REGIONAL DISTRICT
of
NORTH OKANAGAN

TM9
SUMMARY PAPER

File No. 5700.15.11

SUBJECT: 2012 Greater Vernon Water Master Water Plan
Technical Memorandum 9
System Separation Option Analysis

Summary Date: December 2015 / Updated: January 2016

TM9 PURPOSE:

The main purpose for a water utility to complete a MWP is to develop a long term plan to meet Provincial Standards and ensure a sufficient supply of water to its customers into the future. In GVW's case, the long term plan must also ensure that a sufficient supply of water is available to sustain agriculture in addition to providing potable water in sufficient quantities for domestic use.

TM9 uses all the information assembled in TMs 1 through 8 to develop nine (9) long term conceptual water supply options for GVW. A lifecycle cost for each of the options was then calculated using consistent unit estimates to complete a cost comparison between the options. The options were then rated based on non-cost considerations important to operating a sustainable water utility. The final recommended option is based on a weighted Benefit-to-Cost Ratio of both the lifecycle cost and non-cost considerations.

METHODS:

The development and analysis of long term options for GVW was completed by:

- Evaluating alternatives presented during the development of the MWP,
- Developing long term conceptual water supply options for GVW based on the current and potential water supplies available and on the logical arrangements available for agricultural separation (i.e. no separation, partial or full separation),
- Projecting the lifecycle costs for each option, out to 50 years (the estimated life of the new capital works being recommended). Unit prices developed in TM5 and TM7 were applied consistently for each option,
- Developing and weighting non-cost considerations important to the operation of a water utility and then each option was rated using the weighted non-cost considerations, and
- Calculating the net present value (NPV) and a benefit to cost of each option to assist in identifying the final recommended option.

Key assumptions of completing the option analysis that included lifecycle costing of each option were:

- All domestic customers would receive water that met Provincial Standards within 10 years and hence, treatment and system separation would be completed by 2022,
- Treatment facilities would be sized to meet the projected 20 year demands and expanded in the future to meet the projected 40 year demands,
- Pipes and related infrastructure were designed to meet the projected 40 year demands, and
- Lifecycle cost comparisons for all options were completed over a 50 year horizon based on the predicted life of the facilities and infrastructure.

The following outlines the key points of the option analysis considered to ensure that each option was being compared using equivalent parameters (or in other words to complete the comparison using an "apples to apples" approach):

- Options were developed at the conceptual level with costing out of the core infrastructure only (treatment, transmission, pumping and large pipes) and not for localized distribution needs,
- Unit costs, flows, storage and other design parameter estimates developed in prior TMs were used consistently for all options,
- All capital costs include 15% engineering and 30% contingency,
- Timeframes for infrastructure improvements were developed and applied consistently to all options based on the key assumptions above, and
- A consistent increase in O&M costs were calculated based on current O&M costs and applied to each option based on the infrastructure needs. As the current O&M costs were determined to be applicable for all options, the analysis only includes the increase in O&M specific for each option with the exception of full separation options where savings are realized from reduced treatment at DCWTP and included as a negative O&M cost.

RESULTS:

Alternative Review

During the MWP development process, alternative ideas were discussed that were not included in the original work scope. Before the development of the conceptual options, a review of the alternatives was completed and assessed as to whether to include in the long term water supply analysis. The following provides a summary of the alternatives reviewed:

1. Potable Supply from Okanagan Lake - a conceptual plan and cost estimate was completed to examine GVW using Okanagan Lake as the primary potable water supply. Full separation is required to support this plan with raw Duteau Creek water used as the main agricultural source. The conceptual plan includes supplying a maximum flow of 79 ML/day from Okanagan Lake from an intake (30 m deep) located five (5) km from a pump station constructed on Lakeshore Road (i.e. around Kin Beach). Based on the current configuration of the GVW distribution system, treatment would occur at the MHWTP requiring nine (9) km of transmission main from the pump station to MHWTP. The cost of the infrastructure required to support this design is estimated to be $37 M (with an additional $80.9 M for full separation).

2. Alternative source water for Goose Lake – currently Goose Lake is filled with treated water from the DCWTP. To reduce treatment costs, alternative water sources to fill Goose Lake were assessed including reclaimed effluent, BX Creek, Swan Lake, and raw water from Duteau Creek, Okanagan Lake and Kalamalka Lake. BX Creek, Swan Lake and Kalamalka Lake were deemed non-viable options as the infrastructure to implement were too costly. Reclaimed effluent would be the least expensive option as most of the infrastructure was already in place but due to current regulations, this source cannot be used on food crops and hence, not a viable source for agricultural customers. Duteau Creek raw water would be the next best option only if full separation were being completed, therefore it is not a viable option with partial or no separation. The recommended alternative for no separation or partial separation is to use raw water from Okanagan Lake. This option includes building a low flow pump station located around Kin Beach and connecting to the existing separated agricultural pipes in Bella Vista and pumping all year round. The infrastructure needed is estimated to cost $2.6 M with a payback of approximately 10 years from reduced operating and treatment costs.

Long Term Water Supply Options for GVW

As GVW has a large agricultural base with varying separation options (i.e. none, partial or full separation) and uses two water sources with another source potentially available (Okanagan Lake), a total of nine (9) different conceptual long term water supply options for GVW were developed. A detailed cost analysis was completed of each option by estimating the capital costs, O&M costs and the Net Present Value (NPV) that examined lifecycle costs over 50 years. However, for such a vital service, costs alone should not be the only consideration in assessing the options, as the least inexpensive option may not be the most appropriate. Hence, each option was rated based on weighted non-cost considerations to advance the recommended option.

Table 1 provides an overview of the non-cost consideration criteria used and their respective rating. Table 2 provides a summary of the nine (9) options, the main infrastructure needs, capital costs, net annual increase in O&M costs and NPV. It also includes the rating of the Average Benefit to Cost Ratio (BCR) (Capital) and the Average BCR (NPV). The O&M costs takes into consideration the annual electric power cost, O&M costs per length of pipe and treatment costs based on flows. The NPV included the capital and O&M costs over a 50 year period with an inflation rate of 2% and a discount rate of 5%.

Table 1 (Based on Table 5.7 of TM9):

Non Cost Considerations Description	Weighting
System Operational Ease & Flexibility – addresses operation issues of two plants vs one, gravity system vs pumping, maintaining a single piped system vs twinned pipes.	15%
Governance & Administration Variances – examines cost allocation, administration, system expansion, backflow issues, public impressions and management of a combined system vs fully separated system agricultural system.	15%
Emergency Preparedness – examines the ability to respond to emergency situations, such as the loss of a facility due to earthquake, fire, contamination of source water etc. Options having two sources have a better ability to respond to emergencies that impact a source as are options that use the gravity are more resilient to large scale power outages.	10%
Average Finished Water Quality – based on the raw water quality of each source, there are some treated water variations between Kalamalka Lake, Okanagan Lake and Duteau Creek water which are reviewed in this valuation item. The potential impact from invasive species such as zebra and quagga mussels as well as the vulnerability to human impact on the long term viability of the source.	15%
Reliability & Availability of Supply – examines the likelihood that one or more sources will be unable to provide the required volumes of raw water under regular expected operating conditions. Includes consideration of drought, climate change, and interconnection if two sources used.	15%
Ease of Implementation – reviews the ability to implement the option in a timely manner resulting in the customers receiving Interior Health compliant treated water. Considers land acquisition, disruption to the public during construction, conflicts with other utilities, obtaining or transferring water license, government permits and approvals and implementing changes to the operation of the system.	10%
Future Expansion – assessed the ability of the system to respond/adjust to changing future needs in a cost effective and operationally efficient manner. Reviews the ability to expand the domestic and agricultural systems, deferring capital costs, incorporating new technology, adjusting to changing political or economic conditions.	10%
Environmental Impacts – considers the overall environmental impacts of the various options such as residual (waste) production, chemical use, carbon footprint, energy minimization, impact to natural water courses.	10%
Total Weighting	**100%**

Table 2 – Summary of Options, Financial Assessment and Benefit to Cost Ratio (BCR) Analysis

Option - Description	Capital Cost	Net Annual O&M	Total NPV	BCR - Capital	BCR - NPV
Option 1 – No Separation, Two Treatment Facilities: Only complete in-progress separation projects with minimal changes to the system. Large filtration facilities at MHWTP & DCWTP.	$89.1	$1.8	$113.7	55.97	43.87
Option 2 – Partial Separation, Two Treatment Facilities: Separation in Lavington with filtration facilities at MHWTP & DCWTP. Reduces capacity of filtration at DCWTP.	$108.2	$1.4	$123.8	51.98	45.45
Option 3 - Complete Separation, Two Treatment Facilities: Complete separation of domestic and agricultural with filtration at MHWTP & DCWTP. Much reduced capacity at DCWTP.	$146.2	$1.3	$155.8	45.06	42.29
Option 4 – Complete Separation, One Treatment Facility at MHWTP: Kalamalka Lake used only for potable source with increasing water availability from diverting Duteau Creek to Kal Lake and abandoning DCWTP. Duteau Creek only used for agriculture, requires full separation and significant upgrades to pump water upgradient to Duteau domestic customers.	$162.6	$0.9	$171.4	32.22	30.56
Option 5 – Complete Separation, One Treatment Facility at DCWTP: Duteau Creek used for potable source with treatment at DCWTP. Water availability to agricultural system would be increased by diverting Kal Lake to agricultural system and abandoning MHWTP. Requires full separation.	$148.0	$1.2	$161.8	40.28	36.85
Option 6 – Complete Separation, One Treatment Facility at MHWTP with Okanagan Lake Source: Okanagan Lake used for potable source with treatment at MHWTP and Duteau Creek used for agriculture. Requires substantial system upgrades to pump all water upgradient to MHWTP and domestic customers on Duteau Creek system. Also requires a long term filtration deferral and abandoning DCWTP.	$182.8	$1.3	$148.7	19.90	24.46
Option 7 – Complete Separation, One Treatment Facility at MHWTP with Additional Flow to Kalamalka Lake: Kalamalka Lake used for potable source with increasing water availability by moving King Edward and Coldstream Creek water licenses to Kal Lake. Abandoning DCWTP and Duteau Creek only used for agriculture. Requires full separation and upgrades to pump water upgradient to Duteau domestic customers.	$158.1	$0.9	$166.5	27.51	26.14
Option 8 – Complete Separation, Filtration at DCWTP, Filtration Deferral at MHWTP with Intake Extension: Assumes filtration deferral granted beyond the 50 year planning horizon on the Kalamalka Lake source with the intake extension and tower constructed for variable intake depths. Filtration will be added to a smaller DCWTP and supplied to Kalamalka Lake customers seasonally when water quality is not acceptable (high risk if filtration deferral criteria is not met long term).	$145.0	$0.41	$139.1	30.70	31.99
Option 9 - Partial Separation, One Treatment Facility at DCWTP: Similar to Option 2 but only install filtration at DCWTP to reduce capital and operating costs of 2 treatment plants. Separation only for large agricultural properties in Lavington.	$113.8	$1.4	$127.1	37.67	33.73

Some general notes from the financial analysis are as follows:

- The construction of 2 large water treatment plants has the lowest capital cost,
- Complete system separation has a higher capital cost than other options due to the expense of installing pipes,
- Separation within the Lavington area has a lower capital cost per ML ($0.38 M/ML) than the BX/East Vernon area ($0.60 M/ML) due to the larger agricultural fields resulting in much less pipe needing to be installed (36 km in Lavington (partial separation, 123 km in BX/East Vernon (full separation)),
- Single treatment plant options carry high capital cost premiums due to the need to complete full separation and build raw water transmission lines connecting the raw water sources, and
- Option 1 has the lowest NPV (cumulative additional cost) and is therefore the most viable candidate from a financial perspective. Option 2 is the next most viable candidate.

The ranking of the options using the non-cost considerations was completed separately and independently by the various stakeholder groups that formed the basis of the MWP Technical Advisory Committee (TAC); Regional District of North Okanagan, District of Coldstream, City of Vernon, Interior Health and representatives from the agricultural sector. Each group was required to rate each option from 1 to 9 for each criteria. Once completed, the consultant compiled the ratings from each group and calculated the BCR-capital and BCR-NPV for each group and the average based on all the groups rating of the options. Option 2 had the highest average ranking for the BCR-NPV and all groups rated Option 2 as either their first or second choice with the exception of the District of Coldstream. However, after discussion, there was consensus with all stakeholder groups that Option 2 would be the recommended option.

Option 2 was the recommended option brought forward to the RDNO Board of Directors. They endorsed Option 2 with an amendment that the recommendation will also include oversizing the transmission main when separating the agricultural and domestic source in the Lavington area to allow for complete system separation in the future.

Details of the Recommended Option 2 (TM9 - Table 4.4):

Description	Year	Cost ($ million)	Net Annual O&M Change ($ millions)
1. Water Supply and Treatment			
a. Duteau Creek Filtration – 110 ML/d	2017	$ 26.5	$ 0.12
b. Mission Hill Filtration – 56 ML/d	2022	$ 30.0	$ 0.84
c. Aberdeen Dam Improvements – Raise Dam by 4 m	2022	$ 6.41	-
d. Goose Lake Supply from Okanagan Lake	2014	$ 2.6	$ 0.16
e. Gold-Paradise Extension	2037	$ 3.60	-
Sub-Total Water Supply and Treatment		***$ 69.11***	***$ 1.12***
2. Domestic System Distribution Improvements			
a. Domestic System Investments		$ 9.80	$ 0.09
Sub-Total Domestic System Distribution Improvements		***$ 9.80***	***$ 0.09***
3. System Separation Implementation/Expansion			
a. Lavington System Separation	2017	$ 19.5	$ 0.21
b. Transmission Main	2017	$ 9.80	-
Sub-Total Agricultural Irrigation Improvements		***$ 29.3***	***$ 0.21***
TOTAL OPTION 2 CAPITAL COSTS		**$ 108.2**	**$ 1.42**

Note: Additional cost for oversizing the transmission main for complete separation = $3,5 M.