



PORTSMOUTH, NH

**FINAL
APRIL 2021**

Sagamore Avenue Sewer Extension Preliminary Design Report

**SAGAMORE AVE SEWER EXTENSION
PRELIMINARY DESIGN REPORT
FOR THE
CITY OF PORTSMOUTH, NH**

APRIL 2021



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**SAGAMORE AVE SEWER EXTENSION – PORTSMOUTH, NH
PRELIMINARY DESIGN REPORT**

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SECTION 1

INTRODUCTION

1.1 BACKGROUND

The City of Portsmouth, NH, intends to extend public sewer services to the southern portions of Sagamore Avenue and the surrounding area. This action is prompted in part by a number of properties in the area having one or more of the following issues: failed septic systems, difficult soil conditions, and lack of space to address wastewater flows with on-site systems. In addition, the New Hampshire Department of Environmental Services (NHDES) completed a Total Maximum Daily Load (TMDL) study for bacteria of Little Harbor and identified Sagamore Creek (adjacent to the project area) as a potential contributor to impaired water quality in Little Harbor. In 2016, the EPA and NHDES updated a Consent Decree to the City requiring construction of the new sewer extension begin no later than June 2020 and be substantially completed on or before June 30, 2022. The City has placed EPA and other parties on notice that the deadlines should be adjusted to June 2021 and December 2022 respectively.

To meet the requirements of the Consent Decree, installation of a low pressure sewer system (LPSS) is recommended due to the shallow ledge located during field inspections. This type of system reduces construction costs by using small diameter pipes that can be installed at shallower depths than conventional sewer system mains. This system requires that each property has a grinder pump that discharges the sewerage into the small diameter main located in the roadway.

The City and its residents have been in discussion regarding the Sagamore Avenue Sewer extension project since September 2019. In this time there have been eight public meetings discussing project details.

This project will provide an outlet for existing failed septic systems in area with shallow ledge, poor soils, and is adjacent to an impaired water body. Sending the wastewater to the Pierce Island Wastewater Treatment Facility (WWTF) will result in a higher level of treatment than any on-site option. The City's August 20, 2020 letter to the City Manager recommends the City move forward with design and permitting for all work within municipal owned rights of ways or easements (i.e.

Consent Decree Work) and with the service connections to private property. This will include a design for each private property interested in connecting at the time of construction.

Based on the most recent estimates, the City has enough funding authorized to complete the work mandated by the Consent Decree, namely, specifically work to install public sewer mains. This project includes private property work which is not required by the Consent Decree but is environmentally beneficial and desired to be implemented depending on funding availability. The City has recommended to bid the project such that the Base Bid includes all the Right of way work and a bid alternate will be pursued for the non-right of way work. This will allow residents and the City council to understand the direct cost implications of the work while allowing the City to meet its Consent Decree Deadlines. The most recent cost allocation put forth by the City is that the residents pay the cost of their service connection from the grinder pump tank to the roadway including any costs related to landscaping, relocating fencing, and any other impediments located on private property. It is estimated that this will cost \$6,600 for the average house, but could range higher or lower depending on yard features (such as a retaining wall, irrigation, or trees) and subsurface conditions (such as the existence of ledge).

1.2 SUMMARY OF CONCEPTUAL REPORT

Wright-Pierce produced two technical letter reports dated October 2008 and February 2011 for the City of Portsmouth evaluating options for extending part of the City's existing sewer system to the Sagamore South Area, the Walker Bungalow Road Area, and a portion of Sagamore Avenue. The two alternatives for possible sewer extensions were (1) conventional gravity sewer and (2) combination of conventional gravity sewer and low pressure sewer. The letter report produced planning level project cost estimates for the alternatives. Based on the results of the cost-effective analysis performed as part of the conceptual report, a combination of conventional gravity sewer and low pressure sewers was recommended. Following these technical letter reports, the limits of the project area were extended and further preliminary investigations were performed. Based on these preliminary investigations, the installation of a low pressure sewer system is recommended.

1.3 PRELIMINARY DESIGN BASIS

Presented in this document is the preliminary design for a low pressure sewer system for two independent systems that are separated by Sagamore Creek: North Sagamore Area including portions of Sagamore Avenue, Walker Bungalow Road, Shaw Road, Cliff Road, and Little Harbor Road and South Sagamore Area including portions of Sagamore Avenue, Sagamore Grove and Wentworth House Road referred to henceforth as North Sagamore and South Sagamore, respectively. North Sagamore contains an estimated 64 service connections. An existing 8” gravity sewer begins at 650 Sagamore Avenue. This existing downstream 8” sewer line will be extended approximately 400 feet to 692 Sagamore Avenue. The new low pressure sewer system will be connected to the gravity extension. South Sagamore contains an estimated 27 service connections. The low pressure sewer system in South Sagamore will be connected directly to an existing 3” low pressure sewer system downstream on Sagamore Avenue. This 3” low pressure sewer system discharges into an existing manhole approximately three hundred feet downstream near the intersection with Odiorne Point Road to flow by gravity.

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SECTION 2

REGULATORY OVERVIEW

2.1 NEW HAMPSHIRE CODE OF ADMINISTRATIVE RULES

Chapter Env-Wq 700 of New Hampshire Code of Administrative Rules establishes the minimum technical standards and requirements for planning, design, and construction of sewerage to protect the public's health. The specific subsections of the chapter that are directly related to the Sagamore Avenue sewer extension are 704.01, 704.02, 704.03, 704.07, 704.08, 704.09, 704.10 and 704.20. The following paragraphs describe how each subsection is applicable to the Sagamore Avenue sewer extension.

Subsection Env-Wq 704.01 Type of Sewerage makes the distinction between sanitary systems and storm systems. Specifically, that rain water and groundwater are to be excluded from new sanitary sewers. Subsection Env-Wq 704.02 Design Period states that sewerage pipes are to be designed to accommodate flows anticipated for the projected 50-year build-out of the project service area.

Subsection 704.03 Design Flow Basis details how sanitary waste flows are to be estimated. Average Daily Sanitary waste flows are to be estimated using Tables 3-2, 3-3, 3-4 and 3-5 from the text *Wastewater Engineering Treatment and Resource Recovery* (Metcalf and Eddy/AECOM). A peaking factor of 6 is to be used with the average daily flows to estimate peak hourly flow rates, often referred to as peak flow rates, on Sagamore Avenue, where average daily flows are estimated to be less than 100,000 gpd. **Tables 2-1, 2-2, 2-3 and 2-4** show the reproduced tables from *Wastewater Engineering Treatment and Resource Recovery* used to estimate the flow basis for design.

TABLE 2-1

**TYPICAL WASTEWATER FLOWRATES FROM URBAN RESIDENTIAL SOURCES
IN THE UNITED STATES (REPRODUCED FROM METCALF AND EDDY/AECOM)**

Household size, no. of persons	Flowrate, gal/capita-day	
	With current level of conservation	With extensive conservation
1	103	74
2	77	54
3	68	48
4	63	44
5	61	42
6	59	41
7	58	40
8	57	39

TABLE 2-2

**TYPICAL WASTEWATER FLOWRATES FROM COMMERCIAL SOURCES IN THE
UNITED STATES (REPRODUCED FROM METCALF AND EDDY/AECOM)**

Source	Unit	Typical Flowrate, gal/unit-day
Airport	Passenger	3
Apartment	Person	38
Automobile service station	Vehicle served	8
	Employee	10
Bar/cocktail lounge	Seat	11
	Employee	10
Boarding house	Person	30
Conference center	Person	6
Department store	Toilet room	300
	Employee	8
Hotel	Guest	53
	Employee	8
Industrial building (sanitary waste only)	Employee	15
Laundry (self-service)	Machine	338
	Load	38
Mobile home park	Unit	105
Motel (with kitchen)	Guest	38
Motel (without kitchen)	Guest	34
Office	Employee	10
Public lavatory	User	3
Restaurant (conventional)	Customer	6
Restaurant (with bar/cocktail lounge)	Customer	7
Shopping center	Employee	8
	Parking Space	1.5
Theater (indoor)	Seat	2.3

TABLE 2-3

TYPICAL WASTEWATER FLOWRATES FROM INSTITUTIONAL SOURCES IN THE UNITED STATES (REPRODUCED FROM METCALF AND EDDY/AECOM)

Source	Unit	Typical Flowrate, gal/unit-day
Assembly Hall	Guest	2.3
Church	Seat	2.3
Hospital	Bed	150
	Employee	7.5
Institutions other than hospitals	Bed	74
	Employee	7.5
Prison	Inmate	90
	Employee	7.5
School, day (with cafeteria, gym and showers)	Student	19
School, day (with cafeteria only)	Student	11
School, boarding	Student	38

TABLE 2-4

TYPICAL WASTEWATER FLOWRATES FROM RECREATIONAL FACILITIES IN THE UNITED STATES (REPRODUCED FROM METCALF AND EDDY/AECOM)

Source	Unit	Typical Flowrate, gal/unit-day
Apartment, resort	Person	45
Cabin, resort	Person	30
Cafeteria	Customer	2.3
	Employee	7.5
Camp (with toilets only)	Person	18.8
Camp (with central toilet and bath facilities)	Person	33.8
Camp (day)	Person	11.3
Cottages (seasonal with private bath)	Person	37.5
Country club	Member	18.8
	Employee	9.8
Dining hall	Meal served	5.3
Dormitory, bunkhouse	Person	30
Fairground	Visitor	1.5
Picnic park with flush toilets	Visitor	3.8
Recreational vehicle park (with individual connection)	Vehicle	75
Recreational vehicle park (with comfort station)	Vehicle	33.8
Roadside rest area	Person	2.5
Swimming pool	Customer	6.8
	Employee	7.5
Vacation home	Person	37.5
Visitor center	Visitor	2.5

Subsection 704.07 Details of Design and Construction of Force Mains and Pressure Sewers describes design criteria for pressure sewers. This includes specifying minimum pipe sizes for pressure sewers based on the number of connections served and the estimated peak flow.

Subsection 704.08 Force Main and Pressure Sewer Construction Materials details the types of materials that are suitable for pressure sewer construction.

Subsection 704.09 Force Main and Pressure Sewer Testing describes how pressure sewers are to be tested.

Subsection 704.10 Grinder Pumps for Pressure Sewers specifies that each building or residence connected to a pressure sewer system will have at least one grinder pump. This subsection also specifies the type of grinder pump as well as minimum capacity requirements for the grinder pump.

Subsection 704.20 Service Connections specifies how service connections will connect to the sewer system and what valves are required at the connection.

2.2 CITY STANDARDS FOR BASIS OF DESIGN

The City of Portsmouth uses the NHDES standards for sewer system design and construction. The standard design details are summarized above in **Section 2.1**.

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SECTION 3

ENGINEERING PROCESS DESIGN

3.1 CALCULATING THE PEAK HOURLY FLOW RATE

Sagamore Creek divides Sagamore Avenue into two spatially independent sections: the northern portion of Sagamore Avenue, North Sagamore, and the southern portion, South Sagamore. The peak hourly wastewater flow rates were calculated separately for these two sections, and they have been assessed independently as the wastewater flows will be conveyed to two separate receiving gravity sewer system manholes with no interaction in the immediate area.

3.1.1 Identification of Sewer Connections

Identifying the individual service connections in the Sagamore Ave project area, included quantifying the number of connections and then identifying the type of each connection. The number of service connections on Sagamore Avenue was quantified by counting the currently constructed residential, commercial, institutional, and recreational structures using the City's GIS mapping, property searches, and feedback from the City Planning Department. Each service connection type was identified by categorizing the connections into one of the four building types, as referenced in **Tables 2-1, 2-2, 2-3 and 2-4**.

The number of connections and extents of the project may be updated during final design. **Figure 3-1** depicts the section of pipe and service connections that will make up the low pressure sewer system zones for North Sagamore. A low pressure sewer system zone is a pipe network with no loops. Zones are used in the system analysis to facilitate the final selection of pipe sizes, based on maintaining adequate flow velocity and static and dynamic head losses. **Table 3-1** categorizes each of the service connections by building type and lists the number of service connections that match each description.

Figure 3-2 depicts the section of pipe and service connections that will make up the low pressure sewer system zones for South Sagamore. **Table 3-2** categorizes each of the service connections by building type and lists the number of service connections that match each description.

JDM W:\GIS_Development\Projects\NH\Portsmouth\11304-NH-Portsmouth\MXDs\Fig3-1-ProposedSewer-North-11x17.mxd

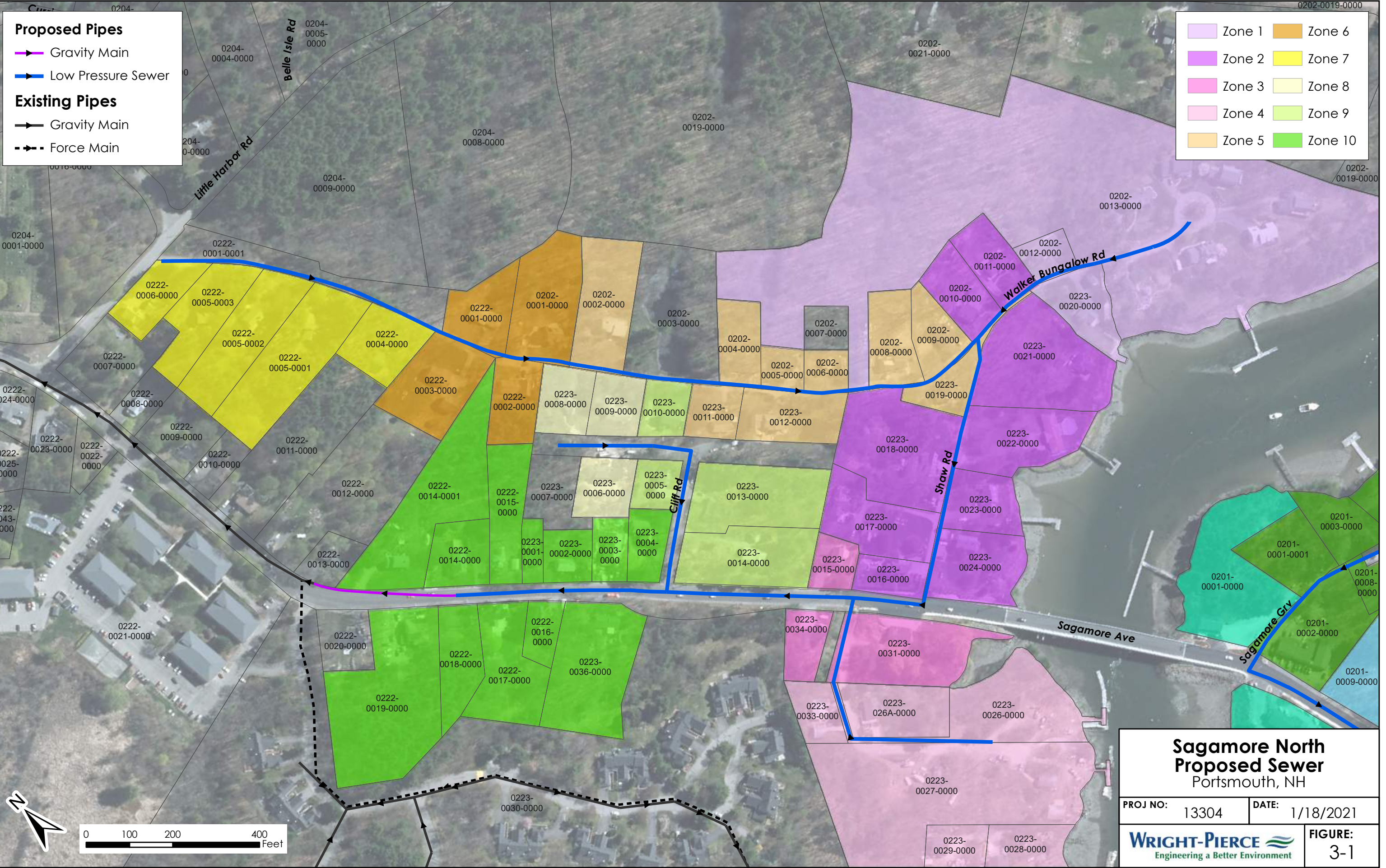
Proposed Pipes

- Gravity Main
- Low Pressure Sewer

Existing Pipes

- Gravity Main
- Force Main

Zone 1	Zone 6
Zone 2	Zone 7
Zone 3	Zone 8
Zone 4	Zone 9
Zone 5	Zone 10



**Sagamore North
Proposed Sewer**
Portsmouth, NH

PROJ NO: 13304 DATE: 1/18/2021


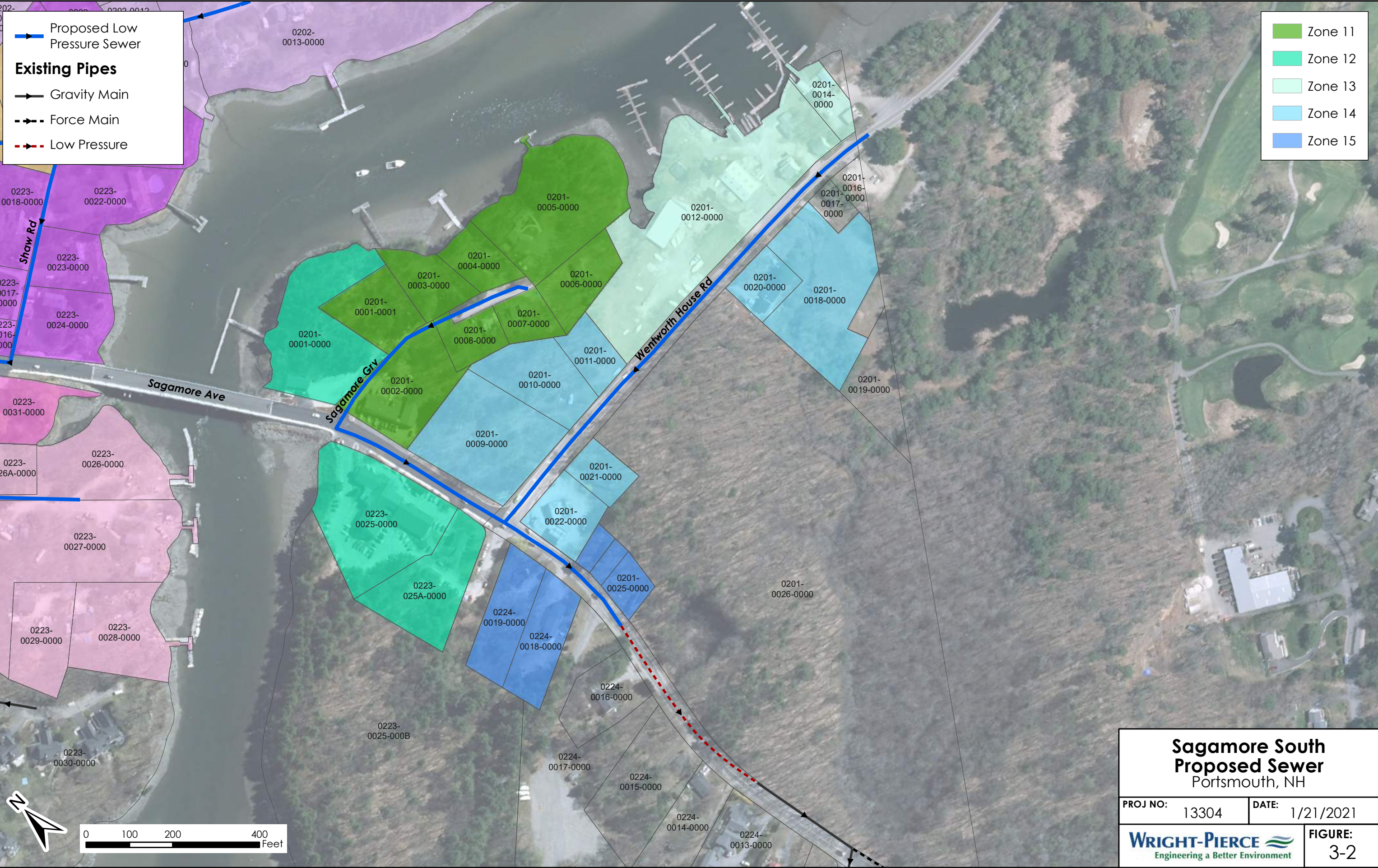
WRIGHT-PIERCE 
Engineering a Better Environment

FIGURE:
3-1



JDM W:\GIS_Development\Projects\NH\Portsmouth\11304-NH-Portsmouth\MXDs\Fig3-2-ProposedSewer-South-11x17.mxd

	Zone 11
	Zone 12
	Zone 13
	Zone 14
	Zone 15

Proposed Low Pressure Sewer

Existing Pipes

- Gravity Main
- - - Force Main
- - - Low Pressure

Sagamore South Proposed Sewer Portsmouth, NH	
PROJ NO: 13304	DATE: 1/21/2021
WRIGHT-PIERCE Engineering a Better Environment	FIGURE: 3-2

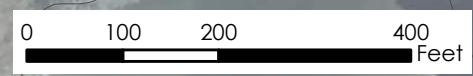


TABLE 3-1

NUMBER AND TYPE OF SERVICE CONNECTIONS - NORTH SAGAMORE

Description of Service Connection	Number of Service Connections	Type of Service Connection
Residences	63	Residential
Scuba shop	1	Commercial

TABLE 3-2

NUMBER AND TYPE OF SERVICE CONNECTIONS - SOUTH SAGAMORE

Description of Service Connection	Number of Service Connections	Type of Service Connection
Residences	17	Residential
Boat club	1	Recreational
Restaurant	2	Commercial
Parking Area	1	Commercial
Real estate agency	1	Commercial
Boathouse / Boat rentals	3	Recreational
Open Lot	1	Commercial
Gas station	1	Commercial

3.1.2 Vacant Lots and Future Growth

For the purposes of this preliminary design, a conservative (high) number of services was used. These connections will be modified as additional information is made available during final design. There was one identified vacant lot within the area of North Sagamore. This lot, 919 Sagamore Avenue, was included in flow estimates and was assumed to be a future single-family residence. Several properties within Sagamore North were identified as potentially needing additional sewer service connections in the future.

- 695 and 697 Sagamore will be converted from 2 service connections to 4 future condexes
- 635 Sagamore will be converted from an auto stop to 5 future condexes
- 749 Sagamore has recently replaced a failed septic system with a new system, a service will be provided for future connection

The proposed number of service connections is for the design basis only to ensure conservative sizing and does not provide any implied approval of proposed development. Any future development will require approval through City Planning Boards.

Several locations within South Sagamore were identified for potential increases in wastewater flow and were included in flow estimates. These are listed below:

- Given the size and layout of the property along Sagamore Creek next to 958 Sagamore Avenue, an average daily flow of 219 GPD is assumed.
- Given the size and layout of the property along Sagamore Creek next to 6 Sagamore Grove, an average daily flow of 219 GPD is assumed.
- Given the size and layout of the property along Wentworth House Road next to 1150 Sagamore Avenue, an average daily flow of 219 GPD is assumed.
- 1145 Sagamore Ave. which is currently a mental health center was assumed to have an average daily flow of 2,193 GPD given the size and layout of the property.
- 960 Sagamore Ave. which is currently a restaurant and boutique was assumed to have an average daily flow of 1,316 GPD given the size and layout of the property.

To account for future wastewater flows, each residential property that was not a condo or condex was assumed to have a 20% increase in wastewater flows. Each condo or condex property was assumed to have a 10% increase in wastewater flow.

3.1.3 Categorization of Service Connections

Section 3.1.1 lists the types of the 64 service connections for the North Sagamore area and the 27 service connections for the South Sagamore area. These service connections were sorted into one of four categories: residential, commercial, institutional, and recreational. These connections were further categorized using **Tables 2-1, 2-2, 2-3 and 2-4** which list specific wastewater sources within residential, commercial, institutional, and recreational categories respectively. According to the 2010 United States Census Bureau, the average household size in New Hampshire was 2.46 persons per household. For this evaluation, a value of 2.5 persons per residence was assumed. In

addition, when referencing **Table 2-1** the flowrate for residences were assumed using the “current level of conservation.”

3.1.4 Peak Hourly Flow Rate Calculation

An estimated peak hourly flow rate into the low pressure sewer system was calculated for each source on North Sagamore and South Sagamore. These estimates are presented in **Tables 3-3 and 3-4**, respectively. Peak hourly flow rate is calculated by multiplying the average daily flow of each user by a peaking factor of 6.

An example calculation is presented below for the peak hourly flowrate for a residence on North Sagamore.

Peak Hourly Flow Rate = (Estimated Number of Units) x (Typical Average Daily Flow per Unit) x (Peaking Factor)

Ex. (1 residence) x (2.5 capita/residence) x (72.5 gal/capita-day) x (6) = 1,088 gal/day or 0.75 gal/min

3.1.5 Comparison of Water Use Data and Flow Estimates

The City provided monthly water use data from January 2017 to September 2019, for available properties within the project area. Using this data, the average daily water use for each property was calculated. It was assumed that the water use per property would provide an estimate as to the wastewater generated per property. A comparison was performed between the estimated wastewater generated (as described in previous sections using Metcalf and Eddy tables) and the actual wastewater generated (from water use data). This comparison is presented in **Appendix A**. Also provided in **Appendix A**, is the planning zone for each evaluated property and the difference between the estimated wastewater quantity and City water use data calculated wastewater quantity. When calculating the total wastewater generated systemwide, the larger value was used between the estimated value and the water use data. **Appendix A** shows which value was used for each property and shows the peaked value for the new sewer system sizing. With the exception eight properties, every property had a larger estimated value.

TABLE 3-3
CALCULATION OF SOURCE DAILY FLOWS – NORTH SAGAMORE

Description of Service Connection	Estimated Number of Units	Typical Daily Flowrate per Unit, gal/unit-day	Peaking Factor	Peak Hourly Flowrate Calculation (+10% for Future Buildout)	Peak Hourly Flowrate, gal/day
Residence <i>with</i> Accessory Dwelling Unit	2.5 capita/residence-day	72.5	6	$(2.5 \times 72.5) \times 6 \times 1.1 \times 1.1$	1,316
Residence <i>without</i> Accessory Dwelling Unit	2.5 capita/residence-day	72.5	6	$(2.5 \times 72.5) \times 6 \times 1.1$	1,196
Scuba shop	75 users/day	3	6	$(75 \times 3) \times 6 \times 1.1$	1,485
Sporting goods store	2 toilet/day; 3 employees/day	300; 8	6	$[(2 \times 300) + (3 \times 8)] \times 6 \times 1.1$	4,118

TABLE 3-4
CALCULATION OF SOURCE DAILY FLOWS – SOUTH SAGAMORE

Description of Service Connection	Estimated Number of Units	Typical Daily Flowrate per Unit, gal/unit-day	Peaking Factor	Peak Hourly Flowrate Calculation (+10% for Future Buildout)	Peak Hourly Flowrate, gal/day
Residence <i>with</i> Accessory Dwelling Unit	2.5 capita/residence-day	72.5	6	$(2.5 \times 72.5) \times 6 \times 1.1 \times 1.1$	1,316
Residence <i>without</i> Accessory Dwelling Unit	2.5 capita/residence-day	72.5	6	$(2.5 \times 72.5) \times 6 \times 1.1$	1,196
Boat club	75 members/day; 4 employees/day	18.8; 9.8	6	$[(75 \times 18.8) + (4 \times 9.8)] \times 6 \times 1.1$	9,565
Restaurant	300 customers/day	6	6	$(300 \times 6) \times 6 \times 1.1$	11,880
Parking Lot ¹	0.5 acer/day	1500	6	$0.5 \times 1500 \times 6$	4,500
Real estate agency	8 employees/day	10	6	$(8 \times 10) \times 6 \times 1.1$	528
Boathouse / boat rentals	75 members/day; 4 employees/day	18.8; 9.8	6	$[(75 \times 18.8) + (4 \times 9.8)] \times 6 \times 1.1$	9,565
Gas station	300 vehicles/day; 3 employees/day	8; 10	6	$[(8 \times 300) + (3 \times 10)] \times 6 \times 1.1$	16,038

¹Parking Lot/Open Lot were assumed to be redeveloped for commercial use and sanitary waste flows were estimated in terms of quantity of flow per unit area, using an allowance of 1500 gal/ac-d, taken from Metcalf & Eddy allowance for commercial developments.

3.2 SIZING OF SEWER PIPING NETWORK

3.2.1 Summary of Design Criteria

The sizing of the low pressure sewer piping for North and South Sagamore was based on *Chapter Env-Wq 700 Subsection 704.07* of the New Hampshire Code of Administrative Rules. The minimum pipe size diameter at a given location in the low pressure sewer network is based on two criteria: the number of service connections, and the estimated peak flow. For the sizing of the pipe network, the larger of the two criteria dictated the pipe size. **Table 3-5** is reproduced from Subsection 704.07 (e) and is used in the following subsections (3.2.2 and 3.2.3) to determine minimum pipe sizes. In addition, *Chapter Env-Wq 700 Subsection 704.07.(f)*, states that the velocity in a pressure sewer system should yield a velocity of 2 feet per second or greater under average conditions.

TABLE 3-5
MINIMUM PIPE SIZE BASED ON NUMBER OF CONNECTIONS AND FLOW

Number of Connections Served	Estimated Peak Flow, gpm	Minimum Pipe Size, inches
1 to 3	15	1.5
4 to 10	20	2
11 to 30	30	3
31 to 150	90	4

3.2.2 North Sagamore Pipe Sizing

The minimum pipe size at each location along the North Sagamore network was dictated by the number of connections within each zone and the estimated peak flow per dwelling in each zone. The number of connections was determined by counting the number of connections upstream of a given zone, as shown in **Figure 3-1**. The peak flow is calculated by taking the sum of the flows in each zone and correlating it with each source type as shown in **Table 3-3**. Location specific values can be found in **Appendix A**. The minimum pipe sizes for locations along North Sagamore are presented in **Table 3-6** and shown on **Figure 3-3**.

The total estimated wastewater flow exiting the proposed North Sagamore force main into a gravity sewer on Sagamore is approximately 100,000 gpd (69 gpm). This value represents a conservative peak hourly flow value.

The 2018 Existing Sewer Capacity Analysis (**Appendix B**) used a total estimated wastewater peak flow of 94,000 gpd exiting the proposed North Sagamore force main into the low pressure sewer on Sagamore. This value is similar to the total estimated flow determined in this report. The results of the capacity analysis indicate that with the additional flow from the proposed low pressure sewer, the existing sewer remains generally under 61% full. Backwater from the interceptor sewer causes slight surcharge in the downstream sewer segment. The capacity analysis concluded that the sewer segments located immediately downstream of the North Sagamore project area appear to have sufficient capacity.

3.2.3 South Sagamore Pipe Sizing

The minimum pipe size at each location along the South Sagamore network was dictated by the number of connections within each zone and the estimated peak flow per dwelling in each zone. The number of connections was determined by counting the number of connections upstream of a given zone, as shown in **Figure 3-2**. The peak flow is calculated by taking the sum of the flows in each zone and correlating it with each source type as shown in **Table 3-4**. Location specific values can be found in **Appendix A**. The minimum pipe sizes for locations along South Sagamore are presented in **Table 3-7** and **Figure 3-4**.

The total estimated wastewater flow exiting the proposed South Sagamore force main into a gravity sewer on Sagamore is approximately 105,000 gpd (73 gpm). This value represents a conservative peaked flow value. An existing low pressure sewer system is installed between 1163 Sagamore Avenue (at the newly developed Moose Lodge Condexes) and the previously existing sewer system found near 1179 Sagamore Avenue. The total estimated wastewater flow into the existing sewer with these properties included (i.e., 1163, 1167, 1169, 1171, 1177 and 1179 Sagamore Ave.) is approximately 115,000 gpd (80 gpm). This value represents a conservative peaked flow value.

For South Sagamore, the capacity analysis used a total estimated wastewater peak flow of 125,000 gpd exiting the proposed low pressure sewer into the existing 3” low pressure sewer on Sagamore Avenue. This value is similar to the total estimated flow determined in this report. The results of the capacity analysis indicate that with the additional flow from the proposed low pressure sewer, the existing sewer remains generally under 47% full. The capacity analysis concluded that the sewer segments located immediately downstream of the South Sagamore project area appear to have sufficient capacity.

TABLE 3-6**PIPE SIZE FOR LOCATIONS ALONG NORTH SAGAMORE**

Location (Lot #)	Cumulative Number of Connections at Location	Cumulative Peak Flow at Location, gpm	Minimum Pipe Size, inches
16	2	2	2
40	4	4	2
58	5	5	2
72	6	6	2
75	7	7	2
86	8	8	2
93	9	8	2
107	10	9	2
137	12	10	3
147	14	11	3
159	15	12	3
174	16	13	3
184	17	14	3
189	18	15	3
251	7	7	2
220	9	11	2
212	12	13	3
36	31	29	4
24	33	31	4
14	35	34	4
7	37	36	4
911	6	6	2
915	38	37	4
895	46	46	4
89	3	3	2
808	7	6	2
766	53	53	4
716	57	57	4
698	61	61	4
692	63	63	4
650	65	68	4

TABLE 3-7
PIPE SIZE FOR LOCATIONS IN THE SOUTH SAGAMORE

Location (Lot #)	Cumulative Number of Connections at Location	Cumulative Peak Flow at Location, gpm	Minimum Pipe Size, inches
1	6	5	2
960	8	12	2
958	9	19	2
1145	10	28	2
1149	11	28	3
191	1	8	2
187	3	9	2
185	4	16	2
74	6	18	2
2	8	20	2
1150	11	32	3
1151	23	61	3
1155	24	62	3

JDM W:\GIS_Development\Projects\NH\Portsmouth\11304-NH-Portsmouth\MXDs\Fig3-3-ProposedSewerDiameter-North-11x17.mxd

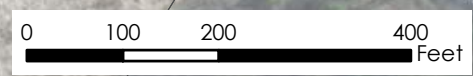
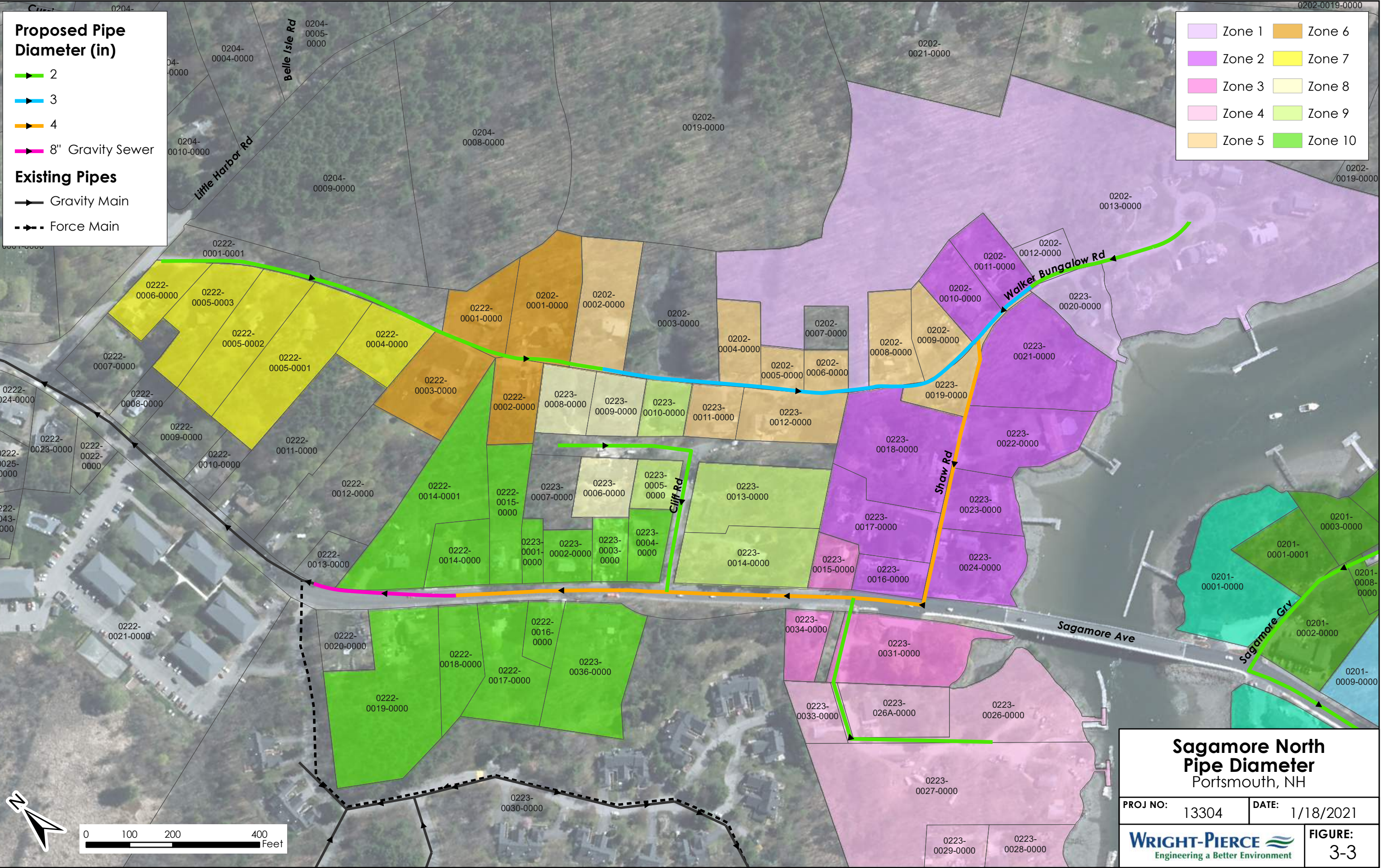
Proposed Pipe Diameter (in)

- ▶ 2
- ▶ 3
- ▶ 4
- ▶ 8" Gravity Sewer

Existing Pipes

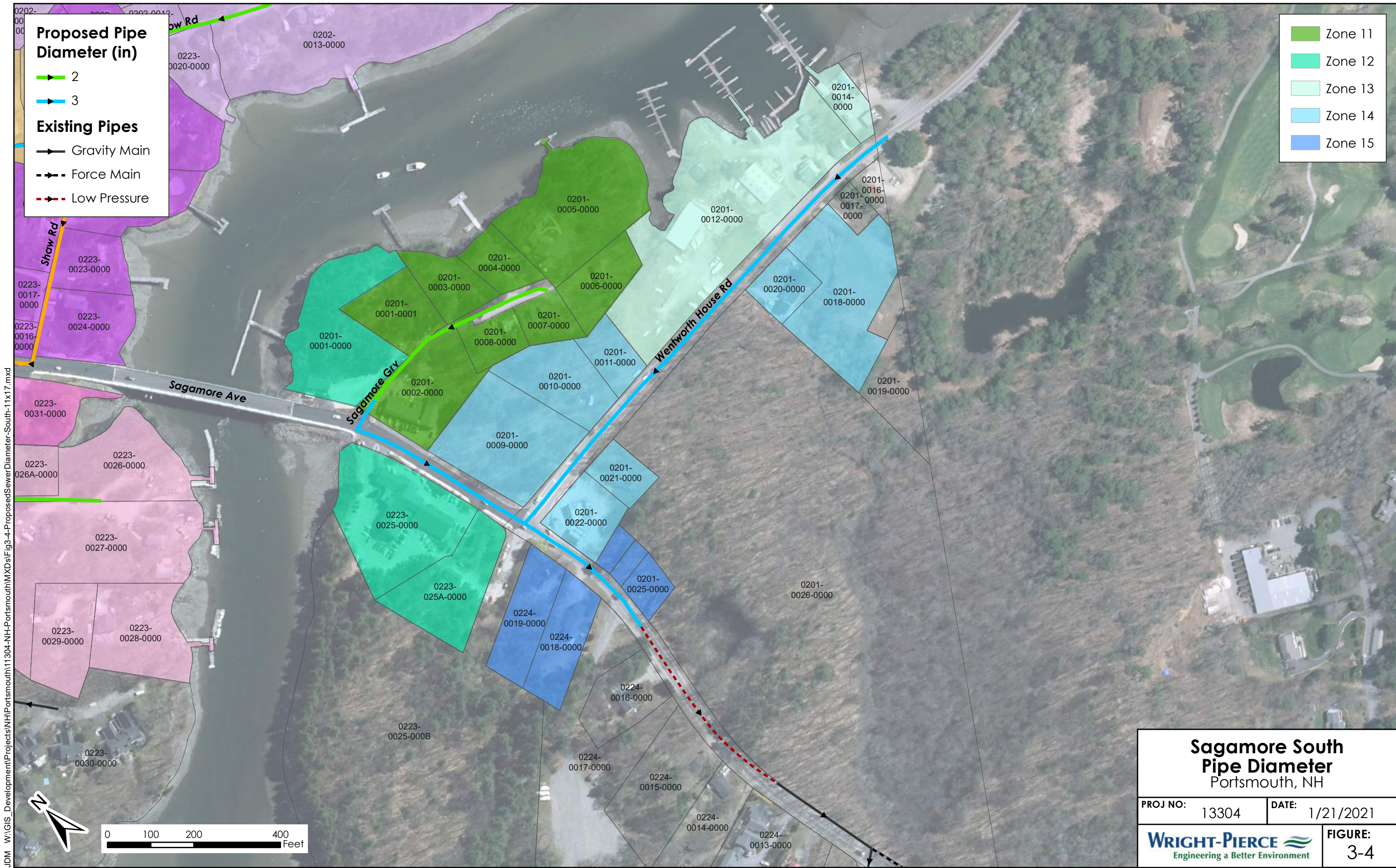
- ▶ Gravity Main
- - - Force Main

Zone 1	Zone 6
Zone 2	Zone 7
Zone 3	Zone 8
Zone 4	Zone 9
Zone 5	Zone 10



**Sagamore North
Pipe Diameter**
Portsmouth, NH

PROJ NO: 13304	DATE: 1/18/2021
WRIGHT-PIERCE Engineering a Better Environment	
FIGURE: 3-3	



Proposed Pipe Diameter (in)

- ▶ 2
- ▶ 3

Existing Pipes

- ▶ Gravity Main
- - - Force Main
- - - Low Pressure

- Zone 11
- Zone 12
- Zone 13
- Zone 14
- Zone 15

Sagamore South Pipe Diameter Portsmouth, NH	
PROJ NO: 13304	DATE: 1/21/2021
WRIGHT-PIERCE <small>Engineering a Better Environment</small>	
FIGURE: 3-4	

JDM W:\GIS_Development\Projects\NH\Portsmouth\11304-NH-Portsmouth\MXDs\Fig3-4-ProposedSewerDiameter-South-11x17.mxd

3.3 CONCEPTUAL DESIGN LAYOUT

Using the criteria for pipe sizing, a conceptual layout of the potential pipeline routing and service connections has been developed. As shown in **Figures 3-3** and **3-4**, the pressure sewer pipes have been designed for three sizes: the green colored pipes are 2-inch pipes, the blue colored pipes are 3-inch pipes and the orange-colored pipes are 4-inch pipes. The two reaches of gravity sewer on North Sagamore have been designed for one size: pink colored pipes are 8-inch PVC gravity pipe. The Conceptual Design Drawings (**Appendix C**) identify that each property has a service connection to a new pressure sewer main. If a resident connects during this project, a portable generator connection plug and manual transfer switch will be provided with each individual grinder pump. All service connections and pressure piping are designed to be HDPE SDR 11, both for pressure considerations and corrosion resistance to raw wastewater. Each service connection is currently sized for 1.25-inch pipe. If desired, HDPE SDR 17 can also be used for the services and low pressure sewer pipes.

The pressure sewer system for the North Sagamore system transitions to 8" PVC gravity sewer in front of 692 Sagamore Avenue. This gravity sewer then discharges into an existing sewer manhole in front of 650 Sagamore Avenue to flow by gravity in the existing 8" VCP gravity sewer. The pressure sewer system for the South Sagamore system discharges into an existing 3" low pressure sewer system, located at 1163 Sagamore Avenue. The existing 3" low pressure sewer system discharges into an existing manhole approximately three hundred feet downstream to flow by gravity.

As an additional design consideration, E|One Design Assistant software was used to prepare a flow model based upon the E|One pump systems flow capacities. The results of the E|One analysis are presented in **Appendix D**. As these results show, the low pressure sewer pipe sizes recommended by the E|One software are consistent with the sizes determined base on the New Hampshire Code of Administrative Rules.

3.4 GEOTECHNICAL INVESTIGATIONS

Geotechnical investigations, including soil borings and ledge probes, were performed in December 2019 to identify subsurface conditions and the location of bedrock. The completed

borings are located in **Appendix E**. The soil borings showed a majority of medium dense sand, with some medium dense sandy silt present. The ledge probes identified a significant presence of ledge within the project site. 40 probes showed ledge at less than 5.5 feet deep, 23 probes showed ledge between 5.5 and 8.5 feet deep, and 25 probes showed ledge at greater than 8.5 feet deep. 44 probes and 2 borings were not completed due to site access issues, these probes have been rescheduled for January 2021. See **Figure 3-5** for the results and locations of the borings.

3.5 PRIVATE PROPERTY

Wright-Pierce conducted non-mandatory private property site meetings between November and December 2020 as a basis for the sewer lateral design on private property. A total of 62 site meetings were completed out of the possible 83 parcels within the project area (75%). The goal of each private property site meeting was to access, evaluate, and document the existing septic system, septic lateral, water service, internal plumbing fixtures, electrical panels, building foundation condition, and any visible obstructions that could potentially complicate the construction of the proposed sewer laterals.

Individual sewer laterals will be designed for each building that a site meeting occurred at. If the property owner did not schedule a site meeting, the sewer service stub within the right-of-way will be placed strategically for future connection. Residential buildings will receive a 1.25-inch private sewer service connection. The private property designs also include recommended electrical upgrades where needed to accommodate for the proposed grinder pump. Grinder pumps will be designed to be located between the existing building and septic system, unless there is a need or other benefit to relocate the service location.

3.6 LOW PRESSURE PAVEMENT RESTORATION

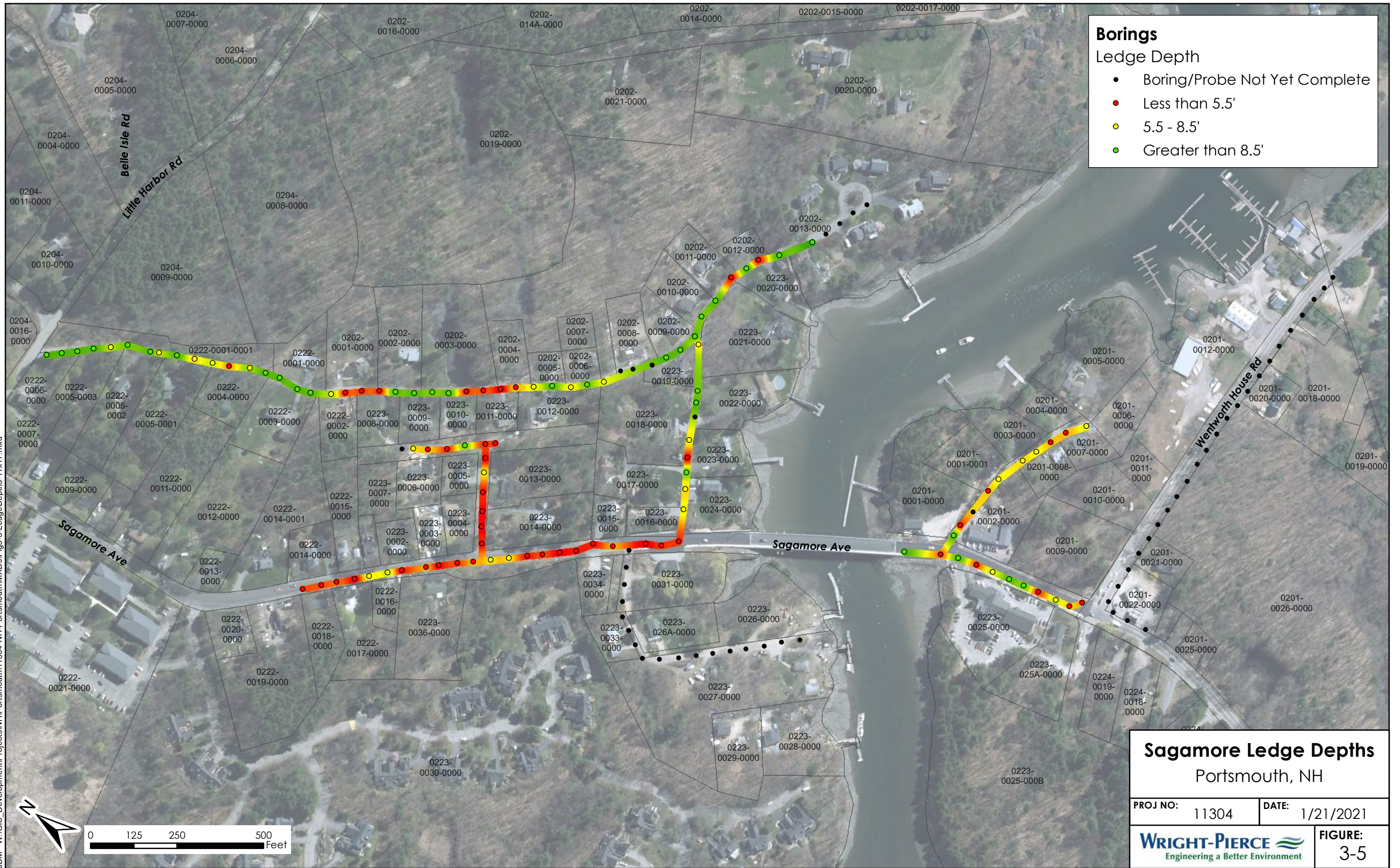
Pavement restoration within roads maintained by the NH Department of Transportation (NHDOT), will consist of trench patching and mill and overlay of the entire roadway. These roads include Sagamore Avenue in South Sagamore and Wentworth House Road. Pavement restoration for roads maintained by the City of Portsmouth will consist of trench patching only. These roads include Sagamore Avenue in North Sagamore, Cliff Road, Sagamore Grove, Shaw Road, and Walker

Bungalow Road. Within the Sagamore West area of Sagamore North, pavement restoration will consist of trench patching and gravel overlay to match existing conditions.

3.7 HAZARDOUS MATERIALS REMEDIATION

In December 2019 Wright-Pierce evaluated potential hazardous materials remediation sites within proximity to the project site. The memorandum in **Appendix F** includes a summary of the six potential remediation sites, owner information, NHDES identification numbers, and the status of each location based on NHDES OneStop Data and Information center.

JDM W:\GIS_Development\Projects\NH\Portsmouth\11304-NH-Portsmouth\MXDs\Fig3-5-LedgeDepths-11x17.mxd



Borings

Ledge Depth

- Boring/Probe Not Yet Complete
- Less than 5.5'
- 5.5 - 8.5'
- Greater than 8.5'

Sagamore Ledge Depths
Portsmouth, NH

PROJ NO: 11304	DATE: 1/21/2021
FIGURE: 3-5	

4

SECTION 4

IMPLEMENTATION

4.1 RECOMMENDATIONS

A low pressure sewer system will be added to properties in North and South Sagamore area in Portsmouth, NH. The North Sagamore system has 64 service connections, of which 63 are private residences. The South Sagamore system has 27 service connections, of which 17 are private residences.

Each service connection will require an independent sewage storage basin with a sewage grinder pump in order to discharge into the low pressure sewer system. It is anticipated that residential service connections will have an *Environmental One* model DH071 grinder pump station. Commercial and recreational connections with less than 700 GPD flow are also anticipated to have a model DH071 grinder pump station where connections with flows greater than 700 GPD are anticipated to use an *Environmental One* model DR152 grinder pump station that includes a submersible grinder pump, basin or tank, check valves, anti-siphon valves, a control panel, level control system, all necessary wiring, flexible discharge hose, and shut off valve.

In both systems, the pressure sewer mains were designed to be either 2-, 3-, or 4-inches in diameter. During final design, each location will be further analyzed with the desired pump system to determine sewer pipeline velocity for final pipe sizing. Final extents of project and total number of connections will be further reviewed during final design.

4.1.1 Permitting

The NH Shoreland Water Quality Protection Act (SWQPA) establishes the standards and regulations for use and development within the Shoreland Protection Area adjacent to public bodies of water. Sagamore Creek is considered a tidal waterway, which is protected by the SWQPA. The proposed project meets the criteria for Shoreland Permit by Notification (PBN) per RSA 483-B:5-b 1(a)(2) since the project will provide considerable environmental enhancement. A PBN is anticipated before construction of the sewer extension work within the Shoreland Protection Area can commence. The Shoreland Permit fee for the Project is estimated at \$200.

The NHDES Wetlands Bureau regulates activity in and around jurisdictional wetlands. It is anticipated that there will be minimal freshwater wetland impacts based on our preliminary study of recorded wetlands on the City's GIS database. The temporary primary wetland impacts anticipated by the Sagamore Avenue Sewer Extension will be within the Tidal Buffer Zone (TBZ), which is the area within 100' from the highest observable tide line (HOTL). A Standard Dredge and Fill Wetlands Permit will be required as the project proposes to establish new utility assets within the 100' TBZ. Additional coastal requirements will also need to be satisfied as required in Env-Wt 600 as work is being proposed within the TBZ. The application also requires a submission to the local Conservation Commission prior to submittal to NHDES. The required fees for this permit are \$0.40 per square foot of proposed impacts.

The State of New Hampshire requires a sewer connection permit be completed for a proposed sewer extension and connection of additional services to an existing sewer system that represents a flow increase. This permit can be found under as an attachment to the submittal cover letter.

The NHDOT requires that an excavation permit be filled out for projects disturbing the pavement, shoulders, and/or slopes within the NHDOT right of way. This permit will be completed and submitted by the contractor. The State of New Hampshire requires that a use and occupancy permit be completed. This permit will be completed and submitted by the City.

4.2 OPINION OF PROBABLE CONSTRUCTION COSTS

Probable Total Project cost opinion was developed for both the North Sagamore and South Sagamore low pressure sewer systems based upon the designed flows and pipe sizes. The estimated cost for the North Sagamore system was \$4,084,000, and the estimated cost for the South Sagamore system was \$2,016,000. The estimated total cost for North and South Sagamore systems was \$6,100,000. After the geotechnical testing is complete, a more refined Right-of-Way cost estimate can be developed which includes a better expectation of ledge excavation requirements.

The City recently completed private property site meetings, where permitted. The private property data gathered during the site meeting will be used to better estimate the anticipated costs outside the City owned rights of way during final design. At this time, private property improvements were assumed to include a new grinder pumps, 50 linear feet of low pressure sewer force main, and the abandonment of the existing septic tank.

Allowances for ledge removal within the City owned rights of way (ROW) were calculated by street based the average depth of ledge within each street, an assumed trench width of 5.5 ft, and an assumed trench depth of 6.5 ft. The allowance for streets with no probing data was calculated using the average ledge depth of the entire project area. Allowances for ledge removal outside the City owned rights of way (non-ROW) were calculated assuming that each property would have a 3 ft by 50 ft trench. Based on the probing results, the bottom 1.5 ft of excavation was assumed to be ledge.

The summary of the detailed opinion of total project cost are presented in **Table 4-1**. The costs include design and construction phase engineering, materials testing allowances, and other project costs.

TABLE 4-1
COST ESTIMATE FOR SAGAMORE SEWER SYSTEM

Description	Unit Price	Unit	Right of Way Costs		Non Right-of-Way Costs	
			QTY	Unit	QTY	Cost
Service Connection	\$45	LF	1,820	\$81,900	4,550	\$204,800
2" Low pressure sanitary sewer main	\$55	LF	4,800	\$264,000	-	-
2" Low pressure sanitary sewer main Allowance South of Scuba Shop"	\$60	LF	650	\$39,000	-	-
3" Low pressure sanitary sewer main Allowance Walker Bungalow to Little Harbor"	\$60	LF	800	\$48,000	-	-
3" Low pressure sanitary sewer main	\$65	LF	1,400	\$91,000	-	-
4" Low pressure sanitary sewer main	\$70	LF	1,700	\$119,000	-	-
4" Low pressure sanitary sewer main Allowance Replace 3" LPSS from Odiorne to Moose Lodge Connection, NHDES Concerns"	\$70	LF	600	\$42,000	-	-
LPS Station (i.e. E One)	\$11,000	EA	0	\$0	87	\$957,000
LPS Station - High Capacity (i.e. E One)	\$16,000	EA	0	\$0	4	\$64,000
Ledge excavation	\$140	CY	2,200	\$308,000	500	\$70,000
Ledge excavation - Allowance additional LPSS	\$38	LF	2,050	\$78,300	-	-
Aggregate base (including excavation)	\$5	LF	7,900	\$39,500	-	-
Aggregate base (including excavation) - Allowance additional LPSS	\$5	LF	2,050	\$10,300	-	-
Aggregate sub-base (including excavation)	\$30	LF	7,900	\$240,700	-	-
Aggregate sub-base (including excavation) - Allowance additional LPSS	\$30	LF	2,050	\$61,500	-	-
Hot bituminous pavement (trench patch)	\$55	LF	7,900	\$434,500	-	-
Hot bituminous pavement (trench patch) - Allowance additional LPSS	\$55	LF	2,050	\$112,800	-	-
Hot bituminous pavement (full width overlay)	\$175	Ton	725	\$126,900	-	-
Hot bituminous pavement (services trench path)	\$800	EA	91	\$72,800	-	-
Traffic control	\$25,000	LS	2	\$50,000	-	-
Pavement Markings	\$2,000	LS	2	\$4,000	-	-
Abandon Private Septic System	\$2,000	EA		\$0	91	\$182,000

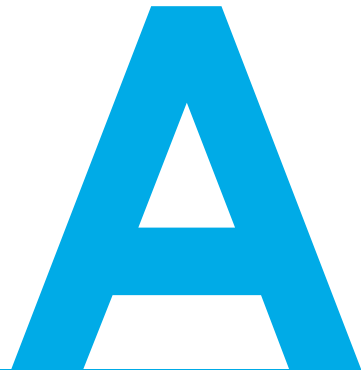
Description	Unit Price	Unit	Right of Way Costs		Non Right-of-Way Costs	
			QTY	Unit	QTY	Cost
Water Main Replacement Allowance	\$125	LF	100	\$12,500	-	-
Water Service Replacement Allowance	\$3,500	EA	10	\$34,700	-	-
Hazardous Material Allowance (soil, groundwater)	\$50,000	LS	1	\$50,000	-	-
Loaming and Seeding	\$5	SY	0	\$0	1,520	\$7,600
Mobilization/Demobilization (5%)	5%	LS	1	\$117,000	1	\$75,000
Miscellaneous and Unitemized (10%)	10%	LS	1	\$244,000	1	\$157,000
Subtotal Construction				\$2,682,000		\$1,717,000
Construction Contingency			10%	\$268,000	10%	\$172,000
Design Engineering			8%	\$361,000		
Construction Phase Engineering			15%	\$402,000	15%	\$258,000
Permitting Fees, Materials Testing, Legal, Other			7.5%	\$201,000		
Subtotal				\$3,914,000		\$2,147,000
Financing			1%	\$39,000	1%	
Total Project Cost				\$3,953,000		\$2,147,000
Total Project Cost Right-of-Way and Non-Right of Way				\$6,100,000		

TABLE 4-2

COST ESTIMATE FOR SAGAMORE SEWER SYSTEM BY PROJECT AREA

Project Area	ROW Costs	Non-ROW Costs	Total Costs
Sagamore North	\$2,600,000	\$1,484,000	\$4,084,000
Sagamore South	\$1,353,000	\$663,000	\$2,016,000
Subtotal	\$3,953,000	\$2,147,000	\$6,100,000

APPENDIX



COMPARISON OF WATER USE DATA AND METCALF AND EDDY ESTIMATE

Area	No.	Street	Zone	Wastewater Generated		Average Flow Difference [Estimate - Water Use] (gpd)	Estimate Used (Water Use Data or Metcalf & Eddy) = Larger Estimate	Wastewater Generated Peaked Value (gpd)
				Water Use Data	Metcalf & Eddy			
				Average (gpd)	Estimate (gpd)			
North	33	CLIFF RD	SRB	60	219	159	Metcalf	1,316
North	44	CLIFF RD	SRB	86	219	133	Metcalf	1,316
North	45	CLIFF RD	SRB	79	219	140	Metcalf	1,316
North	71	CLIFF RD	SRB	69	219	150	Metcalf	1,316
North	89	CLIFF RD	SRB	197	219	22	Metcalf	1,316
North	96	CLIFF RD	SRB	242	219	(-22)	Water Use Data	1,451
North	131	CLIFF RD	SRB	87	219	132	Metcalf	1,316
North	3	LITTLE HARBOR RD	SRB	130	219	89	Metcalf	1,316
North	635	SAGAMORE AVE	SRA	Not included	997	997	Metcalf	5,981
North	650	SAGAMORE AVE	SRB	92	219	128	Metcalf	1,316
North	692	SAGAMORE AVE	SRB	166	219	53	Metcalf	1,316
North	695	SAGAMORE AVE	SRA	65	219	154	Metcalf	1,316
North	697	SAGAMORE AVE	SRA	159	219	60	Metcalf	1,316
North	698	SAGAMORE AVE	SRB	121	219	99	Metcalf	1,316
North	713	SAGAMORE AVE	SRA	110	219	110	Metcalf	1,316
North	714	SAGAMORE AVE	SRB	79	219	140	Metcalf	1,316
North	716	SAGAMORE AVE	SRB	31	219	188	Metcalf	1,316
North	749	SAGAMORE AVE	SRA	107	219	113	Metcalf	1,316
North	766	SAGAMORE AVE	SRB	39	219	180	Metcalf	1,316
North	792	SAGAMORE AVE	SRB	46	219	173	Metcalf	1,316
North	796	SAGAMORE AVE	SRB	75	219	145	Metcalf	1,316
North	808	SAGAMORE AVE	SRB	66	219	153	Metcalf	1,316
North	895	SAGAMORE AVE	WB	25	686	661	Metcalf	4,118
North	900	SAGAMORE AVE	SRB	85	219	134	Metcalf	1,316

Area	No.	Street	Zone	Wastewater Generated		Average Flow Difference [Estimate - Water Use] (gpd)	Estimate Used (Water Use Data or Metcalf & Eddy) = Larger Estimate	Wastewater Generated Peaked Value (gpd)
				Water Use Data	Metcalf & Eddy			
				Average (gpd)	Estimate (gpd)			
North	910	SAGAMORE AVE	WB	83	219	136	Metcalf	1,316
North	911	SAGAMORE AVE	WB	Not included	219	219	Metcalf	1,316
North	912	SAGAMORE AVE	WB	123	219	96	Metcalf	1,316
North	913	SAGAMORE AVE	WB	Not included	439	439	Metcalf	2,632
North	915	SAGAMORE AVE	WB	46	248	202	Metcalf	1,485
North	919	SAGAMORE AVE	WB	Not included	219	219	Metcalf	1,316
North	929	SAGAMORE AVE	WB	Not included	219	219	Metcalf	1,316
North	7	SHAW RD	SRB	508	219	(-289)	Water Use Data	3,051
North	14	SHAW RD	SRB	251	219	(-32)	Water Use Data	1,505
North	17	SHAW RD	SRB	394	219	(-175)	Water Use Data	2,366
North	24	SHAW RD	SRB	120	219	99	Metcalf	1,316
North	27	SHAW RD	SRB	279	219	(-59)	Water Use Data	1,673
North	36	SHAW RD	SRB	161	219	58	Metcalf	1,316
North	140	WALKER BUNGALOW	SRB	157	219	62	Metcalf	1,316
North	16	WALKER BUNGALOW RD	SRB	63	219	157	Metcalf	1,316
North	26	WALKER BUNGALOW RD	SRB	126	219	93	Metcalf	1,316
North	40	WALKER BUNGALOW RD	SRB	116	219	103	Metcalf	1,316
North	58	WALKER BUNGALOW RD	SRB	51	219	169	Metcalf	1,316
North	72	WALKER BUNGALOW RD	SRB	283	219	(-63)	Water Use Data	1,695
North	75	WALKER BUNGALOW RD	SRB	86	219	133	Metcalf	1,316
North	86	WALKER BUNGALOW RD	SRB	147	219	73	Metcalf	1,316
North	93	WALKER BUNGALOW RD	SRB	118	219	101	Metcalf	1,316
North	107	WALKER BUNGALOW RD	SRB	62	219	157	Metcalf	1,316
North	137	WALKER BUNGALOW RD	SRB	105	219	115	Metcalf	1,316
North	147	WALKER BUNGALOW RD	SRB	81	219	138	Metcalf	1,316
North	159	WALKER BUNGALOW RD	SRB	67	219	152	Metcalf	1,316
North	171	WALKER BUNGALOW RD	SRB	119	219	101	Metcalf	1,316

Area	No.	Street	Zone	Wastewater Generated		Average Flow Difference [Estimate - Water Use] (gpd)	Estimate Used (Water Use Data or Metcalf & Eddy) = Larger Estimate	Wastewater Generated Peaked Value (gpd)
				Water Use Data	Metcalf & Eddy			
				Average (gpd)	Estimate (gpd)			
North	184	WALKER BUNGALOW RD	SRB	72	219	148	Metcalf	1,316
North	189	WALKER BUNGALOW RD	SRB	138	219	81	Metcalf	1,316
North	201	WALKER BUNGALOW RD	SRB	206	219	13	Metcalf	1,316
North	209	WALKER BUNGALOW RD	SRB	90	219	129	Metcalf	1,316
North	212	WALKER BUNGALOW RD	SRB	141	219	78	Metcalf	1,316
North	217	WALKER BUNGALOW RD	SRB	94	219	125	Metcalf	1,316
North	220	WALKER BUNGALOW RD	SRB	56	219	164	Metcalf	1,316
North	238	WALKER BUNGALOW	SRB	181	219	39	Metcalf	1,316
North	241	WALKER BUNGALOW RD	SRB	189	219	30	Metcalf	1,316
North	251	WALKER BUNGALOW RD	SRB	177	219	43	Metcalf	1,316
North	260	WALKER BUNGALOW RD	SRB	734	219	(-515)	Water Use Data	4,406
North	272	WALKER BUNGALOW RD	SRB	99	219	120	Metcalf	1,316
North	284	WALKER BUNGALOW RD	SRB	193	219	26	Metcalf	1,316
North	290	WALKER BUNGALOW RD	SRB	110	219	110	Metcalf	1,316
South	955	SAGAMORE AVE	SRB	160	1,594	1,434	Metcalf	9,565
South	960	SAGAMORE AVE	MRB	762	1,316	554	Metcalf	7,895
South	1145	SAGAMORE AVE	MRO	558	2,193	1,844	Metcalf	13,159
South	1149	SAGAMORE AVE	MRO	46	88	42	Metcalf	528
South	0201-0009-0000	SAGAMORE AVE	MRB	Not included	219	219	Metcalf	1,316
South	1150	SAGAMORE AVE	MRO	694	2,673	1,979	Metcalf	16,038
South	1151	SAGAMORE AVE	MRO	27	219	193	Metcalf	1,316
South	1155	SAGAMORE AVE	MRO	259	219	(-40)	Water Use Data	1,555
South	0201-0023-0000/ 0201-0024-0000	SAGAMORE AVE	MRB	Not included	219	219	Metcalf	1,316
South	0201-0025-0000	SAGAMORE AVE	MRB	Not included	219	219	Metcalf	1,316
South	1	SAGAMORE GR	SRB	40	219	180	Metcalf	1,316
South	2	SAGAMORE GR	SRB	125	219	94	Metcalf	1,316

Area	No.	Street	Zone	Wastewater Generated		Average Flow Difference [Estimate - Water Use] (gpd)	Estimate Used (Water Use Data or Metcalf & Eddy) = Larger Estimate	Wastewater Generated Peaked Value (gpd)
				Water Use Data	Metcalf & Eddy			
				Average (gpd)	Estimate (gpd)			
South	3	SAGAMORE GR	SRB	37	219	182	Metcalf	1,316
South	4	SAGAMORE GR	SRB	213	219	6	Metcalf	1,316
South	5	SAGAMORE GR	SRB	199	219	20	Metcalf	1,316
South	6	SAGAMORE GR	SRB	138	219	82	Metcalf	1,316
South	11	SAGAMORE GROVE	SRB	171	219	48	Metcalf	1,316
South	0201-0010-0000	WENTWORTH RD	WB	Not included	219	219	Metcalf	1,316
South	0201-0011-0000	WENTWORTH RD	WB	Not included	219	219	Metcalf	1,316
South	74	WENTWORTH RD	WB	85	219	134	Metcalf	1,316
South	185	WENTWORTH RD	WB	192	1,594	1,402	Metcalf	9,565
South	187	WENTWORTH RD	WB	206	219	14	Metcalf	1,316
South	191	WENTWORTH RD	WB	276	1,980	1,704	Metcalf	11,880
South	0201-0018-0000	WENTWORTH RD	WB	Not included	219	219	Metcalf	1,316
South	2	WENTWORTH ROAD	WB	Not included	219	219	Metcalf	1,316

ZONE LEGEND

Zone	Name
MRB	Mixed Residential Business
MRO	Mixed Residential Office
SRA	Single Residence A
SRB	Single Residence B
WB	Waterfront Business

B

TO:	Michael Theriault, PE	DATE:	10/18/2018
FROM:	Steve Guerrette, PE	PROJECT NO.:	11304B
SUBJECT:	Sagamore Avenue Sewer Extension – Existing Sewer Capacity Analysis [Revised January 2021]		

Revision: Some of the information presented in this memorandum was later adjusted with new information and may be outdated.

INTRODUCTION & BACKGROUND

The purpose of the memorandum is to present the findings of a sewer flow and pipe capacity evaluation downstream of the proposed Sagamore Avenue Sewer Extension. The sections of the sewer that were evaluated include:

- North of Sagamore Creek: The existing gravity sewer located on Sagamore Avenue and Miller Avenue. The southern limit was approximately 120 feet south of the intersection of Tidewatch Condominium Road and Sagamore Avenue. The northern limit was at the intersection of Spring Street and Miller Avenue.
- South of Sagamore Creek: The existing gravity sewer located on Sagamore Avenue, Odiorne Point Road, and Gosport Road, upstream of the Tucker's Cove Pump Station. The northern limit was approximately 270 feet north of the intersection of Sagamore Avenue and Odiorne Point Road, and the southern limit was the Tucker's Cove Pump Station wet well. Modeling was not conducted downstream of the Tucker's Cove Pump Station given that flows are limited by the capacity of the pumps.

The purpose of this evaluation is to determine if potential hydraulic restrictions exist and that adequate capacity is available to accept flows from the proposed sewer extensions. The proposed sewer extensions are shown on Figure 1 in Attachment A.

DATA REVIEW

To complete this evaluation, this information was obtained and reviewed:

- City of Portsmouth GIS sewer database, dated January 22, 2018
- Proposed Site Redevelopment Plans for 1163 Sagamore Avenue, dated March 31, 2016
- Sagamore Avenue Sewer Extension Preliminary Design Report, by Wright-Pierce
- Monthly water consumption data for existing properties within the Sagamore Avenue sewershed area for November 2015 through November 2017, last updated in an email from the City received June 20, 2018
- City of Portsmouth's Existing EPA SWMM Model

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HYDRAULIC MODE DEVELOPMENT

InfoSWMM, by Innovyze, was used by Wright-Pierce as the hydraulic modeling software. InfoSWMM is a fully ArcGIS integrated dynamic rainfall-runoff simulation model. It allows the user to create, edit, modify, run, map, analyze, and design sewer network models and instantly review, query, and display simulation results from within ArcGIS. InfoSWMM is run as an extension within the ArcGIS program.

InfoSWMM runs the most recent version of the EPA SWMM5.1 computational engine, and as such, is capable of accounting for various hydrologic and hydraulic processes such as:

- Time varying rainfall
- Routing direct runoff, dry weather flows, and external inflows
- Using a wide variety of standard closed and open conduit shapes, model flow dividers, pumps, weirs, and orifices
- Applying external flows from surface runoff, Rainfall Dependent Inflow and Infiltration (RDII), and dry weather sanitary flow
- Modeling backwater, reverse flow, surcharging, surface ponding, and tidal effects on the system

Geometric Data Input

The sewer model was created in the InfoSWMM computer modeling software via an import of City's GIS sewer data. This GIS import established the pipe (link) and manhole (node) connectivity of the existing sewers along the two sewer sections modeled. The GIS data also included pipe and manhole rim and invert elevation data, as well as pipe sizes. The model assumes that all pipes are in good condition and are clear of obstructions that may reduce flow capacity. A plan view schematic of the InfoSWMM model is shown on Figure 1 in Attachment A.

Flow Rate Input – Pre-development Conditions without Infiltration

As noted, the City provided monthly water usage data from November 2015 to November 2017 for available properties within the project area. The average daily water use for each property was calculated using this data. It was assumed that the water use per property would equal the wastewater generated per property. The maximum day peak flow for the system was estimated by applying a peaking factor of 6.0 (per NHDES regulations) to the calculated average daily water use data.

The sum of the maximum day peak flows for the individual properties was calculated and applied to the model at various points (insertion nodes) to simulate pre-development conditions in the

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system (without proposed sewer extension flows). The SWMM model allocations are summarized in Table 1.

TABLE 1
EXISTING SWMM MODEL FLOW ALLOCATIONS
(WATER USAGE DATA WITHOUT PROPOSED PROJECT FLOWS)

Insertion Node (MH-ID)	Approximate Location	Average Daily Flow (GPD)	Peaking Factor	Peak Hourly Flow (GPD)
<i>North of Sagamore Creek (Sagamore Avenue)</i>				
2806	South of Tidewatch Condominium Entrance	25,600	6.0	153,600
1102	Near Verdun Ave. and Sagamore Ave. Intersection	4,300	6.0	25,800
1096	Near South St. and Sagamore Ave. Intersection	41,000	6.0	246,000
Totals		70,900	6.0	425,400
<i>South of Sagamore Creek (Tucker's Cove Pump Station)</i>				
5857	End of Gravity Sewer on Sagamore Ave.	9,600	6.0	57,600
5201	Near East End of Odiorne Point Rd.	2,000	6.0	12,000
5198	Near East Intersection of Gosport Rd. and Odiorne Point Rd.	1,500	6.0	9,000
5278	Near West Intersection of Gosport Rd. and Odiorne Point Road.	2,400	6.0	14,400
5282	Gosport Rd. upstream of cross-country to Tucker's Cove Pump Station	1,200	6.0	7,200
Totals		16,700	6.0	100,200

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Flow Rate Input – Pre-development Conditions with Infiltration

Pre-development flow conditions were also run using flows from infiltration. A single peak infiltration rate was calculated for each section using an assumed 4,000 gallons per day per inch-mile (gpd/idm) of tributary sewer. 4,000 gpd/idm is recommended as a rule of thumb for sewer systems that exhibit potentially excessive infiltration. Table 2 summarizes the SWMM model flow allocations for infiltration.

TABLE 2
SWMM MODEL INFILTRATION FLOW ALLOCATIONS

Insertion Node (MH-ID)	Approximate Location	Tributary Area IDM¹	Infiltration Flow (GPD)
<i>North of Sagamore Creek (Sagamore Avenue)</i>			
2806	South of Tidewatch Condominium Entrance	8.72	35,000
1102	Near Verdun Ave. and Sagamore Ave. Intersection	5.04	20,000
1096	Near South St. and Sagamore Ave. Intersection	7.36	29,000
Totals		21.12	84,000
<i>South of Sagamore Creek (Tucker's Cove Pump Station)</i>			
5857	End of Gravity Sewer on Sagamore Ave.	0.97	4,000
5201	Near East End of Odiorne Point Rd.	2.00	8,000
5198	Near East Intersection of Gosport Rd. and Odiorne Point Rd.	1.87	7,000
5278	Near West Intersection of Gosport Rd. and Odiorne Point Rd.	0.91	4,000
5282	Gosport Rd. upstream of cross-country to Tucker's Cove Pump Station	0.96	4,000
Totals		6.71	27,000

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Flow Rate Input – Post-development Conditions

The post-development flow rates were obtained from the Sagamore Avenue Sewer Extension Preliminary Design Report developed by Wright-Pierce. The report indicates that the total estimated wastewater peak flow exiting the proposed North Sagamore force main into the gravity sewer on Sagamore Avenue is approximately 94,000 gpd, and the estimated wastewater peak flow exiting the proposed South Sagamore force main into the gravity sewer on Sagamore Avenue and Odiorne Point Road is approximately 125,000 gpd. These proposed flows represent conservative peak flow values.

As indicated, the proposed sewer extensions will be connected at the far upstream end of each sewer section, therefore the proposed flow rates were added to the pre-development flow rates and entered into the model at the furthest upstream manhole.

The post-development conditions were run for two scenarios, with and without flows from infiltration.

The downstream boundary condition for the model was obtained from the City's Existing EPA SWMM Model. The peak water surface elevation from the model's calibration run was entered at the downstream end of the Sagamore Avenue model (North of Sagamore Creek). The Tucker's Cove Pump Station model (South of Sagamore Creek) was assumed to be discharging freely into the pump station wet well.

MODEL RESULTS

Pre-development Conditions without Infiltration

The pre-development conditions (without infiltration) were run with the total peak dry weather flows inserted to evaluate the capacity of the existing piping. The results of the model indicate that the existing gravity sewer South of Sagamore Creek is generally flowing under 27% full. ~~The only exception is an upstream segment of sewer between manhole 5858 and 5202. The sewer in this location was found to have a reverse slope in the City's GIS database, and therefore is modeled as a reverse sloped sewer. This causes the sewer to surcharge slightly (surcharged to under 1 inch above the crown of pipe) and imposes backwater on the upstream sewer.~~ **Additional investigation confirms that this is not a reverse slope sewer.**

The results of the model for the existing gravity sewer North of Sagamore Creek indicate that the sewer is generally flowing under 44% full. There are two notable exceptions, including the downstream end of the model between manhole 5718 and 5716, ~~and near the upstream end of the model between manholes 5945 and 1102.~~ At the downstream end of the model, where the sewer connects to the main interceptor sewer at the intersection of Miller Avenue and Spring St., backwater from the interceptor sewer is causing slight surcharge in this sewer segment, however

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the sewer is only conveying 12% of its full flow capacity. ~~Additionally, a segment of sewer between manholes 5945 and 1102 was found to have a reverse slope in the City's GIS database, and therefore is modeled as a reverse sloped sewer. This causes the sewer to surcharge slightly (surcharged to under 1 inch above the crown of pipe) and imposes backwater on the upstream sewer.~~ **Additional investigation confirms that this is not a reverse slope sewer.**

InfoSWMM model profiles showing the resultant hydraulic grade lines, or water surface elevations, for both sewer sections for the pre-development conditions without infiltration are included in Attachment B.

Pre-development Conditions with Infiltration

The pre-development conditions (with infiltration) were run with the total peak dry weather flows plus the estimated flows from infiltration inserted to evaluate the capacity of the existing piping. The results of the model indicate that the existing gravity sewer South of Sagamore Creek is flowing under 30% full. ~~Similar to the previous model run, the only exception is between manholes 5858 and 5202, where a reverse sloped sewer is causing the sewer to surcharge slightly (surcharged to approximately 1 inch above the crown of pipe) and imposing a backwater condition on the upstream sewer.~~ **Additional investigation confirms that this is not a reverse slope sewer.**

The results of the model for the existing gravity sewer North of Sagamore Creek indicate that the sewer is flowing under 49% full. Similar to the previous model run, there are two notable exceptions, including the downstream end of the model between manhole 5718 and 5716, and near the upstream end of the model between manholes 5945 and 1102. At the downstream end of the model, where the sewer connects to the main interceptor sewer at the intersection of Miller Avenue and Spring St., backwater from the interceptor sewer is causing slight surcharge in this sewer segment, however the sewer is only conveying approximately 12% of its full flow capacity. ~~Additionally, the reversed slope sewer between manholes 5945 and 1102 is causing the sewer to surcharge slightly (surcharging to approximately 1.7 inches above the crown of pipe) and imposing a backwater condition on the upstream sewer.~~ **Additional investigation confirms that this is not a reverse slope sewer.**

InfoSWMM model profiles showing the resultant hydraulic grade lines, or water surface elevations, for both sewer sections for the pre-development conditions with infiltration are included in Attachment B.

Post-development Conditions without Infiltration

The results of the post-development conditions model run (without infiltration) indicate that the existing gravity sewer South of Sagamore Creek remains generally under 45% full. ~~Similar to the previous model runs, the only exception is between manholes 5858 and 5202, where a reverse sloped sewer is causing the sewer to surcharge to approximately 3.3 inches above the crown of~~

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~~pipe and imposing a backwater condition on the upstream sewer.~~ **Additional investigation confirms that this is not a reverse slope sewer.**

The model results for the North of Sagamore Creek section indicate that the sewer remains generally under 56% full, with the same exceptions at the downstream end of the model between manhole 5718 and 5716, and near the upstream end of the model between manholes 5945 and 1102. Backwater from the interceptor sewer is causing slight surcharge in the downstream sewer segment, however the sewer is only conveying approximately 15% of its full flow capacity, ~~and the reversed slope sewer between manholes 5945 and 1102 is causing the sewer to surcharge slightly (surcharging to approximately 3.0 inches above the crown of pipe) and imposing a backwater condition on the upstream sewer.~~ **Additional investigation confirms that this is not a reverse slope sewer.**

InfoSWMM model profiles showing the resultant hydraulic grade lines, or water surface elevations, for both sewer sections for the post-development conditions without infiltration are included in Attachment B.

Post-development Conditions with Infiltration

The results of the post-development conditions model run (with infiltration) indicate that the existing gravity sewer South of Sagamore Creek remains generally under 47% full. ~~Similar to the previous model runs, the only exception is located between manholes 5858 and 5202, where a reversed sloped sewer is causing the sewer to surcharge to approximately 3.3 inches above the crown of pipe and imposing a backwater condition on the upstream sewer.~~ **Additional investigation confirms that this is not a reverse slope sewer.**

The model results for the North of Sagamore Creek section indicate that the sewer remains generally under 61% full, with the same exceptions the downstream end of the model between manhole 5718 and 5716, and near the upstream end of the model between manholes 5945 and 1102. Backwater from the interceptor sewer is causing slight surcharge in the downstream sewer segment, however the sewer is only conveying approximately 17% of its full flow capacity, ~~and the reversed slope sewer between manholes 5945 and 1102 is causing the sewer to surcharge slightly (surcharging to approximately 3.7 inches above the crown of pipe) and imposing a backwater condition on the upstream sewer.~~ **Additional investigation confirms that this is not a reverse slope sewer.**

InfoSWMM model profiles showing the resultant hydraulic grade lines, or water surface elevations, for both sewer sections for the post-development conditions with infiltration are included in Attachment B.

The model results for each of the scenarios analyzed are summarized in Table 3.

TABLE 3
INFOSWMM MODELING RESULTS SUMMARY

Model Run	Surcharge at SMH-5858 (in.) ¹	Surcharge at SMH-5945 (in.) ¹	Overall South System % Full ²	Overall North System % Full ²
Pre-development (no Infiltration)	< 1”	< 1”	27%	44%
Pre-development (with Infiltration)	1”	1.7”	30%	49%
Post-development (no Infiltration)	3.3”	3.0”	45%	56%
Post-development (with infiltration)	3.3”	3.7”	47%	61%

1. Maximum surcharge depth above crown of pipe in sewer manhole upstream of reversed sloped pipe.
2. Maximum flow depth within sewer section outside of noted surcharged location.

CONCLUSIONS AND RECOMMENDATIONS

The model results indicate that during maximum daily peak flows with infiltration, the existing gravity sewer system remains at or below 60% full, ~~except for two specific locations where reverse sloped pipes were modeled. The reverse sloped pipes, located between manholes 5858 and 5202 and manholes 5495 and 1102, create an existing hydraulic restriction that potentially results in surcharging of the upstream manhole by up to 1.5 inches above the crown of pipe. The post-development maximum daily peak flows further increase the surcharge conditions, resulting in surcharging of the upstream manhole by up to 3.4 inches.~~ **Additional investigation confirms that these are not reverse slope sewers.**

It is recommended that field verification of the two locations be conducted to determine whether the GIS database accurately reflects the system hydraulics. The sewer segments located immediately upstream and downstream of each restriction appear to have sufficient capacity, remaining at or below 30% full during all post-development flow conditions.

If the reverse sloped sewer segments are found to be errors in the City’s GIS database, the model results indicate that there is sufficient capacity for the propose sewer extension. Additionally, if the reverse sloped are verified it is recommended that the City consider replacing the sewers as part of the proposed sewer extension project. **Additional investigation confirms that these are not reverse slope sewers.**

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Attachments:

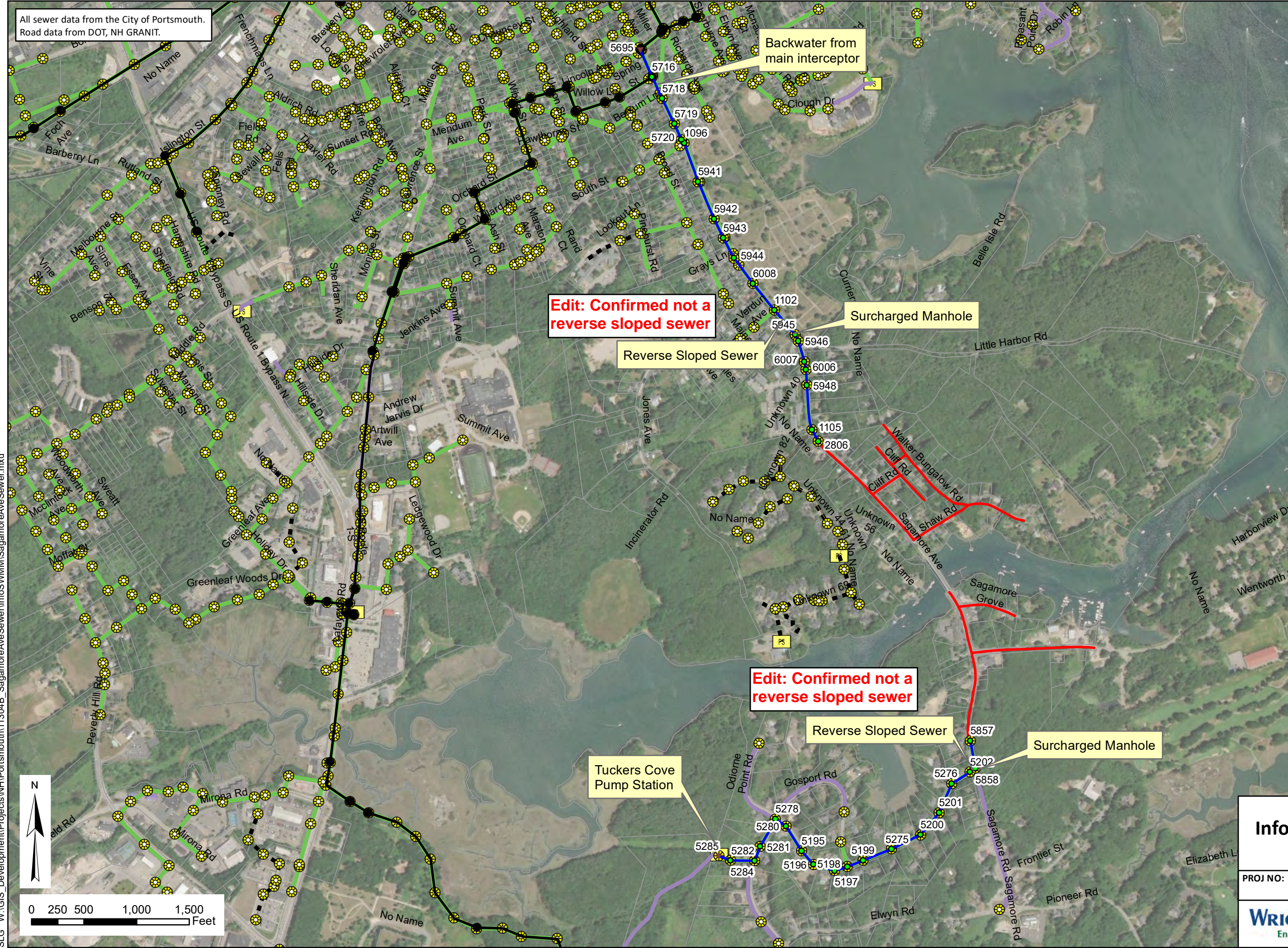
Attachment A – Figure 1

Attachment B – InfoSWMM HGL Profiles

ATTACHMENT A

FIGURE 1

All sewer data from the City of Portsmouth.
Road data from DOT, NH GRANIT.



InfoSWMM Model

- InfoSWMM Junction
- ▼ InfoSWMM Outfall
- InfoSWMM Conduit

Existing SWMM Model

- Junction
- Conduits

SewerManhole

- Normal Manhole
- Other

SewerLine

- City Force Main
- City Main
- City Siphon
- Private Force Main
- Private Main
- Private Siphon

Sewer Facilities

- ▲ Other
- PS Pump Station
- WTF Treatment Plant

Proposed Sewers

-

InfoSWMM Model Schematic
Portsmouth, NH

PROJ NO:	11304B	DATE:	10/19/2018
			FIGURE:
			1

SLG W:\GIS_Development\Projects\NH\Portsmouth\11304B_SagamoreAveSewer\InfoSWMM\SagamoreAveSewer.mxd

ATTACHMENT B
InfoSWMM HGL Profiles

Figure B1 - Pre-development Conditions (without I/I) - South of Sagamore Creek

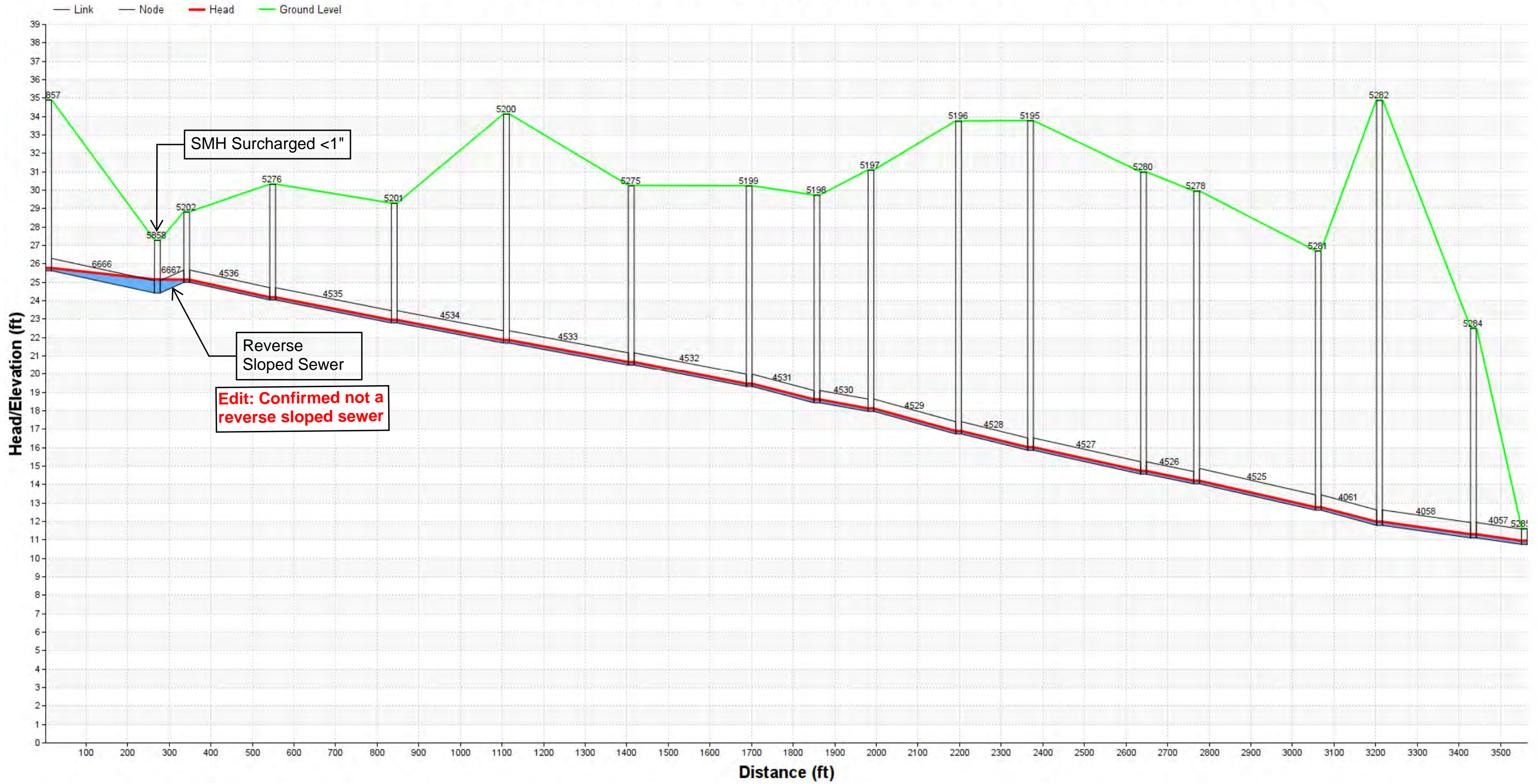


Figure B2 - Pre-development Conditions (without I/I) - North of Sagamore Creek

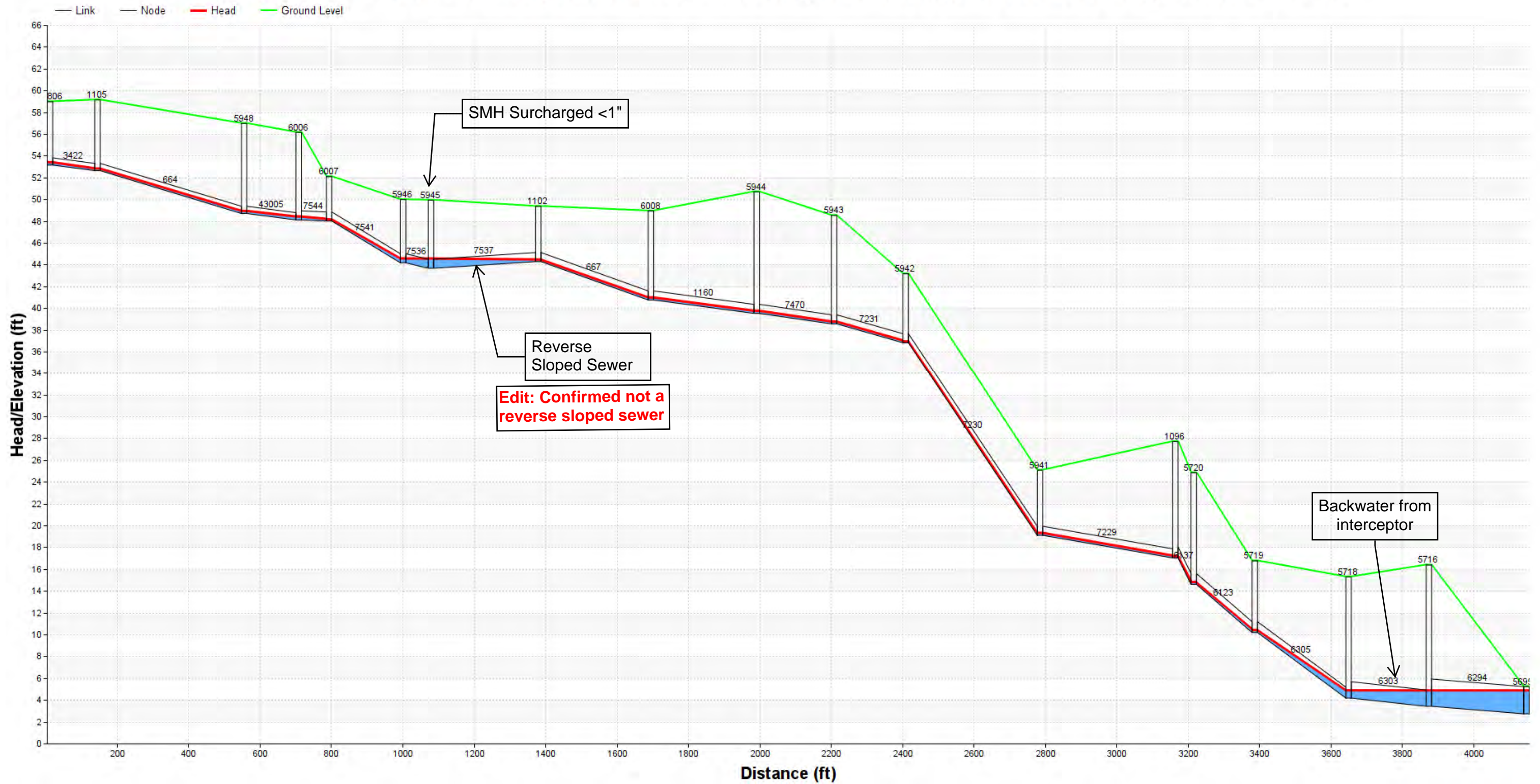


Figure B3 - Pre-development Conditions (with I/I) - South of Sagamore Creek

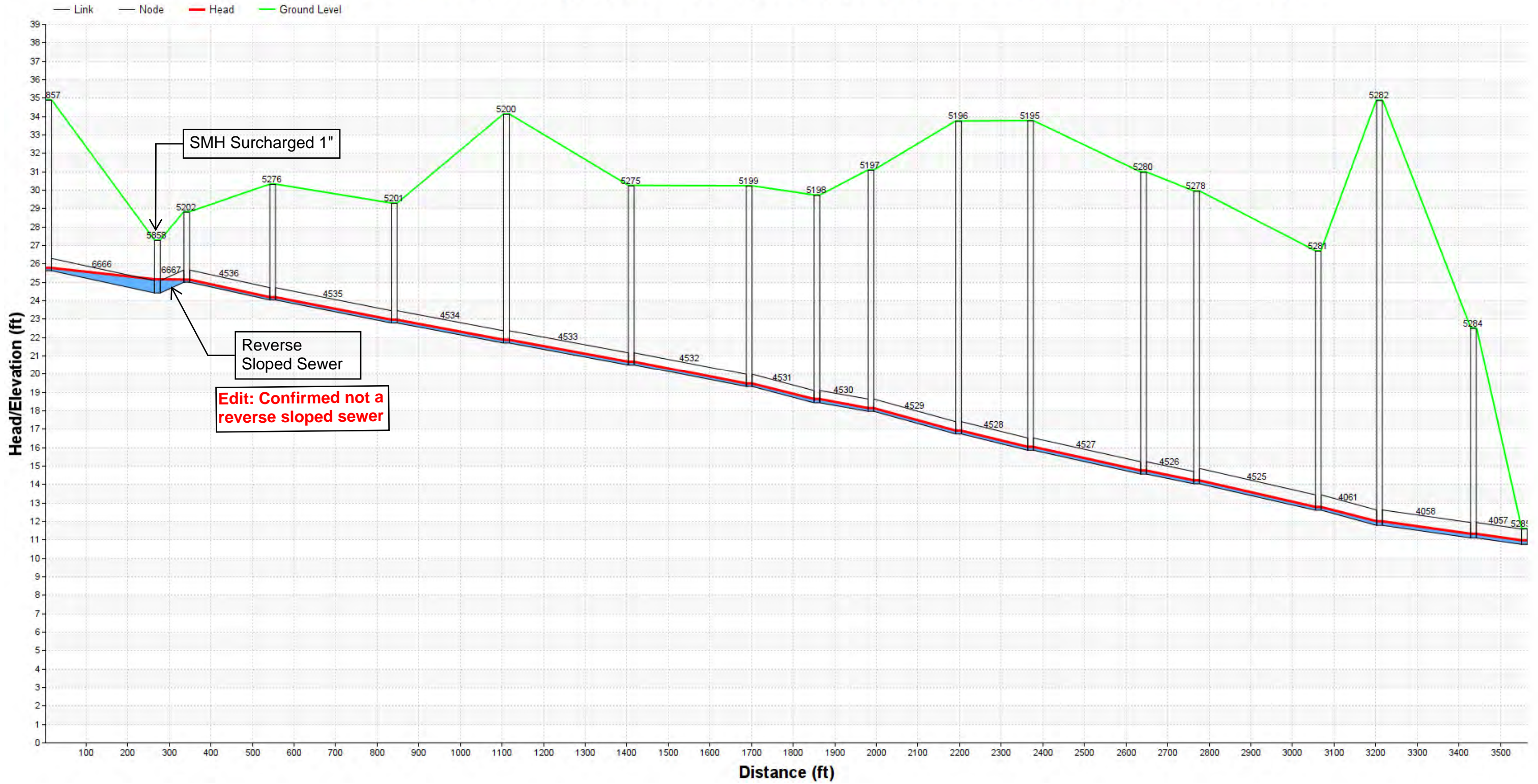


Figure B4 - Pre-development Conditions (with I/I) - North of Sagamore Creek

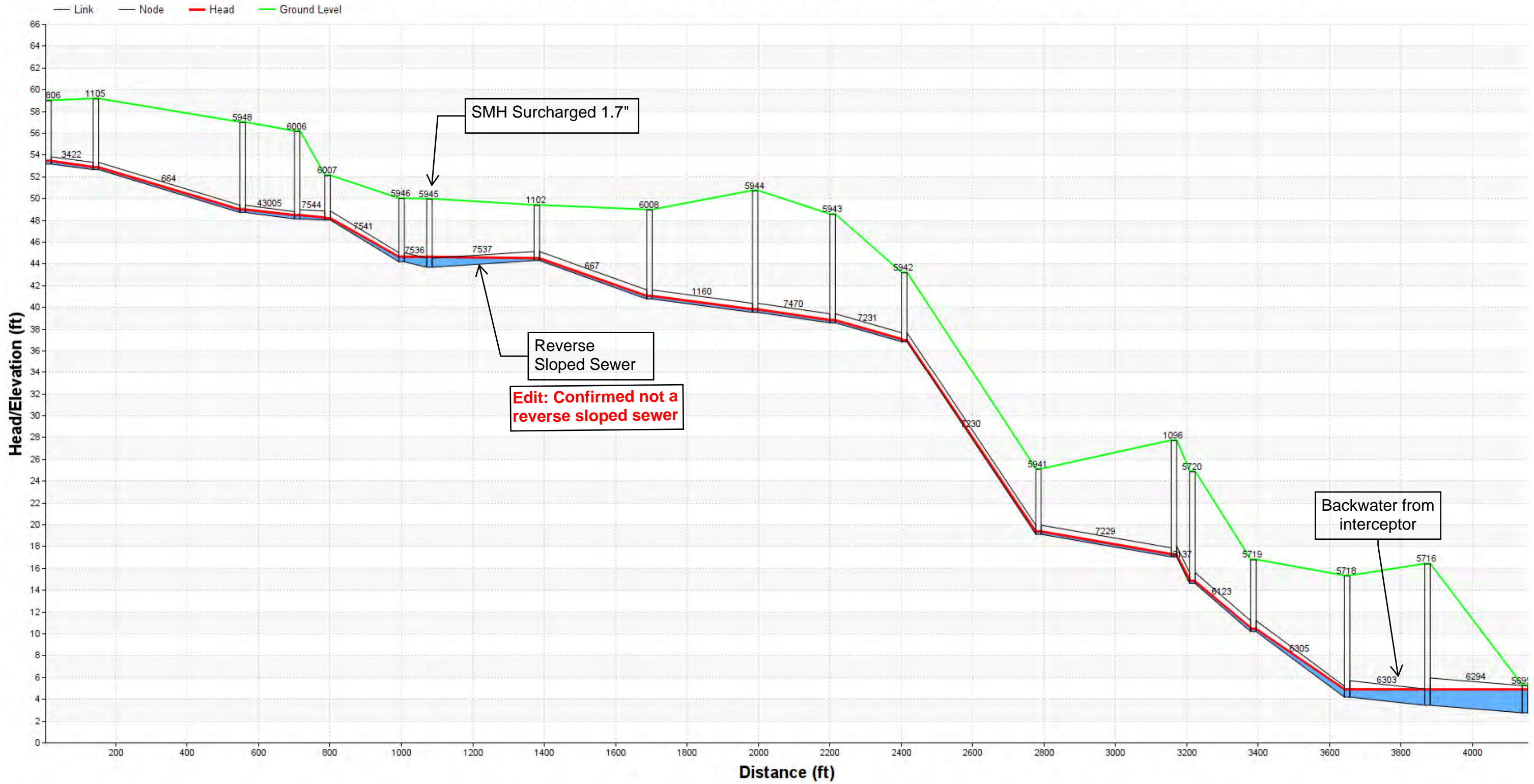


Figure B5 - Post-development Conditions (without I/I) - South of Sagamore Creek

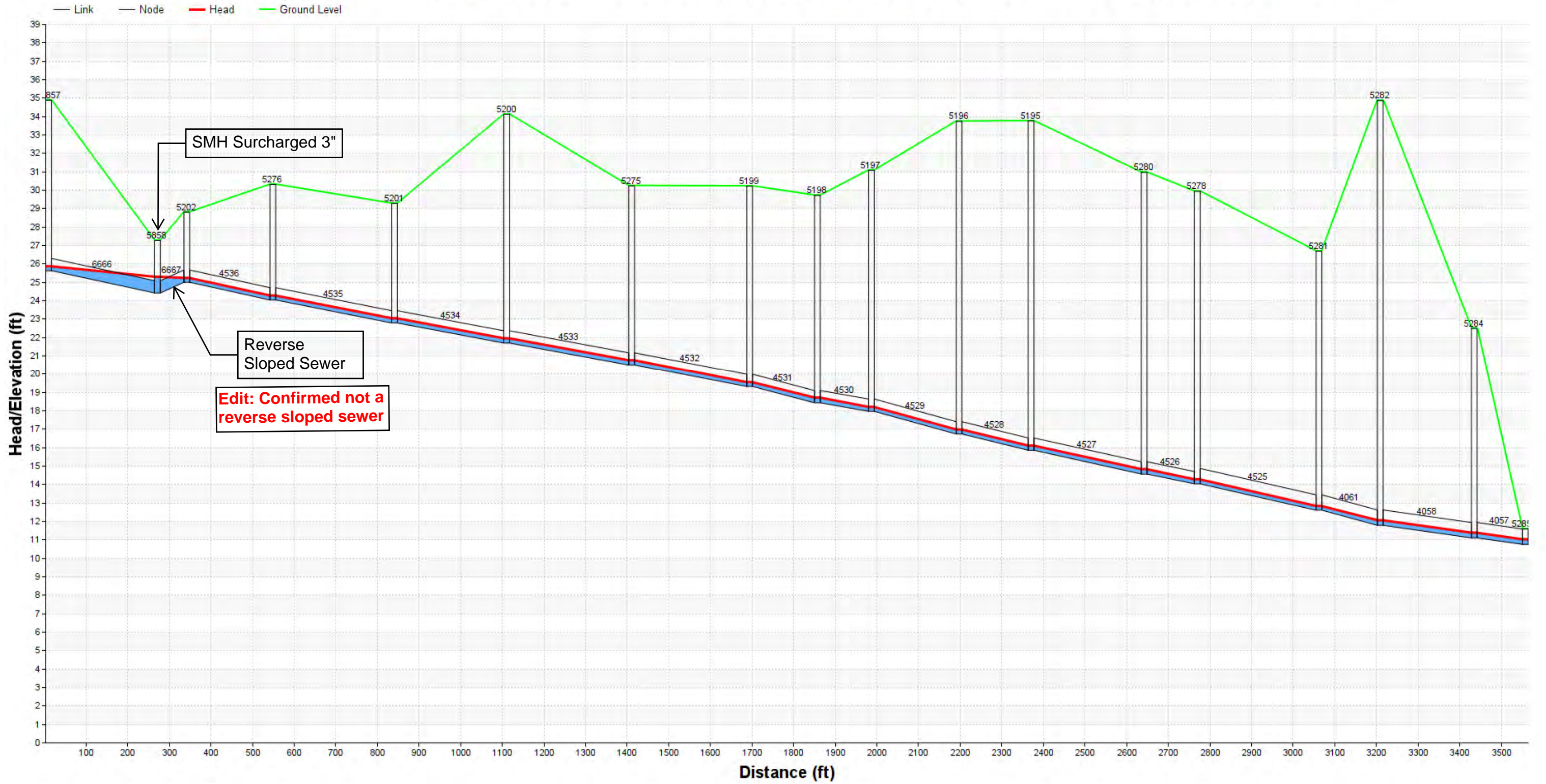


Figure B6 - Post-development Conditions (without I/I) - North of Sagamore Creek

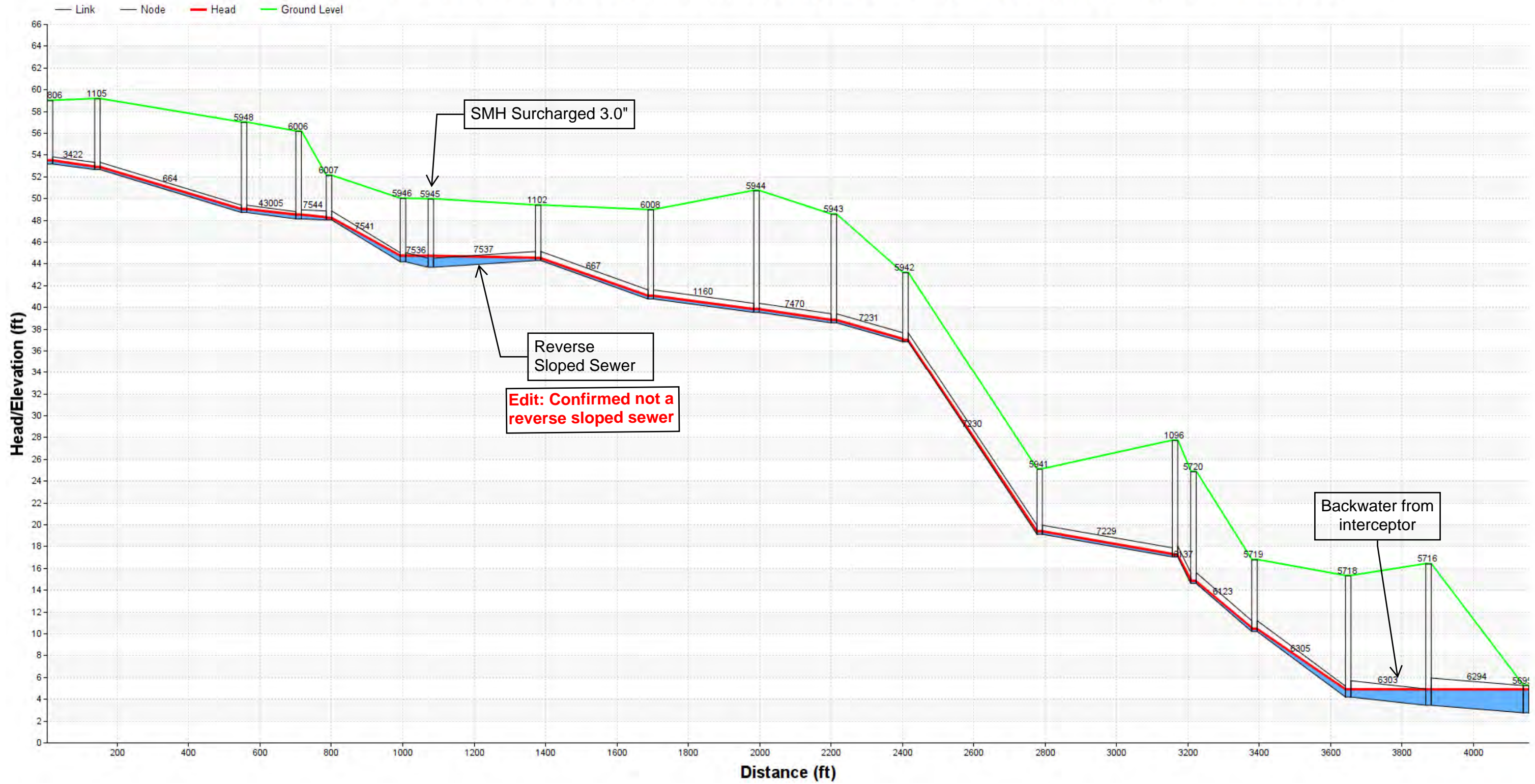


Figure B7 - Post-development Conditions (with I/I) - South of Sagamore Creek

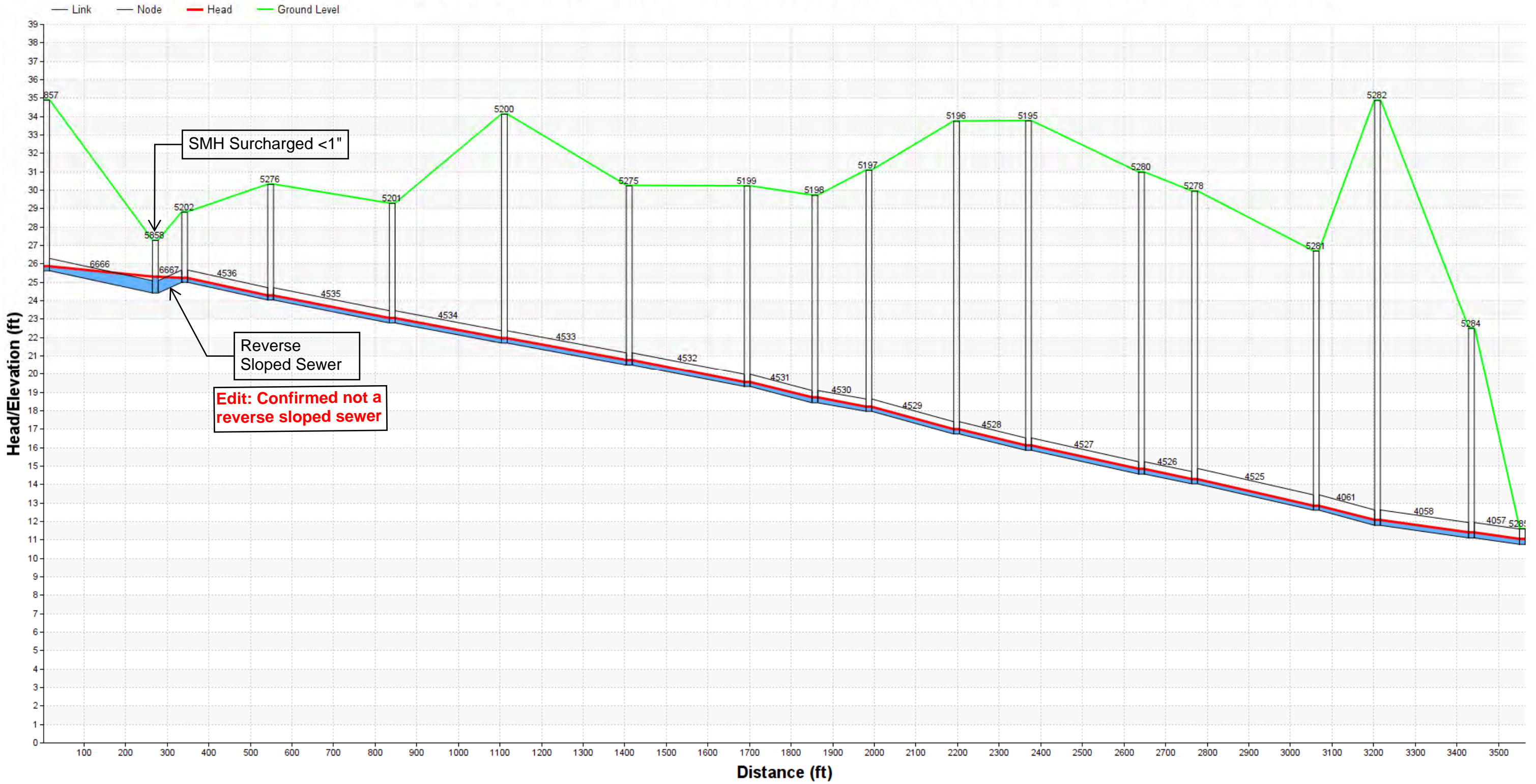
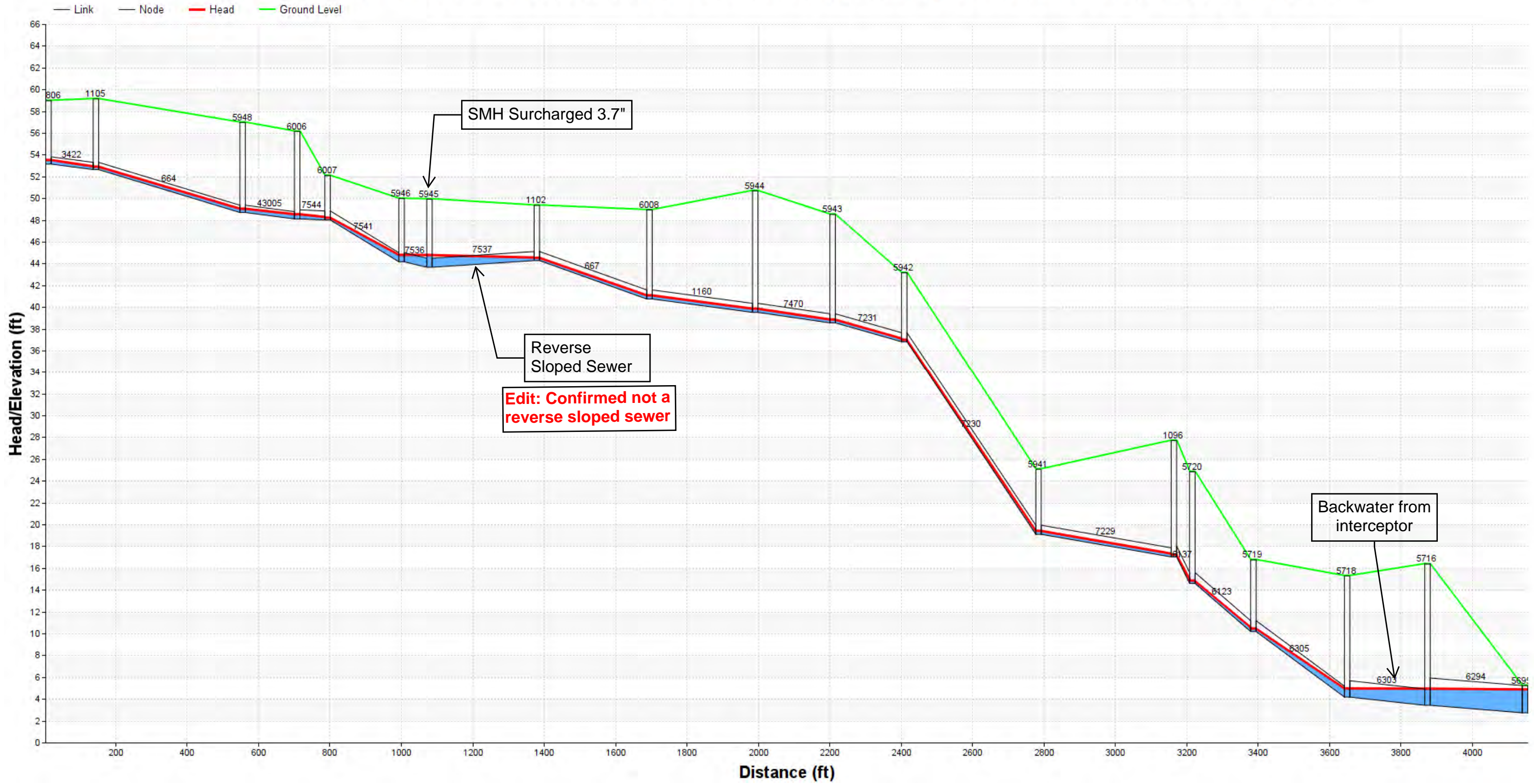


Figure B8 - Post-development Conditions (with I/I) - North of Sagamore Creek



C

Appendix C
Conceptual Design Drawings
provided under separate cover

D



Environment One Corporation

Pressure Sewer Preliminary

Cost and Design Analysis

For

Sagamore Avenue Sewer Extension Project

**Prepared For:
Wright-Pierce**

Tel:

Fax:

Prepared By: Jessica Locke

January 21, 2021

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Sagamore Avenue Sewer Extension Project

Prepared By:
Jessica Locke

January 21, 2021

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Gals/day per Pump	Max Flow Per Pump (gpm)	Max Sim Ops	Max Flow (GPM)	Pipe Size (inches)	Max Velocity (FPS)	Length of Main this Zone	Friction Loss Factor (ft/100 ft)	Friction Loss This Zone	Accum Friction Loss (feet)	Max Main Elevation	Minimum Pump Elevation	Static Head (feet)	Total Dynamic Head (ft)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE										Friction loss calculations were based on a Constant for inside roughness "C" of: 150							
1.00	2.00	9	9	1660	11.00	3	33.00	2.00	3.57	418.00	2.52	10.53	32.90	75.00	13.90	61.10	94.00
2.00	3.00	9	36	1687	11.00	6	66.00	3.00	3.29	837.00	1.38	11.53	22.37	75.00	19.50	55.50	77.87
3.00	10.00	2	45	1401	11.00	6	66.00	3.00	3.29	540.00	1.38	7.44	10.84	75.00	26.90	48.10	58.94
4.00	3.00	7	7	1502	11.00	3	33.00	2.00	3.57	285.00	2.52	7.18	18.02	75.00	14.90	60.10	78.12
5.00	2.00	9	18	1316	11.00	4	44.00	3.00	2.19	775.00	0.65	5.04	27.41	75.00	21.20	53.80	81.21
6.00	5.00	4	9	1411	11.00	3	33.00	2.00	3.57	375.00	2.52	9.45	36.86	75.00	41.50	33.50	70.36
7.00	6.00	5	5	1316	11.00	3	33.00	2.00	3.57	725.00	2.52	18.27	55.13	75.00	36.60	38.40	93.53
8.00	9.00	3	3	1361	11.00	2	22.00	2.00	2.38	233.00	1.19	2.77	17.89	75.00	54.70	20.30	38.19
9.00	10.00	4	7	1316	11.00	3	33.00	2.00	3.57	465.00	2.52	11.72	15.12	75.00	54.90	20.10	35.22
10.00	10.00	13	65	1675	11.00	7	77.00	4.00	2.32	630.00	0.54	3.40	3.40	75.00	70.00	5.00	8.40
11.00	12.00	6	6	1316	11.00	3	33.00	2.00	3.57	486.00	2.52	12.24	21.44	37.00	20.40	16.60	38.04
12.00	15.00	5	11	6493	11.00	4	44.00	3.00	2.19	780.00	0.65	5.07	9.20	37.00	22.00	15.00	24.20
13.00	14.00	6	6	6598	11.00	3	33.00	2.00	3.57	300.00	2.52	7.56	17.75	37.00	9.80	27.20	44.95
14.00	15.00	7	13	3940	11.00	4	44.00	3.00	2.19	932.00	0.65	6.06	10.19	37.00	11.30	25.70	35.89
15.00	15.00	4	28	1376	11.00	5	55.00	3.00	2.74	420.00	0.98	4.13	4.13	37.00	30.10	6.90	11.03

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Sagamore Avenue Sewer Extension Project

Prepared By:
Jessica Locke

January 21, 2021

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (inches)	Gallons per 100 lineal feet	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE							Gals per Day per Dwelling		200	
1.00	2.00	9	2.00	15.40	418.00	64.38	14,940	232.05	0.10	0.38
2.00	3.00	36	3.00	33.47	837.00	280.11	54,191	193.46	0.12	0.27
3.00	10.00	45	3.00	33.47	540.00	180.72	67,507	373.55	0.06	0.15
4.00	3.00	7	2.00	15.40	285.00	43.90	10,514	239.51	0.10	0.25
5.00	2.00	18	3.00	33.47	775.00	259.37	24,068	92.80	0.26	0.53
6.00	5.00	9	2.00	15.40	375.00	57.76	12,224	211.63	0.11	0.65
7.00	6.00	5	2.00	15.40	725.00	111.67	6,580	58.92	0.41	1.05
8.00	9.00	3	2.00	15.40	233.00	35.89	4,083	113.77	0.21	0.48
9.00	10.00	7	2.00	15.40	465.00	71.62	9,347	130.50	0.18	0.27
10.00	10.00	65	4.00	55.31	630.00	348.47	98,629	283.03	0.08	0.08
11.00	12.00	6	2.00	15.40	486.00	74.86	7,896	105.48	0.23	0.41
12.00	15.00	11	3.00	33.47	780.00	261.04	40,361	154.62	0.16	0.19
13.00	14.00	6	2.00	15.40	300.00	46.21	39,588	856.72	0.03	0.17
14.00	15.00	13	3.00	33.47	932.00	311.91	67,168	215.35	0.11	0.14
15.00	15.00	28	3.00	33.47	420.00	140.56	113,033	804.17	0.03	0.03

Sagamore Avenue Sewer Extension Project

Prepared by : Jessica Locke

On: January 21, 2021

Notes :

<<<< END OF NOTES >>>>



BORING LOG

BORING NO.: B-5
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/25/2019
DATE FINISH: 9/25/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 9.0 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS: Water Level
∇ At time of Drilling D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
∇ At Completion of Drilling U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
∇ After Drilling R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
								6 inches Asphalt Pavement			
			1D		0.5-2.5	24/16	11-20-17-23	0.5	Dense to medium dense, brown gravelly SAND some silt (FILL)		
			2D		2.5-4.5	24/18	16-14-12-12				
	5		3D		5-7	24/15	13-10-6-7	4.0	Medium dense, tan sandy SILT some gravel		
			4D		7-9	24/24	10-8-9-10				
Bottom of Exploration at 9.0 feet											

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-5



BORING LOG

BORING NO.: B-6
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/25/2019
DATE FINISH: 9/25/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 10.0 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS: Water Level
∇ At time of Drilling D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
∇ At Completion of Drilling U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
∇ After Drilling R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
								7 1/2 inches Asphalt Pavement			
			1D		0.6-2.6	24/14	10-10-12-14	0.6'	Medium dense, brown gravelly SAND some silt (FILL)		
			2D		2.6-4.6	24/12	10-10-4-6				
	5		3D		5-7	24/12	2-4-6-8				
			4D		7-9	24/8	8-11-8-12				

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Bottom of Exploration at 10.0 feet

BORING NO.: B-6



BORING LOG

BORING NO.: B-8
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/23/2019
DATE FINISH: 9/23/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 4.9 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS: Water Level
∇ At time of Drilling D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
∇ At Completion of Drilling U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
∇ After Drilling R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
∇ After Drilling V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
			1D		0.4-2.4	24/8	12-7-3-2		4 1/2 Asphalt Pavement		
								0.4	Medium dense, brown silty SAND some gravel (FILL)		
			2D		2.4-3.8	17/6	10-17-50/5"		Medium dense, brown gravelly silty SAND (TILL)		
								2.3			

Auger Refusal at 4.9 feet
 Probable bedrock or boulder

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-8



BORING LOG

BORING NO.: B-9
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/27/2019
DATE FINISH: 9/27/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 11.0 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS: Water Level
∇ At time of Drilling D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
∇ At Completion of Drilling U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
∇ After Drilling R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
∇ After Drilling V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
								6 inches Asphalt Pavement			
			1D		0.5-2.5	24/16	11-6-4-4	0.5	Medium dense, brown silty SAND some gravel (FILL)		
			2D		2.5-4.5	24/20	2-2-1-1	1.5	Very loose, gray sandy SILT trace gravel		
	5		3D		5-7	24/4	WOH				
			4D		7-9	24/3	WOH				
	10		5D		9-11	24/12	9-8-17-40	9.0	Medium dense, brown gravelly silty SAND (TILL)		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Bottom of Exploration at 11.0 feet

BORING NO.: B-9



BORING LOG

BORING NO.: B-10
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/27/2019
DATE FINISH: 9/27/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 9.0 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): ∇ 8 ft Soil saturated below 8 feet.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
∇ Water Level
∇ At time of Drilling
∇ At Completion of Drilling
∇ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_u = Unconfined Compressive Strength, kips/sq.ft.
Ø = Friction Angle (Estimated)
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
			1D		0.5-2.5	24/16	7-6-5-3		5 1/2 Asphalt Pavement		
			2D		2.5-4.5	24/20	4-4-9-8	0.5	Medium dense, brown gravelly SAND some silt with reclaimed asphalt (FILL)		
			3D		5-7	24/24	6-5-5-4	3.0	Medium dense, brown silty fine to medium SAND with frequent silt layers		
	5		4D		7-9	24/24	9-10-13-14				
Bottom of Exploration at 9.0 feet											

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-10



BORING LOG

BORING NO.: B-12
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/26/2019
DATE FINISH: 9/26/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 6.6 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
▽ At time of Drilling U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
▼ At Completion of Drilling R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
▽ After Drilling V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
			1D		0.4-2.4	24/3	11-15-8-6		4 1/2 Asphalt Pavement		
			2D		2.4-4.4	24/6	6-6-17-7		0.3 Medium dense to dense, dark brown gravelly SAND some silt with reclaimed asphalt (FILL)		
	5		3D		5-6.7	20/8	7-13-26-50/2"				

Auger Refusal at 6.6 feet
 Probable bedrock or boulder

BORING / WELL 19-0968.GPJ SWCE TEMPLATE.GDT 12/23/19

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-12



BORING LOG

BORING NO.: B-13
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/26/2019
DATE FINISH: 9/26/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 9.0 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS: Water Level
▽ At time of Drilling D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
▽ At Completion of Drilling U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
▽ After Drilling R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
			1D		0.3-2.3	24/16	15-17-11-8		4 inches Asphalt Pavement		
								0.3	Medium dense, brown gravelly SAND some silt (FILL)		
								1.5	Reclaimed Asphalt Pavement		
			2D		2.3-4.3	24/3	16-9-7-7		Medium dense, brown silty SAND some gravel		
								2.0			
	5		3D		5-7	24/14	2-2-2-6		Loose, dark gray silty fine to medium SAND		
								5.0			
			4D		7-9	24/10	6-7-15-14		Medium dense, brown gravelly silty SAND (TILL)		
								7.5			

Bottom of Exploration at 9.0 feet

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-13

BORING / WELL 19-0968.GPJ SWCE TEMPLATE.GDT 12/23/19



BORING LOG

BORING NO.: B-14
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/26/2019
DATE FINISH: 9/26/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 8.1 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): ∇ 7 ft Soil saturated below 7 feet.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS: Water Level
∇ At time of Drilling D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
∇ At Completion of Drilling U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
∇ After Drilling R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
∇ After Drilling V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
			1D		0.5-2.5	24/12	10-10-6-6		6 inches Asphalt Pavement		
								0.5	Medium dense, brown gravelly SAND some silt (FILL)		
			2D		2.5-4.5	24/10	3-5-5-5		Reclaimed Asphalt Pavement		
								2.5	Medium dense, brown fine to medium SAND and SILT some gravel		
	5		3D		5-7	24/20	6-6-7-8		Medium dense, brown silty SAND some gravel		
			4D		7-8.1	13/8	19-17-50/1"			∇	

Split Spoon Refusal at 8.1 feet
 Probable bedrock or boulder

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-14



BORING LOG

BORING NO.: B-15
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/24/2019
DATE FINISH: 9/24/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 4.4 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
 Water Level: At time of Drilling D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
 At Completion of Drilling U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
 After Drilling R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
 V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
			1D		0.4-2.4	24/12	16-13-8-7		4 3/4 inches Asphalt Pavement		
			2D		2.4-4.2	22/10	13-10-14-50/4"		Medium dense, brown gravelly SAND trace silt (FILL)		

Auger Refusal at 4.4 feet
 Probable bedrock or boulder

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-15

BORING / WELL 19-0968.GPJ SWCE TEMPLATE.GDT 12/23/19



BORING LOG

BORING NO.: B-16
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/23/2019
DATE FINISH: 9/23/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 9.0 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS: Water Level
∇ At time of Drilling D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
∇ At Completion of Drilling U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
∇ After Drilling R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
			1D		0.5-2.5	24/18	8-10-10-5		5 1/2 inches Asphalt Pavement		
								0.5	Medium dense, brown gravelly SAND trace silt (FILL)		
								1.5	Reclaimed Asphalt Pavement		
								2.0	Medium dense, brown gravelly silty SAND		
			2D		2.5-4.5	24/6	3-3-8-6				w = 10.2 %
	5		3D		5-7	24/12	5-8-16-18				
			4D		7-9	24/16	9-6-5-6				
								8.0	Medium dense, tan fine SAND and SILT		

Bottom of Exploration at 9.0 feet

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-16



BORING LOG

BORING NO.: B-17
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/27/2019
DATE FINISH: 9/27/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 9.0 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: **HAMMER DROP (inch):** 30

WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
 Water Level: At time of Drilling, At Completion of Drilling, After Drilling
 D = Split Spoon Sample, U = Thin Walled Tube Sample, R = Rock Core Sample, V = Field Vane Shear
 Pen. = Penetration Length, Rec. = Recovery Length, bpf = Blows per Foot, mpf = Minute per Foot
 WOR = Weight of Rods, WOH = Weight of Hammer, RQD = Rock Quality Designation, PID = Photoionization Detector
 S_v = Field Vane Shear Strength, kips/sq.ft., q_u = Unconfined Compressive Strength, kips/sq.ft., Ø = Friction Angle (Estimated), N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
			1D		0.3-2.3	24/4	4-3-5-5		0.3	3 inches Asphalt Pavement Loose, brown gravelly SAND some silt with asphalt (FILL)	
			2D		2.3-4.3	24/16	4-2-2-3		2.5	Loose, brown silty fine to medium SAND	
	5		3D		5-7	24/4	3-6-7-5		5.0	Medium dense, brown gravelly silty SAND	
			4D		7-9	24/24	6-5-5-4		7.0	Medium dense, brown fine SAND and SILT	

Bottom of Exploration at 9.0 feet

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-17

BORING / WELL 19-0968.GPJ SWCE TEMPLATE.GDT 12/23/19



BORING LOG

BORING NO.: B-18
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/27/2019
DATE FINISH: 9/27/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 9.0 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS: Water Level
∇ At time of Drilling D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
∇ At Completion of Drilling U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
∇ After Drilling R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
								5 1/2 inches Asphalt Pavement			
			1D		0.5-2.5	24/8	13-10-5-2	0.5	Medium dense, brown gravelly SAND some silt (FILL)		
			2D		2.5-4.5	24/18	3-3-4-9	3.0	Loose, tan fine sandy SILT		
	5		3D		5-7	24/20	5-6-7-10	5.2	Medium dense, brown silty fine SAND		
			4D		7-9	24/24	7-5-5-12				
Bottom of Exploration at 9.0 feet											

BORING / WELL 19-0968.GPJ SWCE TEMPLATE.GDT 12/23/19

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-18



BORING LOG

BORING NO.: B-19
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/25/2019
DATE FINISH: 9/25/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 4.8 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS: Water Level
∇ At time of Drilling D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
∇ At Completion of Drilling U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
∇ After Drilling R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
∇ After Drilling V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
			1D		0.6-2.6	24/12	10-33-40-36		7 1/2 inches Asphalt Pavement		
			2D		2.6-4.6	24/18	15-28-28-24	w = 4.2 %	0.6' Very dense, brown silty SAND and GRAVEL		

Auger Refusal at 4.8 feet
 Probable bedrock or boulder

BORING / WELL 19-0968.GPJ SWCE TEMPLATE.GDT 12/23/19

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-19



BORING LOG

BORING NO.: B-20
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/25/2019
DATE FINISH: 9/25/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 5.7 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS: Water Level
∇ At time of Drilling D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
∇ At Completion of Drilling U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
∇ After Drilling R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
∇ After Drilling V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
			1D		0.5-2.5	24/16	16-12-8-8		6 1/2 inches Asphalt Pavement		
								0.5	Medium dense, brown gravelly SAND some silt (FILL)		
			2D		2.5-4.5	24/14	13-12-16-12		Medium dense, brown silty SAND some gravel (FILL)		
								2.0			
								4.2	3 inches Asphalt Pavement		
								4.5	Medium dense, brown gravelly SAND some silt (FILL)		
	5		3D		5-5.8	9/4	11-50/3"				

Split Spoon Refusal at 5.7 feet
 Probable bedrock or boulder

BORING / WELL 19-0968.GPJ SWCE TEMPLATE.GDT 12/23/19

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-20



BORING LOG

BORING NO.: B-22
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/25/2019
DATE FINISH: 9/25/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 3.0 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS: Water Level
∇ At time of Drilling D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
∇ At Completion of Drilling U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
∇ After Drilling R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
			1D		0.8-2.6	21/12	16-17-62-50/3"		9 3/4 inches Asphalt Pavement		
								0.8	Dense, dark brown gravelly silty SAND (FILL)		

Auger Refusal at 3.0 feet
Probable bedrock or boulder

BORING / WELL 19-0968.GPJ SWCE TEMPLATE.GDT 12/23/19

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-22



BORING LOG

BORING NO.: B-23
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/24/2019
DATE FINISH: 9/24/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 0.9 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
 Water Level
 ▽ At time of Drilling
 ▼ At Completion of Drilling
 ▾ After Drilling
 D = Split Spoon Sample
 U = Thin Walled Tube Sample
 R = Rock Core Sample
 V = Field Vane Shear
 Pen. = Penetration Length
 Rec. = Recovery Length
 bpf = Blows per Foot
 mpf = Minute per Foot
 WOR = Weight of Rods
 WOH = Weight of Hammer
 RQD = Rock Quality Designation
 PID = Photoionization Detector
 S_v = Field Vane Shear Strength, kips/sq.ft.
 q_u = Unconfined Compressive Strength, kips/sq.ft.
 Ø = Friction Angle (Estimated)
 N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
			1D	⊗	0.3-0.9	7/7	20-50/1"		3 inches Asphalt Pavement		
								0.3	Brown, gravelly SAND some silt (FILL)		

Auger Refusal at 0.9 feet
 Probable bedrock or boulder

BORING / WELL 19-0968.GPJ SWCE TEMPLATE.GDT 12/23/19

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-23



BORING LOG

BORING NO.: B-24
SHEET: 1 of 1
PROJECT NO.: 19-0968
DATE START: 9/24/2019
DATE FINISH: 9/24/2019

CLIENT: Wright-Pierce
PROJECT: Sagamore Avenue Sewer Extension Project
LOCATION: Sagamore Ave, Portsmouth, New Hampshire

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** N/A **TOTAL DEPTH (FT):** 9.0 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Corey Culligan **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Truck Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / N/A **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A / N/A **CORE BARREL:** N/A
HAMMER EFFICIENCY FACTOR: _____ **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): No free water observed.

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
 Water Level: Water Level
 At time of Drilling: At time of Drilling
 At Completion of Drilling: At Completion of Drilling
 After Drilling: After Drilling
 D = Split Spoon Sample Pen. = Penetration Length WOR = Weight of Rods S_v = Field Vane Shear Strength, kips/sq.ft.
 U = Thin Walled Tube Sample Rec. = Recovery Length WOH = Weight of Hammer q_u = Unconfined Compressive Strength, kips/sq.ft.
 R = Rock Core Sample bpf = Blows per Foot RQD = Rock Quality Designation Ø = Friction Angle (Estimated)
 V = Field Vane Shear mpf = Minute per Foot PID = Photoionization Detector N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H ₂ O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD				
			1D		0.4-2.4	24/8	10-10-5-3		4 3/4 inches Asphalt Pavement		
			2D		2.4-4.4	24/0	1/24		Medium dense to very loose, brown gravelly SAND some silt with possible voids (FILL)		
	5		3D		5-7	24/10	WOH-2-2-7				
			4D		7-9	24/12	7-4-4-10				

Auger Refusal at 9.0 feet
 Probable bedrock or boulder

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-24

BORING / WELL 19-0968.GPJ SWCE TEMPLATE.GDT 12/23/19



TO:	Zach Cronin, EIT, City of Portsmouth	DATE:	1/21/2021
FROM:	Rebecca Saucier, PE, Wright-Pierce	PROJECT NO.:	11304C
SUBJECT:	Portsmouth, NH – Sagamore Ave Sewer Extension Hazardous Materials Remediation Memo [Revised]		

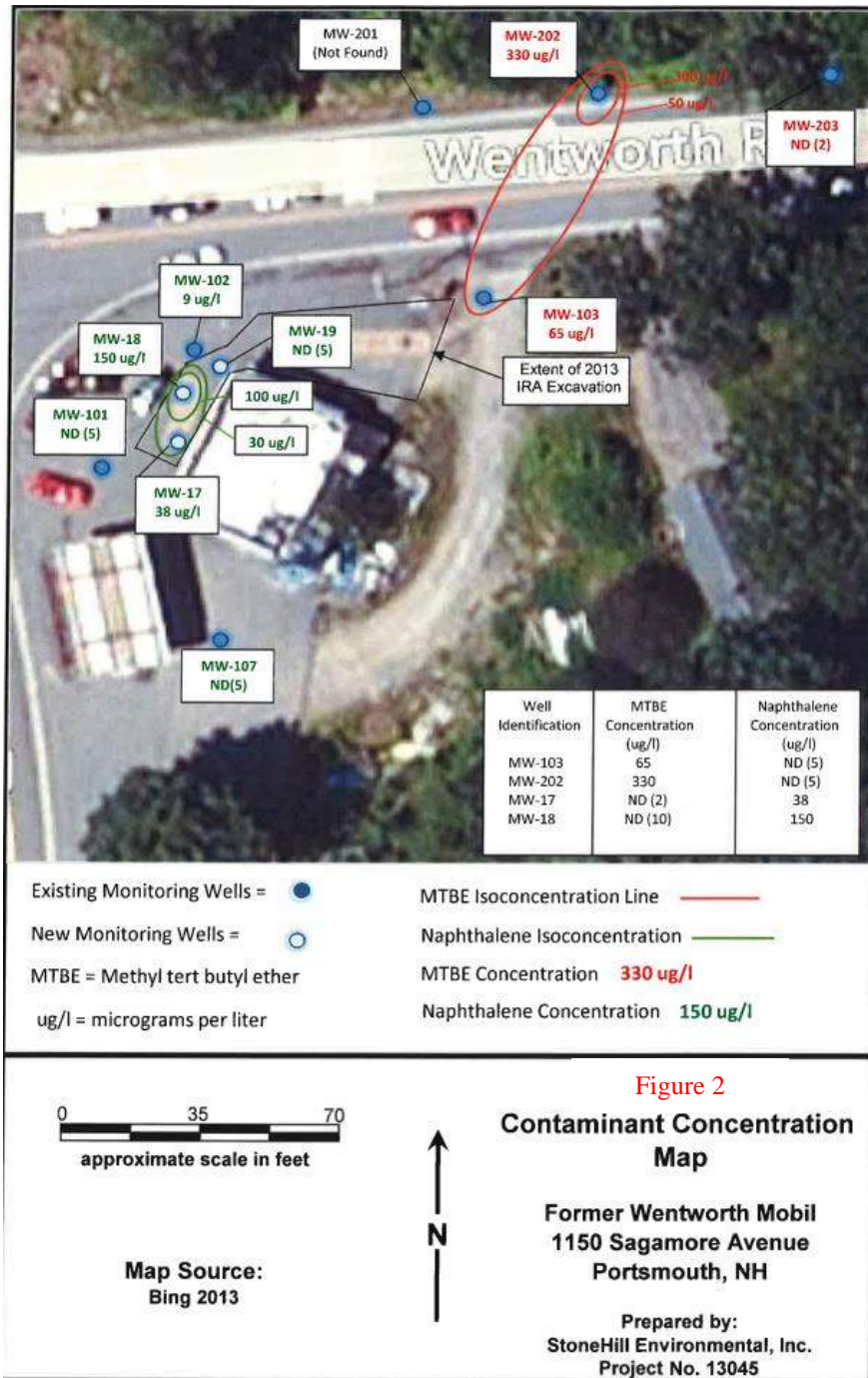
The purpose of this memo is to summarize potential remediation sites within proximity to the above referenced project. A total of six (6) remediation sites were identified within 500 feet of the project alignment. Summarized below, you will find owner information, NHDES identification numbers, and the status of each location of interest based on available information from NHDES' OneStop Data and Information center. A site location map is included below for reference.

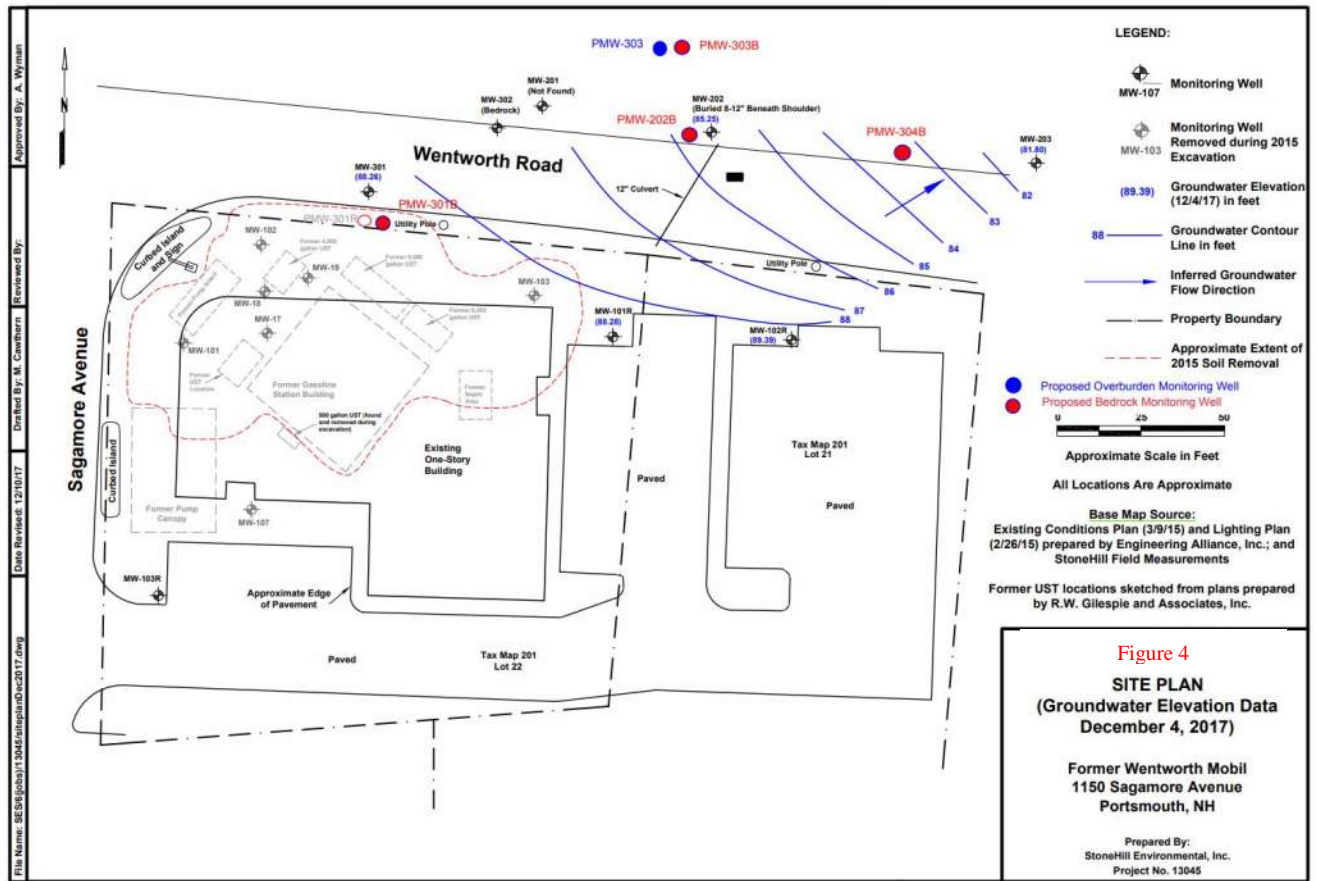
FIGURE 1. SAGAMORE AVE. SEWER EXTENSTION REMEDIATION SITES



1) **MOBIL (1150 Sagamore Ave)**

- **Location: Adjacent to project right-of-way**
- **Owner: Rye Corner Gas, LLC (Ocean Properties)**
- **NHDES Site #: 198706025**
- **Summary:**
 - Gas Station is currently vacant
 - Hazardous waste generator
 - Inactive as of 2013
 - Underground storage tank program
 - 3 USTs were closed for regulatory Site Closure
 - Removed in 2013
 - Underground injection control
 - Floor drains have been non-existent for years
 - DES file closed
 - Leaking underground storage tank
 - With the removal of the tanks an Initial Response Action was conducted which resulted in the removal of 150 tons of petroleum impacted soil.
 - Supplemental subsurface and explorations and analysis performed
 - Site geology and hydrogeology
 - Soil excavated at borings B-5 and B-7
 - Round of groundwater monitoring in September 2014
 - Gas contaminated soils removed by August 2015
 - One story office building built on site
 - Replacement monitoring wells – active project
 - MtBE settlement fund project
 - “Approximately 1,400 tons of gasoline impacted soil primarily contaminated with MTBE, benzene, naphthalene, and alkylbenzenes were removed from the Site during excavation activities completed between June 9 and June 22, 2015”
 - Status: DES File Closed





2) Mulcahy Property (Wentworth House Rd)

- **Location:** 321 ft. from Project Area
- **Owners:** Edmund and David Mulcahy
- **NHDES Site#:** 200409155
 - Unsolicited site assessment
 - Tested groundwater per NHDES request
 - DES File Closed
- No further investigation will be conducted

3) **Bartlett House (120 Wentworth House Rd)**

- **Location: 154 ft. from Project Area**
- **Owner: Great Island Trust Partnership**
- **NHDES Site#: 199406007**
- Underground Storage Tank Program
 - Removal of 500 + gallon underground gasoline storage tank in 1994
- Leaking underground storage tank
 - After removal of tank the concentrations of BTEX compounds and naphthalene are below AGQS standards
- DES File Closed
- No further investigation will be conducted

4) **Jeanne Hopkins Residence (209 Walker Bungalow Rd)**

- **Location: 154 ft. from Project Area**
- **Owner: Jeanne Hopkins**
- **NHDES Site#: 199509012**
- **On premise use facility containing fuel oil**
 - DES filed a complaint form in 1995 for an oily substance being noticed in the catch basin as well as on grass which was sampled. Facility complied and permanently eligible as of 1997
 - DES file Closed
- No further investigation will be conducted

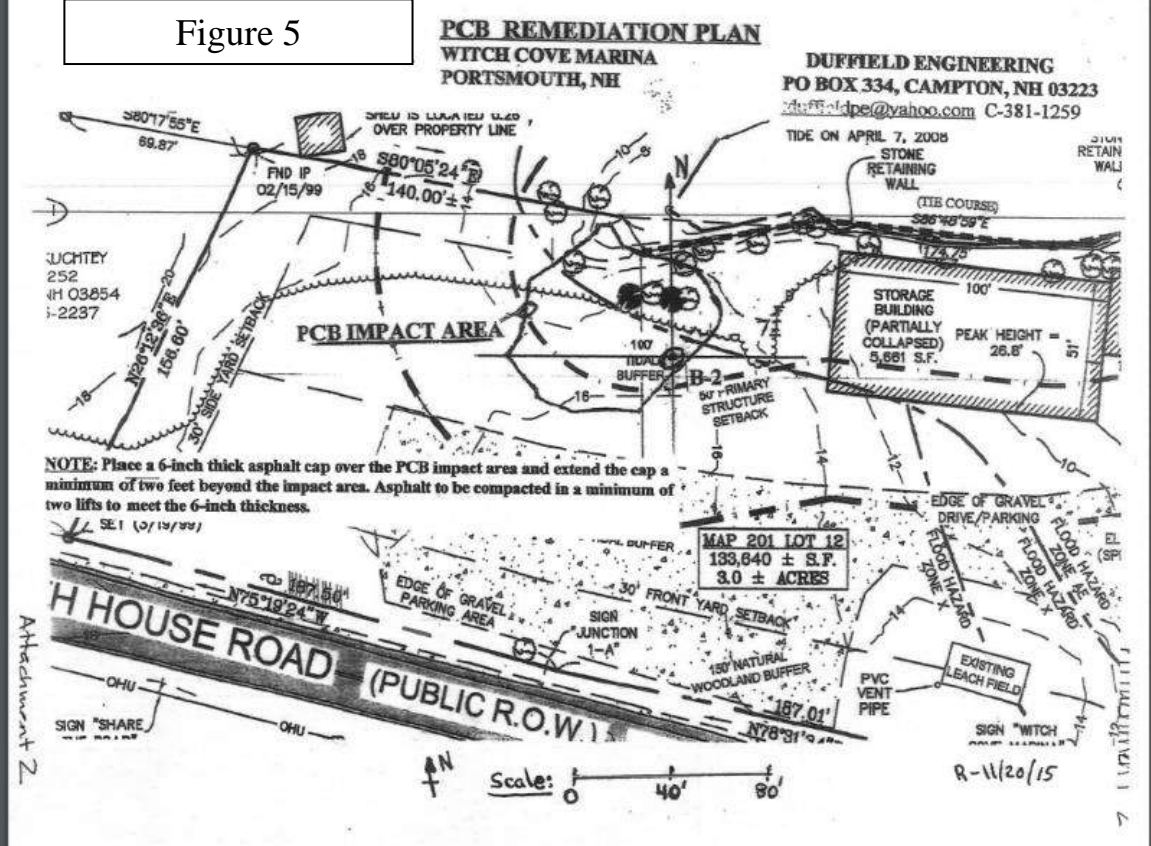
5) **Golden Egg Salon (960 Sagamore Ave)**

- **Location: On Project Area**
- **Commercial Building Owner: Tom Gosselin**
- **NHDES Site#: 201107020**
- Underground injection control
 - Salon approved registration for nondomestic wastewater discharge to a septic system in 2011
 - Excerpt from NHDES response letter to application for 960 Sagamore Ave, nondomestic wastewater discharge registration: “This registration is acknowledgement that nondomestic wastewater is discharging to a septic system and given the submitted information, no chemicals or products used are identified as a regulated contaminant. This registration is not a guarantee that the additional water and/or products discharged to the septic system from commercial activities will not have an influence on the efficiency or the lifespan of that system. Excessive use chemicals including chlorine-based products and products that have quaternary ammonia as an ingredient are potentially destructive to septic system biology. The discharge of all chemicals should be minimized.”
- Further investigation may be necessary

6) Witch Cove (Mikes) Marina (187 Wentworth House Rd)

- **Location: On Project Area**
- **Owner: JP Nadeau**
- **NHDES Site#: 198604143**
- Underground storage tank program
 - Tank (taking in excessive water) removed in 1986
- Unsolicited site assessment (HWRB Reviewed)
 - JP Nadeau has been operating the marina since 2000 and was operated as Mike's Marina from mid 1950s until 2000. Junk boats and junk boats were stored on the land.
 - Initial sampling round was conducted on 8/19/2014 and subsequent sampling rounds conducted on 8/31/14, 9/19/14, 10/20/14, and 11/6/14.
 - December 2014 Remediation Plan:
 - Remove PCB impacted soil from property and material to be hauled to a permitted disposal facility (Waste Management Corporation)
 - If initial post-remediation sampling demonstrates remaining PCB impacted soil above 1.0mg/kg then a further round of removal/disposal and sampling will be conducted
 - March 2016 Remediation Plan 2
 - Remove additional PCB and lead contaminated soils from area of B-2
 - Remove arsenic-impacted soil from area of B-7
 - March 2018 – Request for Final Report
 - Final report was to be submitted 60 days of completion - No documentation received
 - Further investigation is necessary based off the boring testing impacting the project area

Figure 5







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Portsmouth, NH 03801
603.430.3728 | www.wright-pierce.com