Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

MEMO

Date:	May 5, 2020	File:	2018-3181-00E-3.00
To:	Shawn Olson	Page:	Page 1 of 2
From:	Sean Nicoll, P.Eng./Eric Cheung, P.Eng.		
Project:	CRSWSC Master Plan		
Subject:	CRSWSC Master Plan - Scenario 5 Update		

The Capital Region Southwest Water Services Commission (Commission) requested that Associated Engineering (AE) update the water rates for Scenario 5 from the recently completed Water Master Plan to reflect the current water rate set by the Commission Board. The water rate is to be increased from $1.59/m^3, as outlined in the Master Plan, to $1.64/m^3 The following summarizes the changes to Scenario 5:

Scenario 5

This Scenario is similar to Scenario 4, except the current water rate of $1.64/m^3 (2020) is used and held until 2023, and assumes the following:

- The Commission uses a combination of accumulated cash reserve and debt to undertake future capital expenditures.
- The Commission's initial capital reserve is approximately $6.0M in 2020.
- The Commission would reduce the current water reserve rate from $0.375/m^3 to $0.21/m^3 over the next three years.

Based on this Scenario, the Commission would use its accumulated cash reserve of $15.1Mand a debenture of $25.6M in 2035 to complete future capital expenditures. The debenture capacity of the Commission in 2035 is approximately $41.3M. The debenture of $25.1M taken in 2035 is approximately 61% of the Commissions debenture capacity. In 2044 the Commission would take an additional debt of $4.1M, for a combined debenture of $14.2M. The additional debenture undertaken in 2044 is approximately 23% of the Commissions debenture capacity. The Commission would pay back its accumulated debt by 2049.

This updated scenario assumes that the Commission started with an initial capital reserve of approximately $6.0M in 2020. The Water Master Plan, assumed that the capital reserve of $6M started in 2019. The impact of this change is outlined below:

- In 2035 the Commission's anticipated debenture increases from $21.3M to $25.1M.
- In 2044 the Commission combined debt increases from $8.7M to $14.2M.
- The Commission pays its dept in 2049 instead of 2047 as originally forecasted.

Table 11-2
Summary of Projected Water Rates for Scenario 5

Year	Scenario 5 ($/m3)
2020	1.64
2021	1.64
2022	1.64
2023	1.64
2024	1.68
2025	1.73
2030	1.98
2035	2.23
2040	2.48
2044	2.68
2045	2.73

Figures 11.9 and 11.10 have been updated to reflect the above changes.

Should the Commission wish, we are available to discuss this information at the Commission's convenience.

Prepared by:

Eric Cheung, P.Eng.
Project Engineer

Reviewed by:

Sean Nicoll, P.Eng.
Project Manager

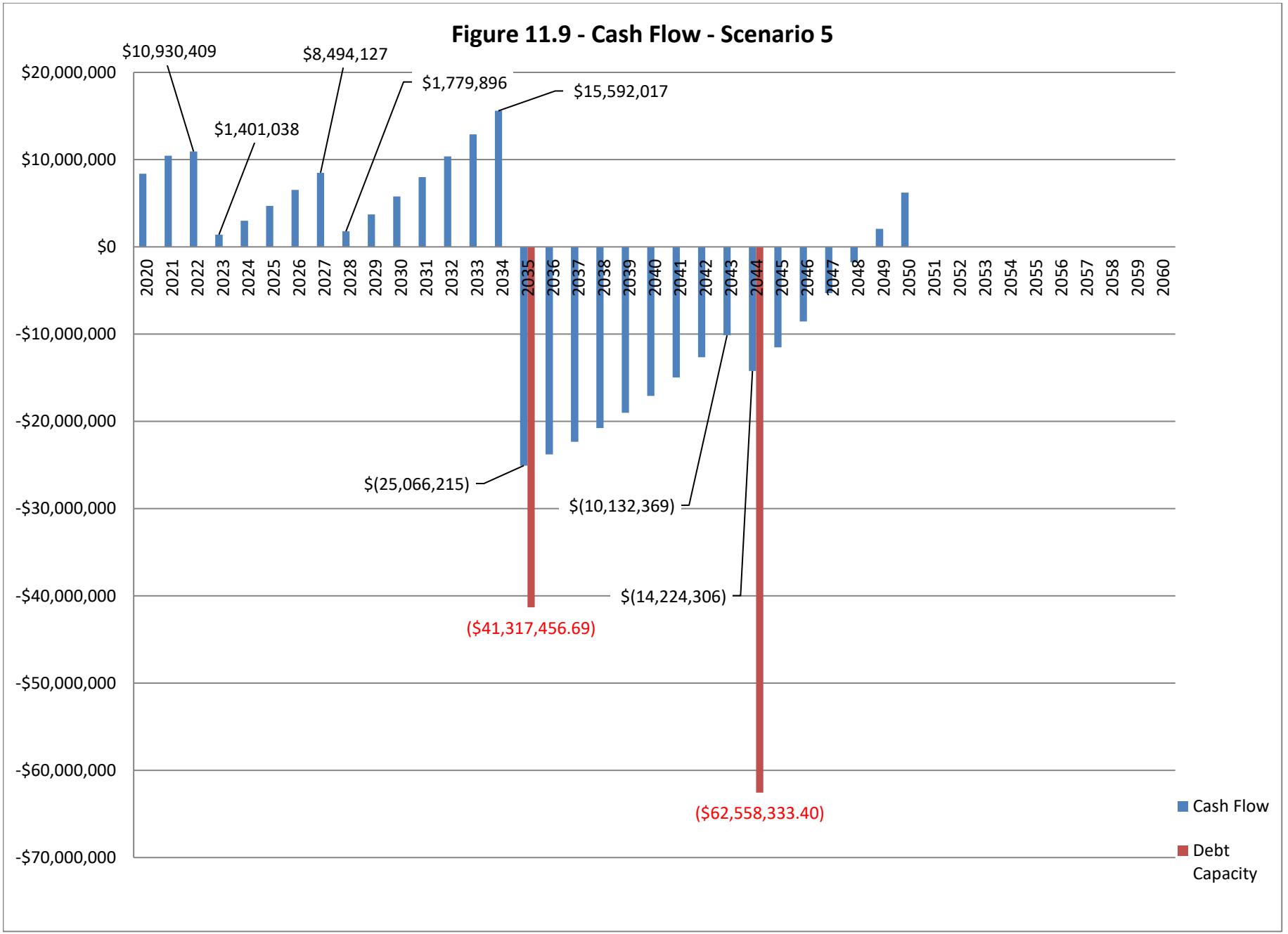
Figure 11.9 - Cash Flow - Scenario 5
$10,930,409
$8,494,127
$1,779,896
$15,592,017
$1,401,038
$20,000,000
$10,000,000
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-$10,000,000
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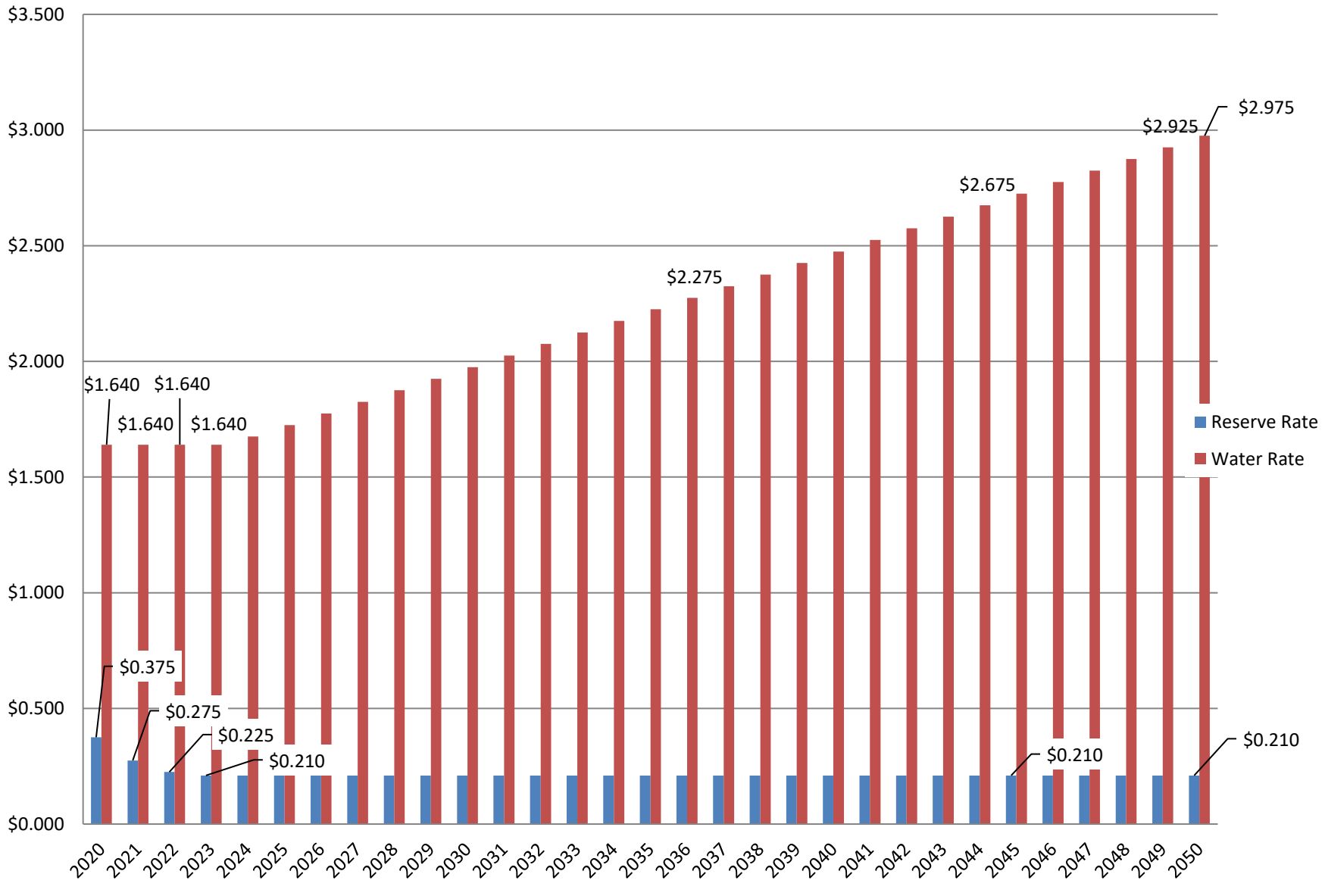
2060
$(25,066,215)
$(10,132,369)
$(14,224,306)
($41,317,456.69)
($62,558,333.40)
Cash Flow
Debt Capacity

Figure 11.10 - Unit Cost Analysis - Scenario 5



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REPORT

Capital Region Southwest Water Services Commission

Master Plan Update

JANUARY 2020

A Carbon Neutral Company

CANADA BEST MANAGED COMPANIES Platinum member

TABLE OF CONTENTS

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LIST OF FIGURES

1 INTRODUCTION

1.1 Scope

The Water Master Plan provides a comprehensive review of the Commission's future water demand requirements, system operations, anticipated future upgrades, water performance review, and capital/operational forecasting.

The purpose of this Master Plan update is to:

- Review the 2013 Water Master Plan and determine if the study area location and physical environment (including topography, geology, soils and climate) remain applicable.
- Review applicable water allocation bylaws.
- Review changes that Commission members have implemented regarding zoning and land use and impact on the Commission system.
- Update planning factors for the latest population forecasts and demographic trends.
- Confirm existing water system demands and update future demand projections based on adjusted assumptions.
- Review water conservation programs and identify opportunities for the Commission to adopt them.
- Define future supply needs and confirm if the existing supply source can meet these needs.
- Identify any potential new regional water users.
- Identify Stakeholders and Regulatory agencies that are affected by, or have a direct interest in, the Water Master Plan.
- Update the WaterCAD model.
- Assess the system in light of the City of Edmonton Annexation.

The Commission recently completed a **STRATEGIC PLAN** which prioritized the following items which relate to the Master Plan :

Level One Priorities

- Educate Members on water conservation methods. **(Strategic Plan Item 4.3.1)**
- Request that members develop permitting processes which identify the location of the Commission Water Lines. **(Strategic Plan Item 4.4.3)**
- Charge reasonable water rates to the members. **(Strategic Plan Item 4.4.1)**
- Align the Commission's Master Plan with Members' municipal master plans. **(Strategic Plan Item 4.1.1)**
- Evaluate crossing agreements within Members' right of ways. **(Strategic Plan Item 4.3.2)**

Level Two Priorities

- Actively seek new members. **(Strategic Plan Item 4.2.5)**

Level Three Priorities

- Updated Commission polices. **(Strategic Plan Item 4.2.4)**

These items will be highlighted within the Master Plan.

2 EXISTING SYSTEM DESCRIPTION

2.1 Introduction

A detailed historical background of the Capital Region Southwest Water Services Commission (the Commission) is provided in **Appendix A**. The current Master Plan provides an assessment of system operation under predicted 25-year demands, an updated plan to address operations and maintenance upgrades, and servicing options for the area.

The Commission supplies water to the following members, along with several small commercial and residential users:

- Leduc County (Nisku East, Nisku West and Hamlet of New Sarepta)
  - Edmonton International Airport (as a customer of Leduc County)
- City of Beaumont
- City of Leduc
- Town of Calmar
- Village of Hay Lakes
- Camrose County (Hamlet of Armena)
- Town of Millet

The Commission's transmission system consists of the following components (Reference **Figure 2-1**):

- 750 mm diameter supply transmission main from 41st Avenue within the City of Edmonton.
- Boundary Pump Station located west of Highway 2 approximately 1 km south of the City of Edmonton limits (41st Avenue South).
- The Boundary Pump Station is the point of transfer between the EPCOR and the Commission.
- 750 mm and 600 diameter transmission mains from 41st Avenue to the City of Leduc.
- Lateral mains to:
  - City of Beaumont (400 mm)
  - Leduc County East (200 mm) - Tie-in with the Beaumont lateral main
  - Leduc County West (500 mm)
  - Discovery Park Reservoir (350 mm) (not commissioned)
  - Edmonton International Airport 1 (200 mm)
  - Edmonton International Airport 2 (300 mm) (not commissioned)
  - City of Leduc North Reservoir (600 mm)
  - City of Leduc Robinson Reservoir (400 mm)
  - Town of Calmar (300 mm)
  - New Sarepta (250 mm HDPE)
  - Hay Lakes (200 mm HDPE)
  - Hamlet of Armena (150 mm HDPE)
  - Town of Millet (300 mm HDPE)
- Highway 21 Booster Station within SW01-50-24-4 which is approximately 11.5 km east of the City of Leduc Boundary.
- Telford Booster Station within NE25-49-25-4.

- Eleven active Fill Stations, and two yet to be commissioned facilities (Discovery Park and Airport No. 2).
- The Commission's radio hub is located at the Highway 21 Booster Station. The main Supervisory Control and Data Acquisition (SCADA) system is located at the Boundary Pump Station.
- In 2014, the Highway 21 system was expanded to service the Hamlet of Armena. The section between Hay Lakes and Armena is a 150 mm diameter HDPE pipe.
- In 2017 the Millet pipeline was expanded to service the Town of Millet. The Millet Pipeline is comprised of the Telford Booster Station, 550 mm diameter HDPE and 300 mm diameter HDPE Pipe.

The majority of the Commission's pipe infrastructure is located within unsecured easements, or within Alberta Transportation's or Member's road right of ways. This is a potential risk to the Commission as it is either more difficult for other utilities to identify the Commission as a utility crossing location, or the Commission is subject to relocation based on landowner developments or realignment of road ways. It is recommended that the Commission work with its members to highlight the Commission's infrastructure within planning documents to increase the awareness of the Commissions pipeline locations. The Commission should work with its respective members to establish crossing protocols for pipelines located within road right of ways.

STRATEGIC PLAN OBJECTIVES

STRATEGIC PLAN NO 4.4.3

Increase the awareness of the locations of the Commission Pipeline within each serviced Community. This could include having the Commission pipelines identified within planning documents by the respective members or incorporating the Commission pipeline with member GIS systems.

STRATEGIC PLAN NO 4.3.2

Evaluate crossing agreements within Member rights of way

As per the Commission's Bylaws, each customer is responsible to provide adequate storage to meet their requirements. Reference **Section 6** for additional information on the Commission's storage requirements.

Table 2-1 shows the existing storage capacity of each customer.

Table 2-1
Current Water Reservoir Capacity

Customer	Reservoir Capacity
Leduc County	11,360 m^3 (East = 6,815 m^3, West-Nisku = 4,545 m^3)
City of Beaumont	7,273 m^3
Edmonton International Airport	4,300 m^3 Reservoir No 1 4,200 m^3 Reservoir No 2, (Currently offline)
City of Leduc	24,957 m^3 (North = 13,638 m^3, South = 6,819 m^3, Robinson = 4,500m^3)
Town of Calmar	3,182 m^3
Leduc County (Hamlet of New Sarepta)	436 m^3

Customer	Reservoir Capacity
Village of Hay Lakes	474 m^3
Camrose County (Hamlet of Armena)	80 m^3
Town of Millet	4,091 m^3

Water supply to the Boundary Pump Station is from EPCOR (City of Edmonton) at a minimum of 255 kPa pressure. The normal operating pressure range from EPCOR is between 300 kPa and 400 kPa.

Figure 2-1 shows the Commission's system. Further information regarding the **Existing System Description** is enclosed in **Appendix A**.

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

N

Parkland County

Edmonton

Devon

Strathcona County

Beaver County

Leduc County

County of Wetaskiwin No. 10

Camrose County

Boundary Station

Leduc County East

Leduc County West

Discovery Park

Airport 1

Airport 2

Leduc North

Saunders Lake Tie-in

Leduc West

Beaumont

Looma

Hwy 21 Booster Station

Looma Tie-in

RollyView Tie-in

Rolly View

New Sarepta

Calmar

Leduc

Telford Booster Station

Leduc Robinson

Miquelon Lake Provincial Park

Hay Lakes

Armena

Millet

Existing Reservoir
Existing Pump Station
Existing Single Connection
Future Reservoir
Future Tie-in

Pipe Diameter
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200 mmø
250 mmø
300 mmø
400 mmø
500 mmø
550 mmø
600 mmø
750 mmø
Transmission Main 1
Transmission Main 2

0 2 4 6 8 km

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DATE: 11/11/2019, Kent Richardson

Associated Engineering

CRSWSC

AE PROJECT No.	2018-3181
SCALE	1:170,000
COORD. SYSTEM	NAD 1983 UTM ZONE 12N
DATE	2019 NOVEMBER
REV	
DESCRIPTION	ISSUED

FIGURE No. 2.1

CAPITAL REGION SOUTHWEST WATER SERVICES COMMISSION

CRSWSC
OVERALL SYSTEM

2.2 Stakeholder of the Commission

In addition to the Commission members and customers, the following organizations are impacted, or have an interest in the Commission's Master Plan:

- **EPCOR**: which is the Commission's water source.
- **Regional Water Customer Group (RWCG):** of which the Commission is a member. The RWCG is the negotiating body for the Water Commission's being serviced by EPCOR.
- **Alberta Environment and Parks**: is the regulator for the water transmission systems.

2.3 System Capacity

The existing Commission's main supply pipe south of the Boundary Pump Station was designed to handle a theoretical ultimate demand of 2,444 m^3/hr, based upon a maximum velocity of 1.5 m/s. A maximum velocity of 1.5 m/s is generally recommended for transmission systems to minimize system headloss, energy pumping requirements, and transient pressure surges. The following are the theoretical capacities of each supply main in the system based on a maximum velocity of 1.5 m/s:

- City of Beaumont and the Leduc County East Reservoir = 678 m^3/hr
- Town of Calmar = 378 m^3/hr
- Town of Millet = 290 m^3/hr
- Highway 21 Booster Station to New Sarepta = 206 m^3/hr
- New Sarepta to Hay Lakes = 133 m^3/hr
- Hay Lakes to Armena = 78 m^3/hr

2.4 Annual Water Allocations

The current minimum annual allocations as per Bylaw 02/2015 are outlined in Table 2-2. A copy of the Bylaw is provided in Appendix B.

Table 2-2
Commission's Water Allocation

Customer	Flow Rate (m^3/hr)
Transmission Line 1	
City of Leduc	498
City of Beaumont	188
Town of Calmar	47
Leduc County (Includes Leduc County East and West Reservoir)	157
Edmonton International Airport	71
Town of Millet	57.5
Sub-Total:	**1,018.5**
Transmission Line 2	
Village of Hay Lakes	26.5
County of Camrose	11.05
Leduc County (includes Rolly View, Looma, New Sarepta)	36.83
Sub-Total:	**74.38**
Water Allocation	**1,092.88**

2.5 Water Supply and Boundary Pump Station

Water is supplied to the Boundary Pump Station from EPCOR via a 750 mm pipe. Inside the station, the pipe is reduced to 400 mm at the meter. EPCOR's billing meter was upgraded in 2009, and the Commission's operation meter was replaced in 2011. EPCOR targets a normal pressure at the station of between 300 kPa - 400 kPa (40.77 m head).

The Boundary Pump Station has three pumps: 200 Hp VSP-102, 375 Hp VSP-103 and 250 Hp VSP-104. Currently, the station operates primarily with pumps VSP-102 and VSP-104. VSP-102 operates on a pressure signal from the City of Leduc Fill Station and will increase or decrease in speed depending on the demand. If the level in the reservoir continues to drop, the pump speed will increase to 100% and variable speed pump VSP-104 will start. After VSP-104 is on line, a time delay of 20 seconds is activated to stop VSP-102. When the high demand exceeds the capacity of VSP-104, VSP-103 will come on line, and VSP-104 will shut down.

Table 2-3 summarizes the pumping capacities at the Boundary Pump Station.

Table 2-3
Summary of Pumping Capacities at Boundary Pump Station

Pump #	Pump ID	Capacity	Rated Discharge Head	Power Required
1	VSP-102	794 m^3/hr	50 m (490 kPa)	149 kW (200 Hp)
2	VSP-103	1,600 m^3/hr	52 m (510 kPa)	280 kW (375 Hp)
3	VSP-104	1,200 m^3/hr	46 m (448 kPa)	187 kW (250 Hp)

2.6 Highway 21 Booster Station at SW01-50-24-4

In May 2010, the Highway 21 Regional Water System completed the construction of a regional water pipeline from the City of Leduc to the Village of Hay Lakes via the Hamlet of New Sarepta. This regional waterline ties into the Commission transmission line upstream of the City of Leduc North Reservoir. The Highway 21 Booster Station was constructed at SW01-50-24-4 to increase system pressure to maintain 140 kPa (20 psi) at the end of regional pipeline at the Village of Hay Lakes (Transmission No 2). The Highway 21 Booster Station is located approximately 11.5 km east of the City of Leduc.

Water is supplied to the Highway 21 Booster Station via a 250 mm diameter connection from the Commissions main pipeline. The supply line to the Booster Station is 250 mm diameter HDPE DR 11 pipe. The section between the Hamlet of New Sarepta and the Village of Hay Lakes is comprised of 200 mm HDPE DR11 pipe.

In 2014 the expansion of the water distribution system to the Hamlet of Armena was completed. The section between the Village of Hay Lakes and the Hamlet of Armena is a 150 mm HDPE DR 11 pipe.

A minimum supply pressure of 140 kPa (20 psi) is to be maintained at the upstream side of the Highway 21 Booster Station. The outlet pressure is controlled by VFD's to approximately 880 kPa leaving the station. Table 2-4 summarizes the pumping capacities for the two booster pumps at the Highway 21 Booster Station.

Table 2-4
Summary of Pumping Capacities at the Highway 21 Booster Station

Pump #	Pump ID	Rated Capacity	Observed Capacity of Pump	Rated Discharge Head	Power Required
1	BP-0406	48.24 m^3/hr	36 m^3/hr	63.3 m (621 kPa)	15 kW (20 Hp)
2	BP-0407	48.24 m^3/hr	36 m^3/hr	63.3 m (621 kPa)	15 kW (20 Hp)

Note: BP-0406 and 0407 have an observed pump capacity of 10 L/s (36 m^3/hr)

The Commission has recently upgraded the pumping capacity within the Highway 21 Booster Station as outlined in Table 2-5. BP-0407 will need to be upgraded in 2028 as the average day demand is anticipated to exceed its pumping capacity. In 2028, BP-0407 should be replaced with the same pump as BP-0406. The Commission has already procured this spare pump as part of the Highway 21 Pump Upgrade project.

Table 2-5
Summary of Pumping Capacities at the Highway 21 Booster Station

Pump #	Pump ID	Capacity	Rated Discharge Head	Power Required
1	BP-0406 (New)	100.8 m^3/hr	89.7 m (880 kPa)	29.8kW (40 Hp)
2	BP-0407	48.24 m^3/hr	63.3 m (621 kPa)	15 kW (20 Hp)

With pump BP-0406 installed, the station will operate in the following manner: Pump BP-0407 will provide the flows from 3.6 m^3/hr to 36 m^3/hr. If higher flows are required, then the system will transfer pumping to pump BP-0406, while pump BP-0407 is shut down. Pump BP-0406 will provide flows up to 100.8 m^3/hr.

2.7 Town of Millet Supply Line and Telford Booster Station

In 2017 the Commission completed the construction of a HDPE pipeline from the City of Leduc to the Town of Millet. This waterline ties into the Commission Transmission Main #1 west of the City of Leduc North Reservoir. A Booster Station (Telford Booster Station) was constructed at NE25-49-25-4 to supply and maintain water pressure to support the Town of Millet. The Telford Booster Station is located just south of Telford Lake within the City of Leduc. Water is supplied to the Telford Booster Station through a 550 mm diameter HDPE waterline from the connection west of the City of Leduc North Reservoir, to the connection to the Robinson Reservoir. There is a 400 mm diameter HDPE DR 11 lateral main to the Robinson Reservoir. Downstream of the Robinson Reservoir tie-in, a 300 mm HDPE DR 11 pipe conveys the water to the Town of Millet fill location.

A minimum supply pressure of 140 kPa (20 psi) is to be maintained at the upstream side of the Telford Booster Station. The outlet pressure is controlled by VFD's to approximately 750 kPa leaving the Telford Booster Station.

Table 2-6 summarizes the pumping capacities for the two booster pumps at the Telford Booster Station.

Table 2-6
Summary of Pumping Capacities at Telford Booster Station

Pump #	Pump ID	Capacity	Rated Discharge Head	Power Required
1	PMP1	566 m^3/hr	67.06 m (657 kPa)	149.15 Kw (200 Hp)
2	PMP2	566 m^3/hr	67.06 m (657 kPa)	149.15 Kw (200 Hp)

The Telford Booster Station operates on a duty/standby pumping configuration, meaning one pump will run at a time

3 WATER DEMAND PROJECTIONS

3.1 Water Demand Projections

3.1.1 Historical Water Demands

The Commission provided water consumption records from 2013 to 2018. These have been reviewed and analysed in conjunction with water consumption records from 1997 to 2012, as presented in the 2013 Master Plan.

Table 3-1 summarizes the historical water consumption records for all members. The records indicate that from 1997 to the end of 2018 there has been an increase in water demand for the Commission. The 10-year average annual increase in water consumption between 2008 and 2018 was 1.9%, and the long-term water demand growth 1998 to 2018 (20 year) was 3.1% per year.

The amount of water supplied to the Commission's members in 2018 was 6,001,894 m^3, or an average day demand of 685 m^3/hr (190 L/s). Figure 3-1 shows the ratio of average water consumption among the Commission's members.

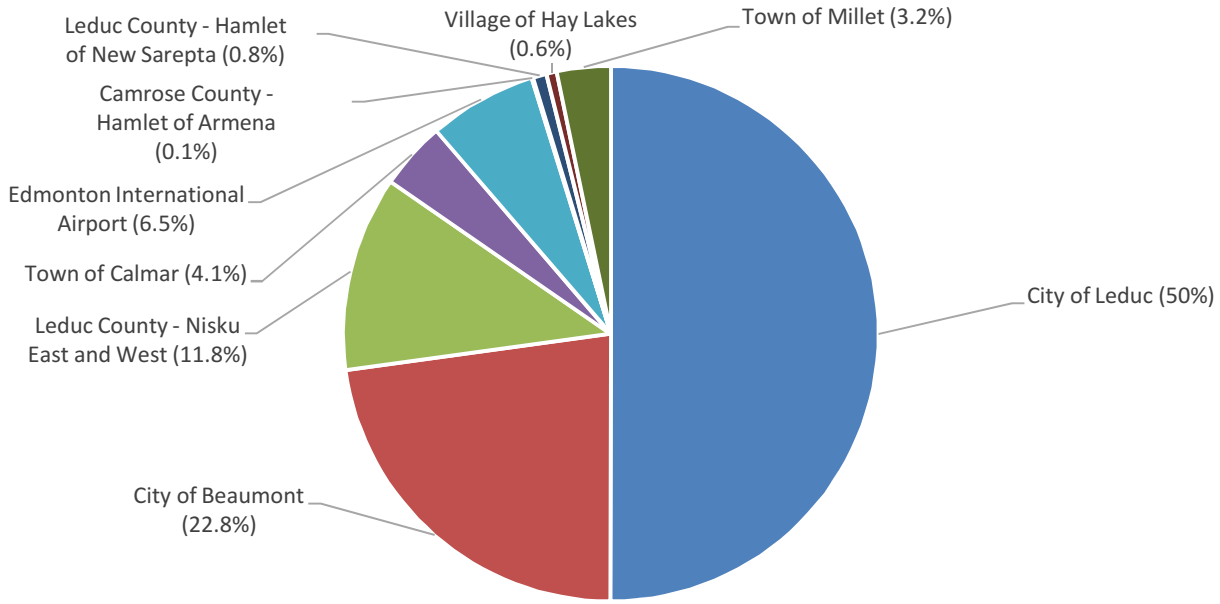


Figure 3-1
2018 Average Water Consumption Within the Commission

The amount of water supplied to the Commission's single Commercial/Residential Customers from the year 2018 is shown in Table 3-2.

Table 3.1
Historical Water Consumption (1997-2018)

Customer	Yearly Total Consumption (m^3)																							
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018 Average Day (L/s)	2018 Peak Day (L/s)
City of Leduc	1,651,734	1,730,922	1,699,926	1,808,199	2,119,526	2,167,998	2,116,210	2,288,822	2,194,661	2,311,962	2,403,911	2,522,606	2,640,576	2,619,184	2,784,215	2,841,830	2,989,374	2,929,991	2,869,926	2,809,860	2,775,148	2,911,949	92.3	166.2
Percentage	56.9%	56.1%	56.2%	56.3%	56.2%	56.9%	56.3%	57.8%	54.1%	52.3%	54.2%	53.5%	54.9%	55.1%	55.3%	54.7%	54.8%	53.2%	52.6%	52.0%	50.8%	50.0%		
Average Growth 2007 to 2017																						1.3%		
Average Growth 1997 to 2017																						2.5%		
Town of Beaumont	576,106	642,525	612,424	656,028	760,640	791,666	760,030	795,133	812,231	884,344	933,913	996,372	1,052,362	1,018,321	1,071,231	1,103,036	1,148,384	1,205,832	1,245,420	1,285,008	1,277,175	1,326,824	42.1	75.7
Percentage	19.9%	20.8%	20.3%	20.4%	20.2%	20.8%	20.2%	20.1%	20.0%	20.0%	21.1%	21.1%	21.9%	21.4%	21.3%	21.2%	21.1%	21.9%	22.8%	23.8%	23.4%	22.8%		
Average Growth 2007 to 2017																						2.6%		
Average Growth 1997 to 2017																						3.5%		
Leduc County - Nisku East and West	340,094	353,641	349,981	389,359	487,957	472,084	515,369	487,220	603,869	755,900	609,153	668,724	605,641	583,855	656,750	715,710	767,430	773,719	726,493	679,266	622,114	685,952	21.8	39.2
Percentage	11.7%	11.5%	11.6%	12.1%	12.9%	12.4%	13.7%	12.3%	14.9%	17.1%	13.7%	14.2%	12.6%	12.3%	13.1%	13.8%	14.1%	14.0%	13.3%	12.6%	11.4%	11.8%		
Average Growth 2007 to 2017																						0.2%		
Average Growth 1997 to 2017																						3.2%		
Town of Calmar	171,692	188,387	177,868	183,544	189,359	200,269	192,355	186,877	203,404	213,911	210,831	215,392	226,433	203,572	190,481	194,065	204,777	215,174	222,237	229,300	233,459	237,193	7.5	13.5
Percentage	5.9%	6.1%	5.9%	5.7%	5.0%	5.3%	5.1%	4.7%	5.0%	4.8%	4.8%	4.6%	4.7%	4.3%	3.8%	3.7%	3.8%	3.9%	4.1%	4.2%	4.3%	4.1%		
Average Growth 2007 to 2017																						0.9%		
Average Growth 1997 to 2017																						1.1%		
Edmonton International Airport	161,907	171,192	183,518	176,483	214,461	176,112	176,395	199,679	239,758	255,168	278,423	312,836	288,339	275,431	261,725	271,026	266,433	302,528	310,914	319,299	330,425	378,415	12.0	21.6
Percentage	5.6%	5.5%	6.1%	5.5%	5.7%	4.6%	4.7%	5.0%	5.9%	5.8%	6.3%	6.6%	6.0%	5.8%	5.2%	5.2%	4.9%	5.5%	5.7%	5.9%	6.0%	6.5%		
Average Growth 2007 to 2017																						1.7%		
Average Growth 1997 to 2017																						3.8%		
Camrose County - Hamlet of Armena																				6,372	5,689	6,558	0.2	0.4
Percentage																				0.1%	0.1%	0.1%		
Average Growth 2016 to 2017																						NA		
Leduc County - Hamlet of New Sarepta														32,404	34,672	37,099	39,696	42,475	45,488	46,819	44,827	47,632	1.5	2.7
Percentage														0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.9%	0.8%	0.8%		
Average Growth 2010 to 2017																					4.1%	4.4%		
Village of Hay Lakes														22,737	31,397	34,498	35,760	38,207	37,621	37,025	35,525	37,097	1.2	2.1
Percentage														0.5%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%		
Average Growth 2010 to 2017																					5.7%	5.6%		
Town of Millet																					144,750	188,019	6.0	10.7
Percentage																					2.6%	3.2%		
Average Growth 2017																					N/A	NA		
Total	**2,901,533**	**3,086,667**	**3,023,717**	**3,213,613**	**3,771,943**	**3,808,129**	**3,760,359**	**3,957,731**	**4,053,923**	**4,421,285**	**4,436,231**	**4,715,930**	**4,813,351**	**4,755,504**	**5,030,471**	**5,197,264**	**5,451,854**	**5,507,926**	**5,458,099**	**5,406,577**	**5,463,423**	**5,819,639**	184.5	332.2
Average Growth 2007 to 2017																						1.9%		
Average Growth 1997 to 2017																						3.1%		
Average Demand (m^3/hr)	331.23	352.36	345.17	366.85	430.59	434.72	429.26	451.80	462.78	504.71	506.42	538.35	549.47	542.87	574.25	593.29	622.36	628.76	623.07	617.19	623.68	664.34	0.02	0.04

Table 3.2
Single Commercial/Residential Customers
Water Consumption from 2002 to 2017

Customer Number	Consumer Residents		Total Consumption (m^3/yr)															
		Legal	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Brezden, Noel and Maureen	SE 05-050-25-4	407	268	236	237	245	259	247	216	210	227	388	246	238	244.5	245.5	241
2	Cunningham Fertilizers	PT SE34-059-26-4	131	184	375	522	310	310	512	294	289	151	44.5	65	70.5	74	64.5	56
3	Gene's Excavating & Bob Cat Services Ltd.	SE36-049-26-4	1,310	257	168	274	425	453	522	615	472	490	355	354	347	416	384	328
4	Leduc Heritage Society	Unknown	349	442	196	205	151	272	115	145	70	58	130	51.3	51	67.5	26.5	221
5	Lowie, Tom and Elaine	SE36-049-26-4			120	141	182	133	142	139	127	145	158	140	148	146.5	159	152
6	Goudreau Feed Services	NW27-050-24-4	294	*Property no longer supplied due to house fire in 2002*														
7	Scott Truss	NW 33-059-25-4	335	495	593	450	483	515	489	389	351	359	355	912	175.5	121.5	75	196

Table 3-3 shows the average annual historical growth rates (water demand) for each Commission member and the Edmonton International Airport over the past 20 years; the average growth of is 3.1%/year.

Table 3-3
Historical Growth Rates (Water Demand)

Customer	Growth in Water Demand (%) (1998 to 2018)
City of Leduc	2.5%
City of Beaumont	3.5%
Leduc County (Nisku East and West)	3.2%
Town of Calmar	1.1%
Edmonton International Airport	3.8%
Camrose County (Hamlet of Armena)	0.1%
Leduc County (Hamlet of New Sarepta)	4.4%**
Village of Hay Lakes	5.6%**
Town of Millet	N/A*

* = *Insufficient data*

** = *Average growth from 2010 to 2018*

In early 2018 the Commission requested that members and customers provide projected water demands for both short-term (5 years) and long-term (25 years). Table 3-4 summarizes the projected water demands provided by each of the members and the Airport.

Table 3-4
Projected Water Demand Usage Increases

Member/Customer	Projected Annual Water Demand Increase (%)
City of Leduc	3.5
City of Beaumont	3.5
Leduc County	2.5
Town of Calmar	1
Edmonton International Airport	6
Camrose County	Detailed Projections Provided
Village of Hay Lakes	2
Hamlet of New Sarepta	2
Town of Millet	4
Leduc County Rural	2018 (0 L/s) - 2023 (2.1 L/s)
	2028 (5.33 L/s)
	2028 (5.33 L/s) + 4% Growth
Discovery Park	2018 (0 L/s) - 2028 (10.5 L/s)
	2028 (10.5 L/s) - 2043 (24.4 L/s)

A complete list of the water demand projections for Leduc County and Camrose County are provided in **Appendix C**.

Table 3-5 presents the five-year water demand projections for each of the members.

Table 3-5
Five-Year Projected Water Demands

Customer	Projected Water Volume (m^3)					
	2018	2019	2020	2021	2022	2023
City of Leduc	2,872,278	2,972,808	3,076,856	3,184,546	3,296,005	3,411,365
City of Beaumont	1,321,876	1,368,142	1,416,027	1,465,588	1,516,883	1,569,974
Leduc County - East and West	638,406	655,124	672,281	689,887	707,953	726,493
Town of Calmar	235,794	238,152	240,533	242,938	245,368	247,821
International Airport	350,251	371,266	393,541	417,154	442,183	468,714
Camrose County	12,500	19,237	28,651	33,438	36,058	36,992
Leduc County (New Sarepta)	45,724	46,638	47,571	48,522	49,493	50,482
Village of Hay Lakes	36,236	36,960	37,699	38,453	39,222	40,007
Town of Millet	198,305	206,237	214,487	223,066	231,989	241,268

As part of the master plan process, the Commission has worked with its members to align this Master plan with its membership.

STRATEGIC PLAN NO 4.1.1

Align the Commission's Master Plan with Member's Municipal Plans.

3.1.2 Future Connections

The Commission is anticipating new services to tie-into the system in the near future. The following future connection locations were reviewed:

- Leduc County Rural (Rolly View and Looma)
- City of Edmonton - Discovery Park (approved)
- Leduc County Saunders Lake Industrial Area
- City of Leduc Robinson Reservoir (approved and currently operational)
- City of Leduc West Reservoir

Leduc County Rural - Rolly View and Looma

Leduc County Rural is comprised of Rolly View and Looma. The Rolly View tie-in is located approximately 12 km east of the City of Leduc boundary along Township Road 500, and the Looma tie-in is located approximately 5 km further east, as shown on **Figure 2-1**. In discussion with Leduc County it is has been assumed that 95% of the total water demand will be allocated to the Looma tie-in.
The water demand projections are identified below:

- 2.1 L/s Average Day Demand (ADD) for the 5-year period
- 5.33 L/s ADD for the 10-year period
- 4% growth after year 10

City of Edmonton - Discovery Park

Discovery Park Reservoir is currently being constructed west of Highway 2 and North of Highway 19. This Reservoir will service a new industrial-commercial development within the City of Edmonton. The following demand flows are anticipated for Discovery Park:

- 10.5 L/s ADD at the 10-year horizon
- 24.4 L/s ADD by 2043
- Initial storage capacity (Phase 1 and 2) 6034m^3, ultimate 10,689 m^3

Leduc County - Saunders Lake Industrial Area

The Saunders Lake Industrial Area is located south of the Nisku Business Park and north of Township Road 500. The following **Figure 3-2** illustrates the conceptual service area for the park. This industrial area is anticipated to be constructed by 2022. It is predicted that the average day demand will be 63m^3/hr (17.5 L/s) at full build out in 2043.

Figure 3-2
Conceptual Service Area for the Park

Leduc Robinson Reservoir

The Leduc Robinson Reservoir is located in the southeast area of the City of Leduc. The Robinson Reservoir started being serviced by the Commission in 2019. For the purposes of this Master Plan Update, it has been assumed that the Robinson Reservoir will supply 30% of the total water demand allocated for the City of Leduc.

Leduc West Reservoir

The Leduc West Reservoir is planned to be located within SE3-50-25-4. It is anticipated that this reservoir will be in commission by 2033. For the purposes of this Master Plan update, it has been assumed that the Leduc West Reservoir will supply 30% of the total water demand allocated for the City of Leduc.

3.1.3 Potential Future Customers

In review of the potential service area of the Commission, the following prospective customers were contacted:

- Miquelon Lake Provincial Park
- City of Camrose
- Village of Thorsby
- Samson Cree Nation

Miquelon Lake Provincial Park

Associated Engineering contacted Alberta Parks to inquire if Miquelon Lake Provincial Park is interested in service from the Commission system. Based on recent discussions with Alberta Parks, they have expressed interest in future supply from the Commission but are currently evaluating their options in relation to the capacity and condition of their existing water infrastructure within the park. This item should be reviewed again within the next Water Master Plan. Servicing Miquelon Lake Provincial Park has not been included in this Master Plan.

City of Camrose

The City of Camrose contacted the Commission regarding the possibility of receiving water from the Commission. Supplying the City of Camrose would require a major capital upgrade and extension of the Commission system to accommodate the projected water demand. Additional study will be required to confirm projected water demands, review potential connection locations, and pipeline alignments, along with the impacts to the Commission system and upgrade costs. The City also has to review how to delineate or separate their current water distribution system if they are proposing to use two difference water sources. Servicing the City of Camrose has not been included in this Master Plan.

STRATEGIC PLAN ITEM: 4.2.5 - ACTIVELY SEEK NEW MEMBERS

Both the City of Camrose and Miquelon Lake Provincial Parks could be potential new service areas for the Commission.

It is recommended that the Commission continue to engage with both City of Camrose and Miquelon Lake (Alberta Parks) regarding the possibility of future service to these areas if cost effective to do so.

Village of Thorsby

There is a possibility of extending the regional water pipe past the Town of Calmar to supply the Village of Thorsby. It is AE's understanding that Thorsby has recently completed a major upgrade to their existing water treatment facility. It does not appear that extending service to Thorsby is likely to occur in the foreseeable future.

Samson Cree Nation

Urban System Inc. contacted the Commission on behalf of the Samson Cree Nation, regarding the potential of water service from the Commission. In discussion with Urban System, AE understands that the Samson Cree Nation will be serviced from the North Red Deer River Water Services Commission located south of the Nation.

4 HYDRAULIC ASSESSMENT

4.1 C-Factor Testing

C-factor testing was performed on May 18, 2018. Flow tests were undertaken, and pressure differentials were measured within the Commission System. The site testing was then followed up with screenshots of the Commission SCADA system provided by the Commission for three sample days, such that overall flows and pressures could be considered. The test results indicated that the following C-factors would be suitable for the model evaluation:

- Steel pipe = 125
- Concrete pressure pipe = 130
- HDPE and PVC pipe = 135

In general, good conformance was found between the test data and the water model, based on the modified C-factors. The best results occurred along the steel and concrete pressure pipe sections, where the observed and modelled pressures came within a very small variance. The pressures observed along the HDPE pipe appeared to be less consistent and had a greater variance along the New Sarepta/Hay Lakes/Armena and Millet pipelines. It is recommended that a typical value of 135 be applied for both HDPE and PVC mains.

4.2 Hydraulic Model Analysis

The existing Commissions' system has been modelled using a computer hydraulics program – WaterCAD. The model was updated to reflect pipeline extensions, new pumping stations, existing and future design flows, and any other additional information. The hydraulic model analysis was carried out based on the minimum likely supply pressure at Boundary Pump Station as indicated by EPCOR, at approximately 300 kPa (720 m HGL). The hydraulic model analysis results are summarized in the following paragraphs.

Figure 4-1 presents the system curve as well as current, and projected average day and peak day demands through 2043. Although the geographic limits of the supply system have changed significantly over the past number of years (with extensions to New Sarepta, Hay Lakes, Armena, as well as to Millet and the Leduc Robinson Reservoir), this has not resulted in a significant change to the system curve. However, demand projections have changed significantly, and the required pumping head associated with the current peak demand is lower than presented in the 2013 Master Plan. As such, it is recommended that the Commission refer to the current system curve when assessing the required pumping head from the Boundary Pump Station. The current system curve indicates that a pumping head of approximately 740 kPa (764 m HGL) would be required at the Boundary Pump Station in order to meet the 2018 peak day demands.

The figure also shows the pumps VSP-102, VSP-104 and VSP-103 operating at different speeds and incoming pressures from EPCOR. The top lines show the pump VSP-103 operating hydraulic gradeline (HGL) at 100% speed with varying incoming upstream pressures of 300 kPa and 400 kPa. The bottom lines show pump VSP-102 operating at the incoming pressure of 300 kPa at different speeds of 100%, 90% and 80%. The orange line shows the parallel operation of the pumps VSP-104 (100% speed) and VSP-102 (90% speed).

From Figure 4-1, the VSP-102 pump curve (light green) at the Boundary Pump Station is capable of supplying all the Member's average day flows up to 2023 when it is operating at 90% speed based on a 300 kPa inlet pressure. At 90% speed, this pump should be able to provide approximately 800 m^3/h at an HGL of 758 m. The figure also shows that VSP-104 is capable of supplying the 2018 peak day demand of 1,174 m^3/h at an HGL of 764 m, operating at less than

100% speed with the incoming pressure of 300 kPa. Pumps VSP-102 and VSP-104 working in parallel will be able to supply the peak day demand up to 2021 (in the order of 1,340 m^3/h) at an HGL of 768 m. Pump VSP-103 is capable of supplying the average day flow up to 2041 and the peak day demand for the next 7 years (to 2025) at an inlet pressure of 300 kPa.

Based on the system curve, the pumps would generally be operating at the tail end of their pump curve, which is not efficient. Future pump upgrades will need to consider the new system curve.

It should be noted that the system curve has been based on maintaining a minimum of 20 psi to the Highway 21 Booster Station and a high point located to the west of the station.

Figure 4-2 presents the Hydraulic Gradeline (HGL) from the Boundary Pump Station to Calmar. HGL's are presented for both 2018 peak day flows and 2033 peak day flows.

Figure 4-3 presents the Hydraulic Gradeline (HGL) from the Boundary Pump Station to Armena. HGL's are presented for either the peak day flow or maximum day fill rate for 2018 and 2033, which ever is greater.

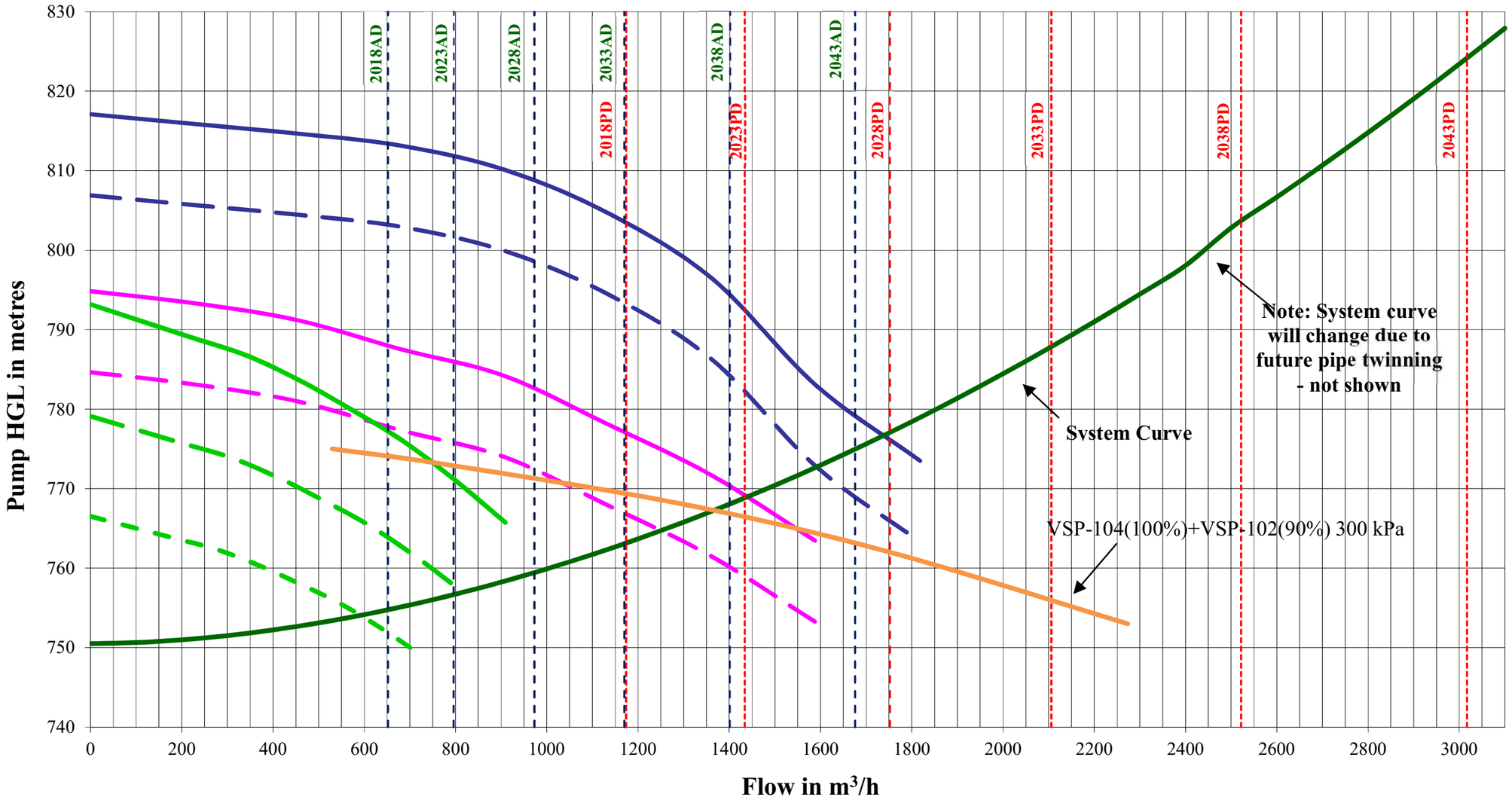
Figure 4-4 presents the Hydraulic Gradeline (HGL) from the Boundary Pump Station to Millet. HGL's are presented for both 2018 peak day flows and 2033 peak day flows.

The system HGL's demonstrates the existing system has sufficient capacity to accommodate to 2033 projected flows. Upgrades to the existing piped system area anticipated beyond this point (estimated in 2035).

Figure 4.1

Pumps
1. VSP 102 - 200 HP
2. VSP 103 - 400 HP
3. VSP 104 - 250 HP

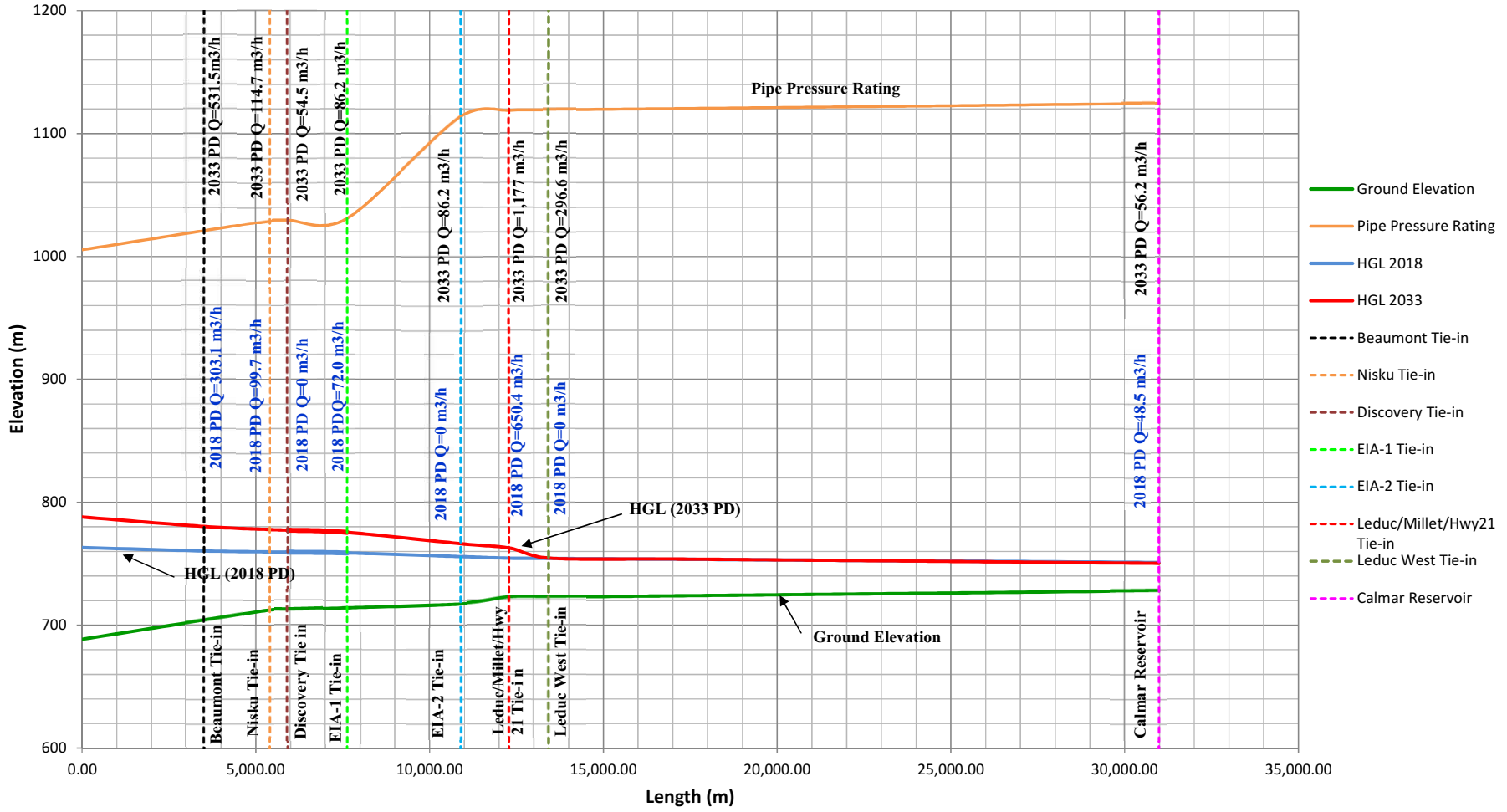
CRSWSC
Boundary Pump Station
Current Pumps Vs. System Demand



- Pump VSP-104 400 kPa inlet
- Pump VSP-104 300 kPa inlet
- Pump VSP-103 400 kPa inlet
- Pump VSP-103 300 kPa inlet
- Pump VSP-102 300 kPa 100%
- Pump VSP-102 300 kPa 90%
- Pump VSP-102 300 kPa 80%
- System Curve
- 2018AD - 652 m3/h
- 2018PD - 1,174 m3/h
- 2023AD - 796 m3/h
- 2023PD - 1,434 m3/h
- 2028AD - 973 m3/h
- 2028PD - 1,752 m3/h
- 2033AD - 1,170 m3/h
- 2033PD - 2,106 m3/h
- 2038AD - 1,401 m3/h
- 2038PD - 2,522 m3/h
- 2043AD - 1,676 m3/h
- 2043PD - 3,017 m3/h
- Parallel pump VSP104 (100%) VSP102 (90%) 300 kPa

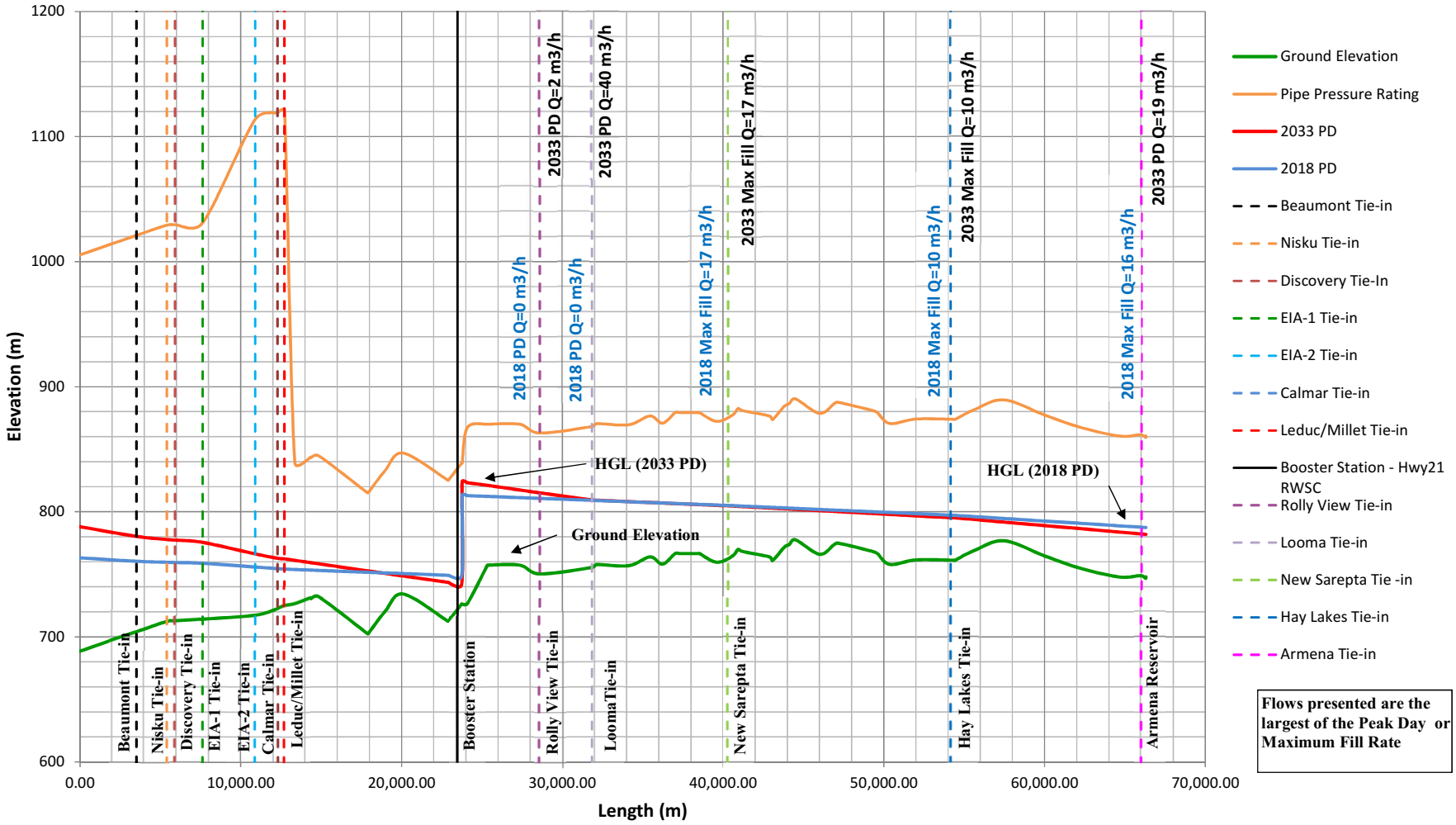
HYDRAULIC GRADE LINE
Boundary Pump Station to Calmar

Figure 4.2



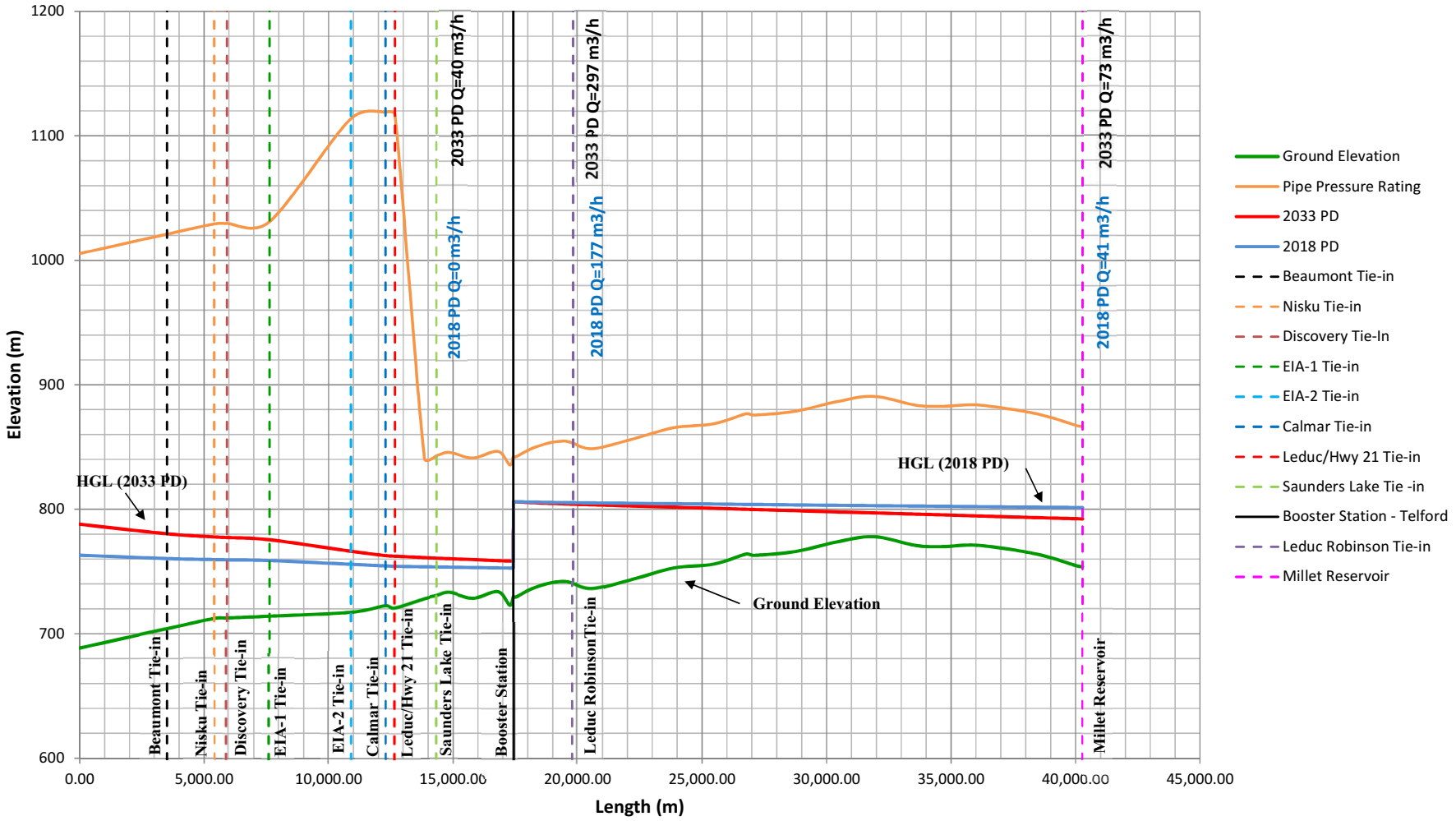
HYDRAULIC GRADE LINE
Boundary Pump Station - Armena

Figure 4.3



HYDRAULIC GRADE LINE
Boundary Pump Station - Millet

Figure 4.4



4.3 Minimum Operating Pressure (Fill Pressure at City of Leduc)

The hydraulic analysis identified that it will be necessary for the Commission to monitor and increase the minimum supply pressure to the City of Leduc North Reservoir over time. Currently, the minimum delivery pressure is controlled to 310 kPa (45 psi) at this location, and pumps at the Boundary Pump station are operated to maintain this minimum system pressure. This setpoint is anticipated to meet the minimum system pressure for the next 5 years.

As demands continue to increase south and east of the City of Leduc, it will be necessary to assess and increase overall system pressure to maintain a minimum pressure of 140 kPa (20 psi) at all locations along the system.

It is understood that the combined maximum fill rates of New Sarepta, Hay Lakes, and Armena total 43 m^3/hour (11.9 L/s), which greatly exceeds the combined 2018 peak day flow of 19 m^3/hour (5.4 L/s). This is significant as the likelihood of simultaneous filling at maximum fill rates is high due to truckfill locations in two of the communities, without sufficient reservoirs to buffer truckfill flow rates. As such, the hydraulic model has been based on the maximum fill rates to these three locations (in the short term) and peak design flows to all other communities. The peak demand flows are used for the three communities once the maximum fill rates are exceeded, which occurs part way through the study period. In the long term it is recommended that additional storage be constructed at these locations. Reference **Section 6** for further discussion regarding current setpoints and peak demands.

4.4 System Upgrades to Meet Projected Water Demands

Based on the projected water demands and system capacities, the following upgrades are anticipated to be required to meet future demands:

- **Next 5 Years (to 2023)**
  - Increase pumping capacity at the Highway 21 Booster Station (2019).
- **Next 25 Years (to 2043)**
  - Increase pumping capacity at the Boundary Pump Station (2023).
  - Install new twin 750 mm diameter pipe from the Boundary Pump Station to the Leduc County East/Beaumont lateral (2035).
  - Install new 750 mm diameter twin pipe from the County East/Beaumont lateral to City of Leduc North Reservoir (2035).
  - Install new 450 mm diameter twin pipe from the mainline to the Leduc County East lateral (2040)
  - Realign the existing 600 mm pipeline out of the alignment of the QE2 developments. (2040). It is assumed that the proposed 750 mm diameter pipe will be constructed outside the proposed QE2 developments.
  - Install new lateral mains to all future fill stations as required. This will depend on the location of the future reservoirs/fill stations and has not been accounted for in terms of costs.

Although just outside the 25-year window of this Master Plan, to meet the projected water demands along Transmission Line No 2, a 5km section of pipe from the Highway 21 Booster Station is proposed to be twinned with a 300 mm diameter pipeline in 2044. Reference **Figure 4-5**.

4.5 Water Conservation

In 2018 the Commission reported water billing of 96.96%, resulting in unaccounted water totaling just over 3%. As it is understood that the current meters are accurate to within approximately $^{+/-}$2%, the actual water loss could be even

less. In order to further reduce water loss in the system and with a goal of increasing water conservation, the Commission could consider the following:

- Track all non-metered water usage (including sampling, flushing etc.) such that it can be accounted for and included in the water capture statistics.
- Continue to ensure that all meters are calibrated regularly to ensure metered data is as accurate as possible.
- Encourage members and customers to adopt water conscious practices and account for lost water within their own systems.

Commission Members should undertake the following water conservation practices, this may include the following:

- Undertake a water audit within their community to identify potential areas of water loss. The audit would assist the members in determining if unaccounted water within there system was due to physical losses such as connection leaks or pipeline breaks, or commercial loss related to errors in meter readings or billing anomalies.
- Develop an education program for businesses and residences to reduce water consumption. This could include providing training materials on how to conduct a water audit of their business or household, review fixtures and operations to determine if lower water usage options are available, and the review of landscaping options or the frequency of watering.

The Commission could assist member municipalities with their water conservation efforts by developing educational materials on water conservation practices.

STRATEGIC PLAN ITEM: 4.3.1 - EDUCATE MEMBERS ON WATER CONSERVATION METHODS

Educate Commission Members on water conservation practices.

4.6 Climate Change

According to Environment, Canada Climate Change is the long-term shift in weather conditions measured by changes in temperature, precipitation, wind, snow cover, and other indicators. It can involve changes in average conditions and extreme conditions.

Impacts from short term extreme climate hazards can result in:

1. **Risk of Water Shortage** (including droughts): lack of sufficient water to meet demand.
2. **Risk of Inadequate Water Quality**: unsuitable quality for a particular purpose.
3. **Risk to Infrastructure**: damage or destruction of infrastructure from climate events such as overflow of the normal confines of water systems, destructive accumulation of water, or extreme heat or cold.

The Commission's source water is the North Saskatchewan River; water is removed from the River, treated, and distributed to the Commission by EPCOR.

1. Risk of Water Shortage

The risk of shortage can potentially impact the Commission depending on the severity of the shortage. If a shortage is identified, water restrictions may be required. The Regional Water Customers Group sets the daily allocated water usage to member Commissions. When a shortage is identified, the Commission will restrict water to its members, and members are expected to reduce their water use. Previously, these restrictions have been short in duration, i.e. a few weeks, and have not extended for a significant period (several months or years).

In the event of more severe droughts, strict water restrictions may need to be put into place to conserve or restrict water usage to ensure that members basic needs are met. These water restrictions may include the following:

- Restriction on watering lawns;
- Washing sidewalks or dust suppression;
- Washing personal vehicles;
- Restrictions on filling fountains, pools, hot tubs or garden ponds; and
- Restrictions on watering new sod.

2. Risk of Inadequate Water Quality

The Commission relies on EPCOR to provide potable water. During periods of high flow within the North Saskatchewan River, EPCOR may have difficulty treating the raw water due to debris or poor quality of the water which may impact the amount of water that can be supplied to the Commission.

During periods of low flow, the quality of raw water can also be compromised when there is insufficient dilution, temperature increase, and sediment accumulation. Upstream activities such as nutrient loading from agricultural practices can also impact the raw water quality.

3. Risk to Infrastructure

The Commission's infrastructure is susceptible to certain climatic events, these would include:

- River floods, high surface water overland flows
- High precipitation

The majority of the Commission's infrastructure is buried pipe. Based on the size of the Commission, this infrastructure crosses several lakes, rivers, and creeks, all of which are susceptible to damage through either flooding, high river flows, scouring of the riverbed and embankments. In addition, the Commission's facilities may be subject to damage due to localized flooding, poor local drainage, or an overwhelmed drainage system.

The Commission also has several booster stations, fill stations, and radio towers, all which may be susceptible to local flooding. As a result of climate change, the Commission may experience higher energy costs related to heating and cooling its buildings, or more damage to facilities due to high winds or related storm events. During extreme hot periods, the Commission may also experience periods of brown outs or black outs due to increased demands on the electrical grid which will impact the Commission's ability to supply water to its members.

In addition, as the Commission's facilities are spread out across nine communities and require Commission Operators to visit the sites on a regular basis, the potential for increased severe storm events may limit the ability of the Commission to access some facilities due to poor driving conditions or damaged roadways.

There are two extreme situations which might impact the Edmonton region as a result of Climate Change; the region becomes wetter and colder than normal, or the region becomes hotter and drier. In the first scenario the Commission's water demand may decrease as consumers are using less water for items like lawn watering, dust suppression, etc. This may result in the proposed upgrades being extended further due to the reduced water demand. In the second scenario, the Commission's water demand could increase as consumers use more water as it becomes scarcer, and there is increased pressure from the Commission to provide more water. This would likely require that the Commission adopt and enforce water conservation policies.

The Commission should review their existing infrastructure and operations, considering the potential impacts of climate change, this could look at reviewing:

- Review the sustainability of the Commission Infrastructure and Operation to the impacts of Climate Change and establish an Emergency Response protocols.
- Establish Water restriction protocols

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

N

Parkland County

Strathcona County

Beaver County

Edmonton

Devon

Beaumont

Leduc

Calmar

Leduc County

County of Wetaskiwin No. 10

Camrose County

Looma

Rolly View

New Sarepta

Hay Lakes

Armena

Millet

Miquelon Lake Provincial Park

Increased pumping capacity at Boundary Pumping Station (2023)

Proposed 750 mmø twin pipe (2035)

Realign section along QE2 (2040)

Proposed 450 mmø twin pipe (2040)

Proposed 750 mmø twin pipe (2035)

Proposed 300 mmø twin pipe (2044)

Increased pumping capacity at Highway 21 Pumping Station (2019)

Boundary Station

Leduc County East

Leduc County West

Discovery Park

Airport 1

Airport 2

Leduc North

Leduc West

Saunders Lake Tie-in

Telford Booster Station

Leduc Robinson

Hwy 21 Booster Station

RollyView Tie-in

Looma Tie-in

- Existing Reservoir
- Existing Booster Station
- Existing Single Connection
- Future Reservoir
- Future Tie-in

Pipe Diameter

- 150 mmø
- 200 mmø
- 250 mmø
- 300 mmø
- 400 mmø
- 500 mmø
- 550 mmø
- 600 mmø
- 750 mmø
- Proposed 300 mmø
- Proposed 450 mmø
- Proposed 750 mmø

0 2 4 6 8 km

\\e-edm-fs-01\projects\2018\3181\00_Master_Plan_Boost\Working_Dwgs\010_GIS\ArcMap\4-5_SystemUpgrades.mxd
DATE: 11/11/2019

Associated Engineering

CRSWSC

AE PROJECT No.	2018-3181
SCALE	1:170,000
COORD. SYSTEM	NAD 1983 UTM ZONE 12N
DATE	2019 NOVEMBER
REV	
DESCRIPTION	ISSUED

FIGURE No. 4.5

CAPITAL REGION SOUTHWEST WATER SERVICES COMMISSION

SYSTEM UPGRADES

5 CONTROL INSTRUMENTATION PHILOSOPHY

5.1 Water Supply

Water supply to the Boundary Pump Station is from EPCOR. EPCOR's minimum target is to maintain a supply pressure at the station of 255 kPa; EPCOR's normal pressure range for Boundary Pump Station is 300 kPa to 400 kPa. The supply pressure is measured by pressure transmitter (PIT-17) and locally displayed by pressure gauge (PI-17), and remotely displayed on the operator's console. Water consumption for the entire system is measured by the billing meter (FE-1) which is owned and maintained by EPCOR. A high flow rate into the system is controlled by flow control valve (FCV-9). Daily flow rate set points are established by the Commission and the Regional Water User Operational Manager.

5.2 Low Suction Protection

Low suction pressure is when there is insufficient pressure at the suction end of the pump, which can cause cavitation within the pump. Low supply pressure could be caused by the following conditions:

- Low pressure by EPCOR (pipeline break).
- Improper valve closure of FCV-9, restricting flow.
- High flow rate.

Low suction pressure protection for the pumping equipment is provided by pressure switch (PS-26) and pressure transmitter (PIT-27), located downstream of flow control valve (FCV-9). Pressure transmitter (PIT-27) and software pressure indicating controller (PIC-27) will maintain a low supply pressure of 240 kPa for variable speed pump VSP-102, VSP-104, and VSP-103 via a software low select relay. In the event of low supply pressure, VSP-102, VSP-104, and VSP-103 operate as follows: Normally the variable speed controllers receive a pressure signal from pressure transmitter located in the City of Leduc Fill Station. The set point maintains a minimum pressure at the City of Leduc. If the actual fill line pressure in the City of Leduc Fill Station is below the set point, pump VSP-102 will increase in speed to satisfy the set point. If the actual pressure is above the set point, the pump will slow down. If a low supply pressure occurs in the Boundary Pump Station due to a reduced flow rate from EPCOR, the variable speed pump will slow down to satisfy the low supply pressure set point of 240 kPa (35 psi).

5.3 Reservoir Fill Control

The reservoir fill control system modification uses a modulating fill system. Each fill station is provided with a PLC with control functions performed by a software calculation block and flow rate controller located in the local PLC of the Fill Station. Each fill station operates in a continuous filling, modulating flow control. The Commission has a minimum of two set points for each fill station:

- Minimum allowable reservoir level.
- Maximum allowable fill flow rate of 1.8 times the annual average day or other lower fill rate selected by the operator to maintain a continuous rate of fill over a 24-hour period. The Commission has provided fill rates which exceed this value due to low storage capacity within serviced communities. This has affected system operations and placed a higher level of service expectation on the Commission at these locations.

Table 5-1 summarizes the fill level and flow rate setpoints for each station. The numbers presented are guideline values; depending on the customer consumption, the Commission may increase or decrease the fill level and flow rate setpoints. Every fill station operates having the fill level dictating the flow rate.

Table 5-1
Fill Level and Flow Rate Set Points

Station	Set Point Criteria								
	1		2		3		4		Full
	Fill Level (%)	Fill Rate (m^3/hr)	Fill Level (%)	Fill Rate (m^3/hr)	Fill Level (%)	Fill Rate (m^3/hr)	Fill Level (%)	Fill Rate (m^3/hr)	Fill Level (%)
City of Leduc	86	188	82	314	78	448	74	561	90
City of Beaumont	86	84	82	140	78	200	74	250	90
Leduc County									
East	82	48	78	68	74	85	-	-	90
West	82	12	78	24	74	30	-	-	90
Town of Calmar	82	19	78	28	74	35	-	-	90
Edmonton International Airport	82	29	78	48	74	60	-	-	89
Camrose County									
Hamlet of Armena	82	5	78	16	-	-	-	-	90
Leduc County									
Hamlet of New Sarepta	82	2.5	78	17	-	-	-	-	90
Village of Hay Lakes	82	3	78	10	-	-	-	-	90
Town of Millet	86	13	84	22	81	32	78	40	90

6 WATER ALLOCATION POLICY

6.1 Update

The Commission has an Allocation Bylaw 02/2015. It is important that the Commission stresses to its members the recommended storage volume to buffer supply main interruptions and to provide the peak demand and adequate fire flow storage. Each Member of the Commission shall be entitled to the minimum allocations. Table 6-1 summarizes when each member/customer is projected to exceed their current allocation based projected water demands.

Table 6-1
Commission's Water Allocation

Customer	Flow Rate m^3/hr)	Year Allocation Will Be Exceeded
Transmission Line 1		
City of Leduc	498	2031
City of Beaumont	188	2025
Town of Calmar*	47	
Leduc County	157	2031
Edmonton International Airport	71	2028
Town of Millet	57.5	2042
Sub-Total:	**1,018.5**	
Transmission Line 2		
Village of Hay Lakes*	26.5	
County of Camrose	11.05	2037
Leduc County	36.83	2039
Sub-Total:	**74.38**	
Total:	**1,092.88**	

*Beyond Study Rage

The Commission has indicated that they are currently reviewing the requirements for allocations within their bylaw.

The supply from EPCOR may be controlled by the Regional Water Operation Manager. In the event of a flow restriction, water will be delivered based on the available flow as a percentage of each members previous years water usage.

The Commission's Bylaw is provided in **Appendix B**.

6.2 Peak Day Demands/Reservoir Capacity

Table 6-2 provides a comparison for each customer's 2017 peak day consumption against their maximum flow rate setpoints. As shown, many of the maximum fill rates are set at or below the 2017 peak day demands. Hay Lakes, New Sarepta, and Armena all have set fill rates significantly beyond their current projected peak day demand. At a combined total of 43 m^3/hr (11.9 L/s), this is approximately the capacity of the Highway 21 Booster Station of 48 m^3/hr (13.4 L/s).

Table 6-2
2017 Peak Day and Flow Rate Setpoint Comparison

Customer	Average Day Demand (ADD) m^3/day	Peak Day 1.8 x ADD m^3/hr	Maximum Flow Rate Setpoint (m^3/hr)
City of Leduc	7,603	570	561
City of Beaumont	3,499	262	250
Leduc County (East and West)	1,704	128	115
Town of Calmar	640	48	35
Edmonton International Airport	905	68	60
Hamlet of New Sarepta	123	9	**16**
Village of Hay Lakes	97	7	**17**
Town of Millet	522	7	10
Hamlet of Armena	16	1	**16**

BOLD indicates that the maximum fill rate is set above the peak day demand.

Table 6-3 provides a comparison of each Community's reservoir capacity and the average two-day storage plus their reported fire storage requirements. As shown, the average two-day demand is significantly lower than the capacity of the majority of the reservoirs.

Table 6-3
Reservoir Capacities

Reservoir	Reservoir Capacity (m^3)	2017 Two-Day Storage (m^3)	Fire Protection Provided	Reported Fire Storage Requirement	Surplus/Deficient Storage
Leduc County	11,360	3,418	Yes	**523**	Surplus
City of Beaumont	17,717	7,017	Yes	2,430	Surplus
Edmonton International Airport	4,300	1,816	Yes	1656	Surplus
City of Leduc	20,457	15,248	Yes	2,452	Surplus
Town of Calmar	3,182	1,283	Yes	**523**	Surplus
Leduc County (Hamlet of New Sarepta)	436	246	Yes	648	Deficient
Village of Hay Lakes	474	194	Yes	**523**	Deficient
Camrose County (Hamlet of Armena)	50	32	No	-	-
Town of Millet	4,091	1,048	Yes	**523**	Surplus

Note- For communities which did not report their fire storage capacity, a fire flow of 83L/s for 1.75hrs (**523** m^3) was used. These are noted as **BOLD** in the table above.

New Sarepta and Hay Lakes does not have enough reservoir storage capacity to meet the Commission's current practice of having members and customers provide two average days water storage plus fire storage if fire protection is provided. The Commission is currently in the process of formalizing its current practices in a Water Supply Policy. The Commission provides a higher level of service to these communities to maintain reservoir storage levels. The Commission will have an increased difficulty providing the higher level of service as the Communities grow and water demands increases. System upgrades will be required earlier than anticipated if additional capacity in each community is not provided.

STRATEGIC PLAN ITEM: 4.2.4 -ENSURE ALL COMMISSION POLICIES ARE CURRENT

It is recommended that the Commission develop a Water Supply Policy which formalizes its current practices.

7 CATHODIC PROTECTION

7.1 General

ARC Cathodic Protection Inc. performed the 2017 Annual Cathodic Protection (CP) Survey on the Capital Region Southwest Water Services Commission System. A copy of the report is provided in **Appendix D**.

The survey included the inspection of seven impressed current CP system refiners, several sacrificial CP systems and measurement of structure-to-soil potentials at accessible test locations throughout the transmission system. The facilities that were surveyed consisted of the watermains that run from the Boundary Pump Station located at 12-08-51-24-W4M to the reservoir stations located at Beaumont, Nisku, Edmonton International Airport, Leduc, and Calmar. The transmission pipeline supplying water to the Hamlet of New Sarepta and the Village of Hay Lakes are non-metallic and did not require CP. Due to this, these pipelines were not included in the CP survey.

Purpose:

- Inspect the impressed current CP system rectifiers for proper operation, measure DC outputs and adjust where required.
- Obtain structure-to-soil potentials with reference to a copper-copper sulfate electrode on the pipelines at accessible test station locations and pipeline appurtenances throughout the system.
- Verify the effectiveness of electrical insulation devices (i.e.: insulating kits, insulating unions, dielectric unions) where required.
- Evaluate the overall performance of the CP systems and verify their efficiency in providing adequate CP coverage on the Commission - Water Transmission pipeline system.
- Prepare and submit a technical report discussing the CP survey results and recommend improvement to the overall CP system where required.

Recommendations:

Recommendations have been categorized based on their priority. The categories are as follows:

A. **High Level Priority:** action will correct pipeline/piping system CP compliance issues.

B. **Mid-Level Priority:** action will correct factors having a negative effect on the CP system(s) and prolong CP system's operating life.

C. **Low Level Priority:** action will assist in future diagnostics and maintenance of the CP system(s).

The recommendations are as follows:

- Substantial CP current drains were found at the City of Beaumont, Edmonton International Airport, City of Leduc and Nisku Fill Stations via connection to A/C grounding systems. These pipelines are still achieving adequate CP levels; however, the overall life-span of the CP systems would benefit from mitigating the faults. It is recommended to install de-coupling devices at these locations to isolate the A/C grounding system from the CP system under normal conditions.
    - **B. Mid-Level Priority**

- The 12” Stub Blow down pipeline at 08-07-51-24-W4M received CP via a Galvanic Magnesium Anode. The Magnesium anode was found depleted. It is recommended to install one 17 lb magnesium anode to restore adequate CP levels.
  - **A. High-Level Priority**
- Establish a rectifier surveillance program to obtain monthly CP system rectifier measurements at the seven locations. If COMMISSION personnel are to conduct this program, a rectifier surveillance form can be provided and submitted to ARC Cathodic Protection Inc. on a monthly basis for in-house review, analysis and record keeping.
- Advise Arc Cathodic Protection Inc. of any scheduled pipeline additions or modifications that may affect the CP system operation.
- Inform Arc Cathodic Protection Inc. if the HDPE pipelines supplying water to the Hamlet of New Sarepta and the Village of Hay Lakes are equipped with metallic pipeline joints similar to those of the City of Beaumont supply line.
- Adhere to the following safety requirements:
  - “Lock Out” and “Tag Out” all direct current sources prior to dismantling piping or performing pipeline modification operations.
  - Use shorting straps across piping joint prior to dismantling as added precaution against electrical arcing.
  - Ensure proper grounding procedures are established and in use.
- Authorize Arc Cathodic Protection Inc. to perform the annual CP survey of Commission - Water Transmission Pipeline

8 REGIONAL SERVICE CONCEPTS

The City of Edmonton has recently annexed select lands located south of the City (City of Edmonton Annexation Application, Appendix 6.0, Leduc Annexation Infrastructure Serviceability Report, Associated Engineering, April 2018). The Southwest Annexation Area encompasses land through which some Commission waterlines/facilities currently operate, including the Boundary Pump Station. In addition, Alberta Transportation has identified a proposed realignment of Queen Elizabeth II Highway. Currently the Commission's pipeline between the Boundary Station and Highway 19 is located within AT's right of way, in an unsecure easement. Based on the proposed realignment, a portion of Commission pipeline will be required to be re-located. As the Commission is within an unsecured easement, it is anticipated that any future realignment will be at Commission's cost. AT has not provided a timeline for the realignment of QE 2, for planning purposes we have assumed that the realignment will occur in 2040.

The Commission and EPCOR have held discussions regarding servicing options for the area, in relation to the annexation boundaries and AT's proposed re-alignment.

Three servicing options were reviewed with the Commission with regards to the City of Edmonton Annexation:

- **Option 1** – Status Quo, the Commission will retain ownership and operation of all existing infrastructure. Reference **Figure 8-1**.
- **Option 2** – The Commission would transfer all existing infrastructure located within City of Edmonton Annexation lands to EPCOR with a second feed to Beaumont. Reference **Figure 8-2**.
- **Option 3** – Is similar to Option 2; however, does not assume that additional water supply will be available to Beaumont through the City of Edmonton Southeast Annexation Area. Reference **Figure 8-3**.

Following initial review with EPCOR, Option 3 was not reviewed in detail as EPCOR has confirmed a second feed (Option 2), to the Commission is acceptable, and, which offers a lower cost approach and provides the benefit of system looping for both the Commission and EPCOR.

As part of the option review, a cost comparison will be undertaken to develop and compare the net present values of Option 1 and 2.

8.1 Option 1 – Status Quo

Option 1 is the status quo and assumes that the Commission will retain ownership and operation of all existing infrastructure. Reference **Figure 8-1**. Custody transfer would continue at the upstream end of the Boundary Pump Station and minimum supply pressures would be provided by EPCOR. The Commission would continue to be responsible for all upgrades to the existing system to meet the needs of current and future customers downstream of the Boundary Pump Station. The Commission would supply Discovery Park Reservoir with its base water needs until such time as EPCOR could service the development. The Commission would be required to re-align the existing pipelines out of the development path of the proposed re-alignment of QE2 Highway.

The following upgrades to existing infrastructure are anticipated to be required to meet the projected peak day design demands:

- **Next 5 Years (to 2023)**
  - Increase pumping capacity at the Highway 21 Booster Station (2019).

- **Next 30 Years (to 2048)**
  - Increase pumping capacity at the Boundary Pump Station (2023).
  - Install new twin 750 mm diameter pipe from the Boundary Pump Station to the Leduc County East/Beaumont lateral (2035).
  - Install new 750 mm diameter twin pipe from the County East/Beaumont lateral to Leduc North Reservoir. (2035).
  - Install new 450 mm diameter twin pipe from the mainline to the Leduc County East/Beaumont Lateral (2040).
  - Install new 450 mm diameter twin pipeline from Leduc County East reservoir to the Beaumont Fill Station. (2045) Install new lateral mains to all future fill stations as required. This will depend on the location of the future reservoirs/fill stations and has not been accounted for in terms of costs.
  - Install new 300 mm diameter twin pipeline from the Highway 21 Booster Station, 5km east. (2044).

We have assumed that by 2035 the re-alignment of QEII has been confirmed by AT. Which will allow the Commission to construct the proposed 750 mm out of the proposed development path of the re-aligned QEII. The 600 mm diameter pipeline which is located along the right of way of the QEII will need to be relocated, and the new alignment of the 600 mm diameter pipeline will be dependant on the proposed configuration and interchange locations of QEII.

8.1.1 Option 1 – Costs

The following cost assumptions were used to estimate the future capital cost for the Commission:

- The cost to upgrade the pumps at Boundary Pump Station is estimated to be $3,500,000.
- The cost to upgrade the pumps within the Highway 21 Booster Station is estimated to be $300,000.
- The Commission's current capital reserve for future expansion is $3,400,000 (December 2018).
- The Commission current capital reservoir for pump upgrades within the Boundary Pump Station is $1,031,616.
- Any proposed pipeline upgrades will follow existing pipeline alignments except for the pipeline along AT's QEII corridor. This pipeline alignment will be selected based on proposed QEII upgrades at the time of development.
- Based on current development within Edmonton International Airport area, the proposed future pipeline will be located within the developed area, which will have restricted work space, and urban restoration requirements.
- Pipe diameters larger than 450 mm are installed using open cut methods, pipe diameters 450 mm and smaller are installed using horizontal directional drilling.
- The estimated cost to cross Highway 2, is $1,000,000 per crossing. This is to take into account the anticipated crossing length, and Alberta Transportations requirements.
- The costs include, 30% project contingency, and 10% engineering.
- Cost are based on 2018 dollars, and recently received tenders for similar work in the local area.
- The above cost does not include the purchasing of land, securing right of ways, or temporary work space.

The following **Table 8-1** summarizes the anticipated upgrade costs for **Option 1**.

Table 8-1
Anticipated Costs – Option 1

Item No.	Description	Length (m)	Cost	Year of Upgrade
Next 5 Years: 2018-2023				
	Increase pumping capacity at the Highway 21 Booster Station		$300,000	2019
			Sub Total:	**$300,000**
Next 30 Years: 2023-2048				
	Increase pumping capacity at the Boundary Pump Station		$3,500,000	2023
	Install new 750 mm diameter twin pipe from the Leduc County East/Beaumont lateral to City of Leduc's Leduc North Reservoir	9415	22,501,850	2035
	Install new twin 750 mm diameter pipe from the Boundary Pump Station to the Leduc County East/Beaumont lateral	3506	$10,062,220	2035
	Install new 450 mm diameter twin pipe from the mainline to the Leduc County East lateral	1980	$2,207,800	2040
	Realignment of the 600 mm Pipeline to accommodate QE2 alignment	5600	$10,724,000	2040
	Install New 450 mm diameter twin pipe from Leduc County East to Beaumont	6240	$8,424,000	2045
	Install new 300 mm diameter pipeline from Highway 21 Booster east	5000	$2,025,000	2044
			Sub Total:	**$59,444,870**
			Total Anticipated Cost - Option 1	**$59,444,870**

8.1.2 Unit Cost Analysis – Option 1

A unit cost analysis was undertaken based on the capital cost and construction schedule outlined in Table 8-1, and is based on the following assumptions:

- Unit cost analysis does not consider any potential funding sources which the project maybe eligible for.
- The annual increase in cost of construction and materials is 5%/year.
- The Commission received an interest rate of 2.5% on any funds held in reserve for this project.
- The Commission has a debenture capacity of two times its annual revenue. To calculate the debenture limits we have taken the estimated annual water demand, times the Commission Water rate. The water rate of $\$1.59/m^3$ was increased by 1% per year to account for increase cost of services.
- The Commission debt service level is based on its accumulated debt.
- The Commission currently allocates $\$0.335/m^3$ to its Future Water Expansion Reserve.
- Any debenture taken has an interest rate of 3.5%.

For **Option 1** the estimated net present value of the project is $91.2M if the Commission maintains its current collection rate of $0.335/$m^3$.

- Reference **Figure 8-4** and **Appendix E** to show the proposed cash flow requirements for Option 1, and
- Reference **Figure 8-5** and **Appendix E** to show the proposed water rate over the period.

8.2 Option 2 – EPCOR Purchase

Option 2 assumes that all existing Commission infrastructure located within the City of Edmonton Annexation lands will be transferred to EPCOR. Reference **Figure 8-2**. As such, EPCOR would own and operate the Boundary Pump Station as well as the 750 mm diameter watermain located within the Annexation Area. As part of the transfer agreement, EPCOR would be precluded from servicing an existing Commission's customer. In discussions between the Commission and EPCOR this option would be phased in the following manner:

2020

The Commission would transfer its assets within the City of Edmonton to EPCOR. This would include the Boundary Pump Station, and the 750 mm diameter pipeline. EPCOR would install an EPCOR billing meter within Discovery Park Reservoir. EPCOR will use the meter at the Boundary Pump Station, minus the readings at Discovery Park to determine volume of water to be billed to the Commission.

2023

Construction of a new Booster Station for the Commission to support members south of Highway 19, and installation of EPCOR billing meters at City of Beaumont, Leduc County East and West Reservoirs, and the Commission new Booster Station.

2028:

Construction of secondary feed to the City of Beaumont. A new supply line from EPCOR would be constructed to support Beaumont. This supply line would connect into the existing Beaumont Fill Station.

The proposed meters are to be installed within the Commission's existing facilities to reduce the overall cost of installation, ease of connecting the units to electrical power and communications and ease of monitoring and maintenance.
Currently, the Commission and Leduc County are in discussion regarding the use of the small parcel of land adjacent to the County's West Reservoir as a potential location for the new Booster Station.

The following upgrades to existing infrastructure are anticipated to be required to meet the projected peak day design demands:

- **Next 5 Years (to 2023)**
  - Increase pumping capacity at the Highway 21 Booster Station (2019).
  - Transfer Commission assets to EPCOR (2020).
  - Construct new Booster Station to support Commission members south of Highway 19. (2023).
  - EPCOR installs new billing meters at City of Beaumont, Leduc County East and West, and the new Booster Station. (2023). This will likely require the modification of fill piping to accommodate the new meters.
- **Next 30 Years (to 2048)**
  - Install new 750 mm diameter twin pipe from the Airport lateral to the Calmar lateral (2035).
  - Construct the secondary supply line from the City of Edmonton boundary to the existing Beaumont Fill location. (2028).

- Install new lateral mains to all future fill stations as required. This will depend on the location of the future reservoirs/fill stations and has not been accounted for in terms of costs.
- Install new 300 mm diameter twin pipeline from the Highway 21 Booster Station, 5km east. (2044).

8.2.1 Option 2 – Capital Costs Assumptions

The following cost assumptions were used to estimate the future capital cost for the Commission:

- The estimated residual value of the Commission's system located within the City of Edmonton Annexation area is $1,500,000.
- The Commission's capital reserve for future expansion is $3,400,000 (December 2018).
- The Commission's current capital reservoir for pump upgrades within the Boundary Pump Station is $1,031,616 (December 2018).
- The replacement cost of the Boundary Pump Station is approximately $10,000,000 and includes $200,000 for the purchase of a lot.
- The cost to upgrade the pumps within the Highway 21 Booster Station is estimated to be $300,000.
- Any proposed pipeline upgrades will follow existing pipeline alignments. With the exception along AT's QEII corridor, the pipeline alignment will be selected based on proposed upgrades at the time of development.
- Based on current development within the Edmonton International Airport area, the proposed future pipeline will be located within the developed area, which will have restricted work space, and urban restoration requirements.
- Pipe diameters larger than 450 mm are installed using open cut methods, pipes diameters 450 mm and smaller are installed using horizontal directional drilling.
- The estimated cost to cross Highway 2, is $1,000,000 per crossing. This is to take into account the anticipated crossing length, and Alberta Transportations requirements.
- The costs include a 30% project contingency and 10% engineering.
- Costs are based on 2018 dollars, and recently received tenders for similar work in the local area.
- The above cost does not include the purchasing of land, securing right of ways or temporary work space.

Table 8-2 summarizes the anticipated upgrade costs for **Option 2**.

Table 8-2
Anticipated Capital Costs – Option 2

Item No.	Description	Length (m)	Cost	Year of Upgrade
Next 5 Years: 2018-2023				
	Increase pumping capacity at the Highway 21 Booster Station		$300,000	2019
	Construct new Boundary Pump Station and water transfer meter at the north of Highway 19 (Including connecting piping and highway crossings (2))		$10,000,000	2023
	New water transfer meters on the lateral to Leduc County East/Beaumont and Leduc County West		$500,000	2023
			Sub Total:	**$10,800,000**
Next 30 Years: 2023-2048				
	Install new 450 mm watermain within the Town of Beaumont (50% Urban, 50% rural)	5800	$5,682,040	2028
	Install new 750 mm diameter twin pipe from the Airport lateral to the City of Leduc North Reservoir Calmar lateral	6600	$19,942,000	2035
	Install new 300 mm diameter pipeline from Highway 21 Booster east	5000	$2,025,000	2044
			Sub Total:	**$27,650,000**
			Total Anticipated Cost - Option 2	**$38,450,000**

8.2.2 Unit Cost Analysis Option 2

A unit cost analysis was undertaken based on the capital cost and construction schedule outlined in Table 1-2, and is based on the following assumptions:

- The annual increase in cost of construction and materials is 5% per year.
- The Commission received an interest rate of 2.5% on any funds held in reserve for this project.
- The Commission has a debenture capacity of two times its annual revenue. To calculate the debenture limits we have taken the estimated annual water demand, time the Commission Water rate. The water rate of $\$1.59/m^3$ was increased by 1% per year to account for increases in the cost of service.
- The Commission currently allocates $\$0.335/m^3$ to its Future Water Expansion Reserve.
- Any debenture taken has an interest rate of 3.5%.

For **Option 2**, the estimated net present valve of the project is $51.5M if the Commission maintains its current reserve allocation of $0.335/$m^3$.

- **Figure 8-6**, and **Appendix E** shows the proposed cash flow requirements for Option 2.
- **Figure 8-7**, and **Appendix E** shows the proposed water rate over the period.

8.3 Review of Option 1 and 2

Table 8-3 summarized the anticipated project cost for both Option 1 and Option 2.

Table 8-3
Summary of Option 1 and Option 2

	Construction Cost (2018) (millions)	Net Present Value of Cost (millions)	Current Capital Reservoir (millions)	Reserve Rate
Option 1	**$59.7**	**$91.2**	• Boundary Pump Station Upgrade - $1.0 • Future Reservoir - $3.4 **Total - $4.4**	$0.335/$m^3$ (2019-2052)
Option 2	**$38.4**	**$51.5**	• Boundary Pump Station Upgrade - $1.0 • Future Reservoir - $3.4 • EPCOR Transfer - $1.5 **Total - $6.0**	$0.335/$m^3$ (2019-2052)

In review of the two options, **Option 2** has the lower net present value. Based on the net present value the recommended option is Option 2 which involves transferring Commission assets to EPCOR which are located within the City of Edmonton and adjacent the to QE2 corridor.

Based on the revisions to Option 1 and 2, Option 2 has the lower net present valve. On June 28th, 2019, the Commission Board decided to proceed with discussions with EPCOR regarding the sale/transfer of assets as per Option 2.

Parkland County
Strathcona County
Beaver County
Edmonton
Devon
Beaumont
Looma
Leduc
Calmar
Leduc County
County of Wetaskiwin No. 10
Camrose County
Rolly View
Miquelon Lake Provincial Park

Boundary Station
Leduc County East
Leduc County West
Discovery Park
Airport 1
Airport 2
Leduc North
Leduc West
Saunders Lake Tie-in
Telford Booster Station
Leduc Robinson
Hwy 21 Booster Station
RollyView Tie-in
Looma Tie-in
New Sarepta
Hay Lakes
Armena
Millet

Increased pumping capacity at Boundary Pumping Station (2023)
Proposed 750 mmø twin pipe (2035)
Proposed 450 mmø twin pipe (2045)
Realign section along QE2 (2040)
Proposed 450 mmø twin pipe (2040)
Proposed 750 mmø twin pipe (2035)
Proposed 300 mmø twin pipe (2044)
Increased pumping capacity at Highway 21 Pumping Station (2019)

- Existing Reservoir
- Existing Booster Station
- Existing Single Connection
- Future Reservoir
- Future Tie-in

Pipe Diameter
- 150 mmø
- 200 mmø
- 250 mmø
- 300 mmø
- 400 mmø
- 500 mmø
- 550 mmø
- 600 mmø
- 750 mmø
- Proposed 300 mmø
- Proposed 450 mmø
- Proposed 750 mmø

0 2 4 6 8 km

Associated Engineering
CRSWSC

AE PROJECT No.	2018-3181
SCALE	1:170,000
COORD. SYSTEM	NAD 1983 UTM ZONE 12N
DATE	2019 NOVEMBER
REV	
DESCRIPTION	ISSUED

FIGURE No. 8.1

CAPITAL REGION SOUTHWEST WATER SERVICES COMMISSION

OPTION 1
SERVICING CONCEPT - STATUS QUO

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Parkland County

Devon

Edmonton

Strathcona County

Leduc County

Beaumont

Leduc

Looma

Rolly View

Boundary Station

Transfer to EPCOR

New Secondary Feed, from EPCOR (2028)

Leduc County East

Future Beaumont Northwest Reservoir

Point of Infrastructure Transfer Between EPCOR/Commission

Leduc County West

Point of Metering - EPCOR Meter

Highway 19

Discovery Park

Point of Metering - EPCOR Meter

Airport 1

New Booster Station (2023), Point of Metering, EPCOR Meter

Proposed 750 mmø twin pipe (2035)

Point of Infrastructure Transfer - Valve - Downstream of Discovery Park (Approximately 10 m south of existing valve)

Airport 2

Increased Pumping Capacity at Highway 21 Pumping Station (2019)

Leduc North

Saunders Lake Tie-in

Hwy 21 Booster Station

RollyView Tie-in

Looma Tie-in

Leduc West

Telford Booster Station

Proposed 300 mmø twin pipe (2044)

Leduc Robinson

Existing Reservoir
Existing Booster Station
Existing Single Connection
Future Reservoir
FutureBooster Station
Future Tie-in

Pipe Diameter
150 mmø
200 mmø
250 mmø
300 mmø
400 mmø
500 mmø
550 mmø
600 mmø
750 mmø
Proposed 300 mmø
Proposed 400 mmø
Proposed 750 mmø

0 1 2 3 4 km

\\s-edm-fs-01\projects\2018\3181\00_Master_Plan_Boost\Working_Dwgs\010_GIS\ArcMap\8-2_Option2.mxd
DATE: 11/11/2019 Kent Richardson

Associated Engineering

CRSWSC

AE PROJECT No.	2018-3181
SCALE	1:90,000
COORD. SYSTEM	NAD 1983 UTM ZONE 12N
DATE	2019 NOVEMBER
REV	
DESCRIPTION	ISSUED

FIGURE No. 8.2

CAPITAL REGION SOUTHWEST WATER SERVICES COMMISSION

OPTION 2
SERVICING CONCEPT

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Parkland County

Devon

Edmonton

Strathcona County

Beaumont

Looma

Leduc County

Leduc

Rolly View

Boundary Station

Transfer to EPCOR

Future Beaumont Northwest Reservoir

Leduc County East

Point of Infrastructure Transfer Between EPCOR/Commission

Leduc County West

Point of Metering - EPCOR Meter

Point of Metering

Proposed 450 mmø twin pipe (2035)

Highway 19

Discovery Park

Airport 1

New Booster Station

Proposed 750 mmø twin pipe (2035)

Point of Infrastructure Transfer - Valve - Downstream of Discovery Park (Approximately 10 m south of existing valve)

Airport 2

Leduc North

Saunders Lake Tie-in

Leduc West

Telford Booster Station

Leduc Robinson

Hwy 21 Booster Station

RollyView Tie-in

Looma Tie-in

Proposed 300 mmø twin pipe (2044)

Existing Reservoir
Existing Booster Station
Existing Single Connection
Future Reservoir
Future Booster Station
Future Tie-in

Pipe Diameter
150 mmø
200 mmø
250 mmø
300 mmø
400 mmø
500 mmø
550 mmø
600 mmø
750 mmø
Proposed 300 mmø
Proposed 450 mmø
Proposed 750 mmø

0 1 2 3 4 km

\\s-edm-fs-01\projects\2018\3181\00_Master_Plan_Boost\Working_Dwgs\010_GIS\ArcMap\8-3_Option3.mxd
DATE: 11/11/2019, Kent Richardson

Associated Engineering

CRSWSC

AE PROJECT No.	2018-3181
SCALE	1:90,000
COORD. SYSTEM	NAD 1983 UTM ZONE 12N
DATE	2019 NOVEMBER
REV	
DESCRIPTION	ISSUED

FIGURE No. 8.3

CAPITAL REGION SOUTHWEST
WATER SERVICES COMMISSION

OPTION 3
SERVICING CONCEPT

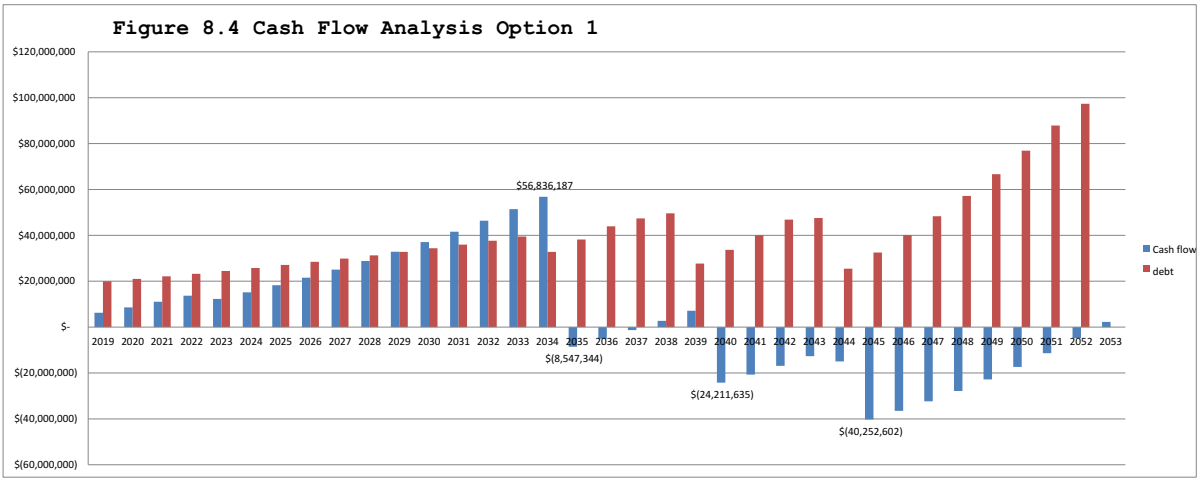


Figure 8.4 Cash Flow Analysis Option 1
$120,000,000
$100,000,000
$80,000,000
$60,000,000
$40,000,000
$20,000,000
$-
$(20,000,000)
$(40,000,000)
$(60,000,000)
$56,836,187
$(8,547,344)
$(24,211,635)
$(40,252,602)
2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053
Cash flow
debt

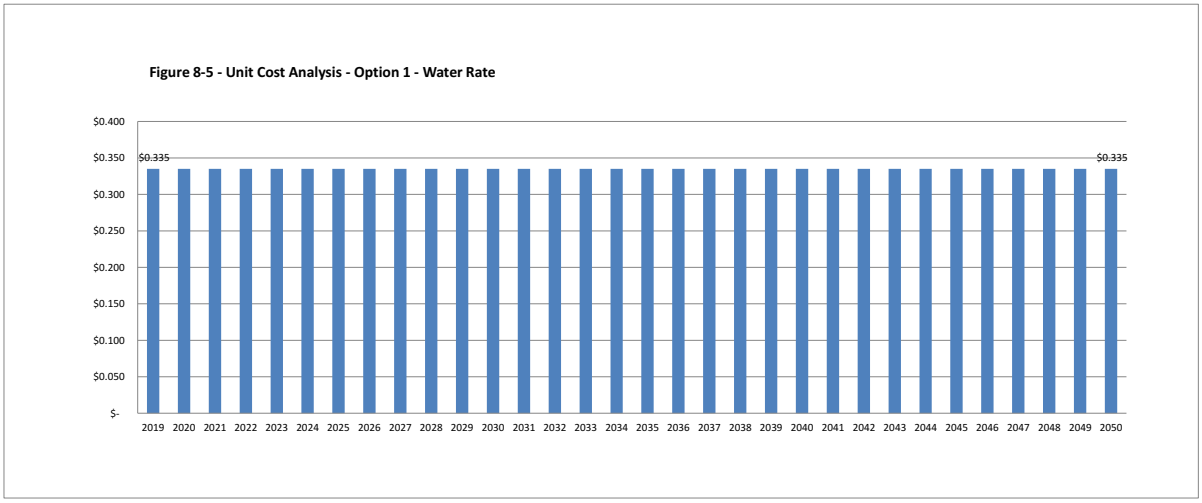


Figure 8-5 - Unit Cost Analysis - Option 1 - Water Rate
$0.400
$0.350
$0.300
$0.250
$0.200
$0.150
$0.100
$0.050
$-
$0.335
$0.335
2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050

Figure 8.6 - Unit Cost Analysis - Option 2 - Cash Flow Projection

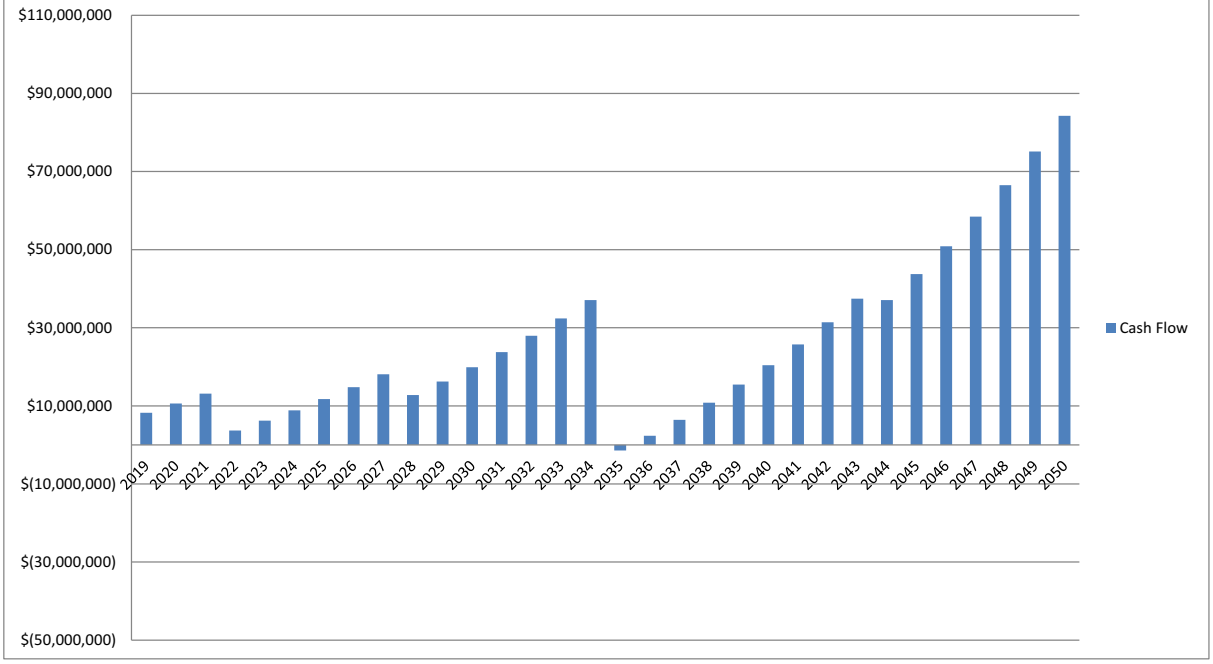
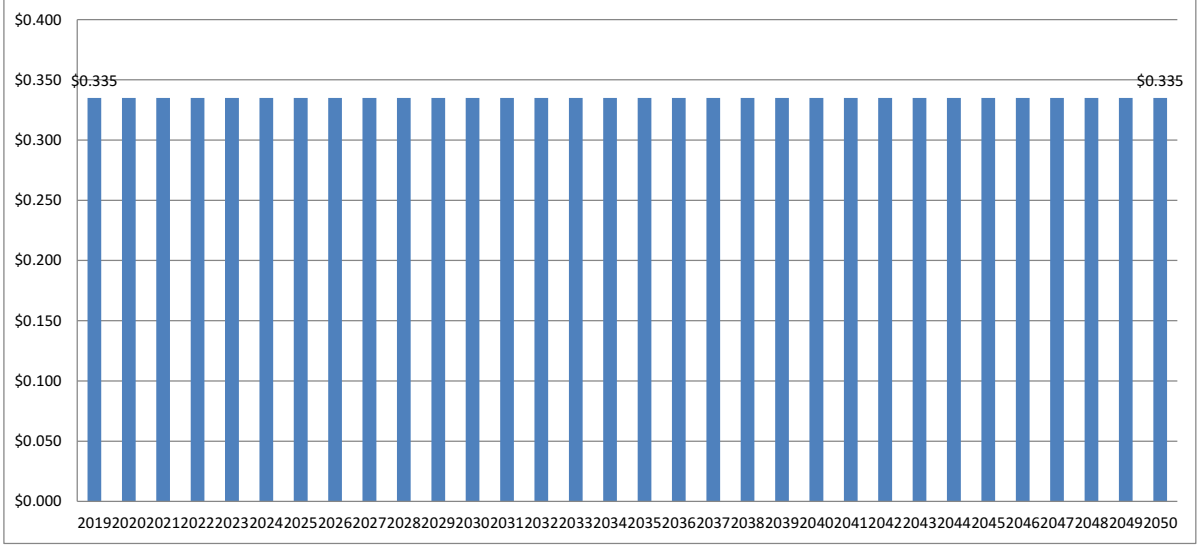


Figure 8.7 - Unit Cost Analysis - Option 2 - Water Rate



9 FACILITY ASSESSMENT

Associated Engineering undertook a facility assessment of the Commission facilities, and a copy of the Facility Assessment is included in **Appendix F**. The recommendations of the Facility Assessment have been included in the development of the 2020 to 2025 capital program.

10 2020 – 2025 PROGRAM

10.1 Breakdown

The capital program is broken down into the following categories for identifying expenditures and funding sources:

- Operation;
- Repair;
- Replacement; and
- System improvements.

10.2 Operation Budget

The operation budget covers the day to day operations and preventative maintenance of the entire system including generating reports, meter readings, providing volumes of water sold, and generally the duties described for the System Operator in the O & M Manual. Funding for this service is from the annual operating budget and included in the water rates set annually.

10.2.1 Cathodic Protection

Arc Cathodic Protection Inc. completed a review of the Commission's Cathodic system and recommends the following:

- Install de-coupling devices at City of Beaumont, Edmonton International Airport, City of Leduc and Nisku Fill Stations to isolate the A/C grounding system from the CP system under normal conditions.
- Install one 17 lb magnesium anode to restore adequate CP levels at the 12" Stub Blow down pipeline at 08-07-51-24-W4M.
- Establish a rectifier surveillance program to obtain monthly CP system rectifier measurements at the seven locations. If Commission personnel are to conduct this program, a rectifier surveillance form can be provided and submitted to Arc Cathodic Protection Inc. on a monthly basis for in-house review, analysis and record keeping.
- Authorize Arc Cathodic Protection Inc. to perform the annual CP survey of the Commission – Water Transmission Pipeline system in 2018.

10.2.2 Relocation of Master PLC

The Commission's Master PLC is currently located at the Boundary Pump Station. As part of the asset transfer to EPCOR, the Commission Master PLC will need to be relocated to another Commission facility. The Master PLC can be relocated to either the Highway 21 Booster Station or the Robinson Reservoir. Both the Highway 21 Booster Station and Robinson Reservoir have sufficient space and have generator backup power at the facility. Before relocating the Master PLC, the Commission should review the following:

- Accessibility and proximity to Commission Staff;
- Possibility of high-speed internet connection for remote access; and
- Site Security.

The Master PLC will need to be reprogramed to remove the pump controls and may be required to be upgraded depending on how the Master PLC and the host site PLC communicate.

The cost to relocate the PLC, upgrade the hardware and reprogram the system is estimated to be $75,000.

10.3 Repair Budget

The repair costs are directly related to Operator's costs, and specialist contractors retained by the Operator to make repairs and service specialty equipment and valves. This service is funded from an annual budget for repair and is included in the water rates set annually.

10.4 Replacement Budget

Planned replacements (pumps, valves, etc.) are normally engineered, scheduled, and budgeted. However, emergency replacements for unscheduled work should be tolerated. The funding for replacements should be from the Commission's accumulated reserve to spread expenditures over several years and provide water rate stability.

10.4.1 Valves Replacement Program

Isolation valves need to be assessed, exercised, and checked for their working conditions. The age of many of the Commission's large isolation valves are approximately 30 to 35 years. Existing isolation valves should be planned for phased replacement.

10.5 System Improvement Budget

Improvements to the system are engineered projects to provide specific improvement to capacity or longevity to the Commission's system. Improvements to the system may be eligible for grant funding and other grants. The available grant programs should be reviewed prior to each major capital project.

Typically, government funding sources will not provide grant funds for the portion of a project that is to service commercial users. This could significantly impact the amount of grant funds the commission is able to obtain for major projects.

10.6 2020 to 2025 Program

Within the next six years the following activities are anticipated to occur within the Commission:

2020

- Commission Assets to be transferred to EPCOR as laid out in Option 2.
- Review the Commission SCADA requirement in relation to the EPCOR transfer and identify a location for the Commission Master PLC.
- Relocate the Commission Master PLC.
- Commission is to coordinate with the City of Beaumont to secure a future pipeline alignment for the future service pipeline from 50th Street to the Beaumont Reservoir.
- Coordinate with EPCOR regarding the ownership and maintenance requirements of the Cathodic bed located at the Boundary Pump Station.
- The Commission should obtain an option to purchase the proposed parcel of land for the Booster Station from Leduc County prior to undertaking the environmental reviews. In preparation for the construction of Commission's new Booster Station, undertake the necessary environmental reviews to purchase the proposed parcel of land.
- The Commission should review the objectives of the Master Plan with Commission Members and work to align the objectives with Member's municipal plans.

2021

- Undertake the preliminary and detailed design of the new Booster Station.
- Miscellaneous maintenance items within the Commission Facilities.
- Annual maintenance requirements.

2022

- Construction of the new Booster Station.
- Miscellaneous maintenance items within the Commission Facilities.
- Installation of new meters at Nisku East, Nisku West and the City of Beaumont.

2023

- Miscellaneous maintenance items within the Commission Facilities.
- Commissioning and Operations of new Booster Station.

2024

- Annual maintenance requirements.

2025

- Annual maintenance requirements.

In addition to the above, it is recommended through a yearly maintenance program that the following be undertaken:

- Servicing all mechanical components, including motors and pumps.
- Servicing all electronic, electrical components.
- SCADA – ensure programing is up to date.
- Variable Speed Drive – Ensure parts are available and up to date.
- All isolation (gate) valves, air valves, interior valves need to be exercised at least once a year.
- GIS – asset inventory updated as required.
- Cathodic protection – check annual (prevent corrosion).
- Inspect and clean all air heating units within the Commission facilities.

Table 10-1 Summaries the **2020- 2025 Capital Plan** for the Commission.

Table 10-1
2020 to 2025 Capital Plan

2020 to 2025 Capital Plan	2020	2021	2022	2023	2024	2025
General						
Cathodic Protection Survey		$10,000	$10,000	$10,000	$12,500	$12,500
ARC Cathodic Recommendations						
New Booster Station						
Land Acquisition		$200,000				
Engineering + Construction		$1,000,000	$8,800,000			
New Transfer Meters - Nisku East/Beaumont, Nisku West				$500,000		
Relocate Master PLC						
Sub-Total		**$1,210,000**	**$8,810,000**	**$510,000**	**$12,500**	**$12,500**
Facility Upgrades						
Airport Reservoir		$5,000	$10,000	$0		
Calmar Fill Station		$5,000	$15,000	$0		
Nisku West Fill Station		$5,000	$10,000	$0		
Nisku East Fill Station		$5,000	$5,000	$0		
City of Beaumont		$5,000	$10,000	$0		
HWY 21 Booster Fill Station		$5,000	$17,500	$10,000		
Boundary Pump Station		$61,950	$68,000	$31,000		
City of Leduc North Reservoir		$5,000	$5,000	$0		
Hamlet of Armena		$5,000	$5,000	$5,000		
Town of Hay Lakes		$5,000	$20,000	$15,000		
Hamlet of New Sarepta		$5,000	$20,000	$0		
Telford Lake Booster		$15,000	$0	$5,000		
Town of Millet		$5,000	$5,000	$5,000		
Sub-Total		$131,950	$190,500	$71,000	$0	$0
Yearly Summary		**$1,341,950**	**$9,000,500**	**$581,000**	**$12,500**	**$12,500**

11 LONG TERM PLANNING

The following long-term capital upgrades have been identified:

- Secondary feed to the City of Beaumont, 2028.
- Upgrade the pump BP-0407 within the Highway 21 Booster Station, 2028.
- Additional Pipeline Capacity from new Booster Station to City of Leduc North Reservoir, 2035.
- Additional Pipeline Capacity east of Highway 21 Booster Station, 2044.

11.1 Long Term Capital Funding Review

The Commission requested that the following scenarios be reviewed and are summarized below:

- **Scenario 1** – Commission maintains the current water rate of $1.59/m^3 any increases by EPCOR or the Commission will be taken out of the Commission's current reserve allocation of $0.375/m^3, until a rate increase is required. The Commission takes a debenture or uses debt financing to pay for capital upgrades.
- **Scenario 2** - Commission increases its reserve allocation so that a future debenture is not required.
- **Scenario 3** – Commission no longer allocates funds for future expenditures and reduces the current water reservoir rate from $0.375/m^3 to $0.00/m^3. Member municipalities will be required to contribute funds to the Commission when upgrades or expansions are required.
- **Scenario 4 and 5** – The Commission used a combination of cash reserves and debt servicing to pay for future capital upgrades.

Each of the reviewed scenario were based the revised unit cost analysis undertaken for Option 2 and are referenced in **Appendix E** along with the following additions:

- The short-term capital spending outlined in the 2020 to 2025 capital plan was incorporated into the analysis.
- Upgrade the pump BP-0407 within the Highway 21 Booster Station, 2028.
- The Commission currently has 2 reserve funds, $0.335/m^3 allocated for future pipeline expansions and $0.04/m^3 for future pump upgrades at the Boundary pump station.

The Commission uses its current capital reserves and funds received by EPCOR for the transfer of assets toward future capital projects as referenced in **Appendix E**, which is approximately $6 million dollars

Scenario 1

This Scenario assumes the following:

- EPCOR increases its rate by $0.03/m^3 per year, based on EPCOR's historical average rate increase.
- The Commission operating costs increase by $0.02/m^3 per year. This increase takes into account increases related to staffing, and operational expenses like insurance, power, etc.
- The Commission maintains a water rate of $1.59/m^3 until the reserve allocation can no longer offset the rate and operational increases.

Based on the above assumptions, the Commission could maintain its current water rate until approximately 2025, at which point regular increases to the water rate will be required to meet future capital upgrades and expected rate increases from EPCOR and the Commission. In this Scenario the Commission would take an estimated debenture of $40.1M in 2035 and based on the projected upgrades the debenture will be paid off in approximately 2061. In 2035 the estimated debt capacity of the Commission is $41M.

The **Cash Flow and Water Rate is summarized in** Figure 11-1 and Figure 11-2, and the detailed analysis is provided in Appendix G.

Scenario 2

This Scenario assumes the following:

- EPCOR increases its rate by $0.03/m^3$ per year, based on EPCOR's historical average rate increase.
- The Commission operating cost increase by $0.02/m^3$ per year.
- The Commission initial water rate is $1.59/m^3$(2019).
- The Commission develop enough of a capital reserve so that a future debenture is not required for the proposed capital upgrades.
- Initial Commission water reserve rate is $0.375/m^3$ in 2019 and increases or decreases as required.

Based on the assumptions above the reserve rate will need to be $0.375/m^3$ until 2034. At which time the Commission can reduce the water rate or maintain current reserve rate to address future capital upgrades.

The **Cash Flow and Water Rate are summarized in** Figure 11-3 and Figure 11-4, and the detailed analysis is provided in Appendix G. In this scenario the water rate would start at $1.59/m^3$ and increase to approximately $2.84/m^3$ in 2044.

Scenario 2B

This scenario assumes the same as what is outlined in Scenario 2 with the following modification:

- The capital reserve is limited to what is required for the proposed capital projects.

In this scenario the Commission is able to fund the proposed projects without taking a debenture, but the Commissions' capital reserve would be depleted after the proposed construction in 2034 and 2043. Based on this additional assumption, the Commission's current water reserve rate of $0.375/m^3$ is reduced by $0.028/m^3$ to $0.347/m^3$ from 2020 until 2034. From 2035 to 2043 the reserve rate is set at $0.06/m^3$.

The **Cash Flow and Water Rate are summarized** in Figure 11-5 and Figure 11-6**,** and the detailed analysis is provided in Appendix G.

Scenario 3

This Scenario assumes the following:

- The Commission would reduce its water reserve rate from $0.375/m^3$ to $0.0/m^3$
- The Commission would maintain its current capital reserve of approximately $6M to off set future capital expenders.

The future capital expenditures would be shared among the Commission members. The Edmonton International Airport is only a customer of the Commission and would not be required to contribute to any future capital projects under this scenario; however, Leduc County could increase the water rate charged to the Edmonton International Airport to recoup any capital contribution made to support them.

The anticipated capital requirements are summarized in Table 11-1 below.

Table 11-1
Anticipated Construction Cost Time Line Scenarios

Year	Anticipated Construction Cost Time Line (2018 Dollars) ($M)	Capital Yearly Costs (F Value) ($M)
	$38,462,000	**$71,912,000**
2019	$300,000.00	
2022	$1,206,500	$1,397,000
2023	$9,306,500	$11,312,00
2028	$5,682,040	$8,815,000
2035	$19,942,000	$43,531,000
2044	$2,025,000	$6,857,000

Scenario 4

This Scenario assumes the following:

- The Commission uses a combination of accumulated cash reserve and debt to undertake future capital expenditures.
- The Commission would reduce the current water reserve rate from $\$0.375/m^3$ to $\$0.25/m^3$ in 2020. The reserve rate of $\$0.25/m^3$ would be maintained until 2035.
- In 2036 the water reserve rate would be reduced from $\$0.25/m^3$ to $\$0.10/m^3$.

Based on this Scenario, the Commission would use its accumulated cash reserve and take a debenture of $16.4M in 2035 to complete future capital expenditures and take an additional debenture of $5.8M in 2044. The total debenture held by the Commission will be $17M in 2044. The debenture capacity of the Commission in 2044 is approximately $62M. The total debenture of $17M taken in 2044 is approximately 27% of the Commissions debenture capacity. The Commission would pay back the debentures by 2055.

The **Cash Flow and Water Rate are summarized in** Figure 11-7 and Figure 11-8, and the detailed analysis is provided in Appendix G.

Scenario 5

This Scenario is similar to Scenario 4, except the current water rate of $\$1.59/m^3$ is held until 2023, and assumes the following:

- The Commission uses a combination of accumulated cash reserve and debt to undertake future capital expenditures.
- The Commission would reduce the current water reserve rate from $\$0.375/m^3$ to $\$0.21/m^3$ over the next four years.

Based on this Scenario, the Commission would use its accumulated cash reserve and a debenture of $21.3M in 2035 to complete future capital expenditures. In 2044 the Commission would take an additional debt of $3.8M, for a combined debt of $8.7M. The debenture capacity of the Commission in 2035 is approximately $41M. The debenture of $21.3M taken in 2035 is approximately 50% of the Commissions debenture capacity. The additional debt undertaken in 2044 is approximately 12% of the Commissions debenture capacity. The Commission would pay back its accumulated debt by 2047.

The **Cash Flow and Water Rate are summarized in** Figure 11-9 and Figure 11-10**.** and the detailed analysis is provided in Appendix G. Table 11-2 provides a comparison of the water rates for the reviewed Scenarios until 2045**.**

Table 11-2
Summary of Projected Water Rates

Year	Scenario 1 ($/m3)	Scenario 2 ($/m3)	Scenario 2B ($/m3)	Scenario 3 ($/m3)	Scenario 4 ($/m3)	Scenario 5 ($/m3)
2019	1.59	1.59	1.59	1.59	1.59	1.59
2020	1.59	1.64	1.61	1.27	1.52	1.59
2021	1.59	1.69	1.66	1.32	1.57	1.59
2022	1.59	1.74	1.71	1.37	1.62	1.59
2023	1.59	1.79	1.76	1.42	1.67	1.63
2024	1.59	1.84	1.81	1.47	1.72	1.68
2025	1.59	1.89	1.86	1.52	1.77	1.73
2030	1.84	2.14	2.11	1.77	2.02	1.98
2035	2.19	2.39	2.36	2.02	2.27	2.23
2040	2.44	2.64	2.32	2.27	2.37	2.48
2044	2.64	2.84	2.52	2.47	2.57	2.68
2045	2.69	2.89	2.57	2.52	2.62	2.73

In review of the **Five Scenarios**:

- **Scenario 1** maintains a constant water rate until 2024. The Commission funds the future capital expenditures by taking a debenture of approximately $40.1M dollars, in 2035 which the Commission pays off until 2062.
- In **Scenario 2** the capital reserve is developed to pay the projected capital upgrades and a debenture is not required and the water rate increases at a steady rate. Once the capital upgrades have been completed, the Commission has the option to either reduce the water rate or save for future upgrades beyond the timelines of this Master Plan.
- In **Scenario 2B** the capital reserve is developed to pay the projected capital upgrades and a debenture is not required and the water rate varies over the time period. Under this Scenario, once the capital upgrades have been completed the Commission's capital reserve will be depleted. Depending on the projected upgrades in the system at the time, the Commission may need to increase its reserve rate to accommodate future upgrades which are beyond the timeline of this Master Plan
- **Scenario 3** has the lowest water rate, but the Commission Members are responsible to pay for the future expenditures.
- **Scenario 4** the Commission would use its accumulated cash reserve and a debenture to pay for future capital expenditures. The maximum debt taken by the Commission is $17M in 2044. The Commission would pay back its accumulated debt by 2055.

- **Scenario 5** the Commission would use its accumulated cash reserve and a debenture to pay future capital expenditures. The maximum debt taken by the Commission is $21.3M in 2035. The Commission would pay back its accumulated debt by 2047.

The Commission should review each of the presented funding scenario's and identify which scenario best services the Commission and the objectives of the Commission's Strategic Plan.

STRATEGIC PLAN NO 4.4.1

Charge Reasonable Rates to Members

Figure 11.1 - Cash Flow - Scenario 1

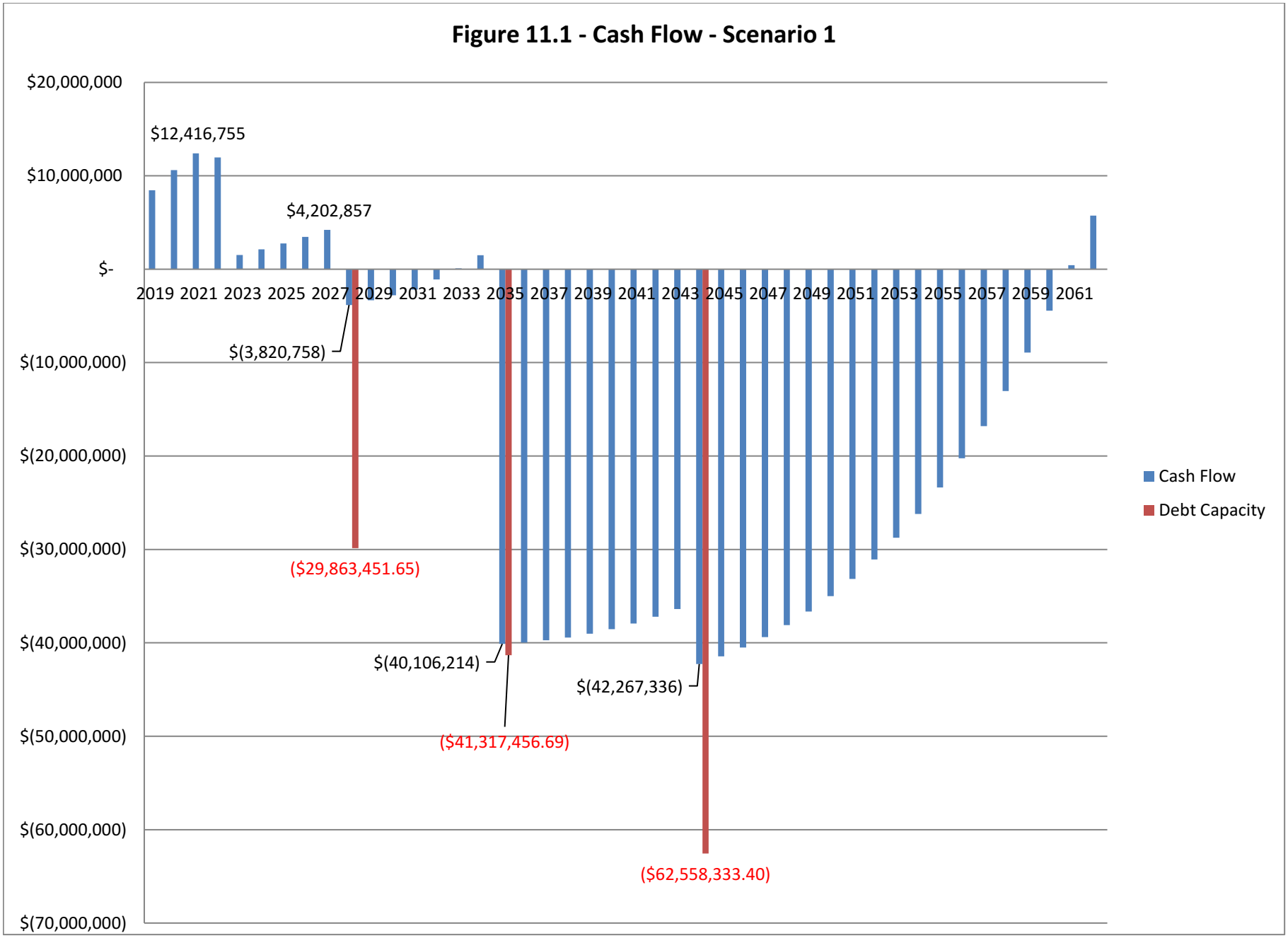
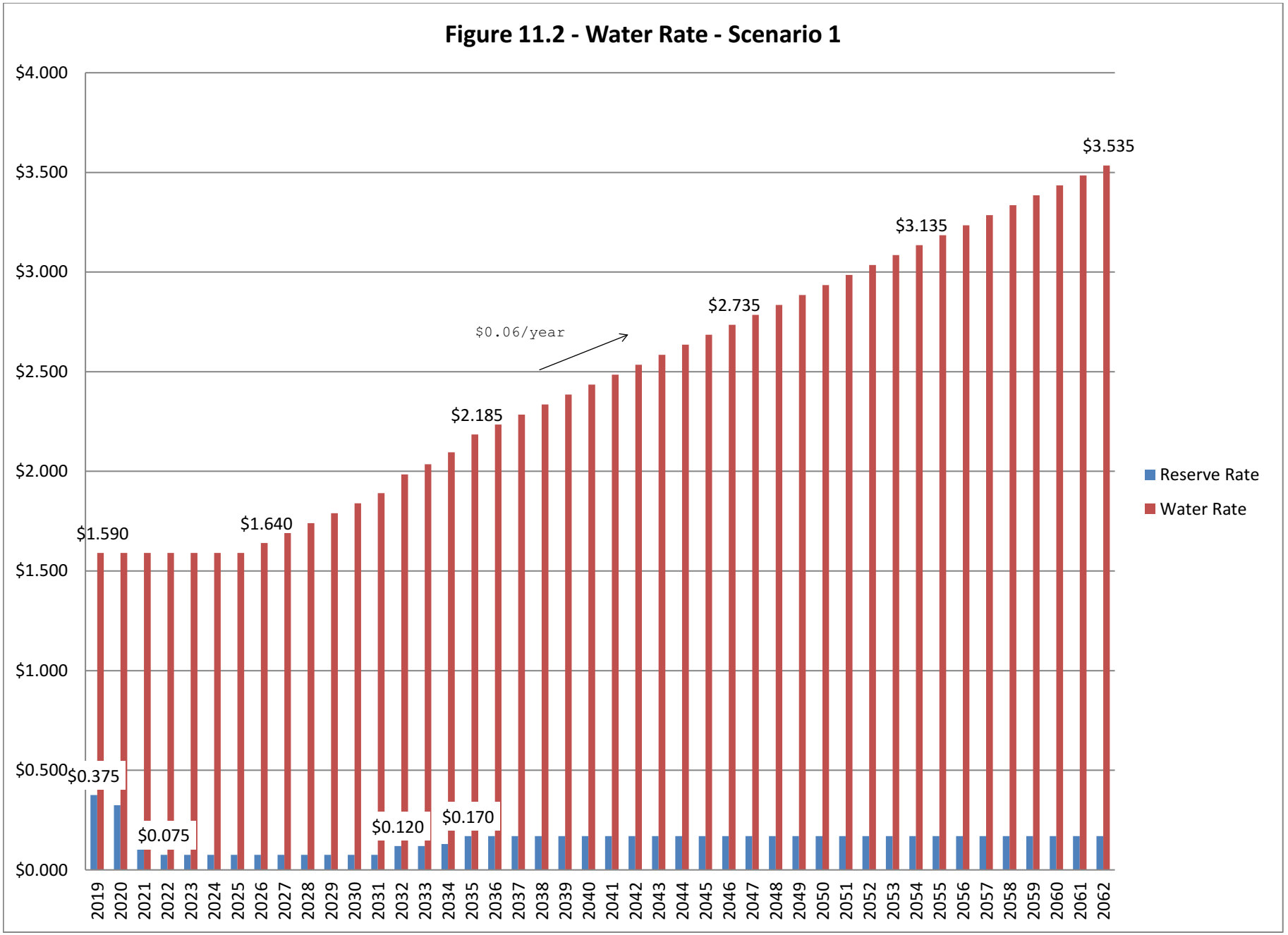


Figure 11.2 - Water Rate - Scenario 1



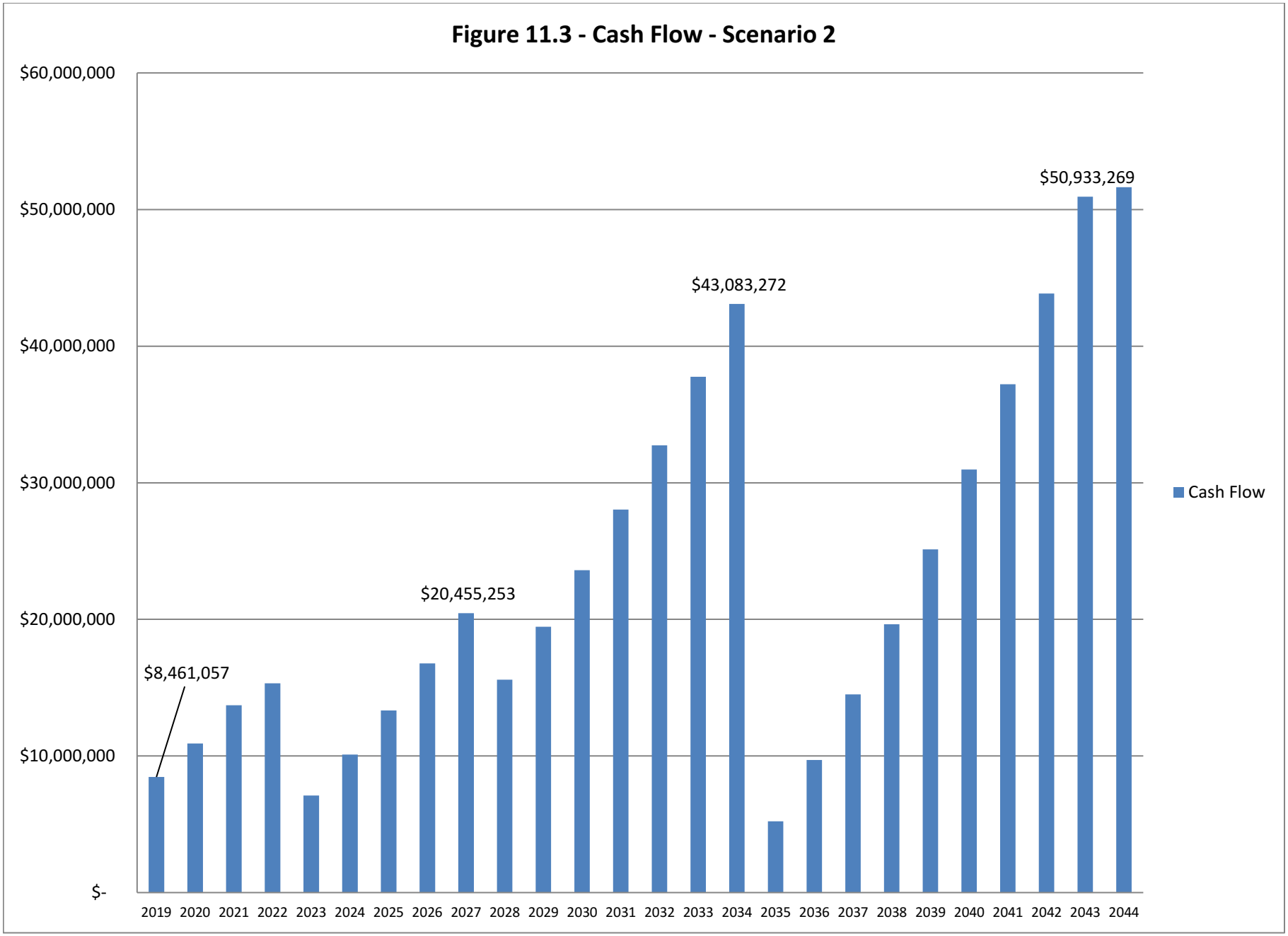


Figure 11.3 - Cash Flow - Scenario 2
$60,000,000
$50,000,000
$40,000,000
$30,000,000
$20,000,000
$10,000,000
$-
$8,461,057
$20,455,253
$43,083,272
$50,933,269
2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044
Cash Flow

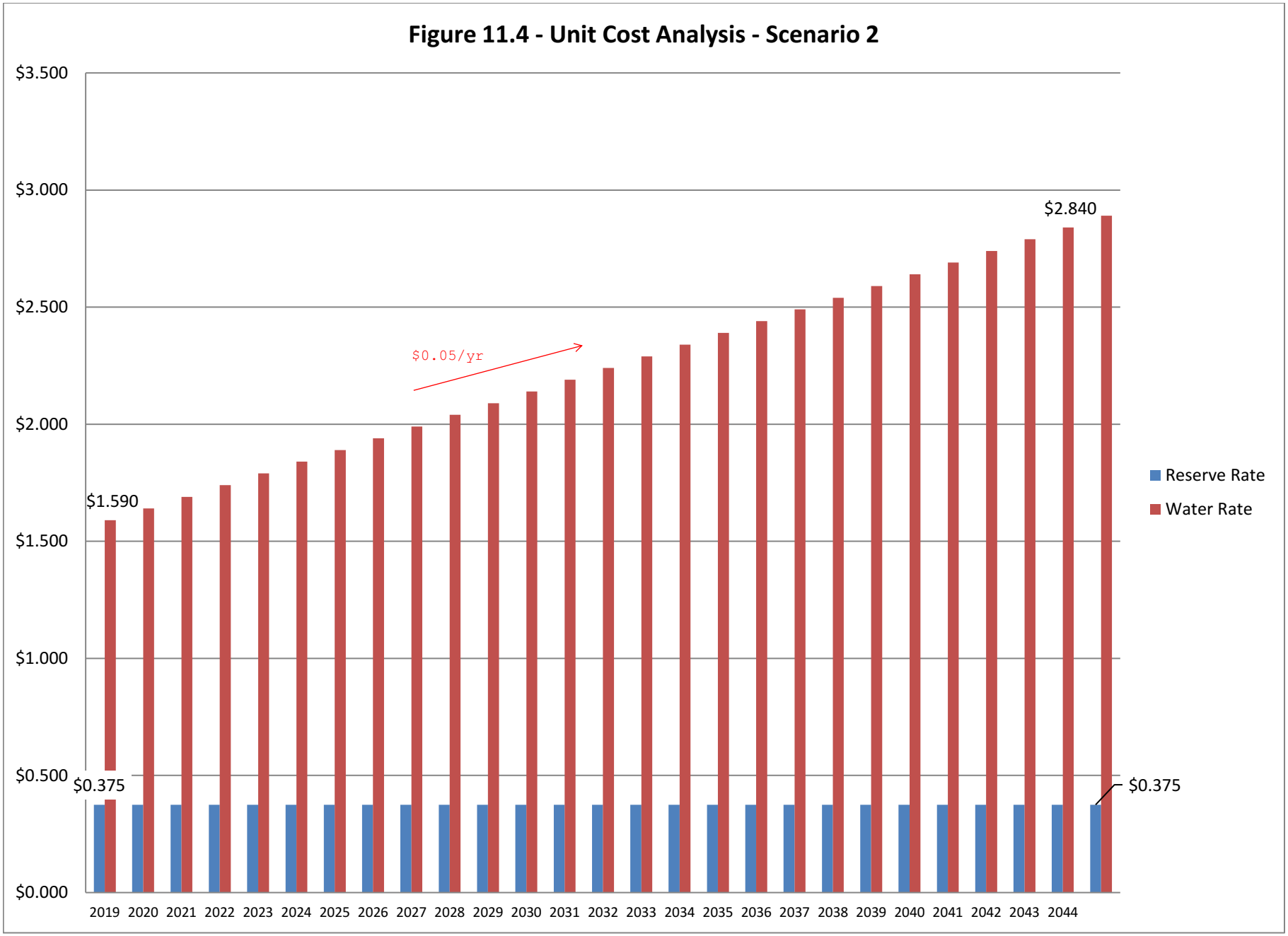


Figure 11.4 - Unit Cost Analysis - Scenario 2
$3.500
$3.000
$2.500
$2.000
$1.500
$1.000
$0.500
$0.000
$2.840
$1.590
$0.375
$0.375
$0.05/yr
Reserve Rate
Water Rate
2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044

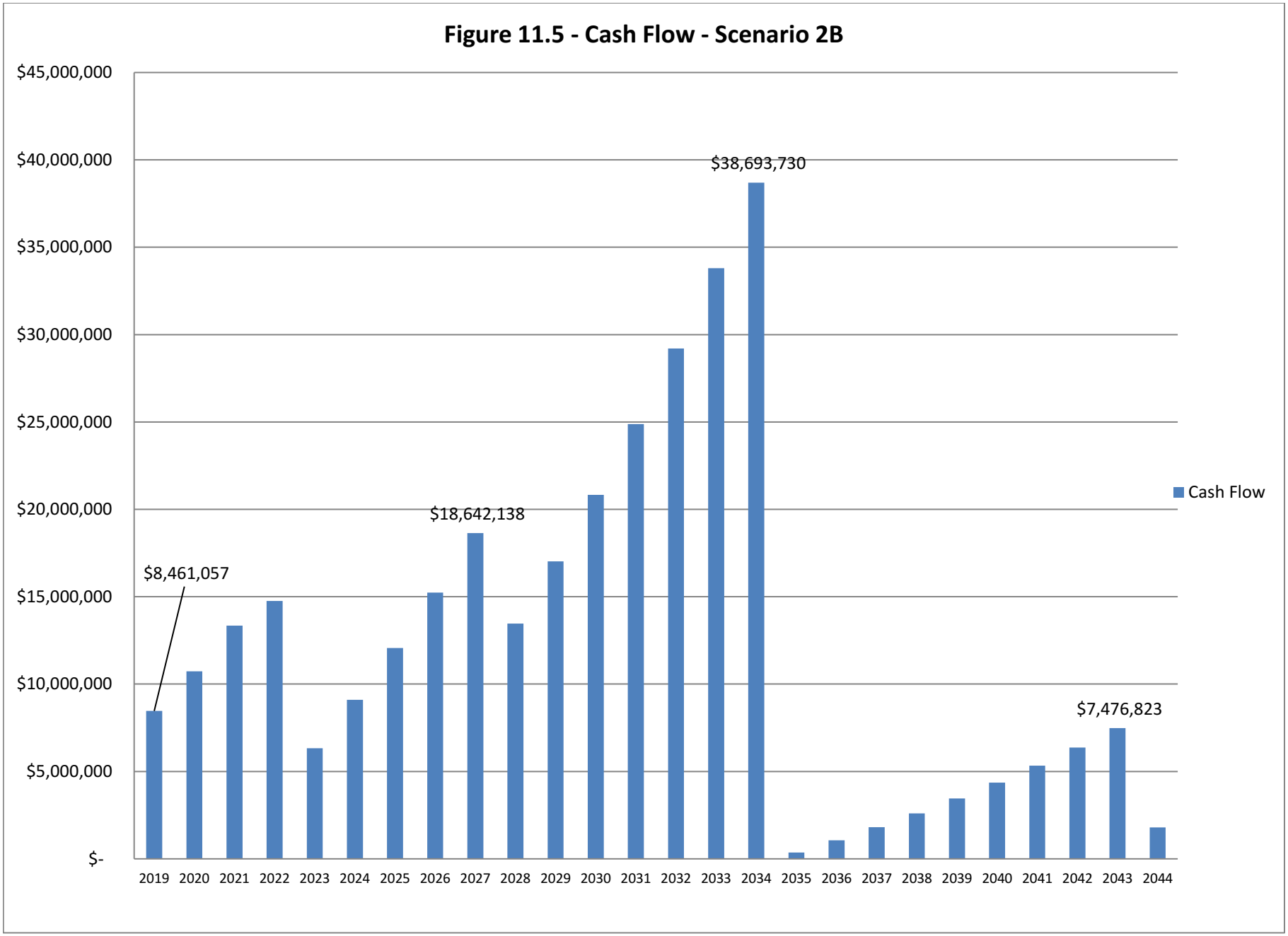


Figure 11.5 - Cash Flow - Scenario 2B
$45,000,000
$40,000,000
$35,000,000
$30,000,000
$25,000,000
$20,000,000
$15,000,000
$10,000,000
$5,000,000
$-
$38,693,730
$18,642,138
$8,461,057
$7,476,823
2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044
Cash Flow

Figure 11.6 - Unit Cost Analysis - Scenario 2B

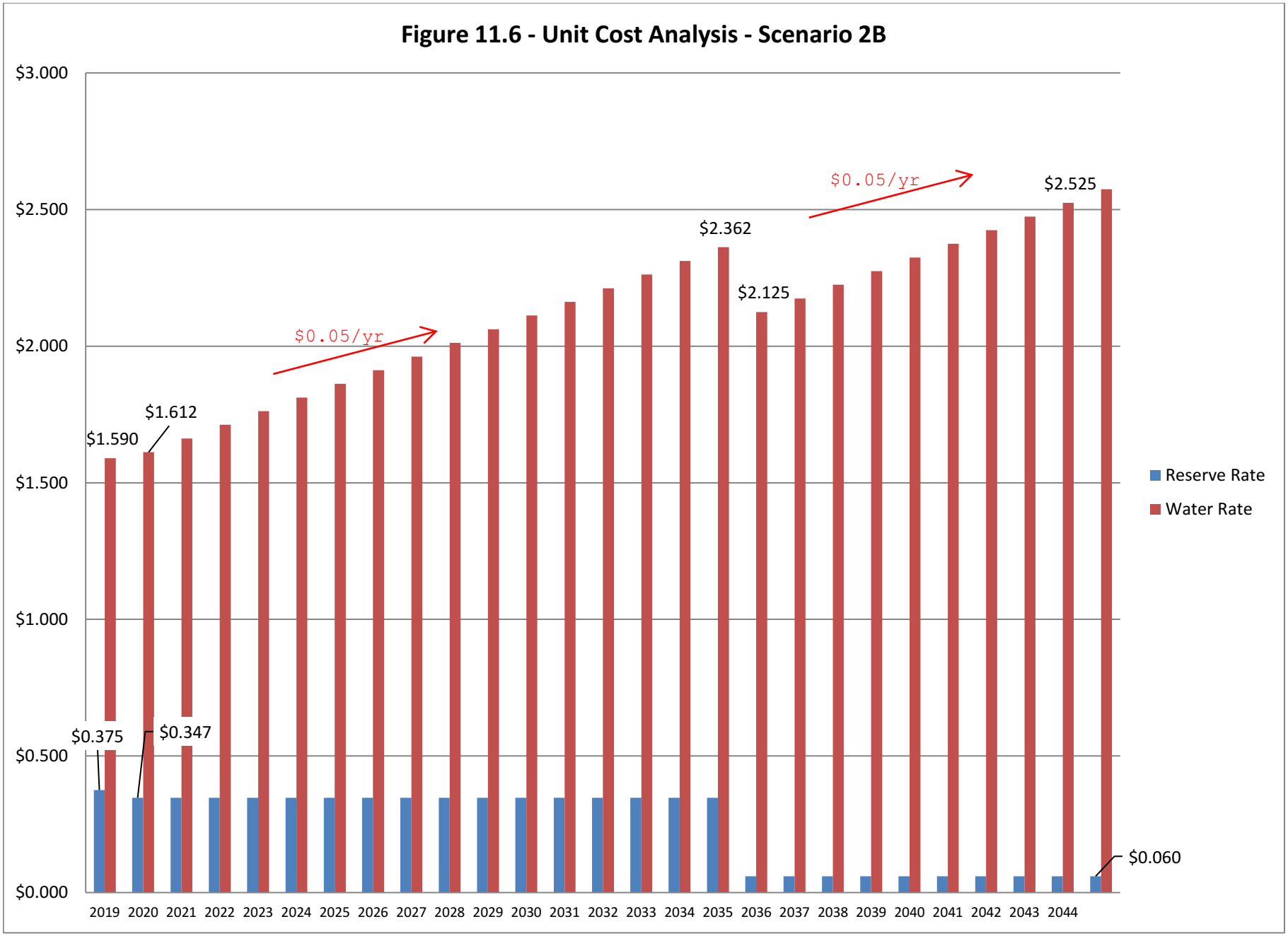


Figure 11.7 - Cash Flow - Scenario No 4.

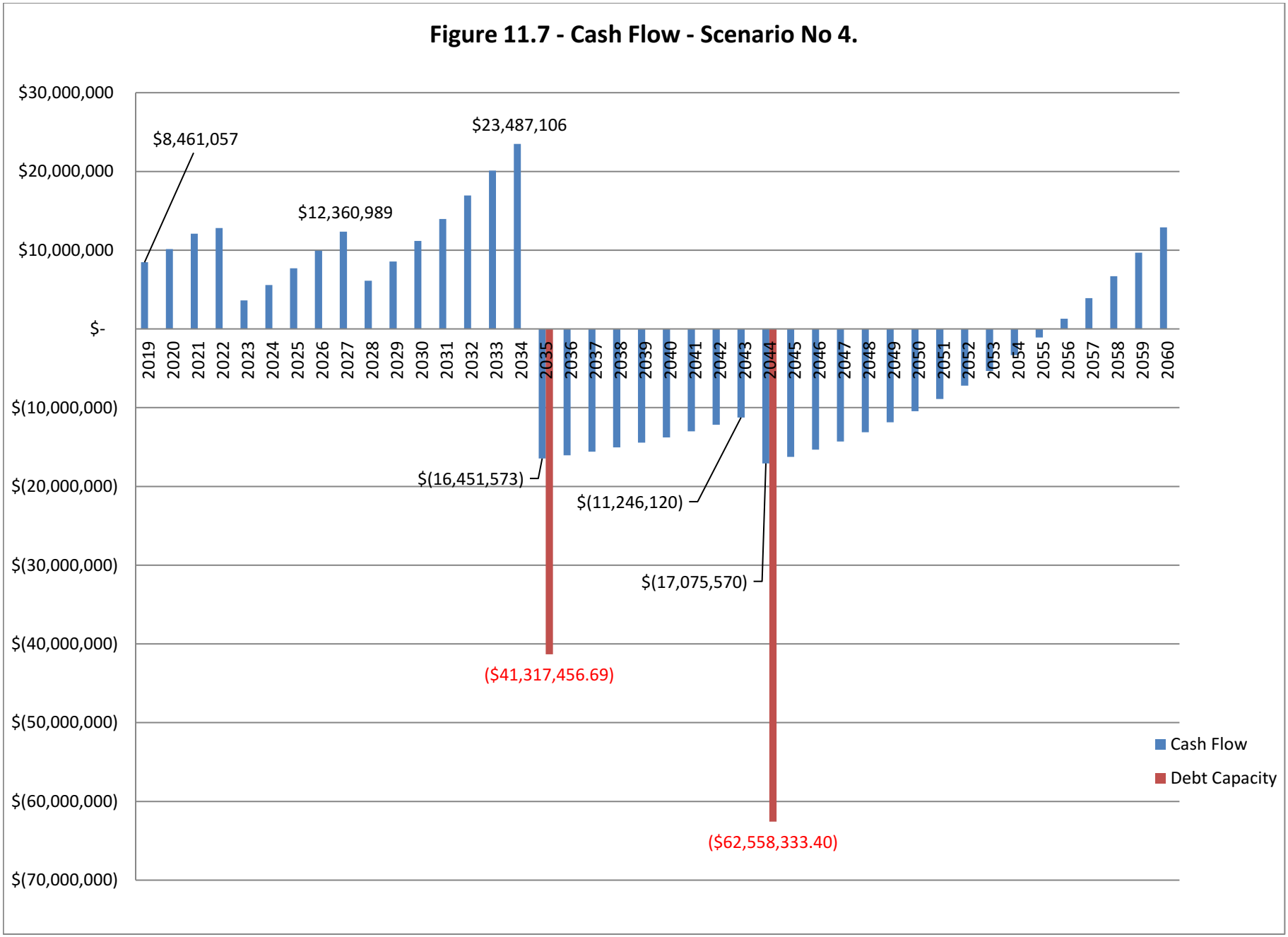
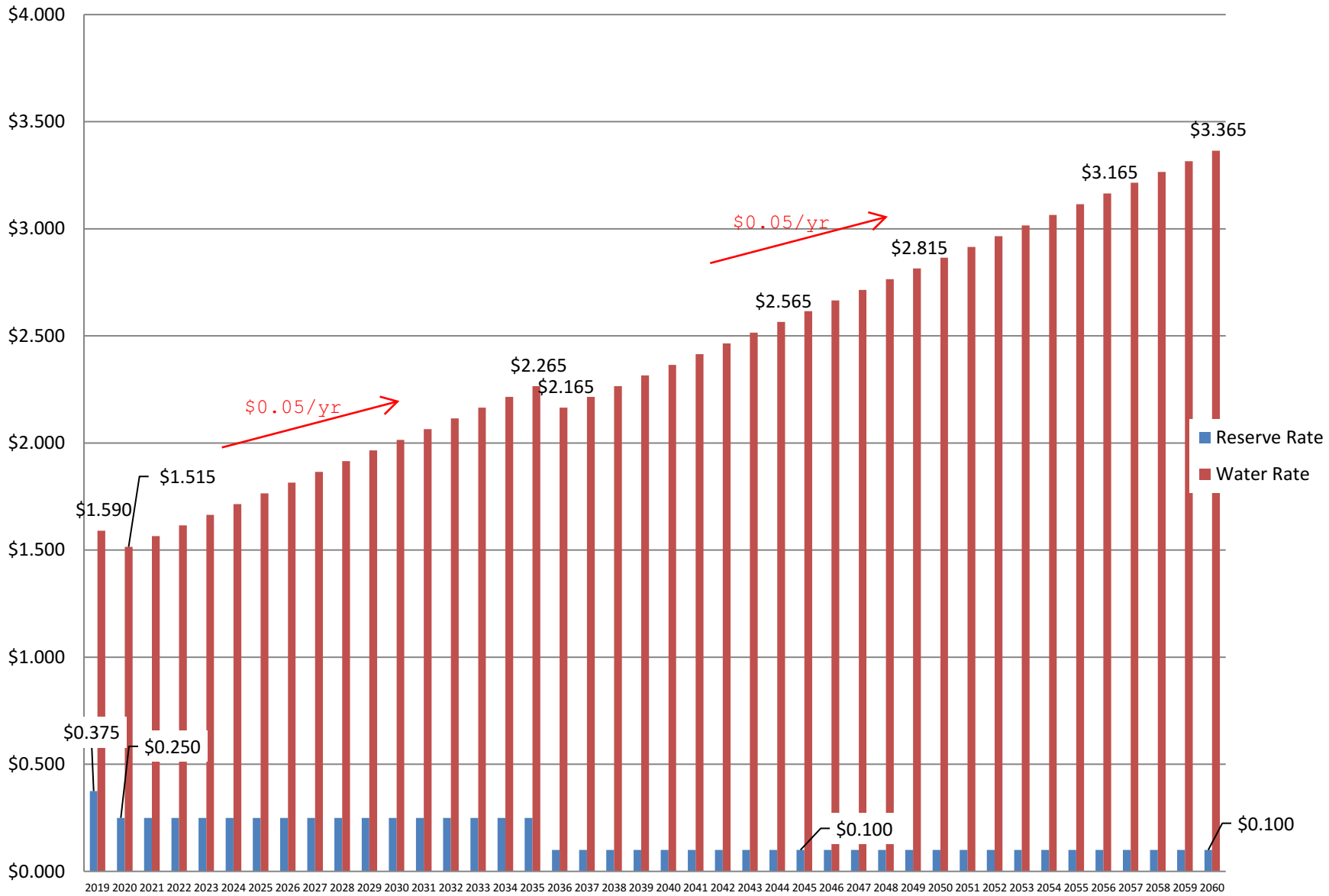


Figure 11.8 - Unit Cost Analysis - Scenario 4



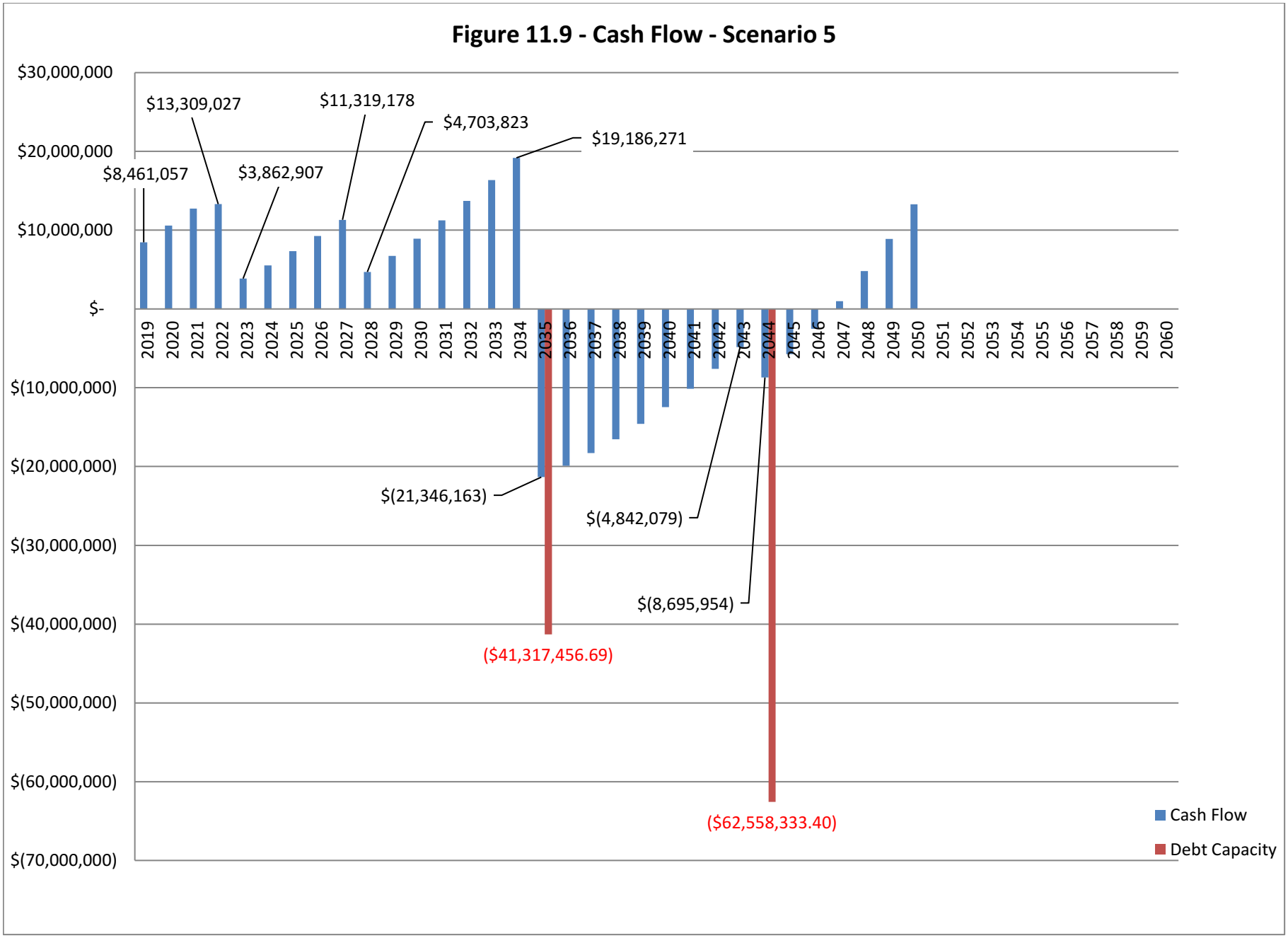


Figure 11.9 - Cash Flow - Scenario 5
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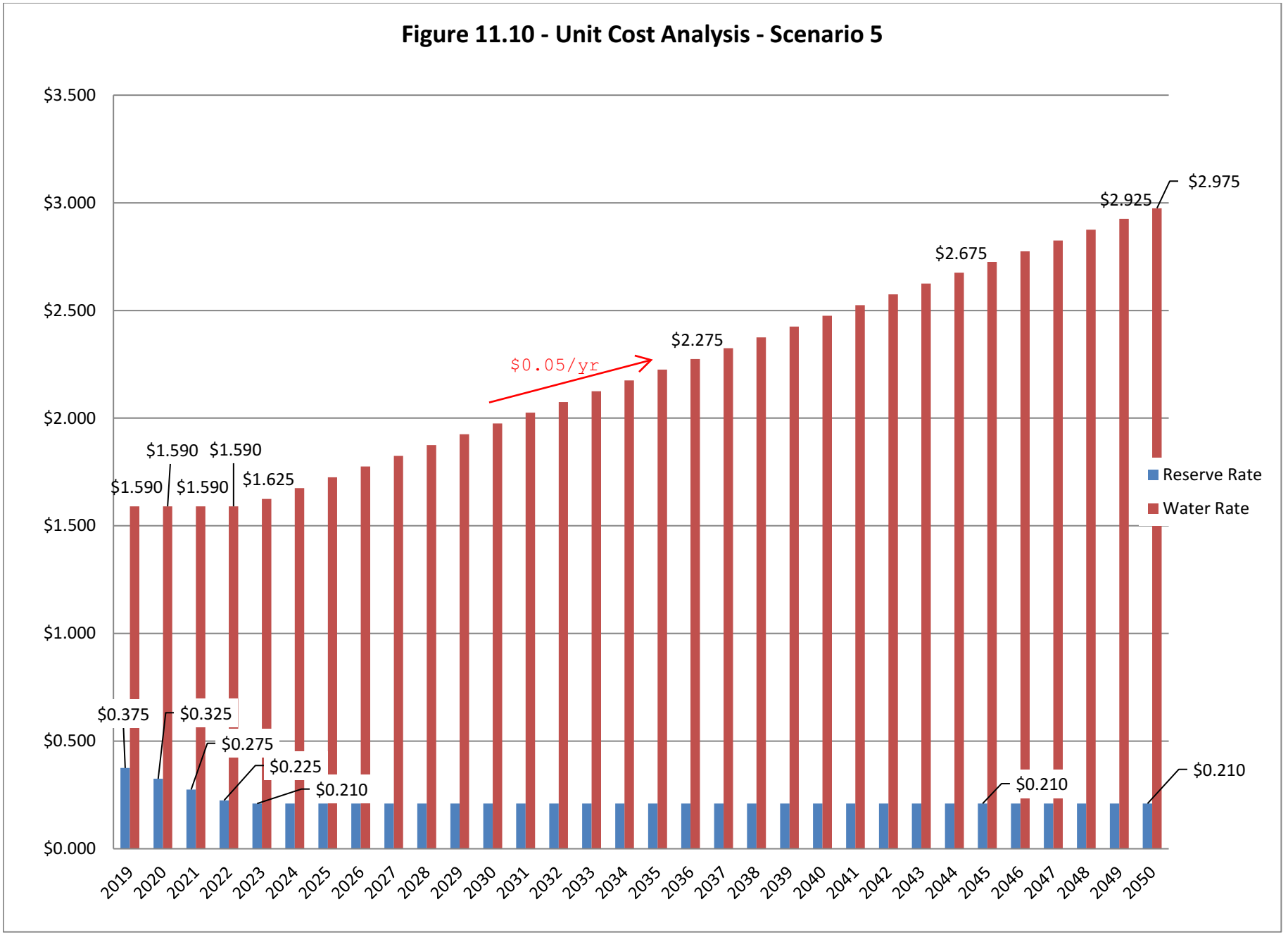
Cash Flow
Debt Capacity

Figure 11.10 - Unit Cost Analysis - Scenario 5



12 POTENTIAL FUNDING SOURCES

Prior to the design and construction of any major project, the Commission should review the currently available grant programs, for there acceptance criteria and eligibility of the project. Below is a list of currently available grant programs.

12.1 Alberta Transportation - Water for Life

In previous discussion with Alberta Transportation regarding similar projects as is proposed by the Commission; Alberta Transportation identified that funding would only be attributed to the portion of the line that supports residential water use. This would leave the portion of the system that services industrial customers not funded. Alberta Transportation would consider the Edmonton International Airport, and Nisku as industrial customers and may also consider industrial water uses within the City of Leduc as part of the overall industrial system demand.

Under the current Water for Life Funding, only the residential water demand would be considered for funding. The need for funding would be based on the residential water demand as compared to the overall system capacity.

12.2 Clean Water and Wastewater Fund (CWWF)

The Clean Water and Wastewater Fund provides funding to projects that contribute to the rehabilitation of both water treatment and distribution infrastructure and existing wastewater and storm water treatment systems; collection and conveyance infrastructure; and initiatives that improve asset management, system optimization, and planning for future upgrades to water and wastewater systems.

12.3 Green Infrastructure Fund

The Green Infrastructure Fund supports environmental infrastructure projects that promote reduced greenhouse gas emissions, cleaner air, cleaner water and cleaner land. There are five eligible categories of investment: wastewater infrastructure, green energy generation infrastructure, green energy transmission infrastructure, solid waste infrastructure, and carbon transmission and storage infrastructure. By providing up to 50 percent federal funding on a cost-shared basis, the fund leverages additional investments from other partners.

The Green Infrastructure Fund started in 2009-2010 and is schedule to end in 2021-2022.

12.4 New Building Canada Fund

The New Building Canada Fund – National Infrastructure Component supports projects of a national significance that have broad public benefits and that contribute to Canada's long-term economic growth and prosperity and reduce potential economic disruptions or foregone economic activity.

12.5 Other Funding Sources or Alternatives

In addition to the above funding sources, Members of the Commission can allocate a portion of their received funding from such sources as the Municipal Sustainability Initiative (MSI) towards the project.

The debenture limit of the Commission can be increased, by having individual members of the Commission take a portion of the overall project debenture. This would require that each member utilize a portion of their debt capacity on behalf of the Commission. The Commission would be responsible to service the debt, through the Commissions water rate.

13 CONCLUSION AND RECOMMENDATIONS

13.1 Conclusions

The following conclusions from the master plan are outlined below:

- The average projected water demand for the Commission is 3.1% over 25 years.
- There has been significant growth within the Commission's system over the last few years. The Commission is anticipating the following new services to tie-into the system:
  - Leduc County Rural (Rolly View and Looma)
  - Leduc West Reservoir
  - Saunders Lake Industrial Area
- Although the limits of the supply system have changed significantly over the past number of years, this has not resulted in a significant change to the system curve. The populations projections have changed; however, and the required pumping head at Boundary Pump Station has reduced.
- System capacity issues were identified through the hydraulic model. Upgrades will be required regardless of which servicing option is selected between the Commission and EPCOR.
- The current supply pressure setpoint to the City of Leduc North Reservoir (310 kPa) adequate to meet requirements for the next 5 years.
- The Commission and EPCOR are currently in discussion regarding the transfer of assets as per the Option 2.
- The City of Camrose has expressed interest in being service by the Commission; however, additional information is required prior to reviewing the impact to the Commission. **(Strategic Plan Item 4.2.5**)
- Prior to transferring asset to EPCOR, the Commission Master PLC should review which Commission facility the Master PLC be relocated to.

The following long term capital scenarios were reviewed:

- **Scenario 1** - The Commission uses it current reserve of$0.375/$m^3$ to maintain the current water rate until approximately 2025, and uses debentures to pay for capital upgrades
- **Scenario 2** - The Commission increases its water rate so that a future debenture is not required.
- **Scenario 2B** – The Commission increases its water rate so that future debenture is not required, and the capital reserve is depleted after the proposed capital projects.
- **Scenario 3** - The Commission no longer saves for future capital upgrades, and the member municipalities are required to contribute to the Commission to undertake future capital costs.
- **Scenario 4 and 5** - The Commission uses a combination of cash reserves and debt servicing to pay for future capital upgrades.

13.2 Recommendations

AE provides the following recommendations:

- The current water allocations identified within the Commission Bylaw should be revised as several members will exceed their current water allocation within the next 5 to 10 years.
- The Commission adopt regional servicing Concept 2 and continue to review and discuss with EPCOR regarding the transfer of the noted Commission assets.

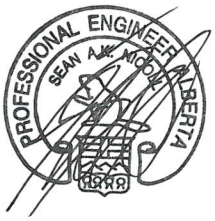
- The Commission should update its Bylaw as a result of the transfer of Commission assets to EPCOR.
- The Commission should relocate the Master PLC out of the Boundary Pump Station prior to the transfer of assets to EPCOR.
- The Commission should work with its members to highlight the Commissions infrastructure within planning documents to increase the awareness of the Commissions pipeline locations. **(Strategic Plan Item 4.4.3)**
- The Commission should work with its Members to establish crossing protocols for pipelines located within road right of ways. **(Strategic Plan Item 4.3.2)**
- The Commission should undertake planning with the City of Beaumont to secure an alignment for the future second service line.
- The Commission should develop a Water Supply Policy which formalizes its current practices. **(Strategic Plan Item 4.2.4)**
- The Commission should review with New Sarepta (Leduc County) Hay Lakes and Armena (Camrose County) the level of service provided to these fill locations.
- The Commission should review the Funding Scenario's presented within and select a Scenario which meets the requirements of the Commission.
- The Commission should plan to undertake a preliminary and detail design of the proposed new Booster Station, in approximately 2021 so that the new Booster Station can be constructed in 2022 and operational in 2023. As part of this project, the Commission should update the overall water demand projections, so the Booster Station is properly sized to meet the Commission requirements.
- The Commission should review the status of potential future service connections, prior to the design and construction of the new Booster Station.
- The Commission should update this Master Plan in 5 years to confirm system water demands and the timing of proposed upgrades. System upgrades should be undertaken based on confirmed water demands
- The Commission should review the availability of potential funding sources prior to undertaking capital projects.
- It is recommended that the Commission continue to engage with both City of Camrose and Miquelon Lake Provincial Park (Alberta Parks) regarding the possibility of future service to these areas if cost effective to do so. **(Strategic Plan Item 4.2.5)**
- The Commission should undertake the objectives outlined in the 2020-2025 program.
- The Commission should continue with its annual cathodic protection survey and undertake the recommendations outlined in Section 7.
- The Commission should undertake the recommendations outlined in the Facility Assessment.
- The Commission should develop policies to address the following items identified in the Strategic Plan;
  - Increase the awareness of the locations of the Commission Pipeline within each serviced Community. This could include having the Commission pipelines identified within planning documents by the respective members or incorporating the Commission pipeline with member GIS systems.
  - Work with the Commission members to registering or establish crossing and proximity requirements for the Commission's pipeline.

CLOSURE

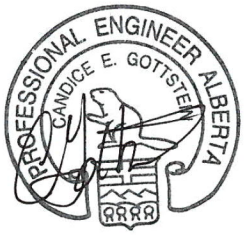
This report was prepared for the Capital Region Southwest Water Services Commission to review historical water demands and to project future water demands for the next 5, 10, 15, 20 and 25 years; review the current operating philosophy and provide recommendations on upgrades, operations and the distribution policy.

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.



2020-01-20
Sean Nicoll, P.Eng.
Project Manager



2020-01-20
Candice Gottstein, P.Eng.
Hydraulic Engineer

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF
Signature:
Date: 2020-01-20

APEGA Permit to Practice P 3979

APPENDIX A – EXISTING SYSTEM DESCRIPTION

INTRODUCTION

System History

- **1959 - 1960**

The Strathcona-Leduc Water Board was originally formed in 1959 as a partnership between the Municipal District of Strathcona, Municipal District of Leduc, and the Town of Leduc (April 16, 1959). The formation of the Board was in response to the Federal Government's need for potable water to the then proposed Edmonton International Airport. With financial contribution of the Federal Government, and debenture borrowing by the three municipalities, the original Edmonton to Leduc water transmission system was constructed in 1959 and 1960.

The original waterline was a 300 mm diameter Asbestos Cement watermain from within the then City of Edmonton limits to the Airport tie-in and 250 mm diameter cast iron watermain from the Airport tie-in to the City of Leduc. Two pump stations; No. 1 at 23rd Avenue, in the City of Edmonton, and No. 2 at Nisku provided the transmission capability.

- **1978 - 1979**

The capacity of the original system was reached, and in 1978/79 a new steel pipeline was constructed as Phase 1 with telescopic diameters; 750 mm, 600 m and 500 mm, from the City of Edmonton (9th Avenue) to the City of Leduc. Phase 2 was constructed in 1982/83 but not put into full operation until 1985. It consisted of the Boundary Pump Station and the Fill Stations for the Airport, County of Leduc - Nisku and City of Leduc. Phase 3 was to have been the On-Line Storage Facility and Repump Facility to Calmar, however this was not constructed. Phase 4 was the Leduc to Calmar waterline, complete with a Fill Station at Calmar. This was implemented by the Town of Calmar and was subsequently transferred to the Commission.

- **1984**

On September 1, 1984 the Capital Region Southwest Water Services Commission was established and it assumed ownership, operation and maintenance of all the Strathcona-Leduc Water Board facilities, as well as the Leduc to Calmar waterline, and the Nisku to Beaumont water supply line.

- **1986 - 1988**

In the fall of 1986, an agreement was finalized for the sale of the Commission's system inside the City limits to the City of Edmonton.

In 1987, an agreement was made between the Commission and the County of Leduc to transfer ownership, operation and maintenance of the original 300 mm water main to the County; with the exception of the Nisku Pumphouse #2. The 300 mm diameter. main now serves as a County distribution main with pressurization from the County's Nisku Reservoir.

In 1988, the Commission completed the construction of a 400 mm dia lateral from the Commission's main line to Beaumont and a Fill Station at Beaumont Reservoir. Additionally, the original Nisku to Beaumont waterline was transferred to the County of Leduc.

- **1993 - 1995**

In 1993/95 the Supervisory Control and Data Acquisition (SCADA) system was upgraded to new technology and radio communication with the five Fill Stations.

- **2010 – 2012**

In 2010, Highway 21 Regional Water Pipeline constructed a regional water line from City of Leduc to Village of Hay Lakes through the Hamlet of New Sarepta. The Village of Hay Lakes and Camrose County then joined the CRSWSC as Commission members. The Highway 21 pipeline consists of a 250 mm diameter HDPE DR11 pipe from the City of Leduc to the New Sarepta and a 200 mm diameter HDPE DR11 from New Serepta to the Village of Hay Lakes. The Fill Stations are located at the existing Water Treatment Plants at the Hamlet of New Sarepta and Village of Hay Lakes.

In 2011 the City of Leduc took over the operation of the Commission. Soon after in 2012, the flow meter at the Boundary Station was upgraded. Additionally, the Town of Millet requested to become a member of the Commission and the Hamlet of Armena extension design work was completed.

- **2013 – 2015**

In 2013 the Edmonton International Airport realignment was completed, the SCADA system was upgraded and the south Highway 21 watermain was transferred to the Commission from Strathcona County.

In 2015 the water distribution system to the Hamlet of Armena was completed. The Town of Millet joined the board as directors at large and the Commission took over the construction management of the supply line project. The Water Master Plan was completed and identified long-term improvements to the existing Commission infrastructure.

- **2016 – 2017**

The Millet water supply line was constructed and brought into commission. The Commission’s radio communication network was upgraded and the Commissions main radio was relocated from the Boundary Station to the Hwy 21 Booster Station. The Master PLC remains at the Boundary Station.

Regional Water Customers Group

The Capital Region Southwest Water Services Commission is one of the members in the Regional Water Customers Group. The members of this group work together to complete long-range planning, rate negotiation and coordination of water supply.

APPENDIX B - BYLAW 02/2015

CAPITAL REGION SOUTHWEST WATER SERVICES COMMISSION

BYLAW 02/2015

BEING A BY-LAW RESPECTING THE APPOINTMENT OF A BOARD OF DIRECTORS AND CHAIRPERSON, GOVERNING THE FEES TO BE CHARGED BY THE COMMISSION AND THE GOVERNANCE OF ADMINISTRATION OF THE COMMISSION

WHEREAS pursuant to the provisions of the Municipal Government Act, the Board of the Commission must pass Bylaws respecting the appointment of its directors and the designation of its Chair, governing the fees to be charged by the Commission for services and may pass Bylaws respecting the provision of the Commission's services and the governance of the administration of the Commission; and

NOW THEREFORE the Board enacts the following:

1. DEFINITIONS

1.1 "Act" means the *Municipal Government Act*, R.S.A. 2004, c. M-26;

1.2 "Chair" means the chairperson of the Board;

1.3 "Commission" means the Capital Region Southwest Water Services Commission;

1.4 "Director" means the representative of a Member on the Board appointed in accordance with this Bylaw;

1.5 "Financial Plan" means the financial plan for the Commission for the forthcoming three (3) financial years, as it exists from year to year;

1.6 "Manager" means the person appointed by the Board as Manager in accordance with this Bylaw;

1.7 "Member(s)" means those members set out in the Regulation;

1.8 "Regulation" means Alberta Regulation No. 292/84 as amended by Order in Council 213/2011;

1.9 "Regular Meeting" means the meetings of the Board to be held each year on dates and at locations to be determined by resolution of the Board pursuant to section 2.9 of this bylaw;

1.10 "System" means the pipelines, reservoirs, pump stations and control systems operated by the Commission for the purpose of providing water

to the members and customers of the Commission.

1.11 "Special Meeting" means a meeting of the Board called in accordance with Section 3.2 of this Bylaw ;

1.12 Transmission Lines means the lines transmitting water to the members of the Commission.

.1 Line 1 - Capital Region Southwest Services Main Transmission Line is a 600mm water line that supplies water from the Capital Region Southwest Water Services Boundary Pump Station to the City of Leduc with lateral mains feeding the Town of Beaumont, Town of Calmar, Leduc County, Edmonton International Airport and Town of Millet;

.2 Line 2 – Capital Region Southwest Water Services South Regional Water Line is a 250mm water line which extends from the Capital Region Southwest Water Services Main Transmission Line through Leduc County to the Hamlet of New Sarepta, Village of Hay Lakes and Camrose County.

1.13 "Water Services" means all treated water services provided by the Commission; and

1.14 "Director at Large" means a person appointed in accordance with this Bylaw, who does not represent a Member of the Commission, and shall be deemed to be a Director;

1.15 All other words in this Bylaw are as defined or used in the Act or the Regulation.

2. Duties of the Board

2.1 The Board shall be responsible for the management and conduct of the affairs of the Commission which responsibility shall include, but not limited to the following:

.1 to adopt the Financial Plan and Budget; and

.2 to maintain the operations of the Commission in a manner which benefits its Members

2.2 The Directors may receive for attending any Board meetings or for carrying out any Director's responsibilities, meeting fees and expenses including travel expenses as permitted by the rates and fees set out in the Financial Plan and Budget

3. MEETINGS

3.1 The Chair shall establish the agenda for any meeting of the Board. Directors shall be entitled to add items to the proposed agenda by submitting a written request to the Manager at least forty-eight (48) hours before the meeting.

3.2 The Board shall adopt the agenda at the beginning of the meeting and may, upon agreement of majority of those Directors present at the meeting, add or delete items from the agenda.

3.3 The Chair shall preside over each Regular Meeting, Special Meeting and the Annual Meeting and of any meetings of any committee of the Commission.

.1 The Chair may call a Special Meeting whenever the Chair considers it appropriate to do so, and

.2 The Chair must call a Special Meeting if the Chair receives a written request for the meeting, stating its purpose, by at least half of the Directors comprised of 4 of the members.

3.4 The Chair and Directors shall vote on all matters before the Board

3.5 The Chair shall be an ex-officio and voting member of all committees

3.6 The Chair shall perform all other and such other duties as are usually performed by the Chair.

3.7 The Vice-Chair shall act and perform the duties of the Chair in his absence in the conduct of his office.

3.8 In the absence of the Chair at any meeting, the Vice-Chair shall preside over the meeting for that meeting only.

3.9 During the absence or inability of the Chair and Vice-Chair, a Director appointed by the Board for that purpose shall exercise the duties and powers of the Chair.

3.10 The Board by resolution may establish the date and number of Regular Meetings held during a year, however, there shall be no less than two (2) Regular Meetings per year.

3.11 Notice of the time and place of every Board meeting shall be given to each Director by telephone, facsimile or any electronic medium not less than forty eight (48) hours before the time of the meeting.

3.12 Notwithstanding section 3.10, a Board meeting may be held at any time and place without such notice if:

.1 All the Directors are present thereat and signify their waiver of such notice at such meeting; or

.2 All the Directors present thereat signify their waiver of such notice and all the Directors that are absent have signified their consent to the meeting being held in their absence

3.13 A Director may participate in a Board meeting or at a meeting of a committee of the Board by means of telephone conference or other electronic communication medium that permits each of the Directors to effectively and clearly communicate to one another for the purposes of conducting a meeting

3.14 Any matter properly placed before a meeting of the Board shall be decided by a majority of the votes cast by the Directors at the relevant Board meeting

3.15 A quorum of the Board shall be a majority of the Directors

4. ADMINISTRATION

4.1 There shall be a Manager and such other Officers as determined by the Board at its discretion from time to time.

4.2 The Manager shall act as the administrative head of the Commission and without limiting the foregoing, the Manager shall:

.1 ensure that the policies and programs of the Commission are implemented

.2 advise and inform the Board on the operations and affairs of the Commission;

.3 maintain custody of the seal of the Commission and when required on any instrument requiring the seal of the Commission, affix the same together with one of the Chair or the Vice Chair

.4 perform the duties and exercise the powers assigned to the Manager in this Bylaw

.5 perform the duties and exercise the powers required of the Manager in the Act or any other applicable legislation

.6 cause the funds of the Commission to be received and disbursed in accordance with the directions of the Board, subject to this Bylaw.

.7 cause to be kept detailed accounts of all income and expenditures including proper vouchers for all disbursements of the Commission

.8 cause to be rendered to the Board at Regular Meetings or whenever required by the Board an account of all transactions of the Commission and the financial position of the Commission

.9 cause all facts and minutes of all proceedings to be kept on all meetings of the Commission

.10 cause all notices to be given to Members and to Directors required by this Bylaw

.11 cause to be kept all books, papers, records, correspondence, contracts and other documents belonging to the Commission and shall cause the same to be delivered up when required by the *Act* or when authorized by the Board to such person as may be named by the Board; and

.12 shall carry out any lawful direction of the Board from time to time

4.3 The Board may select as Manager:

.1 an individual that is an employee of the Commission; or,

.2 an individual, municipality, Member, or firm engaged on a contractual basis;
on such terms and conditions as may be acceptable to the Board

4.4 In addition to the duties set forth herein, the Officers shall have such duties as the Board may from time to time determine.

4.5 Any one of the Chair or Vice-Chair, together with the Manager or designated alternate are authorized to execute and deliver any cheques, promissory notes, bills of exchange and other instruments, whether negotiable or not, on behalf of the Commission.

4.6 The Board may, from time to time, appoint an acting manager who shall be authorized, in the absence the Manager, to perform such duties of the Manager as the Board may prescribe.

4.7 Members shall have the right to inspect and may obtain extracts or copies of all books and records of the Commission.

5. VOLUME OF WATER SUPPLIED

5.1 Each Member of the Commission shall be entitled to the following minimum annual allocations in cubic meters:

Transmission Line 1 –

City of Leduc = 498 cu meter per hour
Town of Beaumont = 188 cu meter per hour
Town of Calmar = 47 cu meter per hour
Leduc County = 157 cu meter per hour
International Airport = 71 cu meter per hour
Town of Millet = 57.5 cu meter per hour

Note: Projected peak demand based on 4.0% average growth as per CRSWSC Master Plan update dated June 2007.

Transmission Line 2 –

Village of Hay Lakes = 26.50 cu metre per hour
County of Camrose = 11.05 cu metre per hour
Leduc County = 36.83 cu metre per hour

Note: Based on Associated Engineering design criteria per municipality

The Commission shall undertake to provide capacity within the System to supply the volume of water annually requested by each Member up to the allocation identified. The Commission may at its discretion, provide to Members volumes of water exceeding these allocations.

5.2 Members shall provide the Commission in the fall of each year, a request for water for the next ensuing year, based on a reasonable estimate of the volume of water expected to be required to meet the needs of the Member's customers in that next year, together with a forecast of volumes anticipated to be required by the member for the second through fifth ensuing years.

5.3 Where the capacity of the System is insufficient to deliver the water requested by the Members, the Members shall be allocated the available capacity proportionately based on the previous year's volumes, until such time as the Commission is able to fully supply the volume required.

6. FINANCIAL

6.1 The financial year of the Commission shall be the calendar year.

6.2 Without limiting the requirements for the Budget pursuant to the Act, the Board in fall of each year will adopt the Financial Plan and Budget which will set out the:

6.2.1 expected water consumption requirements of the Members;

6.2.2 estimated expenditures for the:

.1 operations of the Board and Management;

.2 operations of the System;

.3 purchase of water;

.4 repayment of debt obligations;

.5 non cash expenditures; and

.6 return on equity and investments;

6.2.3 estimated revenue requirements to meet the expenditures of the Commission and the rates and fees to be charged to Members and customers of the Commission;

6.2.4 the second and third year projections of operating expenditure, revenue requirements and rate trends;

6.2.5 capital projects planned and expected to completed in the forthcoming financial year and the second and third years of the Financial Plan;

6.2.6 estimated costs and sources of revenue for each year of the Financial Plan;

6.2.7 rates of remuneration and expenses that may be provided to the Directors

6.3 Subject to and in accordance with the Act and the Budget, the Commission may:

.1 accumulate operating surplus funds to an amount up to but not exceeding 25% of the annual operating expenditures in any year; and

6.4 Each Director shall be entitled to vote on the Budget and on the Financial Plan.

6.5 The Commission shall set out in the annual Budget and Financial Plan, the rate in cubic metres to be charged by the Commission for providing Water Services to the Members and customers. The rate to Members shall be a common rate, calculated by dividing the estimated costs of the System determined under clause 6.9, by the total volume of water requested by the Members under clause 5.2 and anticipated to be sold to customers.

6.6 The estimated costs of the System shall be determined on a cost of service basis utilizing the principles set out in the American Water Works Association (AWWA) manuals of practice dealing with water rates and charges, as revised and updated from time to time, and in accordance with the findings and directives of the Alberta Utilities Commission, such approach being commonly referred to as the "utility rate model" and shall include full recovery of the annual costs of the Commission for those cost components set out in clauses 6.2 and 6.3.

6.7 For those Members purchasing water from the Commission, the Members shall pay to the Commission the product of the actual volume of water purchased by the Member in a year times the rate set out in clause 6.9. Notwithstanding the actual volume of water purchased, the Member shall be responsible for a minimum payment to the Commission of 90% of the volume requested by the Member under clause 5.2 times the rate set out in clause 6.9

6.8 For those Members not purchasing water from the Commission, the Member shall be responsible for a minimum annual payment to the Commission equal to the sum of the following:

.1 1/"*x*" of the annual cost attributed to the Board of Directors where "*x*" is the number of Members of the Commission plus one for Leduc Count which is a member of Line 1 and 2

.2 "*y*" times the cost components set out in sub-clauses 6.3.2.4, 6.3.2.5, 6.3.2.6 for the System where "*y*" is the ratio of the Member's volume allocation to the total volume allocation set out in Clause 5.1.

.3 Although not using the water allocated to them at the present time, Leduc County and Camrose County will pay their portion of Capital Costs for Line 2

6.9 The rates of water shall be established for each Transmission Line as identified in the definitions.

.1 Transmission Line 1 - The rate of the water shall include the cost of water and cost of administration.

.2 Transmission Line 2 – The rate of water will include the debenture cost of the transmission line for those Members being serviced by the line, cost of purchase of water, and administration costs.

6.10 The Members of Line 1 as Identified in Section 5.1 will establish the rates of Transmission Line 1 and have the right of veto on any costs that may affect the cost of water on Transmission Line 1.

7. CUSTOMERS AND RESTRICTIONS IN USE OF WATER

7.1 The Commission shall not sell Water Services to a Member and a Member shall not resell Water Services to any customer for the purpose of the supply of Water Services for water flood injection into any geological subsurface structure or formation for oil and gas recovery.

7.2 The Commission may terminate the supply of Water Services to any Member for failure to pay for Water Services received from the Commission.

7.3 Water Services from the Regional System will be sold at the cost of water and operating water services. Each Member will conform to the prescribed sale of water. The Commission shall be entitled to terminate water supply or Water Services to any Member if the Commission, at its sole discretion, determines that the Member is selling water sold under the cost of water which includes the purchase price, transmission costs, administration and other costs associated with the delivery of water

8. CHANGE IN MEMBERSHIP

8.1 The Board may agree to the addition of a municipality as a Member of the Commission if sufficient capacity for the supply of water can be made available.

8.2 A new Member may be required to pay an amount to be calculated at the time of application.

8.3 Any contribution received by the Commission under Clause 8.2 may inure to the benefit of the existing members in the proportion to the contribution of the existing members to the Commission from the date of inception of the Commission to the date of entry of any new member.

8.4 A Member may withdraw from membership of the Commission upon five (5) years notice. The withdrawing Member may sell the equity contributed by the Member during the Member's term of membership of the Commission to any other Member of the Commission for such compensation and on such terms as the parties may agree subject to the approval of the Board. However, the Commission or any Member shall not be obligated to purchase the withdrawing Member's proportionate share of the system. The Commission shall not utilize the capacity of the system related to the

withdrawing Member's equity or utilize the withdrawing Member's water volume allocation without fair compensation.

9. AMENDMENTS

9.1 An amendment to this Bylaw, with the exception of Clause 6.10, may be passed by the Board upon a three quarters majority of the Directors of the Board.

9.2 An amendment to Clause 6.10 of this Bylaw may be passed by the Board upon a three quarters majority of the Directors of the Board plus a three quarters majority of the Directors of the Board identified in Section 5.1. as part transmission line 1.

9.3 Written notice of a proposed amendment to the Bylaw shall be provided to each Director and each Member not less than thirty (30) days in advance of the meeting at which the amendment is to be considered.

10. Repeal

10.1 This Bylaw repeals Bylaw 02/2011

READ A FIRST TIME AT THE REGULAR MEETING OF THE BOARD OF DIRECTORS OF THE CAPITAL REGION SOUTHWEST WATER SERVICES COMMISSION THIS 26th DAY OF November, 2015.

READ A SECOND TIME AS AMMENDED AT THE REGULAR MEETING OF THE BOARD OF DIRECTORS OF THE CAPITAL REGION SOUTHWEST WATER SERVICES COMMISSION THIS 26th DAY OF November, 2015.

READ A THIRD TIME AS AMMENDED AT THE REGULAR MEETING OF THE BOARD OF DIRECTORS OF THE CAPITAL REGION SOUTHWEST WATER SERVICES COMMISSION AND FINALLY PASSED THIS 26th DAY OF November, 2015.

CHAIR

MANAGER

Approved by Alberta Regulation no. 292/84, as amended by Order in Council 213/2011,

_____

Capital Region Southwest Water Service Commission
Regular Meeting, November 26, 2015

APPENDIX C - SAUNDERS LAKE AND CAMROSE COUNTY WATER DEMAND PROJECTION

March 23, 2018

RE: REQUEST FOR UPDATED WATER DEMAND PROJECTIONS FOR CAMROSE COUNTY FOR CRSWSC WATER MASTER PLAN – CAMROSE COUNTY INFRASTRUCTURE DEVELOPMENT PROJECTS

As per the letter of request dated March 14, 2018 please accept this letter as response to topics below.

- *"Updated 5 year water demand projections (2019 to 2023) for your community."*
- *"Provide a long term (25 year) water demand projection for your community."*
- *"Please identify any planned and proposed developments within your area which may affect your future water demands; such as planned large developments and proposed heavy water users such as industrial complexes or food processing plants etc."*

Background Information

The only CRSWSC connection Camrose County utilizes is that which is located in the Armena Reservoir and Truck Fill Station. This site was commissioned in 2015 and is a prefabricated building supplied by Flowpoint Environmental Systems, sitting on top of a precast concrete tank with a dimension of 4m x 3m x 4.4 m (~50 m^3 capacity). The facility contains two 1.5 hp electric submersible pumps, each sized 2.0 L/s at 32m head. There is a dedicated 7.5 hp truck fill pump sized at 16 L/s at 20 m head. This facility is operated and maintained by Camrose County operators, and apart from the reservoir fill control valve, is solely controlled by Camrose County.

The reservoir fill logic at this facility is remotely controlled by the Capital Region Southwest Water Service Commission (CRSWSC) via a radio link and SCADA system. Other controls and operating parameters are established and maintained by Camrose County personnel (primarily onsite).

The current consumption at the Armena connection has been 6,372 m^3 and 5,689 m^3 in 2016 and 2017, respectively. This equates to an average usage of approximately 16.5 m^3 per day, which can fluctuate widely based on the truckfill demands.

Future Development and Demand Projections

While it is noted that the CRSWSC has provided some percentage-based projections to help predict future water demand, the current situation at Camrose County is anticipated to be much different than those projections.

Camrose County administration is currently in the process of finalizing preliminary design on a reservoir upgrade at Armena and a downstream waterline and subsequent reservoir near the industrial subdivision of Ervick located at the junction of Highway 13 and Highway 21. Talks with CRSWSC on this project have been on-going over the last year and construction is slated to happen in 2018 and 2019, with a current substantial completion date of July 31, 2019.

Water demand projections in the short term as result of this connection will likely be very reflective of current usage levels in the areas that this supply will be meant to service. The two locations, Ervick industrial subdivision and Braim residential subdivision, have been in existence for decades and consumption levels have been fairly static over the past 5 years, which will permit a fairly accurate short-term usage projection. The unknown factors in the equation will be additional requests for residential connections along the Braim section of waterline and growth within the Ervick industrial subdivision. With that in mind, estimates have been provided to try and forecast this.

Further to the currently planned development, there has been internal discussion at Camrose County regarding the potential of expanding this waterline even further, possibly looking to service the hamlet of Ohaton, another industrial

3755 – 43 Avenue, Camrose, Alberta T4V 3S8
780-672-4446
www.county.camrose.ab.ca
E-mail: county@county.camrose.ab.ca

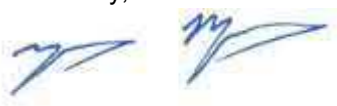
subdivision east of the City of Camrose, as well as the residential lake community of Tillicum beach. While this is only theoretical at the moment, and exceeds the current CRSWSC supply capacity of the Armena connection, it could be considered relevant for the purposes of long-term planning.

It is important to note that at no location within the Camrose County systems connected to the CRSWSC is there expected to be any fire flow requirement.

To help clarify the information noted above, attached is a figure displaying the proposed configuration downstream of the Armena connection (CRSWSC oultlet). As well, the table of consumption values tied to this infrastructure can be referenced in the table below.

Should you have any further comments or questions please do not hesitate to contact me at (780) 672-4449.

Sincerely,



Zach Mazure, P. Eng.
Assistant Manager of Public Works

cc: Paul King, CAO, Camrose County
Graham Backus, Manager of Public Works, Camrose County
Teresa Gratrix, Corporate Services Manager, Camrose County

CAMROSE COUNTY PROPOSED LONG TERM CRSWSC WATER DEMAND

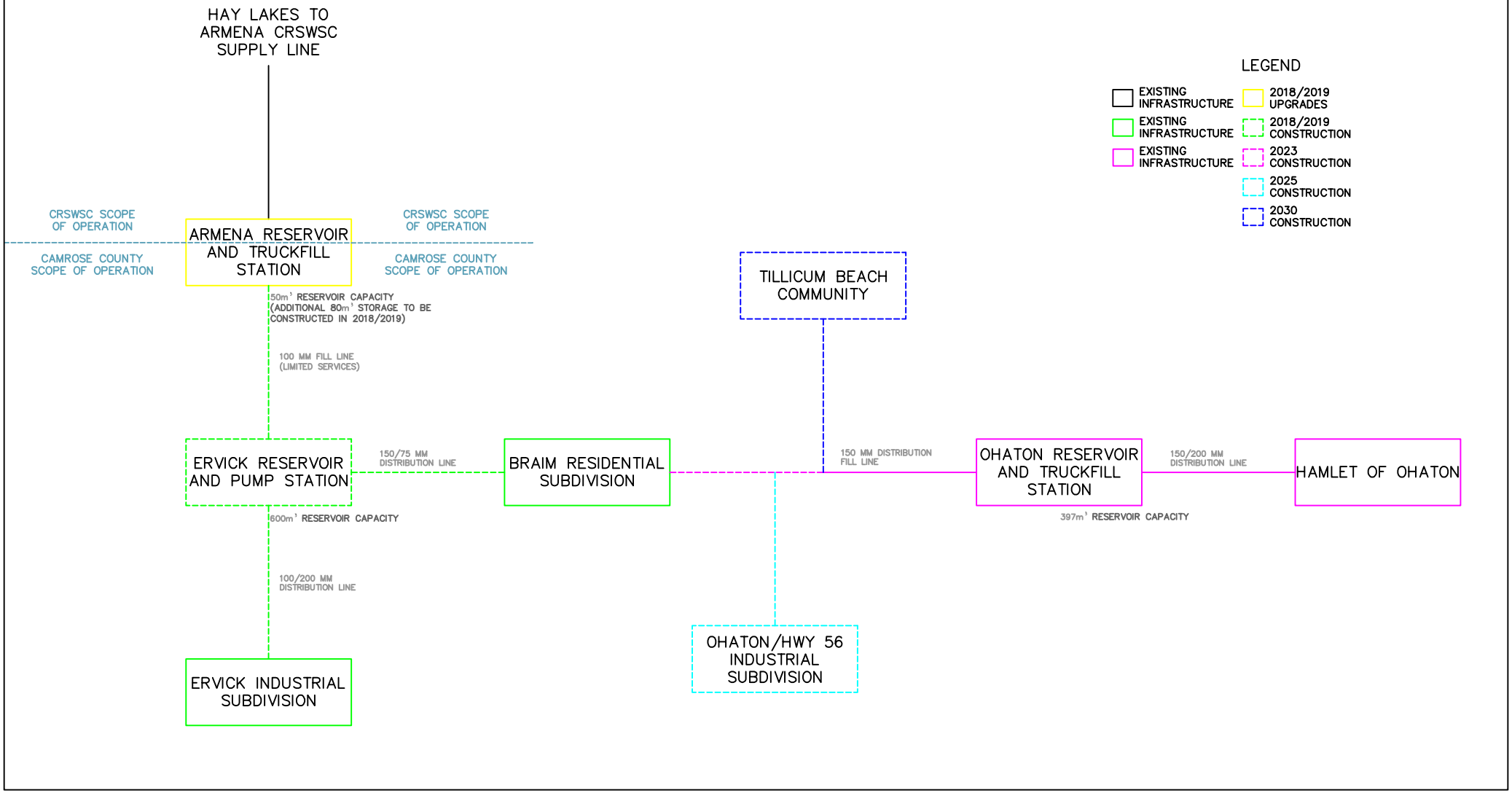
(cubic meters)

March 23, 2018

No.	Year	Hamlet of Armena & Truckfill	Ervick Industrial Subdivision	Braim Residential Subdivision	Hamlet of Ohaton & Truckfill	Ohaton/Hwy 56 Industrial Subdivision	Tillicum Beach Community	Total Demand
1	2019	8,470	6,307	4,460				19,237
2	2020	9,320	13,503	5,829				28,651
3	2021	10,250	17,086	6,103				33,438
4	2022	11,275	18,270	6,513				36,058
5	2023	11,388	18,270	7,334				36,992
6	2024	11,388	20,639	7,408	17,485			56,920
7	2025	11,388	24,222	8,229	17,660			61,499
8	2026	11,388	24,222	8,311	17,660	5,000		66,581
9	2027	11,388	24,222	9,133	17,660	5,100		67,502
10	2028	11,502	24,222	9,224	17,836	5,202		67,986
11	2029	11,502	27,805	10,045	17,836	5,306		72,494
12	2030	11,502	27,805	10,146	18,015	5,412		72,879
13	2031	11,502	27,805	10,967	18,015	5,683	14,400	88,371
14	2032	11,502	27,805	11,076	18,015	5,967	14,544	88,909
15	2033	11,617	27,805	11,898	18,195	6,265	14,689	90,469
16	2034	11,617	31,388	12,017	18,195	6,579	14,836	94,631
17	2035	11,617	31,388	12,838	18,377	6,907	14,985	96,112
18	2036	11,617	31,388	12,966	18,377	7,115	15,135	96,597
19	2037	11,617	31,388	13,788	18,377	7,328	15,286	97,783
20	2038	11,733	31,388	13,925	18,561	7,548	15,439	98,594
21	2039	11,733	34,971	14,747	18,561	7,774	15,593	103,379
22	2040	11,733	34,971	14,894	18,746	8,008	15,749	104,101
23	2041	11,733	34,971	15,715	18,746	8,248	15,907	105,320
24	2042	11,733	34,971	15,873	18,746	8,495	16,066	105,883
25	2043	11,850	34,971	16,031	18,934	8,750	16,226	106,762

MARCH 23, 2018

CAMROSE COUNTY PROPOSED LONG TERM CRSWSC DEMAND



Saunders Lake Water Projections

Year	ADD (L/s)
2018	0
2019	0
2020	0
2021	0
2022	0.4
2023	0.8
2024	1.19
2025	1.59
2026	1.99
2027	2.39
2028	2.78
2029	3.18
2030	3.58
2031	3.98
2032	4.38
2033	4.77
2034	5.17
2035	5.57
2036	5.97
2037	6.36
2038	6.76
2039	7.16
2040	7.56
2041	7.95
2042	8.35
2043	8.75

Assuming 50% build out at the 25 year horizon

APPENDIX D - CATHODIC PROTECTION

2017 Annual Cathodic Protection Survey Report

Capital Region Southwest Water Services Commission

Water Transmission Pipeline System

December 27, 2017

4209-44 Avenue Beaumont, Alberta
T4X 1G8 780-737-4228
www.arccathodic.com

December 27, 2017

Capital Region Southwest Water Services Commission
c/o City of Leduc
1 Alexandra Park
Leduc, Alberta
T9E 4C4

Attention: Shawn Tooth

RE: 2017 Cathodic Protection System Survey
Water Supply Pipeline System

- **International Airport**
- **City of Leduc**
- **Town of Beaumont**
- **Town of Calmar**

ARC Work Order #: ARC1117

On December 21-27, 2016, *Arc Cathodic Protection Inc.* completed the 2017 Cathodic Protection (CP) system survey of the Water Supply pipelines listed above for *Capital Region Southwest Water Services Commission* (CRSWSC)

The enclosed report and structure-to-soil potential data were subsequently prepared for your records.

Our recommendations to ensure continuous and improved CP on the pipelines are discussed in the report.

Arc Cathodic Protection Inc. does not accept responsibility for any use of this information by unauthorized third parties. This letter and information enclosed in the report were prepared for the exclusive use of CRSWSC

We trust the enclosed report will satisfactorily address your cathodic protection concerns for the CRSWSC Water Supply pipelines in 2017.

Our invoice to conduct the 2017 CP survey, analyze the survey data, and prepare the enclosed report is attached.

Arc Cathodic Protection Inc. appreciates your business and values all comments, questions or concerns pertaining to our services. Please direct to our office at (780) 737-4228, admin@arccathodic.com or to the undersigned at (587) 591-1364.

Respectfully,

ARC Cathodic Protection Inc.

Ryan Hewes
General Manager
Email: ryan@arccathodic.com
Cell: (587) 591-1364
Office: (780) 737-4228

Encls: 2017 Cathodic Protection Survey Report and Data
Invoice

Email: Shawn Tooth; stooth@leduc.ca
Keung Lee; klee@leduc.ca

Table of Contents

Executive Summary

On December 27, 2017, *Arc Cathodic Protection* completed the 2017 annual Cathodic Protection (CP) system survey of the Water Transmission pipeline system for *Capital Region Southwest Water Services Commission* (CRSWSC).

The CP survey was performed according to procedures described in the *National Association of Corrosion Engineers* (*NACE*) Standard Test Method TM0497-2012 and International Standard Practice SP0169-2013.

The CRSWSC – Water Transmission pipeline system consists of a network of various sized pipelines supplying water to the following members of the commission:

- City of Leduc
- Town of Beaumont
- Leduc County
- Town of Calmar
- Edmonton International Airport
- Hamlet of New Sarepta
- Village of Hay Lakes

The Transmission pipelines supplying water to the Hamlet of New Sarepta & Village of Hay Lakes are Non-metallic and to *Arc Cathodic Protection's* knowledge, do not require CP. These pipelines were not included in the 2017 CP survey.

Our survey procedures included, but were not limited to, inspection of seven (7) impressed current CP system rectifiers, several sacrificial CP systems and measurement of structure-to-soil potentials at accessible test locations throughout the transmission system.

Structure-to-soil potentials measured on the pipelines during the survey were analyzed and tabulated in 'Appendix 2' of this report.

This report discusses the CP protection status and efficiency of soil-side corrosion control being applied on the CRSWSC – Water Transmission pipeline system.

The analysis results indicated that the pipelines measured in the CRSWSC – Water Transmission system were left receiving adequate CP levels upon completion of the survey. Electrical short repairs which will prolong the life of the CP system and areas found with insufficient CP levels are discussed in detail in the 'Recommendations' section of this report.

The seven (7) impressed current CP system rectifiers were left operating within their previously established target DC amperage output range. Our analysis of the CP systems is further discussed in the 'Cathodic Protection Systems' section of this report.

Project Details

Project Description:	2017 Annual Cathodic Protection System Survey	
Location:	CRSWSC – Water Transmission Pipeline System Beaumont, Leduc, Edmonton & Calmar Alberta	
Project Dates:	Field:	December 20-27, 2017
	Office:	December 28, 2017
Personnel:	Field:	Ryan Hewes
	Office:	Ryan Hewes Donna Cunningham

The purpose of the project conducted on behalf of CRSWSC – Water Transmission pipeline system included but was not limited to:

- To inspect the impressed current CP system rectifiers for proper operation, measure DC outputs and make adjustments where required.
- To obtain structure-to-soil potentials with reference to a copper-copper sulfate electrode on the pipelines at accessible test station locations and pipeline appurtenances throughout the Transmission system.
- To verify the effectiveness of electrical insulation devices (ie. insulating kits, insulating unions, dielectric unions) where required.
- To evaluate the overall performance of the CP systems and verify their efficiency in providing adequate CP coverage on the CRSWSC – Water Transmission pipeline system.
- To prepare and submit a technical report discussing the CP survey results and recommend improvements to the overall CP system where required.

Recommendations

Our recommendations to maintain continuous CP system operation, adequate CP levels and ensure effective soil-side corrosion control on the CRSWSC – Water Transmission pipeline system are discussed below.

For prioritization purposes, the recommendations are assigned a grade based on the following:

A. **High Level Priority**: Action will correct pipeline/piping system CP compliance issues.

B. **Mid-Level Priority**: Action will correct factors having a negative effect on the CP system(s) and prolong CP system's operating life.

C. **Low Level Priority**: Action will assist in future diagnostics and maintenance of the CP system(s)

Location	Recommendation	Grade	Completed (Y or N)
Town of Beaumont, Edmonton International Airport, City of Leduc & Nisku Fill Stations	Substantial CP current drains were recorded at these locations via connection to A/C grounding systems. Although the pipelines are still achieving adequate CP levels, the overall life span of the CP systems would benefit from mitigating these faults. The installation of De-coupling devices at these locations is recommended as they will isolate the A/C Grounding system from the CP system under normal conditions. Further information and pricing can be provided upon request.	B	
08-07-51-24-W4M Blow Down	The 12" Stub Blow down pipeline receives CP via a Galvanic Magnesium Anode. The Magnesium anode was found depleted. Install 1 – 17lb Magnesium anode to restore adequate CP levels.	A	

Recommendations Continued

1. Establish a rectifier surveillance program where *Arc Cathodic Protection Inc.* or qualified CRSWSC personnel obtain monthly CP system rectifier measurements at the seven (7) locations listed below.

2. If CRSWSC personnel are to conduct the rectifier surveillance program, A Rectifier surveillance form can be provided and submitted to *Arc Cathodic Protection Inc.* on a monthly basis for in-house review, analysis & record keeping.

3. Advise *Arc Cathodic Protection Inc.* of any scheduled pipeline additions, or modifications that may affect CP system operation.

4. Carefully review the attached structure-to-soil potential data and system map and contact *Arc Cathodic Protection Inc.* should any questions, concerns or comments arise.

5. Inform *Arc Cathodic Protection Inc.* if the HDPE pipelines supplying water to the Hamlet of New Sarepta & Village of Hay Lakes are equipped with metallic pipeline joints similar to those of the Town of Beaumont supply pipeline.

6. Adhere to the following safety requirements:

    - 'Lock Out' and 'Tag Out' all direct current sources prior to dismantling piping or performing pipeline modification operations.
    - Use shorting straps across piping joint prior to dismantling as added precaution against electrical arcing.
    - Ensure proper grounding procedures are established and in use.

7. Authorize *Arc Cathodic Protection Inc.* to perform the annual CP survey of the CRSWSC – Water Transmission pipeline system in 2018.

Survey Procedure

During the 2017 CP survey, seven (7) impressed current CP system rectifiers were inspected to ensure efficient operation. Structure-to-soil potentials were measured with cathodic DC from the impressed current CP system(s) interrupted.

The CP current interrupter was programmed to cycle 'On' for 3.0 seconds and shut 'Off' for 1.0 second to obtain IR (voltage/error) free (polarized potential) measurements and to ensure the pipelines were electrically continuous to the CP system as required.

Our field test equipment included a saturated copper-copper sulfate ($Cu\text{-}CuSO_4$) reference electrode connected to a high-input impedance digital voltmeter. A steel probe was used to establish electrical contact to the structures being tested.

In order to ensure that the structure being tested was in fact more electronegative than the $Cu\text{-}CuSO_4$ reference electrode, the reference electrode was connected to the negative input on the voltmeter while the steel probe was connected to the positive input of the voltmeter.

Direct current structure-to-soil potentials were measured with reference to the $Cu\text{-}CuSO_4$ reference electrode. The reference electrode was positioned in close proximity to the structures being tested.

Any "high resistant" ground surfaces (ie. rocks, sand, frost) encountered during the survey were saturated with distilled water to establish effective reference electrode-to-soil contact.

Cathodic protection levels, hazardous AC voltages, electrical integrity, foreign structure isolation and electrical interference were evaluated during the survey.

The $Cu\text{-}CuSO_4$ reference electrode was calibrated prior to being used to conduct the 2017 CP survey.

Cathodic Protection Current Source(s)

15-27-50-24-W4M – Beaumont Fill Station - Impressed Current CP system

The CP system consists of a 24 volt - 28 ampere "RTS" rectifier coupled to ten (10) – High Silicon Cast Iron (HSCI) anodes. The anode bed was installed by others in 1996. The rectifier was manufactured in 1996.

On December 27, 2017, following several adjustments throughout 2017, the rectifier was left operating with a total output of 12.96 amperes at 12.12 volts. These represent 46% and 51% of the rectifier's rated amperage and voltage capacities respectively.

The rectifying efficiency was determined to be 79%. The calculated circuit resistance of 0.94 ohms was within the CP system's design parameters and indicative of efficient cathodic protection system ground bed performance.

Cumulative operating data for the CP system rectifier obtained during the survey is enclosed as 'Appendix 1'.

12-08-51-24-W4M – Boundary Pump Station - Impressed Current CP system

The CP system consists of a 24 volt - 22 ampere "RTS" rectifier coupled to ten (10) – High Silicon Cast Iron (HSCI) anodes. The anode bed was installed by others in 1991. The rectifier was manufactured in 1989.

On December 22, 2017, the rectifier was found and left operating with a total output of 13.35 amperes at 7.62 volts. These represent 61% and 32% of the rectifier's rated amperage and voltage capacities respectively.

The rectifying efficiency was determined to be 69%. The calculated circuit resistance of 0.57 ohms was within the CP system's design parameters and indicative of efficient cathodic protection system ground bed performance.

Cumulative operating data for the CP system rectifier obtained during the survey is enclosed as 'Appendix 1'.

08-26-50-25-W4M – Nisku Fill Station - Impressed Current CP system

The CP system consists of a 40 volt - 34 ampere "RTS" rectifier coupled to sixteen (16) – High Silicon Cast Iron (HSCI) anodes. The anode bed was installed by others in 2006. The rectifier was manufactured in 1991.

On December 22, 2017, the rectifier was found and left operating with a total output of 23.36 amperes at 15.62 volts. These represent 69% and 39% of the rectifier's rated amperage and voltage capacities respectively.

The rectifying efficiency was determined to be 80%. The calculated circuit resistance of 0.67 ohms was within the CP system's design parameters and indicative of efficient cathodic protection system ground bed performance.

Cumulative operating data for the CP system rectifier obtained during the survey is enclosed as 'Appendix 1'.

Cathodic Protection Current Source(s) - Continued

04-23-50-25-W4M – International Airport Fill Station - Impressed Current CP system

The CP system consists of a 30 volt - 16 ampere "RTS" rectifier coupled to ten (10) – High Silicon Cast Iron (HSCI) anodes. The anode bed was installed by others in 1992. The rectifier was manufactured in 1982.

On December 17, 2017, the rectifier was found and left operating with a total output of 11.28 amperes at 7.89 volts. These represent 71% and 26% of the rectifier's rated amperage and voltage capacities respectively.

The rectifying efficiency was determined to be 75%. The calculated circuit resistance of 0.69 ohms was within the CP system's design parameters and indicative of efficient cathodic protection system ground bed performance.

Cumulative operating data for the CP system rectifier obtained during the survey is enclosed as 'Appendix 1'.

07-02-50-25-W4M – Leduc Fill Station - Impressed Current CP system

The CP system consists of a 50 volt - 42 ampere "RTS" rectifier coupled to twenty (20) – High Silicon Cast Iron (HSCI) anodes. The anode bed was installed by others in 1994. The rectifier was manufactured in 1993.

On December 22, 2017, the rectifier was found and left operating with a total output of 36.10 amperes at 14.23 volts. These represent 86% and 28% of the rectifier's rated amperage and voltage capacities respectively.

The rectifying efficiency was determined to be 77%. The calculated circuit resistance of 0.39 ohms was within the CP system's design parameters and indicative of efficient cathodic protection system ground bed performance.

Cumulative operating data for the CP system rectifier obtained during the survey is enclosed as 'Appendix 1'.

03-04-50-25-W4M – Calmar Supply Line - Impressed Current CP system

The CP system consists of a 40 volt - 12 ampere "Corrpower" rectifier coupled to five (5) – High Silicon Cast Iron (HSCI) anodes. The anode bed was installed by others in 1992. The rectifier was manufactured in 2011.

On December 22, 2017, the rectifier was found and left operating with a total output of 1.71 amperes at 4.24 volts. These represent 14% and 11% of the rectifier's rated amperage and voltage capacities respectively.

The rectifying efficiency was determined to be 65%. The calculated circuit resistance of 2.48 ohms was within the CP system's design parameters and indicative of efficient cathodic protection system ground bed performance.

Cumulative operating data for the CP system rectifier obtained during the survey is enclosed as 'Appendix 1'.

Cathodic Protection Current Source(s) - Continued

16-25-49-27-W4M – Calmar Fill Station - Impressed Current CP system

The CP system consists of a 40 volt - 28 ampere "RTS" rectifier coupled to seven (7) – High Silicon Cast Iron (HSCI) anodes. The anode bed was installed by others in 1981. The rectifier was manufactured in 1992.

On December 22, 2017, the rectifier was found and left operating with a total output of 18.24 amperes at 14.70 volts. These represent 65% and 37% of the rectifier's rated amperage and voltage capacities respectively.

The rectifying efficiency was determined to be 76%. The calculated circuit resistance of 0.81 ohms was within the CP system's design parameters and indicative of efficient cathodic protection system ground bed performance.

Cumulative operating data for the CP system rectifier obtained during the survey is enclosed as 'Appendix 1'.

Electrical Isolation

During the 2017 CP survey, the majority of the CRSWSC – Water Transmission pipeline system was electrically isolated from respective site piping structures, well casings and third party/foreign pipeline structures as required. This reflects efficiencies of electrical insulating devices (insulating kits, dielectric unions) at the sites inspected.

Four (4) Cathodic electrical shorts to electrical grounding systems were found during the survey which are listed and described in detail in the 'Recommendations' section of this report. Eliminating the CP electrical shorts is imperative to prolong the service life of the CP system.

Electrical Continuity

During the 2017 annual CP survey, structure-to-soil potentials tabulated in 'Appendix 2' of this report were shifting congruently with CP current interruption from their respective CP system as designed suggesting electrical continuity.

Electrical Interference

Test results indicative of significant electrical interference on the CRSWSC – Water Transmission pipeline system, or on foreign structures in close proximity to the CRSWSC – Water Transmission pipeline system pipelines were not recorded during the 2017 annual CP survey.

Status of Cathodic Protection

The Cathodic protection criteria adopted for the 2017 annual CP survey of the CRSWSC – Water Transmission pipeline system is according to *NACE's* Standards TM497-2012 and SP0169-2013. The criteria are discussed in detail under 'Cathodic Protection Criteria.'

Cathodic protection is applied on the CRSWSC – Water Transmission pipeline system via the seven (7) impressed current CP systems listed above, as well as several galvanic magnesium anodes installed at locations throughout the pipeline system.

'Instant Off' (polarized) structure-to-soil potentials measured on the pipelines in the CRSWSC – Water Transmission pipeline system where more electronegative than the minimum polarized potential of -850mV, referenced to a copper-copper sulfate (Cu-$CuSO_4$) electrode. The pipelines were left receiving adequate CP from the impressed current CP system.

Test Equipment Used

Digital Multi-meter:

Model: *Fluke* 179 1000V CAT III

Calibrated: June 2017

Low Current AC/DC Clamp Meter

Model: *Electronic Specialties* ESI-687

Calibrated: June 2017

Saturated Copper-Copper Sulfate (Cu-$CuSO_4$) Reference Electrode

Model: *MC Miller RE-5C*

Calibrated: Prior to survey start/Daily

Current Interrupter

Model: *Tinker & Rasor CI-50*

Calibrated: June 2017

Cathodic Protection Criteria

Metallic surfaces exposed to an electrolyte such as soil or water have a multitude of microscopic anodic and cathodic sites. Where anodic sites are more electronegative than cathodic sites, a potential difference is created between them, allowing for corrosion to occur.

The function of cathodic protection is to reduce the potential difference between anodes and cathodes to a near zero value. This reduction is due to the polarization of all cathodic sites to the same potential of the most active anodic site.

Cathodic protection is accomplished by sending a current into the structure from an external electrode and polarizing the cathodic sites in an electronegative direction.

In order to achieve adequate CP, the protected structure must be polarized to a certain value. The polarized potential is measured with respect to a certain reference electrode. A copper/copper sulfate reference electrode (CSE) is the most common electrode used in soil and freshwater.

There are three types of criteria stated in standard SP0169-2013 for assessing cathodic protection. Any one may be used depending on the circumstances, although the second is considered superior in most cases.

- A negative potential of at least -850mV, measured with reference to a copper-copper sulfate reference electrode, with the CP current applied. Voltage drops other than those across the structure-to-soil (electrolyte) boundary must be considered for valid interpretation of the potential measurement.

- A minimum polarized potential of -850mV, measured with reference to a copper-copper sulfate reference electrode, achieved on buried steel structures during CP current "Instant Off" interruption cycle. In this case, an "Instant" is a time period greater than 0.3 seconds and within one (1) to two (2) seconds.

- A minimum of 100mV of cathodic polarization between the structure surface and a stable reference electrode in contact with the soil or electrolyte.

A minimum of 100mV of cathodic polarization with respect to a copper-copper sulfate electrode is a recommended criterion for aluminum piping structures. However, a polarized structure-to-soil potential not exceeding -1,200mV, with respect to a copper-copper sulfate electrode, may be acceptable provided previous test results indicate no history of pitting attack or similar corrosion has occurred in the particular environment.

It is generally recommended that structure-to-soil potentials on aluminum piping should not exceed -1,200 mV, with respect to a copper-copper sulfate electrode, unless test results indicate that no appreciable corrosion will occur in the particular environment

It should also be noted that the potentials recorded are only indicative of the level of CP at the test location. An assumption is made that the extremity of the system will have the lowest potential in the majority of cases. On long sections of line where no test facilities exist, potential values may drop below protected levels and then increase once again.

Glossary of Terms

The following terms are commonly used in Cathodic Protection (Corrosion Control)

Anode: The electrode of an electrochemical cell at which oxidation occurs. Electrons flow away from the anode in the external circuit. Corrosion usually occurs and metal ions enter the solution at the anode.

Anode Bed: See Ground Bed.

Backfill: Material placed in a hole to fill the space around the anodes, vent pipe and buried components of a cathodic protection system.

Cathode: The electrode of an electrochemical cell at which reduction is the principal reaction. Electrons flow toward the cathode in the external circuit.

Cathodic Protection: A technique employed to reduce corrosion of a metal surface by making the surface a cathode of an electrochemical cell.

Copper-Copper Sulfate Half Cell: See Half Cell

Copper-Copper Sulfate Reference Electrode: See Half Cell

Corrosion: The deterioration of a material, usually a metal, that results from a reaction from its environment.

Dielectric Insulator: An electrically non-conductive material, such as a coating, sheet or pipe that is placed between an anode and an adjacent cathode, usually on the cathode, to improve current distribution in a cathodic protection system.

Electrical Bond Cable: A connection, usually metallic, that provides electrical continuity between structures that can conduct.

Electrical Integrity: Electrical continuity between two or more points.

Electrical Interference: The application or acceptance of current by a foreign structure outside a predetermined circuit.

Electrical Isolation: The condition of being electrically separated from other metallic structures or the environment.

Electrical Short: Electrical connection between a cathodically protected structure and a foreign structure.

Foreign Structure: Any metallic structure that is not intended as part of a system under cathodic protection.

Galvanic Anode: A metal that provides cathodic protection to another metal that is more noble when electrically coupled together in a common electrolyte. This type of anode is the electron source in one type of cathodic protection.

Glossary of Terms Cont'd

Galvanic Protection: Reduction of corrosion of a metal in an electrolyte by galvanically coupling it to a more anodic metal.

Gathering Structure: Consists of pipelines of various sizes used to move product between a well, plant, battery, satellite, etc. The gathering structure being cathodically protected may not include sections of pipelines lease boundaries and wells, plants, batteries, satellites, etc. (See Piping)

Ground Bed: One or more anodes installed below the earth's surface for the purpose of supplying cathodic protection

Half Cell: A pure metal in contact with a solution of known concentration of its own ion, at a specific temperature, develops a potential that is characteristic and reproducible; when coupled with another half-cell, an overall potential that is the sum of both half-cells develops.

Holiday: An imperfection in protective coating exposing the metal to the environment.

Impressed Current: An electric current supplied by a device employing a power source that is external to the electrode system

Piping Structures: Structures which do not form part of a Gathering System, which may or may not be cathodically protected, and includes sections of pipelines between lease boundaries and wells, plants, batteries, satellites, etc

Polarization: The change from the open circuit potential as a result of current across the electrode/electrolyte interface. The potential change depicts improvements in protection levels on the structure.

Rectifier: Equipment that converts alternating current (AC) to direct current (DC).

Reference Electrode: An electrode whose open circuit potential is constant under similar conditions of measurement, and which is used for measuring the relative potentials of other electrodes

Stray Current: Current through paths other than that intended current.

Structure: A metal structure electrically connected to a corrosion control system for the purpose of protecting it from electrolyte side corrosion.

Structure-to-Soil Potential: A potential measurement between a structure under cathodic protection and reference electrode. The position of the electrode is typically at a certain distance from the structure this resulting in an average structure-to-soil potential measurement due to the distance. Although an indicator of protection, it is not conclusive. Unless noted otherwise, structure-to-soil potential data presented in letters or reports are average measurements.

Thermoelectric Generator (TEG): Equipment that produces electrical power through the direct conversion of heat energy into electrical energy.

APPENDIX 1 – CUMULATIVE RECTIFIER OPERATING DATA

Houston Oil & Gas Ltd.
2017 Annual Cathodic Protection Survey
Cumulative Rectifier Operating Data
Technician: Ryan Hewes
Date(s): December 21-27, 2017

Capital Region Southwest Water Services Commission (CRSWSC) ***Beaumont Reservoir/Fill Station*** ***LSD: 15-27-50-24-W4M***

MAKE: RTS *MODEL#: CAYSA 24-28C* *SERIAL#: C-961350* *Vdc: 24* *Adc: 28* *Vac: 115* *Aac: 9.7*

DRAWING #: n/a *ASBUILT IN RECTIFIER: NO* *RECTIFING ELEMENT: Diode Lugs*

AC DISCONNECT LOCATION:

GROUNDBED DATA: 10 - HSCI Anodes Installed November 1996 by others

TARGET CURRENT OUTPUT: 12.0 - 13.0 Amps (Increase in 2017)

SHUNT SIZE: *30*

TARGET Mv:

A/F = As Found *A/C = Alternating Current*

A/L = As Left *D/C = Direct Current*

V = Voltage

A = Amperage

DATE	*STATUS*	*TAP/RHEOSTAT SETTING*	*TOTAL AMPS*	*CCT #1 AMPS*	*VOLTS*	*CIRCUIT RESISTANCE*	*AC TAP VOLTAGE*	*RECTIFING EFFICIENCY*	*REMARKS*
June 5, 2014	*A/F Metered*	CBF4	10.5	8.2	10.0				Measurements taken by others
	A/L Metered		10.5	8.2	10.0				
	A/L Shunt mv		20.2	16.2					
	A/L Measured	CBF4	12.12	9.72	10.52	0.87	13.69	77%	
September 17, 2015	*A/F Metered*	CBF4	11.0	8.2	10.4				Measurements taken by others
	A/L Metered		11.0	8.2	10.4				
	A/L Shunt mv		19.3	15.6					
	A/L Measured	CBF4	11.58	9.36	10.60	0.92	13.67	78%	
December 19, 2016	*A/F Metered*	CBF4	11.0	8.5	10.5				2016 CP Survey
	A/L Metered		11.0	8.5	10.5				
	A/L Shunt mv		18.7	14.9					
	A/L Measured	CBF4	11.22	8.94	10.66	0.95	13.74	78%	
December 27, 2017	*A/F Metered*	CBF3	9.0	3.0	9.0				2017 CP Survey
	A/L Metered		13.0	10.0	12.0				Target incresed to 12-13 Amps.
	A/L Shunt mv		21.6	17.2					
	A/L Measured	CBF5	12.96	10.32	12.12	0.94	15.39	79%	
	A/F Metered								
	A/L Metered								
	A/L Shunt mv								
	A/L Measured								

Houston Oil & Gas Ltd.
2017 Annual Cathodic Protection Survey
Cumulative Rectifier Operating Data
Technician: Ryan Hewes
Date(s): December 21-27, 2017

Capital Region Southwest Water Services Commission (CRSWSC) ***Boundary Pump Station*** ***LSD: 12-08-51-24-W4M***

MAKE: RTS *MODEL#: CAYSA 24-22* *SERIAL#: 89089* *Vdc: 24* *Adc: 22* *Vac: 115* *Aac: 7.5*

DRAWING #: n/a *ASBUILT IN RECTIFIER: NO* *RECTIFING ELEMENT: Diode Lugs*

AC DISCONNECT LOCATION:

GROUNDBED DATA: 10 - HSCI Anodes Installed November 1991 by others. Conventional Horizontal Groundbed

TARGET CURRENT OUTPUT: 12.0 - 14.0 Amps

SHUNT SIZE: *25* *10*

TARGET Mv:

A/F = As Found *A/C = Alternating Current*

A/L = As Left *D/C = Direct Current*

V = Voltage

A = Amperage

DATE	STATUS	TAP SETTING	TOTAL AMPS	CCT #1 AMPS	VOLTS	CIRCUIT RESISTANCE	AC TAP VOLTAGE	RECTIFING EFFICIENCY	REMARKS
June 19, 2014	*A/F Metered*	CBF3	14.7	-	8.2				Measurements taken by others
	A/L Metered		14.7	-	8.2				
	A/L Shunt mv		29.0	67.0					
	A/L Measured	CBF3	14.50	13.40	8.30	0.57	12.2	68%	
September 15, 2015	*A/F Metered*	CBF3	14.4	-	8.5				Measurements taken by others
	A/L Metered		14.0	-	8.5				
	A/L Shunt mv		27.9	65.8					
	A/L Measured	CBF2	13.95	13.16	8.40	0.60	12.4	68%	
December 19, 2016	*A/F Metered*	CBF2	13.5	-	7.5				2016 CP Survey
	A/L Metered		13.5	-	7.5				
	A/L Shunt mv		26.8	54.0					
	A/L Measured	CBF2	13.40	10.80	7.51	0.56	10.9	69%	
December 22, 2017	*A/F Metered*	CBF2	13.5	-	7.5				2017 CP Survey
	A/L Metered		13.5	-	7.5				
	A/L Shunt mv		26.7	-					
	A/L Measured	CBF2	13.35	-	7.62	0.57	11.01	69%	
	A/F Metered								
	A/L Metered								
	A/L Shunt mv								
	A/L Measured								

Houston Oil & Gas Ltd.
2017 Annual Cathodic Protection Survey
Cumulative Rectifier Operating Data
Technician: Ryan Hewes
Date(s): December 21-27, 2017

Capital Region Southwest Water Services Commission (CRSWSC) ***Nisku Reservoir/Fill Station*** ***LSD: 08-26-50-25-W4M***

MAKE: RTS *MODEL#: CAYSA 40-34B* *SERIAL#: C-91353* *Vdc: 40* *Adc: 34* *Vac: 115* *Aac: 19.4*

DRAWING #: n/a *ASBUILT IN RECTIFIER: YES* *RECTIFING ELEMENT: Diode Lugs*

AC DISCONNECT LOCATION:

GROUNDBED DATA: 16 - 50mm (2") x 1500mm (60") HSCI Anodes installed vertically in 300mm (12") x 6000mm (20') holes (8) December 9, 2006

TARGET CURRENT OUTPUT: 20.0 - 24.0 Amps

SHUNT SIZE: *40* *40*

TARGET Mv:

A/F = As Found *A/C = Alternating Current*

A/L = As Left *D/C = Direct Current*

V = Voltage

A = Amperage

DATE	*STATUS*	*TAP SETTING*	*TOTAL AMPS*	*CCT #1 AMPS*	*VOLTS*	*CIRCUIT RESISTANCE*	*AC TAP VOLTAGE*	*RECTIFING EFFICIENCY*	*REMARKS*
June 19, 2014	*A/F Metered*	CBF3	23.0	15.6	15.6				Measurements taken by others
	A/L Metered		23.0	16.1	15.6				
	A/L Shunt mv		32.8	20.7					
	A/L Measured	CBF3	26.24	16.56	15.59	0.59	19.52	80%	
September 15, 2015	*A/F Metered*	CBF3	23.5	15.6	15.4				Measurements taken by others
	A/L Metered		23.5	15.6	15.4				
	A/L Shunt mv		29.5	18.4					
	A/L Measured	CBF3	23.60	14.72	15.38	0.65	19.3	80%	
December 19, 2016	*A/F Metered*	CBF3	22.5	15.0	16.0				2016 CP Survey
	A/L Metered		22.5	15.0	16.0				
	A/L Shunt mv		27.9	18.0					
	A/L Measured	CBF3	22.32	14.40	15.58	0.70	19.61	79%	
December 22, 2017	*A/F Metered*	CBF3	23.5	15.0	16.0				2017 CP Survey
	A/L Metered		23.5	15.0	16.0				
	A/L Shunt mv		29.2	18.5					
	A/L Measured	CBF3	23.36	14.80	15.62	0.67	19.63	80%	
	A/F Metered								
	A/L Metered								
	A/L Shunt mv								
	A/L Measured								

Houston Oil & Gas Ltd.
2017 Annual Cathodic Protection Survey
Cumulative Rectifier Operating Data
Technician: Ryan Hewes
Date(s): December 21-27, 2017

Capital Region Southwest Water Services Commission (CRSWSC) ***Airport Reservoir/Fill Station*** ***LSD: 04-23-50-25-W4M***

MAKE: RTS *MODEL#: CAYSA 30-16* *SERIAL#: C-82107* *Vdc: 30* *Adc: 16* *Vac: 115* *Aac: 7.18*

DRAWING #: n/a *ASBUILT IN RECTIFIER: NO* *RECTIFING ELEMENT: Molded Diode Bridge*

AC DISCONNECT LOCATION:

GROUNDBED DATA: 10 - HSCI Anodes Installed November 1992 by others. Conventional Horizontal Groundbed

TARGET CURRENT OUTPUT: 10.0 - 12.0 Amps

SHUNT SIZE: *20*

TARGET Mv:

A/F = As Found *A/C = Alternating Current*

A/L = As Left *D/C = Direct Current*

V = Voltage

A = Amperage

DATE	STATUS	TAP SETTING	TOTAL AMPS	CCT #1 AMPS	VOLTS	CIRCUIT RESISTANCE	AC TAP VOLTAGE	RECTIFING EFFICIENCY	REMARKS
June 19, 2014	*A/F Metered*	CAF5	10.9	-	8.8				Measurements taken by others
	A/L Metered		10.9	-	8.8				
	A/L Shunt mv		28.3	-					
	A/L Measured	CAF5	11.32	-	7.50	0.66	10.23	73%	
September 14, 2015	*A/F Metered*	CAF5	12.8	-	8.0				Measurements taken by others
	A/L Metered		12.8	-	8.0				
	A/L Shunt mv		34.5	-					
	A/L Measured	CAF5	13.80	-	7.89	0.57	10.56	75%	
December 19, 2016	*A/F Metered*	CAF5	12.0	-	9.0				2016 CP Survey
	A/L Metered		12.0	-	9.0				
	A/L Shunt mv		28.3	-					
	A/L Measured	CBF2	11.32	-	7.83	0.69	10.5	75%	
December 27, 2017	*A/F Metered*	CAF5	12.0	-	9.0				2017 CP Survey
	A/L Metered		12.0	-	9.0				
	A/L Shunt mv		28.2	-					
	A/L Measured	CAF5	11.28	-	7.89	0.70	10.55	75%	
	A/F Metered								
	A/L Metered								
	A/L Shunt mv								
	A/L Measured								

Houston Oil & Gas Ltd.
2017 Annual Cathodic Protection Survey
Cumulative Rectifier Operating Data
Technician: Ryan Hewes
Date(s): December 21-27, 2017

Capital Region Southwest Water Services Commission (CRSWSC) ***Leduc Reservoir/Fill Station*** ***LSD: 07-02-50-25-W4M***

MAKE: RTS *MODEL#: CAYSA 50-42BB* *SERIAL#: C-93006* *Vdc: 50* *Adc: 42* *Vac: 230* *Aac: 14.0*

DRAWING #: n/a *ASBUILT IN RECTIFIER: NO* *RECTIFING ELEMENT: Diode Lugs*

AC DISCONNECT LOCATION:

GROUNDBED DATA: 20 - HSCI Anodes Installed November 1994 by others. Conventional Horizontal Groundbed

TARGET CURRENT OUTPUT: 34.0 - 38.0 Amps

SHUNT SIZE: *50* *50*

TARGET Mv:

A/F = As Found *A/C = Alternating Current*

A/L = As Left *D/C = Direct Current*

V = Voltage

A = Amperage

DATE	STATUS	TAP SETTING	TOTAL AMPS	CCT #1 AMPS	VOLTS	CIRCUIT RESISTANCE	AC TAP VOLTAGE	RECTIFING EFFICIENCY	REMARKS
June 19, 2014	*A/F Metered*	CBF3	38.6	27.9	14.2				Measurements taken by others
	A/L Metered		38.6	27.9	14.2				
	A/L Shunt mv		38.6	27.1					
	A/L Measured	CBF3	38.60	27.10	14.25	0.37	18.53	77%	
September 15, 2015	*A/F Metered*	CBF3	38.6	27.9	14.2				Measurements taken by others
	A/L Metered		38.6	27.9	14.2				
	A/L Shunt mv		38.7	26.1					
	A/L Measured	CBF3	38.70	26.10	14.25	0.37	18.58	77%	
December 19, 2016	*A/F Metered*	CBF3	37.4	27.0	14.3				2016 CP Survey
	A/L Metered		37.4	27.0	14.3				Meter Box Located in North Building.
	A/L Shunt mv		37.4	27.0					CCT #3 = 3/4" Gas Riser
	A/L Measured	CBF3	37.40	27.00	14.30	0.38	18.66	77%	
December 22, 2017	*A/F Metered*	CBF3	36.1	25.5	14.0				2017 CP Survey
	A/L Metered		36.1	25.5	14.0				CCT #2 = 10.1 Amps
	A/L Shunt mv		36.1	25.5					
	A/L Measured	CBF3	36.10	25.50	14.23	0.39	18.47	77%	
	A/F Metered								
	A/L Metered								
	A/L Shunt mv								
	A/L Measured								

Houston Oil & Gas Ltd.
2017 Annual Cathodic Protection Survey
Cumulative Rectifier Operating Data
Technician: Ryan Hewes
Date(s): December 21-27, 2017

Capital Region Southwest Water Services Commission (CRSWSC) ***Calmar Pipeline*** ***LSD: 03-04-50-25-W4M***

MAKE: RTS *MODEL#: CAYSA 40-12* *SERIAL#: C-110041* *Vdc: 40* *Adc: 12* *Vac: 115/230* *Aac: 6.71/3.35*

DRAWING #: n/a *ASBUILT IN RECTIFIER: NO* *RECTIFING ELEMENT: Molded Diode Bridge*

AC DISCONNECT LOCATION:

GROUNDBED DATA: 5 - HSCI Anodes Installed November 1992 by others. Conventional Horizontal Groundbed

TARGET CURRENT OUTPUT: 1.0 - 2.0 Amps

SHUNT SIZE: 15

TARGET Mv:

A/F = As Found *A/C = Alternating Current*

A/L = As Left *D/C = Direct Current*

V = Voltage

A = Amperage

DATE	STATUS	TAP SETTING	TOTAL AMPS	CCT #1 AMPS	VOLTS	CIRCUIT RESISTANCE	AC TAP VOLTAGE	RECTIFING EFFICIENCY	REMARKS
June 20, 2014	*A/F Metered*	CAF4	1.8	-	4.5				Measurements taken by others
	A/L Metered		1.8	-	4.5				
	A/L Shunt mv		6.1	-					
	A/L Measured	CAF4	1.83	-	4.65	2.54	6.6	70%	
September 15, 2015	*A/F Metered*	CAF4	1.8	-	4.5				Measurements taken by others
	A/L Metered		1.8	-	4.5				
	A/L Shunt mv		6.3	-					
	A/L Measured	CAF4	1.89	-	4.60	2.43	6.59	70%	
December 19, 2016	*A/F Metered*	CAF4	1.9	-	5.0				2016 CP Survey
	A/L Metered		1.9	-	5.0				Located in ditch West of NEP Site.
	A/L Shunt mv		5.9	-					
	A/L Measured	CAF4	1.77	-	4.66	2.63	6.68	70%	
December 22, 2017	*A/F Metered*	CAF4	2.0	-	4.0				2017 CP Survey
	A/L Metered		2.0	-	4.0				Located in ditch West of NEP Site.
	A/L Shunt mv		5.7	-					
	A/L Measured	CAF4	1.71	-	4.24	2.48	6.49	65%	
	A/F Metered								
	A/L Metered								
	A/L Shunt mv								
	A/L Measured								

Houston Oil & Gas Ltd.
2017 Annual Cathodic Protection Survey
Cumulative Rectifier Operating Data
Technician: Ryan Hewes
Date(s): December 21-27, 2017

Capital Region Southwest Water Services Commission (CRSWSC) ***Calmar Resorvoir/Fill Station*** ***LSD: 16-25-49-27-W4M***

MAKE: RTS *MODEL#: CAYSA 40-28* *SERIAL#: 92104* *Vdc: 40* *Adc: 28* *Vac: 115* *Aac: 15.9*

DRAWING #: n/a *ASBUILT IN RECTIFIER: NO* *RECTIFING ELEMENT: Diode Lugs*

AC DISCONNECT LOCATION:

GROUNDBED DATA: 7 - HSCI Anodes Installed November 1981 by others. Semi-Deep Vertical Groundbed(s)

TARGET CURRENT OUTPUT: 18.0 - 20.0 Amps

SHUNT SIZE: *30* *10*

TARGET Mv:

A/F = As Found *A/C = Alternating Current*

A/L = As Left *D/C = Direct Current*

V = Voltage

A = Amperage

DATE	*STATUS*	*TAP SETTING*	*TOTAL AMPS*	*CCT #1 AMPS*	*VOLTS*	*CIRCUIT RESISTANCE*	*AC TAP VOLTAGE*	*RECTIFING EFFICIENCY*	*REMARKS*
June 20, 2014	*A/F Metered*	CBF3	20.0	10.0	16.0				Measurements taken by others
	A/L Metered		20.0	10.0	16.0				
	A/L Shunt mv		36.1	17.5					
	A/L Measured	CBF3	21.66	10.50	15.20	0.70	19.45	78%	
September 15, 2015	*A/F Metered*	CBF3	18.2	10.0	16.0				Measurements taken by others
	A/L Metered		18.2	10.0	16.0				
	A/L Shunt mv		31.3	22.2					
	A/L Measured	CBF3	18.78	13.32	15.25	0.81	19.53	78%	
December 19, 2016	*A/F Metered*	CBF3	18.0	0.0	17.0				2016 CP Survey
	A/L Metered		18.0	0.0	17.0				All current going to CCT #1 Pipeline & Station
	A/L Shunt mv		31.2	0.0					
	A/L Measured	CBF3	18.72	-	14.99	0.80	19.89	75%	
December 22, 2017	*A/F Metered*	CBF3	20.0	18.0	15.0				2017 CP Survey
	A/L Metered		20.0	18.0	15.0				
	A/L Shunt mv		30.4	-					
	A/L Measured	CBF3	18.24	-	14.70	0.81	19.36	76%	
	A/F Metered								
	A/L Metered								
	A/L Shunt mv								
	A/L Measured								

APPENDIX 2 – STRUCTURE-TO-SOILPOTENTIAL DATA

Capital Region Southwest Water Services Commission
2017 Annual Cathodic Protection Survey
Structure-to-soil Potential Data
Technician: Ryan Hewes
Survey Date(s): December 21-27, 2017

Town of Beaumont Supply Line																									
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
15	27	50	24	4	Reservoir/Fill Station	December 27, 2017	57 Street & 50 Avenue	Pipeline	400mm (16") Pipeline	Water	2802	928			Yes								Rectifier Location.
							Beaumont, AB																7.2 Ampere current drain to station electrical
																							grounding.
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
6	34	50	24	4	Test Station	December 21, 2017	N. 53° 21.560'	White Lead	400mm (16") Pipeline Valve/Joint	Water	1215	975			Yes								Four Magnesium Anodes installed in
6	34	50	24	4	Test Station	December 21, 2017	W. 113° 26.397'	Blue Leads	Magnesium Anodes (4)	Water			1215	1725					380mA				August 2017.
6	34	50	24	4	Test Station	December 21, 2017		White Lead	400mm (16") Pipeline Valve/Joint	Water	1215	975			Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
8	36	50	25	4	Test Station	December 21, 2017	N. 53° 21.575'	White Lead	400mm (16") Pipeline Valve/Joint	Water	1165	964			Yes								Four Magnesium Anodes installed in
8	36	50	25	4	Test Station	December 21, 2017	W. 113° 30.773'	Blue Leads	Magnesium Anodes (6)	Water			1165	1684					200mA				August 2017.
8	36	50	25	4	Test Station	December 21, 2017		White Lead	400mm (16") Pipeline Valve/Joint	Water	1165	964			Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
12	32	50	24	4	Test Station	December 21, 2017	N. 53° 21.578'	White Lead	400mm (16") Pipeline Valve/Joint	Water	1165	1010			Yes								Four Magnesium Anodes installed in
12	32	50	24	4	Test Station	December 21, 2017	W. 113° 29.313'	Blue Leads	Magnesium Anodes (6)	Water			1165	1799					170mA				August 2017.
12	32	50	24	4	Test Station	December 21, 2017		White Lead	400mm (16") Pipeline Valve/Joint	Water	1165	1010			Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
12	33	50	24	4	Test Station	December 21, 2017	N. 53° 21.579'	White Lead	400mm (16") Pipeline Valve/Joint	Water	1205	921			Yes								Four Magnesium Anodes installed in
12	33	50	24	4	Test Station	December 21, 2017	W. 113° 27.841'	Blue Leads	Magnesium Anodes (6)	Water			1205	1608					230mA				August 2017.
12	33	50	24	4	Test Station	December 21, 2017		White Lead	400mm (16") Pipeline Valve/Joint	Water	1205	921			Yes								

Capital Region Southwest Water Services Commission
2017 Annual Cathodic Protection Survey
Structure-to-soil Potential Data
Technician: Ryan Hewes
Survey Date(s): December 21-27, 2017

City of Leduc & Interntional Airport Supply Lines																								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
3	14	50	25	4	Test Station	December 22, 2017	N. 53° 18.528'	#2/#3 Red	600mm (24") Pipeline	Water	1575	-			Yes								
3	14	50	25	4	Test Station	December 22, 2017	W. 113° 33.253'	#5/#6 Black	Casing				711	-									
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
3	26	50	25	4	Test Station	December 22, 2017	N. 53° 20.313'	#5 Black	Unknown	Water	1583	-			Yes								
3	26	50	25	4	Test Station	December 22, 2017	W. 113° 33.215'	#5 Black	Unknown	Water	1583	-			Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
International Airport Reservoir/Fill Station																								
Test Stations																							Rectifier Location.
4	23	50	25	4	South Test Station	December 22, 2017	N. 53° 19'35"	#5 2 - Green	Unknown	Water			794	-									1.4 Ampere current drain to station electrical
4	23	50	25	4	South Test Station	December 22, 2017	W. 113° 33'36"	#6 2 - Yellow	Unknown	Water			794	-									grounding.
4	23	50	25	4	North Test Station	December 22, 2017		White	600mm (24") Pipeline	Water	1378	1042			Yes								
Inside Building																							
4	23	50	25	4	Pump Station	December 22, 2017		Pipeline	250mm (10") Pipeline	Water	1796	1021			Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
6	2	50	25	4	Test Station	December 22, 2017	N. 53° 17.169'	2 - White	600mm (24") Pipeline	Water	1602	-			Yes								
6	2	50	25	4	Test Station	December 22, 2017	W. 113° 33.097'	2 - Black	Casing				707	-									
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
6	6	51	24	4	Test Station	December 22, 2017	N. 53° 22.248'	#2 White	750mm (30") Pipeline	Water	1461	-			Yes								
6	6	51	24	4	Test Station	December 22, 2017	W. 113° 31.727'	#3 Black	750mm (30") Pipeline	Water	1461	-			Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
City of Leduc Reservoir/Fill Station																								
Outside Building																							Rectifier Location.
7	2	50	25	4	Riser	December 22, 2017	Sparrow Drive	Pipeline	ATCO Gas Riser	NG			1335	1091	Yes								0.8 Ampere current drain to station electrical
Inside Building							Behind Leduc																grounding.
7	2	50	25	4	Pump Station	December 22, 2017	Motors	Pipeline	400mm (16") Pipeline	Water	1315	1070			Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
7	26	51	24	4	Test Station	December 22, 2017	N. 53° 20.686'	#2 Black	600mm (24") Pipeline	Water	1635	-			Yes								Keyera Pipeline Crossing.
7	26	51	24	4	Test Station	December 22, 2017	W. 113° 32.873'	#3 Black	Keyera Pipeline				1635	-	Yes								

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Structure-to-soil Potential Data
Technician: Ryan Hewes
Survey Date(s): December 21-27, 2017

LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
Test Stations																							
7	26	50	25	4	North Test Station	December 22, 2017	N. 53° 20.704'	#2/#5 White	600mm (24") Pipeline	Water	1581	-			Yes								
7	26	50	25	4	North Test Station	December 22, 2017	W. 113° 32.859'	#3/#6 Black	Crossing Casing	Water			817	-	Yes								
7	26	50	25	4	South Test Station	December 22, 2017		#2 White	600mm (24") Pipeline	Water	1581	-			Yes								
7	26	50	25	4	South Test Station	December 22, 2017		#3 Black	Atco?	Water			1322	-	Yes								
7	26	50	25	4	South Test Station	December 22, 2017		#1 White	600mm (24") Pipeline	Water	1503	-			Yes								
7	26	50	25	4	South Test Station	December 22, 2017		#8 Black	Unknown	Water			1503	-	Yes								

LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
8	7	51	24	4	Blow Down	December 22, 2017	N. 53° 23.236'	Pipeline Stub	300mm (12") Stub	Water	741	718			No								Existing Magnesium Anode Depleted.
							W. 113° 31.003'																Install 1 - 17lb Magnesium Anode.

LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
Nisku Reservoir/Fill Station																							
Test Stations																							Rectifier Location.
8	26	50	25	4	4x4 Test Station	December 22, 2017	N. 53° 20.42"	Black	Unknown	Water	1381	1368			Yes								1.2 Ampere current drain to station electrical
8	26	50	25	4	4x4 Test Station	December 22, 2017	W. 113° 32'30"	White	Unknown	Water	1202	1186			Yes								grounding.
8	26	50	25	4	Test Station	December 22, 2017		#3 Yellow	Unknown	Water	1200	1186			Yes								
8	26	50	25	4	Test Station	December 22, 2017		#2 Black	Unknown	Water	-	-			-								Lead Broken
8	26	50	25	4	Test Station	December 22, 2017		#5 White	Unknown	Water	1060	1000			Yes								
8	26	50	25	4	Test Station @ Entrance	December 22, 2017		#2 White	Unknown	Water	1168	1059			Yes								
8	26	50	25	4	Test Station @ Entrance	December 22, 2017		#3 White	Unknown	Water	1133	1086			Yes								
8	26	50	25	4	Test Station @ Entrance	December 22, 2017		#5 Black	Unknown	Water	1168	1059			Yes								
8	26	50	25	4	Test Station @ Entrance	December 22, 2017		#6 Black	Unknown	Water	1133	1086			Yes								
Inside Building																							
8	26	50	25	4	Pump Station	December 22, 2017		Pipeline	250mm (10") Pipeline	Water	1428	1403			Yes								Potential measurements from common
8	26	50	25	4	Pump Station	December 22, 2017		Pipeline	300mm (12") Pipeline	Water	1428	1403			Yes								position outside building.

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LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
Boundary Pump Station																							
Test Stations																							Rectifier Location.
12	8	51	24	4	North Test Station	December 22, 2017	N. 53° 23.21"	#2/#6 White	Unknown	Water	1058	1000			Yes								
12	8	51	24	4	North Test Station	December 22, 2017	W. 113° 30.56"	#3 Black	Unknown	Water	1050	1002			Yes								
12	8	51	24	4	North Test Station	December 22, 2017		#9 Black	Unknown	Water	1060	1000			Yes								
12	8	51	24	4	North Test Station	December 22, 2017		#5 Blk/Wht	Unknown	Water	1104	1005			Yes								
12	8	51	24	4	North Test Station	December 22, 2017		#6 White	Unknown	Water	1060	1000			Yes								
12	8	51	24	4	South Test Station	December 22, 2017		#2 Black	Unknown	Water	1168	1059			Yes								
12	8	51	24	4	South Test Station	December 22, 2017		#3 Black	Unknown	Water	1133	1086			Yes								
12	8	51	24	4	South Test Station	December 22, 2017		#4 White	Unknown	Water	1168	1059			Yes								
12	8	51	24	4	South Test Station	December 22, 2017		#6 White	Unknown	Water	1133	1086			Yes								
Inside Building																							
12	8	51	24	4	Pump Station	December 22, 2017		Pipeline	600mm (24") Pipeline	Water	1185	1063			Yes								Potential measurements from common
12	8	51	24	4	Pump Station	December 22, 2017		Pipeline	150mm (6") Stub	Water	1183	1061			Yes								position outside building.
12	8	51	24	4	Pump Station	December 22, 2017		Pipeline	200mm (8") Stub	Water	1185	1063			Yes								
12	8	51	24	4	Pump Station	December 22, 2017		Pipeline	400mm (16") Pipeline	Water	1185	1063			Yes								
12	8	51	24	4	Pump Station	December 22, 2017		Pipeline	400mm (16") Pipeline	Water	1185	1063			Yes								
12	8	51	24	4	Pump Station	December 22, 2017		Pipeline	400mm (16") Pipeline	Water	1185	1063			Yes								
12	8	51	24	4	Pump Station	December 22, 2017		Pipeline	750mm (30") Pipeline	Water	1185	1063			Yes								

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Survey Date(s): December 21-27, 2017

Town of Calmar Supply Line

LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
3	4	50	25	4	Test Station	December 22, 2017	N. 53° 16.783'	Yellow	300mm (12") Pipeline	Water	1612	-			Yes								Rectifier Location.
3	4	50	25	4	Test Station	December 22, 2017	W. 113° 36.204'	Yellow	300mm (12") Pipeline	Water	1612	-			Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
5	31	49	26	4	Test Station	December 22, 2017	N. 53° 16.331'	#5 Red	300mm (12") Pipeline	Water	1131	-			Yes								
5	31	49	26	4	Test Station	December 22, 2017	W. 113° 48.316'	#6 Red	300mm (12") Pipeline	Water	1131	-			Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
5	32	49	25	4	Blow Down	December 22, 2017	N. 53° 16.334'	Pipeline Stub	250mm (10") Stub	Water	1302	-			Yes								
							W. 113° 38.084'																
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
5	33	49	26	4	Blow Down	December 22, 2017	N. 53° 16.336'	Pipeline Stub	300mm (12") Stub	Water	1128	-			Yes								
							W. 113° 45.396'																
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
5	34	49	26	4	Test Station	December 22, 2017	N. 53° 16.342'	#7/#8 White	300mm (12") Pipeline	Water	1131	-			Yes								
5	34	49	26	4	Test Station	December 22, 2017	W. 113° 43.938'	#2/#3 Black	Casing				722	-									
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
5	36	49	26	4	Blow Down	December 22, 2017	N. 53° 16.336'	Pipeline	250mm (10") Stub	Water	1258	-			Yes								
5	36	49	26	4	Vent Pipe	December 22, 2017	W. 113° 41.011'	Vent Pipe	Vent Pipe		1258	-			Yes								
5	36	49	26	4	Valve Box	December 22, 2017		Valve Box	Valve Box				438	-									
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
6	35	49	26	4	Test Station	December 22, 2017	N. 53° 16.342'	#7 2 - Black	300mm (12") Pipeline	Water	1401	-			Yes								Direct Bond to NEP.
6	35	49	26	4	Test Station	December 22, 2017	W. 113° 41.825'	#6 2 - White	NEP Flowline	NG			1401	-	Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
8	32	49	26	4	Test Station	December 22, 2017	N. 53° 16.336'	#2 Black	300mm (12") Pipeline	Water	1060	-			Yes								
8	32	49	26	4	Test Station	December 22, 2017	W. 113° 45.772'	#3 Black	300mm (12") Pipeline	Water	1060	-			Yes								
8	32	49	26	4	Vent Pipe	December 22, 2017		Pipe	Vent Pipe				535	-	Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
8	34	49	26	4	Test Station	December 22, 2017	N. 53° 16.320'	#2 Black	300mm (12") Pipeline	Water	1148	-			Yes								
8	34	49	26	4	Test Station	December 22, 2017	W. 113° 42.474'	#3 Black	300mm (12") Pipeline	Water	1148	-			Yes								

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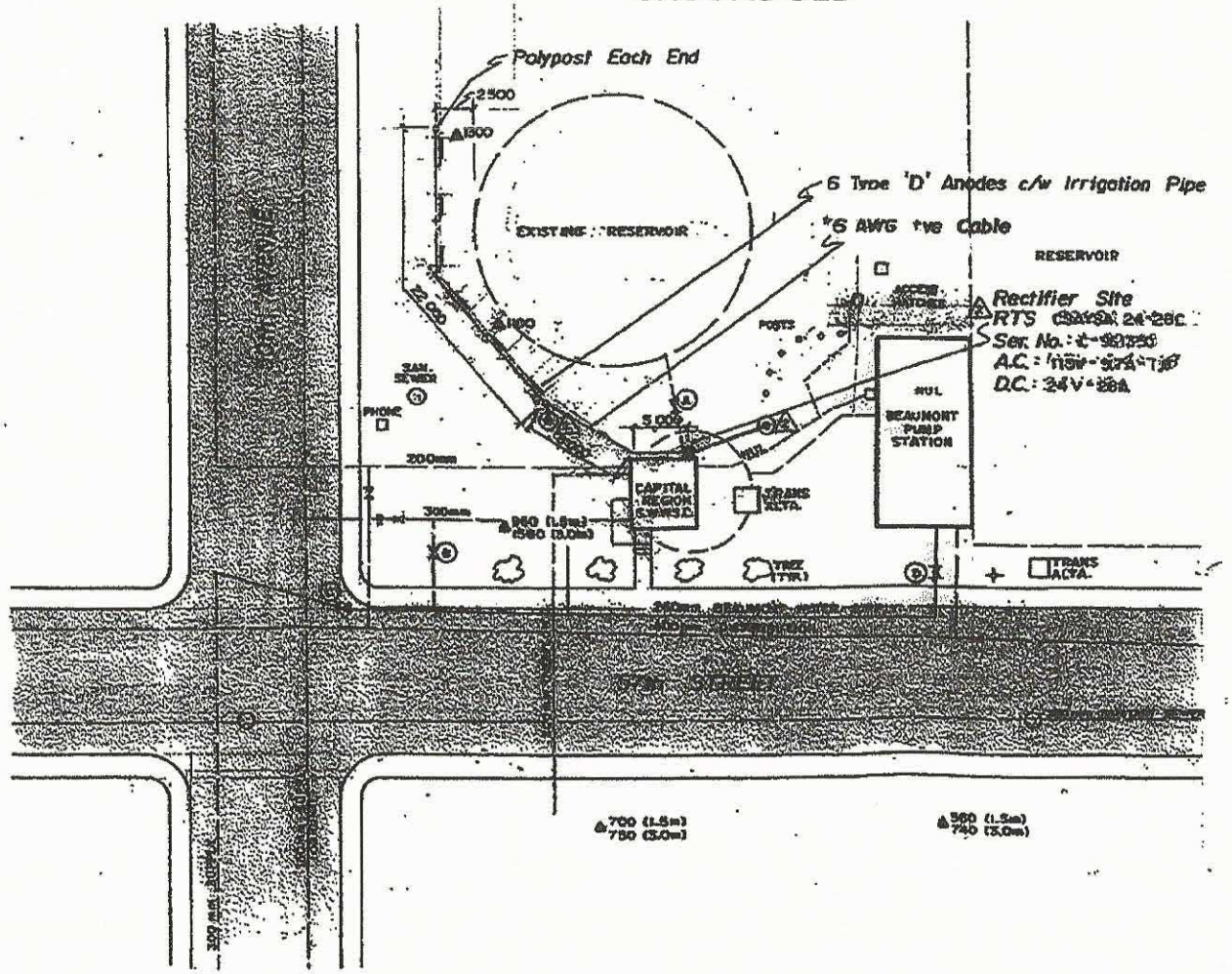
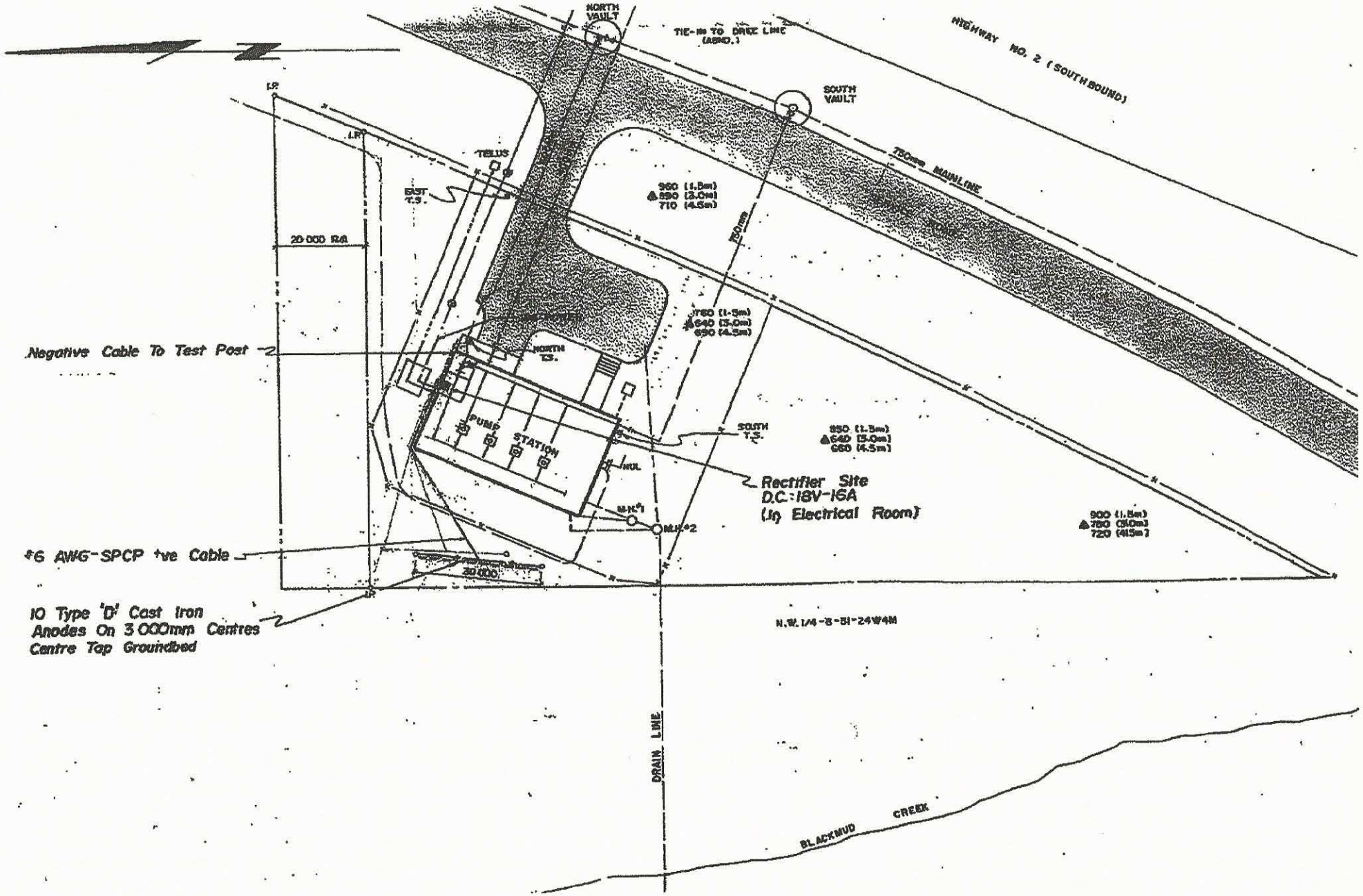
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
9	32	49	25	4	Test Station	December 22, 2017	N. 53° 16.418'	#5 Black	300mm (12") Pipeline	Water	1418	-			Yes								
9	32	49	25	4	Test Station	December 22, 2017	W. 113° 36.623'	#6 Black	300mm (12") Pipeline	Water	1418	-			Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
12	31	49	25	4	Test Station	December 22, 2017	N. 53° 16.353'	#2 Black	300mm (12") Pipeline	Water	1268	-			Yes								
12	31	49	25	4	Test Station	December 22, 2017	W. 113° 39.542'	#3 Black	300mm (12") Pipeline	Water	1268	-			Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Licensed Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
13	33	49	25	4	Test Station	December 22, 2017	N. 53° 16.776'	#5 Black	300mm (12") Pipeline	Water	1562	-			Yes								
13	33	49	25	4	Test Station	December 22, 2017	W. 113° 36.623'	#6 Black	300mm (12") Pipeline	Water	1562	-			Yes								
LSD	SEC	TWP	RGE	MER	Location Description	Measurement Date	GPS Co-ordinates - Degrees Decimal Minutes (DDM)	Measurement Location	Structure Desciption	Product	Structure (-mVCSE)		Foreign (-mVCSE)		Adequate Cathodic Protection	Static or Depol	AC Potential (mV)		Bond/Anode Current		As Found		Remarks
											ON	OFF	ON	OFF		(-mV)	ON	OFF	Meas	Type	ON	OFF	
Town of Calmar Reservoir/Fill Station																							
Inside Building																							Rectifier Location
16	25	49	27	4	Pump Station	December 22, 2017	51 Street & Hwy 39	Pipeline	300mm (12") Pipeline	Water	2530	972			Yes								
16	25	49	27	4	Pump Station	December 22, 2017	51 Street & Hwy 39	Pipeline	Station Piping	Water			1918	968	Yes								

APPENDIX 3 – CP SYSTEM AS-BUILT DRAWINGS

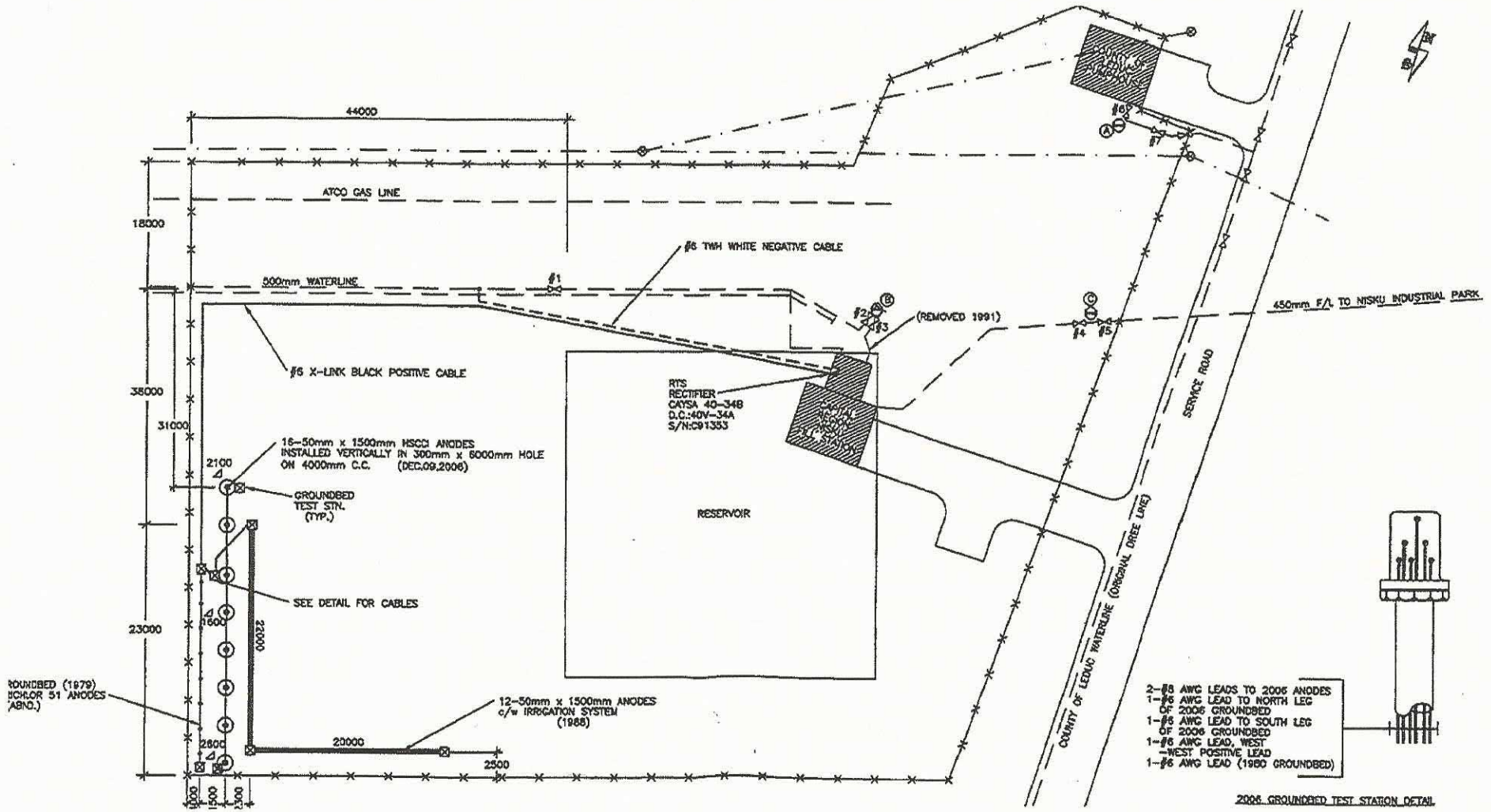
BEAUMONT PUMP STATION
GROUND BED

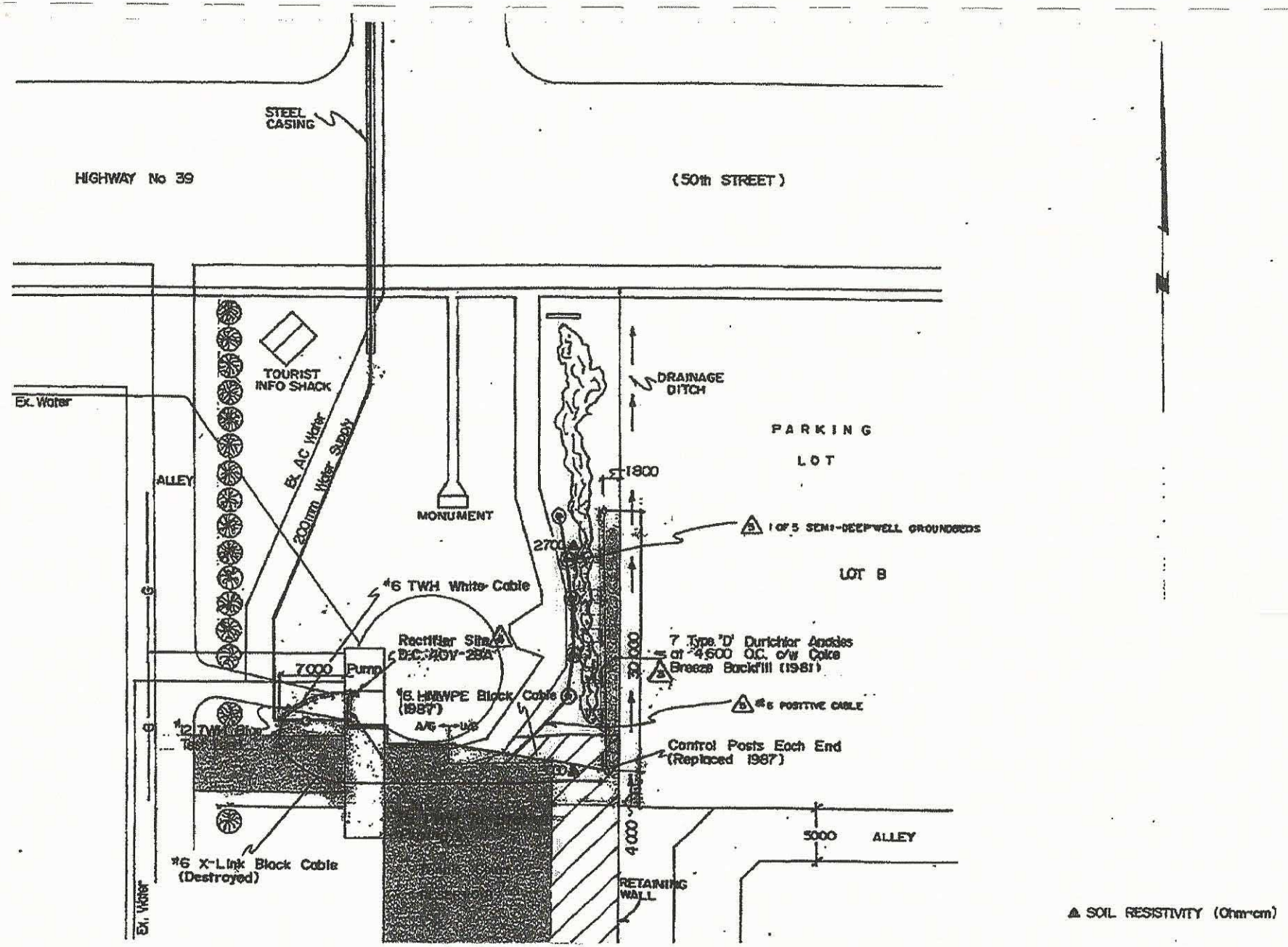


Capital Region Water System
Boundary Station
NW 1/4 08-51-24 W4



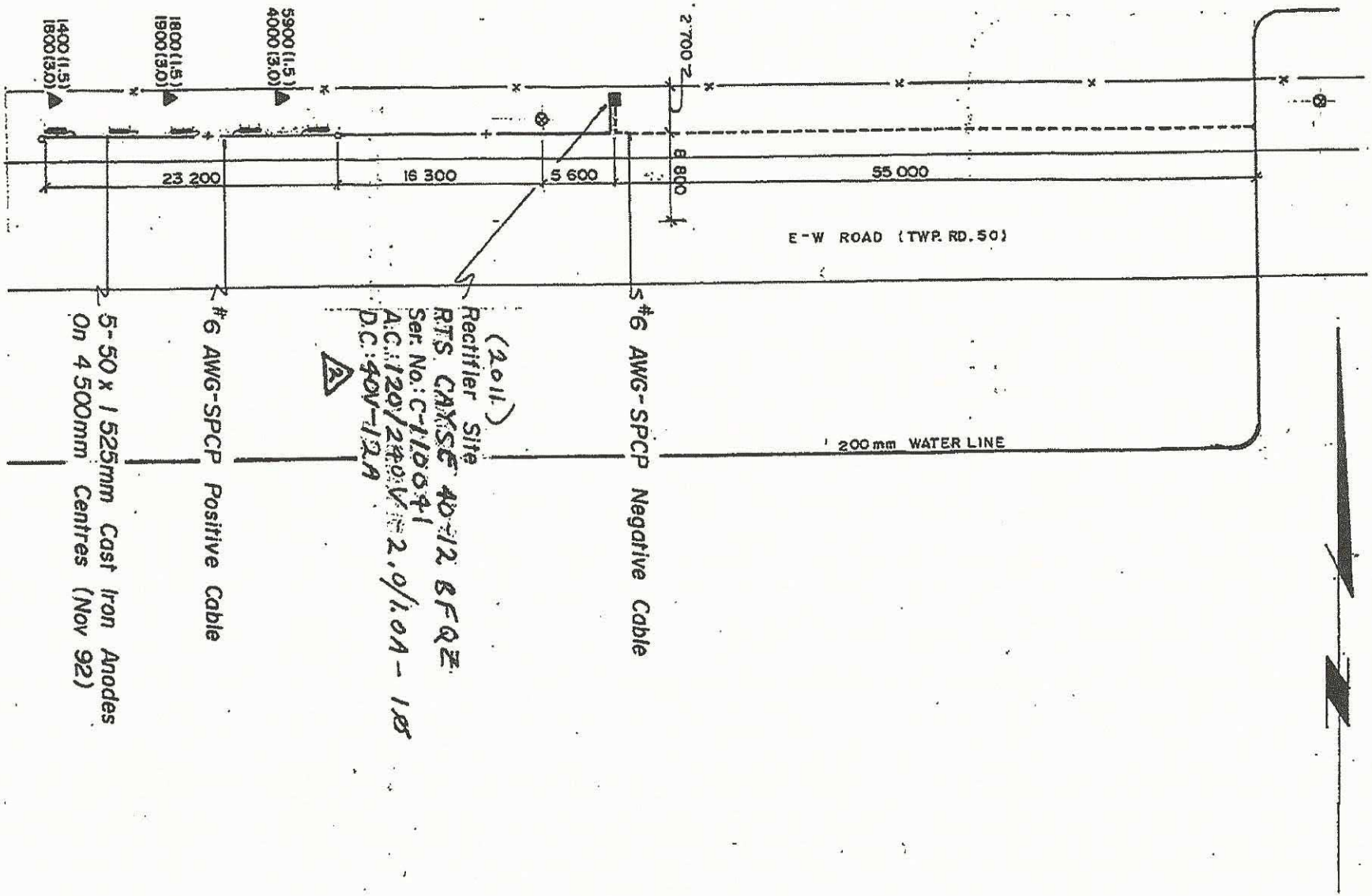
NISKU FILL STATION
CATHODIC PROTECTION SYSTEM



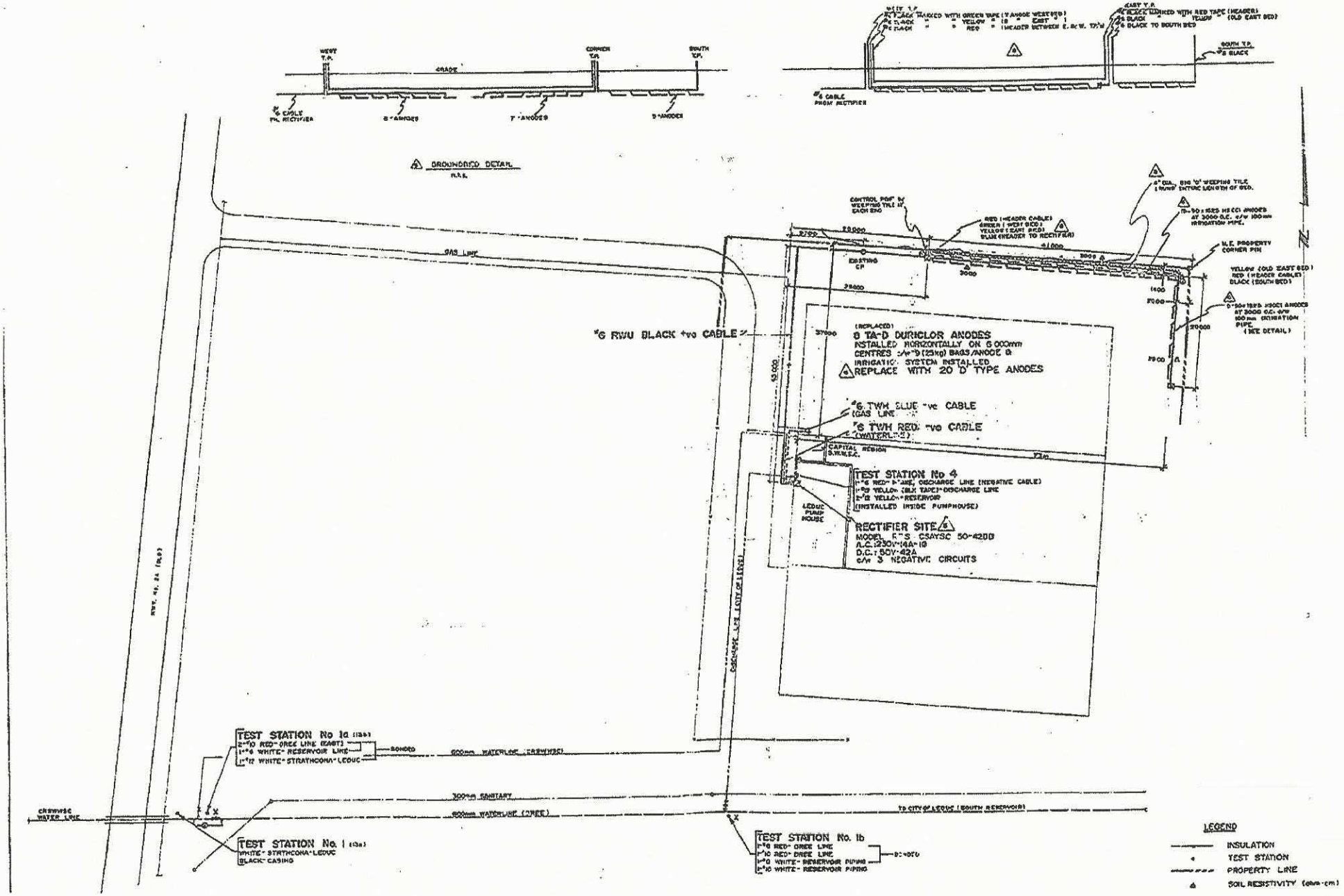


CALMAR GROUND BED SYSTEM

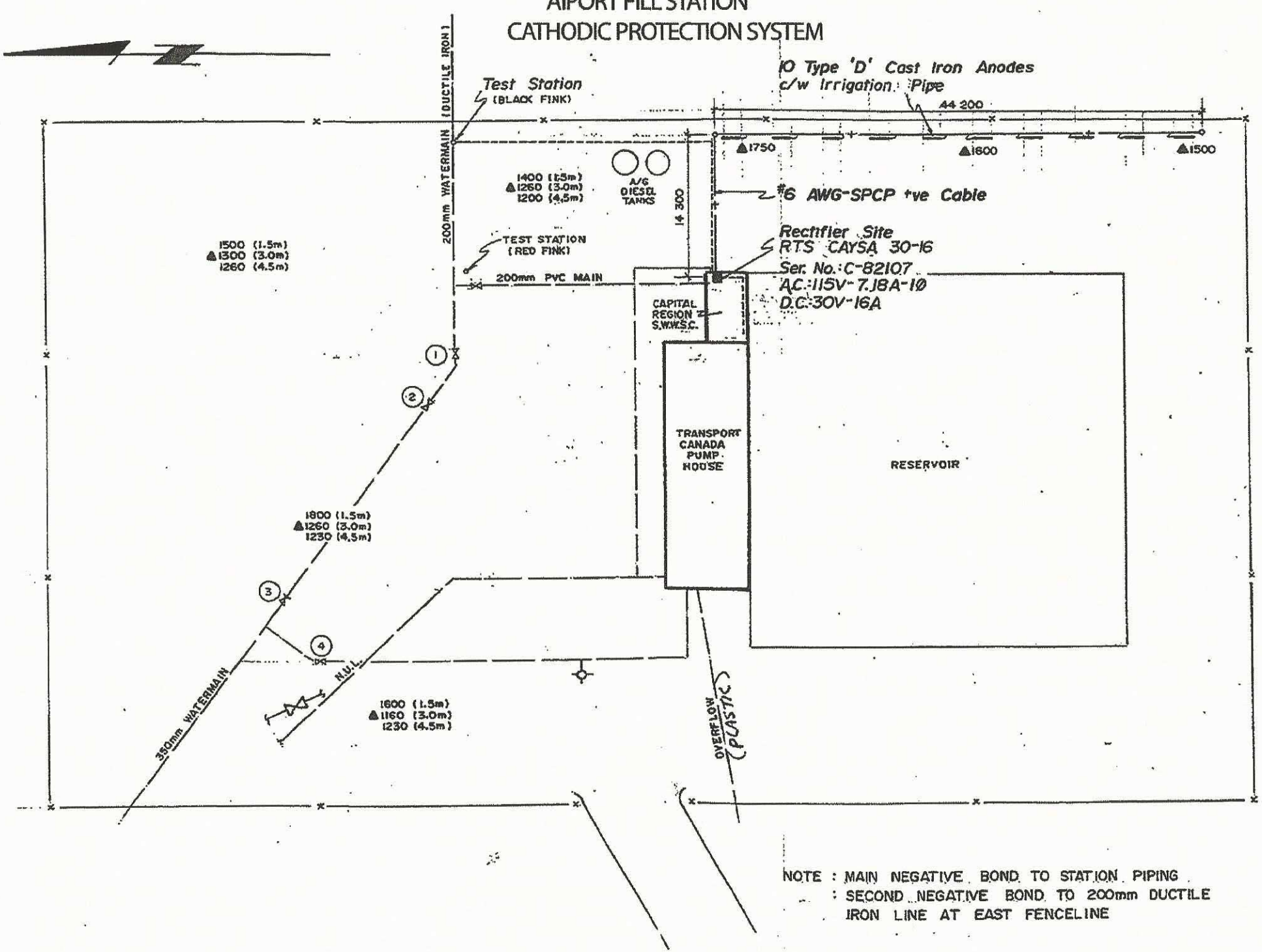
03-04-50-25 W4 Rectifier and Ground Bed



LEDUC NORTH RESERVOIR
CATHODIC PROTECTION SYSTEM



AIPORT FILL STATION
CATHODIC PROTECTION SYSTEM



NOTE : MAIN NEGATIVE BOND TO STATION PIPING
: SECOND NEGATIVE BOND TO 200mm DUCTILE IRON LINE AT EAST FENCELINE

APPENDIX 4 – SYSTEM MAP

RGE 26 W4M

RGE 25 W4M

RGE 24 W4M

TWP 51

TWP 50

TWP 49

EDMONTON

BOUNDARY STATION

BD

EAST LEDUC COUNTY

BEAUMONT

NISKU (WEST) LEDUC COUNTY

NISKU

EXISTING RESERVOIR

NEW RESERVOIR

(HDPE PIPELINE)

LEDUC

CALMAR

R

TP

D:\BACK_UP_2014_2015_2016_2017\CAD\ARC\CRSWSC\113B_0.01.dwg

CORNERSTONE DRAFTING & DESIGN 780.485.7765 www.cornerstonedrafting.com

WATER PIPE DIAMETER	CATHODIC PROTECTION
250 (HDPE PIPELINE)	RESERVOIR/FILL STATION
300	RECTIFIER
400	TEST POINT
500	BLOW DOWN
600	
750	

No.	REVISION	DATE	BY

arc CATHODIC PROTECTION

FOR:

CAPITAL REGION SOUTHWEST WATER SERVICES COMMISSION

REGIONAL WATER TRANSMISSION SYSTEM

Design By: RH	Scale: 1:80,000	Drawing No: 113-B
Drawn By: AB	DATE: JAN.09.2017	

APPENDIX E - UNIT COST

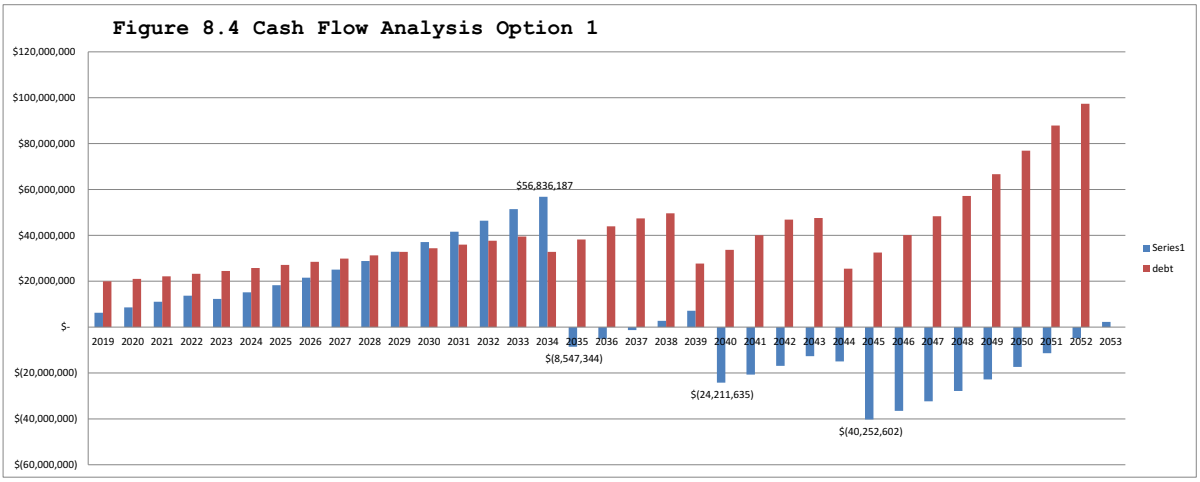


Figure 8.4 Cash Flow Analysis Option 1
$120,000,000
$100,000,000
$80,000,000
$60,000,000
$40,000,000
$20,000,000
$-
$(20,000,000)
$(40,000,000)
$(60,000,000)
$56,836,187
$(8,547,344)
$(24,211,635)
$(40,252,602)
2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053
Series1
debt

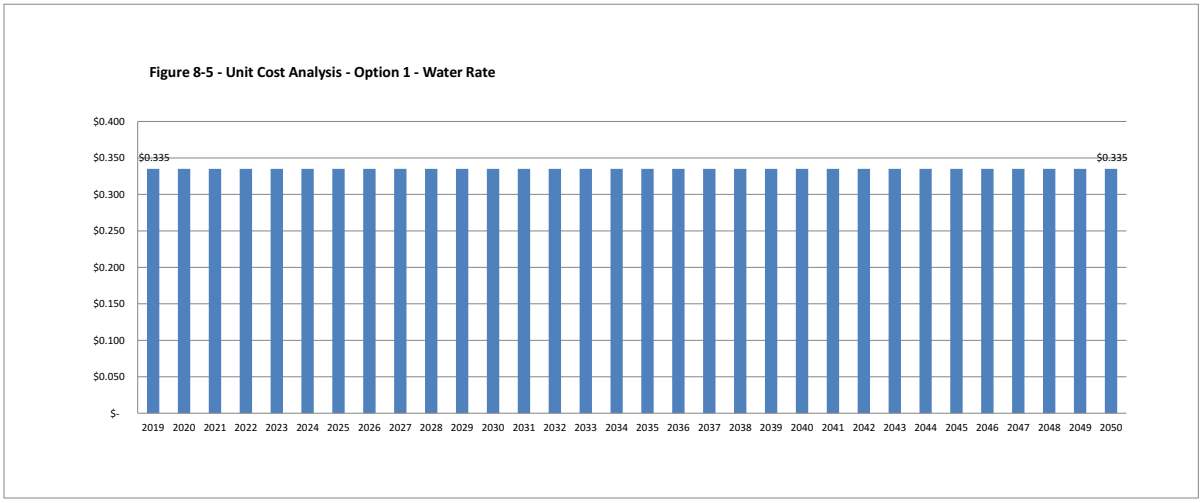


Figure 8-5 - Unit Cost Analysis - Option 1 - Water Rate
$0.400
$0.350
$0.300
$0.250
$0.200
$0.150
$0.100
$0.050
$-
$0.335
$0.335
2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050

CRSWSC - Unti Cost Analysis - Option 1 - Commission Owns all existing Infrastructure

Year	Projected Water Demand	Construction Cost (2018 Dollars) ($M)	Capital Yearly Costs (Fvalue) ($M)	Net Present Valve	Debenture limit		Debt Service Limit		Accured Capital (per year)	Earned Interest	Value in Account	Water Rate ($/m3)
		$ 59,745,570.00	$ 148,476,947	$ 91,157,634							$4,432,940	
2019	5,960,922	$ 300,000.00	$ 300,000.00						$1,996,909	$ 155,153	$ 6,285,002	$ 0.335
2020	6,220,362		$ -		$19,978,559.27	$ -	$ 19,978,559.27		$2,083,821	$ 219,975	$ 8,588,798	$ 0.335
2021	6,482,666		$ -		$21,029,238.21	$ -	$ 21,029,238.21		$2,171,693	$ 300,608	$ 11,061,099	$ 0.335
2022	6,750,587		$ -		$22,117,332.67	$ -	$ 22,117,332.67		$2,261,446	$ 387,138	$ 13,709,684	$ 0.335
2023	7,024,908	$ 3,500,000.00	$ 4,254,271.88		$23,246,268.73	$ -	$ 23,246,268.73		$2,353,344	$ 479,839	$ 12,288,595	$ 0.335
2024	7,332,892		$ -		$24,508,078.78	$ -	$ 24,508,078.78		$2,456,519	$ 430,101	$ 15,175,215	$ 0.335
2025	7,634,217		$ -		$25,770,324.00	$ -	$ 25,770,324.00		$2,557,463	$ 531,133	$ 18,263,810	$ 0.335
2026	7,945,079		$ -		$27,087,875.82	$ -	$ 27,087,875.82		$2,661,601	$ 639,233	$ 21,564,645	$ 0.335
2027	8,261,170		$ -		$28,447,208.33	$ -	$ 28,447,208.33		$2,767,492	$ 754,763	$ 25,086,900	$ 0.335
2028	8,586,586		$ -		$29,863,451.65	$ -	$ 29,863,451.65		$2,876,506	$ 878,041	$ 28,841,447	$ 0.335
2029	8,908,638		$ -		$31,293,358.94	$ -	$ 31,293,358.94		$2,984,394	$ 1,009,451	$ 32,835,292	$ 0.335
2030	9,237,391		$ -		$32,772,651.49	$ -	$ 32,772,651.49		$3,094,526	$ 1,149,235	$ 37,079,053	$ 0.335
2031	9,592,508		$ -		$34,372,868.76	$ -	$ 34,372,868.76		$3,213,490	$ 1,297,767	$ 41,590,310	$ 0.335
2032	9,944,378		$ -		$35,990,063.81	$ -	$ 35,990,063.81		$3,331,367	$ 1,455,661	$ 46,377,338	$ 0.335
2033	10,309,449		$ -		$37,684,416.05	$ -	$ 37,684,416.05		$3,453,665	$ 1,623,207	$ 51,454,210	$ 0.335
2034	10,689,790		$ -		$39,465,434.48	$ -	$ 39,465,434.48		$3,581,080	$ 1,800,897	$ 56,836,187	$ 0.335
2035	11,080,631	$ 32,564,770.00	$ 71,084,808.91		$41,317,456.69	$ 32,770,112.42	$ 32,770,112.42		$3,712,011	$ 1,989,267	$ (8,547,344)	$ 0.335
2036	11,484,191		$ -		$43,250,473.90	$ 38,165,703.03	$ 38,165,703.03		$3,847,204	$ (384,630)	$ (5,084,771)	$ 0.335
2037	11,902,724		$ -		$45,274,975.21	$ 43,948,802.27	$ 43,948,802.27		$3,987,413	$ (228,815)	$ (1,326,173)	$ 0.335
2038	12,335,737		$ -		$47,391,267.88	$ -	$ 47,391,267.88		$4,132,472	$ (59,678)	$ 2,746,621	$ 0.335
2039	12,788,186		$ -		$49,620,772.88	$ -	$ 49,620,772.88		$4,284,042	$ 96,132	$ 7,126,795	$ 0.335
2040	13,252,666	$ 12,931,800	$ 36,027,511.03		$51,937,284.33	$ 27,725,649.52	$ 27,725,649.52		$4,439,643	$ 249,438	$ (24,211,635)	$ 0.335
2041	13,734,402				$54,363,460.20	$ 33,663,326.42	$ 33,663,326.42		$4,601,025	$ (1,089,524)	$ (20,700,134)	$ 0.335
2042	14,232,930		$ -		$56,900,098.67	$ 40,036,490.31	$ 40,036,490.31		$4,768,031	$ (931,506)	$ (16,863,608)	$ 0.335
2043	14,749,944		$ -		$59,556,676.89	$ 46,875,437.33	$ 46,875,437.33		$4,941,231	$ (758,862)	$ (12,681,240)	$ 0.335
2044	15,339,942	$ 2,025,000.00	$ 6,857,368.76		$62,558,333.40	$ 47,587,949.74	$ 47,587,949.74		$5,138,880	$ (570,656)	$ (14,970,384)	$ 0.335
2045	15,953,539	$ 8,424,000.00	$ 29,952,986.72		$65,711,273.40	$ 25,458,671.40	$ 25,458,671.40		$5,344,436	$ (673,667)	$ (40,252,602)	$ 0.335
2046	16,591,681		$ -		$69,023,121.58	$ 32,517,365.56	$ 32,517,365.56		$5,558,213	$ (1,811,367)	$ (36,505,756)	$ 0.335
2047	17,255,348		$ -		$72,501,886.91	$ 40,133,913.46	$ 40,133,913.46		$5,780,542	$ (1,642,759)	$ (32,367,973)	$ 0.335
2048	17,945,562		$ -		$76,155,982.01	$ 48,343,213.02	$ 48,343,213.02		$6,011,763	$ (1,456,559)	$ (27,812,769)	$ 0.335
2049	18,663,384		$ -		$79,994,243.50	$ 57,182,133.70	$ 57,182,133.70		$6,252,234	$ (1,251,575)	$ (22,812,110)	$ 0.335
2050	19,409,920		$ -		$84,025,953.38	$ 66,689,621.77	$ 66,689,621.77		$6,502,323	$ (1,026,545)	$ (17,336,332)	$ 0.335
2051	20,186,317		$ -		$88,260,861.43	$ 76,906,810.97	$ 76,906,810.97		$6,762,416	$ (780,135)	$ (11,354,050)	$ 0.335
2052	20,993,769		$ -		$92,709,208.84	$ 87,877,138.82	$ 87,877,138.82		$7,032,913	$ (510,932)	$ (4,832,070)	$ 0.335
2053	21,833,520		$ -		$97,381,752.97	$ -	$ 97,381,752.97		$7,314,229	$ (217,443)	$ 2,264,716	$ 0.335
2054	22,706,861		$ -		$102,289,793.32	$ -	$ 102,289,793.32		$7,606,798	$ 79,265	$ 9,950,779	$ 0.335
2055	23,615,135		$ -		$107,445,198.90	$ -	$ 107,445,198.90		$7,911,070	$ 348,277	$ 18,210,127	$ 0.335
2056	24,559,741		$ -		$112,860,436.93	$ -	$ 112,860,436.93		$8,227,513	$ 637,354	$ 27,074,995	$ 0.335
2057	25,542,130		$ -		$118,548,602.95	$ -	$ 118,548,602.95		$8,556,614	$ 947,625	$ 36,579,233	$ 0.335
2058	26,563,816		$ -		$124,523,452.54	$ -	$ 124,523,452.54		$8,898,878	$ 1,280,273	$ 46,758,385	$ 0.335
2059	27,626,368		$ -		$130,799,434.54	$ -	$ 130,799,434.54		$9,254,833	$ 1,636,543	$ 57,649,761	$ 0.335
2060	28,731,423		$ -		$137,391,726.04	$ -	$ 137,391,726.04		$9,625,027	$ 2,017,742	$ 69,292,530	$ 0.335
2061	29,880,680		$ -		$144,316,269.04	$ -	$ 144,316,269.04		$10,010,028	$ 2,425,239	$ 81,727,796	$ 0.335
2062	31,075,907		$ -		$151,589,809.00	$ -	$ 151,589,809.00		$10,410,429	$ 2,860,473	$ 94,998,698	$ 0.335

Figure 8.6 - Unit Cost Analysis - Option 2 - Cash Flow Projection

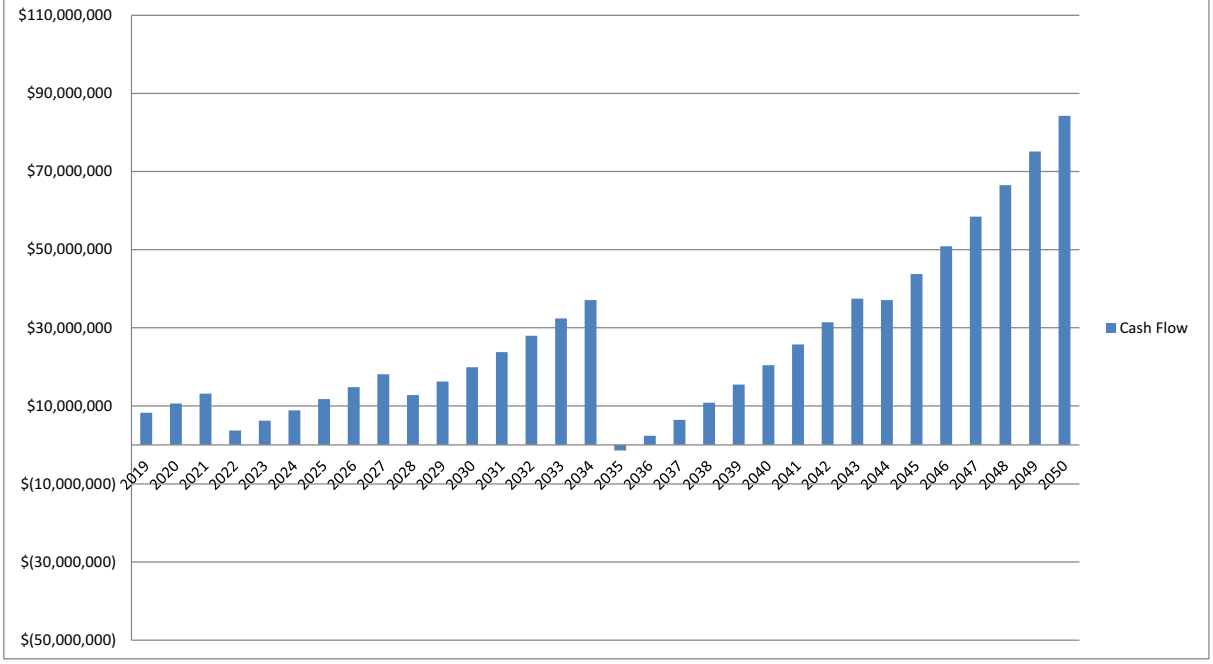
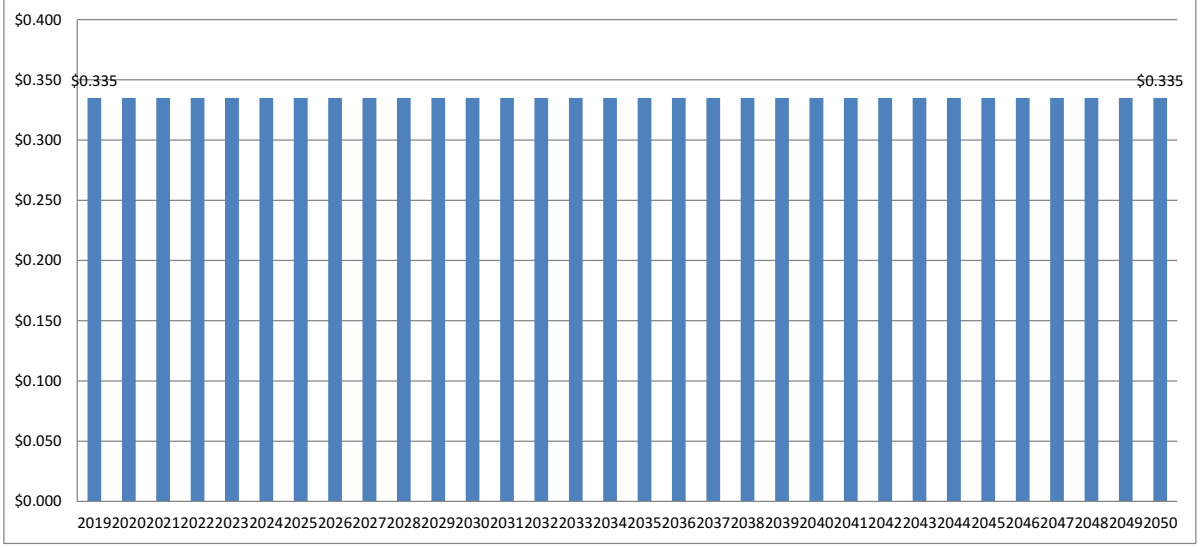


Figure 8.7 - Unit Cost Analysis - Option 2 - Water Rate



CRSWSC - Unit Cost Analysis - Option 2 - Transfer Assest to EPCOR

Year	Projected Water Demand	Construction Cost (2018 Dollars) ($M)	Capital Yearly Costs (Fvalue) ($M)	Net Present Valve	Accured capital (per year)	Earned Interest	Value in Account	Water Rate ($/m3)
		$ 38,449,040.00	**$ 71,358,025**	**$ 51,367,661**			$6,015,180	
2019	5,960,922	$ 300,000.00			$1,996,909	$ 210,531	$ 8,222,620	$ 0.335
2020	6,220,362	$ -	$ -		$2,083,821	$ 287,792	$ 10,594,233	$ 0.335
2021	6,482,666		$ -		$2,171,693	$ 370,798	$ 13,136,725	$ 0.335
2022	6,750,587	$ 10,500,000.00	$ 12,155,062.50		$2,261,446	$ 459,785	$ 3,702,894	$ 0.335
2023	7,024,908		$ -		$2,353,344	$ 129,601	$ 6,185,839	$ 0.335
2024	7,332,892		$ -		$2,456,519	$ 216,504	$ 8,858,862	$ 0.335
2025	7,634,217		$ -		$2,557,463	$ 310,060	$ 11,726,385	$ 0.335
2026	7,945,079		$ -		$2,661,601	$ 410,423	$ 14,798,410	$ 0.335
2027	8,261,170		$ -		$2,767,492	$ 517,944	$ 18,083,847	$ 0.335
2028	8,586,586	$ 5,682,040.00	$ 8,814,708.98		$2,876,506	$ 632,935	$ 12,778,578	$ 0.335
2029	8,908,638		$ -		$2,984,394	$ 447,250	$ 16,210,223	$ 0.335
2030	9,237,391		$ -		$3,094,526	$ 567,358	$ 19,872,106	$ 0.335
2031	9,592,508		$ -		$3,213,490	$ 695,524	$ 23,781,120	$ 0.335
2032	9,944,378		$ -		$3,331,367	$ 832,339	$ 27,944,826	$ 0.335
2033	10,309,449		$ -		$3,453,665	$ 978,069	$ 32,376,561	$ 0.335
2034	10,689,790		$ -		$3,581,080	$ 1,133,180	$ 37,090,820	$ 0.335
2035	11,080,631	$ 19,942,000.00	$ 43,530,885.04		$3,712,011	$ 1,298,179	$ (1,429,875)	$ 0.335
2036	11,484,191		$ -		$3,847,204	$ (64,344)	$ 2,352,984	$ 0.335
2037	11,902,724		$ -		$3,987,413	$ 82,354	$ 6,422,751	$ 0.335
2038	12,335,737		$ -		$4,132,472	$ 224,796	$ 10,780,019	$ 0.335
2039	12,788,186		$ -		$4,284,042	$ 377,301	$ 15,441,362	$ 0.335
2040	13,252,666		$ -		$4,439,643	$ 540,448	$ 20,421,453	$ 0.335
2041	13,734,402		$ -		$4,601,025	$ 714,751	$ 25,737,229	$ 0.335
2042	14,232,930		$ -		$4,768,031	$ 900,803	$ 31,406,063	$ 0.335
2043	14,749,944		$ -		$4,958,753	$ 1,099,212	$ 37,464,028	$ 0.335
2044	15,339,942	$ 2,025,000.00	$ 6,857,368.76		$5,157,103	$ 1,311,241	$ 37,075,003	$ 0.335
2045	15,953,539		$ -		$5,363,387	$ 1,297,625	$ 43,736,015	$ 0.335
2046	16,591,681		$ -		$5,577,922	$ 1,530,761	$ 50,844,698	$ 0.335
2047	17,255,348		$ -		$5,801,039	$ 1,779,564	$ 58,425,302	$ 0.335
2048	17,945,562		$ -		$6,033,081	$ 2,044,886	$ 66,503,268	$ 0.335
2049	18,663,384		$ -		$6,274,404	$ 2,327,614	$ 75,105,287	$ 0.335
2050	19,409,920		$ -		$6,525,380	$ 2,628,685	$ 84,259,352	$ 0.335
2051	20,186,317		$ -		$6,786,395	$ 2,949,077	$ 93,994,825	$ 0.335
2052	20,993,769		$ -		$7,057,851	$ 3,289,819	$ 104,342,495	$ 0.335
2053	21,833,520		$ -		$7,340,165	$ 3,651,987	$ 115,334,647	$ 0.335
2054	22,706,861		$ -		$7,633,772	$ 4,036,713	$ 127,005,132	$ 0.335
2055	23,615,135		$ -		$7,939,123	$ 4,445,180	$ 139,389,434	$ 0.335
2056	24,559,741		$ -		$8,256,688	$ 4,878,630	$ 152,524,752	$ 0.335
2057	25,542,130		$ -		$8,586,955	$ 5,338,366	$ 166,450,074	$ 0.335
2058	26,563,816		$ -		$8,930,433	$ 5,825,753	$ 181,206,260	$ 0.335
2059	27,626,368		$ -		$9,287,651	$ 6,342,219	$ 196,836,130	$ 0.335
2060	28,731,423		$ -		$9,659,157	$ 6,889,265	$ 213,384,551	$ 0.335
2061	29,880,680		$ -		$10,045,523	$ 7,468,459	$ 230,898,534	$ 0.335
2062	31,075,907		$ -		$10,447,344	$ 8,081,449	$ 249,427,326	$ 0.335

APPENDIX F – FACILITY ASSESSMENT

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

REPORT

Capital Region
Southwest Water Services Commission

Facility Assessment

JANUARY 2020

TABLE OF CONTENTS

LIST OF TABLES

1 INTRODUCTION

The Capital Region Southwest Regional Water Services Commission (Commission), has retained Associated Engineering (AE) with undertaking an assessment at the following Commission locations: Edmonton International Airport (Airport No 1) Fill Station, Calmar Fill Station, Nisku West Fill Station, Nisku East Fill Station, Beaumont Fill Station, HWY 21 Booster Station, Boundary Pump station, City of Leduc North Reservoir Fill Station, Armena Fill Station, Hay Lakes Fill Station, New Sarepta Fill Station, Telford Lake Booster Station, and the Millet Fill Station.

The Edmonton International Airport (EIA) has a second reservoir and fill station, which was constructed in 2013 but this facility is currently not active. Prior to re-commissioning of the facility, the Commission should inspect the facility and the related Commission infrastructure. This inspection should include an inspection of the Radio equipment as the radio equipment has been updated at the other Commission's facilities and this location may still have the older equipment.

2 ASSESSMENT DATA

The following is AE's review and assessment of each of the following locations. AE's observations are broken into four main categories:

- Electrical
- Instrumentation
- Process
- Building Mechanical

2.1 Airport Fill Station (No.1)

The Airport Fill Station (No.1) is located within the grounds of the Edmonton International Airport. This facility was constructed in the early 1980's, and the Commission has a dedicated meter room at this facility. The following outlines AE's observations from the facility.

2.1.1 Electrical

The Airport Fill Station (No. 1) has a single-phase 240V 70A service feeding into a 100A 240V 12 circuit distribution panel. The utility meter is mounted on the exterior of the building next to the entrance door. The service entrance enters into the main breaker which then feeds into a single-phase distribution panel. An old, uninterruptible power supply (UPS) distribution panel still exists and is connected to the PLC panel, but is not clear if this is in use as there is a UPS located in the PLC cabinet which has devices plugged in. The use of the old UPS should be confirmed.

The rest of the observations are as follows:

- The main breaker shows significant corrosion and should be replaced as a precaution to failure.
- The main distribution panel appears to be in good condition for original equipment; however, an internal inspection for pitting or corrosion is prudent, and replacement if corrosion is found.
- There is a smoke detector on the ceiling. This should be replaced with a suitable unit to provide an alarm contact.
- Lighting appears to be original fluorescent fixtures. Since the lights are off 99% of the time, there is little benefit to upgrading these to LED.

- An emergency wallpack is present; however, the ability of an old unit like this to provide the 30 minutes of emergency lighting is unlikely. Also, there is no illuminated exit sign over the doorway. Recommend a new emergency exit sign with lights be installed next to the door (include auto exerciser option) to resolve both issues.
- An alarm system with keypad was observed. The system is functional, but the equipment is old.
- A Carbon Monoxide detector was observed, unit yellowed with age. These should be replaced every 5 years. Recommend replacement.
- PLC cabinet UPS has two battery pack power extenders. These need replacement every 5 years on average. Recommend replacement of the batteries to maintain the system runtime.
- An old Schneider power fail relay is seen on the wall. This is assumed to be tied to the SCADA. Replace when it fails otherwise it has no operational impact.
- Active Cathodic protection is installed. This appears to be functional but is outside of AE's expertise to determine the condition.
- An original design telephone entrance panel is present. This panel is not in use.

2.1.2 Controls

The control system PLC was upgraded recently to a Schneider M340 PLC, and the radios upgraded to GE MDS SD4 licensed radios. M340 is a current PLC platform and no upgrade at this time is recommended. A mast-mounted Yagi antenna is mounted to the building and points to the new Hwy 21 repeater station, and PLC communications is via serial MB protocol for system stability.

- The old MDS 4710 series radio has been left in the PLC cabinet post SCADA upgrade. This can be removed and recycled.
- PLC spare rack slots have terminal covers to protect the connections. This is acceptable.
- Cabinet has a Sixnet, 5 port managed ethernet switch for future communications and PLC access.
- Terminals and wiring appear in good condition.
- PIT-0500 (fill line) is a newer E&H unit and is in good condition.
- The flow control valve, actuator, and flow meter are all recent upgrades from the 2013 SCADA upgrade for the PLCs.
- Flow meter has grounding rings and is grounded correctly.
- The chlorine residual analyser is a ProMinent unit. The incoming water feed has an air trap potential. The pipe tap should always rise or fall so air cannot get trapped in the line. Recommend re-routing the water line to eliminate the air traps.
- The analyser discharge rises and goes through the wall for a return to reservoir feed. The line routing is acceptable as it rises consistently but how the line empties to the reservoir should be examined further to confirm that a suitable air gap exists.
- The Level Transmitter (LIT-0580) is a Siemens Milltronics MultiRanger 100 unit and appears to be in good condition. It was not possible to determine if the unit was installed correctly as the transmitter is located in the adjacent room.
- The pressure gauge between the pressure reducing valve (PRV)and flow valve needs a neck extension. The isolation valve handle obscures the face. The gauge is also smaller than the normally recommended 4" dial face.

2.1.3 Electrical and Controls Photos

Image Table 2-1
Airport Fill Station (No. 1) - Electrical and Controls Photos

Rusted MCB

Antenna and Power Meter

Rusting Distribution Panel

PLC Panel

UPS Stack

Radios

PLC Rack

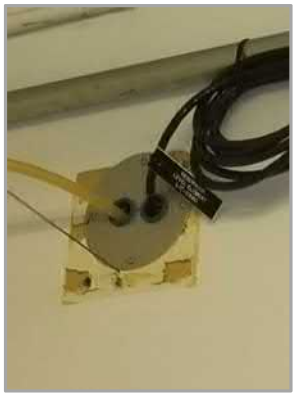
Panel Wiring

Inlet PIT and Analyser Feed

Flow Meter

Cl2 Analyser and CO Detector

Analyser Feed Line



AIT Ret and Level Wall Penetration

PRV

Blocked Gauge

Level Transmitter

Smoke Detector

Lighting and No Exit Light

2.1.4 Process

- Process piping is in generally good condition.
- There is some superficial rusting on fittings and bolts.
- Where the fill line piping enters the building through the floor, the first 200 mm appears to be only primed, not painted. This should be brushed or blasted, and properly coated.
- All valves and related equipment appear to be functioning properly.
- PRV appears to be original based on the corrosion observed. Recommend a rebuild kit be considered to ensure the PRV/pressure sustaining valve (PSV) continues to function correctly for the future. This includes replacing the PRV pilot solenoid as it appears original and is likely nearing failure at end of life.
- Flow meter does not have any upstream or downstream straight run of piping to ensure accuracy.

Image Table 2-2
Airport Fill Station (No. 1) – Piping and Valves

Paint Fill Piping

Superficial Rust

Re-build PSV/PRV

2.1.5 Building Mechanical

- The forced air furnace is located within the Commission Room. It appears newer and has a fresh-air make up.
- Along the ceiling is an exposed uncapped duct. The intent of this duct should be identified, and either capped or properly terminated. Based on its location it is assumed to be vent.
- The venting within the room should be reviewed to determine its adequacy.
- The furnace should be cleaned and maintained on yearly basis.

Image Table 2-3
Airport Fill Station (No. 1) - Building Mechanical

Force Air Furnace

Open Duct.

2.2 Calmar Fill Station

The Calmar Fill Station is located at approximately 50 Avenue and 51 Street within the Town of Calmar. The Commission has a dedicated fill room within this fill station. The following outlines AE's observations from the facility.

2.2.1 Electrical

The Calmar Fill Station has a single-phase 240V 60A service MCC feeding into an oversized 225A 240V 42 circuit distribution panel. The utility meter was not observed, and it is believed that the power is fed from the pumphouse next door. An old UPS distribution panel still exists to feed the PLC panel but is not clear if this is in use as the UPS in the PLC cabinet has devices plugged into it.

- The main breaker looks to be relatively new as does the distribution panel.
- The distribution panel is oversized for such a small space given there are only 9 circuits fed out of 42.The main distribution panel appears to be in good condition for original equipment; however, an internal inspection for pitting or corrosion is prudent and replacement if corrosion is found. This is mentioned here due to the significant pipe corrosion observed.
- There is a smoke detector on the ceiling, and it appears relatively new. This should be replaced in 5 to 10 years with a suitable unit to provide an alarm contact.
- Lighting appears to be original fluorescent fixtures. Since the lights are off 99% of the time there is little benefit to upgrading these to LED at this time. When the existing fixtures fail, AE recommends upgrading to LED units.
- An emergency wallpack is present; however, the ability of an old unit like this to provide the 30 minutes emergency lighting required is low. Also, there is no illuminated exit sign over the doorway. AE recommend a new emergency exit sign with lights be installed next to the door (include auto exerciser option) to resolve both issues.
- An alarm system with keypad was observed. The DSC system appears to be offline, and instead the alarm via the PLC, a keyed switch is used. The system is functional.
- A carbon monoxide detector was observed, the unit is yellowed with age. These units should be replaced every 5 years. AE recommend replacement.
- Cable and pipe penetrations though the block wall are not sealed. These should be sealed to prevent water or vermin ingress.
- Active cathodic protection is installed. This appears to be functional but is outside of AE's expertise to determine the condition.
- An old Schneider power fail relay is seen on the wall. This is assumed to be tied to the SCADA. Replace when it fails, otherwise it has no operational impact.
- The grounding wire above the PLC cabinet for the polyphaser lightning protection system has been disconnected. This needs to be reconnected as soon as possible.
- The PLC cabinet UPS is a single unit. UPS batteries should be replaced every 5 years on average; however, some sort of mud or drilling fluid has been splashed all over the inside of the PLC cabinet coating the Panduit and UPS/cables. Recommend replace the UPS unit entirely to avoid potential issues with damage from this event.
- An original design telephone entrance panel is present. This panel is not in use.

- The grounding to the gas piping and the grounding to the process piping is unacceptable. The Canadian Electrical Code requires a permanent bonding point; however, the bolt on a valve actuator is not permanent. The gas piping connection needs run back to the electrical panel ground and a permanent pipe connection point is required.

2.2.2 Controls

The control system PLC was upgrade recently to a Schneider M340 PLC, and the radios upgraded to GE MDS SD4 licensed radios. M340 is a current PLC platform and no upgrade at this time is recommended. A tower mounted Yagi antenna is mounted several meters away from the building (cable routed via 4" conduit) and points to the HWY 21 repeater station located at the HWY 21 Booster Station. PLC communication is via serial MB protocol for system stability.

- The old MDS 4710 series radio has been left in the PLC cabinet post SCADA upgrade. This can be removed and recycled.
- PLC spare rack slots have terminal covers to protect the connections. This is acceptable.
- Cabinet has a Sixnet 5 port managed ethernet switch for future communications and PLC access.
- Terminals and wiring appear in good condition.
- Instrumentation is newer E&H units, and in good condition.
- The flow control valve, actuator, and flow meter are all new from the recent SCADA upgrade for the PLCs.
- The flow meter has grounding rings and is grounded correctly.
- The chlorine residual analyser is a ProMinent unit with a CTE sensor (Total Chlorine). The incoming water feed is routed correctly, rising at all times to the analyser. The drain line runs directly into a drain pipe that empties into the reservoir. An air gap is recommended to prevent drain contaminants from crawling up the hose into the analyser chamber. Recommend to either add a funnel at the top of the drain pipe stack and position the hose to drop the drain water into the funnel with an air gap, or, insure that where the drain hose returns to reservoir it is air gapped.
- The level transmitter is a Milltronics MiniRanger Plus unit and appears to be in good condition. The element penetrates the floor just in front of the transmitter. The floor penetration is well covered.
- The pressure gauge between the PRV and flow valve has a block and bleed valve, but is small. A 4-inch face is recommended for easier reading.

2.2.3 Electrical and Controls Photos

Image Table 2-4
Calmar Fill Station - Electrical and Controls Photos

MCB

Antenna and Tower

Oversized Distribution Panel

PLC Panel Wiring

UPS Mud Covered

Radios

PLC Rack

Power Fail Relay

Inlet PIT and Analyser Feed

Flow Meter

Ground Connection to Valve

Rusted Piping and Valve

PRV

Rusted Valving and Piping

LIT Access - Is Water Return Sealed?

Ground Not Connected

Penetrations Not Sealed

Mud Covered Wiring

2.2.4 Process

- Valve actuators and piping have significant corrosion. This is usually indicative of poor ventilation allowing humidity to build up. A review of the heating and venting needs to be conducted to resolve these corrosion issues.
- PRV appears to be original based on the corrosion observed. Recommend a rebuild kit be considered to ensure the PRV/PSV continues to function correctly for the future. This includes replacing the PRV pilot solenoid as it appears original and is likely nearing end of life failure.
- The ARV is located downstream of the meter and control valve. This configuration encourages trapped air to travel through the piping to be released. The air release valve (ARV) is better suited to the upstream side to ensure no air is pushed through the flow meter, which will affect accuracy. Recommend that an ARV be installed before flow meter.
- Since the external piping is cathodically protected an isolation kit (bolt sleeves and gasket) where the stainless-steel transitions to carbon steel is required to isolate the system ground from the cathodic system. This also prevents corrosion between the dissimilar metals due to a galvanic series. These different piping materials are the result of a second reservoir feed line being installed. Recommend isolation kits be installed.
- The motorized butterfly valve on the discharge near the floor has been installed vertically. This puts undue stress on the actuator and valve shaft.

Image Table 2-5
Calmar Fill Station – Piping and Valves

Significant Corrosion

Rebuild PSV/PRV

Relocate ARV

Isolate Dissimilar Metals

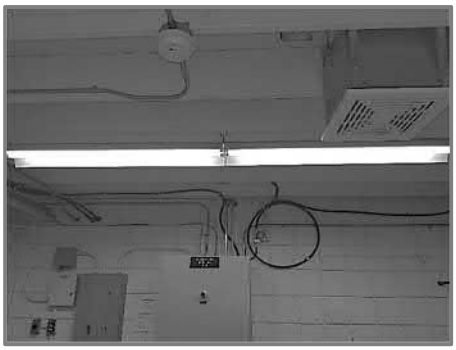
Valve Actuator Orientation

2.2.5 Building Mechanical

- The room is equipped with a ceiling-mounted gas furnace. Based on observation, the unit appears new.
- At time of inspection, a box fan was located in room. AE have assumed that the box fan was to improve air movement within the room.
- Recommend that the ventilation within the building be reviewed, to ensure that the ventilation requirements are met.
- The ceiling mounted gas furnace should be clean and inspected yearly.

Image Table 2-6
Calmar Fill Station - Building Mechanical

Ceiling Mounted Heating Unit



Ceiling Mounted Exhaust Fan

2.3 Nisku West Fill Station

The Nisku West Fill Station is located along the Sparrow Drive Service Road, within the Nisku Industrial Park. The Commission has a dedicated fill room at this location. The following outlines AE's observations from the facility.

2.3.1 Electrical

The Nisku West Fill Station has a single-phase 240V 70A service main circuit breaker (MCB) feeding into a 12 circuit 100A 240V single-phase distribution panel. The utility meter was observed outside the door on the wall. The rest of the observations are as follows:

- The main breaker looks to be visually in good shape, but the internals should be checked and replaced if corrosion is found.
- The main distribution panel appears to be in good condition for original equipment; however, an internal inspection for pitting or corrosion is prudent, with replacement if corrosion is found. Rust is observed on the lower corners of the panel suggesting that corrosion is occurring inside the panel due to excess moisture.
- The venting of this room needs to be examined as the rust observed is indicative that excess moisture is present.
- There is a smoke detector on the ceiling, and it appears relatively new. This should be replaced in 5 to 10 years with a suitable unit to provide an alarm contact.
- Lighting appears to be original fluorescent fixtures, and since the lights are off 99% of the time there is little benefit to upgrading these to LED. However, water damage to several of the lights can be observed and the source of the water needs to be determined, and the damaged fixtures replaced with new LED units.

- An emergency wallpack is present, but the ability of an old unit like this to provide the 30 minutes emergency lighting required is unlikely. As well, there is no illuminated exit sign over the doorway. Recommend a new emergency exit sign with lights be installed next to the door (include auto exerciser option) to resolve both issues.
- An alarm system with keyed switch was observed on the PLC panel above the chlorine analyser. The system is functional.
- A carbon monoxide detector was observed, and the unit appeared yellowed from age. These should be replaced every 5 years. Recommend replacement.
- There is a wall penetration near the PRV through which daylight can be observed. This hole should be sealed to prevent water or vermin ingress.
- Active cathodic protection is installed. This appears to be functional, but is outside of AE's expertise to determine the condition.
- An old Schneider power fail relay is seen on the wall. This is assumed tied to the SCADA. Replace when it fails, otherwise it has no operational impact.
- The pipe appears to be well grounded.
- PLC cabinet UPS is a single unit. UPS batteries should be replaced every 5 years on average.
- An original design telephone entrance panel is present. This panel is not in use.
- There is a Pyrotenax inline heat tracing system for the water line. This system appears to be original to the facility. Recommend updating to a newer GFI system to meet current Electrical Code.

2.3.2 Controls

The control system PLC was recently upgraded to a Schneider M340 PLC, and the radios upgraded to GE MDS SD4 licensed radios. M340 is a current PLC platform and no upgrade at this time is recommended. A Yagi antenna is mounted on a mast to the building and points to the HWY 21 repeater station located at the HWY 21 Booster Station. PLC communications is via serial MB protocol for system stability.

- The old MDS 4710 series radio has been left in the PLC cabinet post SCADA upgrade. This can be removed and recycled.
- PLC spare rack slots have terminal covers to protect the connections. This is acceptable.
- The cabinet has a Sixnet 5 port managed ethernet switch for future communications and PLC access.
- Terminals and wiring appear in good condition.
- The rear door cannot open past the manual isolation valve.
- Online instrumentation is newer E&H units and in good condition.
- The flow control valve, actuator and flow meter are all new from the recent SCADA upgrade for the PLCs.
- Flow meter has grounding rings and is grounded correctly.
- The chlorine residual analyser is a ProMinent unit with a CTE sensor (Total Chlorine). The incoming water feed does have an air-trap, and this should be corrected so the line rises or stays level at all times towards the analyser.
- The drain line runs directly into a drain pipe that empties into the reservoir. An air gap is recommended to prevent drain contaminants from crawling up the hose into the analyser chamber. Recommend either adding a funnel at the top of the drain pipe stack and position the hose to drop the drain water into the funnel with an air gap, or, insure that where the drain hose returns to reservoir it is air gapped.

- An additional note on the analyser drain line; where it enters the floor flange to drain back to the reservoir does not appear to be well sealed. This could allow floor wash water to enter the wetwell. Recommend this hole be sealed with caulking to prevent water contamination.
- The level transmitter is a Milltronics MiniRanger Plus unit and appears to be in good condition. The element penetrates the floor just in front of the transmitter. The floor penetration is well covered.

2.3.3 Electrical and Controls Photos

Image Table 2-7
Nisku West Fill Station - Electrical and Controls Photos

MCB

External Power Meter

Distribution Panel

Power Fail Relay

UPS

Radios

PLC Rack

Valve and PRV Assembly

Inlet PIT and Analyser Feed

Flow Meter

Heat Trace Controller

Hole to Outside

Pipe Grounding

Chlorine Analyser

Drain Line Needs Air Gap

Drain Line and Level Element

Valve Blocks Rear Cabinet Door

Stained Lighting

2.3.4 Process

- Valve actuators and piping do not show signs of corrosion. Piping appears to have been painted in the last few years.
- There is some rusting where pipe supports have been moved/relocated.
- PRV appears to be in good condition based on the lack of corrosion observed. Recommend a rebuild kit be considered to ensure the PRV/PSV continues to function correctly for the future. This includes replacing the PRV pilot solenoid as it appears original and is likely nearing end of life.

Image Table 2-8
Nisku West Fill Station – Piping and Valves

Piping Condition

Pipe Support Rust

Valve Condition

2.3.5 Building Mechanical

- The room is equipped with a ceiling mounted gas furnace. Based on observation the unit appears newer.
- The gas meter is located within the meter room. When the meter is upgraded by the utility company, the gas meter should be relocated to the outside of the building.
- Wall penetration near the PRV should be filled.
- There is a partial dividing wall between the Commission's meter room and the County's pump room. Due to the shared space the heating and ventilation requirements for the space should be reviewed with the County.

Image Table 2-9
Nisku West Fill Station - Building Mechanical

Ceiling Mounted Air Handling Unit

Gas Meter

Fresh Air Make up

2.4 Nisku East Fill Station

The Nisku East Fill Station is located east of 9 Street, and approximately 800 m south of 30 Avenue within the Nisku Industrial Park. The Commission has a dedicated fill room at this location. The following outlines AE's observations from the facility.

2.4.1 Electrical

The Nisku East Fill Station does not have a power panel for the room. All loads are fed from the reservoir side of the building. This can be an issue for simple isolation or reset of circuits as it requires the County to respond and allow reservoir access. Very little wall space exists to allow for the installation of a small power panel, recommend leave as-is. The rest of the observations are as follows:

- The ceiling is very high. No smoke detector was observed. A smoke detector on the wall with an alarm contact to the SCADA is recommended.
- Lighting appears to be chain suspended fluorescent fixtures. Since the lights are off 99% of the time, there is little benefit to upgrading these to LED. Recommend that these units be upgraded to LED when the existing units fail.
- An emergency wallpack is present; however, building code requires the exit to be marked with an illuminated exit sign. Recommend a new emergency exit sign with lights be installed next to the door (include auto exerciser option) to resolve both issues. Note that this will require a dedicated circuit to meet code.
- An alarm system with keyed switch was observed on the PLC panel below the HMI display. The system is functional.
- A Carbon Monoxide detector was not observed in this room. They are not specifically required but one should be installed to be consistent with the other facilities.
- No active cathodic protection was observed in this room.
- The pipe appears to be well grounded.
- PLC cabinet UPS is a single unit. UPS batteries should be replaced every 5 years on average.

2.4.2 Controls

The control system PLC is a Schneider M340 PLC and the radio is a GE MDS SD4 licensed radio. M340 is a current PLC platform and no upgrade at this time is recommended. A Yagi antenna is mounted on a mast to the building and points to the HWY 21 repeater station located at the HWY 21 Booster Station. PLC communications is via serial MB protocol for system stability.

- PLC spare rack slots have terminal covers and slot covers to protect the connections. These are acceptable.
- The cabinet has a Sixnet 5 port managed ethernet switch for future communications and PLC access.
- Terminals and wiring appear in good condition.
- Online instrumentation is newer E&H units and in good condition.
- The flow control valve, actuator, and flow meter are all new.
- Flow meter does not have grounding rings and is therefore not installed per manufacturer's recommendations. Recommend ground rings be added.
- The chlorine residual analyser is a ProMinent unit with a CTE sensor (Total Chlorine). The incoming water feed does have an air trap as it drops down towards the analyser and then rises back up just before connecting. A realignment of the water line along the wall can correct this installation mistake.

- No level transmitter was observed in the room as such it is assumed the level is a signal split with the reservoir side.
- PRV is fairly new and in good condition. It is installed crooked to the pipe
- Pressure gauge PI-0200 at the analyser tap is small and should be replaced with at least a 4” face gauge.
- PIT-0200 has no Block and Bleed to ensure an accurate reading as well a manual line tap directly under the PIT when in use will create a pressure gradient and severely skew the transmitter readings. Recommend the manual line be located elsewhere and a Block and Bleed valve installed for the transmitter.

This facility has an Automation Direct Graphical HMI. The HMI displays the system and setpoint status with trends.

2.4.3 Electrical and Controls Photos

Image Table 2-10
Nisku East Fill Station - Electrical and Controls Photos

Flow Control Valve

PRV

Bypass Isolation Valve

Flow Meter

Cl2 Feed Line

Tap Before Pressure Transmitter

CL2 Analyser

HMI

No Exit Sign

PLC Rack and Radio

UPS and Single Power Supply

2.4.4 Process

- Piping and equipment are in generally good condition.
- The flow control valve appears to be installed backwards. While functional this will render any anti-cavitation trims useless and result in excessive valve wear.
- Pressure gauge PI-0200 is “pegged”. Consider a gauge with a higher range (see EIC photos).
- Remove/replace galvanized fittings on instrumentation piping.

Image Table 2-11
Nisku East Fill Station – Piping and Valves

Pipe, Valves Condition

Flow Control Valve Reversed

Remove Galvanized Fittings

2.4.5 Building Mechanical

- The Fill Station uses one portion of the reservoir building. Air handling unit is in another portion of the building that was not accessible.
- The mechanical equipment in the space consist of one supply outlet mount low and 1 electric baseboard convector mounted below the valve assembly.

2.5 City of Beaumont Fill Station

The City of Beaumont Fill Station is located at 57 Street and 50 Avenue within the City. The Commission has a dedicated fill room at this facility. This facility was constructed in approximately 1982/83. The following outlines AE’s observations from the facility Fill Station.

2.5.1 Electrical

The City of Beaumont Fill Station has a 3 phase 600V 20A incoming electrical service that powers a 15kVA 600/208/120V transformer connected to a single-phase 240V 225A 24 circuit distribution panel.

- The MCB appears to be in good condition with no obvious signs of corrosion; however, it is original to the facility and due to be replaced or re-furbished due to age. A new MCB is recommended to ensure system electrical protection is maintained.
- The distribution panel is several years old but appears to be in good condition with no obvious signs of corrosion. An internal inspection for pitting or corrosion is prudent and replacement if corrosion is found is warranted, but the overall system condition does not suggest it will be corroded inside the panel.
- There is a smoke detector on the ceiling, and it appeared clean. Since the age was not indicated on the device, this device should be replaced with a suitable unit to provide an alarm contact to SCADA.
- Lighting appears to be original fluorescent fixtures. Since the lights are off 99% of the time there is little benefit to upgrading these to LED. When the existing units fail, they should be upgraded to LED units.
- An emergency wallpack is present but the unit is missing a bulb, and the ability of an older unit like this to provide the 30 minutes emergency lighting required is unlikely. Also missing is an illuminated exit sign over the doorway. Recommend a new emergency exit sign with dual lights be installed over/next to the door (include auto exerciser option) to resolve both issues. A dedicated power circuit is required by Code for the exit sign.
- The external light over the door way is a very old HPS wall pack. Recommend that because this unit is on for a considerable amount of time that a new LED vandal resistant unit be installed with integral photocell. The improved light cut-off features of the LED will reduce bleed to the residential properties around the facility.
- An alarm system with keypad was observed, but power appears to be disconnected to the panel. An alarm via the PLC and keyed switch is used instead. The system is functional.
- A carbon monoxide detector was observed. These should be replaced every 5 years and as such AE recommend replacement.
- Active Cathodic protection is installed and mounted externally. This appears to be functional but is outside of AE's expertise to determine the condition. One area of concern is the proximity of the unit heater vent to the Cathodic box, it is partially over top of the box and corrosive vent condensate could drip onto the Cathodic box. Ensuring condensate cannot drip onto the junction box is a prudent preventative measure.
- A power fail relay is seen on the wall. This is assumed tied to the SCADA. Replace when it fails otherwise it has no operational impact.
- PLC cabinet UPS is a single unit with an extension battery pack. UPS batteries should be replaced every 5 years on average.
- A telephone entrance panel is present. This panel is not in use.

2.5.2 Controls

The control system PLC is a Schneider M340 PLC and the radio is a GE MDS SD4 licensed radio. M340 is a current PLC platform and no upgrade at this time is recommended. A Yagi antenna is mounted on a mast to the building and points to the HWY 21 repeater station located at the HWY 21 Booster Station. PLC communications is via serial MB protocol for system stability.

- PLC spare rack slots have terminal covers to protect the connections. This is acceptable.
- Cabinet has a Sixnet 5 port managed ethernet switch for future communications and PLC access.
- Terminals and wiring appear in good condition.

- Online instrumentation is newer E&H units and in good condition.
- The flow control valve, actuator and flow meter are all new.
- Flow meter has grounding rings and is installed per manufacturer's recommendations.
- The chlorine residual analyser is a ProMinent unit with a CTE sensor (Total Chlorine). The incoming water feed line to the transmitter rises consistently from the PRV to the analyser. This is installed correctly.
- The drain line runs directly into a drain pipe that empties into the reservoir, an air gap is recommended to prevent drain contaminants from crawling up the hose into the analyser chamber. Recommend either adding a funnel at the top of the drain pipe stack and position the hose to drop the drain water into the funnel with an air gap or insure that where the drain hose returns to reservoir it is air gapped.
- The level transmitter is a Milltronics MiniRanger Plus and appears to be in good condition.
- Pressure gauge generally are large face units and easy to read but several are not tagged. The gauge between the PRV and flow control valve needs a tube extension as the isolation valve handle blocks the dial face.

2.5.3 Electrical and Controls Photos

Image Table 2-12
City of Beaumont Fill Station - Electrical and Controls Photos

Original Outside Light

Cathodic Box & Antenna Mast

MCB

Distribution Panel

Level Transmitter

Level Element & Drain Line

Flow Control Valve

PRV

Flow Meter

CL2 Analyser

Heat Trace Controller & Keypad

Smoke Detector

PLC Rack

Radios

UPS with Battery Extension Pack

Yellowed Gauge

2.5.4 Process

- Piping and valves are in generally good condition.
- PRV appears to be in good condition based on the lack of corrosion observed. Recommend a rebuild kit be considered to ensure the PRV/PSV continues to function correctly for the future. This includes replacing the PRV pilot solenoid as it appears original and is likely nearing end of life.
- Consider installation of an air release valve in the influent bypass elbow. This will eliminate any entrained air before it can affect any of the downstream instruments.
- Remove galvanized fittings on instrumentation piping.

Image Table 2-13
City of Beaumont Fill Station – Piping and Valves

Piping, Valves Condition

ARV & Galvanized Fittings

2.5.5 Building Mechanical

The mechanical equipment in the space consist of one REZNOR gas fired unit heater vented to the exterior. Combustion air is from the room space. Controls are using a line voltage stat. The unit heater is new and in good operational condition. Service life of 20 years is expected.

2.6 HWY 21 Booster Station

The HWY 21 Booster Station is located at the intersection of Township 500 and Range Road 241 within Leduc County. This facility provides system pressure to the Commission Transmission Line No 2, which services the Hamlet of New Sarepta, Village of Hay Lakes, and Hamlet of Armena. This facility was constructed in 2009/2010. AE's observations from the facility are summarized below.

2.6.1 Electrical

The HWY 21 Booster Station has a 3 phase 600V 75kVA utility transformer with pad mounted metering. This feeds into an Allen-Bradley Bulletin 2100M MCC with a 600A bus 60A MCB, with a 100A rated transfer switch. The booster station contains two 20HP variable frequency drive (VFD) driven pumps operating in Duty/Standby configuration. A 42kW 3 phase 600V natural gas generator provides emergency backup power. The facility was built around 2009/2010, and is in overall good condition from an electrical perspective. The system voltage was observed as 625V_{L-L} average. This a little high, but is within normal tolerance. If the value was closer to 635V then the utility should be contacted to tap the transformer down. Too high of an incoming voltage can result in frequent VFD overload trips as well a higher than specified voltage on the distribution wiring that can cause damage to solenoids and lights.

- The MCC appears to be in good condition with no obvious signs of corrosion, and given its age it has at least another 15 years of life. There is a good section and a half of spare space provided. Expansion physically is not an issue for this MCC.
- The ASCO transfer switch appeared to be operational and operations indicated that routine generator failure testing is conducted.
- The 120/208V distribution panel is in good condition with no obvious signs of corrosion and is fed by a 7.5kVA step down three-phase transformer.
- The two VFD's are 20HP units from Cutler Hammer (SVX9000 series) with passive harmonic filters.
- There is a smoke detector on the ceiling above the MCC. This device is original to the facility and is due for replacement.
- Lighting is the original to the building fluorescent fixtures. Since the lights are off 99% of the time there is little benefit to upgrading these to LED. When these units fail, recommend upgrading to LED lights.
- Emergency lighting wall packs are present upstairs and downstairs including the stairwell. Since these units are 10 years old, the batteries should be replaced to ensure they can function as intended for 30 minutes on battery.
- The main entry door has an illuminated exit sign with lights.
- The external lighting over the door way and around the building is LED with built in photocell control, and appear in good condition.
- An alarm via the PLC and keyed switch is used for security. The system is functional.
- A carbon monoxide detector was observed. These should be replaced every 5 years, and AE recommend replacement, and marking the date of install on the unit.
- PLC cabinet UPS is a single unit. UPS batteries should be replaced every 5 years on average.
- A Sola Hevi-Duty Power Conditioner is installed to filter the power going to the UPS. After 10 years this filter needs to be closely inspected for wear and damage, and replaced if any is found. These units have shown a tendency to wear out and fail if exposed to significant line noise after several years while doing their job of noise filtering. Less expensive options that perform the same function now exist, such as AEGIS Power filters.
- The sump pump in the basement appears to operate often if the flow rate of water to the sump is any indication. Operators test the sump, but replacement is recommended after 10 years of repeated use before it fails. Debris appears to have been swept into the sump pit, a cleanup is recommended to prevent debris and other matter from clogging the pump.
- When onsite, it was noted that someone had stolen/cut the original ground grid. A temporary ground cable had been installed but the new cable has yet to be buried into the ground to protect it.

2.6.2 Controls

The control system PLC is a Schneider Momentum PLC, and the radio is a GE MDS SD4 licensed radio. The Momentum is still a current platform. During the last SCADA upgrade this station was too new to be upgrade, but sufficient years have passed that it is now due to be upgraded to meet the current Commission System. An M340, or the newer M580 is the recommended platform.

A Yagi antenna is mounted on a new 60 m freestanding radio tower. This location acts as the new SCADA repeater node for all the commission SCADA communications. The old radio tower is still present and should be decommissioned. PLC communications are via serial MB protocol for system stability.

- PLC is a Momentum and is due for upgrade to match the rest of the SCADA as an M340.
- Cabinet has a Sixnet 5 port ethernet switch for future communications.
- No HMI exists at this facility. Because this facility contains pumps, AE recommend a small touchscreen interface be added to allow operator access to status and local setpoints. The HMI should be password protected with appropriate operator access levels. Recommend this occur at the same time the PLC is upgraded.
- Terminals and wiring appear in good condition.
- Online instrumentation is newer E&H units and in good condition.
- Flow meter has grounding rings and is installed per manufacturer's recommendations.
- Pressure gauges added to the PIT's in the basement are small. These should be 4" dual scale for easier reading. PIT's all have Block and Bleed valves. Better cable supports should be fabricated to support the instrument cabling to the discharge PIT's to relieve stress on the instruments.
- The sump flood bulb appears to be in good condition

2.6.3 Electrical and Controls Photos

Image Table 2-14
HWY 21 Booster Station - Electrical and Controls Photos


Utility Transformer


PLC Rack


Temporary Ground

MCC

Exit Sign with Lights


Old Radio Tower

PLC Cabinet

UPS

PIT with Tiny Pressure Gauge

Flow Meter

Sump

Power Meter

Basement Piping

Generator Nameplate

2.6.4 Process

- Piping and valving are in good condition. Superficial rust on bolts on the pump heads is noted.
- Both pumps are horizontal split case, each rated at 13.4 L/sec @ 63.3 m TDH.
- BP-0406 actual reading – 2.21 L/sec @ 47 m TDH (48.4 Hz./2,856 rpm) – see table in Appendix A for design vs. actual comparisons of flow and pressure, and the accompanying curve for design vs. actual reading calculated to full speed.
- BP-0407 actual reading – 2.47 L/sec @ 47 m TDH (47.9 Hz./2,826 rpm) – See Appendix A.
- Both pumps are operating close to their design curve but are operating very inefficiently due to low flow conditions at the time of inspection. The Commission should review the set points for these pumps.
- Vibration readings for both pumps and motors were within acceptable limits.
- Sump pump is also rusty, but it is superficial.

- Galvanized fittings have been used for the pressure transmitter, gauge and sample lines. Galvanized piping is not allowed to be used with potable water systems and should be replaced.

Image Table 2-15
HWY 21 Booster Station – Piping and Valves

Head Bolts – Superficial Rust

Sump Pump

Galvanized Fittings

2.6.5 Building Mechanical

- The area has a ceiling mounted unit heater.
- Building space as a supply fan and relief louver for general ventilation.
- A ceiling mounted fan for air circulation within space.
- The generator has an intake louver and exhaust louver for cooling and ventilation purposes.
- The ceiling mounted unit heater should be cleaned on an annual basis.

2.7 Boundary Station

The Boundary Station is the main pumping station for the Commission. The building is located adjacent to the Queen Elizabeth Highway south of 41 Avenue. This facility was constructed in the early 1980's. AE's observations from the facility are as follows.

2.7.1 Electrical

The Boundary Station has a 3 phase 600V 750kVA utility transformer with pad mounted metering fed from overhead powerlines. This feeds into a service entrance MCC section with an 800A MCB bus with an integral customer power meter. The facility does not have a generator or transfer switch. The MCB feeds via tray cable to an MCC section approximately 15m away. This MCC section contains the feeder breakers that connect to the external stand-alone VFD cabinets. The booster station contains four large VFD driven pumps operating in various configurations.

- The utility transformer outside has a significant build-up of dead leaves around the base. This is a fire hazard and needs to be cleaned up annually.
- The radio tower ground appears acceptable.
- The HPS yard lights are original to the facility and showing their age. The pole bases are corroded, and the light themselves are faded and cracked. Recommend these lights be replaced with LED style on new poles.
- Photocell controlled perimeter LED lighting has been added recently to the building.
- The building is equipped with lightning protection along the parapet. The ground conductors appear to be intact and securely fastened to the building exterior.

- An emergency exit light and exit lighting are present at the front and rear exits. The operator indicated the batteries were being replaced at the time of this inspection, but half the bulbs were burnt out on the exit sign at the back door. Although the front exit light is illuminated, there is no other lighting for that exit hallway. Recommend replacement of both front and rear exit signs with a combination exit, and emergency light to meet both criteria of an illuminated sign and illuminated path.
- Lighting in the facility is a mixture of the original compact fluorescent fixtures and some high bay metal halide fixtures; lighting levels seemed adequate. Recommend changing the metal halide fixtures to LED style as this will eliminate restrike wait times should the lights be turned off briefly by accident. Since the facility is not occupied 8 hrs a day, replacement of the fluorescents should only occur as they fail. When the fluorescent fixtures are replaced, AE recommend replacing the fixture, not upgrading with an LED retrofit kit. The cost of the retrofit is almost the same as a new fixture.
- The pot lights in the conference room can have the bulbs replaced with LED. This will extend the life of the fixture, and include the added benefit of reduced energy consumption.
- The distribution MCC is original to the facility (30+ years old) and needs to be replaced due to age.
- The VFD's were inspected via infrared camera in 2014. Typical VFD life is 20 years, based on the estimated installation date these have about 5 years life left.
- Telephone service is present at this facility and is in use.
- A carbon monoxide detector was observed. These should be replaced every 5 years, and as such AE recommend replacement, and marking the date of install on the unit.
- All but one motor was flagged as Inverter Duty rated. That needs to be addressed when the pumps are upgraded as all motors on VFDs need to be inverter duty rated.

2.7.2 Controls

The Master PLC is a Schneider M340 PLC and the radio is a GE MDS SD4 licensed radio. The Master HMI is a GE Cimplicity (700 tag), which was converted from Wonderware several years ago. The HMI includes a 500 tag Historian license.

The Master PLC communicates via licensed serial radio using MB Serial to the SCADA. The radio points to the HWY 21 Booster Station via a Yagi antenna that is on a 30 m tower outside the station. The design intent of the current radio configuration is to allow the Master station to move locations if required as it is a node off the repeater tower not the central repeater location.

Overall, the booster station had major instrumentation and control upgrades only a few years ago and as such the station is in good condition.

- Master HMI uses a software alarm dialer via a Multitech voice modem for call outs. This is a flexible option; however, it does place the onus on a single computer to stay operational for reliable alarm callouts. Hardware versions like a Barnett Engineering system dialer are less likely to crash due to a virus or hard drive failure.
- HMI Computers should be industrial hardened or Server grade machines, with Raid1 mirrored if not Raid5 redundant drives. They operate 24 hrs a day year round, and as such, wear out quickly. The computer hardware needs to be replaced every 5 years. Replacement of hardware often results in new operating systems which drives software upgrades.
- PLC Cabinet has an ethernet switch for HMI and PLC.
- Terminals and wiring appear in good condition for main PLC cabinet.

- Online instrumentation are newer E&H units and are in good condition. There are a couple of old Bristol Babcock pressure transmitters connected still but these are believed to be non-functional and not used.
- The EPCOR temperature transmitter has the cover off and is assumed to be undergoing repair by EPCOR.
- The station discharge flow meter has grounding rings and is installed per manufacturer's recommendations.
- EPCOR inlet flow meter is an Elster/AMCO Flowmeter directly connected to the EPCOR metering cabinet. This cabinet reproduces the flow rate for the booster station SCADA. This meter is owned and maintained by EPCOR.
- Pressure gauges have isolation valves and the pressure transmitters have Block and Bleed valves.

2.7.3 Electrical and Controls Photos

Image Table 2-16
Boundary Booster Station - Electrical and Controls Photos


Light Pole


Light Pole


Utility Transformer


Debris Behind Transformer


Exterior LED Lighting


Lightning Down Conductor


Lightning Protection Spike


Interior Emergency Lighting


Main Entrance: No Emerg. Lighting

MCC

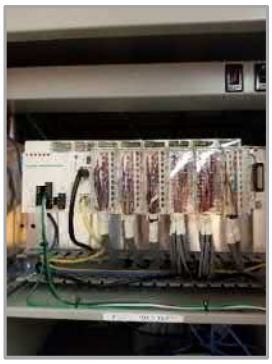
High Bay Fixture

Rear Exit Sign Half Lit

Distribution Panel

Motor Nameplate:
Not Inverter Duty

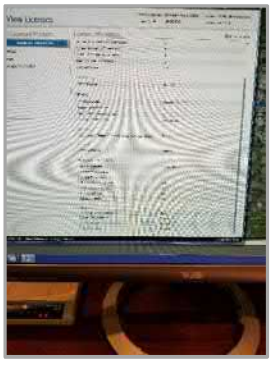
CO Detector



Master PLC Rack

Radio

HMI Licensing

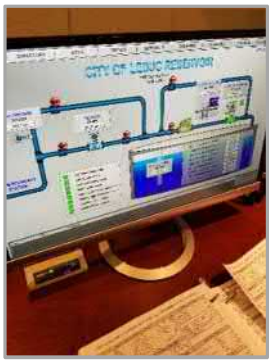


Server Licensing

Old and New Instrumentation

Discharge Magmeter

CL2 Analyser



HMI Screens: Cimplicity

2.7.4 Process

- The piping and equipment are in generally good condition.
- There is no evidence of rust, although there is a calcium build-up on the bearings of P-103.
- Pump P-102 has been dismantled. The internals are out for service at the time of inspection.
- See table in Appendix A for design vs. actual comparisons of flow and pressure, and the accompanying curve for design vs. actual reading calculated to full speed for pumps P-103, 104, the actual flow & pressure in the table and the plotted point were not the same.
- Both pumps are operating close to their design curve, but both were operating very inefficiently due to low flow conditions.
- Vibration readings for both pumps and motors were within acceptable limits.
- All valving appears to be operational.
- Most instrument fittings are either copper or stainless steel, but there are some galvanized fittings that should be replaced.
- Chlorine analyzer is a ProMinent unit with a CTE sensor for total chlorine.

Image Table 2-17
Boundary Booster Station – Piping and Valves

P-102 Dismantled for Service

Pump Gallery

P-103

P-104

General Piping Layout

ProMinent Chlorine Analyzer

2.7.5 Building Mechanical

- One forced-air furnace with a gas heat exchanger and cooling coil, Nordyne Model G5RA896C-16-H installed 1997. supplies conditioned air to the office and service spaces. This unit appears to be near the end of its operational life. The control panel was replaced in 2003. Flue has signs of condensation leaking. Unit is controlled from a line voltage thermostat.
- One roof top HVAC unit (Climate Master, and no longer available). This unit supplies conditioned air to the pump room and is not operated often. The unit is past its expected operation life. Create duct in the pump room.
- One Delhi 200 series direct drive exhaust fan (Located in the main entrance corridor). This unit exhausts air from the service areas. It appears to be in good operational condition; however, it is at, or near the end of its operational life.
- Two Pen Zepyhr ceiling mounted direct drive exhaust fans exhaust air from the washrooms. These are in good operational condition.
- Two Lennox gas-fired unit heaters provide additional heat to the pump room. These are vented directly outside. Combustion air is from the pump room. These appear to be new and are in good operational condition.
- Two relief air hoods mounted on the roof appear to be new and are in good operational condition.
- One roof mounted condensing unit AIRE-FLO model 13ACD-030-230-15. This unit appears to be in good operational condition; however, the unit is not properly mounted and has shifted.
- Roof venting appears to be new and in good condition.
- Domestic hot water is supplied by a John Woods 32000 BTU, commercial/residential water heater.
- The facility transformer is in contact with a large Aspen tree, and additionally, there are downed branches around the base of the unit. The area should be cleaned of debris.

2.8 City of Leduc North Reservoir

The City of Leduc North Reservoir is located at 6611 Sparrow Drive, within the City of Leduc. The Commission has a dedicated meter room within this facility. AE's observations are as follows.

2.8.1 Electrical

The City of Leduc North Reservoir Fill Station has a single-phase 240V 70 A service fed from a pole mounted transformer on the property edge. The power runs underground to an exterior wall mounted utility meter then into the MCB. The MCB then feeds a feeding into a 12 circuit 100A 240V single-phase distribution panel.

- The MCB is severely corroded and needs replacement. Consider sealing the conduit between the meter and the MCB, this is a likely source of cold air which is condensing on the MCB, causing corrosion issues.
- The main distribution panel has surface corrosion and an internal inspection is recommended. With knowledge that this panel is almost as old as the MCB and the presence of rust, replacement is recommended. Rust implies this panel has been exposed to moisture for a long period of time.
- A second UPS distribution panel exists. This is probably redundant and can be combined into one panel with the main distribution panel. Anything on UPS power is typically plugged directly into the UPS.
- The venting of this room needs to be examined as excess moisture is obviously present due to the rust observed on the equipment.
- The external power and telephone conduit are rusted. A coat of protective paint is required to slow down the eventual rust through on these metal conduits.
- There is a smoke detector on the ceiling, and it appears relatively new. This should be replaced in 5 to 10 years with a suitable unit to provide an alarm contact.
- Lighting appears to be original fluorescent fixtures. Since the lights are off 99% of the time there is little benefit to upgrading these to LED. Recommend replacing these units with LED lights when the existing units fail.
- An emergency wallpack is present over the door but the ability of an old unit like this to provide the 30 minutes emergency lighting required is unlikely. Also, there is no illuminated exit sign over the doorway. Recommend a new emergency exit sign with lights be installed over the door (include auto exerciser option) to resolve both issues. An Exit sign will require a dedicated power circuit.
- An alarm system with keyed switch was observed in the PLC panel door. The system is functional. An old DSC alarm system and keypad are still on the wall but disconnected.
- A carbon monoxide detector was observed and appears to be relatively new. These should be replaced every 5 years.
- The gas line is grounded outside, but a gas piping grounding point was not found inside. The wall penetration where the gas line enters does not appear to be plugged. Recommend sealing the hole with foam to prevent vermin from entering the building, and adding a gas piping ground connection.
- The furnace is powered by an extension cord plugged into a wall socket and hardwired to the furnace. This is a possible Code issue; a dedicated circuit is required with a disconnect inline to the furnace. Recommend repairing this condition.
- An old Schneider power fail relay is seen on the wall. This is assumed tied to the SCADA. Replace when it fails otherwise it has no operational impact.
- The process pipe is well grounded with a welded connection and servit post.
- The PLC cabinet UPS is a single unit with a battery extension. UPS batteries should be replaced every 5 years on average.
- A telephone entrance panel is present. This panel is not in use.

2.8.2 Controls

The control system PLC was upgraded recently to a Schneider M340 PLC and the radios upgraded to GE MDS SD4 licensed radios. M340 is a current PLC platform and no upgrade at this time is recommended. A mast-mounted Yagi antenna is mounted to the building and points to the Hwy 21 Booster Station and PLC communications is via serial MB protocol for system stability.

The control system PLC was upgraded recently to a Schneider M340 PLC and the radios upgraded to GE MDS SD4 licensed radios. M340 is a current PLC platform and no upgrade at this time is recommended. A mast-mounted Yagi antenna is mounted to the building and points to the Hwy 21 repeater station. PLC communications is via serial MB protocol for system stability.

- PLC spare rack slots have terminal covers to protect the connections. This is acceptable.
- Cabinet has a Sixnet 5 port managed ethernet switch for future communications and PLC access.
- Terminals and wiring appear in good condition.
- Instrumentation is newer E&H units and are in good condition.
- Flow meter has grounding rings and is grounded correctly.
- The chlorine residual analyser is a ProMinent unit. The incoming water feed has an air trap issue. The pipe tap should always rise or fall so air cannot get trapped in the line; this one falls and then rises to the instrument. Recommend re-routing the water line and adding a support to the frame to facilitate the elimination of the air traps.
- The analyser discharge drops to a conduit chase then to the level transmitter opening in the floor. The line routing is acceptable, but an air gap needs to be verified between the analyser return and the maximum water level to prevent back contamination of the analyser. This was not possible to determine during the inspection. Also, the penetration point is not sealed well, this point should be caulked to prevent water or dust contaminants from entering the wet well.
- The Level transmitter (LIT-0580) is a Siemens Milltronics MiniRanger unit and appears to be in good condition. The element is suspended over the reservoir via a floor opening and cap.
- Cabinet has a Sixnet 5 port managed ethernet switch for future communications and PLC access.

2.8.3 Electrical and Controls Photos

Image Table 2-18
City of Leduc North Reservoir - Electrical and Controls Photos

Level Element and CL2 drain

CL2 analyser

CL2 Drain and Feed

Flowmeter

Flow Control Valve; Rust Stains

PLC Rack

Radio

UPS

PLC Wiring

Temperature Switch

2.8.4 Process

- The flow control valve, actuator, flow meter, and piping are all recent upgrades from the last SCADA upgrade for the PLCs and, with the exception of some rust stains on the flow valve bod, are in good condition. The bolts holding the actuator to the valve should be changed out to SS to avoid further corrosion.
- PRV appears to be original and has been painted recently. Recommend a rebuild kit be considered to ensure the PRV/PSV continues to function correctly for the future. This includes replacing the PRV pilot solenoid as it appears original and is likely nearing failure as it is near its end of life.
- Surface blemishes on the piping appear to be scuff marks, rather than corrosion induced. Exposed areas should be touched up to prevent corrosion.

Image Table 2-19
City of Leduc North Reservoir – Piping and Valves

FCV Actuator Bolts Corrosion

PSV and Piping - Condition

Pipe Surface Scuffing

2.8.5 Building Mechanical

- The Commission room has a forced air furnace the unit appears new.
- The furnace is powered by an extension cord plugged into a wall socket and hardwired to the furnace. A dedicated circuit is required with a disconnect inline to the furnace. Recommend repairing this condition.
- There is insufficient ventilation within the room, due to the observed resting on equipment within the room. The ventilation within the room should be checked for adequacy.

2.9 Armena Fill Station

The Armena Fill Station is located along Main Street as you enter the Hamlet of Armena from Highway 21. The Commission shares this facility with the County of Camrose. This facility was constructed in 2014. AE's observations from the inspection are as follows.

2.9.1 Electrical

The Armena Fill Station is a combination truck fill and fill station. As such, the electrical system is not included in this evaluation other than components directly affecting the Commission filling system.

- The PLC cabinet is missing a power filter. Recommend an AEGIS or equal power filter be added pre-UPS to ensure clean power is going to the cabinet.
- A UPS for the PLC cabinet was not noted. Recommend adding a UPS 1500VA in size.
- No generator or large UPS was found for this system.

2.9.2 Controls

The Commission fill controls are handled by a Schneider M340 PLC communicating over licensed serial radio to the HWY 21 Booster repeater node. M340 is a current PLC platform and no upgrade at this time is recommended. A tower mounted Yagi antenna is used and points to the Hwy 21 repeater station and PLC communications is via serial MB protocol for system stability. A cellular modem and Cisco router are in the cabinet as remnants of the communication system in place before the radio links were updated. The cellular links are still connected and should be disconnected if not in active use.

- The PLC cabinet has a single power supply. Dual redundant supplies are recommended.
- Tower ground is a single wire. Normally with a tower ground you can see the piles connected to each other and then a solid link to the ground grid. It appears that a #6 green ground is bolted to the tower heading into

the earth. The ground is assumed to be adequate from the original design of the facility since all connections are buried.

- The tower does have anti-climbs, but they could extend about 1 m higher to be more effective.
- Incoming pressure transmitter needs a Block and Bleed to ensure all air is bled away from the sensor for an accurate reading. This tap assembly has a very strange configuration that is not recommended as it can lead to leaks, air traps and skewed sensor readings if water is flowing from the sample valve port. The sample valve is also upstream of the PRV so full system pressure is experienced at this point (92 psi).
- PRV does not have a power fail solenoid, and flow control valve does not appear to have a super capacitor backup. In a power fail condition this station could over flow with unmetered water very quickly. Recommend a power fail backup system be designed to allow for system shutdown in the event of a power fail.
- Flow meter does not have grounding rings but since the piping and valve body is stainless steel one is technically not required as water and piping are all in contact and conductive.
- The flow control meter is using a Bray actuator.
- Chlorine analyser is a ProMinent with CTE sensor for total chlorine. The sample line to the analyser is installed correctly with the line running uphill the entire way. The discharge is piped off to a location that was not noted.
- A Red Lion HMI is included on this system. Remote fill systems do not require an HMI typically.

2.9.3 Electrical and Controls Photos

Image Table 2-20
Hamlet of Armena - Electrical and Controls Photos

Radio Tower

Radio Tower Ground

Inlet Piping

Flowmeter

Pressure Gauge

Flow Valve

CL2 Analyser

PLC Cabinet with HMI

PLC Rack

Cell Modem (left) and Radio

Internet Router

2.9.4 Process

- Piping is all stainless steel and is in generally good condition.
- All valves, equipment, etc. appears to be functional.

Image Table 2-21
Hamlet of Armena – Valves and Piping

Valves and Piping

2.9.5 Building Mechanical

- The Armena Fill Station is a combination truck fill and fill station, and the room is shared with the County of Camrose. As such, the building mechanical system was not reviewed.

2.10 Village of Hay Lakes

The Village of Hay Lakes Fill Station is located at the north end of 5 Avenue within the Village. This facility was the Village's old water treatment plant and pump house. The Commission fill piping was installed in approximately 2009, and the old water treatment equipment has since been removed. The Commission shares this facility with the Village of Hay Lakes. AE's observations from this facility are outlined below.

2.10.1 Electrical

The commission does not control the alarm system as the Town accesses the facility on a regular basis. Electrical power to the fill system is provided by the local pumphouse.

- A Sola Hevi-Duty power conditioner is installed to filter the power going to the UPS. After 10 years this filter needs to be closely inspected for wear and damage and replaced if any found. These units have shown a tendency to wear out and fail if exposed to significant line noise after several years while doing their job of noise filtering. Less expensive options now exist like AEGIS Power filters that performs the same function.
- Single EATON Powerware UPS in cabinet. UPS batteries should be replaced every 5 years.

2.10.2 Controls

The Commission fill controls are handled by a Modicon Momentum PLC communicating over licensed serial radio to the HWY 21 repeater station. Momentum is still current but this 340 is due for an upgrade to M340 so it is on par with all other stations.

The Commission's radio tower is located just outside the reservoir foot print. A Yagi antenna is used and points to the Hwy 21 repeater station and PLC communications is via serial MB protocol for system stability. Overhead guy wires support the antenna cable into the building.

- The Fill Station PLC is a Modicon Momentum PLC that, like the HWY 21 Booster, was too new to upgrade at the last SCADA change. It is now time to upgrade this PLC to a M340 series.
- The fill piping is PVC and is overhead due to space restrictions at the time of the original installation.
- Instrumentation is newer E&H pressure and flow meters, and is in good condition. PITs overhead are angled downwards for local visualization.
- E&H flow meter appears to be missing grounding rings. The manufacture recommends installing grounding rings on non-conductive piping systems. If there are no reading discrepancies of concern this can remain; however, if measurement issues have been noted, adding stainless steel grounding rings and additional grounding will help reduce measurement error.
- The Commission has a dedicated level transmitter, a Siemens Milltronics unit that is also in good condition. The magnetic control pad is mounted inside the PLC cabinet for safe storage.
- Flow control valve and Rotork actuator appear to be in good condition as well.
- No obvious signs of rust on any equipment suggesting the ventilation in this facility is adequate.
- PLC cabinet wiring is in good condition.
- The original MDS 4710 radio and an additional SD4 radio are still in the cabinet. The 4710 should be recycled and the spare SD4 radio stored at the Master station as a spare not left in the cabinet.

- The local chlorine analyser is a ProMinent unit using a CTE sensor (total chlorine). The unit is functional, but the water feed has an air trap where the line rises before dropping to the unit. This should be corrected to ensure the line runs continuously up or down to prevent air from being trapped in the line.
- The chlorine analyser discharge drops to a line for wet well return. This needs to be air gapped to ensure the analyser is never at risk from reverse line contamination.

2.10.3 Electrical and Controls Photos

Image Table 2-22
Village of Hay Lakes - Electrical and Controls Photos

New Radio Tower

Radio Tower Grounding

PLC Cabinet

General Fill Piping

PIT Angled Down

Level Transmitter

PLC Rack

PLC Wiring and Radio

UPS

2.10.4 Process

- Piping is a mixture of carbon steel and PVC. The carbon steel pipe is from the Village's original water treatment plant.
- The carbon steel pipe (fill piping) is in reasonable condition, but there is evidence of corrosion on the pipe and fittings.
- The vertical section of this steel line does not appear to be supported well.
- A section of the steel pipe is open ended in the room. It should be capped or removed.
- The majority of the control valves and instrumentation are mounted high above the floor, making maintenance difficult. The piping was installed at the higher elevation due to the presence of the Village's old water treatment plant equipment which was located in the building at the time. Now that the equipment has been removed the Commissions piping can be lowered if desired by the Commission.
- Valving appears to be functional.

Image Table 2-23
Village of Hay Lakes – Valves and Piping

Corrosion & Open-ended Pipe

Pipe Stability Concerns

Elevated Controls

2.10.5 Building Mechanical

- The Hay Lakes Fill Station is a shared with the Village of Hay Lakes. As such, the building mechanical system was not reviewed.

2.11 Hamlet of New Sarepta

The Hamlet of New Sarepta is located along Centre Avenue west of Centre Street. The Commission's fill piping was installed within the Hamlets of New Sarepta existing water treatment plant/pump house in 2009. The Commission shares the facility with Leduc County. AE's observation from the inspection are provided below.

2.11.1 Electrical

The commission does not control an alarm system as the County accesses the facility on a regular basis. Electrical power to the fill system is provided by the local pumphouse.

- A Sola Hevi-Duty power conditioner is installed to filter the power going to the UPS. After 10 years this filter needs to be closely inspected for wear and damage and replaced if any found. These units have shown a tendency to wear out and fail if exposed to significant line noise after several years while doing their job of noise filtering. Less expensive options now exist like AEGIS Power filters that perform the same function.
- Single EATON Powerware UPS in cabinet. UPS batteries should be replaced every 5 years.

2.11.2 Controls

The Commission fill controls are handled by a Modicon Momentum PLC communicating over licensed serial radio to the HWY 21 Booster repeater node. The Modicon Momentum PLC is still current, but is due for an upgrade to M340 to be on par with all other stations. A Yagi antenna on a free-standing radio tower points to the Hwy 21 repeater station, PLC communications is via serial MB protocol for system stability. Overhead guy wires support the antenna cable into the building.

- The Fill Station PLC is a Modicon Momentum PLC that, like the HWY 21 Booster, was too new to upgrade at the last SCADA change. It is now time to upgrade this PLC to a M340 series.
- The piping is a mixture of threaded and flanged components. Corrosion is found on several flanges and needs to be addressed.
- The E&H flow meter has grounding rings and is grounded correctly.
- The Commission has a dedicated level transmitter, a Siemens Milltronics MultiRanger 100 unit that is also in good condition. The magnetic control pad is mounted on top of the unit but should be stored inside the PLC cabinet so as to not get lost.
- Flow control valve and Rotork actuator appear to be in good condition as well but flanges are rusted. The corrosion needs to be addressed.
- PLC cabinet wiring is in good condition.
- The original MDS 4710 radio as well as the newer SD4 radio are in the cabinet. The 4710 should be recycled.
- The local chlorine analyser is a ProMinent unit using a CTE sensor (total chlorine). The unit is functional, and the incoming water line appears to be installed correctly.
- The chlorine analyser discharge rises and then falls to a drain line connection tube. This needs to be replumbed as it imposes some back pressure on the analyser discharge and the direct connection could allow back contamination into the analyser for the drain line.
- It was observed that the Hamlets local level transmitter and the Commission's unit do not read the same and there maybe a reason due to where the readings are taken but it was noted as a concern by the County operators. Further investigation may be warranted but the reading difference has no significant effect on the operation of the facility.

2.11.3 Electrical and Controls Photos

Image Table 2-24
Hamlet of New Sarepta - Electrical and Controls Photos


Radio Tower Ground


CL2 for Commission


Flowmeter


Pressure Transmitter


Flow Valve; Rusting


Level Transmitter


PLC Cabinet


PLC Rack


New Radio (top) & Old Radio


Rusting Isolation Valves

2.11.4 Process

- The fill system is a mixture of carbon steel and stainless-steel piping. The piping is in generally good condition, although there is some superficial rusting on the flanges holding the control valve, and on some of the threaded fittings.
- Control valves are in good condition and appear to be functional.

Image Table 2-25
Hamlet of New Sarepta – Valves and Piping

Corrosion on Fittings

Valve Condition

2.11.5 Building Mechanical

- The New Sarepta Fill Station is a shared with the Leduc County and as such, the building mechanical system was not reviewed.

2.12 Telford Booster

The Telford Booster Station is located on the south side of Telford Lake, along Lions Park Road. This facility provides system pressure to the Millet Line, which services the City of Leduc Robinson Reservoir and the Town of Millet. This facility was constructed in 2016/2017. AE's observations from the facility are summarized below.

2.12.1 Electrical

The Telford Lake Booster Station has a 3 phase 600V 225kVA utility transformer with pad mounted metering. This feeds underground to a 450A MCB that then connects to 600V manual transfer switch (ampacity unknown). The transfer switch connects to an external portable generator connection box and a 600V 600A Eaton Switchboard (PDP-100). The PDP powers a distribution transformer (30kVA) and two external cabinet mounted VFDs (400A breakers). The Telford Booster Station contains two 200HP VFD driven pumps operating in Duty/Standby configuration. The incoming service is too small for both pumps to run at the same time even for a brief transfer of Lead status. As built, the station must shut down before restarting the other pump.

- The electrical equipment appears to be in good condition with no obvious signs of corrosion but given how new the station is none was expected. Typical electrical equipment if maintained can last 20 to 25 years.
- The 18 CCT 120/208V distribution panel schedule is blank. There is no way to determine what breaker operates what device. Recommend this be rectified immediately.
- The PDP has a surge suppressor but no local power meter.
- The PDP was not opened but the VFD inlet screens and internals are dirty and covered in dust. Inlet filters need to be changed and the insides of the VFD cleaned out of the dust. Dust will increase heat retention in

the drives and shorten their life expectancy. Recommend the PDP be serviced as well by qualified personnel. Based on observation the PDP is expected to be dusty as well.

- A smoke detector was not noted as present.
- Lighting appears to be fluorescent fixtures with LED on the exterior, interior lighting levels are good. Since these are new and the lights are off 99% of the time, there is little benefit to upgrading these to LED at this time.
- Emergency lighting wall packs are present on the walls. There is an Exit sign over the door, but it is not lit, this sign should be lit by building code at all times. The operator mentioned that the designers insisted an illuminated exit sign was not required. Referring to the Alberta Building Code any door providing a fire escape must be illuminated either internally or externally. Also, an emergency light was not noted over the door. Recommend replace the exit sign with a combination exit and lighting sign to bring this to code compliance.
- An alarm via keyed switch is used for security. The system is functional. A NetworX alarm panel was located on the wall but its function is not clear if it is integrated to the PLC or is a standalone unit that is armed/disarmed by the keyed switch.
- A Carbon Monoxide detector was not observed in this facility. They are not required by code but should be added to match other Commission facilities. If installed, they should be replaced every 5 years.
- PLC cabinet UPS is a single unit. UPS batteries should be replaced every 5 years on average.
- No power conditioner is installed to filter the power going to the UPS. Recommend adding a power filter like an Eaton AEGIS unit.
- Gas piping has a secure ground and pumps are bonded.
- Process piping appears to be missing a permanent bonding connection as required by code. Recommend this be rectified.
- Fence is not grounded. This is good practice but not strictly required unless near high voltage lines.
- Did not see evidence of a ground grid. Commission is encouraged to obtain record drawings as well as ask for ground resistance tests.

2.12.2 Controls

The control system PLC is a Schneider M340 PLC and the radio is a GE MDS SD4 licensed radio. The M340 is a current platform and consistent with the rest of the stations in the SCADA.

A Yagi antenna is mounted on a mast pointing to the HWY 21 repeater station. PLC communications are via serial MB protocol for system stability. This station has an ethernet switch for HMI PLC communications as well as connection to a “SCADADroid” cellular alarm dialer. A cellular modem and router are also present for what is assumed to be remote system access for the programmers.

- A GE QuickPanel provides a local HMI for this facility.
- Terminals and wiring appear in good condition as the system is new.
- Dual 24VDC power supplies are present in the cabinet.
- With the SCADA connected to the Master node a local alarm dialer is redundant with additional monthly cellular fees for alarm calling that can be handled by the Master node.
- A solid ground connection has been provided for the radio polyphaser surge arrestor. No surge protection for the two cellular antenna lines were observed. This is a concern as a direct lightning strike would energize the

PLC panel and likely destroy it as there is no other path for the surge to travel on the cellular antenna wires. Recommend adding cellular surge suppressors on any cellular lines leading to the outside.

- Online instrumentation is new and in good condition. One major issue is the pressure gauge and transmitter arrangements. Refer to photos, the piping is very non-standard and will allow for air to trap in the line going to the transmitter. Recommend all these trees be reconfigured such that the piping goes line tap -> isolation valve -> tee -> gauge, and from the other tee half -> Block and Bleed valve -> pressure transmitter. This configuration will ensure air is never trapped at the transmitter.
- Flow meter does not have grounding rings. Because the piping is coated steel it is considered non-conductive and stainless steel grounding rings are recommended by the manufacturer. AE recommends stainless steel grounding rings and a ground connection be installed.
- A low building temperature thermostat is located on the wall, but it is in degrees F not Celsius. Suggest at least a fine marker to note typical Celsius values.

2.12.3 Electrical and Controls Photos

Image Table 2-26
Telford Booster Station- Electrical and Controls Photos

Radio Mast & Power Service

Utility Transformer

Electrical Equipment

Distribution Panel; Sched is Blank

Exit Sign

VFD Face

VFD Intake Filter; Plugged

VFD interior; dusty

PLC cabinet

PLC Cabinet Interior

Cellular Modem and Router

Radio Antenna Polyphaser

Odd Gauge Arrangement

Flowmeter

Gasline Grounding

Pump Bonding

2.12.4 Process

- Piping and equipment are in good condition, which is to be expected as the facility is only 2-3 years old.
- Pumps VFD-101 & 102 are each rated at 157.1 L/sec @ 67 m TDH (2,490 USgpm @ 220 ft TDH).
- VFD-101 actual reading – 10.25 L/sec @ 18.8 m TDH (29.6 Hz./888 rpm).
- VFD-102 actual reading – 6.49 L/sec @ 40.3 m TDH (43.3 Hz./1,299 rpm).
- See the table in Appendix A for design vs. actual comparisons of flow and pressure, and the accompanying curve for design vs. actual reading calculated to full speed.
- Both pumps are operating close to their design curve, but both were operating very inefficiently due to low flow conditions at time of observation.
- Vibration readings for both pumps and motors were within acceptable limits.

Image Table 2-27
Telford Booster Station – Piping and Valves

Equipment and Piping

VFD-101

VFD-102

Gap Under Fence

2.12.5 Building Mechanical

- This building was constructed in 2014.
- The ceiling mounted furnace and air handling unit should be inspected and cleaned on an annual basis.
- This facility is new and all mechanical equipment has an expected operational life expectancy of 20 years.
- The mechanical equipment in the space consist of 2 REZNOR gas fired unit heaters with concentric venting.
- Ventilation from the space is with a wall mounted Greenheck propeller belt driven exhaust fan (Model SB-3H-24) and one outside air louver with electric operated motorized dampers. The dampers are energised when the exhaust air fan is energised. Controls are by line voltage thermostats.

2.12.6 General

At the time of inspection there was a large gap that would allow uncontrolled access into the yard. This should be fixed.

2.13 Town of Millet Fill Station

The Town of Millet Fill Station is located along 45 Avenue and 49 Street. The Commission added its fill piping into the Town's existing Water Treatment Plant and pumphouse in 2016. AE's observations from site inspection are as follows.

2.13.1 Electrical

- Electrical power to the fill system is provided by the local pumphouse.
- A Single EATON Powerware UPS is in the PLC cabinet. UPS batteries should be replaced every 5 years.
- The PLC cabinet does not have a power filter. AE recommends that a power filter like an Eaton AEGIS unit be used to pre-filter noise from the power line before it reaches the UPS.
- A new radio tower sits at the bottom of the hill from the reservoir.
- Tower ground is a single wire that is screwed to the sheet metal. Normally with a tower ground you can see the piles connected to each other and then a solid link to the grid. This has what appears is a #6 green ground screwed to the tower heading into the earth. The ground is assumed to be adequate from the original Engineering and test reports since all connections are buried but the screw does not convey that a solid ground has been established in the event of a lightning strike.
- Electric heat trace has been installed on the incoming line to the reservoir pumphouse with insulation and metal cladding for the outside pipe segment. It appears to be functional.

2.13.2 Controls

The control system PLC is a Schneider M340 PLC and the radio is a GE MDS SD4 licensed radio. The M340 is a current platform and consistent with the rest of the stations in the SCADA.

A Yagi antenna is mounted on a mast pointing to the HWY 21 repeater station. PLC communications are via serial MB protocol for system stability. This station has an ethernet switch for PLC communications as well as connection to a "SCADADROID" cellular alarm dialer. A cellular modem and router are also present for what is to be assumed remote system access for the programmers.

- E&H flow meter does not have grounding rings. On non-conductive system this is manufacturer recommended, since this is stainless steel piping technically they are not required. For good measure AE recommends they are still used.
- The bypass valving has a very large handle that is blocking the face of the flowmeter. Recommend a smaller handle so as to not block the meter face.
- The commission has a dedicated level transmitter, a Siemens Milltronics MultiRanger 100 unit that is also in good condition. The level element is located in a shaft directly under the PRV valve; and is a very tight installation.
- Flow control valve and Rotork actuator appear to be in good condition as they are new.
- PLC cabinet wiring is in good condition.
- PLC cabinet has dual 24VDC power supplies.

- Not all the PLC card slots have protective covers. Recommend adding missing covers to the terminal ports on the backplane to prevent contamination.
- The same issue with Pressure Transmitters and Gauges as identified in the Telford Lake booster is seen here. The piping is non-standard and will allow for air to trap in the line going to the transmitter. Recommend the two pressure trees be reconfigured such that the piping goes line tap -> isolation valve -> tee -> gauge and from the other tee half -> Block and Bleed valve -> pressure transmitter. This configuration will ensure air is never trapped at the transmitter.
- Chlorine analyser is a ProMinent with CTE (total chlorine) sensor. The water feed line is piped correctly as it drops down continuously to the instrument avoiding air traps. The discharge line follows an odd route behind piping to an unknown destination. If this goes to drain or the wet well an air gap is required to be maintained to prevent back contamination of the line into the transmitter.

2.13.3 Electrical and Controls Photos

Image Table 2-28
Town of Millet - Electrical and Controls Photos

Radio Tower Grounding

Incoming Line, ARV & Heat Trace

CL_2 Analyser and Piping

General Piping

Odd pressure Gauge Arrangement

PLC Cabinet

PLC Rack

Cellular Modem and Router

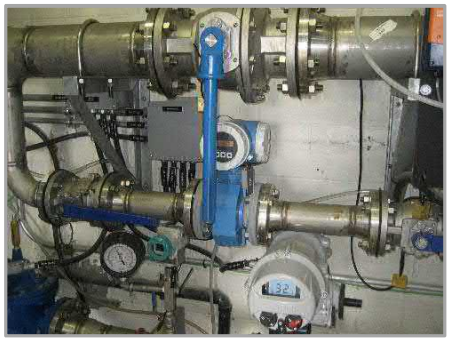
Bad Welding, PRV and Level

Corroding NPT Weld

2.13.4 Process

- Piping (and valves) are all stainless steel. Piping is in generally good condition; the welding is very poor.
- Valves are relatively new and in good condition. All appear to be functional.
- PRV blocks access to the level transmitter.

Image Table 2-29
Town of Millet – Valves and Piping



General Piping Layout

Welding Quality

Level Transmitter Access Blocked

2.13.5 Building Mechanical

This building is shared with the Town of Millet and as such the building mechanical systems were not reviewed.

3 FACILITY UPGRADES

Based on the above site observations the following budget is recommended for the facility upgrades as outlined in Table 3-1. The detailed summary for each facility is provided in Appendix B.

Table 3-1
2020 to 2025 Budget

	2020	2021	2022	2023	2024	2025
Facility Upgrades (2020 to 2025)						
Airport Reservoir		$5,000	$10,000			
Calmar Fill Station		$5,000	$15,000			
Nisku West Fill Station		$5,000	$10,000			
Nisku East Fill Station		$5,000	$5,000			
City of Beaumont		$5,000	$10,000			
HWY 21 Booster Fill Station		$5,000	$17,500	$10,000		
Boundary Pump Station		$61,950	$68,000	$31,000		
City of Leduc North Reservoir		$5,000	$5,000			
Hamlet of Armena		$5,000	$5,000	$5,000		
Town of Hay Lakes		$5,000	$20,000	$15,000		
Hamlet of New Sarepta		$5,000	$20,000			
Telford Lake Booster		$15,000		$5,000		
Town of Millet		$5,000	$5,000	$5,000		
Yearly Summary		**$131,950**	**$190,500**	**$71,000**		

4 RECOMMENDATIONS

Through the facility assessment, Associated Engineering identified many issues that need to be addressed or corrected, most of the items are related to ongoing maintenance items within the facilities and the replacement of items as they reach the end of life. The detailed tables provided in Appendix B provide a detailed summary of when the identify items should be addressed.

CLOSURE

This report is prepared for the Capital Region Southwest Water Services Commission to provide the results from Associated Engineering's review and assessment of a selection of Commission facilities.

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.

Sean Nicoll, P.Eng.
Project Manager

Mitch Lejeune, P.Eng.
Process Engineer

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF
Signature: _____
Date: _____
APEGA Permit to Practice P 3979

Chris Bredo, P.Eng.
Electrical Engineer

APPENDIX A – PUMP CURVE

CRSWCS Pumps' tests

Location	Pump #	Design			Actual			Vibration	
		Flow, L/s	Head, m.	Speed, rpm.	Flow, L/s	Head, m.	Speed, rpm	Pump, mm/sec.	Motor, mm/sec.
Boundary Station	P-102	220.5	50.3	1,800	--	--	--	--	--
	P-103	444.4	52.3	1,800	157.5	48.5	1,473	0.8, 0.8	2.5, 1.2
	P-104	327.6	45.7	1,770	157.5	41.4	1,504	0.8, 1.3	2.9, 1.3
Hwy 21 Booster	P-0406	13.4	63.3	3,600	2.21	46.9	2,904	0.8, 0.8	0.8, 0.8
	P-0407	13.4	63.3	3,600	2.47	47.3	2,874	2.2, 2.5	3.7, 1.5
Telford Lake Booster	P-101	157.1	67.1	1,785	10.25	18.8	821	2.4, 2.2	2.4, 2.2
	P-102	157.1	67.1	1,785	6.44	40.3	1,288	0.9, 0.9	1.8, 1.8

Acceptable vibration limit, as per Hydraulic Inbstitute Standards, is 10 mm/sec.

Boundary Station P-102

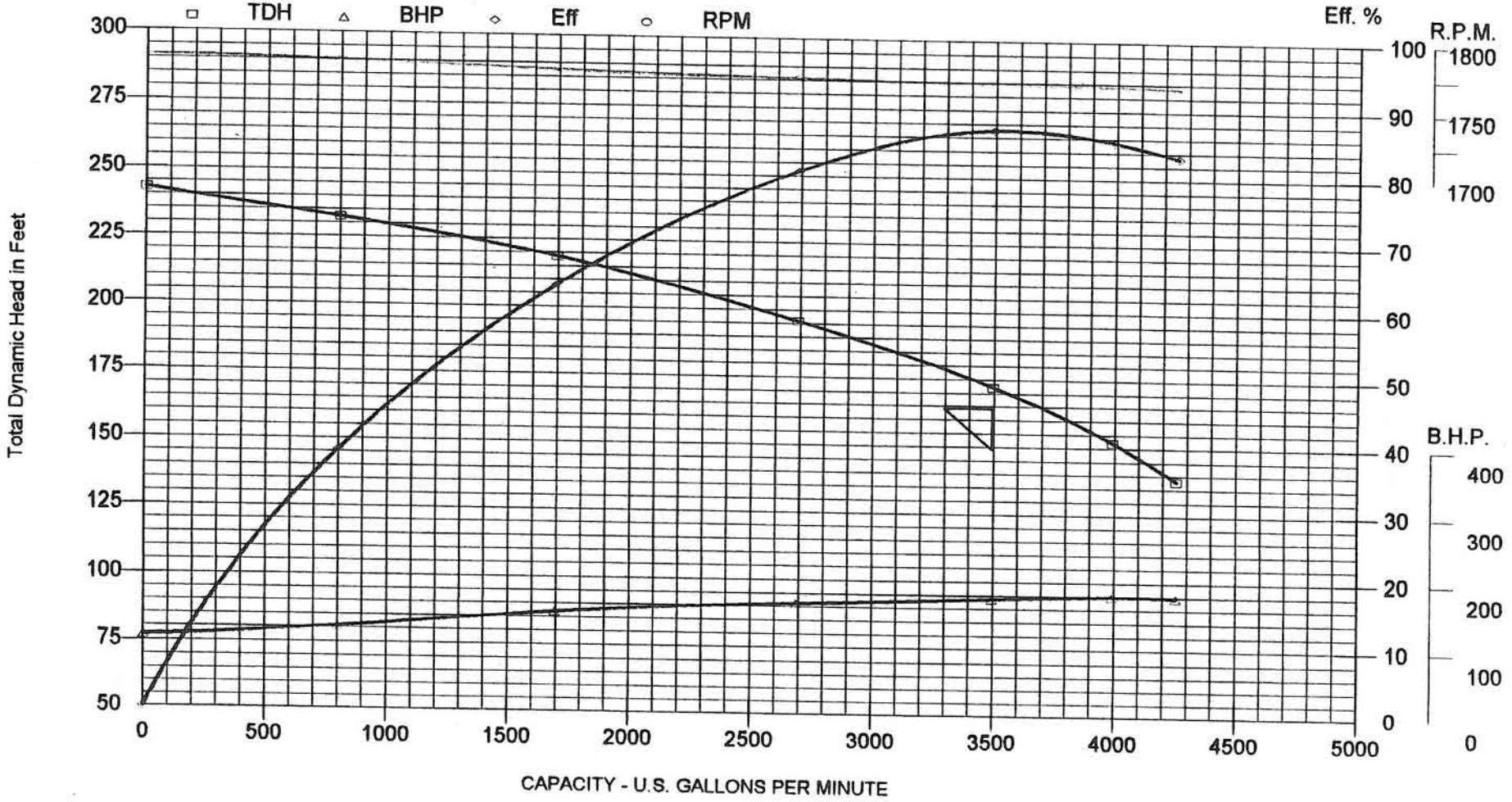
Certified By

6/15/05
Date

AURORA®
PENTAIR PUMP GROUP

Sales Order:	1760 A
Size:	8x10x15B
Type:	411
R.P.M.:	Test
Stage:	1
Spec. Gravity:	1.0
Imp. Dia.:	14.500
WO/Serial No.:	1235872
Curve No:	187885
Test No:	65124
Plotted By:	5260, DM
Date:	6/15/2005

NATIONAL PROCESS
Customer



187885

PUMP DATA SHEET AURORA PUMPS

Company: National Process Equipment
Name: Boundary Pump House - P-103
Date: 01/23/06

AURORA Pentair Water

Pump:

Size: 10x12x18
Type: 410-HSC
Synch speed: 1800 rpm
Speed: 1775 rpm
Dia: 16.1875 in
Curve: PC117403
Impeller:
Specific Speeds:
nq: 43
S: 182
Dimensions:
Suction: --- mm
Discharge: --- mm

Pump Limits:

Temperature: 135 °C
Pressure: 1724 kPa g
Sphere size: 39.7 mm
Power: --- kW
Eye area: --- mm²

Search Criteria:

Flow: 1600 m³/hr
Head: 52 m

Fluid:

Water
SG: 1
Viscosity: 1.104 cP
Temperature: 15.6 °C
Vapor pressure: 1.773 kPa a
Atm pressure: 101.4 kPa a
NPSHa: --- m

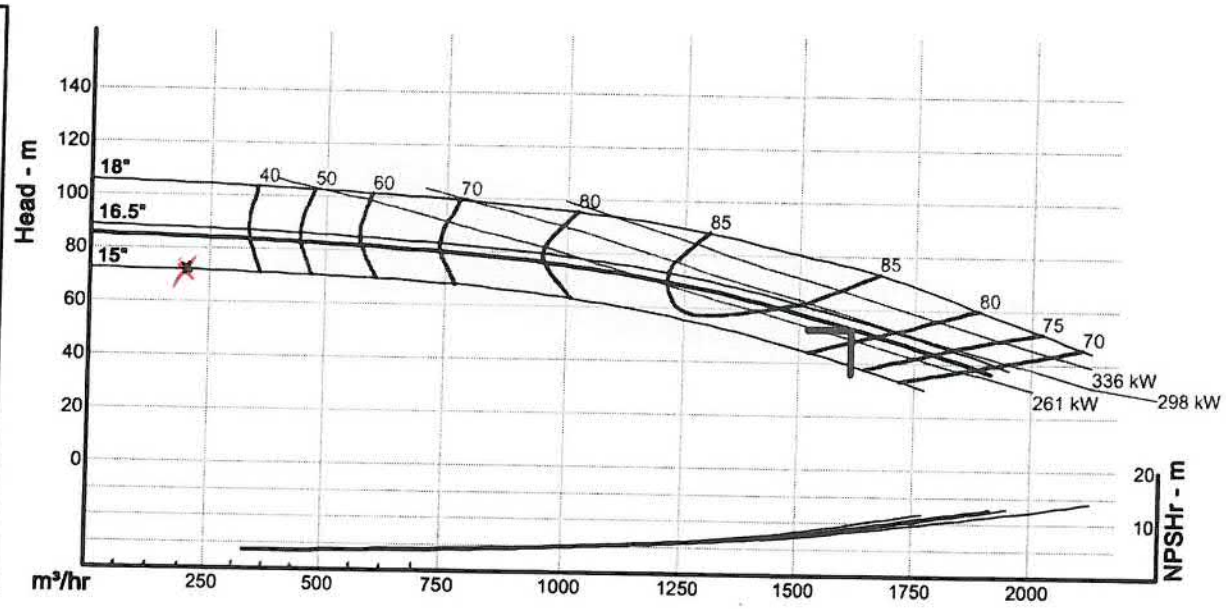
Motor:

Standard: NEMA
Enclosure: ODP
Size: 298 kW
Speed: 1800
Frame: 449T
Sizing criteria: Max Power on Design Curve

--- Data Point ---
Flow: 1600 m³/hr
Head: 52.2 m
Eff: 81%
Power: 278 kW
NPSHr: 8.92 m

-- Design Curve --
Shutoff Head: 84.4 m
Shutoff dP: 826 kPa
Min Flow: --- m³/hr
BEP: 85% eff
@ 1328 m³/hr
NOL Pwr: 279 kW
@ 1656 m³/hr

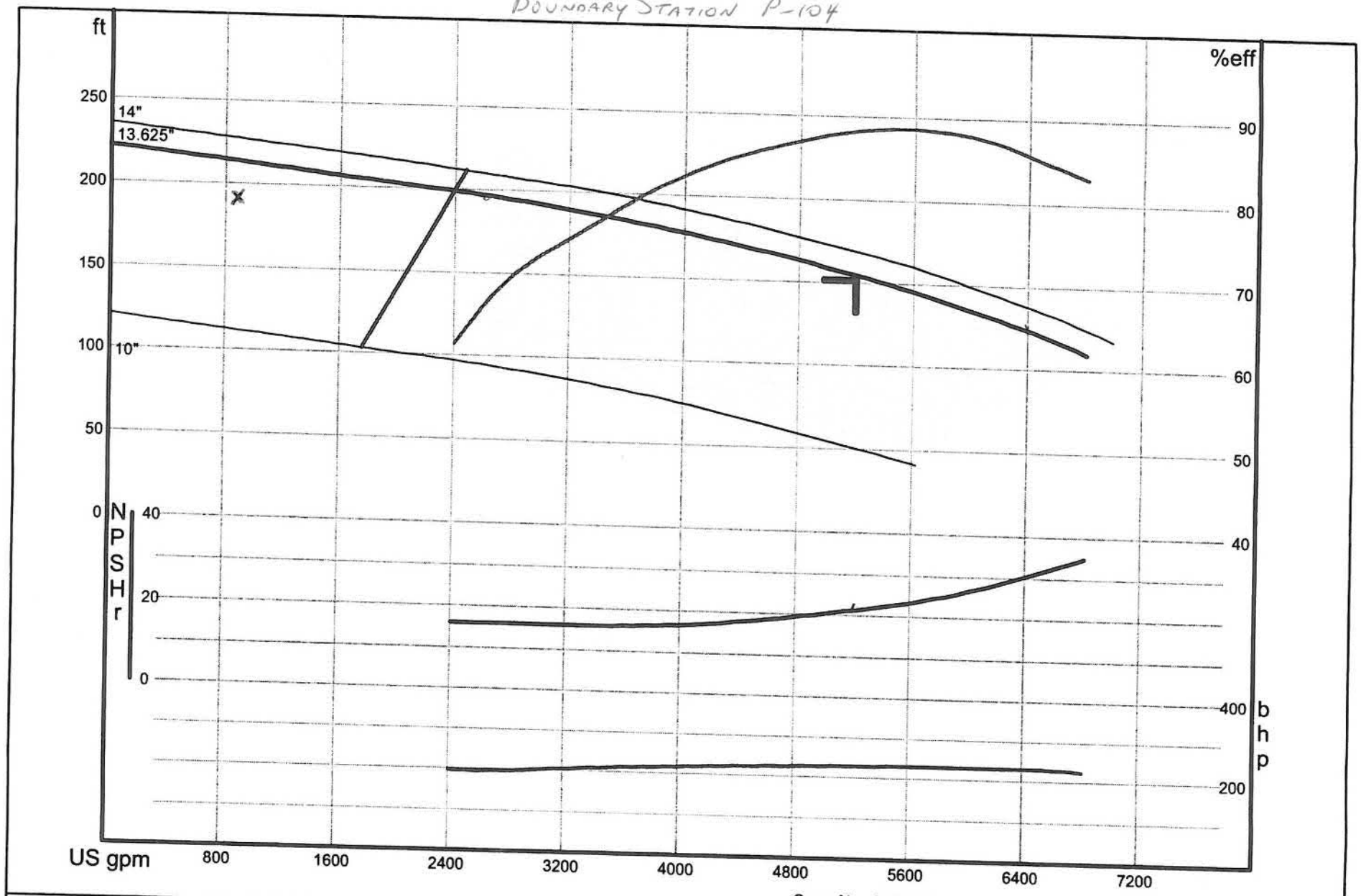
-- Max Curve --
Max Pwr: 384 kW
@ 1658 m³/hr



Performance Evaluation:

Flow m³/hr	Speed rpm	Head m	Pump %eff	Power kW	NPSHr m
1920	1775	---	---	---	---
1600	1775	52.2	81	278	8.92
1280	1775	66.3	85	270	6.24
960	1775	75.1	80	244	4.83
640	1775	80.2	64	216	4.01

BOUNDARY STATION P-104



Curve No.: 3132056

Powered by PUMP-FLO

Associated Engineering
Mitch Lejeune
04/26/04

Peerless Pump
Catalog: Peerless Pumps.60, vers 1.2
AE - 1800
Design Point: 5200 US gpm, 150 ft

Size: 10AE14
Speed: 1770 rpm
Dia: 13.625 in

PEERLESS PUMP

Pump Data Sheet - Crane/Deming

Company: JeffPro Fluid Solutions
Name: Hwy 21 RWS / AE-Edmonton
Date: 7/15/2009

Booster Pumps
BP-406, BP-407

DEMING PUMPS

Pump:

Size: 3x2x8
Type: 5060
Synch speed: 3600 rpm
Speed: 3500 rpm
Dia: 195 mm
Curve: 5061-PC3578
Impeller:
Specific Speeds:
nq: 20
S: 141
Dimensions:
Suction: 80 mm
Discharge: 50 mm

Pump Limits:

Temperature: 107 °C
Pressure: 1207 kPa g
Sphere size: 7.14 mm
Power: ---
Eye area: ---

Search Criteria:

Flow: 13.4 l/s
Head: 62 m

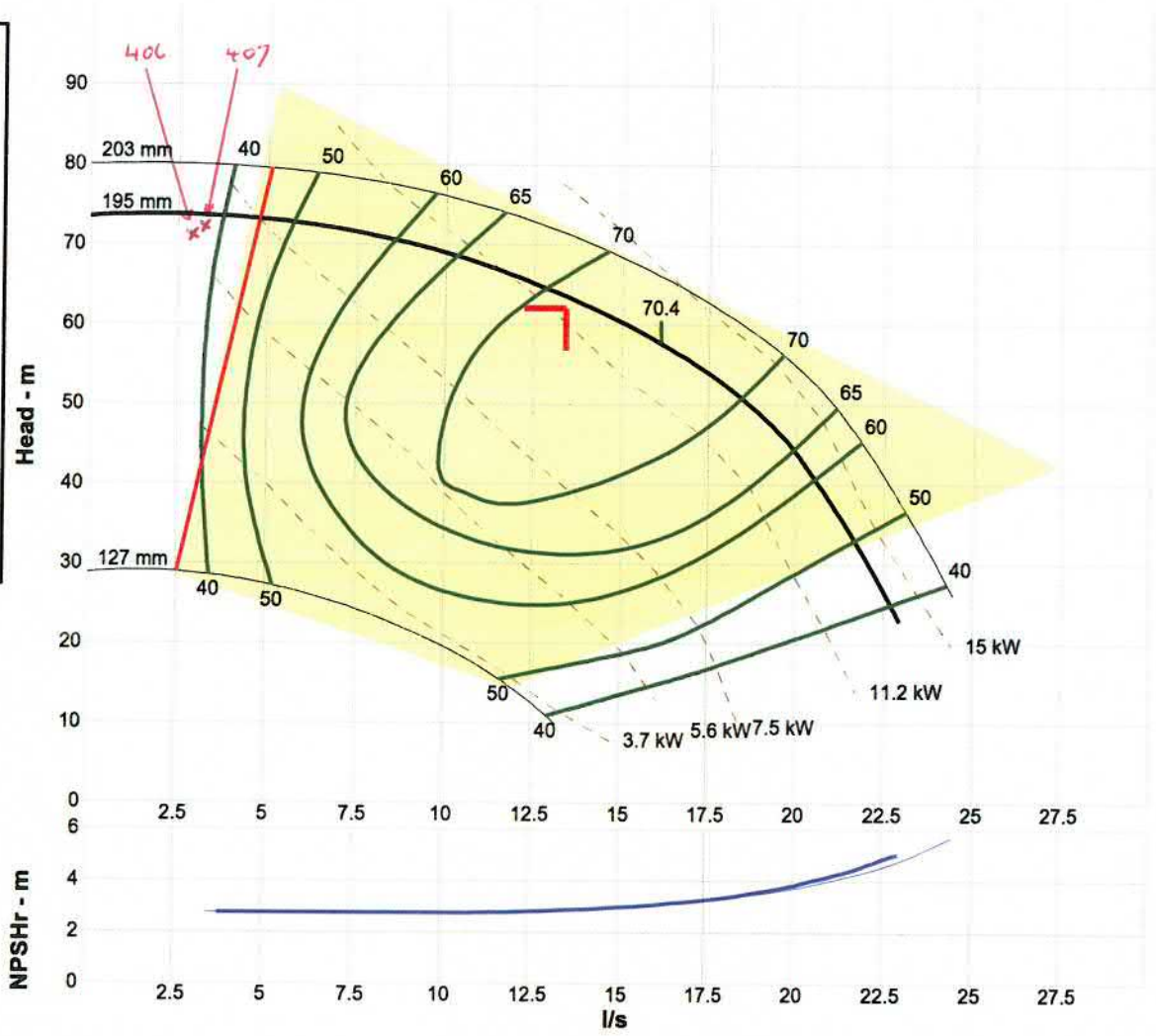
Fluid:

Water
SG: 1
Viscosity: 1.104 cP
Temperature: 15.6 °C
Vapor pressure: 1.773 kPa a
Atm pressure: 101.4 kPa a
NPSHa: ---

Motor:

Standard: NEMA
Enclosure: TEFC
Size: 15 kW
Speed: 3600
Frame: 256T
Sizing criteria: Max Power on Design Curve

---- Data Point ----	
Flow:	13.4 l/s
Head:	63.3 m
Eff:	70%
Power:	11.8 kW
NPSHr:	2.87 m
---- Design Curve ----	
Shutoff head:	73.4 m
Shutoff dP:	718 kPa
Min flow:	4.67 l/s
BEP:	70% @ 16.1 l/s
NOL power:	14 kW @ 21.7 l/s
-- Max Curve --	
Max power:	16.5 kW @ 23.1 l/s



Performance Evaluation:

Flow l/s	Speed rpm	Head m	Efficiency %	Power kW	NPSHr m
16.1	3500	57.7	70	12.9	3.08
13.4	3500	63.3	70	11.8	2.87
10.7	3500	67.9	66	10.8	2.76
8.04	3500	70.9	58	9.54	2.74
5.36	3500	72.9	48	7.9	2.74

Selected from catalog: Crane Deming.60 Vers: 03-09

Bell & Gossett
a xylem brand

TELFORD LAKE

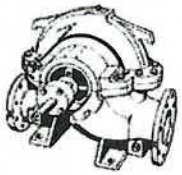
SUBMITTAL
B-543.25A

NAME: Millet Water Supply Line

REPRESENTATIVE: Midwest Engineering (AB) Ltd

UNIT TAG: PMP1-2
ENGINEER: Select Engineering
CONTRACTOR: Weaver Welding Ltd

SUBMITTED BY: Craig Cole



8X10X17L
Series HSC–S
Base Mounted - Double Suction Centrifugal Pumps

SPECIFICATIONS

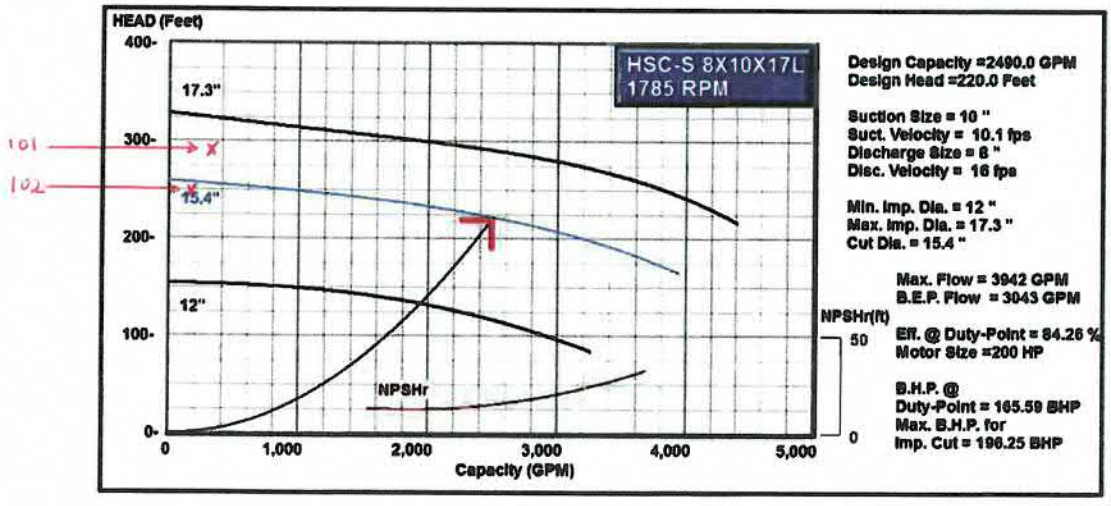
FLOW	2490 (GPM)	HEAD	220 (FT)
HP	200	RPM	1800
VOLTS	575		
CYCLE	60	PHASE	3
ENCLOSURE	U.S. Motors TEFC Nema Premium Efficient Inverter Duty		
APPROX. WEIGHT	1200		
SPECIALS	Bronze Impeller Wear Ring		

MATERIALS OF CONSTRUCTION

- ☒ Cast Iron Bronze Fitted
- ☒ Internally Self Flushing Mech. Seals
- ☒ Fabricated Heavy Duty Baseplate
- ☒ ANSI/OSHA Coupling Guard
- ☒ Flexible Coupling
- ☐ Spacer Coupling (Optional)
- ☐ Galvanized Drip Pan (Optional)

TYPE OF SEAL

- ☐ **STANDARD:** 175 PSIG (12 Bar) working pressure, 125# ANSI Flange Configuration
- ☐ **STANDARD:** Crane Type 21, BUNA/Carbon Ceramic, 75 psig (5 Bar) maximum suction pressure, from -20° to 225°F (-29 °C to 107 °C).
- ☐ **OPTIONAL:** Crane Type 21, EPR/Carbon Ceramic, 75 psig (5 Bar) maximum suction pressure, from -20° to 250°F (-29 °C to 121 °C).
- ☐ **OPTIONAL:** Crane Type 21, EPR/Carbon Tungsten Carbide, 75 psig (5 Bar) maximum suction pressure, from -20° to 250°F (-29 °C to 121 °C).
- ☒ **OPTIONAL:** 280 PSIG (19 Bar) working pressure, 250# ANSI Flange Configuration
- ☒ **STANDARD:** Crane Type 1, BUNA/Carbon-Ceramic, 150 psig (10 Bar) maximum suction pressure, from -20° to 225°F (-29 °C to 107 °C).
- ☐ **OPTIONAL:** 400 PSIG (27 Bar) working pressure, 250# ANSI Flange Configuration
- ☐ **STANDARD:** Crane Type 1B, BUNA/Carbon-Ceramic, 300 psig (20 Bar) maximum suction pressure, from -20° to 225°F (-29 °C to 107 °C).
- ☐ **OTHER:**



xylem
Let's Solve Water

SHOP DRAWING REVIEWED
BY GEORGE SROUJI, P. ENG.
August 25, 2016

APPENDIX B – CAPITAL UPGRADES

Appendix B - Facility Upgrades - Edmonton International Airport

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Airport Reservoir	Electrical	The main breaker shows significant corrosion and should be replaced as a precaution to failure.	$1,500	1-2 years
Airport Reservoir	Electrical	The main distribution panel appears to be in good condition for original equipment; however an internal inspection for pitting or corrosion is prudent, and replacement if corrosion is found.	$200	1-2 years
Airport Reservoir	Electrical	There is a smoke detector on the ceiling. This should be replaced with a suitable unit to provide an alarm contact.	$200	1-2 years
Airport Reservoir	Electrical	Lighting appears to be original fluorescent fixtures. Since the lights are off 99% of the time there is little benefit to upgrading these to LED until they fail.	$3,500	10 years
Airport Reservoir	Electrical	An emergency wallpack is present; however the ability of an old unit like this to provide the 30 min emergency lighting required is low. Also, there is no illuminated exit sign over the doorway. Recommend a new emergency exit sign with lights be installed next to the door (include auto exerciser option) to resolve both issues.	$2,500	1-2 years
Airport Reservoir	Electrical	An alarm system with keypad was observed. The system is functional but old.		
Airport Reservoir	Electrical	A Carbon Monoxide detector was observed. These should be replaced every 5 years. Recommend replacement.	$200	1-2 years
Airport Reservoir	Electrical	PLC cabinet UPS has two battery pack power extenders. These need replacement every 5 years on average. Recommend replacement of the batteries to maintain the system runtime.	$1,500	1-2 years
Airport Reservoir	Electrical	An old Schneider power fail relay is seen on the wall. This is assumed to be tied to the SCADA. Replace when it fails otherwise it has no operational impact.		
Airport Reservoir	Electrical	Active Cathodic protection is installed. This appears to be functional but is outside of our expertise to determine the condition.		
Airport Reservoir	Electrical	An original design telephone entrance panel is present. This panel is not in use		
Airport Reservoir	Controls	The old MDS 4710 series radio has been left in the PLC cabinet post SCADA upgrade. This can be removed and recycled.		
Airport Reservoir	Controls	PLC spare rack slots have terminal covers to protect the connections. Acceptable.		
Airport Reservoir	Controls	Cabinet has a Sixnet 5 port managed ethernet switch for future communications and PLC access.		
Airport Reservoir	Controls	Terminals and wiring appear in good condition.		
Airport Reservoir	Controls	PIT-0500 (fill line) is a newer E&H unit, and is in good condition.		
Airport Reservoir	Controls	The flow control valve, actuator, and flow meter are all recent upgrades from the 2013 SCADA upgrade for the PLCs.		
Airport Reservoir	Controls	Flow meter has grounding rings and is grounded correctly.		
Airport Reservoir	Controls	The chlorine residual analyser is a Prominent unit. The incoming water feed has an air trap potential. The pipe tap should always rise or fall so air cannot get trapped in the line. Recommend re-routing the water line to eliminate the air traps.	$1,000	1

Appendix B - Facility Upgrades - Edmonton International Airport

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Airport Reservoir	Controls	The analyser discharge rises and goes through the wall for a return to reservoir feed. The line routing is ok as it rises consistently but how the line empties to the reservoir should be examined further. How much air gap exists? Can the line back-flow if the reservoir is too full, or contaminate the reservoir, or back contaminate the analyser? This was not possible to determine during the inspection.		
Airport Reservoir	Controls	The Level Transmitter (LIT-0580) is a Siemens Milltronics Multirange 100 unit, and appears to be in good condition. The element ran through the wall to the reservoir so the question of installation spacing must be considered. At max level, does the transmitter have an at least 12” gap to the water level to avoid the blanking distance limitation?		
Airport Reservoir	Controls	The pressure gauge between the PRV and flow valve needs a neck extension. The isolation valve handle obscures the face. The gauge is also smaller than the normally recommended 4” dial face.	$1,000	1-2 years
Airport Reservoir	Process	Piping is in generally good condition.		
Airport Reservoir	Process	There is some superficial rusting on fittings and bolts.		
Airport Reservoir	Process	Where the fill line piping enters the building through the floor, the first 200 mm appears to be only primed, not painted. This should be brushed or blasted, and properly coated.	$1,000	next 1-2 years.
Airport Reservoir	Process	All valves and related equipment appear to be functioning properly.		
Airport Reservoir	Process	PRV appears to be original based on the corrosion observed. Recommend a rebuild kit be considered to ensure the PRV/PSV continues to function correctly for the future. This includes replacing the PRV pilot solenoid as it appears original and is likely nearing failure at end of life.	$2,500	next 1-2 years.
Airport Reservoir	Process	Flow meter does not have any upstream or downstream straight run of piping to ensure accuracy		
Airport Reservoir	Building Mechanical	Forced air furnace within Commission Room, with fresh-air make up.		
Airport Reservoir	Building Mechanical	Along the ceiling is an exposed uncapped duct. Intent of this duct should be identified and either capped or properly terminated. Based on its location it is assumed to be vent.	$1,000	1

Appendix B - Facility Upgrades - Calmar Fill Station

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Calmar Fill Station	Electrical	The Main breaker looks to be relatively new as does the distribution panel.		
Calmar Fill Station	Electrical	The distribution panel is oversized for such a small space given there are only 9 circuits fed out of 42. However, it is already in place, so replacement will achieve nothing.		
Calmar Fill Station	Electrical	The main distribution panel appears to be in good condition for original equipment however an internal inspection for pitting or corrosion is prudent and replacement if corrosion is found. This is mentioned here due to the significant pipe corrosion observed.		
Calmar Fill Station	Electrical	There is a smoke detector on the ceiling and it appears relatively new. This should be replaced in 5 to 10 years with a suitable unit to provide an alarm contact.	$200	10 years
Calmar Fill Station	Electrical	Lighting appears to be original fluorescent fixtures. Since the lights are off 99% of the time there is little benefit to upgrading these to LED until they fail.	$3,500	10 years
Calmar Fill Station	Electrical	An emergency wallpack is present however the ability of an old unit like this to provide the 30 min emergency lighting required is low. Also, there is no illuminated exit sign over the doorway. Recommend a new emergency exit sign with lights be installed next to the door (include auto exerciser option) to resolve both issues.	$2,000	1-2 years
Calmar Fill Station	Electrical	An alarm system with keypad was observed. The DSC system appears to be offline and instead the alarm via the PLC and a keyed switch is used. The system is functional.		
Calmar Fill Station	Electrical	A carbon monoxide detector was observed. These should be replaced every 5 years. Recommend replacement.	$200	1-2 years
Calmar Fill Station	Electrical	Cable and pipe penetrations though the block wall are not sealed. These should be sealed to prevent water or critter ingress.	$500	1
Calmar Fill Station	Electrical	Active cathodic protection is installed. This appears to be functional but is outside of our expertise to determine the condition.		
Calmar Fill Station	Electrical	An old Schneider power fail relay is seen on the wall. This is assumed to be tied to the SCADA. Replace when it fails otherwise it has no operational impact.		
Calmar Fill Station	Electrical	The grounding wire above the PLC cabinet for the Polyphasor lightning protection system has been disconnected. This needs to be reconnected ASAP.	$1,000	1
Calmar Fill Station	Electrical	PLC cabinet UPS is a single unit. UPS batteries should be replaced every 5 years on average. However, some sort of mud or drilling fluid has been splashed all over the inside of the PLC cabinet coating the Panduit and UPS/cables. Recommend replace the UPS unit entirely to avoid potential issues with damage from this event.	$1,000	1
Calmar Fill Station	Electrical	An original design telephone entrance panel is present. This panel is not in use.		

Appendix B - Facility Upgrades - Calmar Fill Station

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Calmar Fill Station	Electrical	The gas piping grounding to the process pipe is unacceptable. Someone has used a servit post connected to a valve head bolt as the ground connection. Canadian Electrical code requires a permanent bonding point and a bolt on a valve actuator is not permanent. The gas piping connection needs run back to the electrical panel ground and a permanent pipe connection point is required.	$500	1
Calmar Fill Station	Control	The old MDS 4710 series radio has been left in the PLC cabinet post SCADA upgrade. This can be removed and recycled.		
Calmar Fill Station	Control	PLC spare rack slots have terminal covers to protect the connections. Acceptable.		
Calmar Fill Station	Control	Cabinet has a Sixnet 5 port managed ethernet switch for future communications and PLC access.		
Calmar Fill Station	Control	Terminals and wiring appear in good condition.		
Calmar Fill Station	Control	Instrumentation is newer E&H units and in good condition.		
Calmar Fill Station	Control	The flow control valve, actuator and flow meter are all new from the recent SCADA upgrade for the PLCs.		
Calmar Fill Station	Control	Flow meter has grounding rings and is grounded correctly.		
Calmar Fill Station	Control	The chlorine residual analyser is a Prominent unit with a CTE sensor (Total Chlorine). The incoming water feed is routed correctly, rising at all times to the analyser.		
Calmar Fill Station	Control	The drain line runs directly into a drain pipe that empties into the reservoir, an air gap is recommended to prevent drain contaminants from crawling up the hose into the analyser chamber. Recommend either adding a funnel at the top of the drain pipe stack and position the hose to drop the drain water into the funnel with an air gap or insure that where the drain hose returns to reservoir it is air gapped.	$1,000	1-2 years
Calmar Fill Station	Control	The Level transmitter is a Milltronics MiniRanger Plus unit and appears to be in good condition. The element penetrates the floor just in front of the transmitter. The floor penetration is well covered.		
Calmar Fill Station	Control	The pressure gauge between the PRV and flow valve has a block and bleed valve but is small. A 4” face is recommended for easier reading.	$1,000	1-2 years
Calmar Fill Station	Process	Valve actuators and piping have significant corrosion. This is usually indicative of poor ventilation allowing humidity to build up. A review of the heating and venting needs to be conducted to resolve these corrosion issues.	$5,000	3
Calmar Fill Station	Process	PRV appears to be original based on the corrosion observed. Recommend a rebuild kit be considered to ensure the PRV/PSV continues to function correctly for the future. This includes replacing the PRV pilot solenoid as it appears original and is likely nearing end of life failure.	$2,500	1-2 years

Appendix B - Facility Upgrades - Calmar Fill Station

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Calmar Fill Station	Process	The ARV is located post filling meter and control valve. This configuration encourages trapped air to travel through the piping to be released. The ARV is better suited to the incoming side to ensure no air is pushed through the flow meter, which will affect accuracy. Recommend that ARV be installed before flow meter.	$1,000	1-2 years
Calmar Fill Station	Process	Since the external piping is cathodically protected an isolation kit (bolt sleeves and gasket) where the stainless steel transitions to carbon steel is required to isolate the system ground from the cathodic system. This also prevents corrosion between the dissimilar metals due to a galvanic series. These different piping materials are the result of a second reservoir feed line being installed. Recommend isolation kits be installed.	$1,000	1-2 years
Calmar Fill Station	Process	The motorized butterfly valve on the discharge near the floor has been installed horizontally. This puts undue stress on the actuator and valve shaft. (Check availability of right angle gear drive.)		
Calmar Fill Station	Building Mechanical	The room is equipped with a ceiling-mounted gas furnace. Based on observation, the unit appears newer.		
Calmar Fill Station	Building Mechanical	At time of inspection, a box fan was located within room. We have assumed that the box fan was to improve air movement within the room.		
Calmar Fill Station	Building Mechanical	Recommend that ventilation testing be conducted for the roof exhaust fan to review if it meets the operational intend.		

Appendix B - Facility Upgrades - Nisku West Fill Station

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Nisku West Fill Station	Electrical	The Main breaker looks to be visually in good shape, but the internals should be checked and replaced if corrosion is found.	$500	1-2 years
Nisku West Fill Station	Electrical	The main distribution panel appears to be in good condition for original equipment however an internal inspection for pitting or corrosion is prudent and replacement if corrosion is found. Rust is observed on the lower corners of the panel suggesting that corrosion is occurring inside the panel due to excess moisture.	$500	1-2 years
Nisku West Fill Station	Electrical	The venting of this room needs to be examined as excess moisture is obviously present due to the rust observed.		
Nisku West Fill Station	Electrical	There is a smoke detector on the ceiling and it appears relatively new. This should be replaced in 5 to 10 years with a suitable unit to provide an alarm contact.	$200	10 years
Nisku West Fill Station	Electrical	Lighting appears to be original fluorescent fixtures. Since the lights are off 99% of the time there is little benefit to upgrading these to LED until they fail. However, water damage to several of the lights can be observed and the source of the water needs to be determined with the damaged fixtures replaced with new LED.	$3,500	1-2 years
Nisku West Fill Station	Electrical	An emergency wallpack is present however the ability of an old unit like this to provide the 30 min emergency lighting required is low. Also, there is no illuminated exit sign over the doorway. Recommend a new emergency exit sign with lights be installed next to the door (include auto exerciser option) to resolve both issues.	$1,500	1
Nisku West Fill Station	Electrical	An alarm system with keyed switch was observed on the PLC panel above the chlorine analyser. The system is functional.		
Nisku West Fill Station	Electrical	A Carbon Monoxide detector was observed. These should be replaced every 5 years. Recommend replacement.	$200	1
Nisku West Fill Station	Electrical	There is a wall penetration near the PRV through which daylight can be observed. This hole needs to be plugged as it is more than large enough to allow vermin to enter the building. This hole should be sealed to prevent water or critter ingress.	$500	1
Nisku West Fill Station	Electrical	Active Cathodic protection is installed. This appears to be functional but is outside of our expertise to determine the condition.		
Nisku West Fill Station	Electrical	An old Schneider power fail relay is seen on the wall. This is assumed tied to the SCADA. Replace when it fails otherwise it has no operational impact.		
Nisku West Fill Station	Electrical	The pipe appears to be well grounded.		
Nisku West Fill Station	Electrical	PLC cabinet UPS is a single unit. UPS batteries should be replaced every 5 years on average.	$500	1-2 years
Nisku West Fill Station	Electrical	An original design telephone entrance panel is present. This panel is not in use.		
Nisku West Fill Station	Electrical	There is a Pyrotenax inline heat tracing for the water line. This system appears to be original to the facility Recommend updating to a newer GFI code compliant system.	$2,500	5 years
Nisku West Fill Station	Controls	The old MDS 4710 series radio has been left in the PLC cabinet post SCADA upgrade. This can be removed and recycled.		
Nisku West Fill Station	Controls	PLC spare rack slots have terminal covers to protect the connections. Acceptable.		
Nisku West Fill Station	Controls	Cabinet has a Sixnet 5 port managed ethernet switch for future communications and PLC access.		
Nisku West Fill Station	Controls	Terminals and wiring appear in good condition.		

Appendix B - Facility Upgrades - Nisku West Fill Station

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Nisku West Fill Station	Controls	The rear door cannot open past the manual isolation valve.		
Nisku West Fill Station	Controls	Online instrumentation is newer E&H units and in good condition.		
Nisku West Fill Station	Controls	The flow control valve, actuator and flow meter are all new from the recent SCADA upgrade for the PLCs.		
Nisku West Fill Station	Controls	Flow meter has grounding rings and is grounded correctly.		
Nisku West Fill Station	Controls	The chlorine residual analyser is a Prominent unit with a CTE sensor (Total Chlorine). The incoming water feed does have an air-trap, and this should be corrected so the line rises or stays level at all times towards the analyser.	$500	1
Nisku West Fill Station	Controls	The drain line runs directly into a drain pipe that empties into the reservoir, an air gap is recommended to prevent drain contaminants from crawling up the hose into the analyser chamber. Recommend either adding a funnel at the top of the drain pipe stack and position the hose to drop the drain water into the funnel with an air gap or insure that where the drain hose returns to reservoir it is air gapped.	$1,000	1
Nisku West Fill Station	Controls	An additional note on the analyser drain line, where it enters the floor flange to drain back to the reservoir does not appear to be well sealed. This could allow floor wash water to enter the wetwell. Recommend this hole be sealed with caulking to prevent water contamination.	$1,000	1
Nisku West Fill Station	Controls	The level transmitter is a Milltronics MiniRanger Plus unit and appears to be in good condition. The element penetrates the floor just in front of the transmitter. The floor penetration is well covered.		
Nisku West Fill Station	Process	Valve actuators and piping do not show signs of corrosion. Piping appears to have been painted in the last few years.	$0	
Nisku West Fill Station	Process	There is some rusting where pipe supports have been moved/relocated.	$1,000	5
Nisku West Fill Station	Process	PRV appears to be in good condition based on the lack of corrosion observed. Recommend a rebuild kit be considered to ensure the PRV/PSV continues to function correctly for the future. This includes replacing the PRV pilot solenoid as it appears original and is likely nearing end of life.	$2,000	1-2 years
Nisku West Fill Station	Building Mechanical	Room is equipped, with a ceiling mounted gas furnace. Based on observation unit appears newer.		
Nisku West Fill Station	Building Mechanical	Gas meter is located within meter room. When meter is upgraded by utility, the gas meter should be installed on the outside of the building.		
Nisku West Fill Station	Building Mechanical	Wall penetration near the PRV should be filled.	$500	1
Nisku West Fill Station	Building Mechanical	No exhaust air vent observed within room. Exhaust vent should be installed to allow for proper air changes within the space and to keep moisture levels down		

Appendix B - Facility Upgrades - Nisku East Fill Station

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Nisku East Fill Station	Electrical	This is a relatively new facility.		
Nisku East Fill Station	Electrical	The ceiling is very high. No smoke detector was observed. A smoke detector on the wall with an alarm contact to the SCADA is recommended.	$500	1-2 years
Nisku East Fill Station	Electrical	Lighting appears to be chain suspended fluorescent fixtures. Since the lights are off 99% of the time, there is little benefit to upgrading these to LED until they fail.	$3,500	10 years
Nisku East Fill Station	Electrical	An emergency wallpack is present; however, building code requires the exit to be marked with an exit sign as well as be illuminated. Recommend a new emergency exit sign with lights be installed next to the door (include auto exerciser option) to resolve both issues. Note that this will require a dedicated circuit to meet code, it cannot be tied to anything other than emergency lighting.	$1,500	1
Nisku East Fill Station	Electrical	An alarm system with keyed switch was observed on the PLC panel below the HMI display. The system is functional.		
Nisku East Fill Station	Electrical	A Carbon Monoxide detector was not observed in this room. They are not specifically required but one should be installed to be consistent with the other facilities.	$200	1-2 years
Nisku East Fill Station	Electrical	No active cathodic protection was observed in this room.		
Nisku East Fill Station	Electrical	The pipe appears to be well grounded.		
Nisku East Fill Station	Electrical	PLC cabinet UPS is a single unit. UPS batteries should be replaced every 5 years on average.	$500	5
Nisku East Fill Station	Controls	PLC spare rack slots have terminal covers & slot covers to protect the connections. Acceptable.		
Nisku East Fill Station	Controls	Cabinet has a Sixnet 5 port managed ethernet switch for future communications and PLC access.		
Nisku East Fill Station	Controls	Terminals and wiring appear in good condition.		
Nisku East Fill Station	Controls	Online instrumentation is newer E&H units and in good condition.		
Nisku East Fill Station	Controls	The flow control valve, actuator and flow meter are all new.		
Nisku East Fill Station	Controls	Flow meter does not have grounding rings and is therefore not installed per manufacturer's recommendations. Recommend ground rings be added.	$2,500	1-2 years
Nisku East Fill Station	Controls	The chlorine residual analyser is a Prominent unit with a CTE sensor (Total Chlorine). The incoming water feed does have an air trap as it drops down towards the analyser and then rises back up just before connecting. A realignment of the water line along the wall can correct this installation mistake.	$1,000	1
Nisku East Fill Station	Controls	No level transmitter was observed in the room as such it is assumed the level is a signal split with the reservoir side.		
Nisku East Fill Station	Controls	PRV is fairly new and in good condition. It is installed crooked to the pipe with a support directly below it as what appears to have been a mis-calculation for wall clearance required during installation.		
Nisku East Fill Station	Controls	Pressure gauge PI-0200 at the analyser tap is small and should be replaced with at least a 4" face gauge.	$1,000	1-2 years
Nisku East Fill Station	Controls	PIT-0200 has no Block and Bleed to ensure an accurate reading as well a manual line tap directly under the PIT when in use will create a pressure gradient and severely skew the transmitter readings. Recommend the manual line be located elsewhere and a Block and Bleed valve installed for the transmitter.	$1,500	1
Nisku East Fill Station	Controls	This facility has an Automation Direct Graphical HMI. The HMI displays the system and setpoint status with trends. Unclear if it allows setpoint access. This HMI is not really necessary from a SCADA standpoint and is unique to this fill station.		

Appendix B - Facility Upgrades - Nisku East Fill Station

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Nisku East Fill Station	Process	Piping and equipment are in generally good condition.	$0	
Nisku East Fill Station	Process	The flow control valve appears to be installed backwards. While functional this will render any anti-cavitation trims useless and result in excessive valve wear.	$1,000	1-2 years
Nisku East Fill Station	Process	Pressure gauge PI-0200 is “pegged”. Consider a (larger) gauge with a higher range (see EIC photos).	$1,000	1-2 years
Nisku East Fill Station	Process	Remove/replace galvanized fittings on instrumentation piping.	$1,000	1-2 years
Nisku East Fill Station	Building Mechanical	The fill station uses one portion of the reservoir building. AHU is in another portion of the building that was not accessible.		
Nisku East Fill Station	Building Mechanical	The mechanical equipment in the space consist of one supply outlet mount low and 1 electric baseboard convector mounted below the valve assembly.		

Appendix B - Facility Upgrades - City of Beaumont

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
City of Beaumont	Electrical	The MCB appears to be in good condition with no obvious signs of corrosion however, it is original to the facility and is due to be replaced or re-furbished due to age. A new MCB is recommended to ensure system electrical protection is maintained.	$1,000	1
City of Beaumont	Electrical	The distribution panel has several years on it but appears to be in good condition with no obvious corrosion. An internal inspection for pitting or corrosion is prudent and replacement if corrosion is found is warranted but the overall system condition does not suggest it will be corroded inside the panel.	$500	1
City of Beaumont	Electrical	There is a smoke detector on the ceiling and it appeared clean. Since the age was not on the device this device should be replaced a suitable unit to provide an alarm contact to SCADA.	$200	1-2 years
City of Beaumont	Electrical	Lighting appears to be original fluorescent fixtures. Since the lights are off 99% of the time there is little benefit to upgrading these to LED until they fail.		
City of Beaumont	Electrical	An emergency wallpack is present however the unit is missing a bulb and the ability of an older unit like this to provide the 30 min emergency lighting required is low. Also, there is no illuminated exit sign over the doorway. Recommend a new emergency exit sign with dual lights be installed over/next to the door (include auto exerciser option) to resolve both issues. A dedicated power circuit is required by code for the exit sign.	$1,500	1-2 years
City of Beaumont	Electrical	The external light over the door way is a very old HPS wall pack. Recommend that because this is on a lot that a new LED vandal resistant unit be installed with integral photocell. The improved light cutoff features of the LED will reduce bleed to the residential units around the facility.	$500	1-2 years
City of Beaumont	Electrical	An alarm system with keypad was observed but power appears to be disconnected to the panel. An alarm via the PLC and keyed switch is used instead. The system is functional.		
City of Beaumont	Electrical	A Carbon Monoxide detector was observed. These should be replaced every 5 years and as such we recommend replacement.	$200	5
City of Beaumont	Electrical	Active Cathodic protection is installed and mounted externally. This appears to be functional but is outside of our expertise to determine the condition. One area of concern is the proximity of the unit heater vent to the Cathodic box, it is partially over top of the box and corrosive vent condensate could drip onto the Cathodic box. Ensuring condensate cannot drip onto the junction box is a prudent preventative measure.	$500	1
City of Beaumont	Electrical	A power fail relay is seen on the wall. This is assumed tied to the SCADA. Replace when it fails otherwise it has no operational impact.		
City of Beaumont	Electrical	PLC cabinet UPS is a single unit with an extension battery pack. UPS batteries should be replaced every 5 years on average.		
City of Beaumont	Electrical	A telephone entrance panel is present. This panel is not in use.		
City of Beaumont	Controls	PLC spare rack slots have terminal covers to protect the connections. Acceptable.		
City of Beaumont	Controls	Cabinet has a Sixnet 5 port managed ethernet switch for future communications and PLC access.		
City of Beaumont	Controls	Terminals and wiring appear in good condition.		
City of Beaumont	Controls	Online instrumentation is newer E&H units and in good condition.		
City of Beaumont	Controls	The flow control valve, actuator and flow meter are all new.		
City of Beaumont	Controls	Flow meter has grounding rings and is therefore installed per manufacturer's recommendations.		

Appendix B - Facility Upgrades - City of Beaumont

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
City of Beaumont	Controls	The chlorine residual analyser is a Prominent unit with a CTE sensor (Total Chlorine). The incoming water feed line to the transmitter rises consistently from the PRV to the analyser. This is installed correctly.		
City of Beaumont	Controls	The drain line runs directly into a drain pipe that empties into the reservoir, an air gap is recommended to prevent drain contaminants from crawling up the hose into the analyser chamber. Recommend either adding a funnel at the top of the drain pipe stack and position the hose to drop the drain water into the funnel with an air gap or insure that where the drain hose returns to reservoir it is air gapped.	$500	1-2 years
City of Beaumont	Controls	The level transmitter is a Milltronics MiniRanger Plus and appears to be in good condition.		
City of Beaumont	Controls	Pressure gauge generally are large face units and easy to read but several are not tagged. The gauge between the PRV and flow control valve needs a tube extension as the isolation valve handle blocks the dial face.	$1,000	1-2 years
City of Beaumont	Process	Piping and valves are in generally good condition.	$0	
City of Beaumont	Process	PRV appears to be in good condition based on the lack of corrosion observed. Recommend a rebuild kit be considered to ensure the PRV/PSV continues to function correctly for the future. This includes replacing the PRV pilot solenoid as it appears original and is likely nearing end of life.	$2,000	1-2 years
City of Beaumont	Process	Consider installation of an air release valve in the influent bypass elbow. This will eliminate any entrained air before it can affect any of the downstream instruments.	$1,000	1-2 years
City of Beaumont	Process	Remove galvanized fittings on instrumentation piping.	$1,000	1-2 years
City of Beaumont	Building Mechanical	The mechanical equipment in the space consist of one REZNOR gas fired unit heater vented to the exterior. Combustion air is from the space. Controls are using a line voltage stat. The UH is new and in good operational condition. Service life of 20 years is expected.		

Appendix B - Facility Upgrades - HWY 21 Booster Fill Station

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
HWY 21 Booster Fill Station	Electrical	The MCC appears to be in good condition with no obvious signs of corrosion and given it's age it has at least another 15 years of life. There is a good section and a half of spare space provided. Expansion physically is not an issue for this MCC.		
HWY 21 Booster Fill Station	Electrical	The ASCO transfer switch appeared to be operational and operations indicated that routine generator failure testing is conducted.		
HWY 21 Booster Fill Station	Electrical	The 120/208V distribution panel is in good condition with no obvious signs of corrosion and is fed by a 7.5kVA step down three phase transformer.		
HWY 21 Booster Fill Station	Electrical	The two VFD's are 20HP units from Cutler Hammer (SVX9000 series) with passive harmonic filters.		
HWY 21 Booster Fill Station	Electrical	There is a smoke detector on the ceiling above the MCC. This device is original to the facility and is due for replacement.	$200	1
HWY 21 Booster Fill Station	Electrical	Lighting are original fluorescent fixtures to the building. Since the lights are off 99% of the time there is little benefit to upgrading these to LED until they fail.		
HWY 21 Booster Fill Station	Electrical	Emergency lighting wall packs are present upstairs and downstairs including the stairwell. Since these units are only 10 years old the batteries should be replaced to ensure they can function as intended for 30m on battery.	$500	1
HWY 21 Booster Fill Station	Electrical	The main entry door has an illuminated Exit sign with lights.		
HWY 21 Booster Fill Station	Electrical	The external light over the door way and around the building is LED with built in photocell control and appear in good condition.		
HWY 21 Booster Fill Station	Electrical	An alarm via the PLC and keyed switch is used for security. The system is functional.		
HWY 21 Booster Fill Station	Electrical	A Carbon Monoxide detector was observed. These should be replaced every 5 years and as such we recommend replacement and place a date of install on the unit.	$200	1
HWY 21 Booster Fill Station	Electrical	PLC cabinet UPS is a single unit. UPS batteries should be replaced every 5 years on average.	$500	5
HWY 21 Booster Fill Station	Electrical	A Sola Hevi-duty power conditioner is installed to filter the power going to the UPS. After 10 years this filter needs to be closely inspected for wear and damage and replaced if any found. These units have shown a tendency to wear out and fail if exposed to significant line noise after several years while doing their job of noise filtering. Less expensive options now exist like AEGIS Power filters that perform the same function.	$1,000	1
HWY 21 Booster Fill Station	Electrical	The sump pump in the basement appears to operate often if the flow rate of water to the sump is any indication. Operators test the sump but replacement is recommended after 10 years of repeated use before it fails. Debris appears to have been swept into the sump pit, a cleanup is recommended to prevent zip ties and other matter from clogging the pump.	$500	1
HWY 21 Booster Fill Station	Electrical	When onsite it was noted that someone had stolen/cut the original ground grid. A temporary ground cable had been installed but priority to bury and protect a new ground cable needs to be performed.	$1,500	1
HWY 21 Booster Fill Station	Controls	PLC is a Momentum and is due for upgrade to match the rest of the SCADA as an M340.	$10,000	1-2 years
HWY 21 Booster Fill Station	Controls	Cabinet has a Sixnet 5 port ethernet switch for future communications.		
HWY 21 Booster Fill Station	Controls	No HMI exists at this facility. Because this facility contains pumps AE recommends a small touchscreen interface be added to allow operator access to status and local setpoints. The HMI should be password protected with appropriate operator access levels. Recommend this occur at the same time the PLC is upgraded.	$5,000	1-2 years

Appendix B - Facility Upgrades - HWY 21 Booster Fill Station

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
HWY 21 Booster Fill Station	Controls	Terminals and wiring appear in good condition.		
HWY 21 Booster Fill Station	Controls	Online instrumentation is newer E&H units and in good condition.		
HWY 21 Booster Fill Station	Controls	Flow meter has grounding rings and is therefore installed per manufacturer's recommendations.		
HWY 21 Booster Fill Station	Controls	Pressure gauges added to the PIT's in the basement as small. These should be 4" dual scale for easier reading. PIT's all have Block and Bleed valves. Better cable supports should be fabricated to support the instrument cabling to the discharge PIT's to relive stress on the instruments.	$1,500	1-2 years
HWY 21 Booster Fill Station	Controls	The sump flood bulb appears to be in good condition		
HWY 21 Booster Fill Station	Process	Piping and valving is in good condition. Superficial rust on bolts on the pump heads.	$0	
HWY 21 Booster Fill Station	Process	Both pumps are horizontal split case, each rated at 13.4 L/sec @ 63.3 m TDH.		
HWY 21 Booster Fill Station	Process	BP-0406 actual reading – 2.21 L/sec @ 47 m TDH (48.4 Hz./2,856 rpm) – see table in Appendix A for design vs. actual comparisons of flow and pressure, and the accompanying curve for design vs. actual reading calculated to full speed.		
HWY 21 Booster Fill Station	Process	BP-0407 actual reading – 2.47 L/sec @ 47 m TDH (47.9 Hz./2,826 rpm) – See Appendix A.		
HWY 21 Booster Fill Station	Process	Both pumps are operating close to their design curve but are operating very inefficiently due to low flow conditions.		
HWY 21 Booster Fill Station	Process	Vibration readings for both pumps and motors were within acceptable limits.		
HWY 21 Booster Fill Station	Process	Sump pump is also rusty. Again superficial.		
HWY 21 Booster Fill Station	Process	Galvanized fittings have been used for the pressure transmitter, gauge and sample lines. Galvanized piping is not allowed to be used with potable water systems and should be replaced.	$1,000	1-2 years
HWY 21 Booster Fill Station	Building Mechanical	The building was constructed in 2009.		
HWY 21 Booster Fill Station	Building Mechanical	Inspect the gas fired unit heater, the exhaust vent pipe and associated thermostat, and confirm the findings. The unit heater needs to be cleaned and maintained on yearly basis.		
HWY 21 Booster Fill Station	Building Mechanical	Check and test fire extinguisher on a regular basis every year.		

Appendix B - Facility Upgrades - Boundary Pump Station

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Boundary Pump Station	Electrical	The utility transformer outside has a significant build-up of dead leaves around the base. This is a fire hazard and needs to be cleaned up annually.		1
Boundary Pump Station	Electrical	The radio tower ground appears solid.		
Boundary Pump Station	Electrical	The HPS yard lights are original to the facility and showing their age. The pole bases are corroded and the light themselves are faded and cracked. Recommend these lights be replaced with LED style on new poles. This would better match the new LED lights found on the building perimeter.	$6,000	1-2 years
Boundary Pump Station	Electrical	Photocell controlled perimeter LED lighting has been added recently to the building.		
Boundary Pump Station	Electrical	The building is equipped with lightning protection along the parapet. The ground conductors appear to be intact and securely fastened to the building exterior.		
Boundary Pump Station	Electrical	An Emergency exit light and exit lighting are present at the front and rear exits. The operator indicated the batteries were being replaced at the time of this inspection, but half the bulbs were burnt out on the exit sign at the back door. Although the front exit light is illuminated, there is no other lighting for that exit hallway. Recommend replacement of both front and rear exit signs with a combination exit and emergency light to meet both criteria of an illuminated sign and illuminated path.	$1,500	1
Boundary Pump Station	Electrical	Lighting in the facility is a mixture of the original compact fluorescent fixtures and some high bay metal halide fixtures; lighting levels seemed adequate. Recommend changing the MH fixtures to LED style as this will eliminate restrike wait time should the lights be turned off briefly by accident. Since the facility is not occupied 8hrs a day replacement of the fluorescents should only occur as they fail to reduce payback time. When the fluorescent fixtures are replaced we recommend replacing the fixture not upgrading with an LED retrofit kit. The end cost of a retrofit is almost the same as a new fixture.	$5,000	1-2 years
Boundary Pump Station	Electrical	The pot lights in the conference room can have the bulbs replaced with LED and the fixture life will be extended plus the added benefit of reduced energy consumption.	$250	1
Boundary Pump Station	Electrical	The distribution MCC is original to the facility (30+ years old) and needs to be replaced due to age.	$35,000	1-2 years
Boundary Pump Station	Electrical	The VFD's were inspected via infrared in 2014. Typical VFD life is 20 years, based on the estimated installation date these have about 5 years life left.	$25,000	5
Boundary Pump Station	Electrical	Telephone service is present at this facility and is in use.		
Boundary Pump Station	Electrical	A Carbon Monoxide detector was observed. These should be replaced every 5 years and as such we recommend replacement and place a date of install on the unit.	$200	1
Boundary Pump Station	Electrical	All but one motor was flagged as Inverter Duty rated. That needs to be addressed when the pumps are upgraded as all motors on VFDs need to be inverter duty rated.		
Boundary Pump Station	Controls	Master HMI uses a software alarm dialer via a Multitech voice modem for call outs. This is a flexible option however it does place the onus on a single computer to stay operational for reliable alarm callouts. Hardware versions like a Barnett Engineering system dialer are less likely to crash due to a virus or hard drive failure.		

Appendix B - Facility Upgrades - Boundary Pump Station

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Boundary Pump Station	Controls	HMI Computers should be industrial hardened or Server grade machines, with Raid1 mirrored if not Raid5 redundant drives. They operate 24hrs a day year round and as such wear out quickly. The computer hardware needs to be replaced every 5 years. Replacement of hardware often results in new operating systems which drives software upgrades.	$20,000	1-2 years
Boundary Pump Station	Controls	PLC Cabinet has an ethernet switch for HMI and PLC.		
Boundary Pump Station	Controls	Terminals and wiring appear in good condition for main PLC cabinet.		
Boundary Pump Station	Controls	Online instrumentation are newer E&H units and are in good condition. There are a couple of old Bristol Babcock pressure transmitters connected still but these are believed to be non-functional and not used.		
Boundary Pump Station	Controls	The EPCOR temperature transmitter has the cover off and is assumed to be undergoing repair by EPCOR.		
Boundary Pump Station	Controls	Station discharge Flow meter has grounding rings and is therefore installed per manufacturer's recommendations.		
Boundary Pump Station	Controls	EPCOR inlet flow meter is an Elster/AMCO Flowmeter directly connected to the EPCOR metering cabinet. This cabinet reproduces the flow rate for the booster station SCADA. This meter is owned and maintained by EPCOR.		
Boundary Pump Station	Controls	Pressure gauges have isolation valves and the pressure transmitters have Block and Bleed valves.		
Boundary Pump Station	Process	The piping and equipment is in generally good condition. Station is 30+ years old.	$0	
Boundary Pump Station	Process	There is no evidence of rust, although there is a calcium build-up on the bearings of P-3.		
Boundary Pump Station	Process	Pump P-102 has been dismantled. The internals are out for service.		
Boundary Pump Station	Process	See table in Appendix A for design vs. actual comparisons of flow and pressure, and the accompanying curve for design vs. actual reading calculated to full speed for pumps P-103, 104.		
Boundary Pump Station	Process	Both pumps are operating close to their design curve, but both were operating very inefficiently due to low flow conditions.		
Boundary Pump Station	Process	Vibration readings for both pumps and motors were within acceptable limits.		
Boundary Pump Station	Process	All valving appears to be operational.		
Boundary Pump Station	Process	Most instrument fittings are either copper or stainless steel, but there are some galvanized fittings that should be replaced.	$1,000	5
Boundary Pump Station	Process	Chlorine analyzer is a ProMinent unit with a CTE sensor for total chlorine.		
Boundary Pump Station	Building Mechanical	The building was constructed in 2009.		
Boundary Pump Station	Building Mechanical	Inspect the gas fired unit heater, the exhaust vent pipe and associated thermostat and confirm the findings. The unit heater needs to be cleaned and maintained on yearly basis.		
Boundary Pump Station	Building Mechanical	Check and test fire extinguisher on a regular basis every year.		

Appendix B - Facility Upgrades - Boundary Pump Station

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Boundary Pump Station	Building Mechanical	1 forced air furnace with a gas heat exchanger and cooling coil. Nordyne Model G5RA896C-16-H installed 1997. Supplies conditioned air to the office and service spaces. This unit appears to be near the end of its operational life. Control panel was replaced in 2003. Flue has signs of condensation leaking. Control from a line voltage stat.	$8,000	1
Boundary Pump Station	Building Mechanical	1 roof top HVAC unit (Climate Master- no longer available). Supplies conditioned air to the pump room. The unit is past its expected operation life. Unit is not operated often. Create duct in the pump room.	$50,000	1
Boundary Pump Station	Building Mechanical	1 Delhi 200 series direct drive exhaust fan (Located in the main entrance corridor). Exhaust air from the service areas. Is appears to be in good operational condition, it is at or near the end of its operational life.	$500	1
Boundary Pump Station	Building Mechanical	2 Pen Zepyhr ceiling mounted direct drive exhaust fans exhaust air from the washrooms. These are in good operational condition.	$500	1
Boundary Pump Station	Building Mechanical	2 Lennox gas fired unit heaters provide additional heat to the pump room. These are vented directly out doors. Combustion air is from the pump room. These appear to be new and are in good operational condition.		
Boundary Pump Station	Building Mechanical	2 relief air hoods mounted on the roof appear to be new and are in good operational condition.		
Boundary Pump Station	Building Mechanical	1 roof mounted condensing unit AIRE-FLO model 13ACD-030-230-15. This unit appear to be in good operational. Is not properly mounted and has shifted.	$5,000	5
Boundary Pump Station	Building Mechanical	Roof venting appears to be new and in good condition.		
Boundary Pump Station	Building Mechanical	Domestic water is supplied by a John Woods 32000 btuh, commercial/residential water hear.	$2,000	1-2 years
Boundary Pump Station	Building Mechanical	The facility transformer is in contact with a large Aspen. There are also downed branches around the base of the unit.	$1,000	1

Appendix B - Facility Upgrades - City of Leduc North Reservoir

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
City of Leduc North Reservoir	Electrical	The MCB is severely corroded and needs replacement. Consider foaming the conduit between the meter and the MCB, a likely source of corrosion is cold air on the MCB causing condensation issues.	$500	1
City of Leduc North Reservoir	Electrical	The main distribution panel has surface corrosion and an internal inspection is required. With knowledge that this panel is almost as old as the MCB and the presence of rust, replacement is recommended. Rust implies this panel has been exposed to too much moisture for a long time.	$1,000	1
City of Leduc North Reservoir	Electrical	A second “UPS” distribution panel exists. This is probably redundant and can be combined into one panel with the main distribution panel. Anything on UPS power is typically plugged directly into the UPS.	$500	1-2 years
City of Leduc North Reservoir	Electrical	The venting of this room needs to be examined as excess moisture is obviously present due to the rust observed on the equipment.		
City of Leduc North Reservoir	Electrical	The external power and telephone conduit are rusted. A coat of protective paint is required to slow down the eventual rust through on these metal conduits.	$500	1-2 years
City of Leduc North Reservoir	Electrical	There is a smoke detector on the ceiling and it appears relatively new. This should be replaced in 5 to 10 years with a suitable unit to provide an alarm contact.	$200	5
City of Leduc North Reservoir	Electrical	Lighting appears to be original fluorescent fixtures. Since the lights are off 99% of the time there is little benefit to upgrading these to LED until they fail.		
City of Leduc North Reservoir	Electrical	An emergency wallpack is present over the door however the ability of an old unit like this to provide the 30 min emergency lighting required is low. Also, there is no illuminated exit sign over the doorway. Recommend a new emergency exit sign with lights be installed over the door (include auto exerciser option) to resolve both issues. An Exit sign will require a dedicated power circuit.	$1,500	1
City of Leduc North Reservoir	Electrical	An alarm system with keyed switch was observed in the PLC panel door. The system is functional. An old DSC alarm system and keypad are still on the wall but disconnected.		
City of Leduc North Reservoir	Electrical	A Carbon Monoxide detector was observed and appears to be relatively new. These should be replaced every 5 years.	$200	1
City of Leduc North Reservoir	Electrical	The gas line is grounded outside but a gas piping grounding point was not found inside. The wall penetration where the gas line enters does not appear to be plugged. Recommend sealing the hole with foam to prevent vermin from entering the building and adding a gas piping ground connection.	$500	1
City of Leduc North Reservoir	Electrical	The Furnace is powered by an extension cord plugged into a wall socket and hardwired to the Furnace. This is possible a code issue, a dedicated circuit is required with a disconnect inline to the furnace. Recommend repairing this condition.	$500	1
City of Leduc North Reservoir	Electrical	An old Schneider power fail relay is seen on the wall. This is assumed tied to the SCADA. Replace when it fails otherwise it has no operational impact.		
City of Leduc North Reservoir	Electrical	The process pipe is well grounded with a welded connection and servit post.		
City of Leduc North Reservoir	Electrical	PLC cabinet UPS is a single unit with a battery extension. UPS batteries should be replaced every 5 years on average.	$500	1-2 years
City of Leduc North Reservoir	Electrical	A telephone entrance panel is present. This panel is not in use.		
City of Leduc North Reservoir	Controls	PLC spare rack slots have terminal covers to protect the connections. Acceptable.		
City of Leduc North Reservoir	Controls	Cabinet has a Sixnet 5 port managed ethernet switch for future communications and PLC access.		
City of Leduc North Reservoir	Controls	Terminals and wiring appear in good condition.		

Appendix B - Facility Upgrades - City of Leduc North Reservoir

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
City of Leduc North Reservoir	Controls	Instrumentation is newer E&H units and are in good condition.		
City of Leduc North Reservoir	Controls	Flow meter has grounding rings and is grounded correctly.		
City of Leduc North Reservoir	Controls	The chlorine residual analyser is a Prominent unit. The incoming water feed has an air trap issue. The pipe tap should always rise or fall so air cannot get trapped in the line; this one falls and then rises to the instrument. Recommend re-routing the water line and adding a support to the frame to facilitate the elimination of the air traps.	$1,000	1
City of Leduc North Reservoir	Controls	The analyser discharge drops to a conduit chase then to the level transmitter opening in the floor. The line routing is acceptable, but an air gap needs to be verified between the analyser return and the maximum water level to prevent back contamination of the analyser. This was not possible to determine during the inspection. Also, the penetration point is not sealed well, this point should be caulked to prevent water or dust contaminants from entering the wet well.	$500	1
City of Leduc North Reservoir	Controls	The Level transmitter (LIT-0580) is a Siemens Milltronics MiniRanger unit and appears to be in good condition. The element is suspended over the reservoir via a floor opening and cap.		
City of Leduc North Reservoir	Controls	Cabinet has a Sixnet 5 port managed ethernet switch for future communications and PLC access.		
City of Leduc North Reservoir	Controls	Terminals and wiring appear in good condition.		
City of Leduc North Reservoir	Controls	Instrumentation is newer E&H units and are in good condition.		
City of Leduc North Reservoir	Controls	Flow meter has grounding rings and is grounded correctly.		
City of Leduc North Reservoir	Process	The flow control valve, actuator, flow meter, and piping are all recent upgrades from the last SCADA upgrade for the PLCs and are in good condition other than some rust stains on the flow valve body. The bolts holding the actuator to the valve should be changed out to SS to avoid further corrosion.	$500	1-2 years
City of Leduc North Reservoir	Process	PRV appears to be original and has been painted recently. Recommend a rebuild kit be considered to ensure the PRV/PSV continues to function correctly for the future. This includes replacing the PRV pilot solenoid as it appears original and is likely nearing failure at end of life.	$2,000	1-2 years
City of Leduc North Reservoir	Process	Surface blemishes on the piping appear to be scuff marks, rather than corrosion induced. Exposed areas should be touched up so that they don't start to corrode.	$500	1-2 years
City of Leduc North Reservoir	Building Mechanical	The Commission room has a forced air furnace.		
City of Leduc North Reservoir	Building Mechanical	Inspect the gas fired unit heater, the exhaust vent pipe and associated thermostat and confirm the findings. The unit heater needs to be cleaned and maintained on yearly basis.		
City of Leduc North Reservoir	Building Mechanical	Check and test fire extinguisher on a regular basis every year.		
City of Leduc North Reservoir	Building Mechanical	The Furnace is powered by an extension cord plugged into a wall socket and hardwired to the Furnace. A dedicated circuit is required with a disconnect inline to the furnace. Recommend repairing this condition.		
City of Leduc North Reservoir	Building Mechanical	There is insufficient ventilation within the room, the ventilation within the room should be checked.		

Appendix B - Facility Upgrades - Hamlet of Armena

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Hamlet of Armena	Electrical	The PLC cabinet is missing a power filter. Recommend a AEGIS or equal power filter be added pre-UPS to ensure clean power is going to the cabinet.	$1,000	1-2 years
Hamlet of Armena	Electrical	A UPS for the PLC cabinet was not noted. Recommend adding one, 1500VA in size.	$1,500	1
Hamlet of Armena	Electrical	No generator or large UPS was found for this system.		
Hamlet of Armena	Controls	The PLC cabinet has a single power supply. Dual redundant supplies are recommended.	$1,000	1-2 years
Hamlet of Armena	Controls	Tower ground is a single wire. Normally with a tower ground you can see the piles connected to each other and then a solid link to the grid. This has what appears is a #6 green ground bolted to the tower heading into the earth. The ground is assumed to be adequate from the original Engineering and test reports since all connections are buried.		
Hamlet of Armena	Controls	The tower does have anti-climbs but they could extend about 1m higher to be more effective.	$2,500	5
Hamlet of Armena	Controls	Incoming pressure transmitter needs a Block and Bleed to ensure all air is bled away from the sensor for an accurate reading. This tap assembly has a very strange configuration that is not recommended as it can lead to leaks, air traps and skewed sensor readings if water is flowing from the sample valve port. The sample valve is also upstream of the PRV so full system pressure is experienced at this point (92 psi).	$1,000	1-2 years
Hamlet of Armena	Controls	PRV does not have a power fail solenoid, and flow control valve does not appear to have a super capacitor backup. In a power fail condition this station could over flow with unmetered water very quickly. Recommend a power fail backup system be designed to allow for system shutdown in the event of a power fail.		
Hamlet of Armena	Controls	Flow meter does not have grounding rings but since the piping is all SS technically they are not required as water and piping are all in contact and conductive.		
Hamlet of Armena	Controls	The flow control meter is using a Bray actuator. While functional, this author has had significant failures with these positioning actuators in the past and they are not recommended.		
Hamlet of Armena	Controls	Chlorine analyser is a Prominent with CTE sensor for total chlorine. The sample line to the analyser is installed correctly with the line running uphill the entire way. The discharge is piped off to a location that was not noted. Air gap to waste or if it is returned to the wetwell is required to avoid system contamination.		
Hamlet of Armena	Controls	A Redlion HMI is included on this system. Remote fill systems do not require an HMI typically.		
Hamlet of Armena	Process	Piping is all stainless steel and is in generally good condition.	$0	
Hamlet of Armena	Process	All valves, equipment, etc. appears to be functional.	$0	
Hamlet of Armena	Building Mechanical	The Armena fill station is a combination truck fill and fill station and the room is shared with the County of Camrose. As such, the building mechanical system was not evaluated.		

Appendix B - Facility Upgrades - Town of Hay Lakes

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Town of Hay Lakes	Electrical	A Sola Hevi-duty power conditioner is installed to filter the power going to the UPS. After 10 years this filter needs to be closely inspected for wear and damage and replaced if any found. These units have shown a tendency to wear out and fail if exposed to significant line noise after several years while doing their job of noise filtering. Less expensive options now exist like AEGIS Power filters that perform the same function.	$1,000	1
Town of Hay Lakes	Electrical	Single EATON Powerware UPS in cabinet. UPS batteries should be replaced every 5 years.	$500	5
Town of Hay Lakes	Controls	The Fill Station PLC is a Modicon Momentum PLC that, like the HWY 21 Booster, was too new to upgrade at the last SCADA change. It is now time to upgrade this PLC to a M340 series.	$15,000	1-2 years
Town of Hay Lakes	Controls	The fill piping is PVC and is overhead due to space restrictions. This has raised the instrumentation as well to overhead. Instrumentation is newer E&H pressure and flow meters and is in good condition. PITs overhead are angle downwards for local visualization.		
Town of Hay Lakes	Controls	E&H flow meter appears to be missing grounding rings. On non-conductive system this is manufacturer recommended. If there are no reading discrepancies of concern this can remain however if measurement issues have been noted adding SS grounding rings and additional grounding will help reduce measurement error.	$1,500	5
Town of Hay Lakes	Controls	The commission has a dedicated level transmitter, a Siemens Milltronics unit that is also in good condition. The magnetic control pad is mounted inside the PLC cabinet for safe storage.		
Town of Hay Lakes	Controls	Flow control valve and Rotork actuator appear to be in good condition as well.		
Town of Hay Lakes	Controls	No obvious signs of rust on any equipment suggesting the ventilation in this facility is adequate.		
Town of Hay Lakes	Controls	PLC cabinet wiring is in good condition.		
Town of Hay Lakes	Controls	The original MDS 4710 radio and an additional SD4 radio are still in the cabinet. The 4710 should be recycled and the spare SD4 radio stored at the Master station as a spare not left in the cabinet forgotten. The spare SD4 results from a failed attempt to link the Armena station to Hay Lakes via a repeater; this failed because no spare licenses were available to allow the configuration. This event triggered the SCADA architecture overhaul on 2018.		
Town of Hay Lakes	Controls	The local chlorine analyser is a Prominent unit using a CTE sensor (total chlorine). The unit is functional, but the water feed has an air trap where the line rises before dropping to the unit. This should be corrected to ensure the line runs continuously up or down to prevent air from trapping.	$500	1
Town of Hay Lakes	Controls	The chlorine analyser discharge drops to a line for wet well return. This needs to be air gapped to ensure the analyser is never at risk from reverse line contamination.	$500	1
Town of Hay Lakes	Process	Piping is a mixture of carbon steel and PVC.		
Town of Hay Lakes	Process	The carbon steel pipe (fill piping) is in reasonable condition, but there is evidence of corrosion on the pipe and fittings.	$500	5
Town of Hay Lakes	Process	The vertical section of this steel line does not appear to be supported well.	$500	1-2 years
Town of Hay Lakes	Process	A section of the steel pipe is open ended in the room. It should be capped or removed.	$500	1-2 years

Appendix B - Facility Upgrades - Town of Hay Lakes

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Town of Hay Lakes	Process	The majority of the control valves and instrumentation are mounted high above the floor, making maintenance difficult. . The piping was installed at the higher elevation due to the presence of the Villages old water treatment plant equipment which was located in the building at the time. Now that the equipment has been removed the Commissions piping can be lowered.	$10,000	5
Town of Hay Lakes	Process	Valving appears to be functional.	$0	
Town of Hay Lakes	Building Mechanical	The Hay Lakes fill station is a shared with the Village of Hay Lakes. As such, the building mechanical system was not evaluated.		

Appendix B - Facility Upgrades - Hamlet of New Sarepta

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Hamlet of New Sarepta	Electrical	A Sola Hevi-duty power conditioner is installed to filter the power going to the UPS. After 10 years this filter needs to be closely inspected for wear and damage and replaced if any found. These units have shown a tendency to wear out and fail if exposed to significant line noise after several years while doing their job of noise filtering. Less expensive options now exist like AEGIS Power filters that perform the same function.	$1,000	1
Hamlet of New Sarepta	Electrical	Single EATON Powerware UPS in cabinet. UPS batteries should be replaced every 5 years.	$500	2
Hamlet of New Sarepta	Controls	The Fill Station PLC is a Modicon Momentum PLC that, like the HWY 21 Booster, was too new to upgrade at the last SCADA change. It is now time to upgrade this PLC to a M340 series.	$15,000	2
Hamlet of New Sarepta	Controls	The piping is a mixture of threaded and flanged components. Corrosion is found on several flanges and needs to be addressed.	$1,000	2
Hamlet of New Sarepta	Controls	The E&H flow meter has grounding rings and is grounded correctly.		
Hamlet of New Sarepta	Controls	The Commission has a dedicated level transmitter, a Siemens Milltronics MultiRanger 100 unit that is also in good condition. The magnetic control pad is mounted on top of the unit but should be stored inside the PLC cabinet so as to not get lost.		
Hamlet of New Sarepta	Controls	Flow control valve and Rotork actuator appear to be in good condition as well but flanges are rusted. The corrosion needs to be addressed.		
Hamlet of New Sarepta	Controls	PLC cabinet wiring is in good condition.		
Hamlet of New Sarepta	Controls	The original MDS 4710 radio as well as the newer SD4 radio are in the cabinet. The 4710 should be recycled.		
Hamlet of New Sarepta	Controls	The local chlorine analyser is a Prominent unit using a CTE sensor (total chlorine). The unit is functional, and the incoming water line appears to be installed correctly.		
Hamlet of New Sarepta	Controls	The chlorine analyser discharge rises and then falls to a drain line connection tube. This needs to be replumbed as it imposes some back pressure on the analyser discharge and the direct connection could allow back contamination into the analyser for the drain line.	$500	1
Hamlet of New Sarepta	Controls	One item noted on site was a discrepancy between the local level transmitter and the Commission's unit. They do not read the same and there maybe a reason due to where the readings are taken but it was noted as a concern by the County operators. Further investigation may be warranted but the reading difference has no significant effect on the operation of the facility.		
Hamlet of New Sarepta	Process	The fill system is a mixture of carbon steel and stainless-steel piping. The piping is in generally good condition, although there is some superficial rusting on the flanges holding the control valve, and on some of the threaded fittings.	$500	5
Hamlet of New Sarepta	Process	Control valves are in good condition and appear to be functional.	$0	0
Hamlet of New Sarepta	Building Mechanical	The New Sarepta Fill Station is a shared with the Leduc County and as such, the building mechanical system was not evaluated.		

Appendix B - Facility Upgrades - Telford Lake Booster

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Telford Lake Booster	Electrical	The electrical equipment appears to be in good condition with no obvious signs of corrosion but given how new the station is none was expected. Typical electrical equipment if maintained can last 20 to 25 years.		
Telford Lake Booster	Electrical	The 18 cct 120/208V distribution panel schedule is blank. There is no way to determine what breaker operates what device. Recommend this be rectified immediately.	$2,500	1
Telford Lake Booster	Electrical	The PDP has a surge suppressor but no local power meter. Power meters are very handy but painful to retrofit into a switchboard.		
Telford Lake Booster	Electrical	The PDP was not opened but the VFD inlet screens and internals are dirty and covered in dust. Inlet filters need to be changed and the insides of the VFD cleaned out of the dust. Dust will increase heat retention in the drives and shorten their life expectancy. Recommend the PDP be serviced as well by qualified personnel. If the VFD's are any indication, the PDP is expected to be dusty as well.	$1,500	1
Telford Lake Booster	Electrical	A smoke detector was not noted as present.	$500	10 years
Telford Lake Booster	Electrical	Lighting appears to be fluorescent fixtures with LED on the exterior, interior lighting levels are good. Since these are new and the lights are off 99% of the time, there is little benefit to upgrading these to LED until they fail.		
Telford Lake Booster	Electrical	Emergency lighting wall packs are present on the walls. There is an Exit sign over the door, but it is not lit, this sign should be lit by building code at all times. The operator mentioned that the designers insisted an illuminated exit sign was not required. I believe this to be false and referring to the AB building code any door providing a fire escape must be illuminated either internally or externally. Also, an emergency light was not noted over the door. Recommend replace the exit sign with a combination exit and lighting sign to bring this to code compliance.	$1,500	1
Telford Lake Booster	Electrical	An alarm via keyed switch is used for security. The system is functional. A NetworX alarm panel was located on the wall but its function is not clear if it is integrated to the PLC or is a standalone unit that is armed/disarmed by the keyed switch.		
Telford Lake Booster	Electrical	A Carbon Monoxide detector was not observed in this facility. They are not required by code but if installed they should be replaced every 5 years.	$500	1
Telford Lake Booster	Electrical	PLC cabinet UPS is a single unit. UPS batteries should be replaced every 5 years on average.	$500	5
Telford Lake Booster	Electrical	No power conditioner is installed to filter the power going to the UPS. Recommend adding a power filter like an Eaton AEGIS unit.	$1,000	1
Telford Lake Booster	Electrical	Gas piping has a secure ground and pumps are bonded.		
Telford Lake Booster	Electrical	Process piping appears to be missing a permanent bonding connection as required by code. Recommend this be rectified.	$1,500	1
Telford Lake Booster	Electrical	Fence is not grounded. This is good practice but not strictly required unless near high voltage lines.	$2,500	5
Telford Lake Booster	Electrical	Did not see evidence of a ground grid. Owner is encouraged to obtain record drawings as well as ask for ground resistance tests.		
Telford Lake Booster	Controls	A GE Quickpanel provides a local HMI for this facility. Because this facility contains pumps AE agrees a local HMI be present.		
Telford Lake Booster	Controls	Terminals and wiring appear in good condition as the system is new.		
Telford Lake Booster	Controls	Dual 24VDC power supplies are present in the cabinet.		

Appendix B - Facility Upgrades - Telford Lake Booster

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Telford Lake Booster	Controls	With the SCADA connected to the Master node a local alarm dialer is redundant with additional monthly cellular fees for alarm calling that can be handled by the Master node.		
Telford Lake Booster	Controls	A solid ground connection has been provided for the radio polyphaser surge arrestor. No surge protection for the two cellular antenna lines were observed. This is a concern as a direct lightning strike would energize the PLC panel and likely destroy it as there is no other path for the surge to travel on the cellular antenna wires. Recommend adding cellular surge suppressors on any cellular lines leading to the outside.	$500	1
Telford Lake Booster	Controls	Online instrumentation is new and in good condition. One major issue is the pressure gauge and transmitter arrangements. Refer to photos, the piping is very non-standard and will allow for air to trap in the line going to the transmitter. Recommend all these trees be reconfigured such that the piping goes line tap -> isolation valve -> tee -> gauge, and from the other tee half -> Block and Bleed valve -> pressure transmitter. This configuration will ensure air is never trapped at the transmitter.	$1,500	1
Telford Lake Booster	Controls	Flow meter does not have grounding rings. Because the piping is coated steel it is considered non-conductive and SS grounding rings are recommended by the manufacturer. AE recommends SS grounding rings and a ground connection be installed.	$2,500	1
Telford Lake Booster	Controls	A low building temperature thermostat is located on the wall, but it is in degrees F not Celsius. Suggest at least a fine marker to note typical Celsius values at the graduations to avoid mental math conversions.		
Telford Lake Booster	Process	Piping and equipment is in good condition (to be expected since the facility is only 2-3 years old).		
Telford Lake Booster	Process	Pumps VFD-101 & 102 are each rated at 157.1 L/sec @ 67 m TDH (2,490 USgpm @ 220 ft TDH)		
Telford Lake Booster	Process	VFD-101 actual reading – 10.25 L/sec @ 18.8 m TDH (29.6 Hz./888 rpm).		
Telford Lake Booster	Process	VFD-102 actual reading – 6.49 L/sec @ 40.3 m TDH (43.3 Hz./1,299 rpm).		
Telford Lake Booster	Process	See table in Appendix A for design vs. actual comparisons of flow and pressure, and the accompanying curve for design vs. actual reading calculated to full speed.		
Telford Lake Booster	Process	Both pumps are operating close to their design curve, but both were operating very inefficiently due to low flow conditions.		
Telford Lake Booster	Process	Vibration readings for both pumps and motors were within acceptable limits.		
Telford Lake Booster	General	At the time of inspection there was a big gap that would allow uncontrolled access into the yard. This should be fixed.	$1,500	1
Telford Lake Booster	Building Mechanical	This facility is new and all mechanical equipment has an expected operational life expectancy of 20 years.		
Telford Lake Booster	Building Mechanical	The mechanical equipment in the space consist of 2 REZNOR gas fired unit heaters with concentric venting		
Telford Lake Booster	Building Mechanical	Ventilation from the space is with a wall mounted Greenheck propeller belt driven exhaust fan (Model SB-3H-24). and 1 outside air louver with electric operated motorized dampers. The dampers are energised when the exhaust air fan is energised. Controls are by line voltage thermos stats.		

Appendix B - Facility Upgrades - Town of Millet

LOCATION	DISCIPLINE	ITEM	COST	TIMELINE/ YEAR
Town of Millet	Electrical	A Single EATON Powerware UPS is in the PLC cabinet. UPS batteries should be replaced every 5 years.	$500	5
Town of Millet	Electrical	The PLC cabinet does not have a power filter. AE recommends that a power filter like an Eaton AEGIS unit be used to pre-filter noise from the power line before it reaches the UPS.	$1,000	1
Town of Millet	Electrical	Tower ground is a single wire that is screwed to the sheet metal. Normally with a tower ground you can see the piles connected to each other and then a solid link to the grid. This has what appears is a #6 green ground screwed to the tower heading into the earth. The ground is assumed to be adequate from the original Engineering and test reports since all connections are buried but the screw does not convey that a solid ground has been established in the event of a lightning strike.		
Town of Millet	Electrical	Electric heat trace has been installed on the incoming line to the reservoir pumphouse with insulation and metal cladding for the outside pipe segment. It appears to be functional.		
Town of Millet	Controls	E&H flow meter does not have grounding rings. On non-conductive system this is manufacturer recommended, since this is SS piping technically they are not required. For good measure we recommend they are still used. The bypass valving has a very large handle that is blocking the face of the flowmeter. Recommend a smaller handle so as to not block the meter face.	$2,500	2
Town of Millet	Controls	The commission has a dedicated level transmitter, a Siemens Milltronics Multiranger 100 unit that is also in good condition. The level element is located in a shaft directly under the PRV valve; a very tight installation.		
Town of Millet	Controls	Flow control valve and Rotork actuator appear to be in good condition as they are new.		
Town of Millet	Controls	PLC cabinet wiring is in good condition.		
Town of Millet	Controls	PLC cabinet has dual 24VDC power supplies.		
Town of Millet	Controls	Not all the PLC card slots have protective covers. Recommend adding missing covers to the terminal ports on the backplane to prevent contamination.	$500	2
Town of Millet	Controls	The same issue with Pressure Transmitters and Gauges as identified in the Telford Lake booster is seen here. The piping is non-standard and will allow for air to trap in the line going to the transmitter. Recommend the two pressure trees be reconfigured such that the piping goes line tap -> isolation valve -> tee -> gauge and from the other tee half -> Block and Bleed valve -> pressure transmitter. This configuration will ensure air is never trapped at the transmitter.	$1,500	1
Town of Millet	Controls	Chlorine analyser is a Prominent with CTE (total chlorine) sensor. The water feed line is piped correctly as it drops down continuously to the instrument avoiding air traps. The discharge line follows an odd route behind piping to an unknown destination. If this goes to drain or the wet well an air gap is required to be maintained to prevent back contamination of the line into the transmitter.		
Town of Millet	Process	Piping (and valves) are all stainless steel. Piping is in generally good condition; the welding is very poor.		
Town of Millet	Process	Valves are relatively new and in good condition. All appear to be functional.		
Town of Millet	Process	PRV blocks access to the level transmitter.	$5,000	5

APPENDIX G – SCENARIO COST REVIEW

Figure 11.1 - Cash Flow - Scenario 1

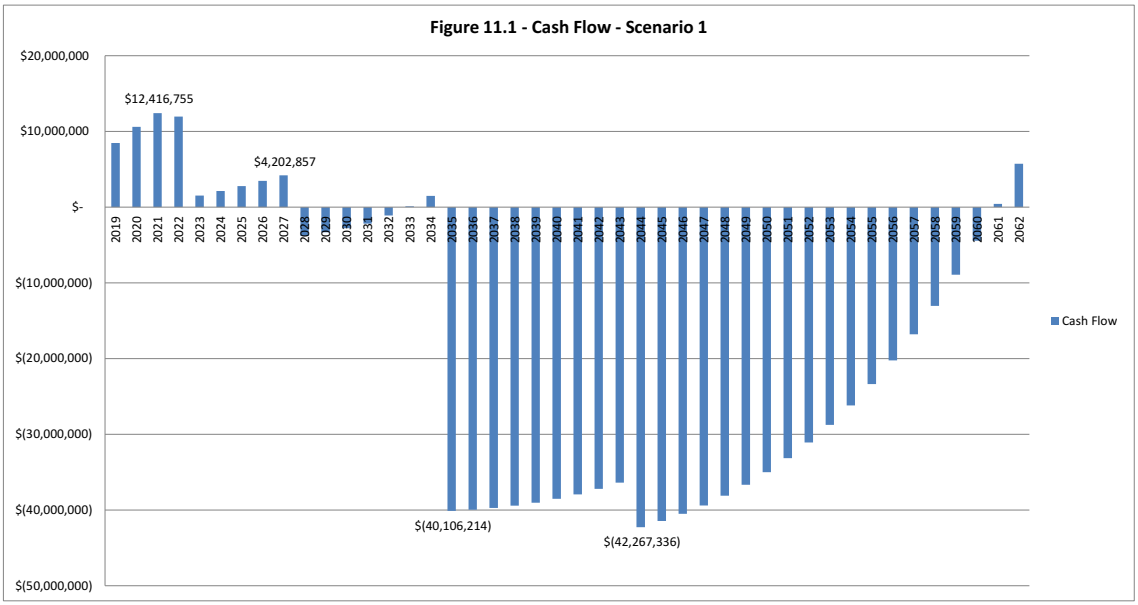
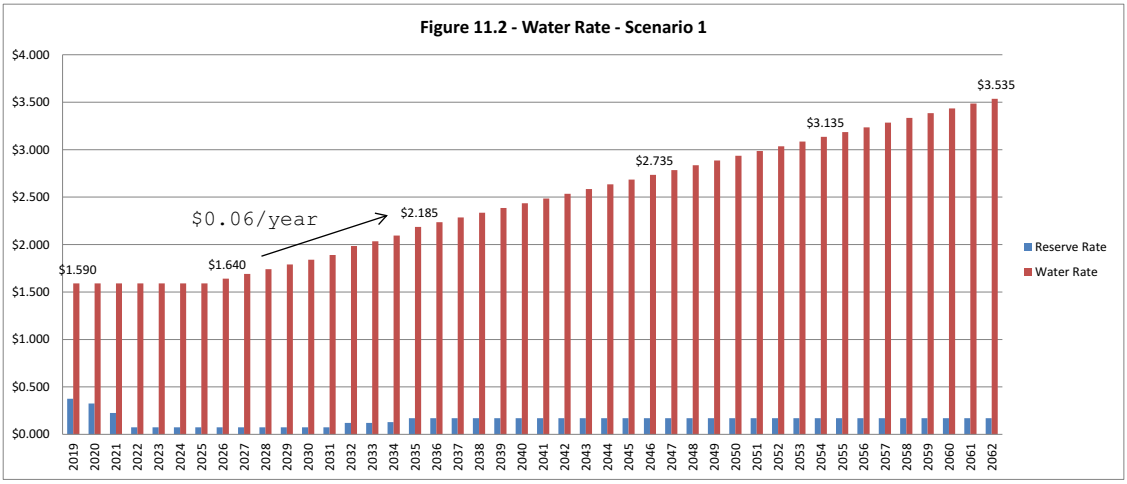


Figure 11.2 - Water Rate - Scenario 1



CRSWSC - Lond Term Capaital Planning Scenario No 1

Year	Projected Water Demand	Construction Cost (2018 Dollars) ($M)	Operting Cost	Capital Yearly Costs (Fvalue) ($M)	Net Present Valve	Accured capital (per year)	Earned Interest	Value in Account	Reserve Rate ($/m3)	Water Rate ($/m3)
		$ 38,462,040.00		$ 72,178,455	$ 51,880,314			$6,015,180		
2019	5,960,922	$ 300,000.00	$ 180,200.00			$2,235,346	$ 210,531	$ 8,461,057	$ 0.375	$ 1.590
2020	6,220,362	$ -	$ 170,450.00	$ 178,972.50		$2,021,618	$ 296,137	$ 10,599,839	$ 0.325	$ 1.590
2021	6,482,666		$ 11,500.00	$ 12,678.75		$1,458,600	$ 370,994	$ 12,416,755	$ 0.225	$ 1.590
2022	6,750,587	$ 1,206,500.00	$ -	$ 1,396,674.56		$506,294	$ 434,586	$ 11,960,961	$ 0.075	$ 1.590
2023	7,024,908	$ 9,306,500.00	$ 61,750.00	$ 11,387,166.43		$526,868	$ 418,634	$ 1,519,296	$ 0.075	$ 1.590
2024	7,332,892			$ -		$549,967	$ 53,175	$ 2,122,438	$ 0.075	$ 1.590
2025	7,634,217			$ -		$572,566	$ 74,285	$ 2,769,290	$ 0.075	$ 1.590
2026	7,945,079			$ -		$595,881	$ 96,925	$ 3,462,096	$ 0.075	$ 1.640
2027	8,261,170			$ -		$619,588	$ 121,173	$ 4,202,857	$ 0.075	$ 1.690
2028	8,586,586	$ 5,682,040.00		$ 8,814,708.98		$643,994	$ 147,100	$ (3,820,758)	$ 0.075	$ 1.740
2029	8,908,638			$ -		$668,148	$ (171,934)	$ (3,324,544)	$ 0.075	$ 1.790
2030	9,237,391			$ -		$692,804	$ (149,605)	$ (2,781,345)	$ 0.075	$ 1.840
2031	9,592,508			$ -		$719,438	$ (125,161)	$ (2,187,067)	$ 0.075	$ 1.890
2032	9,944,378			$ -		$1,193,325	$ (98,418)	$ (1,092,160)	$ 0.120	$ 1.985
2033	10,309,449			$ -		$1,237,134	$ (49,147)	$ 95,827	$ 0.120	$ 2.035
2034	10,689,790			$ -		$1,389,673	$ 3,354	$ 1,488,854	$ 0.130	$ 2.095
2035	11,080,631	$ 19,942,000.00		$ 43,530,885.04		$1,883,707	$ 52,110	$ (40,106,214)	$ 0.170	$ 2.185
2036	11,484,191			$ -		$1,952,312	$ (1,804,780)	$ (39,958,682)	$ 0.170	$ 2.235
2037	11,902,724			$ -		$2,023,463	$ (1,798,141)	$ (39,733,359)	$ 0.170	$ 2.285
2038	12,335,737			$ -		$2,097,075	$ (1,788,001)	$ (39,424,285)	$ 0.170	$ 2.335
2039	12,788,186			$ -		$2,173,992	$ (1,774,093)	$ (39,024,386)	$ 0.170	$ 2.385
2040	13,252,666			$ -		$2,252,953	$ (1,756,097)	$ (38,527,530)	$ 0.170	$ 2.435
2041	13,734,402			$ -		$2,334,848	$ (1,733,739)	$ (37,926,421)	$ 0.170	$ 2.485
2042	14,232,930			$ -		$2,419,598	$ (1,706,689)	$ (37,213,512)	$ 0.170	$ 2.535
2043	14,749,944			$ -		$2,507,490	$ (1,674,608)	$ (36,380,629)	$ 0.170	$ 2.585
2044	15,339,942	$ 2,025,000.00		$ 6,857,368.76		$2,607,790	$ (1,637,128)	$ (42,267,336)	$ 0.170	$ 2.635
2045	15,953,539			$ -		$2,712,102	$ (1,902,030)	$ (41,457,265)	$ 0.170	$ 2.685
2046	16,591,681			$ -		$2,820,586	$ (1,865,577)	$ (40,502,256)	$ 0.170	$ 2.735
2047	17,255,348			$ -		$2,933,409	$ (1,822,602)	$ (39,391,448)	$ 0.170	$ 2.785
2048	17,945,562			$ -		$3,050,746	$ (1,772,615)	$ (38,113,318)	$ 0.170	$ 2.835
2049	18,663,384			$ -		$3,172,775	$ (1,715,099)	$ (36,655,642)	$ 0.170	$ 2.885
2050	19,409,920			$ -		$3,299,686	$ (1,649,504)	$ (35,005,459)	$ 0.170	$ 2.935
2051	20,186,317			$ -		$3,431,674	$ (1,575,246)	$ (33,149,031)	$ 0.170	$ 2.985
2052	20,993,769			$ -		$3,568,941	$ (1,491,706)	$ (31,071,797)	$ 0.170	$ 3.035
2053	21,833,520			$ -		$3,711,698	$ (1,398,231)	$ (28,758,329)	$ 0.170	$ 3.085
2054	22,706,861			$ -		$3,860,166	$ (1,294,125)	$ (26,192,288)	$ 0.170	$ 3.135
2055	23,615,135			$ -		$4,014,573	$ (1,178,653)	$ (23,356,368)	$ 0.170	$ 3.185
2056	24,559,741			$ -		$4,175,156	$ (1,051,037)	$ (20,232,248)	$ 0.170	$ 3.235
2057	25,542,130			$ -		$4,342,162	$ (910,451)	$ (16,800,537)	$ 0.170	$ 3.285
2058	26,563,816			$ -		$4,515,849	$ (756,024)	$ (13,040,713)	$ 0.170	$ 3.335
2059	27,626,368			$ -		$4,696,483	$ (586,832)	$ (8,931,062)	$ 0.170	$ 3.385
2060	28,731,423			$ -		$4,884,342	$ (401,898)	$ (4,448,618)	$ 0.170	$ 3.435
2061	29,880,680			$ -		$5,079,716	$ (200,188)	$ 430,909	$ 0.170	$ 3.485
2062	31,075,907			$ -		$5,282,904	$ 15,082	$ 5,728,895	$ 0.170	$ 3.535

Figure 11.3 - Cash Flow - Scenario 2

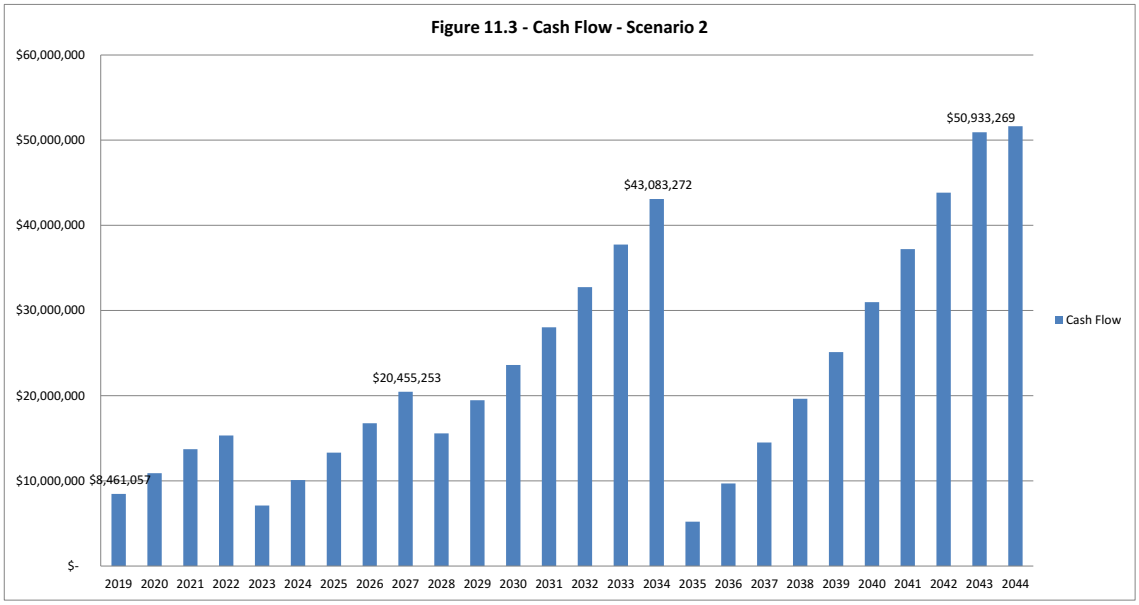
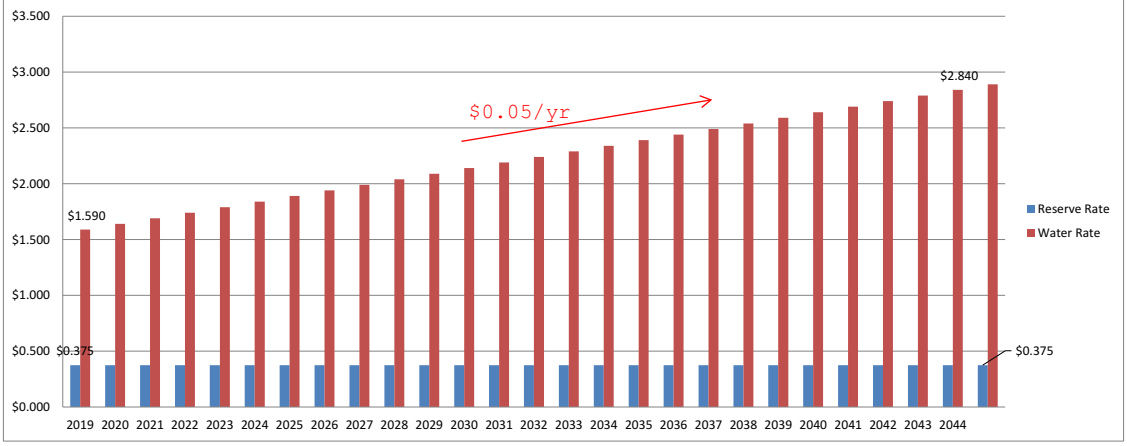


Figure 11.4 - Unit Cost Analysis - Scenario 2



CRSWSC - Unit Cost Analysis - Scenario 2

Year	Projected Water Demand	Construction Cost (2018 Dollars) ($M)	Operating Cost (2018 Dollars)	Capital Yearly Costs (Fvalue) ($M)	Net Present Valve	Accured capital (per year)	Earned Interest	Value in Account	Water Reserve Rate ($/m3)	Water Rate
		$ 38,462,040.00		**$ 72,178,455**	**$ 51,880,314**			$6,015,180		
2019	5,960,922	$ 300,000.00	$ 180,200.00			$2,235,346	$ 210,531	$ 8,461,057	$ 0.375	$ 1.590
2020	6,220,362	$ -	$ 170,450.00	$ 178,972.50		$2,332,636	$ 296,137	$ 10,910,857	$ 0.375	$ 1.640
2021	6,482,666		$ 11,500.00	$ 12,678.75		$2,431,000	$ 381,880	$ 13,711,058	$ 0.375	$ 1.690
2022	6,750,587	$ 1,206,500.00	$ -	$ 1,396,674.56		$2,531,470	$ 479,887	$ 15,325,741	$ 0.375	$ 1.740
2023	7,024,908	$ 9,306,500.00	$ 61,750.00	$ 11,387,166.43		$2,634,340	$ 536,401	$ 7,109,316	$ 0.375	$ 1.790
2024	7,332,892			$ -		$2,749,834	$ 248,826	$ 10,107,976	$ 0.375	$ 1.840
2025	7,634,217			$ -		$2,862,831	$ 353,779	$ 13,324,587	$ 0.375	$ 1.890
2026	7,945,079			$ -		$2,979,405	$ 466,361	$ 16,770,352	$ 0.375	$ 1.940
2027	8,261,170			$ -		$3,097,939	$ 586,962	$ 20,455,253	$ 0.375	$ 1.990
2028	8,586,586	$ 5,682,040.00	$ -	$ 8,814,708.98		$3,219,970	$ 715,934	$ 15,576,448	$ 0.375	$ 2.040
2029	8,908,638			$ -		$3,340,739	$ 545,176	$ 19,462,363	$ 0.375	$ 2.090
2030	9,237,391			$ -		$3,464,022	$ 681,183	$ 23,607,567	$ 0.375	$ 2.140
2031	9,592,508			$ -		$3,597,191	$ 826,265	$ 28,031,023	$ 0.375	$ 2.190
2032	9,944,378			$ -		$3,729,142	$ 981,086	$ 32,741,250	$ 0.375	$ 2.240
2033	10,309,449			$ -		$3,866,043	$ 1,145,944	$ 37,753,237	$ 0.375	$ 2.290
2034	10,689,790			$ -		$4,008,671	$ 1,321,363	$ 43,083,272	$ 0.375	$ 2.340
2035	11,080,631	$ 19,942,000.00		$ 43,530,885.04		$4,155,237	$ 1,507,915	$ 5,215,538	$ 0.375	$ 2.390
2036	11,484,191			$ -		$4,306,572	$ 182,544	$ 9,704,653	$ 0.375	$ 2.440
2037	11,902,724			$ -		$4,463,522	$ 339,663	$ 14,507,837	$ 0.375	$ 2.490
2038	12,335,737			$ -		$4,625,901	$ 507,774	$ 19,641,513	$ 0.375	$ 2.540
2039	12,788,186			$ -		$4,795,570	$ 687,453	$ 25,124,536	$ 0.375	$ 2.590
2040	13,252,666			$ -		$4,969,750	$ 879,359	$ 30,973,644	$ 0.375	$ 2.640
2041	13,734,402			$ -		$5,150,401	$ 1,084,078	$ 37,208,123	$ 0.375	$ 2.690
2042	14,232,930			$ -		$5,337,349	$ 1,302,284	$ 43,847,755	$ 0.375	$ 2.740
2043	14,749,944			$ -		$5,550,843	$ 1,534,671	$ 50,933,269	$ 0.375	$ 2.790
2044	15,339,942	$ 2,025,000.00		$ 6,857,368.76		$5,772,876	$ 1,782,664	$ 51,631,441	$ 0.375	$ 2.840
2045	15,953,539			$ -		$6,003,791	$ 1,807,100	$ 59,442,333	$ 0.375	$ 2.890

Figure 11.5 - Cash Flow - Scenario 2B

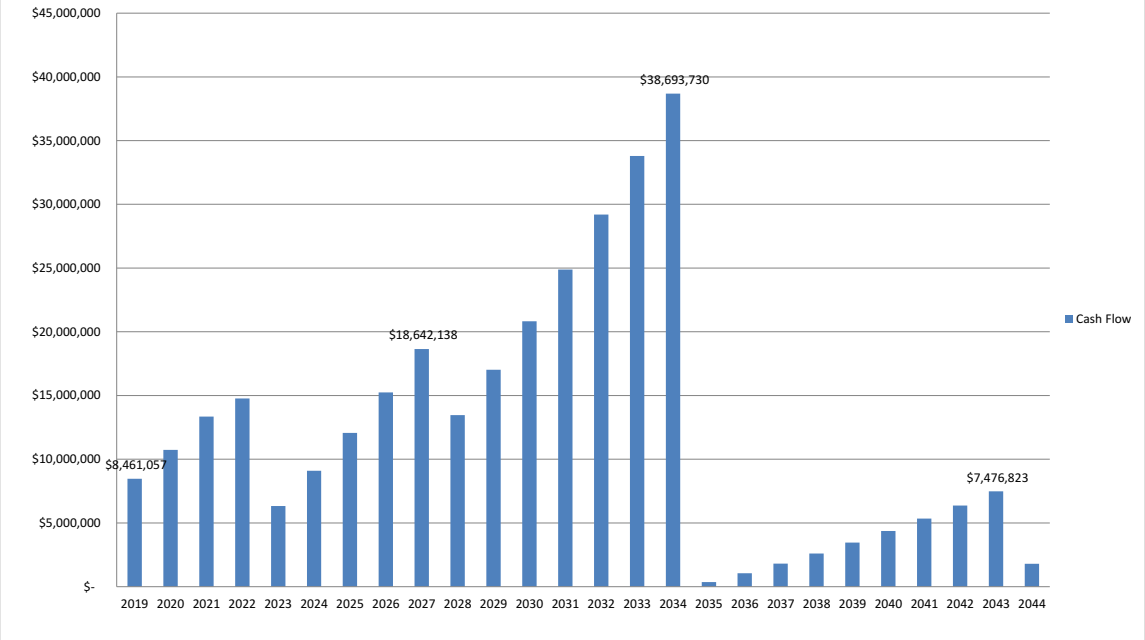
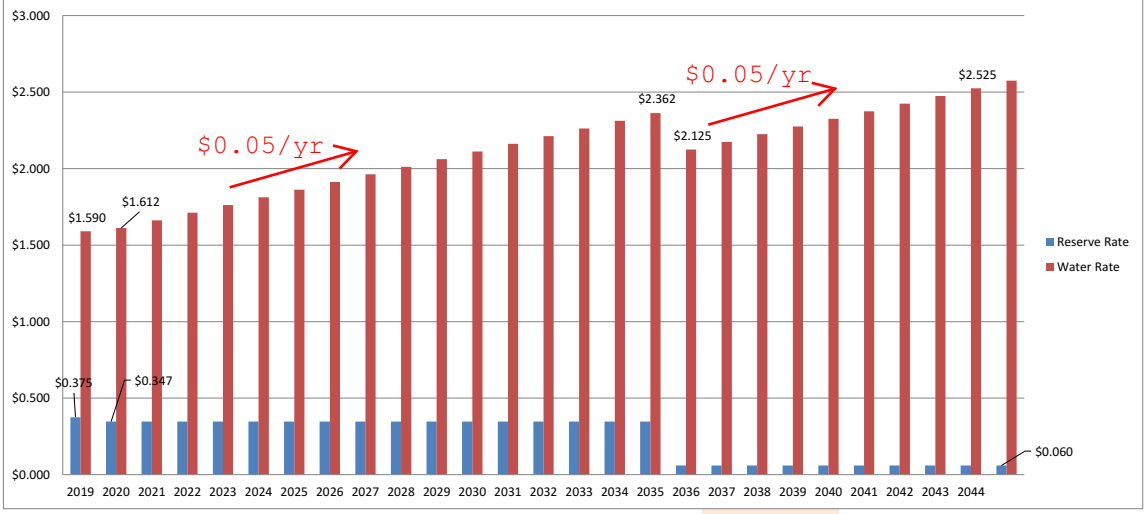


Figure 11.6 - Unit Cost Analysis - Scenario 2B



CRSWSC - Unit Cost Analysis - Scenario 2 B

Year	Projected Water Demand	Construction Cost (2018 Dollars) ($M)	Operating Cost (2018 Dollars)	Capital Yearly Costs (Fvalue) ($M)	Net Present Valve	Accured capital (per year)	Earned Interest	Value in Account	Water Reserve Rate ($/m3)	Water Rate
		$ 38,462,040.00		**$ 72,178,455**	**$ 51,880,314**			$6,015,180		
2019	5,960,922	$ 300,000.00	$ 180,200.00			$2,235,346	$ 210,531	$ 8,461,057	$ 0.375	$ 1.590
2020	6,220,362	$ -	$ 170,450.00	$ 178,972.50		$2,158,466	$ 296,137	$ 10,736,687	$ 0.347	$ 1.612
2021	6,482,666		$ 11,500.00	$ 12,678.75		$2,249,485	$ 375,784	$ 13,349,278	$ 0.347	$ 1.662
2022	6,750,587	$ 1,206,500.00	$ -	$ 1,396,674.56		$2,342,454	$ 467,225	$ 14,762,281	$ 0.347	$ 1.712
2023	7,024,908	$ 9,306,500.00	$ 61,750.00	$ 11,387,166.43		$2,437,643	$ 516,680	$ 6,329,438	$ 0.347	$ 1.762
2024	7,332,892			$ -		$2,544,513	$ 221,530	$ 9,095,482	$ 0.347	$ 1.812
2025	7,634,217			$ -		$2,649,073	$ 318,342	$ 12,062,897	$ 0.347	$ 1.862
2026	7,945,079			$ -		$2,756,942	$ 422,201	$ 15,242,041	$ 0.347	$ 1.912
2027	8,261,170			$ -		$2,866,626	$ 533,471	$ 18,642,138	$ 0.347	$ 1.962
2028	8,586,586	$ 5,682,040.00	$ -	$ 8,814,708.98		$2,979,545	$ 652,475	$ 13,459,449	$ 0.347	$ 2.012
2029	8,908,638			$ -		$3,091,297	$ 471,081	$ 17,021,827	$ 0.347	$ 2.062
2030	9,237,391			$ -		$3,205,375	$ 595,764	$ 20,822,966	$ 0.347	$ 2.112
2031	9,592,508			$ -		$3,328,600	$ 728,804	$ 24,880,370	$ 0.347	$ 2.162
2032	9,944,378			$ -		$3,450,699	$ 870,813	$ 29,201,882	$ 0.347	$ 2.212
2033	10,309,449			$ -		$3,577,379	$ 1,022,066	$ 33,801,327	$ 0.347	$ 2.262
2034	10,689,790			$ -		$3,709,357	$ 1,183,046	$ 38,693,730	$ 0.347	$ 2.312
2035	11,080,631	$ 19,942,000.00		$ 43,530,885.04		$3,844,979	$ 1,354,281	$ 362,105	$ 0.347	$ 2.362
2036	11,484,191			$ -		$684,119	$ 12,674	$ 1,058,898	$ 0.060	$ 2.125
2037	11,902,724			$ -		$709,052	$ 37,061	$ 1,805,011	$ 0.060	$ 2.175
2038	12,335,737			$ -		$734,847	$ 63,175	$ 2,603,033	$ 0.060	$ 2.225
2039	12,788,186			$ -		$761,799	$ 91,106	$ 3,455,938	$ 0.060	$ 2.275
2040	13,252,666			$ -		$789,469	$ 120,958	$ 4,366,365	$ 0.060	$ 2.325
2041	13,734,402			$ -		$818,166	$ 152,823	$ 5,337,353	$ 0.060	$ 2.375
2042	14,232,930			$ -		$847,863	$ 186,807	$ 6,372,024	$ 0.060	$ 2.425
2043	14,749,944			$ -		$881,778	$ 223,021	$ 7,476,823	$ 0.060	$ 2.475
2044	15,339,942	$ 2,025,000.00		$ 6,857,368.76		$917,049	$ 261,689	$ 1,798,192	$ 0.060	$ 2.525
2045	15,953,539			$ -		$953,731	$ 62,937	$ 2,814,860	$ 0.060	$ 2.575