TATA & HOWARD

September 23, 2016

Mr. Normand Labbe, President
Board of Directors
Southern Maine Regional Water Council
P.O. Box 88
Kennebunk, ME 04043

Subject: Southern Maine Regional Water Council
Regional System Study

Dear Mr. Labbe:

In accordance with our agreements with member water systems, Tata & Howard, Inc. is pleased to present this Regional System Study that will serve as an update to portions of the 2008 Regional Water System Master Plan Study, which studied possible interconnections between the water systems within the Southern Maine Regional Water Council (SMRWC).

This evaluation included the development of a regional hydraulic model including the Portland Water District (PWD), Maine Water Company – Biddeford & Saco (MWCB&S), Kennebunk, Kennebunkport, Wells Water District (KKWWD), Sanford Water District (SWD), South Berwick Water District (SBWD), York Water District (YWD), and Kittery Water District (KWD) hydraulic models. Portions of this project for each system except for the PWD were funded by the Maine Drinking Water Program (MDWP) Capacity Development Grants.

Evaluations were completed to review the feasibility of mutual aid opportunities among the water systems. The evaluation included reviewing existing demands, system capacities, hydraulic gradeline elevations, existing infrastructure, and water chemistry. Available water supply was also reviewed for each system. Recommendations on infrastructure improvements necessary for each interconnection location are included in Section 6.

During the course of this project, the undersigned served as Project Manager, Mr. Donald J. Tata, P.E. provided project technical reviews, Ms. Justine M. Carroll, P.E. served as Senior Modeling Specialist, Ronald S. Ponte, P.E. served as the Senior Project Engineer Treatment Specialist, Ms. Marie T. Rivers, P.E. provided modeling assistance, and Mr. Collin A. Stuart, E.I. served as the Engineer on the Project.

At this time, we wish to express our appreciation to the SMRWC including each of the participating water systems, including the PWD, MWCB&S, KKWWD, SWD, SBWD,

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YWD, and KWD for participation in this study and for the help collecting information and data.

Tata & Howard, Inc. appreciates the opportunity to assist the participating water systems with this important project. Should you have any questions or comments, please do not hesitate to contact our office.

Sincerely,

TATA & HOWARD, INC.

Paul E. Cote, P.E.
Associate

Enclosures

cc: Portland Water District
Maine Water Company – Biddeford & Saco
Kennebunk, Kennebunkport, Wells Water District
Sanford Water District
South Berwick Water District
York Water District
Kittery Water District

REGIONAL SYSTEM STUDY
SEPTEMBER 2016

TATA & HOWARD

SECTION 1 - EXECUTIVE SUMMARY

1.1 General

Tata & Howard, Inc. was retained by the Southern Maine Regional Water Council (SMRWC) to complete a Regional System Study for the Portland Water District (PWD), Maine Water Company – Biddeford & Saco (MWCB&S), Kennebunk, Kennebunkport, Wells Water District (KKWWD), Sanford Water District (SWD), South Berwick Water District (SBWD), York Water District (YWD), and Kittery Water District (KWD). The purpose of the study was to provide a detailed update to Section 7 of the 2008 Regional Water System Master Plan Study, which studied possible interconnections between the water systems within the SMRWC. A combined water distribution system regional hydraulic model was developed using the hydraulic models of each individual water system. The regional hydraulic model was used to evaluate the hydraulic feasibility and impacts of the proposed interconnections as well as the potential of transferring water from northern systems to southern systems through a completely connected and open system. The PWD and MWCB&S have large water sources and are interested in exploring the option of providing water to southern systems. The study evaluated the needed infrastructure improvements, each system's available water supply, and demands through the potential and existing interconnections.

Potential interconnection locations between PWD and MWCB&S were considered along Route 1 and Pine Point Road. Potential interconnection locations between KKWWD and SWD were considered on Route 99 and Route 109. A potential interconnection between SWD and SBWD was considered along Route 4. This connection would involve transporting water through North Berwick and would require cooperation with the North Berwick Water District (NBWD). Potential interconnection locations between SBWD and KWD were considered along Route 91 and Route 236. A potential interconnection between YWD and KWD was considered along Route 91. The feasibility of each interconnection location was determined by geographic locations specified by each water system. Existing interconnections are located between MWCB&S and KKWWD, KKWWD and YWD, and KWD and YWD. A summary of each existing interconnection is located in Table No. 1-1, and a summary of each proposed location, including the required improvements, is located in Table No. 1-2.

The study also examined the effects that the proposed system improvements and interconnections would have on water quality. Not all water systems treat water in the same way; therefore, finished water is unique to the chemicals and treatment techniques used by each system. Specifically, pertinent available data was collected and chemicals used for coagulation, sequestering, primary disinfection, secondary disinfection, corrosion control, pH adjustment, and dental health were reviewed. Raw water parameters such as turbidity, alkalinity, temperature, pH, and total hardness were also collected. Finished water parameters such as turbidity, alkalinity, temperature, pH, and total hardness were also considered. Of the seven participating water systems in the study, three disinfect with chloramines and four disinfect with only chlorine solution. Operating the systems together as a permanent solution to water supply concerns would

require modifications to the treatment processes in some if not all of the systems. Ideally, each water system involved in water sharing would need to agree to a treatment method to give each system acceptable water quality and eliminate concerns with blending systems.

The identified improvements were based on hydraulic feasibility. Infrastructure recommendations at the interconnection locations include construction of new water mains, pressure reducing valves (PRVs) and booster pumping stations (BPSs). Recommended improvements can be found in Table No. 6-2.

Table No. 1-1
Existing Interconnection Summary

Location	Flow Direction	HGL (ft)	PRV or Pump Needed	Comments
Route 1	KKWWD to MWCB&S	260 to 261	Pump	Pump stations in Arundel can be used to transfer water to and from KKWWD and MWCB&S
	MWCB&S to KKWWD	261 to 260	Pump	
Route 9	KKWWD to MWCB&S	256 to 261		This connection is limited to local service, pressure sustaining valves are in-place at the connection
	MWCB&S to KKWWD	261 to 256		
Route 1	KKWWD to YWD	200 to 190	Pump	Existing BPS in place
	YWD to KKWWD	190 to 200	Pump	
Route 1	KWD to YWD	183 to 190	Pump	Existing BPS in place
	YWD to KWD	190 to 183	Pump	

Table No. 1-2
Proposed Interconnection Summary

Location	Flow Direction	HGL (ft)	Piping Needed (LF)	Pipe Size (in)	PRV or Pump Needed	Comments
MWCB&S / PWD						
Route 1	MWCB&S to PWD	214 to 265	1,700	12	Pump	As requested, a 12-inch diameter interconnection would provide an estimated flow of 300 gpm from PWD to MWCB&S. A BPS would be required to transfer from the MWCB&S to PWD
	PWD to MWCB&S	265 to 214			PRV	
Route 1	MWCB&S to PWD	214 to 265	5,700	16, 20	Pump	To achieve flows of up to 4 mgd, replace 1,900 feet of existing 8-inch water main with new 20-inch water main on Route 1 in Scarborough from Old Blue Point Road to the town line. Add 3,800 feet of new 20-inch water main on Cascade Road in Old Orchard Beach from Portland Road to 1,300 feet east of Milliken Mills Road
	PWD to MWCB&S	265 to 214			PRV	
KKWWD / SWD						
Route 99	SWD to KKWWD	516 to 273	27,100	16	PRV	This connection could involve the creation of a new pressure zone and storage tank. Size and location of pump stations, PRVs and storage needs would be determined in a future study
	KKWWD to SWD	273 to 516			Pump	
Route 109	SWD to KKWWD	516 to 200	38,900	16	PRV	This connection could involve the creation of a new pressure zone and storage tank. Size and location of pump stations, PRVs and storage needs would be determined in a future study
	KKWWD to SWD	200 to 516			Pump	
SWD / SBWD						
Route 4	SWD to SBWD	516 to 298	47,000 or 21,800	12	PRV	Size and location of pump stations and PRVs would be determined in a future study. A discussion would need to be held with the NBWD to see how the potential interconnection could tie into the NBWD distribution system.
	SBWD to SWD	298 to 516			Pump	

Table No. 1-2 (continued)
Proposed Interconnection Summary

Location	Flow Direction	HGL (ft)	Piping Needed (LF)	Pipe Size (in)	PRV or Pump Needed	Comments
KWD / SBWD						
Route 91	KWD to SBWD	183 to 298	30,000	12	Pump	Size and location of pump stations and PRVs would be determined in a future study
	SBWD to KWD	298 to 183			PRV	
Route 236	KWD to SBWD	193 to 298	37,700	12	Pump	Size and location of pump stations and PRVs would be determined in a future study
	SBWD to KWD	298 to 193			PRV	
KWD / YWD						
Route 91	KWD to YWD	183 to 190	5,850	12	Pump	Approximately 900 linear feet of new 12-inch water main and associated valves and appurtenances to connect the two systems. Additionally, 4,600 feet of existing 6-inch KWD water main and 350 feet of existing 6-inch YWD water main on Route 91 would be replaced with new 12-inch water main to prevent bottlenecks and facilitate this interconnection.
	YWD to KWD	190 to 183			N/A	

SECTION 6 - RECOMMENDATIONS & CONCLUSIONS

6.1 General

The hydraulic feasibility of each of the proposed interconnections was evaluated and impacts of the proposed interconnections were analyzed. Each interconnection was also evaluated for water quality compatibility. The transfer volumes through each interconnection are theoretical only. In reality, the blend of water received as a result of a transfer would be dependent upon a combination of the sources in use and the consumption at a particular point in time. Upon review of each proposed interconnection, improvements for each water system were identified individually as well as for the SMRWC as a whole. A summary of the recommendations and associated costs are also shown in Table No. 6-2. Costs are based on the April 2016 Engineering News Record (ENR) construction cost index for Boston, MA of 13177.41 and include costs associated with valves, hydrants, and permanent and temporary trench pavement and a 25 percent allowance for engineering and contingencies. Estimates do not include costs for land acquisition, easements, or legal fees. Each of the systems in the SMRWC construct water system improvements using different procurement methods, design standards, and materials. The cost estimates are to be used to compare the cost of one investment versus another. As each system considers whether to build one of the recommended improvement a specific design and cost estimate should be prepared. Infrastructure improvements can be located on the Recommendations Map in Appendix D.

6.2 Recommendations

6.2.1 MWCB&S - PWD Interconnection

After reviewing the proposed 12-inch interconnection between the MWCB&S and the PWD along Route 1, as requested in the RFP, it was concluded that it does not provide as much value as a longer, larger diameter water main in the same location. The 1,700 foot long, 12-inch interconnection along Route 1 could be constructed in the short term to establish a business and hydraulic connection between the two systems. This connection would be able to deliver about 300 gpm from PWD to MWCB&S. A PRV would be required to reduce pressure from the PWD HGL of 265 feet to the MWCB&S HGL of 214 feet.

For a longer term, higher volume interconnection capable of transferring up to 4.0 mgd on the PWD side of the Scarborough/Saco boundary, the PWD would need to construct approximately 4,200 feet of 20-inch water main on Route 1 from Queens Drive to Broadturn Road and 16,500 feet of 16-inch water main on Route 1 from Broadturn Road to the existing 20-inch on Gorham Road. On the MWCB&S side of the boundary, 3,800 feet of 20-inch water main on Cascade Road would be recommended from Portland Road to 1,300 feet east of Milliken Mills Road, and 5,300 feet of 20-inch water main would recommended on Route 1 from Cascade Road to the municipal boundary.

The difference in water chemistry between the MWCB&S and the PWD is not significant. Both systems use a form of phosphate for corrosion control, have a pH between 7.7 and 8.3, fluoridate water, and use chloramines.

6.2.2 KKWWD - SWD Interconnection

After reviewing the proposed interconnections between the KKWWD and the SWD at Route 109 and Route 99, it was concluded that an interconnection is not necessary at this time. Each of the proposed interconnections would require at least 30,000 linear feet of water main, including at least one BPS and PRV. Each water system also currently possesses a surplus in water supply with the largest source offline, the KKWWD has approximately 1.8 mgd and the SWD has 1.1 mgd in excess water capacity compared to the 2015 MDDs. However, if a situation develops where a developer proposes to place a large development in an area off of Route 99 (casino, waterpark, etc.) as has been speculated currently and proposed in the past, an interconnection between the KKWWD and the SWD could be feasible. In this situation, the partial and/or total cost of the interconnection could be covered by the developer.

From a water quality standpoint, the KKWWD has its Kennebunk River Wells near Route 99, close to where the systems would interconnect. The groundwater wells in KKWWD produce similar water quality to that found in the groundwater sources in the SWD. Both water systems utilized a form of chlorine for disinfection and a form of phosphate for corrosion control. The proposed Route 109 interconnection is less feasible than the Route 99 interconnection due to the pipe length, location, and water quality.

6.2.3 KWD - SBWD Interconnection

After reviewing the proposed interconnections between KWD and SBWD at Route 91 and Route 236, it was concluded that an interconnection is not economically feasible. Each of the proposed interconnections would require at least 30,000 linear feet of water main, including at least one BPS and PRV. At this time, there is not an economic driver for such an expensive and physically long interconnection. Each water system also currently has a surplus in water supply, the KWD has 1.4 mgd and the SBWD has 0.2 mgd in excess water capacity compared to the 2015 MDDs. The KWD currently has an existing interconnection with the YWD, so a second interconnection would not be necessary at this time. Additionally, the water systems have different water chemistries. The SBWD receives water from ground water sources, does not disinfect all of its water sources, and does not use corrosion control. The KWD receives water from surface water sources, chlorinates, and uses corrosion control. If these systems were to ever consider an interconnection, an agreement would need to be reached on similar finished water chemistry.

The SBWD also has several potential interconnections that would be more cost effective. Both interconnections with the NBWD and the Town of Rollinsford, NH could be considered by the SBWD due to the minimal length of water main required to interconnect each system. These interconnections would provide a backup water supply in the event on an emergency. Further studies would need to be conducted by the SBWD to determine the hydraulic feasibility as well as the water quality compatibility between

each system. Neither of the interconnections were evaluated as it is outside of the project scope.

6.2.4 SWD - SBWD Interconnection

After reviewing the proposed interconnection between the SWD and the SBWD, it was concluded that an interconnection may not be justified in the immediate future. The proposed interconnection would require approximately 47,000 linear feet of water main, including a BPS and PRV to bypass the NBWD water system or it would require approximately 21,800 linear feet of water main, including a BPS and a PRV to connect to the NBWD water system. Each water system also currently has a surplus in water supply with the largest source offline, the SWD has 1.1 mgd and the SBWD has 0.2 mgd compared to the 2015 MDDs. To accomplish this interconnection, the SWD and SBWD would need to enter an agreement with the NBWD.

6.2.5 KWD - YWD Interconnection

To transfer over 2.5 mgd at the proposed interconnection between the KWD and the YWD at the interconnection of Route 91 and Route 1, 12,000 feet of new 20-inch water main on Route 1 in York from York Street to the Kittery town line is recommended parallel to the existing 12-inch water main. Additionally, approximately 6,600 feet of new 20-inch water main in Kittery would be would be recommended on Route 1 from the York town line to Cutts Road. The size of the new water main will depend on the desired transfer. Pump station upgrades will also be required for transfers from YWD to KWD greater than 2.0 mgd and for transfers from KWD to YWD greater than 2.5 mgd.

A second potential interconnection between KWD and YWD is located on Route 91, west of Interstate 95. To transfer up to 2.0 mgd, approximately 900 linear feet of new 12-inch water main and associated valves and appurtenances is recommended. Construction of this water main would involve crossing the Cider Hill Creek. Additionally, 4,600 feet of existing 6-inch KWD water main and 350 feet of existing 6-inch YWD water main on Route 91 would be recommended to be replaced with new 12-inch water main to prevent bottlenecks and facilitate this interconnection. Transfers greater than 2.0 mgd would require larger diameter water mains.

6.2.6 MWCB&S - KWD Transfer

Overall, there is potential to transfer significant quantities of water from MWCB&S to KWD through the KKWWD and YWD transmission grids. If 4.0 mgd is transferred from MWCB&S to Kittery, approximately 2,300 gpm flows from MWCB&S to KKWWD at Route 1 if the KKWWD WTP is online. If 4.0 mgd is transferred from MWCB&S to Kittery, approximately 2,600 gpm flows from MWCB&S to KKWWD at Route 1 if the KKWWD WTP is offline.

Within the KKWWD transmission grid, approximately 2,900 feet of new 12-inch diameter water main would be recommended parallel to the existing 12-inch water main on Route 1 in Ogunquit along Shore Road between Beach Street and Bournes Lane.

Within the YWD transmission grid, approximately 3,000 feet of new 16-inch water main on Route 1 in York between the existing 16-inch water main and River Road would also be recommended parallel to the existing 12-inch water main. In addition, the existing 12-inch and 16-inch diameter water mains should be reinforced with a 12-inch diameter water main on Route 1 between Bournes Lane in Ogunquit and River Road in York. However, the existing 16-inch water main would be adequate for infrequent transfers of 4.0 mgd between KKWWD and YWD. Pump station upgrades will also be required for transfers greater than 2.5 mgd.

Additionally, approximately 6,600 feet of existing 12-inch water main in Kittery would be replaced with new 20-inch diameter water main on Route 1 from the York town line to Cutts Road. A summary of the upgrades required to transfer 4.0 mgd from MWCB&S to KWD is located in Table No. 6-1.

Table No. 6-1
Regional Improvements Required to Transfer 4.0 mgd

District	Length of Improvements	Pipe Size (in)
KKWWD	2,900	12
YWD	3,000	16
YWD	12,000	20
KWD	6,600	20

6.2.7 Southern Maine Regional Water Council

The SMRWC has a strong sense and spirit of collaboration and support that offers the basis for a successful supply development scenario that can benefit all participating members. After reviewing all proposed interconnections between the individual water systems, it became apparent that the largest technical problem facing the SMRWC is the difference in treatment chemicals and finished water quality. It is our recommendation that the SMRWC come to an agreement on a common finished water chemistry. To accomplish this goal, the SMRWC would need to agree on the types of chemicals needed to reach the desired water quality. The dosages of each chemical would be unique to each system due to dissimilar sources, and differing treatment needs such as iron and manganese.

Accomplishing the goal of producing compatible and interchangeable finished water quality comes with challenges. Some or all participating water systems would have to make changes, particularly with the types of chemicals used for disinfection and corrosion control. It is recommended that the SMRWC consider using an ortho-polyphosphate blend that fits the needs of each system. A detailed review of each system's chemical feed equipment and storage systems would be needed to determine the costs of an agreed upon corrosion control strategy.

It is also recommend that each water system disinfect water with chloramines instead of chlorine. The use of chloramines prevents disinfection by-products from forming and helps to maintain a higher chlorine residual for longer than chlorine, which is important for water systems that are located miles apart. A detailed review of chemical feed equipment and storage systems would be needed to determine the costs of a chloramine program for each system.

Of the participating water systems in the SMRWC, four of the seven fluoridate. Fluoridation needs the approval of the voters in each community served by the water systems, and therefore, presents the biggest potential external water quality challenge in sharing sources among systems. Title 22 of Maine Revised Statutes Chapter 601 section 2653 prescribes the public voting process to add or remove fluoride to drinking water in Maine. This section also provides that if a water system receives or purchases less than 50 percent of its total annual water supply from a water supply authorized to add fluoride, the receiving system is not required to have authorization from its customers.

The decision to pursue interconnections with neighboring water systems needs to consider water quality, hydraulic implications, existing transfer agreements, and governance of each water system. Governance was reviewed in the 2008 Regional Water System Master Plan Study, but was not included as a part of this study. Further review and discussions of the collaborative interests in a different type of governance of this group and its individual members would be addressed in future studies. The interconnections that do not yet exist may be developed after there are internal or external economic drivers. This study includes a general cost estimate for each proposed project. A more detailed cost estimate would need to be developed as needed for each future interconnection as the economic interests evolve at each location.

This study focused on existing infrastructure, hydraulics, and water chemistry but a bigger challenge is the condition and need for treatment on a regional basis. The following is a summary of the treatment plants and the status of completed or pending improvements in the region:

- PWD recently completed a major treatment plant renovation.
- YWD recently completed treatment plant improvements.
- MWCB&S is planning a replacement to the Saco River plant.
- KKWWD has an aging plant and has considered replacement.
- KWD is planning to replace the Boulter Pond treatment plant.

Another point to consider is the transfer of water between systems. The cost of water needs to be considered both from a production standpoint and also the transfer. The strong hydraulic infrastructure that the members of the SMRWC have in place facilitates sharing water and may allow for greater efficiencies over the three new treatment plants planned in the future to meet needs.

The opportunity to build less treatment capacity overall offers an economic driver to share resources among the member systems. For example, water could be moved from MWCB&S to KWD with the current infrastructure that exists. Additionally, with the

investments shown on Table No. 6-2, enough water could be moved to avoid building new WTPs, or plants with less capacity could be implemented in KWD or KKWWD.

Due to the strong potential for cost efficiencies among member systems through the sharing of water resources, it is recommended that the SMRWC continue the evaluation of the merits of such measures. It is recommended that the SMRWC consider a new phase of work that would include but not be limited to the following:

- Review alternative implementation scenarios including cost factors associated with various treatment and conveyance options,
- Develop consensus target water quality ranges for participating systems to achieve,
- Review existing agreements among systems and provide recommendations for a structured approach to governance,
- Provide recommendations for the potential systematic implementation of resource sharing among the SMRWC members.

Due to the number of potential considerations in the next phase of work, a roundtable discussion in a workshop format is recommended to allow for prioritizing appropriate items to be included.

Table No. 6-2
Recommendations Summary

Location	Flow Direction	HGL (ft)	Piping Needed (LF)	Pipe Size (in)	PRV or Pump Needed	Estimated Costs*	Comments
Route 1	MWCB&S to PWD	214 to 265	1,700	12	BPS	$2,225,000	For the near term the 12-Inch diameter interconnection would provide an estimated flow of 300 gpm from PWD to MWCB&S. A flow meter and PRV would be installed in conjunction with the pipeline. A BPS would be needed to transfer water from MWCB&S to PWD.
	PWD to MWCB&S	265 to 214			PRV		
Route 99	SWD to KKWWD	516 to 273	27,100	16	PRV	$9,300,000	This connection could involve the creation of a new pressure zone and storage tank. Size and location of pump stations, PRVs and storage needs would be determined in a future study.
	KKWWD to SWD	273 to 516			BPS		
Route 1	KKWWD to YWD	273 to 190	2,900	12	Pump Station Upgrades	$2,310,000	Installed parallel to the existing 12-inch Beach Street and Bournes Lane.
	YWD to KKWWD	190 to 273	3,000	16			Install in York between the existing 16-inch and River Road installed parallel to the existing 12-inch water main.
Route 91	KWD to YWD	183 to 190	5,850	12	BPS	$3,200,000	Approximately 900 linear feet of new 12-inch water main is required to connect the two systems. Additionally, 4,600 feet of existing 6-inch KWD water main and 350 feet of existing 6-inch YWD water main on Route 91 would be replaced with new 12-inch water main. A BPS with a flow meter and control valve would be needed for higher flows and to maintain water quality.
	YWD to KWD	190 to 183			N/A		
Route 1	KWD to YWD	183 to 190	18,600	20	Pump Station Upgrades	$7,200,000	Approximately 12,000 feet of new 20-inch water main on Route 1 in York from York Street to the town line would be installed parallel to the existing 12-inch water main. Additionally, approximately 6,600 feet of new 20-inch water main in Kittery would be required on Route 1 from the York town line to Cutts Road. Pump station upgrades will also be required for transfers from YWD to KWD greater than 2.0 mgd and for transfers from KWD to YWD greater than 2.5 mgd.
	YWD to KWD	190 to 183					

*Includes 25 percent allowance for engineering and contingencies.