other installations meeting the South Street WWTF target total phosphorus concentration, at these concentrations, meeting the limit is very difficult and is affected by the speciation of phosphorus in the wastewater. In all wastewaters there is a portion of non-reactive phosphorus that will not be removed. During the Phase 2 Facilities Plan, Blue PRO performed some off site bench scale process testing of the South Street WWTF's secondary effluent, showing their ability to meet the target total phosphorus concentrations. However due to this limited data set and the low target concentration , it is recommended that performance of the technology be tested on a larger scale before proceeding with a full design. As an initial step in design it is recommended that this testing be performed on a pilot scale over a several week period to observe the Blue PRO system performance under varying flow and loading conditions. If the performance testing does not show the ability to meet the target effluent limits, the need to provide a second stage of Blue PRO filters or to utilize one of the other technologies (both tertiary phosphorus removal technologies and MBRs) will need to be reconsidered.

Site Constraints, Constructability and Plant Operations. The South Street WWTF site is extremely constrained. The site is only accessible from the two gates on South Street and a rear gate in the south east corner of the site from the Highway Department yard/parking area. In addition WWTF access roads are narrow and there is limited unused space on the site. The site will become even more constrained based on the recommended new facilities including; the partially enclosed septage receiving facility, the expanded influent box at the Influent Building, the Blower Building, the new generator and associated oil tank, the new odor control systems, the Post Aeration Tank and the UV Disinfection, Garage and Switchgear Building. In addition to the site constraints, the WWTF will need to be able to maintain operations throughout the upgrade construction while still meeting permit.

As a result, the design will need to address the site constraints and the need to maintain plant operations during construction. Constraints on the sequencing of work during construction will be evaluated and recommended during design to address these issues. Examples of these recommendations include:

- Sequencing of the work including the aeration tank work, the new UV disinfection and Post Aeration work (with demolition of the existing facilities, the new and existing filter cell modification work for the Blue PRO system), other system replacement components (pumps, final settling tank components), etc.
- Identifying wastewater unit process bypass requirements as needed.
- Specifying WWTF operations access requirements including those for staff, septage haulers, fuel and chemical deliveries, sludge hauling, etc.
- Identifying the needs for temporary facilities including staff facilities, temporary chemical feed systems (if necessary), temporary electrical systems, etc.

The design will also evaluate the staging area needs for the upgrade which will result in identifying areas for contractor trailers, worker parking, and equipment staging. Based in the site constraints it is likely that some of these areas will need to be located outside of the existing WWTF fence line.

Request Revised Compliance Schedules in Both NPDES Permits

Once DEEP's comments on the Draft Phase 2 Wastewater Facilities Plan report are obtained and the comments are addressed, the WPCA should request that the Compliance Schedules contained in the NPDES permits for both the Route 7 WWTF and the South Street WWTF be revised to match the implementation schedule contained in the Final Phase 2 Wastewater Facilities Plan report.

Respectfully submitted by:

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TABLE 11-2. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE COMPONENT DESIGN CRITERIA

	Initial Year 2015	Design Year 2035
<u>WASTEWATER FLOW (Gravity and Pumped Flows)</u>		
Average Daily, mgd	0.903	1.12
Max Month, mgd	1.91	2.33
Peak hourly, mgd	5.24	6.0
Route 7 Pump Station		
Wet Well No. 1 (New)		
Number of pumps (to be replaced in kind)	3	3
Type: pump	Solids Handling Submersible	
drive	Close Coupled	
speed	Variable	
Unit capacity, gpm @ TDH	3 @ 250 gpm @ 105 ft	
Dry Pit No. 1 (New)		
Number of Pumps	3	3
Type: pump	Solids Handling Dry Pit Submersible	
drive	Close Coupled	
speed	Variable	
Unit capacity, gpm @ TDH	3 @ 250 gpm @ 100 ft	
<u>INFLUENT CONVEYANCE</u>		
South Street WWTF Sewage Pumps		
Wet Well No. 1 (Existing)		
Number of existing pumps (to be replaced in kind)	2	2
Type: pump	Solids Handling Submersible	
drive	Close Coupled	
speed	Variable	
Unit capacity, gpm @ TDH	2 @ 680 gpm @ 18 ft	
Wet Well No. 2 (New)		
Number of Pumps	2	2
Type: pump	Solids Handling Submersible	
drive	Close Coupled	
speed	Variable	
Unit capacity, gpm @ TDH	2 @ 1,600 gpm @ 18 ft	

TABLE 11-2. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE COMPONENT DESIGN CRITERIA

	Initial Year 2015	Design Year 2035
PRETREATMENT		
Influent Screening		
Screens		
Number of Screens	2	2
Type	Mechanically Cleaned	
Cleaning method	Chain and Rake	
Unit Capacity, mgd	3	3
Total Capacity, mgd	6	6
Bar opening size, in	0.25	
Screening Conveyor		
Type	Two Directional Belt	
Conveyor runs	1	1
Washpress		
Number of units	1	1
Features	screenings conveyor	
Back Up Systems		
Drop in Manual Cleaned Bar Rack	1	1
Grit Removal		
Vortex Grit Chamber		
Number of tanks	1	1
Diameter	8	8
Lower Chamber Diameter	3	3
Upper Chamber Sidewater Depth, ft	4.5	4.5
Side water depth, ft	5	5
Number of tanks in services	1	1
Upper Chamber Unit area, sq. ft.	50	50
Lower Chamber Unit area, sq. ft.	7	7
Total unit area, sq. ft.	57	57
Unit volume, cu. ft.	262	262
gal	1,956	1,956
Total volume, cu. ft.	262	262
gal	1,956	1,956
Wastewater detention time, min		
at average flow	3.1	2.5
at peak flow	0.5	0.5
Grit Slurry Pump	Turbo Grit Pump	
Number on line	1	1
Type: pump	4" Vertical	
drive	Close Coupled	
speed	Variable	
Unit capacity, cfm @ psi	180 @ 4.0	
Features	Vacuum priming system	

TABLE 11-2. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE COMPONENT DESIGN CRITERIA

	Initial Year 2015	Design Year 2035
<u>SEPTAGE RECEIVING</u>		
Septage Storage Tanks		
Number of Tanks	2	
Arrangement	In Series	
Screening	Manual Bar Rack	
Tank Dimensions		
Length	16	
Width	10	
Depth	7	
Usable Storage Volume (per tank), gal	4,800	
Total Storage Volume, gal	9,600	
Septage Transfer Pumps		
Type: pump	Submersible Chopper	
drive	Close Coupled	
speed	Variable	
Unit capacity, gpm @ TDH	2 @ 200 gpm @ 18 ft	
<u>SECONDARY TREATMENT</u>		
Aeration Distribution Chamber (Distribution Box No. 1) Mixing		
Number of Mixers	1	
Type: mixer	Submersible	
speed	Variable	
Unit horsepower	2	
Aeration Tanks		
Process Configuration	4-Stage Bardenpho	
Sets of tanks	2	2
Aeration Tanks (continued)		
<u>1968 Aeration Tanks (Existing Aeration Tanks Nos. 1 and 2)</u>		
Length, ft.	84	84
Width, ft.	84	84
Side water depth, ft	10.4	10.4
Unit volume, cu. ft.	73,382	73,382
gal	549,000	549,000
1968 Tanks Zone Volumes		
Anoxic Zone 1 (15%)	82,350	82,350
Aerobic Zone 1 (58%)	318,420	318,420
Anoxic Zone 2 (22%)	120,780	120,780
Aerobic Zone 2 (5%)	27,450	27,450

TABLE 11-2. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE COMPONENT DESIGN CRITERIA

	Initial Year 2015	Design Year 2035
1990 Aeration Tanks (Existing Aeration Tanks Nos. 3 and 4)		
Length, ft.	64	64
Width, ft.	64	64
Side water depth, ft	15	15
Unit volume, cu. ft.	61,440	61,440
gal	460,000	460,000
1990 Tanks Zone Volumes		
Anoxic Zone 1 (15%)	69,000	69,000
Aerobic Zone 1 (58%)	266,800	266,800
Anoxic Zone 2 (22%)	101,200	101,200
Aerobic Zone 2 (5%)	23,000	23,000
Number of tanks in service	2	2
Detention time, hrs		
at average flow (without Return Activated Sludge (RAS)	26.8	21.6
at peak flow (without RAS)	4.6	4.0
Standard Oxygen Required, lbs/day		
Average	6,340	7,930
Maximum month	9,080	11,340
Peak hour	11,740	14,680
Aeration Equipment		
Mixers (1968 and 1990 Tanks)		
Quantity per anoxic zone	1	1
Total Quantity Mixers	4	4
Type: mixer	Submersible	
speed	Variable	
Size Anoxic Zone 1, hp	5	5
Size Anoxic Zone 2, hp	10	10
Aeration Equipment (continued)		
Internal Recycle Pumps		
Number of pumps	4 (2 operating, 2 standby)	
Type: pump	Submersible Solids Handling - Axial Flow	
drive	Close Coupled	
speed	Variable	
Unit pump capacity, gpm @ TDH	3,250 @ 4 ft	
Maximum internal recycle pumping capacity, percent of design max month flow	400%	

TABLE 11-2. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE COMPONENT DESIGN CRITERIA

	Initial Year 2015	Design Year 2035
Blowers		
Number of large blowers	3	
Service	Two (2) for 1968 Tanks and one(1) standby for both 1968 and 1990 Tanks	
Unit capacity, cfm	988	
Unit horsepower maximum	40	
Type: blower	Hybrid Rotary Lobe Compressor	
drive	Direct	
speed	Variable	
Number of small blowers	2	
Unit capacity, cfm	590	
Unit horsepower maximum	30	
Type: blower	Hybrid Rotary Lobe Compressor	
drive	Direct	
speed	Variable	
Air Requirements (Summer Conditions - Highest Demand)		
Average conditions		
Number of large blowers in service	1	1
Number of small blowers in service	1	2
Air required for tanks, cfm	1,190	1,490
Peak conditions		
Number of large blowers in service	2	2
Number of small blowers in service	2	2
Air required for tanks, cfm	2,210	2,760
Micro C Storage (Supplemental Carbon)		
Tank Type	Polyethylene Tank	
Number of Tanks	1	
Diameter, ft.	10	
Height, ft.	10	
Usable volume, gal.	6,000	
Micro-C Metering Pumps		
Total number of pumps	3	
Operating	2 (1 per set of aeration tanks)	
Standby	1 (to serve both sets of aeration tanks)	
Type: pump	Peristaltic	
drive	Direct	
speed	Variable	
Unit capacity, gph	1	

TABLE 11-2. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE COMPONENT DESIGN CRITERIA

	Initial Year 2015		Design Year 2035
Final Settling Tanks			
Number of tanks	2		2
Diameter, ft.		65	
Side water depth, ft		13	
Number of tanks in service	2		2
Unit Surface area, sq. ft.		3,318	
Total surface area, sq. ft. in service	6,637		6,637
Unit volume, cu. ft.		43,138	
gal		322,715	
Total unit volume, cu. ft. in service		86,276	
gal		645,431	
Overflow rates, gal/day/sq. ft.			
At average flow	136		169
At peak flow	790		904
Detention time, hrs.			
At average flow	17.2		13.8
At peak flow	3.0		2.6
Solids loading			
Average MLSS applied, lb/day	27,370		36,430
Unit solids loading, lb/day/sq. ft.	4.43		5.49
Return Sludge Pumps			
Number of pumps		3 (2 operating)	
Type: pump		Horizontal Centrifugal, Non Clog, Chopper	
drive		Direct	
speed		Variable	
Unit pump capacity, gpm @ TDH		850 @ 30 ft	
Maximum return sludge pumping capacity, percent of design max month flow		100%	
Waste Sludge Pumps			
Number of pumps		2	
Type: pump		Recessed Impeller	
drive		Direct	
speed		Variable	
Unit pump capacity, gpm @ TDH		100 @ 17 ft	
<u>TERTIARY PHOSPHORUS REMOVAL</u>			
Primary Chemical Phosphorus Removal			
Dosing Location No. 1		Distribution Box No. 2	
Chemical		Ferric Chloride	
Dose, gph @ 40% strength			
At average flow	2.3		3.2
At peak flow	10.2		11.5
Ferric Chloride Metering Pump			
Number of Pumps		1 operating, 1 standby	

TABLE 11-2. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE COMPONENT DESIGN CRITERIA

	Initial Year 2015	Design Year 2035
Tertiary Chemical Phosphorus Removal Dosing		
Dosing Location	Final Settling Tank Effluent Box	
Chemical	Ferric Chloride	
Dose, gph @ 40% strength		
At average flow	0.8	1.1
At peak flow	3.4	3.8
Ferric Chloride Metering Pump		
Number of Pumps	1 operating, 1 standby	
Blue PRO Tertiary Phosphorus Removal Filters		
No. of filter cells	8	
No. of filter modules per cell	2	
Total Number Filter Modules	16	
Filter Media Depth, in.	60	
Total Filter Area Available, sq. ft.	1,024	
Surface area per filter cell, sq. ft.	128	
No. cells in service		
At average flow	2	2
At peak flow	6	7
Hydraulic Loading Rate, gpm/sq. ft.		
At average flow	2.45	3.04
At peak flow	4.74	4.65
Blue PRO Filter Compressor		
Type:	Rotary Screw	
Number of units, total	2 (1 operating, 1 standby)	
Unit rating, scfm	47	
Discharge Pressure, psig	110	
Unit Horsepower, hp	15	
Air Required, scfm		
At average flow	11	
At peak flow	39	
Blue PRO Ferric Chloride Storage		
Tank Type	Polyethylene Tank	
Number of Tanks	1	
Diameter, ft.	10	
Height, ft.	10	
Usable volume, gal.	6,000	
Blue PRO Polymer System		
Polymer Type	Liquid	
Dosing Location	Final Settling Tank Effluent Box	
Dose, mg/L	TBD - Estimated between 5 - 15 mg/L	

TABLE 11-2. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE COMPONENT DESIGN CRITERIA

	Initial Year 2015	Design Year 2035
DISINFECTION		
UV Disinfection System		
Number of channels	2	
Number of banks per channel	1	
Number of modules per bank	8	
Number of lamps per module	8	
Total number of duty lamps	64	
Total number of overall lamps	128	
Lamp Type	Low Pressure	
Wattage per lamp, w	250	
Total lamp wattage, kw	16	
Design Dose, mg/cm^2	30	
Average power draw		
@ design average, w	614.4	
POST AERATION		
Post Aeration Tanks		
Number of tanks	1	
Volume on line, gal	12,600	
cu. ft.	1,684	
Average Conditions		
Post Aeration air required, cfm	95	125
Number of blowers in service	1	1
Peak conditions		
Post Aeration air required, cfm	244	322
Number of blowers in service	1	1
Post Aeration Blowers		
Type: blower	Rotary Lobe Positive Displacement	
drive	Direct	
speed	Variable	
Unit capacity, cfm	325	
Unit horsepower maximum	15	
SOLIDS HANDLING		
Aerated Sludge Storage Tank		
Total solids to storage, lbs./day		
At average flow	986	1228
At max month flow	2,093	2,419
Volume to storage, gal/day		
At average flow	12,716	15,831
At max month flow	26,987	31,186

TABLE 11-2. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE COMPONENT DESIGN CRITERIA

	Initial Year 2015	Design Year 2035
Aerated Sludge Storage Tank (continued)		
Number of units	1	
Diameter, ft.	35	
Sidewater Depth, ft.	10	
Total Volume, cu. Ft.	9,621	
Total Volume, gal	71,976	
Aerated Sludge Storage Tank Blowers		
Number of blowers	2	
Service	2 (1 operating, 1 standby)	
Unit capacity, cfm	120	
Unit horsepower maximum	10	
Type: blower	Rotary Lobe Positive Displacement	
drive	Direct	
speed	Variable	
Centrifuge (WAS Thickening)		
Total solids to centrifuge, lbs./week		
At average flow	6,902	8,596
At max month flow	14,651	16,933
Volume to centrifuge, gal/day		
At average flow	89,012	110,817
At max month flow	188,909	218,302
Number of units	1	
Unit capacity , gpm	120	
Hydraulic loading rate, gpm		
At average flow	7.0	9.0
At max month flow	15.0	17.0
Operating Hours per Week @ hydraulic loading		
At average flow	12	15
At max month flow	26	30
Centrifuge Polymer System		
Polymer Type	Liquid	
Dosing Location	Centrifuge Feed Line	
Estimated Dose, lbs./dry ton	4	
Dose, gph @ 40% active	TBD during design	
At average flow	1.50	2.00
At peak flow	3.20	4.00
Centrifuge Feed Pumps		
Number of Pumps	2	2
Type: pump *	Plunger Pump	
drive	Direct	
Unit Capacity, gpm @ THD	40 - 120 gpm @ 45 feet	

* Assumes the same type as existing. Alternatives to be evaluated during deisgn

TABLE 11-2. RECOMMENDED WASTEWATER TREATMENT FACILITIES UPGRADE COMPONENT DESIGN CRITERIA

	Initial Year 2015	Design Year 2035
Thickened Sludge Storage Tank		
Number of Tanks	1	
Tank Dimensions		
Length	35	
Width	16	
Overall Depth	10	
Usable Storage Depth	7	
Usable Storage Volume (per tank), gal	29,326	
Total Storage Volume, gal	29,326	

LIST OF APPENDICES

APPENDIX A – TECHNICAL MEMORANDUM NO. 1: DYED WATER TESTING AND TRACING (OCTOBER 27, 2016)

Attachment A – Stacey DePasquale Engineering, Inc. - Dye Testing Report CD (February 29, 2016)
Attachment B – EST Associates, Inc. - Dye Flooding Report
Disc 1 – EST Associates, Inc. - Dye Flooding Report (July 2016)
Disc 2 – EST Associates, Inc. - Dye Flooding with CCTV Inspections (July 14, 2016)
Disc 3 – EST Associates, Inc. - Dye Flooding with CCTV Inspections (July 15, 2016)
Disc 4 – EST Associates, Inc. - Dye Flooding with CCTV Inspections (July 18, 2016)

APPENDIX B – TECHNICAL MEMORANDUM NO. 2: INTERNAL CCTV INSPECTION OF SELECTED MAINLINE SEWERS AND LATERAL SERVICE CONNECTIONS (NOVEMBER 17, 2016)

Attachment A – National Water Main Cleaning Company, Mainline and Lateral CCTV Inspection Report
Disc 1 – NWMCC CCTV Inspections – Rev. 1
Disc 2 – NWMCC CCTV Inspections – Rev. 2

APPENDIX C – TECHNICAL MEMORANDUM NO. 3: MANHOLE INSPECTIONS (DECEMBER 21, 2016)

Attachment A – Dye Flooding Data
EST Associates, Inc. – Dye Flooding Report (November 16, 2016)
EST Associates, Inc. – Manhole Inspection Report – Book 1
EST Associates, Inc. – Manhole Inspection Report – Book 2
EST Associates, Inc. – Manhole Inspection Report – Book 3
EST Associates, Inc. – Manhole Inspection Report – Book 4
EST Associates, Inc. – Manhole Inspection Report – Book 5
EST Associates, Inc. – Manhole Inspection Report – Book 6

APPENDIX D – TECHNICAL MEMORANDUM NO. 4: HOUSE TO HOUSE INSPECTIONS (DECEMBER 21, 2016)

Attachment A – Building Inspection Reports
EST Associates, Inc. – Subarea 1 Building Inspection Report
EST Associates, Inc. – Subarea 2 Building Inspection Report
EST Associates, Inc. – Subarea 3 Building Inspection Report
EST Associates, Inc. – Subarea 4 Building Inspection Report
EST Associates, Inc. – Subarea 5 Building Inspection Report
EST Associates, Inc. – Subarea 6 Building Inspection Report
EST Associates, Inc. – Subarea NA Building Inspection Report

APPENDIX E – DRAFT INFLOW CONTROL PLAN (JANUARY 26, 2016)

APPENDIX F – ROUTE 7 WWTF NPDES PERMIT (SEPTEMBER 17, 2014)

APPENDIX G – SOUTH STREET WWTF NPDES PERMIT (SEPTEMBER 29, 2015)

APPENDIX H – PHASE 2 WASTEWATER FACILITIES PLAN – WWTF CONDITION ASSESSMENTS (MARCH 2, 2016)

Highlighted items in yellow have not been included in the posted website material due to either large file sizes or PDF incompatibility. These materials can be reviewed at the office of the WPCA upon request.