



# CONCEPTUAL WATER SERVICING REVIEW



## EXECUTIVE SUMMARY

In May 2013, the Town of Okotoks requested that BSEI review the CRP Servicing Study (*Summary Report – Planning and Technical Study on Water and Wastewater Servicing in the Calgary Region – Phase 3*) with respect to water servicing for the Town of Okotoks.

The report reviews population projections, servicing options, and cost estimates in the CRP Servicing Study. Additionally, the Town requested that the report explore additional options for supplying the Town of Okotoks' needs for a water supply.

With cooperation from the Town, the following servicing options have been developed for review:

- Option 1: Treated water from the City of Calgary.
- Option 2A: Raw water from the Bow River, directly north of Okotoks, to the existing water treatment plant.
- Option 2B: Raw water from the Bow River, directly north of Okotoks, to a new water treatment plant on the north side of Town.
- Option 3A: Raw water from the Highwood River to the existing water treatment plant.
- Option 3B: Raw water from the Highwood River, directly east of Okotoks, to a new water treatment plant on the north side of Town.

For each of the servicing options, two scenarios were considered:

- Supplement the Sheep River WTP
  - This scenario assumes the water supply from the Sheep River is retained and water from alternative water supplies (Calgary, Bow River or Highwood River) is used for future growth.
- Standalone Water Supply
  - This scenario assumes that the water from the Sheep River is no longer used. Water from Calgary, or the Bow River, or the Highwood River services the entire future population.

Based on recent census information, the Town of Okotoks has been increasing in population at a rate of about 1270 people per year. Using this rate, the Town of Okotoks will reach a population of approximately 58,000 people by the year 2038. A total cost of ownership is calculated for each servicing option assuming that the required infrastructure for each option is constructed and operational by 2015 and is operated and maintained until 2038. Future cash flows were indexed to 2012 dollars using the consumer product index.

Cost estimates for each option were prepared using a variety of tools. WTP construction cost estimates were prepared based on recent construction projects, and published cost estimating curves. The published curves closely correlated with the CRP construction cost estimates.

WTP O&M was estimated based on a study by Stats Canada and the estimated O&M costs at the Town's existing WTP. Both of these pieces of information agreed with the O&M estimates used in the CRP report.

Pipeline construction estimates were prepared using values from a 600mm water line project that was recently completed by BSEI from Calgary to one of its regional customers. Each pipeline option considered a conceptual alignment to create a unique cost estimate for each alignment. The energy costs for the pipeline are based on geography and hydraulic grade lines.

The costs of options involving receiving treated water from the City of Calgary are significantly and directly related to the cost of bulk water. Several years of data has been analyzed, and the assumption that the City's bulk water rate will increase at 3.7 cents/m<sup>3</sup>/year is used throughout this report. The bulk water rate is key to the calculation of the total cost of ownership for servicing options from Calgary.

The resulting costs for each option and scenario are summarized in the following table.

	Option 1		Option 2A		Option 2B		Option 3A		Option 3B	
	Pipeline from Calgary		Bow River to Existing WTP		Bow River to New WTP		Highwood to Existing WTP		Highwood to New WTP	
	Supplement	Standalone	Supplement	Standalone	Supplement	Standalone	Supplement	Standalone	Supplement	Standalone
<b>Water Supply</b>										
Source Construction	\$0.0 M	\$0.0 M	\$1.5 M	\$1.8 M	\$1.5 M	\$1.8 M	\$1.5 M	\$1.8 M	\$1.5 M	\$1.8 M
Source O&M	\$0.0 M	\$0.0 M	\$1.0 M	\$1.2 M	\$1.0 M	\$1.2 M	\$1.0 M	\$1.2 M	\$1.0 M	\$1.2 M
Raw Water Storage	\$0.0 M	\$0.0 M	\$1.2 M	\$2.5 M	\$0.1 M	\$0.2 M	\$1.2 M	\$2.5 M	\$0.1 M	\$0.2 M
Bulk Water Charge	\$28.7 M	\$84.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M
Additional Water License	\$0.0 M	\$0.0 M	\$27.8 M	\$27.8 M	\$27.8 M	\$27.8 M	\$27.8 M	\$27.8 M	\$27.8 M	\$27.8 M
<b>Pipeline</b>										
Pipeline Construction	\$18.2 M	\$19.4 M	\$24.1 M	\$25.7 M	\$17.6 M	\$18.8 M	\$15.3 M	\$16.3 M	\$7.8 M	\$8.4 M
Pipeline Pump Construction	\$1.2 M	\$1.9 M	\$2.2 M	\$3.8 M	\$2.4 M	\$4.1 M	\$1.2 M	\$2.1 M	\$1.9 M	\$3.2 M
Pipeline Pump Maintenance	\$0.8 M	\$1.3 M	\$1.5 M	\$2.6 M	\$1.7 M	\$2.8 M	\$0.8 M	\$1.4 M	\$1.3 M	\$2.2 M
Pipeline Energy Cost	\$1.8 M	\$5.7 M	\$5.5 M	\$11.8 M	\$5.9 M	\$12.7 M	\$3.1 M	\$6.6 M	\$5.3 M	\$11.4 M
Pipeline Maintenance	\$5.9 M	\$5.9 M	\$6.3 M	\$6.3 M	\$5.3 M	\$5.3 M	\$3.8 M	\$3.8 M	\$2.5 M	\$2.5 M
<b>Water Treatment Plant</b>										
New WTP Construction	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$16.0 M	\$25.0 M	\$0.0 M	\$0.0 M	\$16.0 M	\$25.0 M
Raw Water Storage Construction	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$1.2 M	\$2.5 M	\$0.0 M	\$0.0 M	\$1.2 M	\$2.5 M
New WTP O&M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$19.4 M	\$28.5 M	\$0.0 M	\$0.0 M	\$19.4 M	\$28.5 M
Sheep River WTP Construction/Upgrade	\$0.0 M	\$0.0 M	\$25.0 M	\$25.0 M	\$0.0 M	\$0.0 M	\$25.0 M	\$25.0 M	\$0.0 M	\$0.0 M
Sheep River WTP O&M	\$23.3 M	\$5.8 M	\$28.5 M	\$28.5 M	\$19.4 M	\$5.8 M	\$28.5 M	\$28.5 M	\$19.4 M	\$5.8 M
<b>Additional Treated Water Storage</b>										
Construction	\$17.8 M	\$38.4 M	\$17.8 M	\$38.4 M	\$0.0 M	\$0.0 M	\$17.8 M	\$38.4 M	\$0.0 M	\$0.0 M
<b>CAPITAL \$2012</b>	\$37.2 M	\$59.7 M	\$99.6 M	\$125.0 M	\$66.6 M	\$80.2 M	\$89.8 M	\$113.9 M	\$56.3 M	\$68.9 M
<b>TOTAL COST OF OWNERSHIP</b>	\$97.7 M	\$162.4 M	\$142.4 M	\$175.4 M	\$119.3 M	\$136.5 M	\$127.0 M	\$155.4 M	\$105.2 M	\$120.5 M



The following observations can be made by analyzing the cost estimates and reviewing the total costs of ownership for each of the options:

1. The total costs of ownership for options considering servicing from the City of Calgary are significantly and directly influenced by:
  - a. The City of Calgary bulk water rate.
  - b. The cost of treated water storage.
2. Storing treated water costs approximately 100 times more than storing the same volume of raw water. Therefore, options including raw water storage at the North WTP, which mitigate the requirement for treated water storage, have lower total costs of ownership.
3. In general, retaining the Sheep River WTP and supplementing the Town with an alternate supply of water costs less than supplying the entire Town's population with an alternate, standalone, water supply.
4. Although the options considering servicing from the Highwood River have low total costs of ownership, the likelihood of procuring sufficient water licensing is low. Additionally, the Highwood River may not be able to yield sufficient water to meet the Town's demand. The actual volume of water available in the Highwood River was not reviewed in this report.
5. Building a pipeline to the existing Sheep River WTP costs significantly more than a pipeline to a North WTP because of the river crossing and the urban roadway rehabilitation that would be required.
6. Estimates involving a pipeline from the Bow River, originating at the confluence of the Highwood River and the Bow River, yielded approximately an eight million dollar increase in cost when compared to a pipeline from Bow River directly north of Okotoks. For this reason, a pipeline from the confluence of the Bow and Highwood was not considered in detail in this report.

We trust this report satisfies your current requirements and provides suitable documentation for your records.

If you should have any comments or questions, please do not hesitate to contact the undersigned.



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Principal/Project Engineer

SPD/daf

## Table of Contents

1. Introduction .....	1
2. Population Projections.....	2
3. Cost Indexing.....	3
3.1. Consumer Product Index.....	3
3.2. Net Present Value and Total Cost of Ownership .....	3
4. City of Calgary Bulk Water Rate .....	4
5. Cost Estimating Tools.....	5
5.1. Water Supply.....	5
5.2. Water Treatment .....	5
5.2.1. Capital Costs.....	5
5.2.2. Operations & Maintenance Costs .....	6
5.3. Pipeline.....	9
5.3.1. Pipeline Capital Costs.....	9
5.3.2. Energy Costs.....	9
5.3.3. Maintenance Costs.....	9
5.4. Treated Water Storage .....	9
6. Servicing Options .....	10
6.1. Common Assumptions .....	11
6.2. Option 1 – Treated Water Pipeline from Calgary .....	12
6.2.1. Supplement Sheep River WTP .....	12
6.2.2. Standalone Water Supply .....	14
6.3. Option 2A – Bow River to Sheep River WTP .....	16
6.3.1. Supplement Sheep River WTP .....	16
6.3.2. Standalone Water Supply .....	18
6.4. Option 2B – Bow River to North WTP .....	20
6.4.1. Supplement Sheep River WTP .....	20
6.4.2. Standalone Water Supply .....	22
6.5. Option 3A – Highwood River to Sheep River WTP.....	24
6.5.1. Supplement Sheep River WTP .....	24

6.5.2.	Standalone Water Supply .....	26
6.6.	Option 3B – Highwood River to North WTP.....	28
6.6.1.	Supplement Sheep River WTP .....	28
6.6.2.	Standalone Water Supply .....	30
6.7.	Total Cost of Ownership.....	32
6.7.1.	Supplement Sheep River WTP .....	33
6.7.2.	Standalone Water Supply .....	34
6.8.	Observations .....	35

## 1. INTRODUCTION

In May 2013, the Town of Okotoks requested that BSEI review the CRP Servicing Study (*Summary Report – Planning and Technical Study on Water and Wastewater Servicing in the Calgary Region – Phase 3*) with respect to water servicing for the Town of Okotoks.

This report reviews population projections, servicing options, and cost estimates in the CRP Servicing Study. Additionally, this report explores additional options for supplying the Town of Okotoks' needs for a water supply.

With cooperation from the Town, the following servicing options have been developed for review:

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- Option 3B: Raw water from the Highwood River to a new water treatment plant

Conceptual pipeline alignments have been prepared for the purposes of cost estimating and were selected based on geography and engineering related attributes. The alignments are conceptual only.

This report reviews the total costs of ownership for each of the options.

No wastewater servicing issues were considered, nor were decisions related to the triple bottom line approach used in the CRP Servicing Study.

We thank the Town of Okotoks administration for the opportunity and their assistance in preparing this report.

## 2. POPULATION PROJECTIONS

Extensive population data for the Town of Okotoks was available from various federal and municipal censuses. The following census data was used for analyzing population projections:

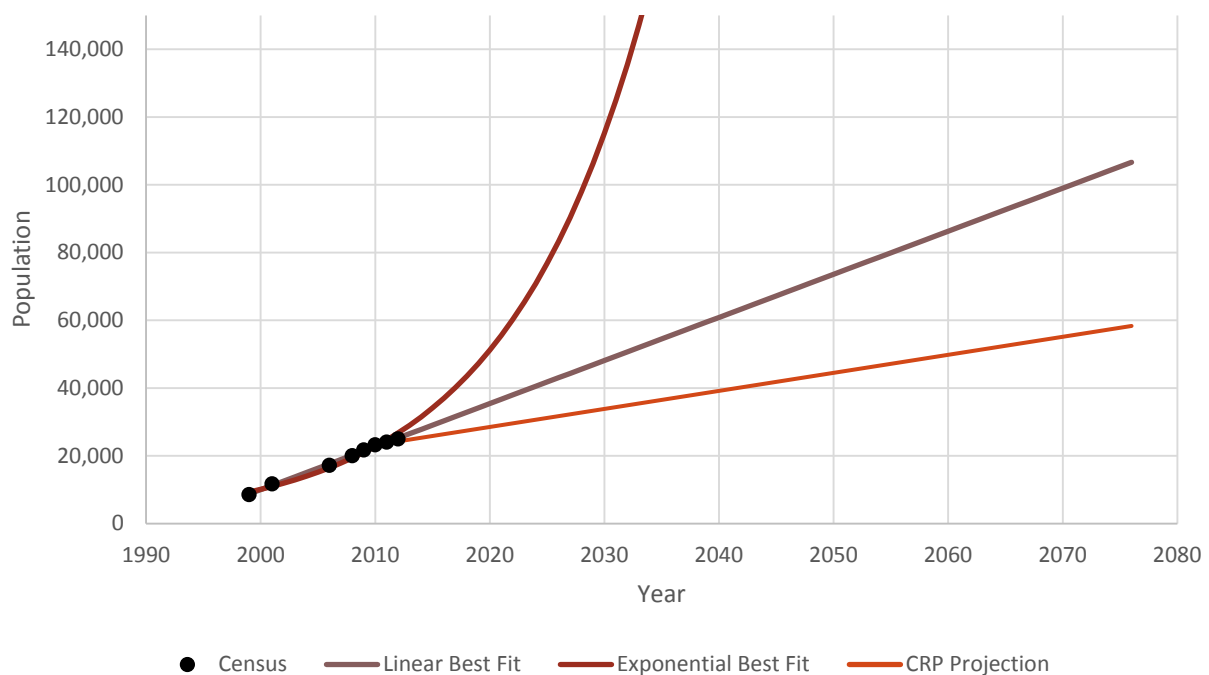
Year	1999	2001	2006	2008	2009	2010	2011	2012
Census	8528	11664	17145	19996	21690	23201	23981	24962

Linear population projections assume a fixed yearly growth rate. Based on a best fit line obtained from the available census data, Okotoks has grown at a rate of 1,271.5 people per year.

Alternatively, a best fit exponential curve shows that the Town of Okotoks has grown at a rate of 8.1% annually over the data collection period. 8.1% is exceptionally high but illustrates the exceptionally high growth rate that the Town has experienced over the past decade (192% in 13 years).

The CRP Servicing Study has assumed that the Town of Okotoks will have a population of 58,338 by the year 2076. The CRP Servicing Study assumes linear growth at a rate of 532.4 people per year.

Census Vs. Various Population Projections



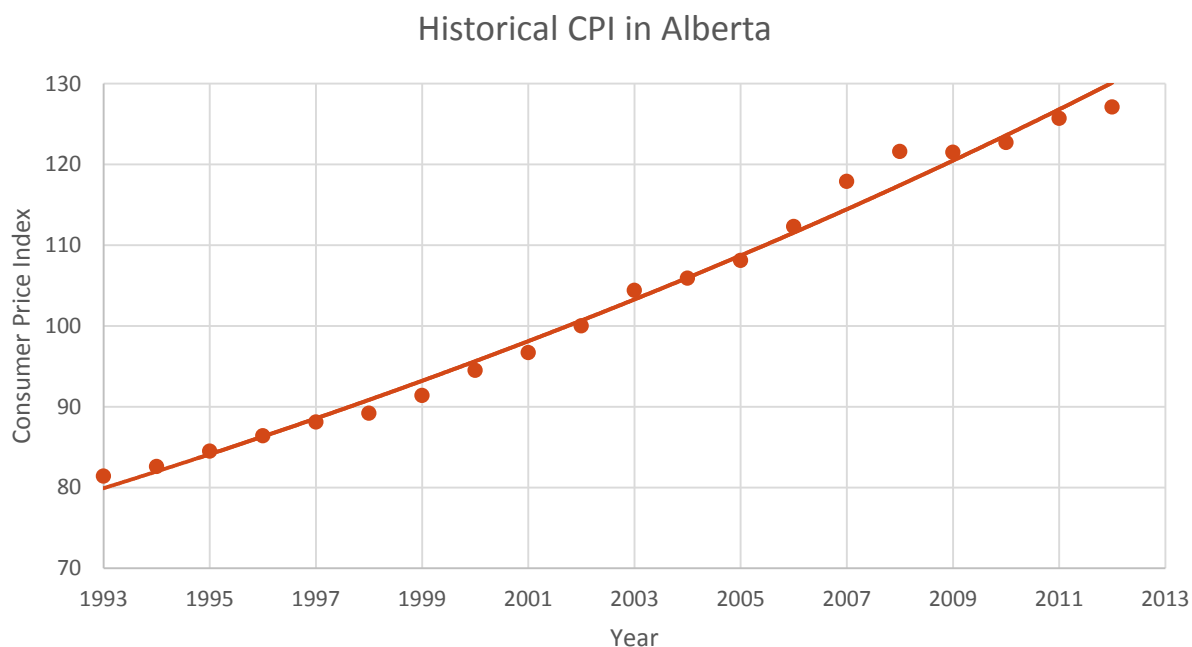
Based on discussions with the Town of Okotoks, this report will assume that population will increase according to the linear best fit line, or 1271.5 people per year. Using this projection, the Town of Okotoks will reach approximately 58,000 people by the year 2038. This population aligns with the population used in the CRP Servicing Study, although the year in which it is reached differs between this report and the CRP Servicing Study.

### 3. COST INDEXING

#### 3.1. Consumer Product Index

In order to forecast the future operations and maintenance costs for each of the options developed in this report, a measure of inflation must be established. The Consumer Price Index (CPI) is a measure of cost for a fixed basket of goods and services. Stats Canada has monitored the CPI in Alberta since 1988.

To establish a trend, a line has been fit to the past 20 years CPIs in Alberta.



The best fit line increases exponentially at a rate of 2.57% per year.

For the purposes of this report, CPI will be assumed to increase at a rate of 2.6% and will be used to forecast the future costs of goods and services.

#### 3.2. Net Present Value and Total Cost of Ownership

Net Present Value (NPV) is a tool that is used to index past and future cash flows to present value, or today's dollars. The discount rate in the NPV formula is key to the calculation. The discount rate can be considered the rate of return one would expect to gain if it were invested elsewhere. To put this in perspective, a \$1,000,000 GIC for a 10 year term currently pays about 2% interest annually. Investments involving more risk could yield a higher return rate.

For the purposes of this report, the discount rate for the NPV calculation is considered to be the same as CPI, 2.6%. NPV is used in this report to index future cash expenditures to 2012 dollars to determine the Total Cost of Ownership for each of the servicing options.

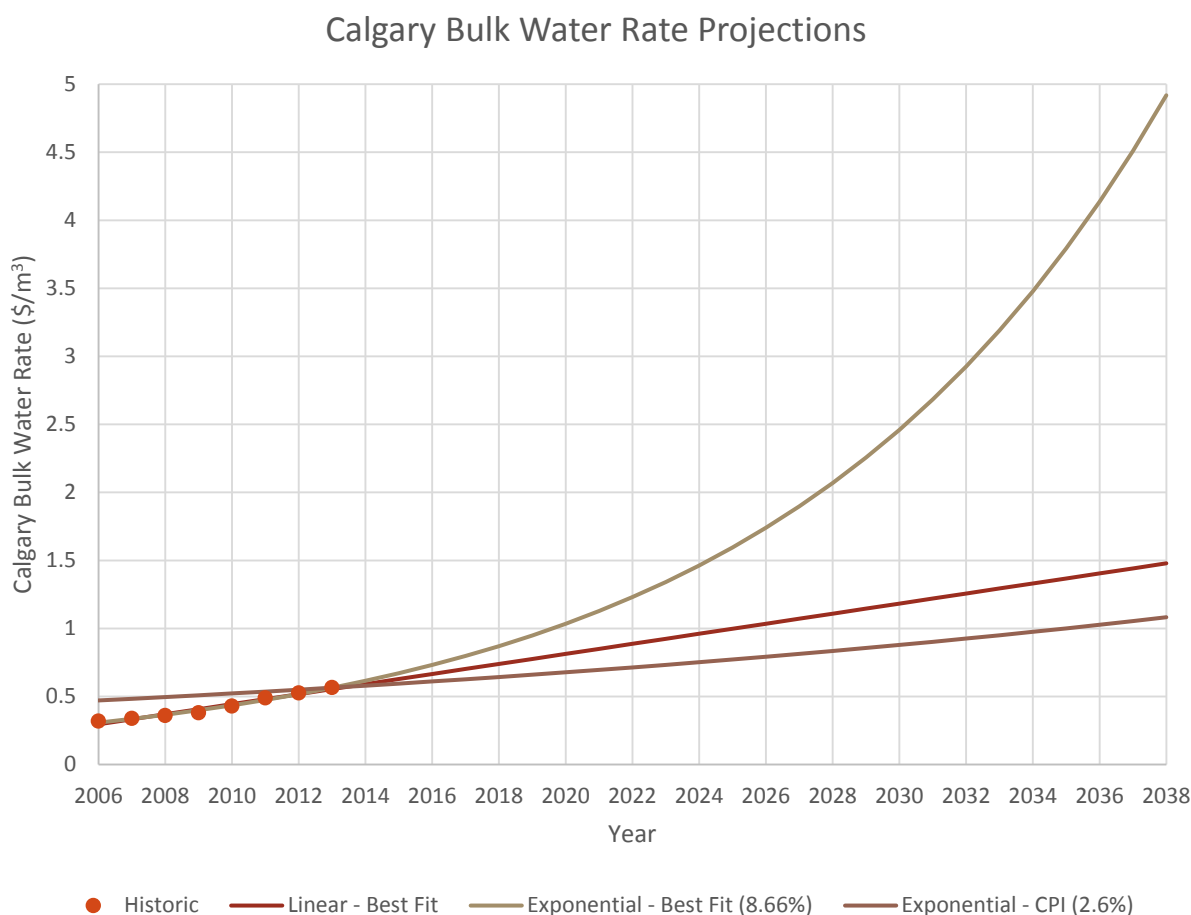


#### 4. CITY OF CALGARY BULK WATER RATE

For options considering the use of a treated water pipeline from Calgary the cost of bulk water needs to be considered. We are required to understand what the cost of bulk water from Calgary is likely to cost in the future. In order to do this, the historical bulk water rates are reviewed to establish a trend. The historical bulk water rates charged by the City of Calgary are as follows:

Year	2006	2007	2008	2009	2010	2011	2012	2013
Rate (\$/m <sup>3</sup> )	.3180	.3379	.3591	.3799	.4288	.4885	.5256	.5650

The historic rates are shown below as orange dots. Linear (\$0.037/year) and exponential (8.66%/year) best-fit lines have been applied to the historical data to project future bulk water rates. The chart also shows that projected rate if the bulk water demand followed the CPI projection (2.6%/year).



This report assumes that the bulk water rate charged by the City of Calgary will increase at a rate equal to the linear – best fine line at \$0.037/year.

## 5. COST ESTIMATING TOOLS

Similar to the CRP report, a collection of tools must be used to estimate the capital and operating costs for each portion of the proposed servicing options. Where possible, the curves used in the CRP report are compared against alternative cost estimating tools. Positive correlation with the CRP developed tools and the alternatives used in this report provide confidence to the Town that the tools used in the servicing reports are appropriate.

Class 5 cost estimates were prepared for this report with an expected accuracy range of +70/-35%.

### 5.1. Water Supply

For options requiring a river intake, an infiltration gallery has been assumed. The cost for an intake for 28,000 people is estimated to cost \$1,500,000 and an intake for 58,000 people is estimated to cost \$1,800,000.

Certain options will require raw water storage reservoirs at the river intake. An open air reservoir is estimated to cost \$10,000 per megalitre of raw water storage required.

For options requiring additional water licenses, it is assumed to cost \$11,000 per acre-foot.

For the options obtaining treated water from the City of Calgary, the bulk rate as discussed in the previous section was used.

### 5.2. Water Treatment

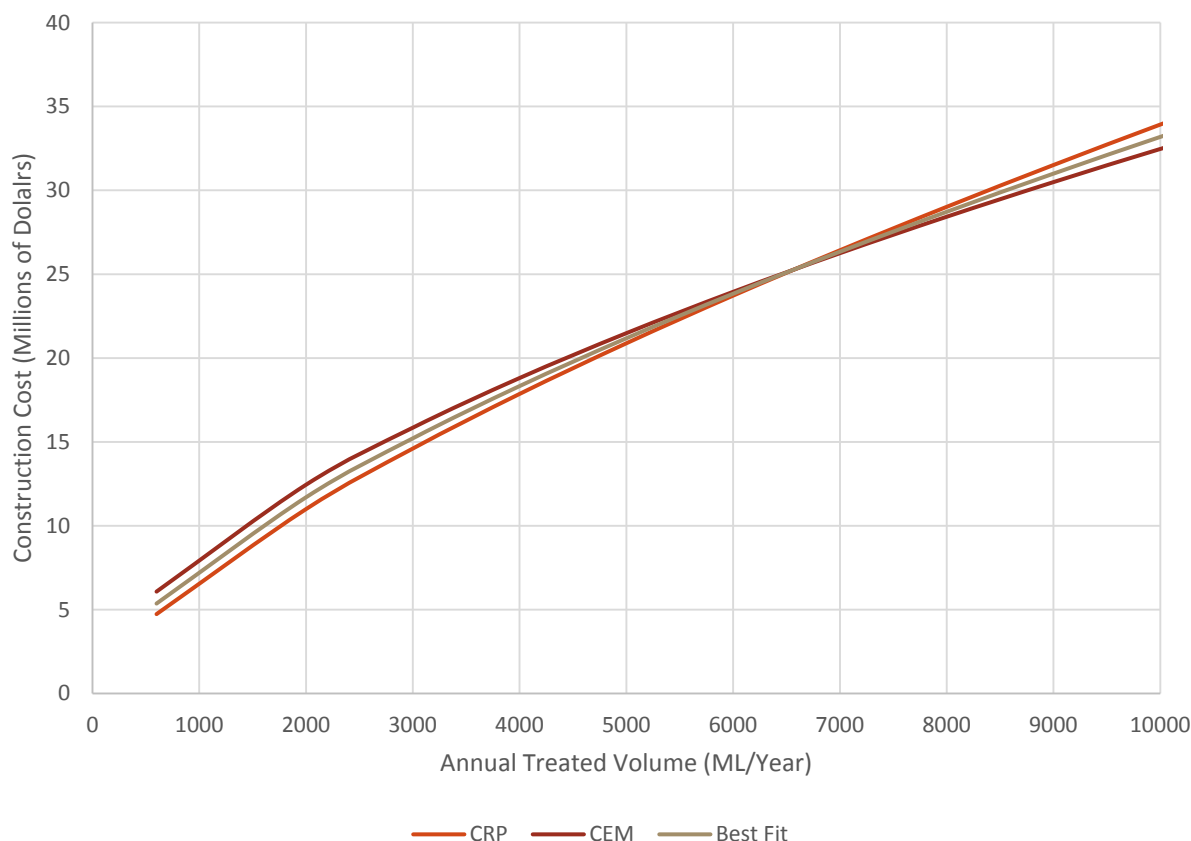
#### 5.2.1. Capital Costs

The CRP report has established a cost curve for estimating the construction of water treatment plants using three WTPs from the region and two from other places in Canada.

For comparison, this report will use cost curves from the reference text “Cost Estimating Manual for Water Treatment Facilities” (*CEM*) authored by William McGivney and Susumu Kawamura. The text includes information from construction cost estimates for more than 500 water treatment plant projects. One of the authors, Susumu Kawamura, was inducted into the AWWA Water Industry Hall of Fame in 2008.

The chart on the following pages illustrates both the CRP developed cost curve and the cost curve for a conventional water treatment plant from the CEM.

## Comparison of WTP Construction Cost Curves



The curves from both the CRP and the CEM very closely correlate. This report will use a curve that is best fit between the CRP and CEM. The curve is represented by the equation:

$$\text{Construction Costs (\$2012)} = 85027.35262 \times \text{Annual Treated Volume (ML/Year)}^{0.64785}$$

Certain options will require raw water storage reservoirs at the WTP. An open air earthen reservoir is estimated to cost \$10,000 per megalitre of raw water storage required.

## 5.2.2. Operations & Maintenance Costs

### 5.2.2.1. Okotoks Historical O&M

In 2006, Stats Canada published information regarding Operations and Maintenance (O&M) costs for Water Treatment Plants (WTPs). In the years 2005 through 2007, the total costs attributed to O&M for WTPs in Alberta are categorized as Materials, Labour, Energy, and Other. The proportion of the total O&M cost, for each category, is as follows:

Category	Materials	Labour	Energy	Other
Percentage of Total	34.70%	34.00%	19.05%	12.25%

At the time this report was being written, the Town of Okotoks didn't have specific information regarding the total O&M cost for the existing water treatment plant. The Town contracts EPCOR to operate and maintain the water treatment, water distribution, waste water collection and wastewater treatment facilities. EPCOR is in the process of reporting the cost breakdown for each facility.

The Town was able to provide the total energy costs (*electricity and natural gas*) for the WTP. Using the proportions obtained from Stats Canada, the total cost of O&M for the existing WTP can be estimated.

Year	Material	Labour	Energy	Other	Total
2010	\$263,587.03	\$258,269.71	\$144,707.00	\$93,053.06	\$759,616.80
2011	\$328,163.64	\$321,543.62	\$180,159.00	\$115,850.28	\$945,716.54
2012	\$331,883.19	\$325,188.14	\$182,201.00	\$117,163.37	\$956,435.70

Using the total treated water volume for each of these years, a cost per megalitre can be calculated. The Town has indicated that the estimated total O&M costs for the Sheep River WTP are within the expected range when the cost of distributing water is included. The costs are adjusted to 2012 dollars and will be used later to compare against the O&M cost estimating curve.

Year	Volume (m <sup>3</sup> )	\$2012/ML
2010	2,551,147	\$313.65
2011	2,975,633	\$326.19
2012	2,787,671	\$343.09

#### 5.2.2.2. Cost Estimating Curves

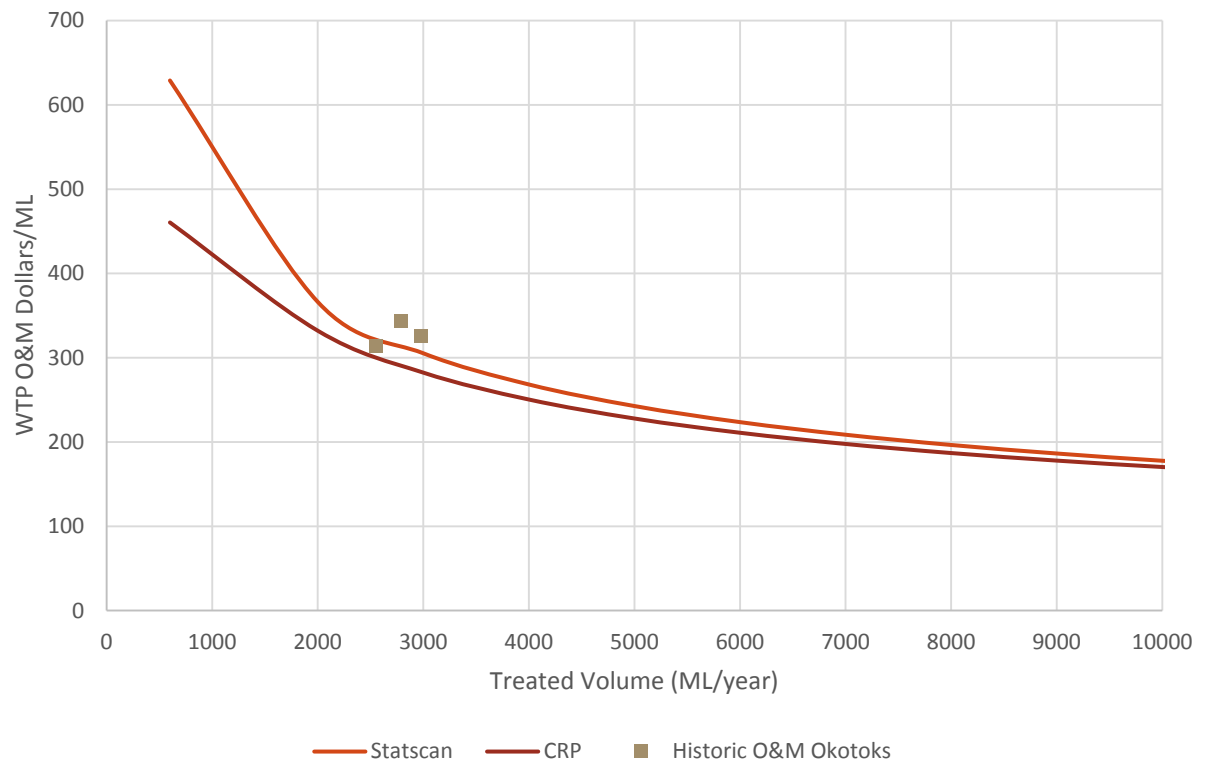
The CRP report used a variety of equations for power, heating, labour, chemicals, and repair/maintenance to estimate the total O&M costs for a water treatment plant. For simplicity, this report has combined the equations used in the CRP Report into a single curve.

In 2006, Stats Canada published data regarding the O&M costs for WTPs. The data includes a curve that predicts the O&M costs per volume of water treated relative to the total annual treated water.

Both the CRP and Stats Canada O&M cost estimating curves are shown in the figure on the following page. Additionally, the estimated O&M costs established in the previous section are shown for comparison.

The CRP and Stats Canada Curve, as well as the estimated Sheep River WTP O&M costs, include water distribution costs from the water treatment facility.

### WTP O&M Costs (\$2012 per ML) vs Annual Treated Volume



The Statscan, CRP, and Historic O&M costs all closely correlate. This report uses the Stats Canada cost curve for the purposes of estimating WTP O&M costs.

### 5.3. Pipeline

#### 5.3.1. Pipeline Capital Costs

A cost estimate was prepared for each pipeline using a conceptual alignment. By using this approach, each estimate will account for construction costs that are unique to each alignment such as highway and river crossings, procurement of utility right of ways, road rehabilitation, pipe costs, and open trench vs. trench-box installation.

#### 5.3.2. Energy Costs

For each option the estimated pumping power will be used to calculate the energy cost for operating the pipeline. The pumping power is a function of the elevation profile of the conceptual pipeline, the pipe diameter, and the average day flow requirements for the year being calculated. The cost of power is assumed to increase at the same rate as the CPI. All energy costs will be indexed to 2012 dollars, totalized, and used to calculate total cost of ownership for each option.

#### 5.3.3. Maintenance Costs

Pipeline maintenance is a function of the overall length of the pipeline. A municipality that currently receives water from Calgary via pipeline currently budgets approximately \$16,000/km/year for pipeline maintenance. Maintenance also includes maintaining the booster/transfer pumps associated with each option. These costs are assumed to increase at the same rate as the CPI. All maintenance costs will be indexed to 2012 dollars, totalized, and used to calculate total cost of ownership for each option.

### 5.4. Treated Water Storage

The costs for constructing a concrete underground reservoir to store treated water are estimated to be approximately \$1,000,000 per required megalitre of storage. These costs include the associated distribution pumping system.



## 6. SERVICING OPTIONS

In discussions with the Town of Okotoks, a variety of servicing options have been developed. This section describes each of the options and the assumptions made. Each option has had the cost estimating tools as discussed in the previous section applied to them to establish their total costs of ownership.

The developed servicing options are:

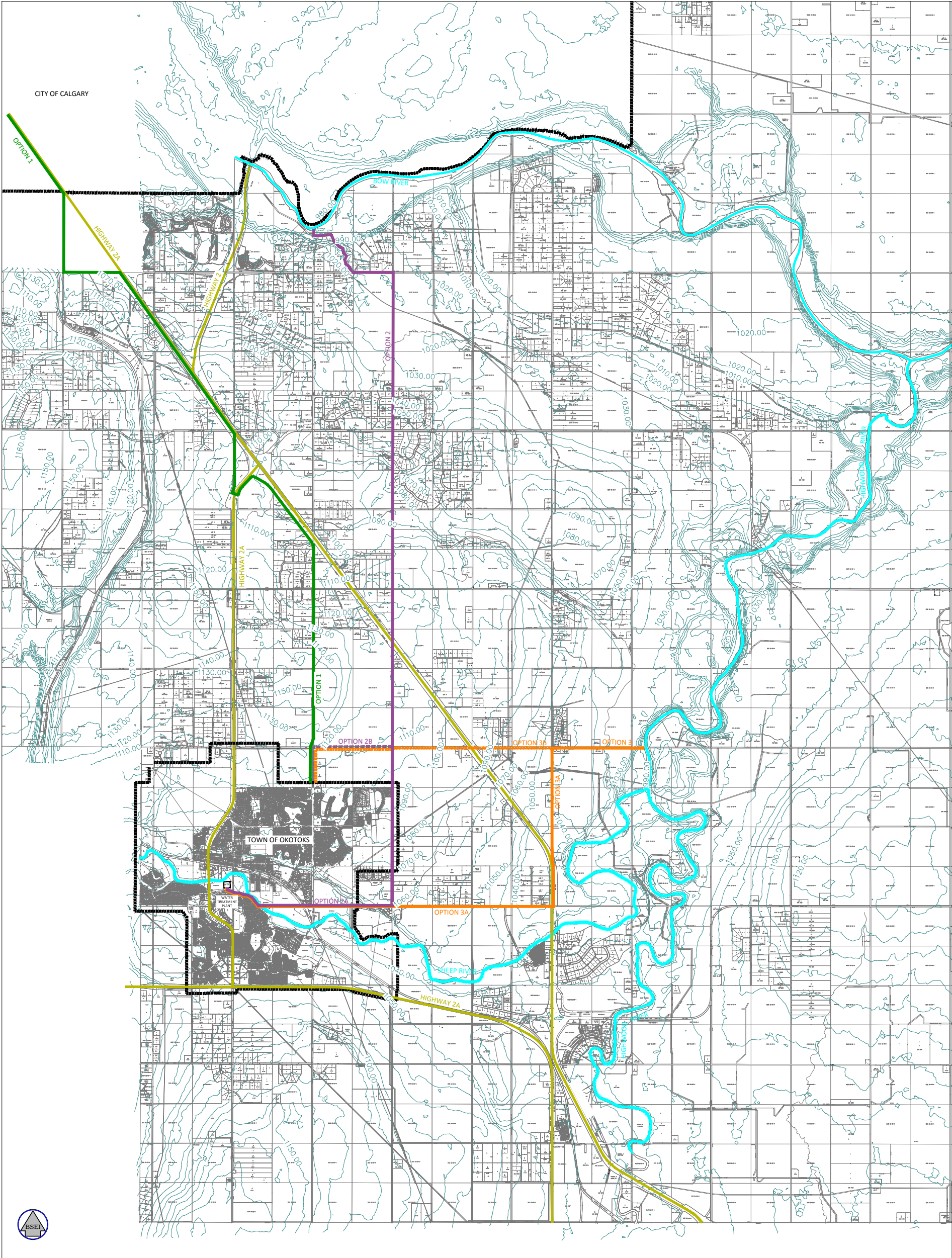
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For each of the servicing options, two scenarios were considered:

- Supplement the Sheep River WTP
  - This scenario assumes the water supply from the Sheep River is retained and water from alternative water supplies (Calgary, Bow River or Highwood River) is used for future growth.
- Standalone Water Supply
  - This scenario assumes that the water from the Sheep River is no longer used. Water from Calgary, or the Bow River, or the Highwood River services the entire future population.

Options considering servicing from the Highwood River may encounter difficulty in the actual procurement of the required water license. Additionally, the Highwood River may not be able to yield sufficient water to meet the Town's demand. The actual volume of water available in the Highwood River was not reviewed in this report. The Highwood River options have been considered for the purposes of comparison from a cost perspective.

The following sections develop construction and operating costs for each option and scenario and discuss the assumptions made.



TOWN OF OKOTOKS

WATER SUPPLY OPTIONS



- MAJOR HIGHWAYS
- MUNICIPAL BOUNDARY
- EXISTING GROUND CONTOUR
- OPTION 1
- OPTION 2
- OPTION 3

## 6.1. Common Assumptions

The following assumptions have been made and are common to all the servicing options and scenarios:

- The Town of Okotoks will reach approximately 58,000 people in the year 2038.
- The Town of Okotoks has enough water license from the Sheep River to allow the Town to grow to 30,000 people.
- The average day demand (ADD) is equal to 305 L/capita/day.
- The maximum day demand is equal to 1.75 x ADD.
- The Consumer Product Index increases at a rate equal to 2.6% annually.
- Electricity costs \$0.15/kilowatt-hour in 2012 dollars. This rate increases at a rate equal to the Consumer Product Index.
- All required infrastructure will be built by 2015.
- All annual O&M expenses are considered to increase a rate equal to Consumer Product Index.
- All costs are calculated in 2012 dollars. Future costs are indexed to 2012 dollars using the Consumer Product Index.
- The City of Calgary bulk rate has increased exponentially at a rate of 8.6% annually for the past 8 years. This report assumes a more conservative annual adjustment at a rate of 3.7 cents/m<sup>3</sup> per year (approximately equal to 3.9% annually)
- All cost estimates include engineering and contingency and are rounded to the near \$100,000.
- Treated Water Storage
  - For populations served by a pipeline required storage is equal to three times the average day demand.
  - For populations served by the existing WTP, storage is determined by Alberta Environment's formula.
  - For populations served by a WTP with local raw water storage, treated water storage is determined by Alberta Environment's formula.
- No raw water storage can be constructed at the Sheep River WTP site.
- Raw water storage can be constructed at a new WTP site.
- Two weeks' worth of raw water storage is required from a river intake. This assumes junior water licenses are used. This is in the event that diversion from a river is restricted due to river stress conditions.
- Pipeline pumping is sized for maximum day demand. Pipeline energy costs are determined using average day flow rates for a given population.
- Pipelines are assumed to be constructed in MD road right of ways where possible.
- New water treatments plants deliver conventional treatment and consist of flocculation, sedimentation, filtration, and disinfection.
- Land costs for WTPs and reservoir are not included.
- All options and scenarios assume the operational costs associated with distributing water to the Town are included with WTP O&M.
- The Bow River is considered a reliable and sustainable water source for the future.



## 6.2. Option 1 – Treated Water Pipeline from Calgary

### 6.2.1. Supplement Sheep River WTP

A pipeline from the City of Calgary delivers treated water to Okotoks to supplement the existing Sheep River WTP to a total population of 58,000. The City of Calgary charges a bulk rate to the Town of Okotoks which is currently \$0.565/m<sup>3</sup> (2013). As previously mentioned, the projected cost for bulk water from the City of Calgary is increasing at a rate greater than the CPI. This report assumes an increase in bulk water pricing at \$0.037/m<sup>3</sup> per year.

Growth fees charged to regional customers that are supplied water from the City of Calgary are currently being negotiated between municipalities. Additional fees charged by the City, applying to new development in the Town, have not been included in the cost estimates in this scenario.

#### Supply

A treated water pipeline connects to the City of Calgary water system at MacLeod Trail and 210 Avenue. The cost to upgrade the required infrastructure up to the connection point in the City of Calgary was not included in this report.

It is assumed the supply will be commissioned in 2015 and operational costs consist of the total amount paid for bulk water from the City of Calgary between 2015 and 2038.

Estimated Capital Costs	\$0
Estimated Total Operational Costs (2015 to 2038)	\$28,700,000

#### Pipeline

The conceptual pipeline is 450mm in diameter and approximately 16.0km long. Vaults containing isolation valves and combination air valves are located approximately every 1.5km along the alignment.

A booster pump system is required to lift treated water to a treated water reservoir on the north side of the Town of Okotoks. Assuming a suction head pressure of 42m, a booster pump station will require approximately 256HP in pump power to deliver maximum day flow to the Town. A flow meter chamber is required by the City of Calgary near their boundary and has been included in the cost estimate.

Starting in 2015, the pipeline is assumed to service 1000 people. When the Sheep River WTP reaches a service population of 30,000 people, the Calgary pipeline's service population increases until the population of the entire Town reaches 58,000.

Operational and Maintenance costs for the pipeline include energy costs, maintenance costs for the associated pump stations, and maintenance costs for the pipeline itself.

Estimated Capital Costs	\$19,400,000
Estimated Total Operational Costs (2015 to 2038)	\$8,500,000

## Water Treatment

The existing Sheep River WTP can service the maximum population for which water license is currently held on the Sheep River. The maximum population that can be serviced from the Sheep River WTP is assumed to be 30,000.

The operations and maintenance costs for the Sheep River WTP are assumed to be for approximately 29,000 people in 2015 and for 30,000 people for each subsequent year until the year 2038.

Estimated Capital Costs	\$0
Estimated Total Operational Costs (2015 to 2038)	\$23,300,000

## Treated Water Storage

Water from Calgary is stored in treated water reservoirs in the Town in addition to the water produced from the Sheep River WTP. The population served by the Sheep River WTP (30,000) is assumed to store water according to the Alberta Environment's Standards and Guidelines. The population served by the City of Calgary pipeline should store enough water for three days. This allows for up to three days to deal with problems with the pipeline.

The following table illustrates the assumed storage requirements:

Source	Population Served	Required Treated Storage	Existing Usable Storage	Additional Storage Required
Calgary	28,000	25,600 m <sup>3</sup>	---	---
Sheep River	30,000	6,800 m <sup>3</sup>	---	---
Total	58,000	32,400 m <sup>3</sup>	14,600 m <sup>3</sup>	17,800 m <sup>3</sup>

Estimated Capital Costs	\$17,800,000
Estimated Total Operational Costs (2015 to 2038)	\$0

### 6.2.2. Standalone Water Supply

A pipeline from the City of Calgary delivers treated water to the Town of Okotoks for the total projected population of 58,000. The City of Calgary charges a bulk rate to the Town of Okotoks which is currently \$0.565/m<sup>3</sup> (2013). As previously mentioned, the projected cost for bulk water from the City of Calgary is increasing at a rate greater than the CPI. This report assumes a conservative increase in bulk water pricing at \$0.037/m<sup>3</sup> per year.

Growth fees charged to regional customers that are supplied water from the City of Calgary are currently being negotiated between municipalities. Additional fees charged by the City, applying to new development in the Town, have not been included in the cost estimates in this scenario.

#### Supply

A treated water pipeline connects to the City of Calgary water system at MacLeod Trail and 210 Avenue. The cost to upgrade the required infrastructure up to the connection point in the City of Calgary was not included in this report.

It is assumed the supply will be commissioned in 2015 and operational costs consist of the total amount paid for bulk water from the City of Calgary between 2015 and 2038.

Estimated Capital Costs	\$0
Estimated Total Operational Costs (2015 to 2038)	\$84,000,000

#### Pipeline

The conceptual pipeline is 600mm in diameter and approximately 16.0km long. Vaults containing isolation valves and combination air valves are located approximately every 1.5km along the alignment.

A booster pump system is required to lift treated water to a treated water reservoir on the north side of the Town of Okotoks. Assuming a suction head pressure of 42m, a booster pump station will require approximately 520HP in pump power to deliver maximum day flow to the Town.

Starting in 2015, the pipeline is assumed to service the entire population and the existing Sheep River WTP is decommissioned.

Operational and maintenance costs for the pipeline include energy costs, maintenance costs for the associated pump stations, and maintenance costs for the pipeline itself.

Estimated Capital Costs	\$21,300,000
Estimated Total Operational Costs (2015 to 2038)	\$12,900,000



## Water Treatment

In this scenario, the treated water pipeline from Calgary services the Town's entire population. The Sheep River WTP is decommissioned. However, the treated water storage and distribution pumping system remains in service. The operational costs are for the treated water reservoir and pumping station only.

Estimated Capital Costs	\$0
Estimated Total Operational Costs (2015 to 2038)	\$5,800,000

## Treated Water Storage

Water from Calgary is stored in treated water reservoirs in the Town of Okotoks. Since a single pipeline is the source of treated water for the entire Town, it is assumed that three days' worth of storage is required to give adequate time to repair the pipeline in event it is damaged.

The following table illustrates the assumed storage requirements:

Source	Population Served	Required Treated Storage	Existing Usable Storage	Additional Storage Required
Calgary	58,000	53,000 m <sup>3</sup>	---	---
Total	58,000	53,000 m <sup>3</sup>	14,600 m <sup>3</sup>	38,400 m <sup>3</sup>

Estimated Capital Costs	\$38,400,000
Estimated Total Operational Costs (2015 to 2038)	\$0

### 6.3. Option 2A – Bow River to Sheep River WTP

#### 6.3.1. Supplement Sheep River WTP

A pipeline from the Bow River, conceptually assumed to originate near Policeman's Flats, delivers raw water to Okotoks to supplement the raw water supply to the existing Sheep River WTP. The total raw water supplied from the Sheep River and the Bow River is suitable for a total population of 58,000.

##### Supply

A river intake is constructed at the Bow River, directly north of Okotoks. Since raw water storage cannot be constructed at the Sheep River WTP, due to land constraints, raw water storage is constructed near the river intake. The raw water reservoir is sized for two weeks supply in the event that diversion from the Bow River is restricted for a short period of time.

An additional water license is required to be purchased for 28,000 people (30,000 continuing to be serviced from the Sheep River).

Operational costs consist of maintenance of the raw water reservoir and river intake.

Estimated Capital Costs	\$30,500,000
Estimated Total Operational Costs (2015 to 2038)	\$1,000,000

##### Pipeline

The conceptual pipeline is 450mm in diameter and approximately 17.0km long. Vaults containing isolation valves and combination air valves are located approximately every 1.5km along the alignment.

A booster pump station will require approximately 525HP in pump power to deliver maximum day flow to the Town.

Starting in 2015, the pipeline is assumed to supply half the Town's population with water. The other half is supplied from the Sheep River.

Operational and maintenance costs for the pipeline include energy costs, maintenance costs for the associated pump stations, and maintenance costs for the pipeline itself.

Estimated Capital Costs	\$26,300,000
Estimated Total Operational Costs (2015 to 2038)	\$13,300,000

##### Water Treatment

The existing Sheep River WTP requires an upgrade to service a population of 58,000. The cost of this upgrade is assumed to be the same as a new water treatment plant for 58,000 people due to land constraints and the additional costs incurred when retrofitting an existing facility.

The operations and maintenance costs required at the Sheep River WTP are assumed to be for the entire population of the Town between the years 2015 and 2038.

Estimated Capital Costs	\$25,000,000
Estimated Total Operational Costs (2015 to 2038)	\$28,500,000

### **Treated Water Storage**

Since there is no raw water storage at the WTP, the portion of the Town serviced by the new raw water pipeline is at risk if the pipeline failed. The population served by raw water from the Sheep River (30,000) can store water according the Alberta Environment's Standards and Guidelines. The population served by the Bow River pipeline should allow for three days of storage. It is assumed that three days' worth of storage is adequate to repair the pipeline in the event it is damaged.

The following table illustrates the assumed storage requirements:

Source	Population Served	Required Treated Storage (m <sup>3</sup> )	Existing Usable Storage	Additional Storage Required
Bow River	28,000	25,600 m <sup>3</sup>	---	---
Sheep River	30,000	6,800 m <sup>3</sup>	---	---
Total	58,000	32,400 m <sup>3</sup>	14,600 m <sup>3</sup>	17,800 m <sup>3</sup>

Estimated Capital Costs	\$17,800,000
Estimated Total Operational Costs (2015 to 2038)	\$0

### 6.3.2. Standalone Water Supply

A pipeline from the Bow River, conceptually assumed to originate near Policeman's Flats, delivers raw water to Okotoks to supply the Sheep River WTP. It is assumed that the existing water license on the Sheep River is transferred to the Bow River and the total raw water supplied is suitable for a total population of 58,000.

#### Supply

A river intake is constructed at the Bow River, directly north of Okotoks. Since raw water storage cannot be constructed at the Sheep River WTP, due to land constraints, raw water storage is constructed near the river intake. The raw water reservoir is sized for two weeks supply in the event that diversion from the Bow River is restricted for a short period of time.

An additional water license is required to be purchased for 28,000 people (30,000 transferred from the Sheep River).

Operational costs consist of maintenance of the raw water reservoir and river intake.

Estimated Capital Costs	\$32,100,000
Estimated Total Operational Costs (2015 to 2038)	\$1,200,000

#### Pipeline

The conceptual pipeline is 600mm in diameter and approximately 17.0km long. Vaults containing isolation valves and combination air valves are located approximately every 1.5km along the alignment.

A booster pump station will require approximately 1080HP in pump power to deliver maximum day flow to the Town.

Starting in 2015, the pipeline is assumed to supply Town's entire population with water.

Operational and Maintenance costs for the pipeline include energy costs, maintenance costs for the associated pump stations, and maintenance costs for the pipeline itself.

Estimated Capital Costs	\$29,500,000
Estimated Total Operational Costs (2015 to 2038)	\$20,700,000

#### Water Treatment

The existing Sheep River WTP requires an upgrade to service a population of 58,000. The cost of this upgrade is assumed to be the same as a new water treatment plant for 58,000 people due to land constraints and the additional costs incurred when retrofitting an existing facility.

The operations and maintenance costs required at the Sheep River WTP are assumed to be for the entire population of the Town between the years 2015 and 2038.

Estimated Capital Costs	\$25,000,000
Estimated Total Operational Costs (2015 to 2038)	\$28,500,000

### **Treated Water Storage**

Since there is no raw water storage at the WTP, the Town would be at risk if the pipeline failed. The Bow River pipeline serves the entire population and allowance should be made to store treated water for three days. This allows for up to three days to deal with problems with the pipeline if they occur.

The following table illustrates the assumed storage requirements:

Source	Population Served	Required Treated Storage (m <sup>3</sup> )	Existing Usable Storage	Additional Storage Required
Bow River	58,000	53,400 m <sup>3</sup>	---	---
Total	58,000	53,400 m <sup>3</sup>	14,600 m <sup>3</sup>	38,400 m <sup>3</sup>

Estimated Capital Costs	\$38,400,000
Estimated Total Operational Costs (2015 to 2038)	\$0

## 6.4. Option 2B – Bow River to North WTP

### 6.4.1. Supplement Sheep River WTP

A pipeline from the Bow River, conceptually assumed to originate near Policeman's Flats, delivers raw water to a new water treatment plant conceptually located on the north side of the Town of Okotoks. The Sheep River WTP services a population of 30,000 using the Sheep River as its source. The new North WTP is constructed to serve a population of 28,000 using the Bow River as its source.

#### Supply

A river intake is constructed at the Bow River, directly north of Okotoks. Since raw water storage can be constructed at the North WTP, the required raw water storage at the intake is only sized for one days' worth of storage.

An additional water license is required to be purchased for 28,000 people (30,000 continuing to be serviced from the Sheep River).

Operational costs consist of maintenance of the raw water reservoir and river intake.

Estimated Capital Costs	\$29,400,000
Estimated Total Operational Costs (2015 to 2038)	\$1,000,000

#### Pipeline

The conceptual pipeline is 450mm in diameter and approximately 14.3km long. Vaults containing isolation valves and combination air valves are located approximately every 1.5km along the alignment.

A booster pump station will require approximately 566HP in pump power to deliver maximum day flow to the Town.

Starting in 2015, the pipeline is assumed to supply half the Town's population with water. The other half is supplied from the Sheep River.

Operational and Maintenance costs for the pipeline include energy costs, maintenance costs for the associated pump stations, and maintenance costs for the pipeline itself.

Estimated Capital Costs	\$20,000,000
Estimated Total Operational Costs (2015 to 2038)	\$12,900,000



## Water Treatment

The existing Sheep River WTP can service the maximum population for which water license is currently held on the Sheep River. The maximum population that can be serviced from the Sheep River WTP is assumed to be 30,000.

The new North WTP is constructed to service a population of 28,000. A raw water reservoir that can store two weeks' worth of water is constructed at the North WTP site. The raw water reservoir located at the North WTP site mitigates the requirement for increased treated water storage in the Town.

The operations and maintenance costs required at the Sheep River WTP and the North WTP are assumed to be for the entire population with each WTP servicing approximately half of the Town's population between the years 2015 and 2038.

Estimated Capital Costs	\$24,200,000
Estimated Total Operational Costs (2015 to 2038)	\$38,800,000

## Treated Water Storage

Each WTP has its source water located adjacent to the treatment facilities. The Sheep WTP is located next to the Sheep River with multiple wells supplying it. The North WTP is located next to a 14 day supply of raw water. Therefore, the treated water storage requirements can be assumed to be equal to Alberta Environment's Standards and Guidelines.

The following table illustrates the assumed storage requirements:

Source	Population Served	Required Treated Storage	Existing Usable Storage	Additional Storage Required
Bow River	28,000	6,500 m <sup>3</sup>	---	---
Sheep River	30,000	6,800 m <sup>3</sup>	---	---
Total	58,000	13,300 m <sup>3</sup>	14,600 m <sup>3</sup>	0 m <sup>3</sup>

Estimated Capital Costs	\$0
Estimated Total Operational Costs (2015 to 2038)	\$0

## 6.4.2. Standalone Water Supply

A pipeline from the Bow River, conceptually assumed to originate near Policeman's Flats, delivers raw water to a new water treatment plant conceptually located on the north side of the Town of Okotoks. The new North WTP is constructed to serve a population of 58,000 using the Bow River as its source. The Sheep River WTP is decommissioned.

### Supply

A river intake is constructed at the Bow River, directly north of Okotoks. Since raw water storage can be constructed at the North WTP, the raw water storage at the intake is sized for one days' worth of storage.

An additional water license is required to be purchased for 28,000 people (30,000 continuing to be serviced from the Sheep River).

Operational costs consist of maintenance of the raw water reservoir and river intake.

Estimated Capital Costs	\$29,800,000
Estimated Total Operational Costs (2015 to 2038)	\$1,200,000

### Pipeline

The conceptual pipeline is 600mm in diameter and approximately 14.3km long. Vaults containing isolation valves and combination air valves are located approximately every 1.5km along the alignment.

A booster pump station will require approximately 1165HP in pump power to deliver maximum day flow to the Town.

Starting in 2015, the pipeline is assumed to supply the Town's entire population with water.

Operational and maintenance costs for the pipeline include energy costs, maintenance costs for the associated pump stations, and maintenance costs for the pipeline itself.

Estimated Capital Costs	\$22,900,000
Estimated Total Operational Costs (2015 to 2038)	\$20,800,000

## **Water Treatment**

The new North WTP is constructed to service a population of 58,000. A raw water reservoir that can store two weeks' worth of water is constructed at the North WTP site. The raw water reservoir located at the North WTP site mitigates the requirement for increased treated water storage in the Town.

The Sheep River WTP is decommissioned. However, the treated water storage and distribution pumping system remains in service. The operational costs are for the Sheep River treated water reservoir and pumping station are in addition to the O&M required at the North WTP.

The operations and maintenance costs required for the North WTP are assumed to be for the entire population between the years 2015 and 2038.

Estimated Capital Costs	\$27,500,000
Estimated Total Operational Costs (2015 to 2038)	\$34,300,000

## **Treated Water Storage**

The North WTP is located next to a 14 day supply of raw water. Therefore, the treated water storage requirements can be assumed to be equal to Alberta Environment's Standards and Guidelines.

The following table illustrates the assumed storage requirements:

Source	Population Served	Required Treated Storage	Existing Usable Storage	Additional Storage Required
Bow River	58,000	12,000 m <sup>3</sup>	---	---
Total	58,000	12,000 m <sup>3</sup>	14,600 m <sup>3</sup>	0 m <sup>3</sup>

Estimated Capital Costs	\$0
Estimated Total Operational Costs (2015 to 2038)	\$0

## 6.5. Option 3A – Highwood River to Sheep River WTP

### 6.5.1. Supplement Sheep River WTP

A pipeline from the Highwood River, conceptually assumed to originate on the Highwood directly east of Okotoks, delivers raw water to Okotoks to supplement the raw water supply to the existing Sheep River WTP. The total raw water supplied from the Sheep River and the Highwood River is suitable for a total population of 58,000.

#### Supply

A river intake is constructed at the Highwood River, directly east of Okotoks. Since raw water storage cannot be constructed at the Sheep River WTP, due to land constraints, raw water storage is constructed near the river intake. The raw water reservoir is sized for two weeks supply in the event that diversion from the Highwood River is restricted for a short period of time.

An additional water license is required to be purchased for 28,000 people (*30,000 continuing to be serviced from the Sheep River*).

Operational costs consist of maintenance of the raw water reservoir and river intake.

Estimated Capital Costs	\$30,500,000
Estimated Total Operational Costs (2015 to 2038)	\$1,000,000

#### Pipeline

The conceptual pipeline is 450mm in diameter and approximately 10.2km long. Vaults containing isolation valves and combination air valves are located approximately every 1.5km along the alignment.

A booster pump station will require approximately 295HP in pump power to deliver maximum day flow to the Town.

Starting in 2015, the pipeline is assumed to supply half the Town's population with water. The other half is supplied from the Sheep River.

Operational and Maintenance costs for the pipeline include energy costs, maintenance costs for the associated pump stations, and maintenance costs for the pipeline itself.

Estimated Capital Costs	\$16,500,000
Estimated Total Operational Costs (2015 to 2038)	\$7,700,000

## Water Treatment

The existing Sheep River WTP requires an upgrade to service a population of 58,000. The cost of this upgrade is assumed to be the same as a new water treatment plant for 58,000 people due to land constraints and the additional costs incurred when retrofitting an existing facility.

The operations and maintenance costs required at the Sheep River WTP are assumed to be for the entire population of the Town between the years 2015 and 2038.

Estimated Capital Costs	\$25,000,000
Estimated Total Operational Costs (2015 to 2038)	\$28,500,000

## Treated Water Storage

Since there is no raw water storage at the Sheep River WTP, the portion of the Town serviced by the new raw water pipeline is at risk if the pipeline failed. The population served by raw water from the Sheep River (30,000) can store water according the Alberta Environment's Standards and Guidelines. The population served by the Highwood River pipeline should allow for three days of storage. This allows for up to three days to deal with problems with the pipeline.

The following table illustrates the assumed storage requirements:

Source	Population Served	Required Treated Storage (m <sup>3</sup> )	Existing Usable Storage	Additional Storage Required
Bow River	28,000	25,600 m <sup>3</sup>	---	---
Sheep River	30,000	6,800 m <sup>3</sup>	---	---
Total	58,000	32,400 m <sup>3</sup>	14,600 m <sup>3</sup>	17,800 m <sup>3</sup>

Estimated Capital Costs	\$17,800,000
Estimated Total Operational Costs (2015 to 2038)	\$0

### 6.5.2. Standalone Water Supply

A pipeline from the Highwood River, conceptually assumed to originate on the Highwood directly east of Okotoks, delivers raw water to Okotoks to supply the Sheep River WTP. It is assumed that the existing water license on the Sheep River is transferred to the Highwood River and the total raw water supplied is suitable for a total population of 58,000.

#### Supply

A river intake is constructed at the Highwood River, directly east of Okotoks. Since raw water storage cannot be constructed at the Sheep River WTP, due to land constraints, raw water storage is constructed near the river intake. The raw water reservoir is sized for two weeks supply in the event that diversion from the Highwood River is restricted during times of river stress conditions.

An additional water license is required to be purchased for 28,000 people (*30,000 transferred from the Sheep River*).

Operational costs consist of maintenance of the raw water reservoir and river intake.

Estimated Capital Costs	\$32,100,000
Estimated Total Operational Costs (2015 to 2038)	\$1,200,000

#### Pipeline

The conceptual pipeline is 600mm in diameter and approximately 10.2km long. Vaults containing isolation valves and combination air valves are located approximately every 1.5km along the alignment.

A booster pump station will require approximately 605HP in pump power to deliver maximum day flow to the Town.

Starting in 2015, the pipeline is assumed to supply the Town's entire population with water.

Operational and maintenance costs for the pipeline include energy costs, maintenance costs for the associated pump stations, and maintenance costs for the pipeline itself.

Estimated Capital Costs	\$18,400,000
Estimated Total Operational Costs (2015 to 2038)	\$11,800,000

#### Water Treatment

The existing Sheep River WTP requires an upgrade to service a population of 58,000. The cost of this upgrade is assumed to be the same as a new water treatment plant for 58,000 people due to land constraints and the additional costs incurred when retrofitting an existing facility.

The operations and maintenance costs required at the Sheep River WTP are assumed to be for the entire population of the Town between the years 2015 and 2038.

Estimated Capital Costs	\$25,000,000
Estimated Total Operational Costs (2015 to 2038)	\$28,500,000

### **Treated Water Storage**

Since there is no raw water storage at the WTP, the Town would be at risk if the pipeline failed. The Highwood River pipeline serves the entire population and allowance should be made to store treated water for three days. This allows for up to three days to deal with problems with the pipeline if they occur.

The following table illustrates the assumed storage requirements:

Source	Population Served	Required Treated Storage (m <sup>3</sup> )	Existing Usable Storage	Additional Storage Required
Highwood River	58,000	53,000 m <sup>3</sup>	---	---
Total	58,000	53,000 m <sup>3</sup>	14,600 m <sup>3</sup>	38,400 m <sup>3</sup>

Estimated Capital Costs	\$38,400,000
Estimated Total Operational Costs (2015 to 2038)	\$0

## 6.6. Option 3B – Highwood River to North WTP

### 6.6.1. Supplement Sheep River WTP

A pipeline from the Highwood River, conceptually assumed to originate on the Highwood directly east of Okotoks, delivers raw water to a new WTP located on the north side of the Town of Okotoks. The Sheep River WTP services a population of 30,000 using the Sheep River as its source. The new North WTP is constructed to serve a population of 28,000 using the Highwood River as its source.

#### Supply

A river intake is constructed at the Highwood River, directly east of Okotoks. Since raw water storage can be constructed at the North WTP, the raw water storage at the intake is sized for one days' worth of storage.

An additional water license is required to be purchased for 28,000 people (*30,000 continuing to be serviced from the Sheep River*).

Operational costs consist of maintenance of the raw water reservoir and river intake.

Estimated Capital Costs	\$29,400,000
Estimated Total Operational Costs (2015 to 2038)	\$1,000,000

#### Pipeline

The conceptual pipeline is 450mm in diameter and approximately 6.8km long. Vaults containing isolation valves and combination air valves are located approximately every 1.5km along the alignment.

A booster pump station will require approximately 450HP in pump power to deliver maximum day flow to the Town.

Starting in 2015, the pipeline is assumed to supply half the Town's population with water. The other half is supplied from the Sheep River.

Operational and Maintenance costs for the pipeline include energy costs, maintenance costs for the associated pump stations, and maintenance costs for the pipeline itself.

Estimated Capital Costs	\$9,700,000
Estimated Total Operational Costs (2015 to 2038)	\$9,500,000



## Water Treatment

The existing Sheep River WTP can service the maximum population for which water license is currently held on the Sheep River. The maximum population that can be serviced from the Sheep River WTP is assumed to be 30,000.

The new North WTP is constructed to service a population of 28,000. A raw water reservoir that can store two weeks' worth of water is constructed at the North WTP site. The raw water reservoir located at the North WTP mitigates the requirement for increased treated water storage in the Town.

The operations and maintenance costs required at the Sheep River WTP and the North WTP are assumed to be for the entire population with each WTP servicing approximately half of the Town's population between the years 2015 and 2038.

Estimated Capital Costs	\$17,200,000
Estimated Total Operational Costs (2015 to 2038)	\$38,800,000

## Treated Water Storage

Each WTP has its source water located adjacent to the treatment facilities. The Sheep WTP is located next to the Sheep River with multiple wells supplying it. The North WTP is located next to a 14 day supply of raw water. Therefore, the treated water storage requirements can be assumed to be equal to Alberta Environment's Standards and Guidelines.

The following table illustrates the assumed storage requirements:

Source	Population Served	Required Treated Storage	Existing Usable Storage	Additional Storage Required
Bow River	28,000	6,500 m <sup>3</sup>	---	---
Sheep River	30,000	6,800 m <sup>3</sup>	---	---
Total	58,000	13,300 m <sup>3</sup>	14,600 m <sup>3</sup>	0 m <sup>3</sup>

Estimated Capital Costs	\$0
Estimated Total Operational Costs (2015 to 2038)	\$0

## 6.6.2. Standalone Water Supply

A pipeline from the Highwood River, conceptually assumed to originate on the Highwood directly east of Okotoks, delivers raw water to a new water treatment plant located on the north side of the Town of Okotoks. The new North WTP is constructed to serve a population of 58,000 using the Highwood River as its source. The Sheep River WTP is decommissioned.

### Supply

A river intake is constructed at the Highwood River, directly east of Okotoks. Since raw water storage can be constructed at the North WTP, the raw water storage at the intake is sized for one days' worth of storage.

An additional water license is required to be purchased for 28,000 people (license adequate for 30,000 is transferred from the Sheep River).

Operational costs consist of maintenance of the raw water reservoir and river intake.

Estimated Capital Costs	\$29,800,000
Estimated Total Operational Costs (2015 to 2038)	\$1,200,000

### Pipeline

The conceptual pipeline is 600mm in diameter and approximately 6.8km long. Vaults containing isolation valves and combination air valves are located approximately every 1.5km along the alignment.

A booster pump station will require approximately 925HP in pump power to deliver maximum day flow to the Town.

Starting in 2015, the pipeline is assumed to supply the Town's entire population with water.

Operational and maintenance costs for the pipeline include energy costs, maintenance costs for the associated pump stations, and maintenance costs for the pipeline itself.

Estimated Capital Costs	\$11,600,000
Estimated Total Operational Costs (2015 to 2038)	\$16,100,000

## Water Treatment

The new North WTP is constructed to service a population of 58,000. A raw water reservoir that can store two weeks' worth of water is constructed at the North WTP site. The raw water reservoir located at the North WTP site mitigates the requirement for increased treated water storage in the Town.

The Sheep River WTP is decommissioned. However, the treated water storage and distribution pumping system remains in service. The operational costs are for the Sheep River treated water reservoir and pumping station are in addition to the O&M required at the North WTP.

The operations and maintenance costs required the North WTP are assumed to be for the entire population between the years 2015 and 2038.

Estimated Capital Costs	\$27,500,000
Estimated Total Operational Costs (2015 to 2038)	\$34,300,000

## Treated Water Storage

The North WTP is located next to a 14 day supply of raw water. Therefore, the treated water storage requirements can be assumed to be equal to Alberta Environment's Standards and Guidelines.

The following table illustrates the assumed storage requirements:

Source	Population Served	Required Treated Storage	Existing Usable Storage	Additional Storage Required
Highwood River	58,000	12,000 m <sup>3</sup>	---	---
Total	58,000	12,000 m <sup>3</sup>	14,600 m <sup>3</sup>	0 m <sup>3</sup>

All options and scenarios consider the same value for delivering water to the town. There is assumed to be no appreciable difference in operating a large treated water reservoir compared to a smaller one. Therefore, the operational costs for treated water reservoirs in this report are \$0.

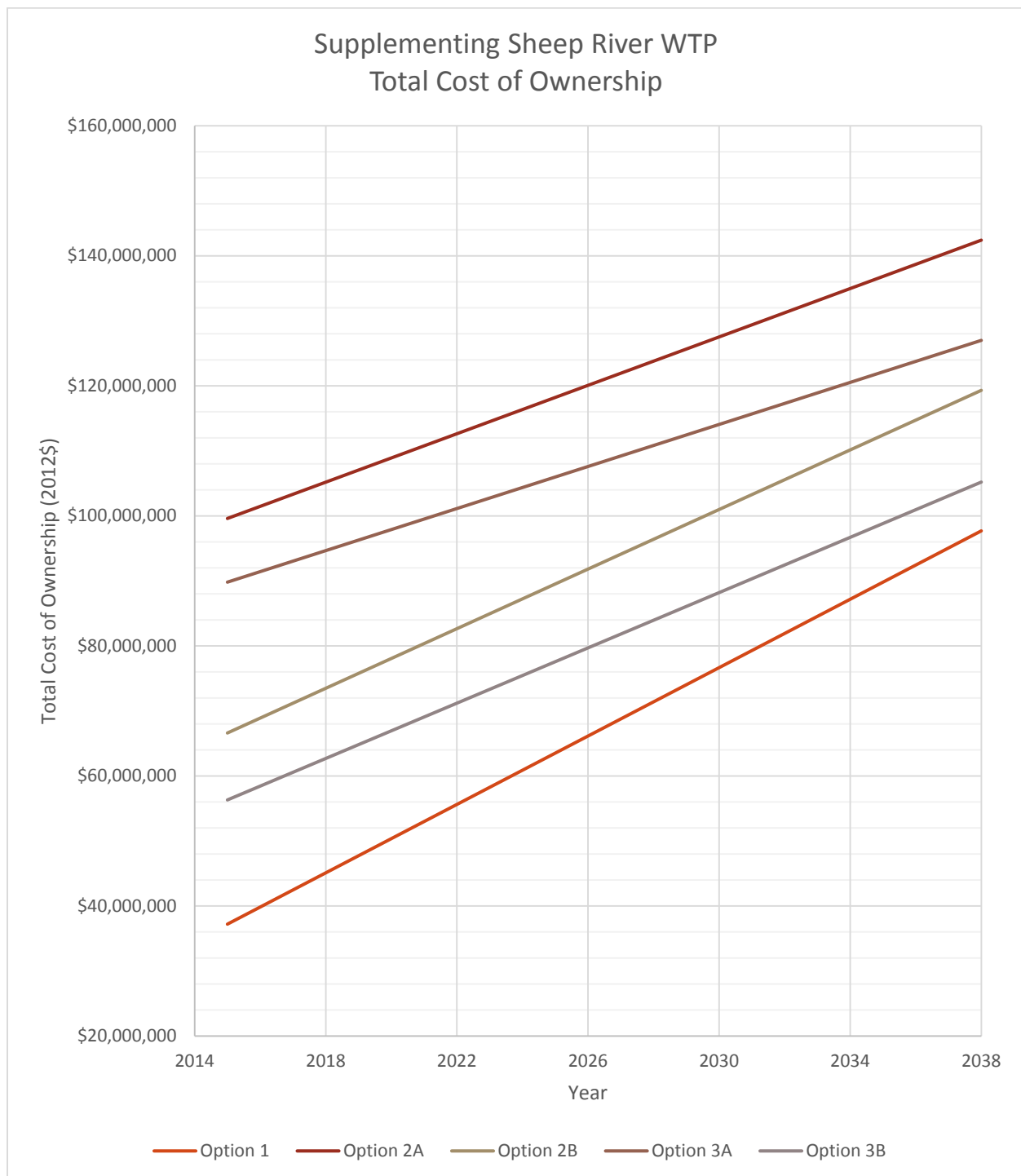
Estimated Capital Costs	\$0
Estimated Total Operational Costs (2015 to 2038)	\$0

## 6.7. Total Cost of Ownership

	Option 1		Option 2A		Option 2B		Option 3A		Option 3B	
	Pipeline from Calgary		Bow River to Existing WTP		Bow River to New WTP		Highwood to Existing WTP		Highwood to New WTP	
	Supplement	Standalone	Supplement	Standalone	Supplement	Standalone	Supplement	Standalone	Supplement	Standalone
<b>Water Supply</b>										
Source Construction	\$0.0 M	\$0.0 M	\$1.5 M	\$1.8 M	\$1.5 M	\$1.8 M	\$1.5 M	\$1.8 M	\$1.5 M	\$1.8 M
Source O&M	\$0.0 M	\$0.0 M	\$1.0 M	\$1.2 M	\$1.0 M	\$1.2 M	\$1.0 M	\$1.2 M	\$1.0 M	\$1.2 M
Raw Water Storage	\$0.0 M	\$0.0 M	\$1.2 M	\$2.5 M	\$0.1 M	\$0.2 M	\$1.2 M	\$2.5 M	\$0.1 M	\$0.2 M
Bulk Water Charge	\$28.7 M	\$84.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M
Additional Water License	\$0.0 M	\$0.0 M	\$27.8 M	\$27.8 M	\$27.8 M	\$27.8 M	\$27.8 M	\$27.8 M	\$27.8 M	\$27.8 M
<b>Pipeline</b>										
Pipeline Construction	\$18.2 M	\$19.4 M	\$24.1 M	\$25.7 M	\$17.6 M	\$18.8 M	\$15.3 M	\$16.3 M	\$7.8 M	\$8.4 M
Pipeline Pump Construction	\$1.2 M	\$1.9 M	\$2.2 M	\$3.8 M	\$2.4 M	\$4.1 M	\$1.2 M	\$2.1 M	\$1.9 M	\$3.2 M
Pipeline Pump Maintenance	\$0.8 M	\$1.3 M	\$1.5 M	\$2.6 M	\$1.7 M	\$2.8 M	\$0.8 M	\$1.4 M	\$1.3 M	\$2.2 M
Pipeline Energy Cost	\$1.8 M	\$5.7 M	\$5.5 M	\$11.8 M	\$5.9 M	\$12.7 M	\$3.1 M	\$6.6 M	\$5.3 M	\$11.4 M
Pipeline Maintenance	\$5.9 M	\$5.9 M	\$6.3 M	\$6.3 M	\$5.3 M	\$5.3 M	\$3.8 M	\$3.8 M	\$2.5 M	\$2.5 M
<b>Water Treatment Plant</b>										
New WTP Construction	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$16.0 M	\$25.0 M	\$0.0 M	\$0.0 M	\$16.0 M	\$25.0 M
Raw Water Storage Construction	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$1.2 M	\$2.5 M	\$0.0 M	\$0.0 M	\$1.2 M	\$2.5 M
New WTP O&M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$19.4 M	\$28.5 M	\$0.0 M	\$0.0 M	\$19.4 M	\$28.5 M
Sheep River WTP Construction/Upgrade	\$0.0 M	\$0.0 M	\$25.0 M	\$25.0 M	\$0.0 M	\$0.0 M	\$25.0 M	\$25.0 M	\$0.0 M	\$0.0 M
Sheep River WTP O&M	\$23.3 M	\$5.8 M	\$28.5 M	\$28.5 M	\$19.4 M	\$5.8 M	\$28.5 M	\$28.5 M	\$19.4 M	\$5.8 M
<b>Additional Treated Water Storage</b>										
Construction	\$17.8 M	\$38.4 M	\$17.8 M	\$38.4 M	\$0.0 M	\$0.0 M	\$17.8 M	\$38.4 M	\$0.0 M	\$0.0 M
<b>CAPITAL \$2012</b>	\$37.2 M	\$59.7 M	\$99.6 M	\$125.0 M	\$66.6 M	\$80.2 M	\$89.8 M	\$113.9 M	\$56.3 M	\$68.9 M
<b>TOTAL COST OF OWNERSHIP</b>	\$97.7 M	\$162.4 M	\$142.4 M	\$175.4 M	\$119.3 M	\$136.5 M	\$127.0 M	\$155.4 M	\$105.2 M	\$120.5 M

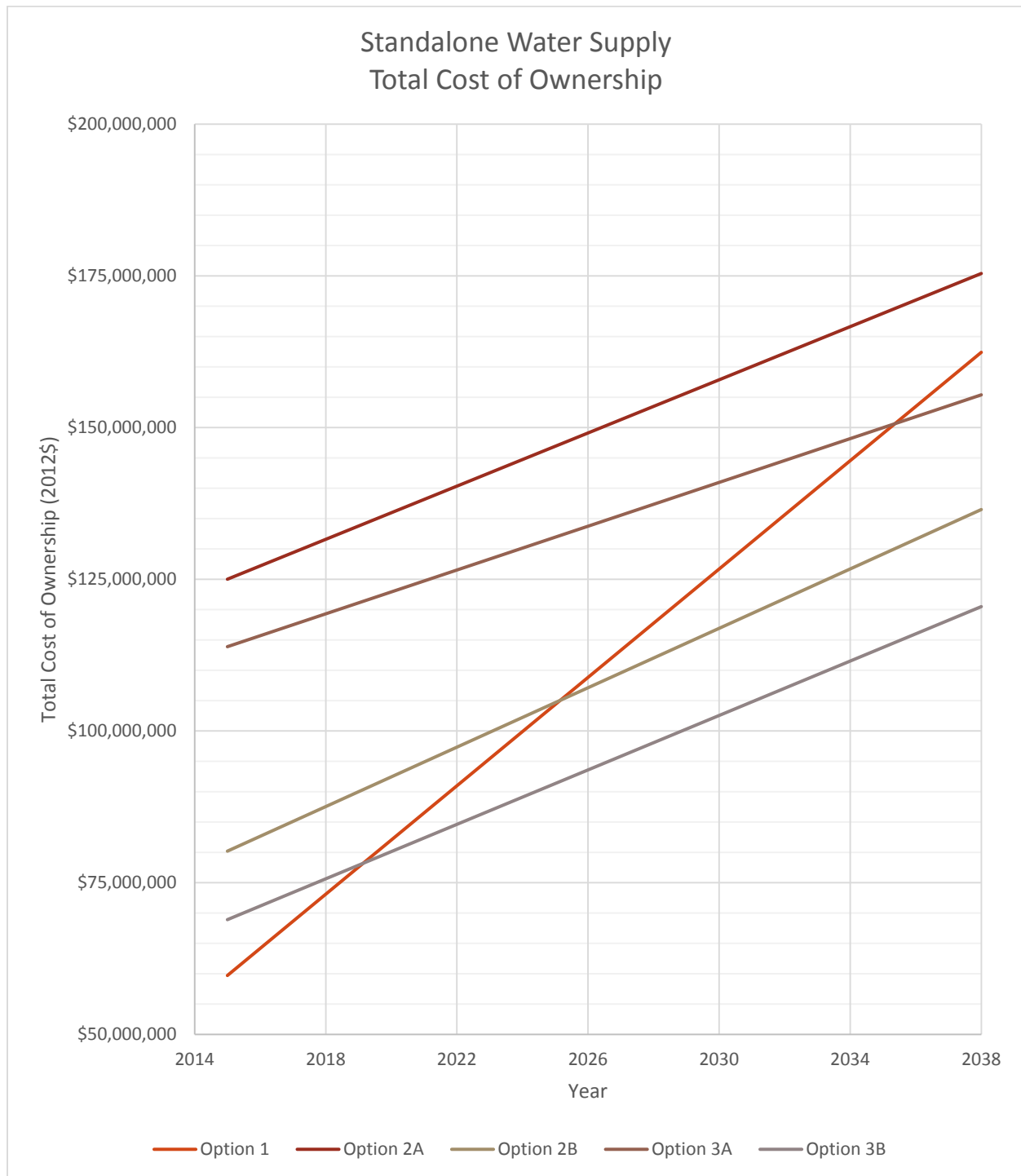
### 6.7.1. Supplement Sheep River WTP

The following chart illustrates the estimated total cost of ownership for each of the servicing options.



### 6.7.2. Standalone Water Supply

The following chart illustrates the estimated total cost of ownership for each of the servicing options.



## 6.8. Observations

1. The total costs of ownership for options considering servicing from the City of Calgary are significantly and directly influenced by:
  - a. The City of Calgary bulk water rate.
  - b. The cost of treated water storage.
2. Storing treated water costs approximately 100 times more than storing the same volume of raw water. Therefore, options including raw water storage at the North WTP, which mitigate the requirement for treated water storage, have lower total costs of ownership.
3. In general, retaining the Sheep River WTP and supplementing the Town with an alternate supply of water costs less than supplying the entire Town's population with an alternate, standalone, water supply.
4. Although the options considering servicing from the Highwood River have low total costs of ownership, the likelihood of procuring sufficient water licensing is low. Additionally, the Highwood River may not be able to yield sufficient water to meet the Town's demand. The actual volume of water available in the Highwood River was not reviewed in this report.
5. Building a pipeline to the existing Sheep River WTP costs significantly more than a pipeline to a North WTP because of the river crossing and the urban roadway rehabilitation that would be required.
6. Estimates involving a pipeline from the Bow River originating at the confluence of the Highwood River and the Bow River yielded approximately an eight million dollar difference when compared to a pipeline from the Policeman's Flats area. For this reason, a pipeline from the confluence of the Bow and Highwood was not considered in detail in this report.