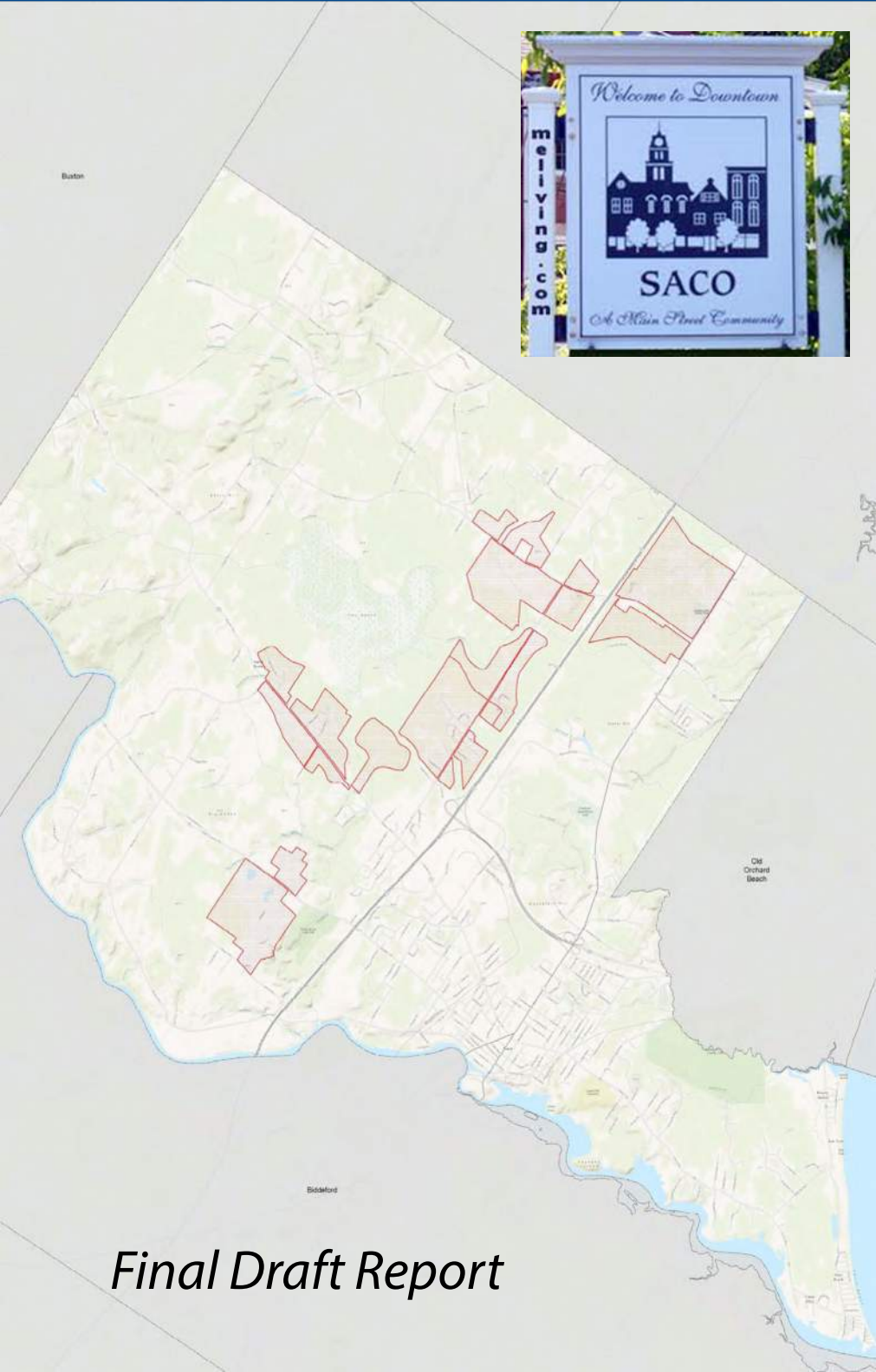


Sewer and Water Infrastructure Expansion Plan



Prepared for:
City of Saco, Maine and
Maine Water Company

February 2016

**CDM
Smith**



MaineWater

Final Draft Report

Executive Summary

Sewer and Water Infrastructure Expansion

Purpose

Development pressure in West Saco has prompted the City to evaluate the water and sewer infrastructure improvements needed to support growth west of the Maine Turnpike. The City of Saco in conjunction with the Maine Water Company retained CDM Smith to assist with this planning study. The resulting Technical Memorandum establishes a basis for future sewer and water infrastructure expansion while considering overall coordination among the two utilities. The plan will serve as a road map for sensible expansion of sewer and water utilities on the west side of the Maine Turnpike to support that development when it occurs.

Background

The east side of Saco includes the majority of the existing sewer and water infrastructure. See Figures 1 and 2 in the Technical Memorandum. The existing sewer system includes 71 miles of mainline sewer and force mains, 31 pumping stations and a wastewater treatment plant. The water system in Saco is served by Maine Water Company, which is a regulated water utility that owns 12 public water systems in Maine, including the system for Saco and three adjacent municipalities (Scarborough, Old Orchard Beach, Biddeford).

Future Development Areas

There were four future land development and system expansion opportunities identified on the west side of the Maine Turnpike. Coordination meetings were held with the City of Saco to determine the limits of sewer expansion, coinciding with future development areas, topography and current private development planning projects. The majority of the expansion areas are zoned for R-1D (low density single residential), with one area falling in the R-4 category (General resident district). The future development areas, shown on Figure 3, were named by a centrally-located street, and include the following:

- New County Road Area
- Buxton Road Area
- Jenkins Road Area
- Flag Pond Road Area

The future development areas had a 30% factor deducted to account for roadways, open space, parks, and other planning items. Each area was divided by three lot size development rates to

determine projected house counts. The house counts were then used to estimate future sewer flows and water demands. Those lot size development rates were:

- 7,500 Square feet per house
- 15,000 Square feet per house
- 30,000 Square feet per house

Sewer Expansion Plan

The planning for the sewer system expansion began with the analysis of several factors, which included topography, location of existing sewers, failing septic systems, future development areas, brook crossings, and feasibility of water system expansion. The topography and brook crossings created natural boundaries where gravity sewers could be installed. Further extension beyond the natural boundaries or low spots would require additional pump stations, which add more cost and maintenance to the City. The closer existing sewers were located to a development area, the more feasible sewer expansion could be to serve these areas. The table below summarizes the linear footage (LF) of gravity sewer, force main, pump stations (PS) and Maine Turnpike (Tpk) crossing proposed for each development area.

Area	Sewer Expansion Summary			
	Gravity (LF)	Force Main (LF)	PS (#)	Tpk Crossing
Jenkins Road (Fig. 6-9)	9,420	1,900	1	0
New County Road (Fig. 4)	3,300	2,450	1	0
Buxton Road (Fig. 5)	5,830	0	0	0
Flag Pond Road (Fig. 10)	20,240	1,500	1	1
Totals	38,790	5,850	3	1

Note: Jenkins Road preferred Alternative B included.

Water Expansion Plan

The existing water distribution system in Saco is fed from a booster station and 24-inch water main from Biddeford. The water distribution expansion plan follows along the same areas as the sewer expansion plan. A water model was used to determine the needs for the future development areas. Due to higher elevation on the west side of the highway, a high service zone and new booster station will be required. Further, a new water storage tank near Flag Pond Road/Jenkins Road intersection will be required to sustain the service pressures determined by the Fire Chief. A summary of the water infrastructure needs follow.

Area	Water Expansion Summary		
	Main (LF)	PS (#)	Tank (#)
Jenkins Road	8,600	0	0
New County Road	4,650	0	0
Buxton Road	0	1	0
Flag Pond Road	12,300	0	1
Totals	25,550	1	1

Planning Level Costs

The utility expansion program includes providing a planning level cost estimate for both sewer and water infrastructure. The planning level costs are divided by expansion area and include present day (Year 2016) costs for all planning level estimates. Also, a 25% construction contingency and a 25% engineering and implementation allowance are factored into the totals. The preparation of final design plans will provide more information on site-specific conditions and can impact these figures. Factors to consider will include increased rock removal, wetland issues, endangered species, brook crossings, etc. The table below provides a summary of the planning level costs.

Area	Sewer Planning Level Cost Estimate	Water Planning Level Cost Estimate
Jenkins Road	\$5,070,000	\$1,700,000
New County Road	\$1,140,000	\$900,000
Buxton Road	\$2,560,000	\$1,700,000
Flag Pond Road	\$9,280,000	\$6,800,000
Totals	\$18,050,000	\$11,100,000

Note: Cost reflect February 2016 dollars.

Implementation Plan

The implementation of the utility expansion should be done in a phased manner. The future development projects will help dictate where and when each phase of the expansion should begin. Below is a brief summary of the future development areas and associated phasing for both sewer and water.

New County Road

The sewer and water expansion in this area can proceed independently from the other three areas. The sewer expansion will include gravity sewer and a pump station, which will connect to an existing gravity sewer on the east side of the highway. Further, the lot sizes should be limited to a minimum of 15,000 square feet (SF). Smaller lot sizes (7,500 SF) would increase house counts and sewer flows, which would be larger than what the highway crossing sewer and downstream system can handle.

The water expansion will draw from the existing main on New County Road, west of the highway. The water service will remain on the current hydraulic grade line provided by the existing booster station in Biddeford.

Buxton Road

The sewer expansion in this area can proceed when a future development area is ready. The developer will have to coordinate with the City to determine if the projected flow to the Buxton pump station warrants an upgrade.

The existing water network extends through the Buxton Road area. However, design conditions (maximum day demand plus fire flow) are reaching their limits with the existing system. Any

future development in this area may require the construction of the new booster station on Pine Street near the Buxton Road intersection.

Jenkins Road

A portion of the sewer expansion in this area is currently under design in coordination with a private developer. The remaining sewer expansion can proceed as the development projects arise, including a new pump station near the midpoint on Jenkins Road.

Similarly to the sewer expansion, a portion of the water expansion is currently under design with the same private developer. It is not expected that the new booster station will be needed for this project. However, any future development projects will need to plan for installation of the booster station along with a new water main on Jenkins Road.

Flag Pond Road

The sewer expansion in this area will require extensive construction of new sewer main, a pump station and trenchless highway crossing. However, the sewer expansion can be done independently of the other three areas.

The water expansion in this area will require construction of water mains to both Jenkins Road and Flag Pond Road, east of the highway. This work cannot be completed until the Jenkins Road water expansion is constructed first. The other important infrastructure improvement to this area is the elevated water storage tank near the Flag Pond Road/Jenkins Road intersection. The tank will need to be constructed prior to development areas becoming active to create available water storage and minimize booster station operation.



Technical Memorandum

To: City of Saco, Maine and Maine Water Company

From: Neal Campbell, P.E. (NH) and Erin Smith, P.E. (NH)

Date: February 11, 2016

Subject: Sewer and Water Infrastructure Expansion Plan

The purpose of this technical memorandum is to establish the basis for a future and comprehensive facilities plan update, serve as a decision making tool in evaluating future developer requests for sewer and water expansion, and discuss other considerations toward the Sewer and Water Infrastructure Expansion Plan. The technical memorandum was prepared as part of Task Order No. 2 with the City of Saco and Task Order No. 1 with Maine Water Company.

Background and Existing Information

This technical memorandum was prepared with help and coordination from representatives from the Planning Department, Public Works, City Engineer, Water Resource Recovery Division, Maine Water Operations and Engineering, and the Fire Chief.

The City of Saco, Maine owns and maintains a wastewater collection system comprised of 71 miles of mainline sewer/force main, 31 pumping stations and a wastewater treatment plant (WWTP). The collection system services approximately 15,500 people and has 4,750 residential users and 240 commercial/industrial users. The majority of the wastewater infrastructure and customers are located east of the Maine Turnpike (Route 95). See Figure 1.

The Maine Water Company is a regulated public water utility that owns 12 public water systems in the state of Maine, and which serves more than 32,000 customers (approximately 80,000 residents). One of those public water systems serves the City of Saco and three adjacent municipalities (Scarborough, Old Orchard Beach, and Biddeford). See Figure 2.

To understand the existing sewers and water systems, both the City of Saco and Maine Water Company provided their latest GIS data. The data was combined with State of Maine GIS features, to create mapping for each utility. Maine Water Company also provided their existing water model data to assist with the future development analysis.

Future Development Areas

The existing sewer and water systems are both well developed on the east side of the Maine Turnpike. Future land development opportunities and system expansion were investigated on the west side of the Maine Turnpike plus two others off the northern portion of Route 1. The future development areas were named by a centrally-located street.

Insert – Figure 1

Insert – Figure 2

The four future development areas are shown on Figure 3 and include the following:

- New County Road Area (see the areas labeled “NC”)
- Buxton Road Area (see the areas labeled “BX”)
- Jenkins Road Area (see the areas labeled “JK”)
- Flag Pond Road Area (see the areas labeled “FP”)

Coordination meetings were held with the City of Saco to determine the limits of sewer expansion, coinciding with future development areas, topography and current private development planning projects. Discussion over the current town zoning maps and zone designations helped develop this task. Further explanation is provided below.

Failing Septic Systems/Contaminated Wells

The existence of failing septic systems and contaminated wells within existing sewer or water systems can be a key factor when investigating the expansion of a utility. Clustering of these negative environmental conditions will create adverse conditions and could warrant utility expansion. The City of Saco noted a few problematic areas at the mobile home parks on the northerly end of Route 1 and Boothby Park. Maine Water did not report any contaminated wells, so no further analysis was performed on this issue.

Sewer Expansion Plan

The planning for the sewer system expansion began with the analysis of several factors, which included topography, location of existing sewers, failing septic systems, future development areas, brook crossings, and feasibility of water system expansion. The topography and brook crossings created natural boundaries where gravity sewers could be installed. Further extension beyond the natural boundaries or low spots would require additional pump stations, which add more cost and maintenance to the City. The closer existing sewers were located to a development area the more feasible sewer expansion could be to serve these areas.

The next step in planning the sewer system expansion was to determine the future flows from each area. The majority of the expansion areas are zoned for R-1D (low density single residential), with one area (Boothby) falling in the R-4 category (General residential district). Upon discussions with the City (representatives from Planning Board, Public Works and Water Resource Recovery Division), three lot sizes were chosen to divide into the future development areas. The lot sizes were as follows:

- 7,500 Square feet (SF) per house
- 15,000 Square feet per house
- 30,000 Square feet per house

Before calculating the number of houses for each future development area, a 30% factor was deducted from the area to account for roadways, open space, parks, and other planning items.

Insert – Figure 3

Table 1 displays the house count summary for all the sewer expansion areas and future development areas within them.

New County Road Area

The New County Road Area (see Figure 4) extends from an existing sewer located at the intersection of Shadagee Road and New County Road (Route 5), east of the Maine Turnpike (Route 95) westerly to a high point near Big Ledge Brook. New County Road extends over the highway, where sewer expansion would need to pass underneath the highway. On the west side of the highway, the topography gradually increases from a low point at Deep Brook crossing, where a pump station will be located to send flow back to the existing sewer.

A private developer is preparing plans to develop approximately 90 new houses (Precious Hidden Valley Estates) to a property located directly west of the highway and south of New County Road. As part of their wastewater management plan, the developer intends to install a pump station to send flow underneath the highway to the same existing sewer mentioned above. In coordination with the City, they are required to install a second force main parallel to their force main, to serve as a future highway crossing for the New County Road sewer flow.

There are approximately 19 existing homes located along the roadway and two large future development areas. The future development areas (NC1 and NC2) are on either side of New County Road and can be seen in Figure 4. The downstream capacity (495,000 gpd @ slope = 0.004, n = 0.013) of the existing 8-inch sewer is smaller than the peak flow (641,300 gpd) assuming the 7,500 SF lot size. As a result the City has to limit the lot sizes in the development areas to 15,000 SF or higher. Further, the City is requiring the current developer of Precious Hidden Valley Estates to install the second force, parallel to the development's 4-inch force main, to 6-inch diameter to meet flow constraints. A summary of the sewer flows can be seen in Table 2.

A downstream sewer capacity analysis was performed to determine if the additional flow from New County Road would create an adverse downstream condition. Ten sewer segments ranging in diameter from 10-inch to 12-inch were investigated on Bradley Street. Recent invert elevations gathered from field inspections were used to calculate the pipe capacities. The segment with the smallest capacity was 1,070,300 gpd (SMH 1037.108 to 1037.109). Comparing the projected peak New County flows plus the theoretical peak flow from the existing residents/businesses along Bradley Street, the downstream pipe capacity can easily accommodate the flow (474,600 gpd).

Buxton Road Area

The Buxton Road Area sewer extends from an existing sewer on Buxton Road near the Blake Avenue intersection westerly to a high point just south of Loudon Road. The topography gradually increases from the existing sewer to the high point. From that high point the topography quickly drops off at the Sandy Brook crossing.

There are approximately 138 homes located along Buxton Road and a few side streets. The five future development areas are on either side of Buxton Road and can be seen in Figure 5. The City reports that the Buxton Road pump station has been designed to accommodate larger

Table 1
Existing and Future House Count Summary

Area	Future Development Area Size (SF)		House Count at Lot Size with 70% Size of Area		
	100%	70%	7,500	15,000	30,000
Jenkins Road					
Existing			58	58	58
JK1	3,263,165	2,284,216	305	152	76
JK2	3,716,945	2,601,862	347	173	87
JK3	12,910,771	9,037,540	1,205	603	301
W. Side Village			100	100	100
Jenkins Subtotal	19,890,881	13,923,617	2,014	1,086	622
New County Road					
Existing			19	19	19
NC1*	2,250,654	1,575,458	105	105	53
NC2*	10,918,794	7,643,156	510	510	255
Precious HV Ests.			90	90	90
New County Subtotal	13,169,448	9,218,614	724	724	416
Buxton Road					
Existing			138	138	138
BX1	2,666,769	1,866,738	249	124	62
BX2	4,698,342	3,288,839	439	219	110
BX3	4,204,650	2,943,255	392	196	98
BX4	3,162,504	2,213,753	295	148	74
BX5	1,252,674	876,872	117	58	29
Buxton Subtotal	15,984,939	11,189,457	1,630	884	511
Flag Pond Road					
Existing			135	135	135
Hearns Rd			93	93	93
FP1	1,403,846	982,692	131	66	33
FP2	2,501,852	1,751,296	234	117	58
FP3	9,461,837	6,623,286	883	442	221
FP4	2,503,116	1,752,181	234	117	58
FP5	1,310,122	917,085	122	61	31
High Service Zone Subtotal	17,180,773	12,026,541	1,832	1,030	629
FP6*^	5,355,234	3,748,664	250	250	125
FP7*^	14,232,122	9,962,485	664	664	332
Flag Pond Subtotal	36,768,129	25,737,690	2,746	1,944	1,086
Grand Total (w/o FP6 & 7)	66,226,041	46,358,229	6,200	3,724	2,178
Grand Total (w/ FP6 & 7)	85,813,397	60,069,378	7,114	4,638	2,635

* = Proposed Areas shall only consider 15,000 SF lot size or larger. Small 7,500 SF lot size not feasible

■ = House counts impacted by above scenario

^ = Flag Pond Road Areas FP6 and FP7 are not included in new High Service Zone.

Insert – Figure 4

Table 2
New County Road - Future Sewer Flows

Scenario	Area	# of Houses	Average No. of people per house	Avg. flow rate (gpd/person)	Average Flow (gpd)	Average Flow (gpm)	Peaking Factor	Peak Flow (gpd)	Pipe Size (inch)	Length (feet)	Inch-Miles	Infiltration Rate (gpd/inch-mile)	Infiltration (gpd)	Total Average Flow (gpd)	Total Average Flow (gpm)	Total Peak Flow (gpd)	Total Peak Flow (gpm)
Existing	New County Road Development PS																
	<i>New County Road - Existing</i>	19	2.5	50	2,375	1.6	4.4	10,450	8	3,700	5.6	1,000	5,606	7,981	5.5	16,056	11.2
	Subtotal	19			2,375	1.6		10,450		3,700			5,606	7,981	5.5	16,056	11.2
1	Future Development (7,500 SF Lots) at 70% Area:																
	NC1 (~2.25 mil SF)	210	2.5	50	26,258	18.2	4.0	105,031	8	2,000	3.0	1,000	3,030	29,288	20.3	108,061	75.0
	NC2 (~10.92 mil SF)	1,019	2.5	50	127,386	88.5	3.6	458,589	8	6,000	9.1	1,000	9,091	136,477	94.8	467,680	324.8
	Precious Hidden Valley Estates	90	2.5	50	11,250	7.8	4.2	47,250	8	1,500	2.3	1,000	2,273	13,523	9.4	49,523	34.4
	Subtotal (Future)	1,319			164,894	114.5		610,870		9,500			14,394	179,287	124.5	625,264	434.2
	Total (Existing + Future)	1,338			167,269	116.2		621,320		13,200			20,000	187,269	130.0	641,320	445.4
2	Future Development (15,000 SF Lots) at 70% Area:																
	NC1 (~2.25 mil SF)	105	2.5	50	13,129	9.1	4.2	55,141	8	2,000	3.0	1,000	3,030	16,159	11.2	58,171	40.4
	NC2 (~10.92 mil SF)	510	2.5	50	63,693	44.2	3.8	242,033	8	6,000	9.1	1,000	9,091	72,784	50.5	251,124	174.4
	Precious Hidden Valley Estates	90	2.5	50	11,250	7.8	4.2	47,250	8	1,500	2.3	1,000	2,273	13,523	9.4	49,523	34.4
	Subtotal (Future)	705			88,072	61.2		344,424		9,500			14,394	102,466	71.2	358,818	249.2
	Total (Existing + Future)	724			90,447	62.8		354,874		13,200			20,000	110,447	76.7	374,874	260.3
3	Future Development (30,000 SF Lots) at 70% Area:																
	NC1 (~2.25 mil SF)	53	2.5	50	6,564	4.6	4.3	28,227	8	2,000	3.0	1,000	3,030	9,595	6.7	31,257	21.7
	NC2 (~10.92 mil SF)	255	2.5	50	31,846	22.1	4.0	127,386	8	6,000	9.1	1,000	9,091	40,937	28.4	136,477	94.8
	Precious Hidden Valley Estates	90	2.5	50	11,250	7.8	4.2	47,250	8	1,500	2.3	1,000	2,273	13,523	9.4	49,523	34.4
	Subtotal (Future)	397			49,661	34.5		202,863		9,500			14,394	64,055	44.5	217,257	150.9
	Total (Existing + Future)	416			52,036	36.1		213,313		13,200			20,000	72,036	50.0	233,313	162.0

Insert – Figure 5

pumps and should be able to handle the additional flows from the future areas. A summary of the sewer flows can be seen in Table 3.

A sewer capacity analysis was performed to determine if the additional flow from the Buxton Road Area would create an adverse downstream condition. Nineteen sewer segments ranging in diameter from 8-inch to 24-inch were investigated on North Street and cross country off North Street/Nye Street. The sewer flows from this area flow southerly on North Street through a 12-inch sewer then southwest along Spring Street through an 18-inch then 24-inch sewer. During peak conditions, the flow can exit through an higher elevated invert into a relief 10-inch sewer cross country pipe near Nye Street connecting to the 24-inch sewer on Spring Street. Recent invert elevations gathered from field inspections and existing elevations were used to calculate the pipe capacities. There was one pipe segment with unknown elevation through the cross country route that was not included. The segments with the smallest capacity were 1,399,100 gpd (SMH 1242.131 to 1242.130) along North Street and 406,800 gpd (SMH 1247.105 to 1247.109) along the cross country sewer. Comparing the projected peak Buxton Road flows plus the theoretical peak flow from the existing residents/businesses upstream, the combined downstream pipe capacity can accommodate the flow (1,478,400 gpd) assuming the 7,500 SF lot size. Further, the downstream capacity of the sewer just along North Street can accommodate the flow (1,128,400 gpd) assuming the 15,000 SF lot size.

A discussion of the downstream sewer capacity analysis for both Buxton Road Area and Jenkins Road Area is included under the Jenkins Road Area below.

Jenkins Road Area

The Jenkins Road Area is located along Jenkins Road which runs parallel to the highway. The sewer limits along Jenkins extend from the existing sewer near the Steeple Drive intersection northerly to the Cascade Brook crossing.

There are approximately 58 homes located along Jenkins Road. The three future development areas are on either side of Jenkins Road. There is also a private developer that intends to install 100 houses (West Side Village) on a parcel adjacent to the highway.

This sewer expansion layout was not as straightforward as the other three areas. As a result, seven alternatives were investigated on how to serve this area. The following is brief description of the alternatives and the feasibility of each.

Alternative A

This alternative considered a gravity sewer pipe from the last existing house on Jenkins Road south of Cascade Brook to the entrance of the new West Side Village private development near Sofia Road. The sewer flows would then be incorporated into the private development's new pump station design. Due to the topography of Jenkins Road, there is an approximate stretch of 2,000 linear feet of sewer that needs to be 25-30 feet deep. Typical construction equipment and means/methods are not feasible at this construction depth, so this alternative was not recommended. See Figure 6 for a map of this alternative.

**Table 3
Buxton Road - Future Sewer Flows**

Scenario	Area	# of Houses	Average No. of people per house	Avg. flow rate (gpd/person)	Average Flow (gpd)	Average Flow (gpm)	Peaking Factor	Peak Flow (gpd)	Pipe Size (inch)	Length (feet)	Inch-Miles	Infiltration Rate (gpd/inch-mile)	Infiltration (gpd)	Total Average Flow (gpd)	Total Average Flow (gpm)	Total Peak Flow (gpd)	Total Peak Flow (gpm)	
Existing	Buxton Road Development PS																	
	Existing houses	138	2.5	50	17,250	12.0	4.1	70,725	8	6,000	9.09	1,000	9,091	26,341	18.3	79,816	55.4	
	Subtotal	138			17,250	12.0		70,725		6,000			9,091	26,341	18.3	79,816	55.4	
1	Future Development (7,500 SF Lots) at 70% Arez																	
	BX1 (~2.67 mil SF)	249	2.5	50	31,112	21.6	4.0	124,449	8	700	1.06	1,000	1,100	32,212	22.4	125,549	87.2	
	BX2 (~4.70 mil SF)	439	2.5	50	54,814	38.1	3.8	208,293	8	400	0.61	1,000	1,100	55,914	38.8	209,393	145.4	
	BX3 (~4.20 mil SF)	392	2.5	50	49,054	34.1	3.9	191,312	8	2,800	4.24	1,000	1,100	50,154	34.8	192,412	133.6	
	BX4 (~3.16 mil SF)	295	2.5	50	36,896	25.6	3.9	143,894	8	2,000	3.03	1,000	1,100	37,996	26.4	144,994	100.7	
	BX5 (~1.25 mil SF)	117	2.5	50	14,615	10.1	4.1	59,920	8	2,500	3.79	1,000	1,100	15,715	10.9	61,020	42.4	
	Subtotal (Future)	1,492			186,491	129.5		727,867		8,400			5,500	191,991	133.3	733,367	509.3	
Total (Existing + Future)	1,630			203,741	141.5		798,592		14,400			14,591	218,332	151.6	813,183	564.7		
2	Future Development (15,000 SF Lots) at 70% Arez																	
	BX1 (~2.67 mil SF)	124	2.5	50	15,556	10.8	4.1	63,780	8	700	1.06	1,000	1,100	16,656	11.6	64,880	45.1	
	BX2 (~4.70 mil SF)	219	2.5	50	27,407	19.0	4.0	109,628	8	400	0.61	1,000	1,100	28,507	19.8	110,728	76.9	
	BX3 (~4.20 mil SF)	196	2.5	50	24,527	17.0	4.0	98,109	8	2,800	4.24	1,000	1,100	25,627	17.8	99,209	68.9	
	BX4 (~3.16 mil SF)	148	2.5	50	18,448	12.8	4.1	75,637	8	2,000	3.03	1,000	1,100	19,548	13.6	76,737	53.3	
	BX5 (~1.25 mil SF)	58	2.5	50	7,307	5.1	4.2	30,691	8	2,500	3.79	1,000	1,100	8,407	5.8	31,791	22.1	
	Subtotal (Future)	746			93,245	64.8		377,844		8,400			5,500	98,745	68.6	383,344	266.2	
Total (Existing + Future)	884			110,495	76.7		448,569		14,400			14,591	125,086	86.9	463,160	321.6		
3	Future Development (30,000 SF Lots) at 70% Arez																	
	BX1 (~2.67 mil SF)	62	2.5	50	7,778	5.4	4.2	32,668	8	700	1.06	1,000	1,100	8,878	6.2	33,768	23.4	
	BX2 (~4.70 mil SF)	110	2.5	50	13,703	9.5	4.1	56,184	8	400	0.61	1,000	1,100	14,803	10.3	57,284	39.8	
	BX3 (~4.20 mil SF)	98	2.5	50	12,264	8.5	4.2	51,507	8	2,800	4.24	1,000	1,100	13,364	9.3	52,607	36.5	
	BX4 (~3.16 mil SF)	74	2.5	50	9,224	6.4	4.2	38,741	8	2,000	3.03	1,000	1,100	10,324	7.2	39,841	27.7	
	BX5 (~1.25 mil SF)	29	2.5	50	3,654	2.5	4.3	15,711	8	2,500	3.79	1,000	1,100	4,754	3.3	16,811	11.7	
	Subtotal (Future)	373			46,623	32.4		194,811		8,400			5,500	52,123	36.2	200,311	139.1	
Total (Existing + Future)	511			63,873	44.4		265,536		14,400			14,591	78,464	54.5	280,126	194.5		

Insert – Figure 6

Alternative B

This alternative sends all flow by gravity to a low spot near the midpoint of Jenkins Road. A proposed pump station would send flow from the low spot southwesterly on Jenkins Road to a new gravity sewer at the high point near Sofia Road. In order to extend gravity sewer from the high point to the existing sewer near Steeple Drive, the road elevation must be raised by approximately 6-feet at the low spot at the Goosefare Brook crossing. A retaining wall would be a feasible solution to help support this road construction. This grade adjustment would allow the gravity sewer to connect into the existing system and avoid the need for a second pump station. This is the preferred alternative and a summary of the sewer flows can be seen in Table 4. Also, see Figure 7 for a map of this alternative.

Alternative C

This alternative is reliant upon the downstream portion of the Flag Pond Road Area sewer expansion being constructed. Similarly to Alternative B, gravity sewer goes to a low spot near the midpoint of Jenkins Road. However, the proposed pump station for this alternative instead sends flow northeasterly towards a second proposed pump station just north of the Cascade Brook crossing along Jenkins Road. This second pump station sends flow northeasterly to the proposed new gravity sewer along Flag Pond Road. This alternative requires two pump stations and extensive downstream infrastructure construction in order to be feasible. The additional cost of the second pump station and sequence/schedule make this alternative not recommended. See Figure 8 for a map of this alternative.

Alternative D

This alternative is also reliant upon the downstream portion of the Flag Pond Road Area sewer expansion being constructed. The location of the proposed pump station on Jenkins Road is the same as Alternative B and C, with the force main sending flow northeasterly to the Flag Pond Road Area. No gravity flow on Jenkins Road north of Cascade Brook is included. This alternative does not accommodate development along Jenkins Road north of Cascade Brook and south of Flag Pond Road. Also, the need for extensive downstream infrastructure construction makes this alternative not recommended. See Figure 8 for a map of this alternative.

Alternative E

This alternative is also reliant upon the downstream portion of the Flag Pond Road Area sewer expansion being constructed. The location of the proposed pump station on Jenkins Road is adjacent to the Cascade Brook crossing. Gravity flow north of the brook enters the pump station. The force main sends flow northeasterly to the proposed new gravity sewer along Flag Pond Road. This alternative requires approximately 2,700 linear feet of sewer to be installed 20-30 feet deep. Further the need for extensive downstream infrastructure construction makes this alternative not recommended. See Figure 9 for a map of this alternative.

Alternative F

This alternative is similar to Alternative A, where all flow along Jenkins uses gravity sewer. The flows in this alternative are directed towards the low spot located at the midpoint of the street. From there, flow travels cross country southeasterly through a partially open area, southwesterly parallel to the highway, then ends at the private developer's pump station. Due to the topography of the cross country area adjacent to the highway, the sewer depth would need

Table 4
Jenkins Road - Future Sewer Flows

Scenario	Area	# of Houses	Average No. of people per house	Avg. flow rate (gpd/person)	Average Flow (gpd)	Average Flow (gpm)	Peaking Factor	Peak Flow (gpd)	Pipe Size (inch)	Length (feet)	Inch-Miles	Infiltration Rate (gpd/inch-mile)	Infiltration (gpd)	Total Average Flow (gpd)	Total Average Flow (gpm)	Total Peak Flow (gpd)	Total Peak Flow (gpm)
Existing	Jenkins Road Development PS																
	Jenkins Road	37	2.5	50	4,625	3.2	4.3	19,888	8	4,800	7.3	1,000	7,273	11,898	8.3	27,160	18.9
	Country Woods Road	10	2.5	50	1,250	0.9	4.4	5,500	8	1,415	2.1	1,000	2,144	3,394	2.4	7,644	5.3
	Ashwood Drive	11	2.5	50	1,375	1.0	4.4	6,050	8	800	1.2	1,000	1,212	2,587	1.8	7,262	5.0
	Subtotal	58			7,250	5.0		31,438		7,015		10,629	17,879	12.4	42,066	29.2	
1	Future Development (7,500 SF Lots) at 70% Area																
	JK1 (~4.68 mil SF)	305	2.5	50	38,070	26.4	3.9	148,474	12	3,300	7.5	1,000	7,500	45,570	31.6	155,974	108.3
	JK2 (~0.77 mil SF)	347	2.5	50	43,364	30.1	3.9	169,121	12	700	1.6	1,000	1,591	44,955	31.2	170,712	118.5
	JK3 (~1.71 mil SF)	1,205	2.5	50	150,626	104.6	3.5	527,190	12	1,500	3.4	1,000	3,409	154,035	107.0	530,599	368.5
	West Side Village	100	2.5	50	12,500	8.7	4.2	52,500	8	2,000	3.0	1,000	3,030	15,530	10.8	55,530	38.6
		Subtotal (Future)	1,956			244,560	169.8		897,285		7,500		15,530	260,091	180.6	912,815	633.9
	Total (Existing + Future)	2,014			251,810	174.9		928,722		14,515		26,159	277,969	193.0	954,881	663.1	
2	Future Development (15,000 SF Lots) at 70% Area																
	JK1 (~4.68 mil SF)	152	2.5	50	19,035	13.2	4.1	78,044	10	3,300	6.3	1,000	6,250	25,285	17.6	84,294	58.5
	JK2 (~0.77 mil SF)	173	2.5	50	21,682	15.1	4.1	88,897	10	700	1.3	1,000	1,326	23,008	16.0	90,223	62.7
	JK3 (~1.71 mil SF)	603	2.5	50	75,313	52.3	3.7	278,657	10	1,500	2.8	1,000	2,841	78,154	54.3	281,498	195.5
	West Side Village	100	2.5	50	12,500	8.7	4.2	52,500	8	2,000	3.0	1,000	3,030	15,530	10.8	55,530	38.6
		Subtotal (Future)	1,028			128,530	89.3		498,098		7,500		13,447	141,977	98.6	511,545	355.2
	Total (Existing + Future)	1,086			135,780	94.3		529,536		14,515		24,076	159,856	111.0	553,612	384.5	
3	Future Development (30,000 SF Lots) at 70% Area																
	JK1 (~4.68 mil SF)	76	2.5	50	9,518	6.6	4.2	39,974	8	3,300	5.0	1,000	5,000	14,518	10.1	44,974	31.2
	JK2 (~0.77 mil SF)	87	2.5	50	10,841	7.5	4.2	45,533	8	700	1.1	1,000	1,061	11,902	8.3	46,593	32.4
	JK3 (~1.71 mil SF)	301	2.5	50	37,656	26.2	3.9	146,860	8	1,500	2.3	1,000	2,273	39,929	27.7	149,133	103.6
	West Side Village	100	2.5	50	12,500	8.7	4.2	52,500	8	2,000	3.0	1,000	3,030	15,530	10.8	55,530	38.6
		Subtotal (Future)	564			70,515	49.0		284,866		7,500		11,364	81,879	56.9	296,230	205.7
	Total (Existing + Future)	622			77,765	54.0		316,304		14,515		21,992	99,757	69.3	338,296	234.9	

Insert – Figure 7

Insert – Figure 8

Insert – Figure 9

to be approximately 20-35 feet over 1,500 linear feet. Typical construction equipment and means/methods, especially adjacent to the highway, are not feasible. This alternative was not recommended. See Figure 6 for a map of this alternative.

Alternative G

This alternative is similar to Alternative B, where all flow is sent by gravity to a low spot near the midpoint of Jenkins Road. A proposed pump station would send flow from the low spot southerly on Jenkins Road to the high point near Sofia Road. The flow would run southeasterly to the private developer's sewer and enter their pump station. Flow would be pumped underneath the highway to the existing sewer on Industrial Park Road. This alternative includes a challenging and expensive crossing under the highway and is not recommended. See Figure 7 for a map of this alternative.

A sewer capacity analysis was performed to determine if the additional flow from the Jenkins Road Area and Jenkins plus Buxton Road Area would create an adverse downstream condition. The same nineteen sewer segments in the Buxton Road discussion above were included in this analysis. Comparing the projected peak Jenkins Road flows plus the theoretical peak flow from the existing residents/businesses upstream, the combined downstream pipe capacity (1,805,924 gpd) can accommodate the flow (1,531,968 gpd) assuming the 7,500 SF lot size. Further, the downstream capacity of the sewer just along North Street (1,399,135 gpd) can accommodate the flow (1,172,027 gpd) assuming the 15,000 SF lot size.

The full build out scenario for Buxton Road Area and Jenkins Road Area will send sewer flows through the same North Street sewers. Assuming the 7,500 SF lot size, the combined peak flow from both areas plus the existing upstream peak flows (2,345,151 gpd) would exceed the sewer capacity (1,805,924 gpd). Assuming the 15,000 SF lot size, the downstream sewer capacity can accommodate the peak flow (1,635,187 gpd). Also, the existing 500 gpm pumps at the Buxton Road pump station will need to be upgraded to approximately 1,200 gpm to handle the future flow of both Buxton Road Area and Jenkins Road Area. Force main velocities within the 8-inch and 10-inch section are not expected to exceed 5 and 8 feet per second respectively during this peak flow condition. Based on these flows/capacity, it is not recommended to allow for full build out to 7,500 SF lots throughout both future development areas unless upgrades are made to the sewer capacity along the North Street.

Flag Pond Road Area

The Flag Pond Road Area sewer extends from an existing sewer on Route 1 near the Cascade Road intersection northerly on Route 1, westerly on Flag Pond Road, crosses underneath the highway, to a pump station at the low point near Harmon Brook, westerly to Lincoln Road and the Boothbay Area.

There are approximately 135 existing homes along Flag Pond and Lincoln Road (a.k.a. Boothby Park), with another 93 homes on Hearn's Road, which is a perpendicular street to Flag Pond running northerly towards Scarborough. Flow from these existing homes is included in the analysis. There are five future development areas on the west side of the highway and two larger areas on the east side. See Figure 10 to view the future development areas. Due to the location of the two larger areas on the east side and adjacent to Route 1 and the likelihood of

Insert – Figure 10

development in this area, the house count calculation did not use the 7,500 SF lot size house count, but instead utilizes the 15,000 SF count. A summary of the sewer flows can be seen in Table 5.

There was no downstream capacity analysis performed for the Flag Pond Area because all flow was accounted during the design of the existing downstream sewers and Cascade Pump Station.

Water Distribution Expansion Plan

The water distribution expansion plan follows along the same areas as the sewer expansion plan. This joined utility expansion effort allows for developers to understand how both sewer and water can reach their prospective area. The plan also gives the City of Saco and Maine Water Company a planning and financial tool for guiding developers on how they should proceed with future development areas.

The existing water distribution system is fed from a 24-inch water main from Biddeford that runs northerly along the western side of the Maine Turnpike to Route 5 (New County Road). There is a booster station in Biddeford that creates a hydraulic grade line of approximately 210 feet and services Saco to the east of the Maine Turnpike and a few small areas to the west of the Maine Turnpike. Further, a new water storage tank in Biddeford is under construction that will provide a few extra feet of head (~214-feet) into the system. There are currently no booster pumping stations or high-service zones in Saco.

The water distribution expansion plan will focus on the same four areas discussed in the sewer expansion plan. The existing and future house counts used to calculate sewer flows will be used for calculating the water demand for the water expansion. The range of future house counts relative to lot size will be presented separately along with the expected water flows. In coordination with Maine Water, the calculation of average day demand used 2.5 persons per home and 50 gallons per day per person. A peaking factor of 2.3 was used to determine the maximum day demand. Table 6 includes the water flows for each area under the different demands based on house count.

Water model software (InfoWater developed by Innovyze) was used with the existing water model provided by Maine Water Company's engineer, Tata & Howard. The service goal is to provide all homes with enough water to meet the maximum day demand plus fire flow at satisfactory pressure. A meeting was held with the Fire Chief to ascertain the fire flow requirement in the expansion areas. The Chief stated that all expansion to the west of the highway will be residential/rural and 500 gallons per minute (gpm) was sufficient. Any development along the Route 1 corridor on the east side of the highway will need to be 1,000 gpm because it is commercial/mixed use district (MU-3 zoned). Below is the area-specific discussion of water expansion infrastructure and hydraulics, while Figure 11 includes a map of the water expansion plan.

New County Road Area

The New County Road Area is in close proximity to the 24-inch water main. An existing 8-inch water main extends westerly a short distance along New County Road from the 24-inch. It is recommended that a 12-inch water main will connect to the existing 8-inch main and extend

Table 5
Flag Pond Road - Future Sewer Flows

Scenario	Area	# of Houses	Average No. of people per house	Avg. flow rate (gpd/person)	Average Flow (gpd)	Average Flow (gpm)	Peaking Factor	Peak Flow (gpd)	Pipe Size (inch)	Length (feet)	Inch-Miles	Infiltration Rate (gpd/inch-mile)	Infiltration (gpd)	Total Average Flow (gpd)	Total Average Flow (gpm)	Total Peak Flow (gpd)	Total Peak Flow (gpm)	
Existing	Flag Pond Road Development PS																	
		Park	16	2.5	50	2,000	1.4	4.4	8,800	8	1,730	2.6	1,000	2,621	4,621	3.2	11,421	7.9
		Charles	6	2.5	50	750	0.5	4.4	3,300	8	1,100	1.7	1,000	1,667	2,417	1.7	4,967	3.4
		Blueberry	5	2.5	50	625	0.4	4.5	2,813	8	200	0.3	1,000	303	928	0.6	3,116	2.2
		Dixie	4	2.5	50	500	0.3	4.5	2,250	8	200	0.3	1,000	303	803	0.6	2,553	1.8
		Boothby	7	2.5	50	875	0.6	4.4	3,850	8	960	1.5	1,000	1,455	2,330	1.6	5,305	3.7
		Virginia	12	2.5	50	1,500	1.0	4.4	6,600	8	1,930	2.9	1,000	2,924	4,424	3.1	9,524	6.6
		Lincoln	32	2.5	50	4,000	2.8	4.3	17,200	8	4,765	7.2	1,000	7,220	11,220	7.8	24,420	17.0
		Lebanon	2	2.5	50	250	0.2	4.5	1,125	8	300	0.5	1,000	455	705	0.5	1,580	1.1
		Flag Pond	25	2.5	50	3,125	2.2	4.3	13,438	8	6,765	10.3	1,000	10,250	13,375	9.3	23,688	16.4
		Ranwall	8	2.5	50	1,000	0.7	4.4	4,400	8	800	1.2	1,000	1,212	2,212	1.5	5,612	3.9
		Marguerite	7	2.5	50	875	0.6	4.4	3,850	8	610	0.9	1,000	924	1,799	1.2	4,774	3.3
		Flag Pond (beginning section)	11	2.5	50	1,375	1.0	4.4	6,050	8	880	1.3	1,000	1,333	2,708	1.9	7,383	5.1
	Subtotal	135			16,875	11.7		73,675		20,240			30,667	47,542	33.0	104,342	72.5	
1	Future Development (7,500 SF Lots) at 70% Area																	
		Potential development (Hearns Rd - PS required)	93	2.5	50	11,625	8.1	4.2	48,825	8	4,600	7.0	1,000	6,970	18,595	12.9	55,795	38.7
		FP1 (~1.40 mil SF)	131	2.5	50	16,378	11.4	4.1	67,151	8	1,500	2.3	1,000	2,273	18,651	13.0	69,423	48.2
		FP2 (~2.50 mil SF)	234	2.5	50	29,188	20.3	4.0	116,753	8	4,800	7.3	1,000	7,273	36,461	25.3	124,026	86.1
		FP3 (~9.27 mil SF)	883	2.5	50	110,388	76.7	3.6	397,397	12	13,500	30.7	1,000	30,682	141,070	98.0	428,079	297.3
		FP4 (~2.50 mil SF)	234	2.5	50	29,203	20.3	4.0	116,812	12	3,000	6.8	1,000	6,818	36,021	25.0	123,630	85.9
		FP5 (~1.31 mil SF)	122	2.5	50	15,285	10.6	4.1	62,668	12	1,600	3.6	1,000	3,636	18,921	13.1	66,304	46.0
		FP6 (~5.35 mil SF)*	250	2.5	50	31,239	21.7	4.0	124,955	12	7,200	16.4	1,000	16,364	47,603	33.1	141,319	98.1
		FP7 (~14.24 mil SF)*	664	2.5	50	83,021	57.7	3.7	307,177	12	19,800	45.0	1,000	45,000	128,021	88.9	352,177	244.6
		Subtotal (Future)	2,611			326,327	226.6		1,241,738		56,000			119,015	445,342	309.3	1,360,753	945.0
	* = FP6 and FP7 are not feasible for 7,500 SF lots sizing																	
	Total (Existing + Future)	2,746			343,202	238		1,315,413		76,240			149,682	492,884	342.3	1,465,094	1017.4	
2	Future Development (15,000 SF Lots) at 70% Area																	
		Potential development (Hearns Rd - PS required)	93	2.5	50	11,625	8.1	4.2	48,825	8	4,600	7.0	1,000	6,970	18,595	12.9	55,795	38.7
		FP1 (~1.38 mil SF)	66	2.5	50	8,189	5.7	4.2	34,394	8	1,500	2.3	1,000	2,273	10,462	7.3	36,667	25.5
		FP2 (~2.50 mil SF)	117	2.5	50	14,594	10.1	4.1	59,836	8	4,800	7.3	1,000	7,273	21,867	15.2	67,109	46.6
		FP3 (~9.27 mil SF)	442	2.5	50	55,194	38.3	3.8	209,737	12	13,500	30.7	1,000	30,682	85,876	59.6	240,419	167.0
		FP4 (~2.50 mil SF)	117	2.5	50	14,602	10.1	4.1	59,866	12	3,000	6.8	1,000	6,818	21,420	14.9	66,684	46.3
		FP5 (~1.31 mil SF)	61	2.5	50	7,642	5.3	4.2	32,098	12	1,600	3.6	1,000	3,636	11,279	7.8	35,734	24.8
		FP6 (~5.35 mil SF)	250	2.5	50	31,239	21.7	4.0	124,955	12	7,200	16.4	1,000	16,364	47,603	33.1	141,319	98.1
		FP7 (~14.24 mil SF)	664	2.5	50	83,021	57.7	3.7	307,177	12	19,800	45.0	1,000	45,000	128,021	88.9	352,177	244.6
		Subtotal (Future)	1,809			226,106	157.0		876,889		56,000			119,015	345,121	239.7	995,904	691.6
	Total (Existing + Future)	1,944			242,981	169		950,564		76,240			149,682	392,663	272.7	1,100,246	764.1	
3	Future Development (30,000 SF Lots) at 70% Area																	
		Potential development (Hearns Rd - PS required)	93	2.5	50	11,625	8.1	4.2	48,825	8	4,600	7.0	1,000	6,970	18,595	12.9	55,795	38.7
		FP1 (~1.38 mil SF)	33	2.5	50	4,095	2.8	4.3	17,607	8	1,500	2.3	1,000	2,273	6,367	4.4	19,879	13.8
		FP2 (~2.50 mil SF)	58	2.5	50	7,297	5.1	4.2	30,648	8	4,800	7.3	1,000	7,273	14,570	10.1	37,920	26.3
		FP3 (~9.27 mil SF)	221	2.5	50	27,597	19.2	4.0	110,388	12	13,500	30.7	1,000	30,682	58,279	40.5	141,070	98.0
		FP4 (~2.50 mil SF)	58	2.5	50	7,301	5.1	4.2	30,663	12	3,000	6.8	1,000	6,818	14,119	9.8	37,481	26.0
		FP5 (~1.31 mil SF)	31	2.5	50	3,821	2.7	4.3	16,431	12	1,600	3.6	1,000	3,636	7,458	5.2	20,067	13.9
		FP6 (~5.35 mil SF)	125	2.5	50	15,619	10.8	4.1	64,040	12	7,200	16.4	1,000	16,364	31,983	22.2	80,403	55.8
		FP7 (~14.24 mil SF)	332	2.5	50	41,510	28.8	3.9	161,890	12	19,800	45.0	1,000	45,000	86,510	60.1	206,890	143.7
		Subtotal (Future)	951			118,865	82.5		480,492		56,000			119,015	237,881	165.2	599,507	416.3
	Total (Existing + Future)	1,086			135,740	94		554,167		76,240			149,682	285,422	198.2	703,849	488.8	

■ = 7,500 SF lot size not feasible, utilize 15,000 SF lot size house count

**Table 6
Water Demand Summary**

Area	# of houses			Average Day Demand (gal)			Maximum Day Demand (gal)		
	7,500 SF Lots	15,000 SF Lots	30,000 SF Lots	7,500 SF Lots	15,000 SF Lots	30,000 SF Lots	7,500 SF Lots	15,000 SF Lots	30,000 SF Lots
Jenkins Road									
JK1	305	152	76	38,070	19,035	9,518	87,562	43,781	21,890
JK2	347	173	87	43,364	21,682	10,841	99,738	49,869	24,935
JK3	1,205	603	301	150,626	75,313	37,656	346,439	173,220	86,610
W. Side Village	100	100	100	12,500	12,500	12,500	28,750	28,750	28,750
Jenkins Subtotal	1,956	1,028	564	244,560	128,530	70,515	562,489	295,619	162,185
New County Road									
Existing	19	19	19	2,375	2,375	2,375	5,463	5,463	5,463
NC1*	105	105	53	13,129	13,129	6,564	30,196	30,196	15,098
NC2*	510	510	255	63,693	63,693	31,846	146,494	146,494	73,247
Precious HV Ests.	90	90	90	11,250	11,250	11,250	25,875	25,875	25,875
New County Subtotal	724	724	416	90,447	90,447	52,036	208,028	208,028	119,683
Buxton Road									
Existing	138	138	138	17,250	17,250	17,250	39,675	39,675	39,675
BX1	249	124	62	31,112	15,556	7,778	71,558	35,779	17,890
BX2	439	219	110	54,814	27,407	13,703	126,072	63,036	31,518
BX3	392	196	98	49,054	24,527	12,264	112,825	56,412	28,206
BX4	295	148	74	36,896	18,448	9,224	84,861	42,430	21,215
BX5	117	58	29	14,615	7,307	3,654	33,613	16,807	8,403
Buxton Subtotal	1,630	884	511	203,741	110,495	63,873	468,604	254,140	146,907
Flag Pond Road									
Existing	135	135	135	16,875	16,875	16,875	38,813	38,813	38,813
Hearns Rd	93	93	93	11,625	11,625	11,625	26,738	26,738	26,738
FP1	131	66	33	16,378	8,189	4,095	37,670	18,835	9,417
FP2	234	117	58	29,188	14,594	7,297	67,133	33,567	16,783
FP3	883	442	221	110,388	55,194	27,597	253,893	126,946	63,473
FP4	234	117	58	29,203	14,602	7,301	67,167	33,583	16,792
FP5	122	61	31	15,285	7,642	3,821	35,155	17,577	8,789
High Service Zone Subtotal	1,832	1,030	629	228,942	128,721	78,611	526,567	296,059	180,804
FP6*^	250	250	125	31,239	31,239	15,619	71,849	71,849	35,925
FP7*^	664	664	332	83,021	83,021	41,510	190,948	190,948	95,474
Flag Pond Subtotal	2,746	1,944	1,086	343,202	242,981	135,740	789,364	558,856	312,203
Grand Total (w/o FP6 & 7)	6,142	3,666	2,120	767,690	458,194	265,034	1,765,688	1,053,845	609,579

* = Proposed Areas shall only consider 15,000 SF lot size or larger. Small 7,500 SF lot size not feasible.

█ = House counts impacted by above scenario

^ = Flag Pond Road Areas FP6 and FP7 are not included in new High Service Zone.

Insert – Figure 11

approximately 4,600 linear feet to a point before the Big Ledge Brook crossing. The same low system hydraulic grade line (210-feet) as the existing system can service the high point elevation and water flow/pressure requirement in this expansion area.

Buxton Road Area

The Buxton Road Area has an existing water main which extends from the east side of the highway, under the highway and along Buxton Road where it ends just before the Sandy Brook crossing. The limits of this existing water system exists with the City streets of this future expansion areas, so no mainline water mains are required. However, the water model determined that the existing water pressure at the westernmost point is close to the maximum day plus fire flow limit. Any expansion along this Buxton Road corridor would increase water demand and require more flow. As a result, a new booster station will be required to deliver the additional demands at satisfactory pressure. In anticipation of this requirement, Maine Water has already provided a 12-inch service and valving off the 24-inch main along Pine Street presenting an ideal location for the booster station. Concurrent with the booster station implementation, a new control valve will be required on the existing 24-inch main prior to crossing under the highway, to isolate the high and low service zones. The existing pressure in the low service area would not be able to accept the high service zone as pressure would exceed the residential limits of 80 psi.

The new booster station was sized using the three lot size/house count scenarios. A 650 gpm, 400 gpm and 250 gpm pump was determined for the 7,500, 15,000 and 30,000 SF lots size respectively. The booster station will operate at 90-feet of total dynamic head (TDH) in each case.

Jenkins Road Area

The Jenkins Road Area has a short stretch of 12-inch water main extending northerly up Jenkins Road from Buxton Road. The recommended 16-inch water main (or 12-inch if only 30,000 SF lots are used) would connect to this 12-inch main and extend northerly approximately 8,000 linear feet to the Cascade Brook crossing. Similarly to Buxton Road, future expansion areas would require the need for a booster station and inclusion within the high service system.

The West Side Village development project, mentioned in the sewer discussion above, is currently under design to build approximately 100 homes off Jenkins Road adjacent to a parcel along the highway. Maine Water is working with them to coordinate extension of the water main to their development in conjunction with this memorandum. The existing water system will be able to service this development without the need for the booster station.

Flag Pond Road Area

The Flag Pond Road Area includes an existing 8-inch water main which extends westerly from Route 1 and ends just before the highway. The recommended 16-inch water main (12-inch if only 30,000 SF lots are used) would connect to this 8-inch water main, cross underneath the highway and continue westerly to Lincoln Road for approximately 8,300 linear feet. Further, the water main will branch off southerly on Jenkins Road for approximately 4,500 linear feet and connect to the future water main at the Cascade Brook crossing. The connection of these two streets will tie the existing low pressure system on the east side of the highway to the new high

pressure system on the west side. A second control valve will be required on Flag Pond Road, near the highway. This PRV, along with the Buxton Road PRV will create the pressure isolation of these two systems.

Another major infrastructure improvement recommended during the Flag Pond Road Area future development is an elevated water storage tank. Maine Water has acquired a piece of land off Flag Pond Road east of the Jenkins Road intersection for the tank. The purpose will be to provide a high service level for the entire expansion area, reduce the booster station run time and plan for future water main extension to existing residents along Lincoln Road. This road reaches a high point approximately 5,100 linear feet northwesterly from Flag Pond Road. The active storage size will vary depending on the lot size/house count scenario. For planning purposes, the active storage sizing is based herein on 25% of the maximum day demand plus needed fire flow. The 7,500 SF lot size will result in a minimum tank size of 475,000 gallons, the 15,000 SF lot size will result in 300,000 gallons, and the 30,000 SF lot size will result in 190,000 gallons. In each case the approximate overflow height of the tank should be 125 feet above ground surface elevation (approximately 291 feet elevation).

Planning Level Costs

The sewer and water expansion program includes providing a planning level cost estimate for both sewer and water infrastructure. The most conservative pipe sizing (7,500 SF lots) was used when determining costs. The planning level costs are divided by expansion area and infrastructure improvement type. Present day costs (February 2016 dollars) are used for all planning level estimates. The gravity sewer and force main costs were determined using recent New England bid results per linear foot. Included in the linear footage number are manholes, service connections, gravel, full width reclaim, final pavement, miscellaneous work, policing, mobilization and a small rock removal allowance. Also, a 25% construction contingency and a 25% engineering and implementation allowance are factored into the totals. The preparation of final design plans will provide more information on site-specific conditions and can impact these figures. Factors to consider include increased rock removal, wetland issues, endangered species, brook crossings, etc. Further, costs for land acquisition, rights-of-way, legal fees, although many of the sewer and water improvements are on City streets, were not included in the costs. Tables 7 and 8 display the linear foot cost for gravity sewer and force main used prior to adding engineering and contingency.

Table 7

Sewer Mains Costs			
Diameter	Depth		
	0-12	12-16	16+
8	\$240	\$265	\$315
10	\$250	\$270	\$320
12	\$270	\$290	\$350
15	\$280	\$310	\$435

Table 8

Force Main Costs	
Diameter	Cost
4	\$140
6	\$145
8	\$150

The cost for sewer pump stations can vary depending on many factors such as the size of the station, pumps, standby generator, building (if necessary), etc. The pump stations included in each expansion area are assumed to be submersible stations and shall carry the same cost for each location. An average cost of submersible pump station bids in New England was determined. The same construction contingency and engineering/implementation allowance were included which totaled \$500,000 per pump station.

The Flag Pond Road sewer and water expansion area will require a highway crossing underneath the Maine Turnpike (Route 95). The means and methods of the sewer and water main installation crossing have not been determined, but it is assumed that a trenchless technology, such as horizontal directional drilling, will be used to avoid impacting traffic on the highway. A typical cost for implementing this trenchless technology is \$600 per foot. Assuming the crossing is approximately 400-linear feet, plus construction contingency and engineering/implementation allowance, the planning level estimate was \$360,000.

The following Table 9 presents a summary of the sewer lengths by depth range and diameter for each area, and Table 10 presents a summary of the sewer expansion costs for the areas discussed within this memorandum.

Table 9

Sewer Main Lengths (FT)					
Area	Depth (FT)	Sewer Diameter (inch)			Total
		8	10	12	
New County	<12	3,000			3,300
	12-16	300			
	>16				
Buxton Rd	<12	1,000			5,830
	12-16	1,000	830		
	>16	1,000	2,000		
Jenkins Rd	<12	1,190		3,490	9,420
	12-16	570		900	
	>16	570		2,700	
Flag Pond	<12	7,620		3,995	20,240
	12-16	5,275		300	
	>16	2,080		970	
Total		23,605	2,830	12,355	38,790

Table 10

Area	Sewer Expansion Cost Summary				Planning Level Cost Estimate
	Gravity (\$)	Force Main (\$)	PS (\$)	Tpk Crossing (\$)	
Jenkins Road (Fig. 6-9)	\$4,150,000	\$420,000	\$500,000	\$0	\$5,070,000
New County Road (Fig. 4)	\$120,000	\$520,000	\$500,000	\$0	\$1,140,000
Buxton Road (Fig. 5)	\$2,460,000	\$0	\$100,000	\$0	\$2,560,000
Flag Pond Road (Fig. 10)	\$8,090,000	\$330,000	\$500,000	\$360,000	\$9,280,000
Totals	\$14,820,000	\$1,270,000	\$1,600,000	\$360,000	\$18,050,000

Note: Jenkins Road preferred Alternative B included.

The water expansion planning level costs include water mains, a booster station and an elevated water storage tank. The 12-inch and 16-inch DI water main costs (assuming the more conservative 7,500 & 15,000 SF lot size) were prepared using recent New England bid results.

Similarly, a booster station and elevated water storage tank project, assuming the more conservative sizing based on 7,500 SF lot size, was bid recently with comparable design conditions. The 25% construction contingency and 25% engineering and implementation factors are included in the planning level cost. The following Table 11 presents a summary of the water expansion costs for the four areas discussed within this memorandum.

Table 11

Area	Water Expansion Cost Summary			Planning Level Cost Estimate
	Main (\$)	PS (\$)	Tank (\$)	
Jenkins Road	\$1,700,000	\$0	\$0	\$1,700,000
New County Road	\$900,000	\$0	\$0	\$900,000
Buxton Road	\$0	\$1,700,000	\$0	\$1,700,000
Flag Pond Road	\$2,400,000	\$0	\$4,400,000	\$6,800,000
Totals	\$5,000,000	\$1,700,000	\$4,400,000	\$11,100,000

Needs Evaluation

The scope of work intended for a task to conduct a needs evaluation for rating each development area and provide a ranking. The ranking would provide a road map for sensible expansion of utilities on the west side of the Maine Turnpike. However, the focus of this study transitioned to just four areas and their implementation, while also providing the City of Saco and Maine Water with a planning document to present to future developers as to how sewer and water infrastructure would expanded to service their developments.

Implementation Plan

The implementation of the sewer and water expansion should be done in a phased manner with some consideration for the expansion areas. The future development projects will help dictate where and when each phase of the expansion should begin. Below is a summary of the future development areas and associated phasing for both sewer and water:

New County Road

The sewer and water expansion in this area can proceed independently from the other three areas. The sewer expansion will include gravity sewer and a pump station, which shall connect to a force main stub provided by a private developer to pass underneath the Maine Turnpike and into an existing gravity sewer on the east side of the highway. The City is currently coordinating the design of this stub with the private developer. Further, the lot sizes should be limited to a minimum of 15,000 square feet. Smaller lot sizes (7,500 SF) will increase house counts and sewer flows, which will be larger than what the highway crossing sewer and downstream system can handle.

The water expansion will draw from the existing main on New County Road, west of the highway. The water service will remain on the current hydraulic grade line provided by the existing booster station in Biddeford.

Buxton Road

The sewer expansion in this area can proceed when a future development area is ready. The developer will have to coordinate with the City to determine if the projected flow to the Buxton pump station warrants an upgrade. As mentioned above, the Buxton Road pump station has future built out space for larger pumps to satisfy future flows.

The existing water network extends through the Buxton Road Area. However, design conditions (maximum day demand plus fire flow) are reaching their limits with the existing system. Any future development in this area may require the construction of the new booster station on Pine Street near the Buxton Road intersection.

Jenkins Road

A portion of the sewer expansion in this area is currently under design in coordination with a private developer (West Side Village). The remaining sewer expansion can proceed as the development projects arise, including a new pump station near the midpoint on Jenkins Road.

Similar to the sewer expansion, a portion of the water expansion is currently under design with the same private developer. It is not expected that the new booster station will be needed for this project. However, any future development projects will need to plan for installation of the booster station along with a new water main on Jenkins Road.

Flag Pond Road

The sewer expansion in this area will require extensive construction of new sewer main, a pump station and trenchless highway crossing. However, the sewer expansion can be done independently of the other three areas.

The water expansion in this area will require construction of water mains to both Jenkins Road and Flag Pond Road, east of the highway. This work cannot be completed until the Jenkins Road water expansion is constructed first. Once in place, the Flag Pond expansion will create a loop in the water system and provide a second point to separate the high and low service zones. The other important infrastructure improvement to this area is the elevated water storage tank near the Flag Pond Road/Jenkins Road intersection. The tank will need to be constructed prior to

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development areas becoming active to create available water storage and minimize booster station operation.

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