

TECHNICAL MEMORANDUM

Sturgeon County

Alcomdale Waterline Option Re-Evaluation – Draft #2

Draft



September 2016

Document	Description	Issue Date	Prepared By:	Approved by:
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Alcomdale Report – Draft #2	Client Review - Update to cost table	Sept 27, 2016	J. VanDoesburg	T. Chakanyuka

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TECHNICAL MEMORANDUM

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TECHNICAL MEMORANDUM

1 Introduction

1.1 BACKGROUND

In January 2014, Sturgeon County (County) commissioned Associated Engineering (AE) to complete a feasibility study for the proposed Alcomdale Water Pipeline. In May 2014, AE completed the feasibility study, which analysed two options for supplying water to Alcomdale, namely:

- Option 1 - Riviere Qui Barre (RQB) to Alcomdale.
- Option 2 - Busby to Alcomdale.

Following analysis of the two options, the Busby to Alcomdale (Option 2) was recommended due to its lower capital and life cycle cost. Risks and opportunities were also identified for each of the options.

In November 2014, the County submitted an application for grant funding to Alberta Transportation (AT) for the proposed Alcomdale waterline. This application was supported by the feasibility study report. In addition, the County initiated negotiations for a Water Supply Agreement with the Westlock Regional Water Services Commission (WRWSC). This resulted in WRWSC issuing an agreement in principle for the transfer of water to Sturgeon County.

Supply from Busby will also require an Inter-basin Transfer Agreement from the Province. This process was put on hold until funding was received.

It is our understanding that AT has awarded funds for engineering design of the Alcomdale waterline.

1.2 OBJECTIVES AND SCOPE OF WORK

The County has requested that AE re-evaluate the options listed above prior to commencement of engineering design work.

The objective of the option re-evaluation is to revisit the costs and Risk/Benefit analysis of the two options, considering the potential for more connections and tie in opportunities along the waterline, particularly the RQB to Alcomdale line.

The scope of work includes:

- Complete a desktop investigation of the opportunity to supply residents and communities within reasonable distance from the alignment of the proposed waterline;
- Update lifecycle cost comparison based on the potential increase in service population and revenue;
- Update the risk benefit analysis; and,
- Review cost and schedule implications with the Inter-basin Transfer Agreement for the Busby supply Option.

2 Study Area

For the purposes of this report, the desktop investigation to identify opportunity to supply additional residents was reviewed for Option 1 only. Alignment Options are shown in **Figure 2-1** attached

2.1 OPTION 1 SERVICE AREA

As part of the desktop investigation, AE expanded the servicing area outside of Alcomdale to service rural residents within 1 mile (1,600m) on both sides of the proposed waterline alignment. This yields an approximate total of 62 quarter sections that could potentially be serviced. Also included in the service area is the Morinville Hutterite Colony located immediately west of Highway 44, north of Township road 564. The service area for the Option 1 waterline is shown in **Figure 2-2** attached.

As shown on Figure 2-1, there are 57 existing residents within the study area. This service area was utilized in the population demand projection analysis that was completed in **Section 3.0** of this report.

3 Design Criteria

3.1 GENERAL

The design criteria presented in this section is an update of what was previously stated in the *Alcomdale Feasibility Report*, (AE, 2014).

The proposed water distribution system design criteria, has been based on the following sources of information:

- *Alcomdale Waterline Feasibility report*, May, 2014 (AE)
- Sturgeon County Gateway Property Viewer
- Sturgeon County General Design Standards.

3.2 POPULATION CRITERIA

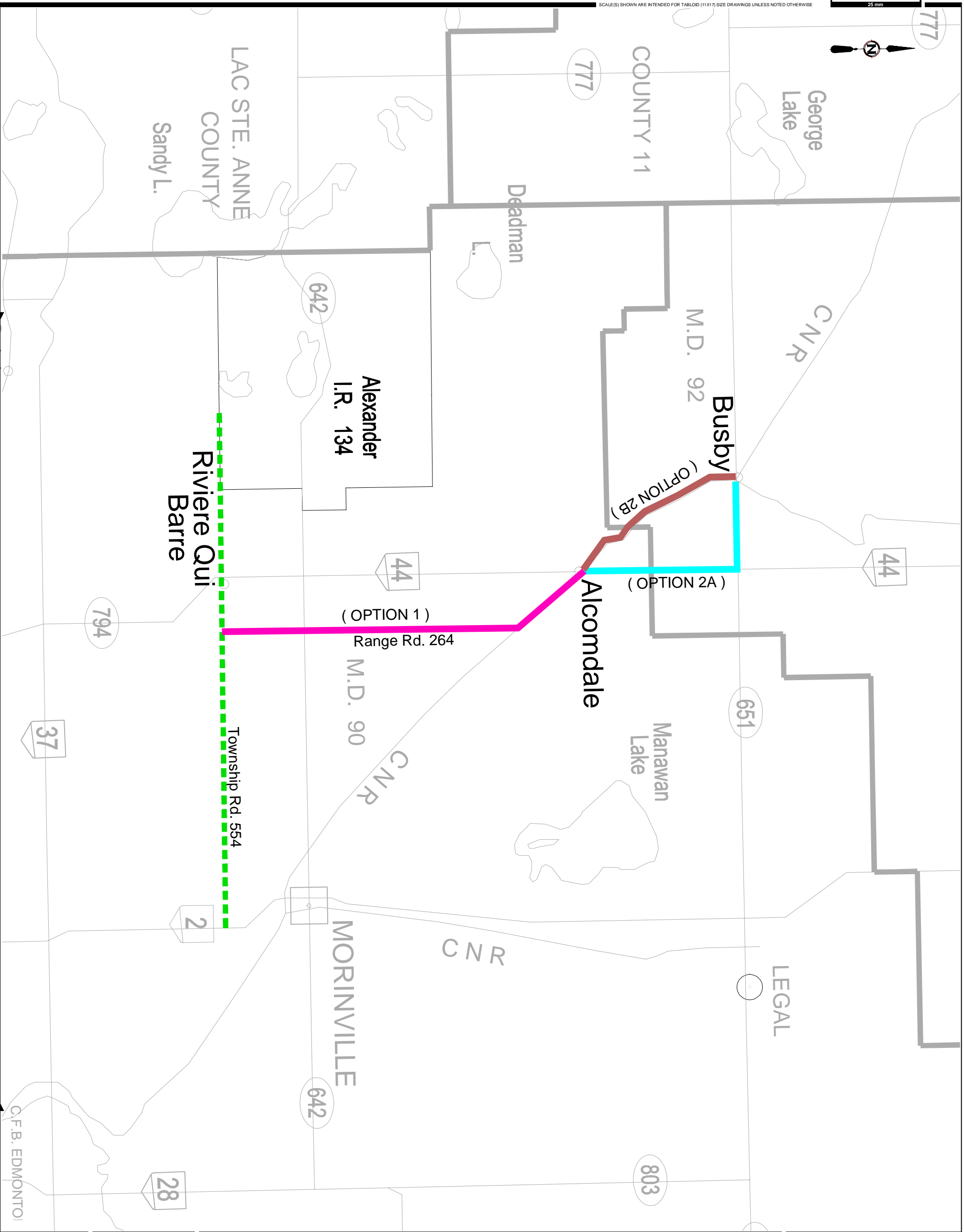
One of the key variables in assessing the servicing requirements of a community is the population to be served. The population will provide a basis to establish water use.

3.2.1 Alcomdale Population Projection

AE has updated the projected population for Alcomdale for a 25-year design horizon. Based upon typical growth rates for a Hamlet, a 1% annual population growth rate was applied. **Table 3-1** shows the population projection to 2041.



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LEGEND

- PROPOSED WATER PIPELINE (OPTION 1)
(Exist. RGB Waterline To Alcomdale)
- PROPOSED WATER PIPELINE (OPTION 2A)
(Exist. Busby To Alcomdale)
- PROPOSED WATER PIPELINE (OPTION 2B)
(Exist. Busby To Alcomdale)
- EXISTING 200mmØ RGB WATER PIPELINE

FIGURE NO. 2-1

STURGEON COUNTY
ALCOMDALE WATER CO-OPERATIVE
PROPOSED WATER PIPELINE ALIGNMENTS

AE PROJECT No.	20143016
SCALE	NOT TO SCALE
APPROVED	--
DATE	2014-04-08
REV	A
DESCRIPTION	--





STUDY AREA

Option 1 - RQB to Alcomdale

ALCOMDALE

FIGURE 2-2 - STUDY AREA

Legend:

-  - Proposed Water Alignment
-  - Study Area Boundary
-  - Morinville Hutterite Colony
-  - Single Residence

RIVIERE QUI BARRE



Table 3-1 – Alcomdale Population Projection

Year	Population
2016	92
2021	96
2026	101
2031	107
2036	112
2041	118

3.2.2 Rural Population Outside Alcomdale

Based on Sturgeon County’s general servicing standards, the average number of people per household within Sturgeon County is 3.5 persons. As such, it is proposed that a density of 3.5 people/household be applied for the purpose of this analysis.

The number of existing residences within the study area were counted using mapping provided on the Sturgeon County Gateway Property Viewer. **Table 3-2** presents the number of residences within a mile of the proposed waterline alignment and population projections based on a growth rate of 1%. The associated population is also indicated, based on 3.5 people per residence.

Table 3-2 – Rural Population Outside of Alcomdale

Year	Number of Residence	Population
2016	57	200
2021	60	210
2026	63	220
2031	66	232
2036	70	243
2041	73	256

3.2.3 Morinville Hutterite Colony

At the time of this report, AE did not have information regarding the current population or number of residences within the Morinville Hutterite Colony. For the purposes of the option re-evaluation analysis, AE reviewed aerial photos and estimated the number of individual residents that may occupy the area.

Table 3-3 provides the number of residents and population projection for the Colony based on a growth rate of 1%.

Table 3-3 – Morinville Hutterite Colony Population Projection

Year	Number of Residence	Population
2016	26	91
2021	27	96
2026	29	101
2031	30	106
2036	32	111
2041	33	117

3.2.4 Total Population

Table 3-4 below summarizes the overall population projection for the total study area which includes Alcomdale, Rural residents outside of Alcomdale, and the Morinville Hutterite Colony.

Table 3-3 – Overall Population Projection

Year	Population
2016	383
2021	402
2026	422
2031	445
2036	466
2041	491

The total overall population for the study area is **491 people**.

3.3 LAND USE

It has been assumed that those locations serviced will primarily be residential dwellings. AE recommends that should the Morinville Hutterite Colony be serviced that they construct a reservoir to supply their residents.

3.4 WATER DEMAND

Water demand is critical in determining the distribution network, pumping capability and storage required for a water system. Typically distribution systems are assessed using three critical rates of demand: Average Day, Peak Day and Peak Hour flow.

The following briefly describes each of the critical flow conditions:

Average Daily Day (ADD)

An average daily demand (ADD) of 320 Liter/capita/day (L/c/d) was used in the 2014 Feasibility Study. This has been utilized in this evaluation as it is consistent with Sturgeon County's General Municipal Servicing Standards.

Maximum Daily Demand (MDD)

The Maximum Day demand is determined by the single day of maximum consumption observed in the distribution system. In using the single day maximum flow, one must ensure that the record is not distorted by fire fighting demand, equipment malfunction or watermain breaks. The peaking factor is determined by comparing the peak consumption day to the average day demand. The Peak Day demand is used in determining the delivery capacity required of supply mains, treatment facilities, storage facilities and pumping facilities. For the purposes of this report a peak day factor of 2 was used in accordance with Sturgeon County's General Municipal Servicing Standards.

For the rural residents outside of Alcomdale, a trickle fill has been assumed for this analysis. These systems provide water to private cisterns at a lower delivery pressure. Pumps are installed within the cisterns and water is delivered to each home at typical operating pressures. A MDD water demand of 0.5 USgpm (0.032 L/s peak flow) restricted flow feeding into cisterns for a trickle fill system has been used for each single residential application.

The MDD has been used in determining the capacity of the proposed waterline to supply Alcomdale, rural residents, and the Morinville Hutterite Colony. MDD for rural residents it was assumed that during peak periods 50% of the households with private cisterns will have their systems running.

Table 3-4 summarizes the ADD and MDD for Alcomdale, the rural residents outside of Alcomdale, and the Morinville Hutterite Colony.

Table 3-4: Projected Water Demand

Year		2016	2021	2026	2031	2036	2041	
Alcomdale ADD (Based on 320 L/capita/Day)	m³/d	29.4	30.9	32.5	34.1	35.8	37.7	
	L/s	0.340	0.357	0.376	0.395	0.415	0.436	
Alcomdale MDD (2 x ADD)	m³/d	58.8	61.8	64.9	68.2	71.7	75.4	
	L/s	0.680	0.715	0.751	0.790	0.830	0.872	
Rural Residents ADD and MDD	Average Day	m³/d	63.8	67.1	70.5	74.1	77.9	81.9
		L/s	0.74	0.78	0.82	0.86	0.90	0.95
	Peak Day	m³/d	78.8	82.8	87.0	91.5	96.1	101.1
		L/s	0.912	0.959	1.007	1.059	1.113	1.170
Morinville Colony ADD and MDD	Average Day	m³/d	29.1	30.6	32.2	33.8	35.5	37.3
		L/s	0.34	0.35	0.37	0.39	0.41	0.43
	Peak Day	m³/d	58.2	61.2	64.3	67.6	71.1	74.7
		L/s	0.67	0.71	0.74	0.78	0.82	0.86
TOTAL MDD Flows		m³/d	195.8	205.8	216.3	227.3	238.9	251.1
		L/s	2.266	2.382	2.503	2.631	2.765	2.906

The 2012 annual water treatment plant report for Alcomdale shows its current water use to be approximately 12.6 m³/day (133 L/cap/day). With the introduction of improved water quality, we expect water usage to increase to an average daily demand of 320 L/cap/day as per the Sturgeon County General Municipal Servicing Standards.

3.5 VELOCITY

The recommended maximum operating velocity is 1.5 m/s.

3.6 OPERATING PRESSURE CONDITIONS

The Operating Pressure Conditions utilized in the Option re-evaluation are consistent with the 2014 Feasibility Study.

- Tie-in pressure at the RQB waterline - 736.7m (43m of head (61 psi).
- Alcomdale Clearwell minimum tie-in pressure - 14 m (20 psi).
- Minimum pressure along water line - 14 m (20 psi).

3.7 FIRE FLOW

This water system will not be designed with fire flow provision capacity.

3.8 PIPING MATERIAL AND SIZE

The pipe material being considered is consistent with the 2014 Feasibility Study which is high density polyethylene (HDPE) pipe.

3.9 PIPE ROUGHNESS COEFFICIENT

The pipe roughness coefficient “C” factor is used in the Hazen-Williams equation to determine flow capacity.

A C-value of 130 will be used for the proposed pipelines within the hydraulic model.

4 Updated Hydraulic Analysis

With the expanded study area and increased service population, AE reviewed the hydraulics of the proposed 150mm diameter DR11 HDPE waterline from Riviere Qui Barre to Alcomdale to determine the maximum capacity of the line and the resulting population it can serve.

Based on the hydraulic analysis shown in **Figure 4-1**, the system can provide a maximum day flow of **227 m³/day**.

The total flow required to accommodate the total study area population to 2041 is **251.1 m³/day** as shown in **Table 3-4**.

Based on a maximum daily flow demand of 227 m³/day, AE calculated the number of people that can be serviced. **Table 4-1** presents the number of residents that can be serviced based on the system capacity of 227 m³/day.

Table 4-1 – Morinville Hutterite Colony Population Projection

Population	Total population within service area (2041)	Total population that may be serviced within the capacity	Total MMD (m³/day)
Alcomdale	118	118	75.4
Rural Residents	256 (73 residences)	189 (54 residences)	76.9
Morinville Hutterite Colony	117	117	74.7
TOTAL	491	424	227 m³/day

Table 4-1 shows that the total 2041 population for Alcomdale and the Morinville Hutterite Colony can be fully supplied to 2041. In addition to Alcomdale and the Morinville Hutterite Colony, 54 residences within the study area may also be accommodated to 2041.

If the proposed pipeline is required to accommodate the 2041 population for all the rural residents outside Alcomdale, the pipe will need to be upsized to a 200mm diameter pipe.

5 Inter-basin Agreement

Following the 2014 Feasibility study, it was determined that an Inter-basin Transfer agreement would be required for alignment Options 2a and 2b to transfer water from Busby to Alcomdale.

AE provided the County with a scope change on December 16, 2014 in the amount of \$73,800.00 to complete the environmental component of the Inter-basin agreement requirements.

It should be noted that the requirement of the Inter-basin agreement will significantly prolong the project schedule, and will likely push construction back by at least a year. This delay will be less desirable to Alcomdale which is currently under a boil water notice.

Option 1 alignment from Riviere Qui Barre does not require an inter-basin transfer agreement and is not expected to incur these similar delays.

6 Cost Analysis

Associated Engineering updated the cost estimates for the three (3) options. The cost estimates are shown in **Table 6-1** below and **Appendix A**. In completing the cost estimates, the following assumptions were made:

- A minimum contingency of 20% was included to account for cost fluctuations and omissions.
- Engineering cost of 10% of the overall construction cost.
- Land compensation and acquisition rates have been based on Sturgeon County's Land Value Report (April 8, 2014).
- Rate for temporary working easement was assumed to be 50% of the permanent easement rate.
- A 25-year project life cycle.
- Water charges from EPCOR are estimated to be \$0.78/m³.
- Sturgeon County's water charges will be \$2.90/m³, plus a bi-monthly flat rate of \$23.00.
- WRWSC's water charges will be \$2.00/m³.
- Annual Maintenance costs assumed to be 1% of capital costs.
- Construction method assumed to be Horizontal Directional Drill (HDD).

Table 6-1 shows a cost comparison for the three (3) options.

**Technical Memorandum
Alcomdale Waterline Option
Re-Evaluation**

Table 6-1 Summary of Costs

	Option 1 (RQB) Cost	Option 2a (Busby) Cost	Option 2b (Busby) Cost
Total Estimated Pipeline Capital Costs (Including 10% Engineering fees, 20% Contingency and costs for inlet works to the Alcomdale WTP)	\$5,091,000	\$4,135,000	\$3,582,000
Contributions to Capital Costs			
Estimated Alcomdale Water Co-operative Contribution (10%)	\$509,100	\$413,500	\$358,200
Estimated funding required from the "Water for Life" grant (90%)	\$4,581,900	\$3,721,500	\$3,223,800
Water Purchase and Maintenance Costs			
Cost to Sturgeon County for Water Purchase from EPCOR* - Over 25 years (Assuming 7% discount rate over 25 years). Based on annual water charge of \$0.78/m ³ at average day consumption.	\$421,000	\$0	\$0
Cost to Sturgeon County for Water purchase from Westlock -Over 25 years (Assuming 7% discount rate over 25 years). Based on annual water charge of \$2/m ³ at average day consumption (Does not cover maintenance of the proposed Alcomdale waterline).	\$0	\$314,400	\$314,400
Waterline Maintenance Costs over 25 years (Assume 1% of Capital Costs annually)	\$956,000	\$663,000	\$556,000
Total Water Purchase and Maintenance Costs	\$1,377,000	\$977,000	\$870,000
Revenue to be generated from the waterline over 25 years. (Assuming 7% discount rate over 25years). Based on a charge of \$2.90/m ³ and a bi-monthly flat rate of \$23.00 at average day consumption.	\$1,746,000	\$481,000	\$481,000
Net Revenue (Revenue – Total water purchase and Maintenance)	\$369,000	-\$496,000	-\$389,000
Total Life Cycle Cost	\$4,722,000	\$4,631,000	\$3,971,000

* Average day consumption for Option 1 larger than Option 2 due to the additional rural residents and Morinville Hutterite Colony that the line may potentially serve.

From **Table 5-1** above, the following summary can be drawn:

- Option 2b has the lowest capital and total life cycle cost due to its short length.
- Option 1 has the highest capital and total life cycle costs due to its long length.
- Option 1 revenue generation will be sufficient to pay for the waterline's water purchase and maintenance costs.

- Options 2a and 2b will not provide the County sufficient revenue to offset water purchase and maintenance costs. Therefore, the County may have to pay for the deficit of \$496,000 and \$389,000 for Options 2a and 2b, respectively.

7 Risks and Opportunities

Updated **Table 7-1** below summarizes the risks and opportunities for the three (3) options.

Table 7-1 Summary of risks and Opportunities

	Option 1: RQB – Alcomdale	Option 2a & b: Busby - Alcomdale
Advantages	<ul style="list-style-type: none"> Part of Sturgeon County system. No negotiations for water supply with another County or Water Commission. Lower Operational expenditure. Supply to approximately 56 rural residential properties and the Morinville Hutterite Colony along pipeline route. 	<ul style="list-style-type: none"> Shorter pipe length. Less number of crossings. Lower capital costs. Lower Lifecycle costs.
Disadvantages	<ul style="list-style-type: none"> Longer pipeline route. More crossings along the proposed alignment. Higher capital costs. Must lease water allocation from Morinville and Legal for 5 years. 	<ul style="list-style-type: none"> Deficit in Operational Costs (negative revenue). Sturgeon County has no control over water charges. Relies on cost sharing discussion/agreement with the Westlock commission. May require pump upgrade at Westlock to increase flow to Busby. Involves acquisition of more land compared to option 1. Part of the revenue generated from water consumption goes to Westlock Commission. Requires an Inter Alberta River basin transfer agreement which will delay the project.
Risks	<ul style="list-style-type: none"> Alberta Transportation may only fund the lowest capital cost option. Some residents identified along the proposed waterline may decide not to connect to the line. 	<ul style="list-style-type: none"> Unpredicted future cost increases (if Westlock decides to increase its water charges). Possible delays due to land acquisition. Unknown cost contribution for existing infrastructure. Agreements with CN and Alberta Transportation may be required. This could result in project delays.
Opportunities	<ul style="list-style-type: none"> Opportunity to generate revenue, which can go towards maintaining the waterline (Estimated to be \$1,747,000). Can potentially generate enough revenue to cover the operation and maintenance of the waterline. 	<ul style="list-style-type: none"> Opportunity to generate revenue by servicing the Hutterite Colony and some residents along the alignment of the waterline.

8 Summary and Recommendations

8.1 SUMMARY

The following is a summary of the principal conclusions made in this report:

- Servicing opportunity has been assessed for the areas covering 1 mile (1,600m) on either side of the proposed waterline alignment and the Morinville Hutterite Colony.
- The proposed 150mm diameter waterline has enough capacity to service Alcomdale, the Morinville Hutterite Colony, and 54 rural residents outside of Alcomdale. Should the County decide to supply all the residences in the study area, the pipe will need to be upsized to a 200mm diameter HDPE DR11 pipeline.
- An Inter-basin Transfer agreement is required for the Option 2 alignment. This will increase cost as significantly delay the project schedule.
- Option 1 (RQB) has the highest capital cost **(\$5,091,000)**, and life cycle costs **(\$4,722,000)**. However, the costs of water purchase and maintenance will be offset by the revenue to line has potential in generating.
- Option 2b has the least capital **(\$3,582,000)** and total life cycle cost **(\$3,971,000)**. It requires the least capital cost contribution amount from Alcomdale Water Co-operative **(\$358,200)**. Compared to Option 1 (RQB), it has higher water purchase and maintenance costs, relies on negotiations with WRWSC (no formal agreement yet) and leaves Sturgeon County with no control over water rates and future increases.

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Closure

This report was prepared for the Sturgeon County to present the findings of the alignment option re-evaluation for Alcomdale as well as present updated costs and risk analysis.

The services provided by Associated Engineering Alberta Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Engineering Alberta Ltd.

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Project Engineer

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Appendix A – Cost Estimates

Alcomdale Feasibility Study - Cost Comparison



Description	Unit	Option 1 (RQB) Quantities	Option 1 (RQB) Cost	Option 2a (Busby) Quantities	Option 2a (Busby) Cost	Option 2b (Busby) Quantities	Option 2b (Busby) Cost
				0			
Supply and Install 150 mm Diameter HDPE DR 11 by HDD	lm	13800	\$2,638,000	9200	\$1,759,000	8100	\$1,549,000
Supply and Install 150 mm Valves	ea	16	\$70,000	10	\$44,000	8	\$35,000
Supply and Install Combination Air/Vacuum Valve Chamber	ea	10	\$550,000	8	\$440,000	5	\$275,000
Hydrants	ea	14	\$184,000	9	\$119,000	7	\$92,000
Services	ea	22	\$87,000	10	\$40,000	10	\$40,000
Inlet works at Alcomdale Reservoir	Sum		\$150,000		\$150,000		\$150,000
Alcomdale Reservoir ammonia dosing system	Sum		\$80,000		\$80,000		\$80,000
Waterline			\$3,759,000		\$2,632,000		\$2,221,000
Engineering (10%)			\$376,000		\$264,000		\$223,000
Sub-total 1			\$4,135,000		\$2,896,000		\$2,444,000
20% Contingency			\$827,000		\$580,000		\$489,000
Working Easement	ha	3.6	\$10,000	9	\$58,000	8	\$51,000
Permanent Easement	ha	3.6	\$19,000	9	\$29,000	8	\$26,000
Railway Crossing (application for approval, geotechnical analysis, track monitoring during construction & easement)	Sum		\$0		\$100,000		\$100,000
Allow for pump upgrades at Westlock to increase flow	Sum		\$0		\$200,000		\$200,000
Allow for flowmeter installation including chamber	Sum		\$100,000		\$100,000		\$100,000
Estimated costs for the Interbasin Transfer agreement Preparation and Execution	Sum		\$0		\$100,000		\$100,000
Estimated upfront costs to be paid to Westlock Regional Water Services Commission (11% of Westlock's contribution to the capital cost of the existing Westlock-Busby waterline).	Sum		\$0		\$72,000		\$72,000
TOTAL - Waterline Capital Costs			\$5,091,000		\$4,135,000		\$3,582,000
Estimated Alcomdale Water Co-operative Contribution (10%)			\$509,100		\$413,500		\$358,200
Estimated funding required from the "Water for Life" grant (90%)			\$4,581,900		\$3,721,500		\$3,223,800
Water Purchase and Maintenance Costs							
Cost to Sturgeon County for Water Purchase from EPCOR - Over 25 years (Assuming 7% discount rate over 25 years). Based on annual water charge of \$0.78/m ³ at average day consumption.	Sum		\$421,000		\$0		\$0
Cost to Sturgeon County for Water purchase from Westlock -Over 25 years (Assuming 7% discount rate over 25 years). Based on annual water charge of \$2/m ³ at average day consumption (Does not cover maintenance of the proposed Alcomdale waterline).	Sum		\$0		\$314,000		\$314,000
Waterline Maintenance Costs over 25 years (Assume 1% of Capital Costs annually)			\$956,000		\$663,000		\$556,000
Total Water Purchase and Maintenance Costs			\$1,377,000		\$977,000		\$870,000
Revenue Generated by Sturgeon County (it is envisaged that the revenue will go towards operation and maintenance of the proposed waterline)							
Revenue to be generated from the waterline over 25 years. (Assuming 7% discount rate over 25years). Based on a charge of \$2.90/m ³ and a bi-monthly flat rate of \$23.00 at average day consumption.	Sum		-\$1,746,000		-\$481,000		-\$481,000
Total Revenue Generated to Sturgeon County			-\$1,746,000		-\$481,000		-\$481,000
Net Revenue (Revenue - Total Water Purchase and Maintenance)			-\$369,000		-\$496,000		-\$389,000
Total Life Cycle Cost			\$4,722,000		\$4,631,000		\$3,971,000