Engineering Feasibility Report
Water Supply Improvements
Bow Junction & Bow Mills

Town of Bow, NH

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Project Number 324345

Prepared for:

Town of Bow, NH
10 Grandview Road
Bow, NH 03304

Prepared by:

DuBois & King, Inc.
831 Union Ave
Laconia, NH 03249
Nicholas Sceggell, P.E.

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Chapter 1 - Background and Project Planning

The Town of Bow, New Hampshire (Town) is exploring the feasibility and costs of addressing methyl tertiary-butyl ether (MtBE) contamination at public water systems on the north end of Town. MtBE is a gasoline additive, and its occurrence in groundwater is often associated with leaking underground gasoline storage tanks. It is understood that MtBE was originally detected some years ago in the northern portion of the Town of Bow, in an area known locally as "Bow Junction". Two water systems, Grappone Honda and Pitco Frialator, in this area have historically utilized point-of-entry water treatment systems to treat drinking water and remove MtBE. A second area in the northern portion of Bow, known as "Bow Mills", has an MtBE treatment system at the Bow Mobil gas station as a result of contamination in that location. A map that identifies the project area in the northern portion of Bow, and the general location of these (and other) existing water supplies is shown in Appendix A.

In an effort to advance this project, the Town has met with a representative from the New Hampshire Drinking Water and MtBE Settlement Fund. This fund was established under RSA 485-F, and is intended to provide for the protection, preservation, and enhancement of the drinking water and groundwater resources of the state. The Town is interested in exploring the feasibility and costs of extending the existing limits of the municipal water distribution system to provide potable water to the area of MtBE contamination.

Following completion and submission of an application, the Town received funding from the MtBE Settlement Fund to prepare this feasibility study to identify and explore alternatives for providing municipal water system to Bow Junction and Bow Mills. The study includes a review of the areas to be served by the municipal water system, including projections of water use over a 20-year planning period. Alternatives and options for providing water service to these areas are briefly summarized as follows:

1. Extending the existing Town of Bow municipal water system with alternative piping routes.
2. Extension and inter-connection with the City of Concord's water system, which currently terminates just to the north of the areas of contamination.
3. Developing a second (new) municipal community water source and distribution system in proximity to the area of contamination.

Overview of MtBE Contamination at Public Water Systems Within the Project Area

Following construction of the Grappone Honda building in 2004 (Tax Map 16-1 Lot 57), routine water quality compliance monitoring was conducted on the on-site bedrock water supply well, which was also drilled in 2004. The results of the monitoring signified that the MtBE levels did not meet the Drinking Water Quality standards set by NH Department of Environmental Services (NHDES). Multiple properties abutting the Grappone Honda site are either an active or inactive registered underground storage tank site (UST), or closed ETHER projects. A map of the remediation sites and Public Water Systems (PWS) within the project area can be found in

Appendix A. A feasibility study conducted in 2006 concluded that the nearby Exxon retail fuel station, currently the 7-Elevan store, and the Irving retail fuel station, were likely the primary sources for MtBE in the drinking water. A point-of-entry water treatment system has since been installed.

Based on documents found on NHDES database (OneStop), MtBE has also been detected in the Pitco Frialator property supply well since 2000. In 2005, Pitco Frialator was directed to prepare a Feasibility Study to evaluate long-term solutions that would address the MtBE contamination. Pitco Frialator was initially reimbursed a total of $52,432.84 for the installation of the point-of-entry treatment system, but has not been reimbursed for any work after February 2009, according to OneStop.

Since around 1967, the Bow Mobil site on South Street has been operated as a gas station. According to files on OneStop, roughly 300 gallons of gasoline leaked from an on-site UST in August 1983. However, no remediation was done at that time because the USTs were supposedly to be replaced sometime soon thereafter. Based on groundwater samples collected in a May 1991 site assessment, MtBE and other groundwater contaminants were observed.

Table 1-1 below summarizes the MtBE Settlement Fund reimbursement amounts for the Bow Mobil, Pitco Frialator, and Grappone Honda Dealership found on the NHDES OneStop website. The majority of these reimbursements were for annual preventative maintenance on the point-of-entry treatment systems, sampling, lab analysis, and report summaries.

Table 1-1 Fund Reimbursement amounts for Bow Mobil and Grappone Honda Building

Fund Reimbursement Amount	**Bow Mobil Gas Station #10571 Site No. 1994102011**	**Grappone Honda Dealership Site No. 200304047**	**Pitco Frialator Site No. 199105025**
2007	$19,690.39	$0.00	$47,432.84
2008	$20,365.80	$5,541.16	
2009	$13,479.18	$3,742.48	$5,000.00
2010	$6,880.64	$719.00	
2011	$14,129.18	$2,484.77	
2012	$20,485.62	$7,210.30	
2013	$5,470.28	$2,582.95	
2014	$9,131.91	$4,905.27*	
2015	$5,314.84	$8,141.82	
2016	$6,887.12	$1,543.42	
2017	$8,776.48	$3,177.89	
2018	$5,107.75	$9,271.40	
Total	$135,719.19	$49,320.46	$52,432.84
Average per year	$11,309.93	$4,110.04	$13,108.21**

*Value from Reimbursement Request, no notice of reimbursement available.
** Pitco data available for 2006-2009, annual average based on 4 years.

Environmental Resources

The Turkey River and Bow Bog Brook both flow through the proposed project area. The Turkey River first enters the project area when crossing South Street and then again when crossing Route 3A. Bow Bog Brook is encountered when crossing Interstate 93 behind the Grappone and Pitco Frialator sites. Two other miscellaneous perennial streams cross on Dow Road, Route 3A near Eastview Drive, and on Grandview Drive near Ridgewood Drive. Two wetland maps of the project area printed from OneStop can be found in Appendix A of this report. These environmental resources will need to be considered with any of the proposed water main routing options, and measures to protect these resources would be incorporated into the design and construction of the selected alternative.

Population Trends

In 2000, the population of Bow was 7,138 according to US Census, NH Office of Energy and Planning. The population in Bow as of July 2018 is 7,938 with roughly 2,961 total housing units, according to NH Home Town Locator. The Town of Bow population census trends are summarized below in Table 1-2:

Table 1-2 Town of Bow Population Trends

Year	Population	% Change	Land Area (sq. mi)	Pop. Density (per sq. mi)
1990	5,500	-	28.03	196
2000	7,138	29.8%	-	255
2010	7,519	5.3%	-	268
2018	7,938	5.6%	-	283

Current and Future Water Demands

A memorandum titled "City of Concord Water Supply and Water Demands for Bow Junction and South Street" prepared by the Bow Drinking Water Protection Committee in January of 2018, provides an analysis and summary of estimated current water demands within the project area. A copy of the memo can be found in Appendix B of this report. In summary, the estimated water demand was estimated at 10,000 gpd for the Bow Junction Area and at 50,000 gpd for the South Street area. It is noted that these estimates are conservative. However, the potential for ongoing development of these areas could result in significant variability in future domestic demands. Based on a memo from the Town of Bow Fire Department, a minimum fire flow of 1,500 gpm for two hours, or a total volume of 180,000 gallons should be considered for fire protection requirements for potential new development within the Bow Mills Mixed Use District.

This memorandum also makes the following summary statement: "Future water demands for the Bow Junction area are not expected to change significantly as the area is built out with established industry. The South Street area is projected to grow such that water needs in that corridor will likely increase in the future." The extent of future growth in the South Street area was not established in the memorandum, is considered highly variable, and therefore, is difficult to

predict. Therefore, for purposes of evaluating alternatives for bringing municipal water service to the project area, the demands established in the memorandum will be utilized. Prior to actually implementing a selected alternative, the potential for future growth should be revisited.

Chapter 2 - Existing Facilities

This chapter describes the existing municipal water system infrastructure that currently serves the Town of Bow. The Town operates several "public water systems" including the municipal system. Other public water systems are smaller systems at the offices and buildings owned by the Town. The smaller systems typically consist of a well source and a pressure tank to serve small populations and demands. The focus of this report is on the municipal water system (PWS ID 0261010) which is being considered for an extension to serve the contaminated locations in the northern portion of the Town, as identified in the previous chapter.

Water Supply Source and Treatment

The existing municipal water supply source is comprised of two gravel packed wells, located in close proximity to each other and approximately 800 feet north of the River Road Pump Station/treatment plant building. The pump station/treatment building is located off of River Road, behind several large commercial buildings. Each well contains a submersible turbine pump with 30 HP motor and capability to deliver approximately 700 gpm of water to the treatment plant building.

Well No. 1 is an 18 x 24-inch gravel packed well, approximately 131-feet below ground surface (bgs). A 12-foot long 90-slot screen well screen was installed from 118 to 130-feet. Well No. 2 is a 12 x 18-inch gravel packed well, approximately 133.5-feet bgs. A 4-foot long 125-slot screen and a 10-foot long 85-slot screen (total of 14.5 feet) well screen was installed from 119 to 133.5-feet bgs. Well details are included in Table 2-1. Raw water pumps are capable of pumping up to 700 gallons per minute (GPM) from the wells into the treatment plant.

Table 2-1 River Road Well Details

Description	Well No. 1	Well No. 2
Final Grade at Well Head El.	266.75'	266.75'
Top of Well Head El.	272.25'	272.25'
Discharge El.	261.0'	261.0'
Static Water Level El.	200.0'	200.0'
Low Water level Cut-off El.	163.0'	163.0"
Pressure Transducer El.	158.0'	158.0'
Bottom of Pump Intake Screen El.	153.0'	153.0'
Top of Well Screen El.	148.0'	148.0'
Bottom of Well El.	136.00'	133.5'

Figure 2-1 Existing gravel packed wells.

An aeration system provides pretreatment of the raw water. Aeration is provided to remove trace volatile organics that may be present in the groundwater supplies, to remove naturally occurring radon, and to strip/remove carbon dioxide which is corrosive to piping and plumbing materials. Aeration occurs through a process called deep bubble air stripping in which fine bubbles are injected into the water stream within a tank. Dissolved radon and carbon dioxide are volatized through aeration, and discharged into the atmosphere through a screened vent. The fine bubbles are created by a blower that pumps air through diffuser pipes in the aeration tank.

Figure 2-2 Treatment plant building for the Town of Bow's water source.

Calcium Hypochlorite is injected into the raw water prior to aeration to disinfect and kill bacteria. Potassium hydroxide is injected into the finished water to adjust pH for corrosion control. The finished water is stored in a clear well at the treatment plant on River Road. It is pumped into the distribution system by finished water pumps, and fills an atmospheric storage tank. The wells and treatment plant have a design capacity of one million gallons per day. The plant currently operates as needed to fill the atmospheric storage tank. The well pumps are paced to match flow rates of the finished water pumps. Monthly pumping totals for 2018 were provided by the system operator and are presented in Table 2-2.

Table 2-2 Pumping Totals for 2018

Month	Monthly Totals	Daily Totals
January	969,800	31,284
February	948,400	33,871
March	627,000	20,226
April	984,300	32,810
May	1,319,700	42,571
June	1,129,200	37,640
July	1,326,400	42,787
August	1,412,400	45,561
September	1,121,100	37,370
October	1,384,300	44,655
November	920,800	30,693
December	861,400	27,787

Recently, the Town of Bow has identified water quality concerns with iron and manganese levels in their wells. The Town is in the process of investigating these water quality issues and developing a strategy to address the problem.

Distribution and Storage

Finished water pumps have a design capacity of 700 GPM at 201 feet of total dynamic head (TDH). The pumps are operated on a variable frequency drive (VFD) that reduces the operating pumping rate, and the pumps are typically run at 400 GPM. The treatment plant and finished water pumps are at approximate elevation 262' above sea level (ASL).

The atmospheric storage tank located at a high point between Route 3A and Interstate 93, is a pre-stressed wire wound concrete tank. The tank has a storage capacity of one million gallons. The base of the tank is at approximate elevation 415' ASL, and the tank operates with a water level between 15 and 18-feet above the base of the tank (operating elevations range from 430' to 433' ASL).

Figure 2-3 Existing atmospheric storage tank

The existing distribution system consists of 12-inch diameter ductile iron water mains, and smaller diameter water service pipes to individual customers. Fire hydrants are spread throughout the distribution system along the mains. The system is located in the southeastern General Industrial and Business Development zoning districts along Route 3A between Vaughn Road and River Road, along Dunklee Road, and along River Road between Vaughn Road and Thibeault Road with approximately five miles of water mains. The service area elevations range from approximately 205' to 320' ASL, and static pressures range from approximately 48 to 100 pounds per square inch (PSI). Figure 2-4 provides an aerial layout of the existing water distribution components. Figure 2-5 provides a simplified schematic diagram of the existing municipal water system.

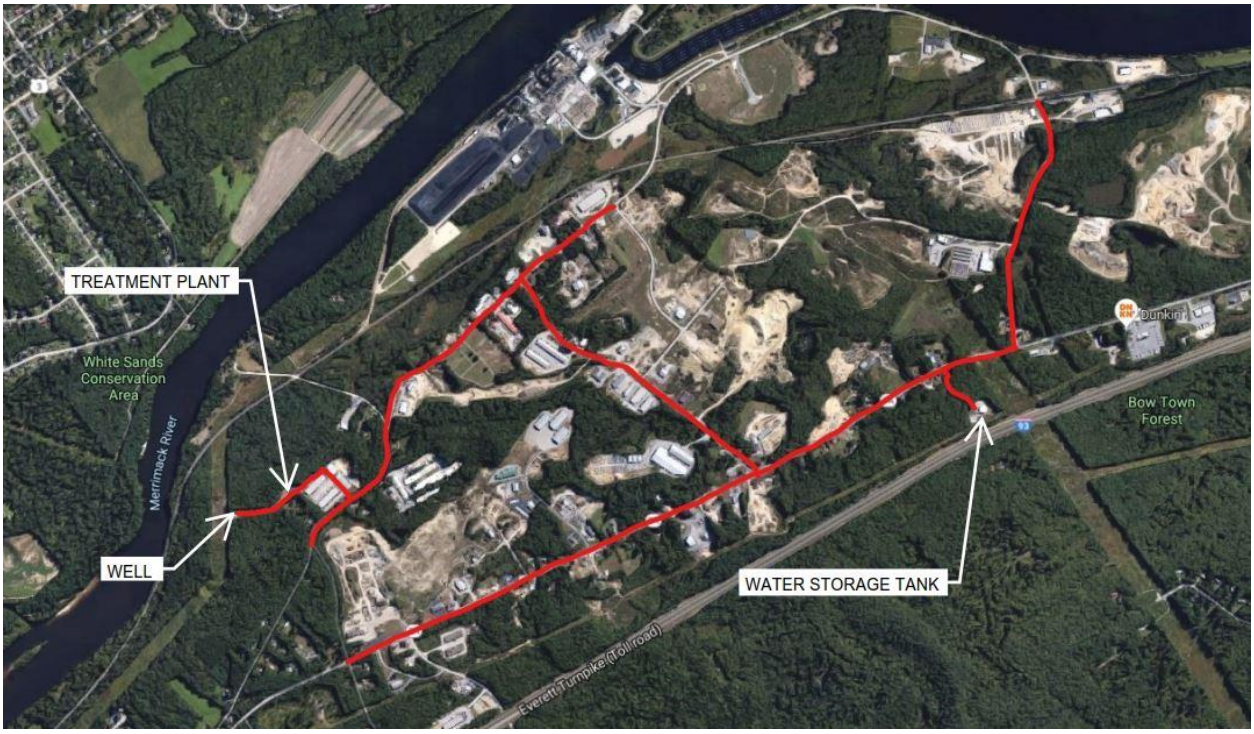


Figure 2-4 Aerial View of the existing water distribution system.

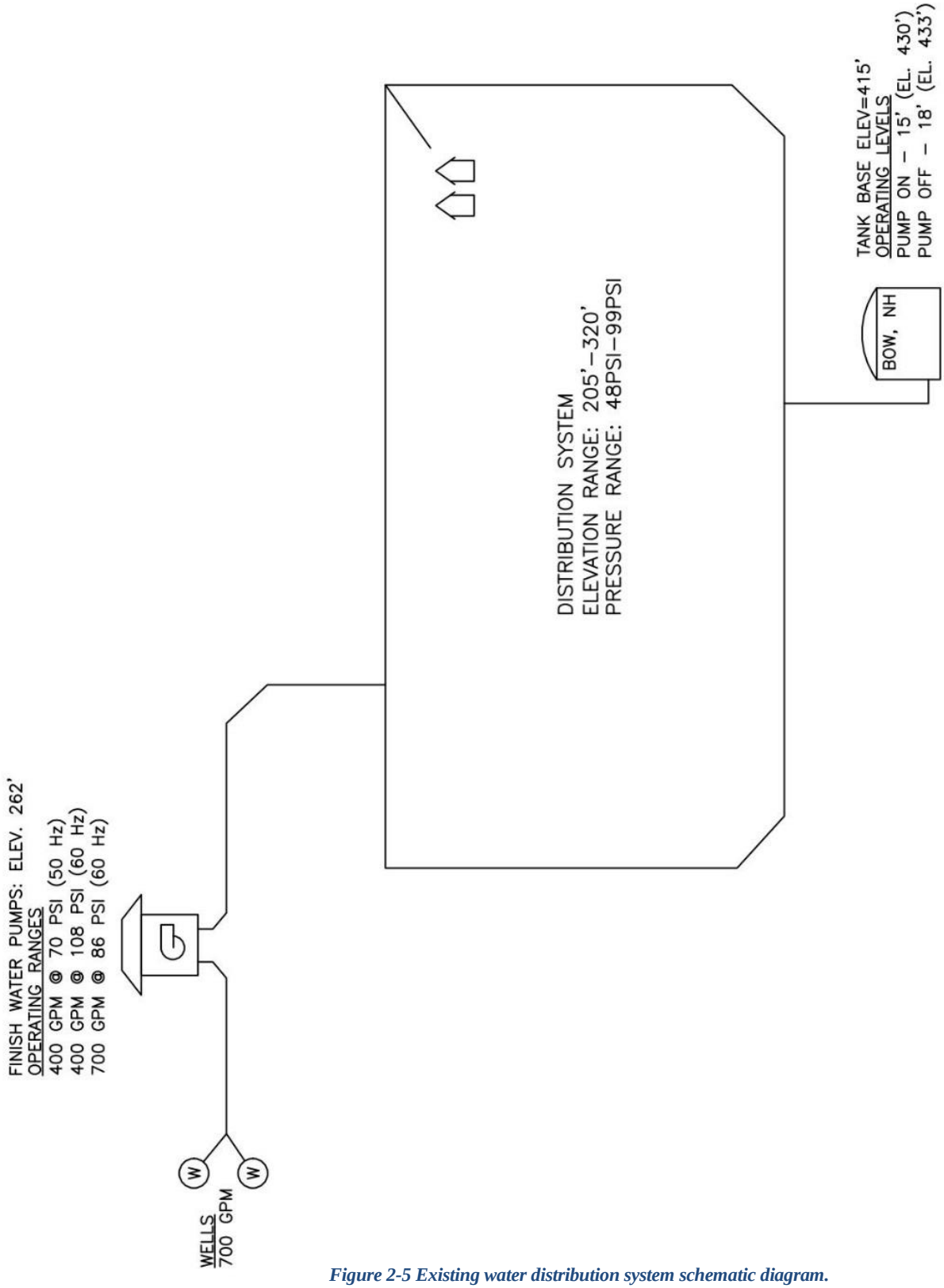


Figure 2-5 Existing water distribution system schematic diagram.

Chapter 3 - Need for Project

The purpose of this report is to explore the feasibility and costs of extending the existing limits of the municipal water distribution system to provide potable water to a portion of the Town that has experienced MtBE contamination. However, when considering the need for the project, additional investigations on water quality were completed to inform decision-makers about the water which is currently available at these locations.

Public Water Systems (PWS)

The Town of Bow has 38 active regulated public water systems (PWS) within the corporate limits of the Town, according to a review of OneStop. Eight of these systems are directly managed by the Town or School District. Table 3-1 lists all the public water systems, active and inactive. It is beyond the scope of this study to investigate deficiencies with all of the public water systems within the Town of Bow. This study focuses on the systems currently impacted by MtBE contamination, systems nearby known MtBE contamination sites that may be impacted in the future, and systems located along the proposed alternative routes from the existing municipal water system to the contaminated areas. Appendix A identifies the locations of existing municipally owned and privately owned PWS's within the project area.

Table 3-1 Bow Public Water Systems

PWS_ID	**SYSTEM_NAME**
0261010	BOW MUNICIPAL WATER SYSTEM
0262010	EVERGREEN DRIVE WATER
0262020	ABENAKI WATER/WHITE ROCK WATER
0262030	BELA BROOK WATER
0262040	COTTAGES AT WINDCHIMES
0262050	PEU/WHITE ROCK SENIOR LIVING
0262060	PEU/STONE SLED FARM
0265010	BOW MEMORIAL SCHOOL
0265020	BOW ELEMENTARY SCHOOL
0265030	BOW HIGH SCHOOL
0265040	JOYFUL NOISE PRESCH
0265050	BOW YOUTH CENTER
0265060	MEETING HOUSE MONTESSORI
0266010	GSP/MERRIMACK STATION
0266020	BOVIE SCREEN PROCESS PRINTING
0266050	GRAPPONE FORD COMPLEX
0266070	KELLER PRODUCTS
0266090	PITCO FRIALATOR

0266110	BOW TECHNOLOGIES CENTER
0266120	GRAPPONE COLLISION CENTER
0266130	RUGGLES III OFFICE BLDG
0266140	NH AUTO DEALERS ASSN
0266150	CONCORD GROUP
0266160	Z TECH CORPORATION
0266170	COMMUNITY BRIDGES BLDG
0266180	GRANITE ST GYMNASTICS CENTER
0266190	LORACO PLAZA
0266200	GRAPPONE TOYOTA
0266210	CONCORD GROUP /NH CLAIMS DIV
0266220	501 SOUTH STREET
0266230	RIVER ROAD BUSINESS BAY
0266240	GRAPPONE HONDA
0268020	ALLTOWN
0268030	CHEN YANG LI RESTAURANT
0268040	BOW IRVING
0268110	BIRCHWOOD BAR AND GRILL
0268120	HAMPTON INN
0268130	BOW MOBIL
0268140	FIELDHOUSE SPORTS
0269010	BOW MUNICIPAL BUILDING
0269020	BOW COMMUNITY BUILDING
0269030	BOW MILLS UNITED METHODIST CHR
0269040	JOYFUL NOISE LEARNING CENTER
0269050	SARA LEE COFFEE AND TEA
0269060	BAKER FREE LIBRARY
0269070	PUBLIC WORKS DEPT
0269080	OLD TOWN HALL
0269090	514 SOUTH ST

Known Contamination

Three sites are known to have MtBE contamination in the project area as discussed previously: Grappone Honda, Pitco Frialator, and Bow Mobil Station. Table 3-2 below lists the remediation sites found in the project area using information collected from the NHDES OneStop database. These sites represent a variety of potential contamination sources to public drinking water.

Table 3-2 Remediation Sites in the Project Area

	Site Number	System Name	Description	Open Or Closed
1	199208022	Exxon Div. Of Cfi 70100	Leaking Underground Storage tank (LUST)	C
2	198708008	Former Graphic Packaging International	Former incinerator system	O
3	198406024	Hall Street Study	Groundwater contamination	C
4	200006023	Bow Junction Circle K	8 spills and LUST	C
5	200304047	Grappone Honda Dealership	MtBE Settlement Fund Project	C
6	200304047	Formerly Grappone Honda	Spill, ETHER	C
7	199702005	Grappone Ford Complex	ETHER contaminated site, site investigation	C
8	199105025	Pitco Frialator Inc.	Spill, ETHER, oil spills, site assessment	C
9	199702005	Grappone Ford Complex	ETHER	
10	199703048	Grappone Toyota And Truck Center	Spill, ETHER, Underground Injection Control	C
11	199706012	Concord Group - Claims	Hazwaste project	C
12	199010019	Bovie Screen Printers	Site assessment, injection control	C
13	199102011	Mobil 10571	Injection control, 2 spills, LUST	O, C
14	201511018	Paint Thinner Release	Spill	C
15	199412011	Jerrys Auto Clinic	Injection control	C
16	201610204	Truck Accident Diesel Fuel Release	Oil spills	C
17	201409014	Roadside Spill	Oil spills	C
18	199403016	G & N Realty (Hansen & Fox Site)	LUST	C
19	200302028	Ruggles III Office Building	Underground injection control	O- Registration
20	199606010	Superior Coffee	Underground injection control	O- Registration
21	198400062	Associated Minerals	Unlined wastewater lagoon	C
22	200308089	Z-Tech LLC	Underground injection control	O- Registration

Public Health

From a public health perspective, several public water systems, each managed and operated independently, is considered more challenging to operate and maintain when compared to a single municipally managed system. Since there are multiple water sources, there are varying levels of operator technical expertise, and in general more opportunity for contamination. The Bow Mills and Grappone Junction service areas are fairly congested, and it would be difficult to provide a new source that is adequate for the projected need. Table 3-3 outlines the sanitary protective radius requirements for various water supply source production rates according to NH Administrative Rule Env-Dw 302.10. The daily flow rates required for this service area were previously summarized in the project planning section of this report. The protective radii for wells serving Bow Mills (50,000 gallons per day) and Grappone Junction (10,000 gallons per day) would be 200

and 150 feet, respectively, or 250 feet if the service areas were combined (60,000 gallons per day). Identifying and siting a new water supply source within the service area that meets the protective radius requirement nearby the contaminated systems is considered non-feasible given the extent of existing development and known contamination areas.

Table 3-3 Sanitary Protective Radius Requirements for Water Sources

Permitted Production Volume (gallons in a 24-hour period)	Radius (feet)
less than 14,400	150
14,401 to 28,800	175
28,801 to 57,599	200
57,600 to 86,400	250
86,401 to 115,200	300
115,201 to 144,000	350
greater than 144,000	400

The Bow Drinking Water Committee (BDWC) prepared a memorandum dated May 14, 2018 which outlines additional water quality issues in the Bow Mills, or Bow South Street area. A copy of the memorandum is included in Appendix B of this report. In summary, five of the ten public water systems in the service area are currently being tested for and provide treatment for naturally occurring arsenic and radionuclides. While the remaining five do not currently test for these contaminants, it is reasonable to believe that similar water quality exists for the untested systems as those that test. Further review of historical data with NHDES identified additional violations and treatment for the South Street area. Table 3-4 is included at the end of this chapter which provides updated information for these systems.

A similar review was conducted for the Bow Junction water systems to outline additional water quality issues in that location. The review identified several contaminants which are being treated for, including MtBE, Arsenic, Radionuclides, Chloride, Radon, Hardness, and Lead and Copper corrosion. It was also noted that each of the systems has at least one violation on file with NHDES, and most have several violations noted. The violations range from water quality standard exceedances to reporting violations. The number of violations is indicative of the struggle for small public water systems to maintain compliance with Safe Drinking Water Rules. The results of the review are summarized in the Table 3-5.

System resiliency and/or reliability can also be considered a public health impact. Smaller PWS like those in Bow, rely on pressure systems that will not operate without electricity. Because most of these smaller systems do not have standby backup generators, they are not able to provide water during a power outage. By comparison, the existing municipal water system operates from atmospheric storage and if necessary emergency backup power at the treatment plant. The municipal system continues to serve customers during power outages. The number of violations is also an indication of the difficulty that small systems can have with compliance, especially without full-time dedicated water operators.

Table 3-4 Bow Mills South St Water Quality Summary

Bow Junction Public Water Supply Summary Updated July 2019							
PSW #	**Type**	**Name**	**Address**	**Pop. Served**	**Known Raw WQ Issues**	**Treatment**	**Violation Notices**
0266020	NTNC	Bovie Screen	4 Northeast Ave	32	As	POU Arsenic	62
0266140	NTNC	NH Auto Dealers	507 South St	104	Fe, As, U, Rn	Cation/Anion Xch, Aeration	14
0266150	NTNC	Concord Group	504 South St	64	As & Rn	Greensand, Arsenic Adsorption, Aeration	17
0266220	NTNC	501 South St	501 South St	25	As & U	POU Arsenic/Uranium	23
0268030	TNC	Chen Yang Li Restaurant	520 South St	300	Not tested		32
0268120	TNC	Hampton Inn	515 South St	228	Not tested	Cation Softener, Chlorination	22
0268130	TNC	Bow Mobil	519 South St	500	MtBE	Activated Carbon / UV	25
0269030	TNC	Bow Mills United Methodist	505 South St	120	Not tested		6
0269060	TNC	Baker Free Library	509 South St	60	Not tested		3
0269090	TNC	Med. Offices	514 South St	30	Not tested		10

Table 3-5 Bow Junction Water Quality Summary

Bow Junction Public Water Supply Summary Updated July 2019							
PSW #	**Type**	**Name**	**Address**	**Pop. Served**	**Known Raw WQ Issues**	**Treatment**	**Violation Notices**
0268040	TNC	Bow Irving	500 Route 3A	900	Hardness	POE Softener	1
0266050	NTNC	Grappone Ford Complex	516 Route 3A	100	Hardness, Chloride, Lead-Copper Corrosion	5 POU Softener + RO (one for each drinking water location).	7
0266240	NTNC	Grappone Honda	519 Route 3A	100	As, MtBE, Chloride, Radon	POE Softener, GAC, Aeration, Calcite + POU-RO	11
0266090	NTNC	Pitco Frialator	552/523 Route 3A	326	As, MtBE, Radionuclides	POE Cation / Anion Exchange, Arsenic Adsorption, GAC, Aeration, Chlorination	18
0266200	NTNC	Grappone Toyota	594 Route 3A	119	Phthalate, Uranium, Chloride, Lead-Copper Corrosion	POE Softener, Chlorination + 3 POU Softener, RO, Calcite, UV Disinfection	28

Chapter 4 - Identify Alternatives

DuBois & King (D&K) and the Town identified four alternatives to supply drinking water to the contaminated water systems in the northern portions of Bow. These alternatives are briefly summarized as follows:

- Alternatives 1 and 2 would extend water from the existing municipal distribution system's northern end at the intersection of Vaughn Road and Route 3A. The difference between these alternatives is the water main route that is associated with each.
- Alternative 3 would provide municipal water service from the City of Concord (City) system, through a connection to the existing water system on South Street and South Main Street/Route 3A.
- Alternative 4 would be a new municipal water supply source and distribution system that serves the project area. For the purpose of this study, the new well for Alternative 4 would be located adjacent to the Town Offices and would require an atmospheric storage tank.

Area maps displaying the routes for each alternative can be found in Appendix C. Each alternative is further defined below.

Alternative 1

This alternative includes extending the existing Bow municipal water system north along NH Route 3A and Grandview Drive. The water main would continue north along Carriage Road and back to Route 3A in the Grappone/Bow Junction area. It would continue north along Route 3A to serve water systems at Pitco Frialator and Grappone car dealerships, then west towards Bow Mills to serve Bow Mobil. Several other small public water systems would be connected along the route.

D&K met with officials from NHDOT District 5 which is responsible for permitting utilities in the right of way. NHDOT right of way requirements include maintaining the water line approximately five to ten feet off from the edge of existing pavement. There may be some areas where this distance is reduced because of physical obstructions, but working within the travel lanes needs to be avoided. The existing waterline is located along the western edge of the right of way on Route 3A. D&K reviewed drawings depicting a future sanitary sewer collection system along this same alignment. Consideration of design separation requirements of ten feet for water and sewer mains and avoiding existing gas mains along the eastern side of the roadway may impact the final alignment selection within the right of way.

Once the alignment enters Grandview Road, there are fewer restrictions in the right of way. An existing gas main runs along the eastern edge, and a conceptual sewer alignment has been developed, but not yet constructed. It is likely that the water alignment will impact one of the travel lanes during construction. Carriage Road has a conceptual sewer alignment (again, not yet constructed) and an existing gas main, which will need to be considered when establishing a final water main alignment.

As the water main alignment re-enters the Route 3A corridor, the water main must cross the Turkey River. An alignment for the proposed water main that is similar to the existing sewer gravity pipe and force main upstream of the culvert under Route 3A has been identified. The eastern edge of the right of way is very congested in this area with railroad tracks running parallel with the roadway. After crossing the Turkey River, the sewer also crosses Route 3A and runs along the eastern edge of the roadway. A gas main occupies the western edge. To avoid impacts to the travel way, one alternative could include occupying an easement along the Grappone Dealership frontage on Route 3A. To minimize environmental impacts, the Turkey River Crossing is expected to utilize horizontal directional drilling (HDD). HDD could also be incorporated into the work along the Grappone easement to minimize impacts during construction.

Figure 4-1 Turkey River Crossing on Route 3A.

In order to serve customers, including the Bow Mobil, in the Bow Mills area, the water main alignment would continue west under Interstate 93. The most direct route would utilize an easement between Pitco Frialator and the Grappone Ford dealership; implementing HDD under Interstate 93. Two options have been identified in order to reach South Street after crossing the interstate. Option A would utilize the existing New England Telephone and Telegraph Company Easement located on Tax Map 11 Lot 42. Option B would utilize a proposed 20-foot-wide easement from Tax Map 11 Lot 43-A until it reached Northeast Avenue. After reaching South Street, both options would continue south towards the Bow Mobil and terminate at Bow Mobil.

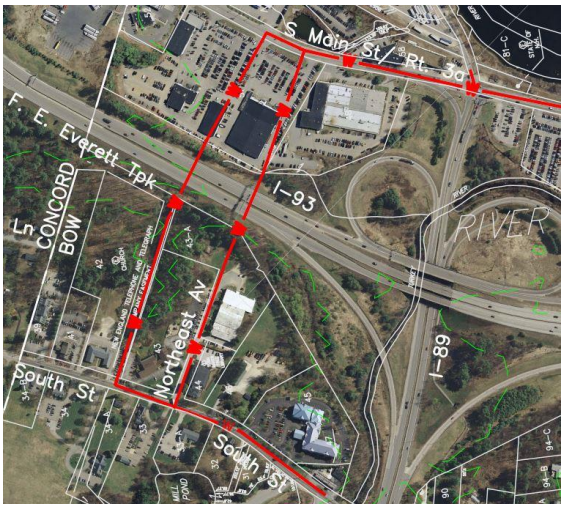


Figure 4-2 Alternate 1 Easement options A and B.

Alternative 2

This alternative includes extending the existing Bow municipal water system north along NH Route 3A and Grandview Drive similar to Alternative 1. The water main would continue west on Grandview Drive beyond the intersection at Carriage Road. Grandview Road passes over Interstate 93 via a bridge, and the water main would either need to be hung from the existing bridge or HDD under the Interstate 93. The alignment would continue on Grandview Road passing

the Town offices and heading towards the intersection with South Street. The alignment would turn north onto South Street towards the Bow Mobil, and would continue down South Street until it turned east to cross the interstate to service the Grappone Junction area.

The alignment constraints with regards to proposed sewer and existing gas utility alignments are identical to Alternative 1 up until the Grandview Drive Bridge crossing over Interstate 93. The Interstate 93 crossing at Grandview Drive has two options, to HDD the pipe under the highway or an above ground crossing hung from the bridge. Figure 4-4 & Figure 4-5 for each option can be found at the end of this section.

As the water continues north onto South Street, prior to reaching the Mobil station, the water main alignment must cross under Interstate 89 and the Turkey River. The water main will need to be installed via HDD under the river. To pass under Interstate 89, the water main can either be installed in a typical trench or HDD if necessary. Both options have their advantages and disadvantages. Using a typical excavated trench is more cost effective, but is more invasive and would need more significant traffic control measures. HDD can be costly, but would not require any excavation under the bridge and minimizes lane closures.

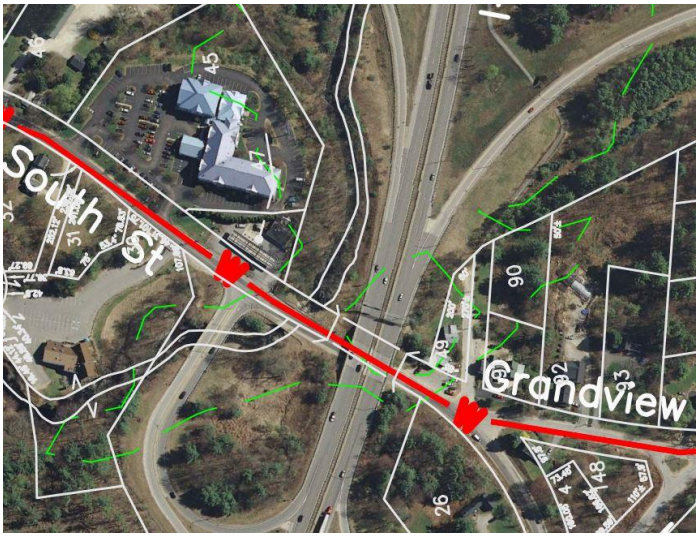


Figure 4-3 Alternative 2 Crossing under Interstate 89 and the Turkey River.

Like Alternative 1, in order to serve both the Bow Mobil site and Grappone/Pitco sites with Alternative 2, the waterline must cross Interstate 93 between the two areas. The same approach as previously identified for Alternative 1 was utilized for Alternative 2, utilizing either the NET&T easement or Northeast Drive, directionally drilling under Interstate 93, and Grappone/Pitco Frialator property.

Alternative 3

In this alternative the water main would connect to and extend the City of Concord water system that is understood to terminate just north of the Bow Junction and Bow Mills areas. Alternative 3 would connect on South Street and head toward Bow Mobil, and would terminate before having to cross the Turkey River. In order to serve both the Bow Mills area and Grappone area, there would also be a connection to the City water system on South Main Street/Route 3A. An additional option for Alternative 3 would be to connect to the City water system on Hall Street and continue to the intersection at Route 3. This would allow the water system to have a closed loop and increase the number of potential connections and the hydraulic performance of the extension.

A memorandum for the City of Concord Water Supply and water demands for Bow Junction and South Street was prepared by the Bow Drinking Water Protection Committee in January of 2018. A copy of the memo can be found in the appendix. In summary, Penacook Lake is the primary source of water for the City of Concord with a sustainable yield estimated at 2.5 million gallons per day (MGD). During periods of drought, the Penacook River is pumped into the lake by the pumping station that has a capacity of 7.2 MGD. The city also has an additional well field with a sustainable yield of 1 MGD. Therefore, the total supply source for the City is 9.7 MGD with a backup source of 1 MGD. The average daily demand for the City was 4.7 MGD in 2003, and the demand for the year 2030 was estimated to be 6 MGD average, 7.6 MGD peak day. As previously discussed, the estimated water demand is 10,000 gpd (0.01MGD) for the Bow Junction area and 50,000 gpd (0.05 MGD) for South Street. Based on these water use projections from the Bow service area (0.06 MGD), the City water system has sufficient capacity to service the Bow Junction and South Street services areas with very little impact on the available reserve capacity.

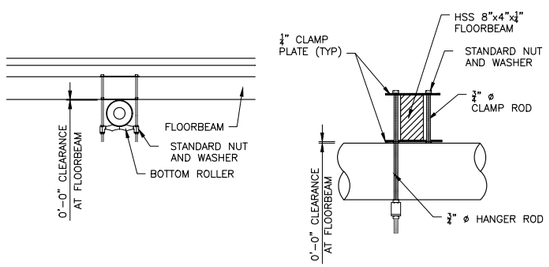
An initial inquiry was made with City representatives during the course of this study, to discuss the potential feasibility of this alternative. Unfortunately, the City is not ready to discuss this approach to providing water to the service area in Bow. Therefore, a detailed analysis of this alternative has not been included. However, from a conceptual standpoint this alternative appears feasible based on system elevations and projected water demands. From a constructability and initial construction cost perspective, this alternative would also appear to be the most favorable, when compared with the other alternatives considered herein. Obviously, the cost to purchase water from the City, which has not been established at this time, would be a large factor in the overall cost of this alternative. Considerable additional discussions and planning would need to occur between the City and Bow, in order to be able to fully identify the capital and operational costs of this alternative.

Alternative 4

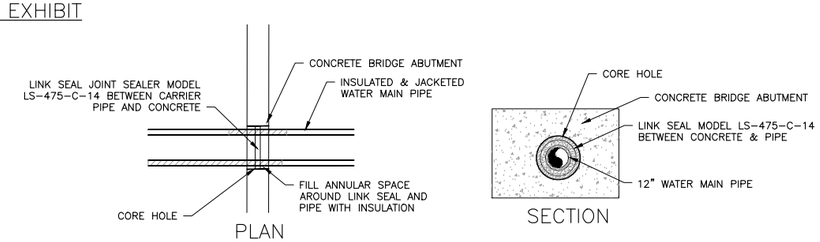
For this alternative, the existing water system that serves the Bow Town Office, which is located on Grandview Drive, would be expanded for the Bow Mills and Grappone service area. It is anticipated that a new well (or several wells) will need to be developed that can meet the demands of the area. This alternative would also require an atmospheric storage tank to provide storage and pressure to meet the water demands of the service area. After leaving the Town Office property, the water main would follow the same alignment as Alternative 2; north under Interstate 89 and the Turkey River, past the Bow Mobil station, and east under Interstate 93 in order to serve Grappone Junction. Identifying the potential for developing a new water supply source (one or more drilled wells) in the vicinity of the Town Office is beyond the scope of this study, but could be better defined following further hydrogeologic investigations.

Maps for each alternative are included in Appendix C of this report.

GRANDVIEW ROAD BRIDGE ABOVE GROUND CROSSING EXHIBIT



HANGER DETAIL



CONCRETE ABUTMENT PENETRATION DETAIL

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TEL: (603) 637-1043
FAX: (866) 783-7101
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PROFESSIONAL SEAL

NOT FOR CONSTRUCTION PRELIMINARY PLANS

NO.	DATE	DESCRIPTION	BY	CK'D

BOW, NH

BOW WATER SYSTEM IMPROVEMENTS

SHEET TITLE

GRANDVIEW BRIDGE CROSSING EXHIBIT

DRAWN BY	DATE
TMG	MAY 2019
CHECKED BY	D&K PROJECT #
	324345
PROJ. ENG.	D&K ARCHIVE #
NJS	

SHEET NUMBER

Figure 4-4

SHEET 1 OF 1

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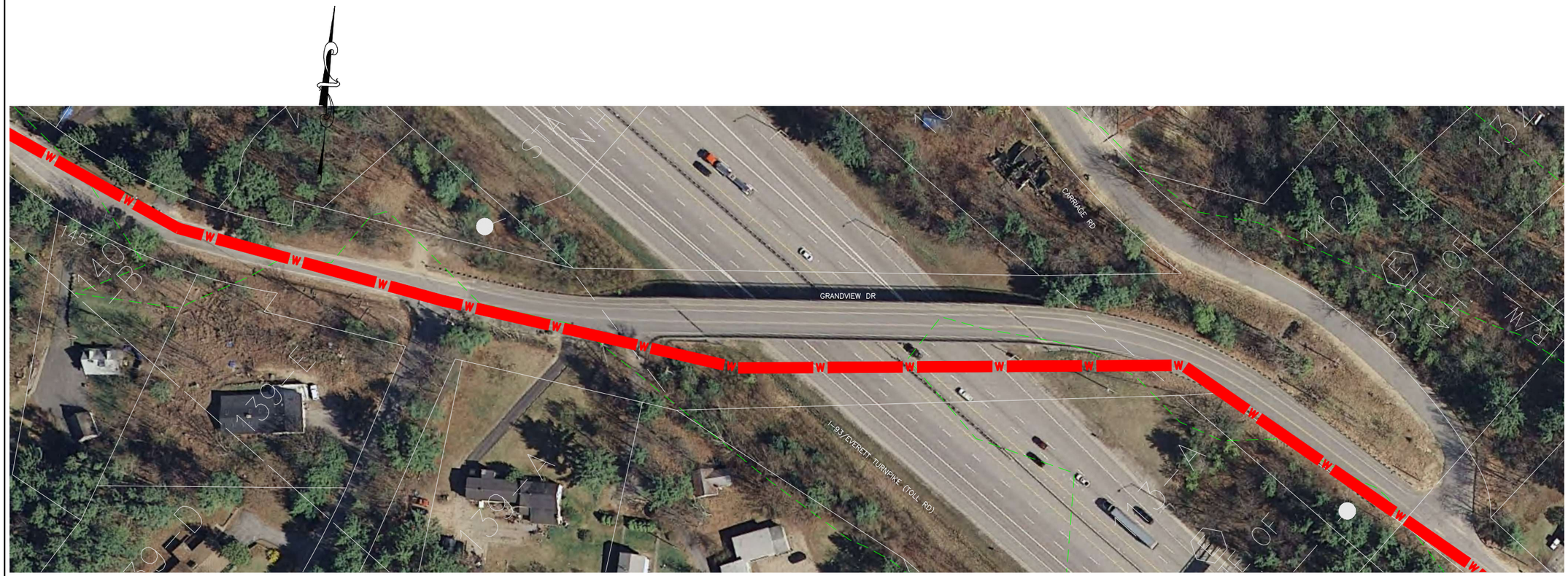
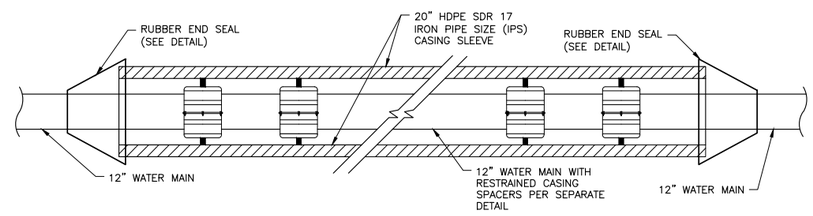


GRANDVIEW ROAD BRIDGE HDD CROSSING EXHIBIT



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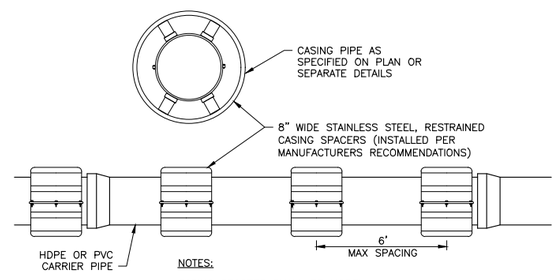
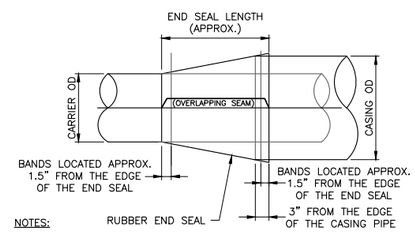


NOTES:

CASING SPACERS SHALL BE MODEL CCS AS MANUFACTURED BY CASCADE WATERWORKS MFG. CO. OF YORKVILLE, IL OR EQUAL.

CASING SPACER DETAIL

NOT TO SCALE



NOTES:

RUBBER END SEALS SHALL BE A PULL-OVER TYPE CONSTRUCTION AND MADE FROM NEOPRENE WITH T-304 STAINLESS STEEL BANDS FOR SECURING THE ENDS OF THE END SEAL TO THE CASING PIPE AND CARRIER PIPE. CASING SPACER END SEALS SHALL BE MODEL CCES AS MANUFACTURED BY CASCADE WATERWORKS MFG. CO. OF YORKVILLE, IL OR APPROVED EQUAL.

CASCADE MODEL CCES END SEALS

PULL OVER THE CASING AND CARRIER PIPES AFTER INSTALLATION TO PROVIDE A BARRIER TO BACKFILL DEBRIS AND SEEPAGE.

RUBBER END SEALS DETAIL

NOT TO SCALE

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BEDFORD, NH 03110
TEL: (603) 637-1043
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PROFESSIONAL SEAL

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NO.	DATE	DESCRIPTION	BY	CK'D

BOW, NH

BOW WATER SYSTEM IMPROVEMENTS

SHEET TITLE

GRANDVIEW BRIDGE CROSSING EXHIBIT

DRAWN BY	DATE
TMG	MAY 2019
CHECKED BY	D&K PROJECT #
	324345
PROJ. ENG.	D&K ARCHIVE #
NJS	

SHEET NUMBER

Figure 4-5

SHEET 1 OF 1

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Chapter 5 – Feasibility Level Evaluation of Alternatives

In order to identify and evaluate the hydraulic characteristics of the water main extension alternatives developed in the previous chapter, contour information available from existing mapping resources was utilized to establish approximate ground elevations along the water main routes. The extension alternatives were incorporated into the existing computerized hydraulic model that the Town has previously prepared. The adjusted computer model was then utilized to assess operating pressures under "average" water use conditions and "worst case" conditions.

Alternatives 1 and 2 would either need a booster pump station or a water storage tank in order to maintain a required minimum pressure of 35 psi within the distribution system. Through discussions with the Town's Drinking Water Committee and staff, an elevated water storage tank was identified as the preferred means to meet pressure requirements rather than a booster pump station and corresponding pressurized zone. Further investigation and hydraulic modelling determined that a proposed elevated storage tank could be filled with water from the treatment plant and that the existing finished water pumps have capacity to meet the elevation requirements. An estimated storage tank elevation of 470 feet was incorporated into the existing hydraulic model to verify the effect on system pressures. An altitude valve would need to be incorporated into the existing distribution system to avoid over-filling the existing tank.

Two potential water storage tank locations were identified based on the elevation requirement and undeveloped land nearby the proposed alignments. The estimated size for both of the tank location options was based from the existing water storage tank located on Tax Map 40 Lot 200-C described previously in this report. Both options would need an easement of approximately 68,000 square-feet, and a 30-foot-wide right of way for an access drive. Proposed Water Storage Tank Location A is located on the State of New Hampshire property as shown in Figure 5-1. An easement from Tax Map 26 Lot 53 would be necessary, along with horizontal directional drilling (HDD) to get across Interstate 93. In order to access the site, a 15-foot-wide (minimum) access road with a 30-foot-wide right of way off of Heather Lane would be needed on the State of NH Property. Proposed Water Storage Tank Location B would be located on Dow Road on Tax Map 26 Lot 51-A as shown in figure 5-2. Dow Road currently crosses under Interstate 93, and the water line to the Tank B location would do the same. An easement from the property owner on Lot 51-A would be necessary for the storage tank and access road.

The hydraulic model was also used to assess "water age" and to identify in a preliminary manner, if there is a potential need for a disinfection (chlorine) booster station to be included in the project to supplement chlorine residuals within the area of water main extensions. The results of the modelling showed that the existing system has potential "water age" issues. The model indicated that there would be some potential reduction in water age by adding more customers and use to the system, but until the demand within the existing distribution network increases, there will continue to be "water age" related operational requirements which may include wasting water to improve system turnover.

Alternatives 1 and 2 were compared in terms of environmental impacts, land requirements, potential construction problems, sustainability considerations (water and energy efficiency, green

infrastructure, and any other aspect of sustainability), potential number of new connections, and costs. The two alternatives that extended the existing municipal system had similar impacts and requirements. Alternative 3 appears to have the least environmental impact and no land requirements because all of the work is within public rights of way. The full extent of environmental impacts and land requirements for Alternative 4 have not been determined as the number and location of new water supply sources have not been determined. A new well source will require land for the protective radius. As previously noted, further study of Alternative 4 is necessary to identify the full extent of impacts.

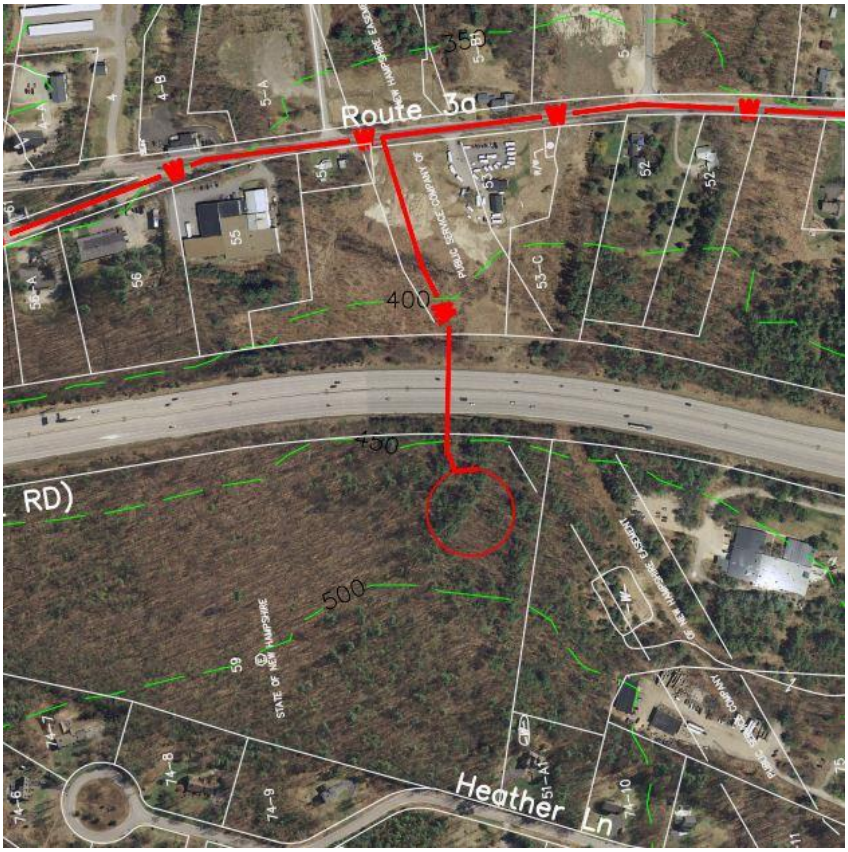

Figure 5-1 Water Storage Tank Option A located on the State of NH property.

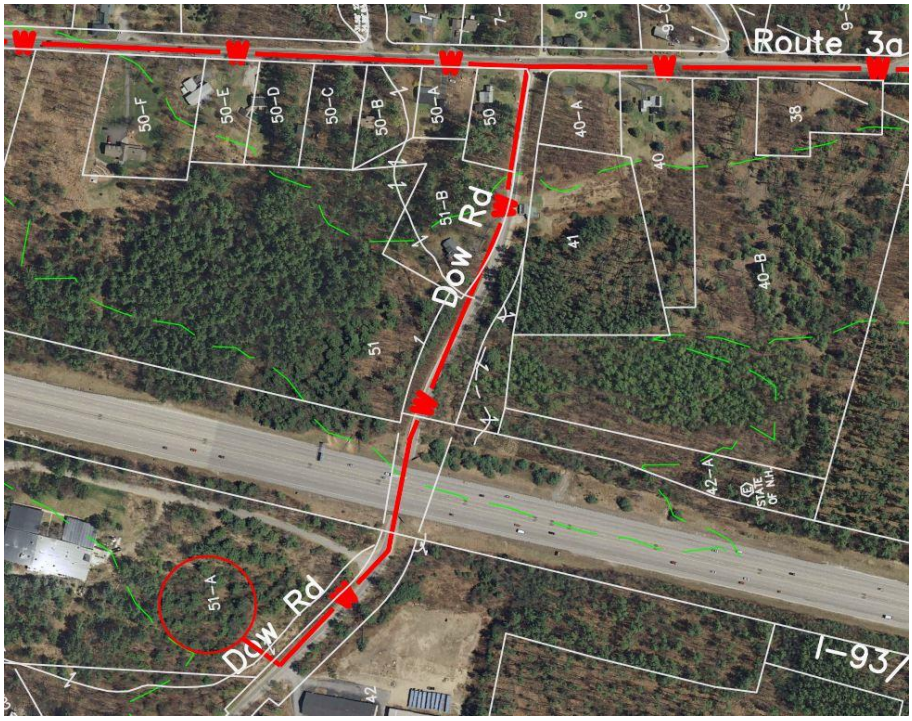

Figure 5-2 Water Storage Tank Option B located on Tax Map 26 Lot 51-A.

Chapter 6 - Selection of a Preferred Alternative

The most promising water system extension alternative was vetted in a systematic manner in terms of life cycle cost analysis over a 20-year planning period, maximizing new customers, and non-monetary factors. Table 6-1 summarizes the number of potential connections and estimates of land acquisition required for each alternative. These values are considered preliminary and are based on the water main routing of each alternative alignment and the number of lots the water main passes.

Table 6-1 Potential Connections for each Alternative.

Alternative	Potential Number of New Connections	Land Requirements	Land Requirements Notes
Alternative 1	85	22,400 SF – 116,804 SF	Dependent on what option is selected for the water tank or pump station and interstate 93 crossing at Grappone.
Alternative 2	95	22,400 SF – 116,804 SF	Dependent on what option is selected for the water tank or pump station and interstate 93 crossing at Grappone.
Alternative 3	42	None	No easements are necessary because all work is within the right-of-way.
Alternative 4	31	22,400 SF – 116,804 SF	Dependent on location of new water source and tank and interstate 93 crossing at Grappone.

The opinion of probable costs for all four alternatives are provided in Appendix D. The capital costs for each alternative were combined with estimated annual operation and maintenance costs to develop a present worth comparison of the alternatives. The results are summarized in Table 6-2 below.

Table 6-2 Life Cycle Cost Analysis Summary

Alternative	Notes	Project Capital Cost	Annual O&M Cost	Net Present Worth
Alternative 1	Extension of existing Bow water system. From Rt. 3A to Grandview and back to Rt. 3A.	$6,508,400 - $7,549,400	$40,000	$7,572,513
Alternative 2	Extension of existing Bow water system. From Rt. 3A to Grandview to South St.	$6,671,550 - $7,996,550	$40,000	$7,877,663
Alternative 3	Extension of existing Concord water system on Rt. 3A, South St, and Hall St.	$2,334,375	$161,600*	$4,530,572
Alternative 4	Create new Bow North municipal PWS, expanding the existing Town Office PWS	$4,102,450- $4,523,950	$75,000	$5,332,474

*O&M Costs for Alt. 3 include shared revenue paid to City of Concord, it does not include the cost to purchase water from Concord.

A comparison of the Net Present Worth for each alternative identifies Alternative 3 as the most cost effective option for providing reliable drinking water to the systems impacted by MtBE contamination, as well as other public water systems impacted by poor water quality in the Bow Mills and Bow Junction areas of Town. Based on an economic comparison of alternatives, Alternative 3 would be the recommended alternative. However, when considering other factors beyond economics, it appears that Alternative 3 is not a feasible option due to the current political climate. Therefore, Alternative 4, the creation of a new community municipal system for the northern portion of Bow, is the second preferred alternative.

Chapter 7 - Proposed Project (Recommended Alternative)

The concept for pursuing development of a separate municipal water system specific for the Bow Mills and Grappone Junction service areas (i.e., Alternative 4) was developed as a result of a presentation of the first three alternatives to the Bow Drinking Water Protection Committee. During the presentation, a discussion on the significant length of water main which is required to extend water from the existing municipal system took place. The Town suggested that a fourth alternative be considered which would eliminate a significant portion of the transmission main. This alternative did not eliminate the need for a storage tank, but it does reduce the elevation requirements of the atmospheric storage because the distribution system does not have to traverse a high point at the intersection of Grandview and 3A, which dictates the storage elevation for Alternatives 1 and 2. The proposed service area elevations range from 225 to 350 feet ASL. The atmospheric storage tank would need to operate at approximately elevation 435 feet ASL. A preliminary review of elevation information indicates that land may be available adjacent to the Town office parcel which would meet the elevation requirement for the tank.

As previously noted, the potential for developing a new water supply source (presumably one or more drilled wells) in the vicinity of the Town Office is beyond the scope of this study. If the Town wants to purse Alternative 4, a hydrogeologic study would be necessary to further establish the feasibility of this alternative. A hydrogeologic study would likely include assembling as much information as possible regarding existing groundwater sources and water quality in vicinity of the Town Office. Other sources of information prior to siting a test well include a field reconnaissance survey, surficial geologic mapping, and a fracture-trace analysis. The objective of collecting this geophysical information is to lead to a more informed selection of test drilling sites. An allowance for the cost of developing a new water supply source has been provided for in this alternative, which could be further refined at the conclusion of a hydrogeologic study.

The proposed demand for this alternative is approximately 60,000 gpd, according to the previously developed water demand of the service area. A storage tank which provides at least one day's supply in addition to providing storage for fire flows, would be on the magnitude of 250,000 gallons. The distribution system would consist of 12" water mains to allow for future growth and provide capacity for fire flows. Approximately 6,000 feet of new water main is required to serve all three facilities that are impacted by MtBE contamination. The water main passes by several residences and businesses which are anticipated to connect to the system. Approximately 31 new customers would be expected based on the parcels abutting the proposed alignment.

At this preliminary stage of developing this alternative, the estimated total project cost to implement Alternative 4 is expected to range between $3.9 to $4.3 million. These costs do not include land acquisition costs.

Appendix A

EXISTING CONDITIONS

REMEDIATION SITES		
	SITE NUMBER	SYSTEM NAME
1	199208022	EXXON DIV OF CFI 70100
2	198708008	FORMER GRAPHIC PACKAGING INTERNATIONAL
3	198406024	HALL STREET STUDY
4	200006023	BOW JUNCTION CIRCLE K
5	200304047	GRAPPONE HONDA DEALERSHIP
6	200304047	FORMERLY GRAPPONE HONDA
7	199702005	GRAPPONE FORD COMPLEX
8	199105025	PITCO FRIALATOR INC
9	199702005	GRAPPONE FORD COMPLEX
10	199703048	GRAPPONE TOYOTA AND TRUCK CENTER
11	199706012	CONCORD GROUP - CLAIMS
12	199010019	BOVIE SCREEN PRINTERS
13	199102011	MOBIL 10571
14	201511018	PAINT THINNER RELEASE
15	199412011	JERRYS AUTO CLINIC
16	201610204	TRUCK ACCIDENT DIESEL FUEL RELEASE
17	201409014	ROADSIDE SPILL
18	199403016	G & N REALTY (HANSEN & FOX SITE)
19	200302028	RUGGLES III OFFICE BUILDING
20	199606010	SUPERIOR COFFEE
21	198400062	ASSOCIATED MINERALS
22	200308089	Z-TECH LLC

PUBLIC WATER SUPPLY WELLS		
	PSW ID	SYSTEM NAME
1	266050	GRAPONNE FORD COMPLEX
2	0266240	GRAPPONE HONDA
3	0266090	PITCO FRIALATOR
4	0266200	GRAPPONE TOYOTA
5	0266220	501 SOUTH STREET
6	0269030	BOW MILLS UNITED METHODIST CHR
7	0266140	NH AUTO DEALERS ASSN
8	0266020	BOVIE SCREEN PROCESS PRINTING
9	0266150	CONCORD GROUP
10	0269090	514 SOUTH ST
11	0269060	BAKER FREE LIBRARY
12	0268120	HAMPTON INN
13	0268130	BOW MOBIL
14	0268030	CHEN YANG LI RESTAURANT
15	0269010	BOW MUNICIPAL BUILDING
16	0266130	RUGGLES III OFFICE BLDG

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NO.	DATE	DESCRIPTION	BY	CK'D

BOW, NH

BOW WATER SYSTEM IMPROVEMENTS

SHEET TITLE

EXISTING CONDITIONS

DRAWN BY	DATE
TMG	APR 2018
CHECKED BY	D&K PROJECT # 324345
PROJ. ENG. NJS	D&K ARCHIVE #

SHEET NUMBER

EX1

SHEET 1 OF 1

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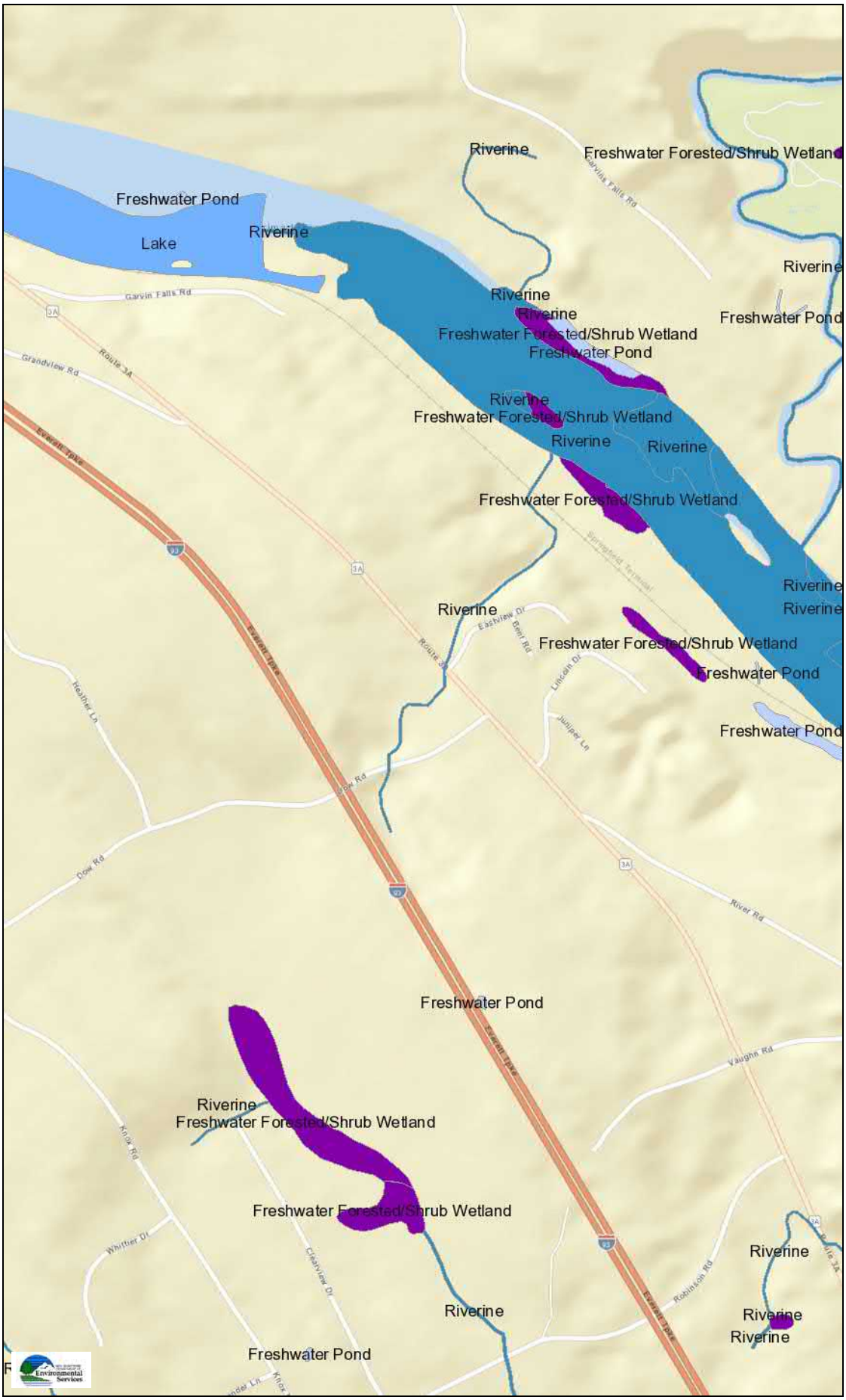
Map By



Legend

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetlan
- Freshwater Pond
- Lake
- Other
- Riverine

Map Scale

1: 12,988

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Map Generated: 4/18/2019

Notes

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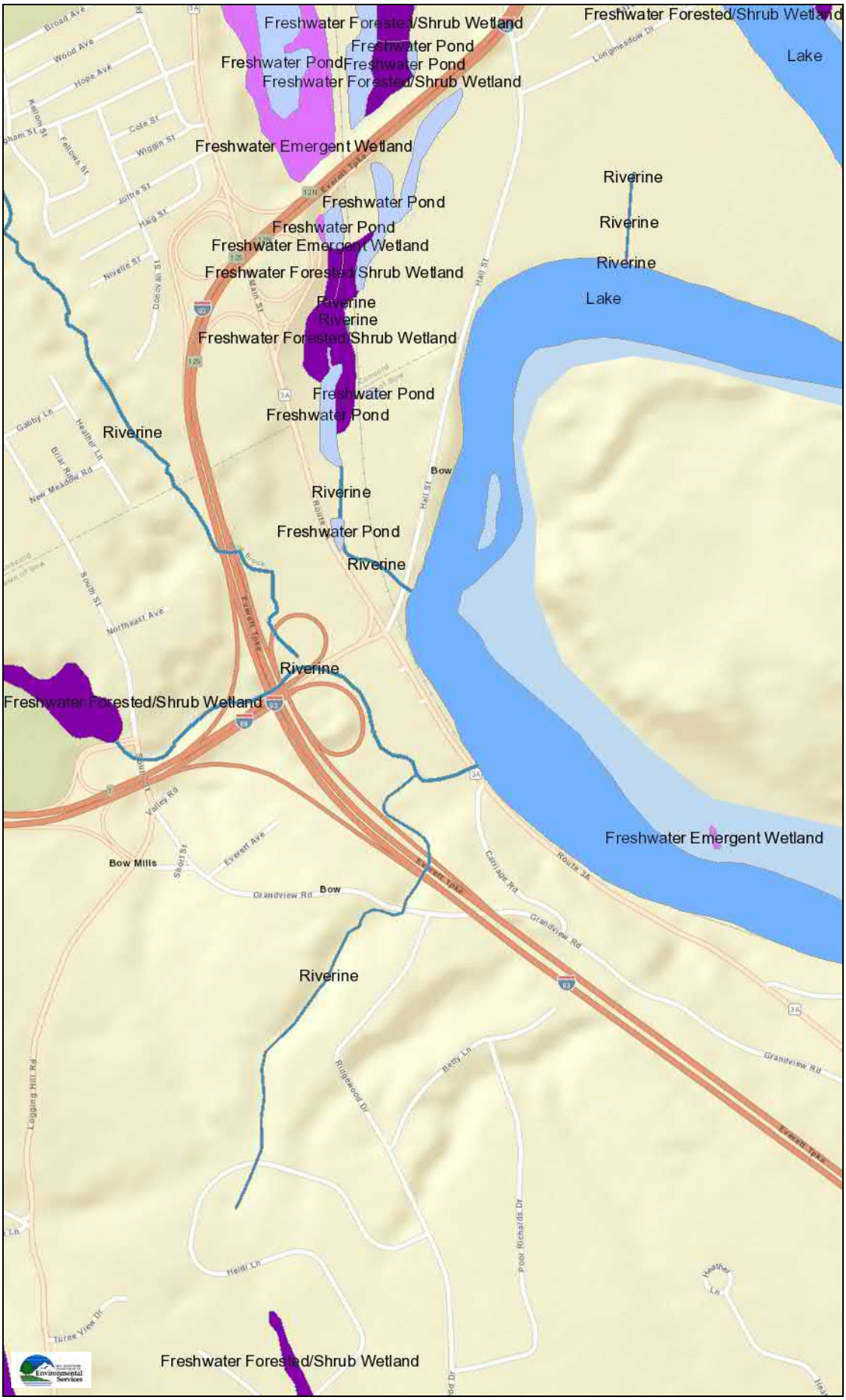

Legend

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetlan
- Freshwater Pond
- Lake
- Other
- Riverine

Map Scale

1: 12,988

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Notes

Appendix B

TOWN OF BOW

Drinking Water Protection Committee

10 Grandview Road, Bow, New Hampshire 03304

Phone (603) 223-3970 | Fax (603) 225-2982 | www.bownh.gov

Date:	January 8, 2018
From:	Bow Drinking Water Protection Committee
To:	Matt Taylor, Bow Community Development Director
Cc:	Dave Stack-Town Manager; Colleen Hunter-Bow Selectboard; Bill Hickey-BDC Chair
Re:	City of Concord Water Supply and Water Demands for Bow Junction and South Street

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In the summer of 2017, some editorial articles in the Concord Monitor suggested that one of the City's objections to extending drinking water service to the Bow Junction Business area was due to insufficient safe yield or production capacity. Obtaining water from the City has been discussed for decades, as the most technically and cost effective solution to address naturally occurring and man-made groundwater contaminants affecting both the Bow Junction and South Street business areas of Bow. As this topic is included in the BDWPC's Source Water Protection Plan activities[i], Item 2c "Wellhead Protection Plans, Groundwater Contamination in Bow Junction Area", the committee researched the public records to document the City of Concord's water supply capacity vs estimated needs for the Bow Junction and South Street areas. This memorandum documents the BDWPC's review.

1. Concord Water Supply Sources

On August 9, 2017 BDWPC members R. Kraybill and C. Klevens conducted a file review at the New Hampshire Department of Environmental Services to obtain information regarding the City's water supplies. In accordance with Weston and Sampson's draft report from 2004[ii]:

- Penacook Lake is the primary source of water with a sustainable yield estimated at 2.5 MGD. The Contoocook River is used as a supplemental source with water pumped into Penacook Lake during periods of drought. The pumping station capacity is 7.2 MGD which is well below the sustainable yield of the river source. **Total supply with both surface water sources is thus 2.5 + 7.2 = 9.7 MGD.**
- The average daily demand for the City of Concord users in 2003 was 4.7 MGD; while projected growth and **demand for the year 2030 was estimated at 6 MGD average, 7.6 MGD peak day**.

The city treats all surface water at its rapid sand filtration plant at 53 Hutchins Street in Concord. The water plant facility is approved by the NHDES to treat up to 10 MGD[iii]. The plant currently produces about **5 MGD** or half of its permitted capacity[iv]. This production rate is in line with the City's population and water use projections as documented by Weston and Sampson (2004). From this information, the plant currently has excess capacity of 5 MGD, and will still have excess capacity of about 4 MGD in the year 2030, when average water demand is projected to reach 6 MGD.

In addition to the surface water sources, the City operates the **Pembroke Well field** which consists of 4 gravel packed wells along the Soucook River off of Rte. 3. Although all wells are currently active and maintained, the wellfield is reserved solely as a backup source and therefore were not included in the City's supply capacity. **The sustainable yield from these wells is estimated at an additional 1 MGD**[v].

2. Water Demands for Bow Junction and South Street Business Corridors

Town Community Development staff performed a telephone survey in Oct 2017 of local businesses and the BDWPC again consulted public records to establish current number of employees and customers to estimate existing water demands[vi]. Based on this information, and NHDES Design Rules Env-Dw 1008 establishing unit flow basis for different business activities, the BDWPC prepared Table 1 – Bow Junction and South Street Estimated Water Demands.

Estimated water needs were found to be on the order of **10,000 gpd (0.01 MGD) for the Bow Junction area**, and up to **50,000 gpd (0.05 MGD) for the Bow South Street area**. Note that the South Street estimate is conservatively high based on maximum occupancy of the Hampton Inn Hotel, and actual water uses are likely lower. The BDWPC contacted the hotel for actual meter records but found that the water is not metered[vii]. This information can be updated as new information becomes available.

Summary

The BDWPC's review suggests that the City of Concord's water supply sources have a sustainable yield of 9.7 million gallons per day (MGD) from their primary water sources, the Penacook Reservoir and the Contoocook River, and an additional 1 MGD backup supply from the Pembroke Well field. Current demands for the City are reported to be on the order of 5 MGD, or about half of their available plant capacity. In the year 2030, City demands are projected to reach 6 MGD so the plant will still have approximately 4 MGD excess capacity.

Bow Junction area water needs were estimated at 10,000 gpd (0.01 MGD), or 0.2% of the City's available capacity of 4.7 MGD. Current water demands for the South Street area were estimated at 50,000 gpd (0.05 MGD), for a total 0.06 MGD or 1.3% of the City's excess capacity. Based on this review, the City's production rate of 5 MGD would be essentially unchanged (5.06 MGD) if supply were to be extended to the Bow Junction and South Street areas.

Future water demands for the Bow Junction area are not expected to change significantly as the area is built out with established industry. The South Street area is projected to grow such that water needs in that corridor will likely increase in the future.

References

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[i] BDWPC (2017a); Source Water Protection Plan activities, Item 2c "Wellhead Protection Plans, Ground-water Contamination in Bow Junction Area" http://bownh.gov/DocumentCenter/Home/View/1658.

[ii] Weston & Sampson Engineers, Inc., May 2004. City of Concord, NH Sustainable Yield & Drought Management Study (DRAFT).

[iii] NHDES (2015); Fact Sheet WD-DWGB-13-2; *Large Surface Water Treatment Plants in New Hampshire.*

[iv] BDWPC (2017b); R. Kraybill Water Filtration Plant Tour and Interview with Marco Philippon, Water Treatment Plant Superintendent, Concord Water Dept, 53 Hutchins St, Concord NH, Oct 5, 2017.

[v] BDWPC (2017c); Request for Information to NHDES Drinking Water and Groundwater Bureau, Oct 17, 2017.

[vi] Bow Community Development Dept Telephone Survey of Bow Businesses, Oct 2017; and NHDES (2017); OneStop Database, Public Water System Inventory www.des.nh.gov/onestop/index.htm.

[vii] BDWPC (2017d); R. Kraybill phone call to Hampton Inn Hotel, Nov 15, 2017.

TABLE 1 - BOW JUNCTION AND SOUTH STREET ESTIMATED WATER DEMANDS 1/8/2018

Prepared by: Bow Drinking Water Protection Committee

bowdrinkingwater@gmail.com gpd = gallons per day

Name	PWS ID	Est Staff*	gpd/pp**	Staff gpd	Other gpd	Total gpd	NOTES**
BOW JUNCTION AREA							
GRAPPONE TOTAL	---	319	10	3190	2,683	5,873	5000 customers/month x 5 gpd, 9000 carwash/year x 75 gal/car
Grappone Honda	0266240	100				--	
Grappone Ford	0266050	100				--	
Grappone Toyota	0266200	119				--	
Pitco Frialator	0266090	326	10	3260	0	3260	10 gpd/employee, no process water
Blue Seals	----	5 + 100	10	50	500	550	10 gpd/employee + 5 gpd transient x 100 customers/day
					Total Est	9,683	
					Say	**10,000**	
SOUTH STREET AREA							
Residential	---	2 homes			900	900	150 gpd/bedroom x 3 br / home
501 South Street	0266220	25	10	250		250	10 gpd/employee
Merrimack Savings	---	10 + 100	10	100	500	600	10 gpd/employee + 5 gpd transient
Concord Group	0266150	64	10	640		640	10 gpd/employee
Bow Mills UMC	0269030	120	3	360	360	720	3 gpd/seat + 12 gpd/person church suppers x 1 supper/wk
NH Auto Dealers + Daycar	0266140	104	10	1040		1,040	10 gpd/employee or child
Bovie Printing	0266020	32	10	320		320	10 gpd/employee
514 South St Dr Offices	0269090	30	35	1050	100	1,150	35 gpd/employee + 10 gpd/chair x est. 10 chairs
Baker Free Library	0269060	5 + 100	10	50	500	550	10 gpd/employee + 5 gpd transient
Hampton Inn	0268120	28 + 145	10	280	29000	29,280	10 gpd/employee + 145 rooms x 200 gpd/room
Chen Yang Li	0268030	10 + 280	20	200	11200	11,400	20 gpd/employee + 40 gpd/seat
Bow Mobil	0268130	2 + 500	10	20	2650	2,670	10 gpd/employee + 5 gpd transient +75 gpd/Island
					Total Est	49,520	
					Say	**50,000**	

* Population estimate from NHDES public water system inventory, www.des.nh.gov/OneStop or Oct 2017 phone survey

** GPD/pp from NH Env-Wq 1008.03 Daily Flow Volume, from Env-Wq 1000 Subdivision and Individual Sewage Disposal Design Rules

https://www.des.nh.gov/organization/commissioner/legal/rules/documents/env-wq1000.pdf

TOWN OF BOW

Drinking Water Protection Committee

10 Grandview Road, Bow, New Hampshire 03304

Phone (603) 223-3970 | BowDrinkingwater@gmail.com | www.bownh.gov

Date: May 14, 2018

From: Bow Drinking Water Protection Committee (BDWPC)

To: Matt Taylor, Director, Bow Community Development

Cc: Dave Stack, Town Manager; Colleen Hunter, Selectboard; Bill Hickey, BDC Chair

Re: BDWPC Memo #2 – Bow South Street Area Water Quality Issues

---

In January 2018, the BDWPC prepared its first memorandum on the drinking water needs for Bow Junction and South Street entitled "City of Concord Water Supply and Water Demands for Bow Junction and South Street". That document estimated that the total water needs for both Bow Junction (0.01 MGD), and South Street (0.05 MGD) area businesses represented about 1.3% of the City of Concord's current excess capacity of 4.7 MGD, and 1.5% of the City's projected excess capacity in the year 2030. As an alternative to connecting to the city of Concord's water supply, Town voters approved the creation of a Tax Increment Finance (TIF) District in March 2018, to help fund a water main extension from the Town's own municipal well water to support growth in these two industrial areas.

The Bow Business Development Commission (BDC) recently requested that the BDWPC review existing water quality issues in the South Street area. This memo provides this review. The Bow Junction water quality problems are well documented and are known to include MtBE, Salt, Corrosivity, Arsenic, Uranium and Radon; however, the South Street water quality issues had not been compiled.

In March and April 2018, the BDWPC reviewed public water supply records on the New Hampshire Department of Environmental Services' (DES) *One-Stop* data portal (www.des.nh.gov) and conducted a public file review for water treatment processes currently in use. There are 10 active public water supplies between the Bow town line and I-89 (see Table 1). The service population for this area is about 1400 people per day, mostly pass-through or transient users due to the presence of the Hampton Inn, Chen Yang Li Restaurant, and the Baker Free Library. Non-transient, small business water systems in this stretch include Bovie Screen Printing, NH Auto Dealers, Casa Dei Bambini Daycare, the 501 South Street Business Park, and the Medical Offices. Five of the ten systems are currently tested for and provide treatment for naturally occurring arsenic and radionuclides. The remaining five are not tested for these parameters but likely exhibit similar characteristics. MtBE is also present and treated for at the Bow Mobil water supply.

In addition to these water quality issues and the need to maintain water filtration equipment, these ten public water systems have a history of more than 45 violations cited by DES. Most of these violations involve monitoring or reporting issues and do not pose an immediate danger to public health. However, the information is presented here to illustrate the burden of compliance for these very small water systems, where there is no dedicated staff to tend to the well water or treatment maintenance.

In summary, the BDWPC recommends the town seek a solution to the water issues in the South Street area in conjunction with similar issues in the Bow Junction area, based on the following benefits:

- Improved water quality and quantity from a single municipal water source.
- Water supply quantity and pressure for fire protection which in turn reduces insurance costs.
- Reduced costs from avoidance of on-site treatment, sampling, and system maintenance.
- Avoidance of labor for management, operations, and monitoring of individual public water systems.
- Avoid the need for Contract Water Operator services.
- Avoid state and federal compliance requirements for public water systems.

Table 1

South Street Public Water Supply Summary

Compiled by Bow Drinking Water Protection Committee, May 2018

PWS #	Type	Name	Address	Pop Served	Well Depth	Est Yield (gpm)	Known Raw WQ Issues	Treatment	Viol. Notices
0266020	NTNC	Bovie Screen	4 Northeast Ave.	32			As	POU Arsenic	13
0266140	NTNC	NH Auto Dealers	507 South Street	104	350	25	Fe, As, U, Rn	Cation/Anion Xch, Aeration	4
0266150	NTNC	Concord Group	504 South Street	64			As & Rn	Ion Exchange, Aeration	3
0266220	NTNC	501 South Street	501 South Street	25			As & U	POU Arsenic / Uranium	1
0268030	TNC	Chen Yang Li Restaurant	520 South Street	300	800 (Grist Mill)	4	not tested		10
0268120	TNC	Hampton Inn	515 South Street	228	755	25	not tested		8
0268130	TNC	Bow Mobil	519 South Street	500	500/705/1006	20/5/3	MtBE	Activated Carbon / UV	7
0269030	TNC	Bow Mills United Methodist	505 South Street	120			not tested		0
0269060	TNC	Baker Free Library	509 South Street	60			not tested		0
0269090	TNC	Med. Offices	514 South Street	30			not tested		3
			Total Population Served	**1463**				Total Violation Notices	**49**

Appendix C

WATER SYSTEM EXTENSION MAP – ALTERNATIVE 1

500 250 0 500
SCALE IN FEET

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PROFESSIONAL SEAL

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NO.	DATE	DESCRIPTION	BY	CK'D

BOW, NH

BOW WATER SYSTEM IMPROVEMENTS

SHEET TITLE

WATER SYSTEM EXTENSION MAP

DRAWN BY TMG	DATE APR 2018
CHECKED BY	D&K PROJECT # 324345
PROJ. ENG. NJS	D&K ARCHIVE #

SHEET NUMBER

ALT 1

SHEET 1 OF 1

WATER SYSTEM EXTENSION MAP – ALTERNATIVE 2

500 250 0 500
SCALE IN FEET

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NO.	DATE	DESCRIPTION	BY	CK'D

BOW, NH

BOW WATER SYSTEM IMPROVEMENTS

SHEET TITLE

WATER SYSTEM EXTENSION MAP

DRAWN BY	DATE
TMG	APR 2018
CHECKED BY	D&K PROJECT # 324345
PROJ. ENG. NJS	D&K ARCHIVE #

SHEET NUMBER

ALT 2

SHEET 1 OF 1

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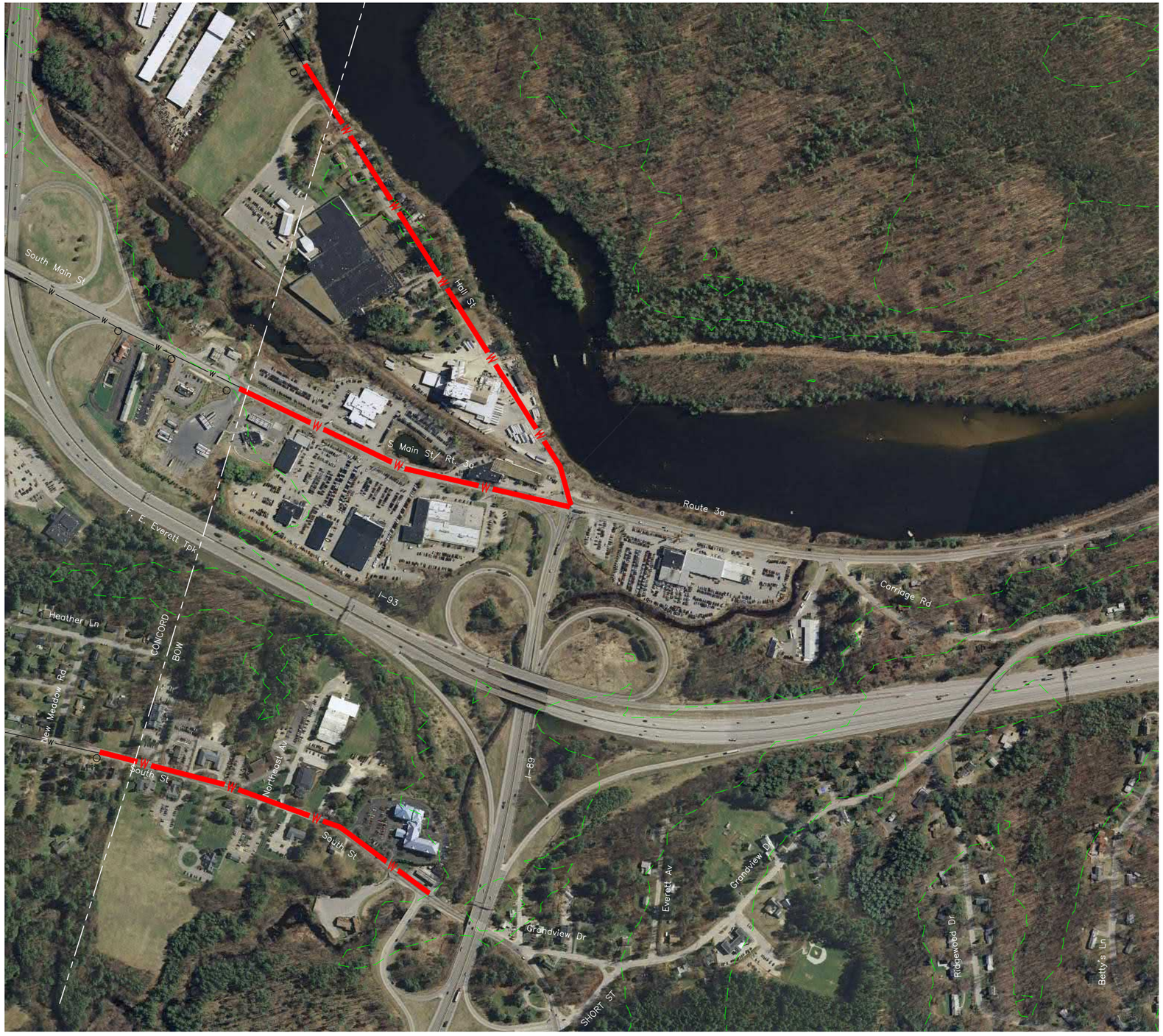

WATER SYSTEM EXTENSION MAP – ALTERNATIVE 3

250 125 0 250
SCALE IN FEET

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NO.	DATE	DESCRIPTION	BY	CK'D

BOW, NH

BOW WATER SYSTEM IMPROVEMENTS

SHEET TITLE

WATER SYSTEM EXTENSION MAP

DRAWN BY TMG	DATE APR 2018
CHECKED BY	D&K PROJECT # 324345
PROJ. ENG. NJS	D&K ARCHIVE #

SHEET NUMBER

ALT 3

SHEET 1 OF 1

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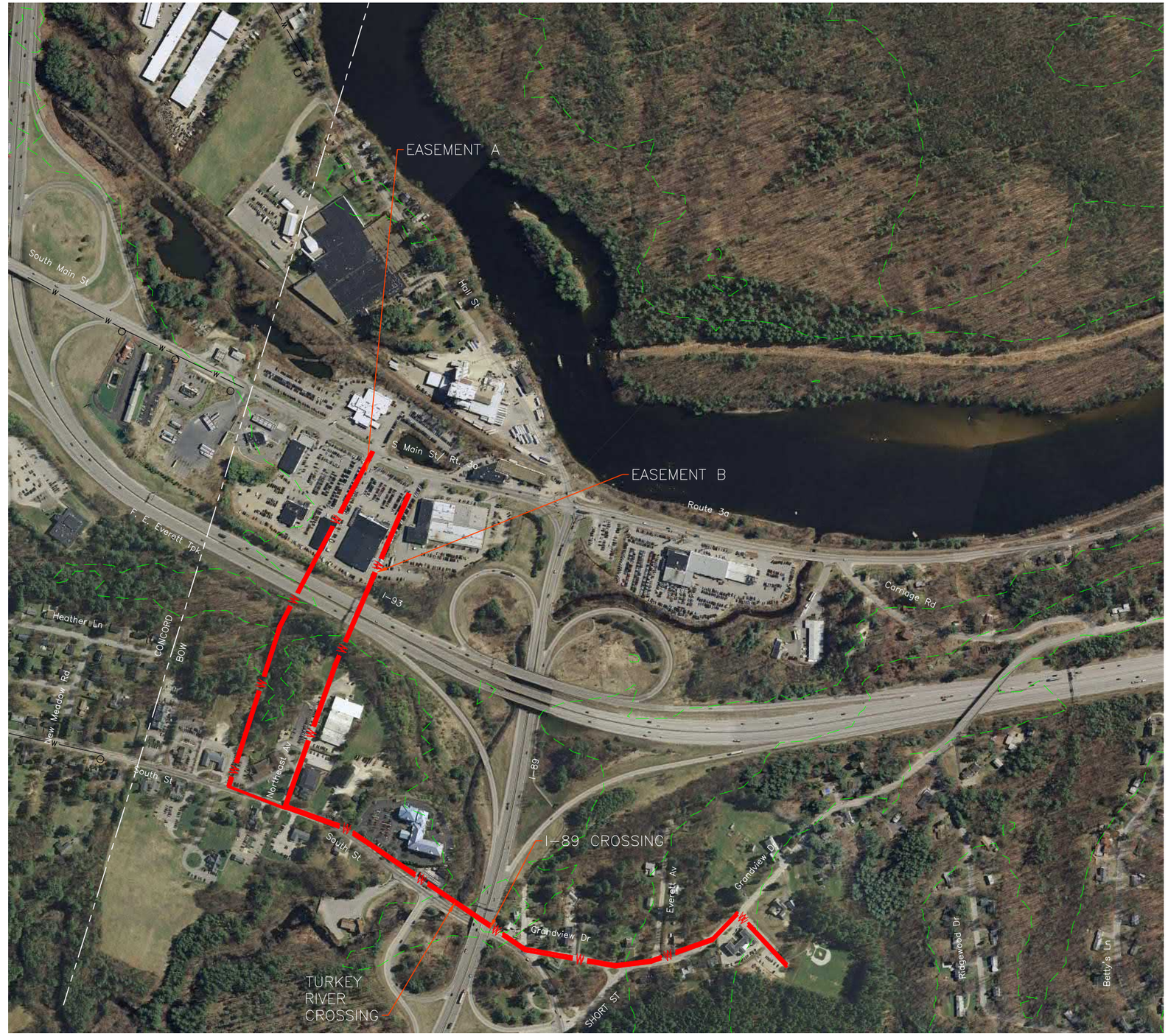

WATER SYSTEM EXTENSION MAP – ALTERNATIVE 4

250 125 0 250
SCALE IN FEET

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NO.	DATE	DESCRIPTION	BY	CK'D

BOW, NH

BOW WATER SYSTEM IMPROVEMENTS

SHEET TITLE

WATER SYSTEM EXTENSION MAP

DRAWN BY TMG	DATE APR 2018
CHECKED BY	D&K PROJECT # 324345
PROJ. ENG. NJS	D&K ARCHIVE #

SHEET NUMBER

ALT 4

SHEET 1 OF 1

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Appendix D

Project: Bow Water System Improvements
Alternative 1
Probable Cost Estimate

Calculated By: TMG Date:

Checked By: NJS Date: 5/13/2019

NOTE: In providing opinions of probable construction costs, the Client understands that DuBois & King, Inc. has no control over the cost or availability of labor, equipment or materials, or over market conditions or the Contractor's methods of pricing, and that our Opinion of Probable Construction Costs are made on the basis of our professional judgment and experience. DuBois & King, Inc. makes no warranty, expressed or implied, that the bids or the negotiated costs of the Work will not vary from the Opinion of Probable Construction Cost provided herein.

OPINION OF PROBABLE CONSTRUCTION COST

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Alternative 1				
Mobilization	LS	1	$ 315,000.00	$ 315,000.00
Erosion Control	LS	1	$ 50,000.00	$ 50,000.00
12" Ductile Iron Water Main & Trench	LF	14,200	$ 150.00	$ 2,130,000.00
Service Connections	EA	87	$ 5,000.00	$ 435,000.00
12" Gate Valve	EA	14	$ 5,000.00	$ 70,000.00
Hydrant With Tee and Valve	EA	36	$ 5,000.00	$ 180,000.00
Pavement Restoration	LF	10,000	$ 30.00	$ 300,000.00
Crossing Turkey River at Route 3a	LF	80	$ 1,000.00	$ 80,000.00
			Subtotal	**$ 3,560,000.00**
Easements A - Northeast Ave				
12" Ductile Iron Water Main & Trench	LF	2,310	$ 150.00	$ 346,500.00
I-93 Crossing atTax Map 11 Lot 42 (Directional Drill)	LF	415	$ 1,000.00	$ 415,000.00
			Easements A Subtotal	**$ 761,500.00**
Easements B - NET&T Company Easement				
12" Ductile Iron Water Main & Trench	LF	1,810	$ 150.00	$ 271,500.00
I-93 Crossing at Tax Map 11 Lot 43-A (Directional Drill)	LF	315	$ 1,000.00	$ 315,000.00
			Easements B Subtotal	**$ 586,500.00**
Booster Station - Location TBD				
Booster Station Building and Equipment	LS	1	$ 500,000.00	$ 500,000.00
			Booster Station Subtotal	**$ 500,000.00**
Water Storage Tank A - State of NH Property	LS	1	$ 850,000.00	$ 850,000.00
12" Ductile Iron Water Main & Trench	LF	1,170	$ 150.00	$ 175,500.00
Easement from Tax Map 26 Lot 53	LS	1	$ 25,000.00	$ 25,000.00
I-93 Crossing at Tax Map 26 Lot 53 (Directional Drill)	LF	310	$ 1,000.00	$ 310,000.00
			Tank A Subtotal	**$ 1,360,500.00**
Water Storage Tank B - Dow Road	LS	1	$ 850,000.00	$ 850,000.00
12" Ductile Iron Water Main & Trench	LF	2,080	$ 150.00	$ 312,000.00
Easement from Tax Map 26 Lot 51-A	SF	68,000	$ 3.00	$ 204,000.00
			Tank B Subtotal	**$ 1,366,000.00**
		Construction Subtotal	**$ 4,646,500.00**	**-$5,687,500.00**
		Construction Contingency (20%)		**$ 1,061,900.00**
		Engineering Costs (15%)		**$ 800,000.00**
		Alternative 1 Range:	**$ 6,508,400.00**	**-$7,549,400.00**

Project: Bow Water System Improvements
Alternative 2
Probable Cost Estimate

Calculated By: TMG Date:

Checked By: NJS Date: 8/1/2019

NOTE: In providing opinions of probable construction costs, the Client understands that DuBois & King, Inc. has no control over the cost or availability of labor, equipment or materials, or over market conditions or the Contractor's methods of pricing, and that our Opinion of Probable Construction Costs are made on the basis of our professional judgment and experience. DuBois & King, Inc. makes no warranty, expressed or implied, that the bids or the negotiated costs of the Work will not vary from the Opinion of Probable Construction Cost provided herein.

OPINION OF PROBABLE CONSTRUCTION COST

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Alternative 2				
Mobilization	LS	1	$ 315,000.00	$ 315,000.00
Erosion Control	LS	1	$ 50,000.00	$ 50,000.00
12" Ductile Iron Water Main & Trench	LF	14,480	$ 150.00	$ 2,172,000.00
Service Connections	EA	100	$ 5,000.00	$ 500,000.00
12" Gate Valve	EA	18	$ 5,000.00	$ 90,000.00
Hydrant With Tee and Valve	EA	37	$ 5,000.00	$ 185,000.00
Pavement Restoration	LF	10,000	$ 30.00	$ 300,000.00
Crossing Turkey River at South St	LF	50	$ 1,000.00	$ 50,000.00
			Subtotal	**$ 3,662,000.00**
Easements A - Northeast Ave				
12" Ductile Iron Water Main & Trench	LF	2,020	$ 150.00	$ 303,000.00
I-93 Crossing atTax Map 11 Lot 42 (Directional Drill)	LF	415	$ 1,000.00	$ 415,000.00
			Easements A Subtotal	**$ 718,000.00**
Easements B - NET&T Company Easement				
12" Ductile Iron Water Main & Trench	LF	1,690	$ 150.00	$ 253,500.00
I-93 Crossing at Tax Map 11 Lot 43-A (Directional Drill)	LF	315	$ 1,000.00	$ 315,000.00
			Easements B Subtotal	**$ 568,500.00**
Booster Station				
Booster Station Land, Building, and Equipment	LS	1	$ 500,000.00	$ 500,000.00
			Booster Station Subtotal	**$ 500,000.00**
Water Storage Tank A - State of NH Property	LS	1	$ 850,000.00	$ 850,000.00
12" Ductile Iron Water Main & Trench	LF	1,170	$ 150.00	$ 175,500.00
I-93 Crossing at Tax Map 26 Lot 53 (Directional Drill)	LF	310	$ 1,000.00	$ 310,000.00
			Tank A Subtotal	**$ 1,335,500.00**
Water Storage Tank B - Dow Road	LS	1	$ 850,000.00	$ 850,000.00
12" Ductile Iron Water Main & Trench	LF	2,080	$ 150.00	$ 312,000.00
			Tank B Subtotal	**$ 1,162,000.00**
I-93 Crossing A - Grandview Dr (Hanging)	LF	340	$ 500.00	$ 170,000.00
			I-93 Crossing A Subtotal	**$ 170,000.00**
I-93 Crossing B - Grandview Dr (Directional Drill)	LF	340	$ 1,000.00	$ 340,000.00
			I-93 Crossing B Subtotal	**$ 340,000.00**
I-89 Crossing A - Grandview Dr (Sleeved)	LF	340	$ 1,000.00	$ 340,000.00
			I-89 Crossing A Subtotal	**$ 340,000.00**

Project: Bow Water System Improvements
Alternative 2
Probable Cost Estimate

Calculated By: TMG Date:

Checked By: NJS Date: 8/1/2019

NOTE: In providing opinions of probable construction costs, the Client understands that DuBois & King, Inc. has no control over the cost or availability of labor, equipment or materials, or over market conditions or the Contractor's methods of pricing, and that our Opinion of Probable Construction Costs are made on the basis of our professional judgment and experience. DuBois & King, Inc. makes no warranty, expressed or implied, that the bids or the negotiated costs of the Work will not vary from the Opinion of Probable Construction Cost provided herein.

OPINION OF PROBABLE CONSTRUCTION COST

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
I-89 Crossing B - Grandview Dr (Unsleeved)	LF	340	$ 150.00	$ 51,000.00
		I-89 Crossing B Subtotal		**$ 51,000.00**
		Construction Subtotal	**$ 4,730,500.00**	**-$6,055,500.00**
		Construction Contingency (20%)		**$ 1,109,050.00**
		Engineering Costs (15%)		**$ 832,000.00**
		Alternative 2 Range: $	**$ 6,671,550.00**	**-$7,996,550.00**

Project: Bow Water System Improvements
Alternative 3
Probable Cost Estimate

Calculated By: TMG Date:

Checked By: NJS Date: 5/13/2019

NOTE: In providing opinions of probable construction costs, the Client understands that DuBois & King, Inc. has no control over the cost or availability of labor, equipment or materials, or over market conditions or the Contractor's methods of pricing, and that our Opinion of Probable Construction Costs are made on the basis of our professional judgment and experience. DuBois & King, Inc. makes no warranty, expressed or implied, that the bids or the negotiated costs of the Work will not vary from the Opinion of Probable Construction Cost provided herein.

OPINION OF PROBABLE CONSTRUCTION COST

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Alternative 3				
Mobilization	LS	1	$ 150,000.00	$ 150,000.00
City Connection Fee	LS	1	$ 250,000.00	$ 250,000.00
Erosion Control	LS	1	$ 20,000.00	$ 20,000.00
Master Meter Vault	LS	1	$ 40,000.00	$ 40,000.00
8" Ductile Iron Water Main & Trench	LF	6,139	$ 125.00	$ 767,375.00
Pavement Restoration	LF	6,000	$ 30.00	$ 180,000.00
Service Connections	EA	42	$ 5,000.00	$ 210,000.00
8" Gate Valve	EA	8	$ 4,000.00	$ 32,000.00
Hydrant With Tee and Valve	EA	16	$ 5,000.00	$ 80,000.00
			Construction Subtotal	$ 1,729,375.00
			Construction Contingency (20%)	**$ 346,000.00**
			Engineering Costs (15%)	**$ 259,000.00**
			Alternative 3 Total	**$ 2,334,375.00**

Project: Bow Water System Improvements
Alternative 4
Probable Cost Estimate

Calculated By: TMG Date:

Checked By: NJS Date: 8/1/2019

NOTE: In providing opinions of probable construction costs, the Client understands that DuBois & King, Inc. has no control over the cost or availability of labor, equipment or materials, or over market conditions or the Contractor's methods of pricing, and that our Opinion of Probable Construction Costs are made on the basis of our professional judgment and experience. DuBois & King, Inc. makes no warranty, expressed or implied, that the bids or the negotiated costs of the Work will not vary from the Opinion of Probable Construction Cost provided herein.

OPINION OF PROBABLE CONSTRUCTION COST

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Alternative 4				
Mobilization	LS	1	$ 200,000.00	$ 200,000.00
Erosion Control	LS	1	$ 8,700.00	$ 8,700.00
12" Ductile Iron Water Main & Trench	LF	2,895	$ 150.00	$ 434,250.00
Service Connections	EA	31	$ 5,000.00	$ 155,000.00
12" Gate Valve	EA	7	$ 5,000.00	$ 35,000.00
Pavement Restoration	LF	2,500	$ 30.00	$ 75,000.00
Hydrant With Tee and Valve	EA	8	$ 5,000.00	$ 40,000.00
Crossing Turkey River at South St	LF	50	$ 1,000.00	$ 50,000.00
Expansion of Existing Source	LS	1	$ 500,000.00	$ 500,000.00
Water Storage Tank	LS	1	$ 850,000.00	$ 850,000.00
			Subtotal	**$ 2,347,950.00**
Easements A - Northeast Ave				
12" Ductile Iron Water Main & Trench	LF	2,020	$ 150.00	$ 303,000.00
I-93 Crossing atTax Map 11 Lot 42 (Directional Drill)	LF	415	$ 1,000.00	$ 415,000.00
			Easements A Subtotal	**$ 718,000.00**
Easements B - NET&T Company Easement				
12" Ductile Iron Water Main & Trench	LF	1,690	$ 150.00	$ 253,500.00
I-93 Crossing at Tax Map 11 Lot 43-A (Directional Drill)	LF	315	$ 1,000.00	$ 315,000.00
			Easements B Subtotal	**$ 568,500.00**
I-89 Crossing A - South Street (Sleeved)	LF	340	$ 1,000.00	$ 340,000.00
			I-89 Crossing A Subtotal	**$ 340,000.00**
I-89 Crossing B - South Street (Unsleeved)	LF	340	$ 150.00	$ 51,000.00
Pavement Restoration	LF	340	$ 50.00	$ 17,000.00
			I-89 Crossing B Subtotal	**$ 68,000.00**
			Construction Subtotal	**$ 2,984,450.00 -$3,405,950.00**
			Construction Contingency (20%)	**$ 639,000.00**
			Engineering Costs (15%)	**$ 479,000.00**
			Alternative 4 Range: $	**$ 4,102,450.00 -$4,523,950.00**

Present Worth Analysis				
Item	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Project Capital Cost	$ 7,028,900	$ 7,334,050	$ 2,334,375	$ 4,313,200
O&M Costs (first year)	$ 40,000	$ 40,000	$ 10,000	$ 75,000
Revenue Share w/ Concord*			$ 151,600	
Present Worth O&M plus Revenue Share	$ 543,613	$ 543,613	$ 2,196,197	$ 1,019,274
Total Present Worth	**$ 7,572,513**	**$ 7,877,663**	**$ 4,530,572**	**$ 5,332,474**

*Based on 2017 Municipal Tax Rate $7.58 per $1,000, $40M in Assessed Value Increase split 50/50