APPENDIX E DFO NEED FOR DEVELOPMENT REPORT

Need for Development
Transmission Facilities
in the Chestermere Area

August 30, 2016

	Name	Signature	Date
Prepared:	Shane Long P.Eng, Operations & Engineering Services		Aug 30, 2016
Reviewed:	Kevin Noble Manager, Distribution Planning		AUG 31, 2016
Approved:	Richard Bahry Director, Engineering		2016-Aug-31

Executive Summary

Load growth in the greater Chestermere area is producing concerns related to the adequacy of the existing transmission and distribution facilities to provide capacity and reliability to meet customer needs. The associated load growth driving the concerns is comprised of:

- Existing firm customer committed load additions greater than 37 MVA over 2014 – 2017.
- Anticipated significant future load growth due to a large proposed subdivision development (Waterbridge).

This area is currently served by distribution systems connected to three Altalink Management Ltd. (Altalink) substations: Carseland 525S, Strathmore 151S, Balzac 391S; and two Enmax Power Corporation (Enmax) substations: Enmax EN24S and Enmax EN39S.

This project is needed in order to resolve the following near term issues resulting from the existing load growth:

- The back-up capability for these substations does not satisfy restoration criteria:
    - At Carseland 525S, an N-1 contingency would result in unsupplied load, predicted to be 10.1 MVA in 2014 and 18.2 MVA in 2023.
    - At Strathmore 151S, an N-1 contingency would result in unsupplied load, predicted to be 3.6 MVA in 2015 and 12.2 MVA in 2023.
    - At Enmax EN24S, an N-1 contingency would result in unsupplied load in the town of Chestermere, predicted to be 0.6 MVA in 2016 and 7.0 MVA in 2023.
- The loading on these 25 kV distribution feeders are predicted to exceed loading criteria:
    - 525S-261L in 2015
    - 391S-316L in 2017
    - EN39S-2266L in 2020
    - 151S-2010L in 2021

A number of alternatives have been considered to address these concerns. The recommended alternative is to install: one (1) new substation at NW8-24-27-4 complete with two (2) 138/25 kV 25/33/42 MVA source transformers and six (6) 25 kV feeder breakers to connect six (6) new 25 kV distribution feeders; and one (1) new 25 kV feeder breaker at the Balzac 391S substation to connect one (1) additional 25 kV distribution feeder.

The proposed development has an estimated distribution capital cost of $8.9 million (2014, ±30%). This does not include the cost for transmission upgrades.

An estimate for the transmission system capital cost will be provided by the Transmission Facility Owner.

The requested in-service date for the proposed facility upgrades is December 1, 2016.

Upon completion of this transmission system upgrade FortisAlberta is prepared to execute a DTS contract for the new POD for 43.7 MW and a DTS contract for the Balzac 391S substation for 28.0 MW.

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1. Project Description

1.1 Background

The Town of Chestermere is a suburban center bordering the east side of Calgary. It is experiencing very high population growth – over 25% in the last 5 years – with a current population of approximately 17,000.

In 2009 the Town of Chestermere annexed land to the west, approximately 970 hectares (2400 acres). In February 2014, Town Council approved the third and final reading of the master plan for the Waterbridge Development. This development has the potential for the addition of up to 46,000 residents.

Distribution service in and around the town/lake is provided by three circuits fed from two Enmax substations: Enmax EN24S and Enmax EN39S. Although fed from Enmax substations, the distribution facilities east of the border between Calgary and Chestermere are owned and operated by FortisAlberta. The surrounding areas to the north, east, and south of Chestermere are served by three Altalink substations: Carseland 525S, Strathmore 151S, and Balzac 391S. The distribution facilities emanating from these substations are owned and operated by FortisAlberta. See Appendix A, Figure A-1, for a simplified sketch of the distribution facilities in this area.

The Enmax substations, EN24S and EN39S, are located within the city limits of Calgary to the west of the town of Chestermere. The Enmax EN24S substation currently has 100 MVA of 25 kV capacity; the Enmax EN39S substation currently has 100 MVA of 25 kV capacity. The Enmax 25kV distribution feeder EN39S-2266L is predicted to exceed capacity criteria in 2020. An N-1 contingency at Enmax EN24S would result in unsupplied load in the town of Chestermere, predicted to be 0.6 MVA in 2016 and 7.0 MVA in 2023. An N-1 contingency at Enmax EN39S would result in unsupplied load in the town of Chestermere, predicted to be 0.3 MVA in 2022 and 1.8 MVA in 2023.

The Carseland 525S substation is located approximately 27 km southeast of Chestermere. The substation has a 138/25 kV 15/20/22.5 MVA source transformer with two 25 kV feeders supplying the surrounding rural area. Feeder 525S-261L is predicted to exceed capacity criteria in 2015. An N-1 contingency would result in unsupplied load, predicted to be 10.1 MVA in 2014 and 18.2 MVA in 2023.

The Strathmore 151S substation is located approximately 31 km east of Chestermere. This substation has two 138/25 kV 15/20/25 MVA source transformers, T1 and T2. Two 25 kV feeders connected to transformer T2 supply the town of Strathmore and two 25 kV feeders connected to transformer T1 supply the surrounding rural areas to the west, north, and east of Strathmore. Distribution feeder 151S-2010L is predicted to exceed capacity criteria in 2021. An N-1 contingency would result in unsupplied load, predicted to be 3.6 MVA in 2015 and 12.2 MVA in 2023.

The Balzac 391S substation is located approximately 18 km northwest of Chestermere and just southeast of the CrossIron Mills development. The substation has two 138/26.5 kV 25/33/42 MVA source transformers. Both supply three 25 kV distribution feeders. Distribution feeder 391S-303L extends to the south and east of this substation supporting the rural area north and east of Chestermere. Distribution feeder 391S-316L is predicted to exceed capacity criteria in 2017.

To summarize, based on the existing load, committed new load additions and the forecast growth, the loading on the following 25 kV distribution feeders are predicted to exceed 13.0 MVA, the FortisAlberta feeder loading criteria, as follows:

- 525S-261L in 2015
- 391S-316L in 2017
- EN39S-2266L in 2020
- 151S-2010L in 2021

The back-up capability for these substations does not satisfy restoration criteria:

- At Carseland 525S, an N-1 contingency would result in unsupplied load, predicted to be 10.1 MVA in 2014 and 18.2 MVA in 2023.
- At Strathmore 151S, an N-1 contingency would result in unsupplied load, predicted to be 3.6 MVA in 2015 and 12.2 MVA in 2023.
- At Enmax EN24S, an N-1 contingency would result in unsupplied load in the town of Chestermere, predicted to be 0.6 MVA in 2016 and 7.0 MVA in 2023.
- At Enmax EN39S, an N-1 contingency would result in unsupplied load in the town of Chestermere, predicted to be 0.3 MVA in 2022 and 1.8 MVA in 2023.

The predicted load on the Carseland 525S substation T3 source transformer is predicted to exceed its 22.5 MVA rating by 2022.

1.2 Proposal

A number of alternatives have been considered to address these concerns.

The recommended alternative is to install: one (1) new substation at NW8-24-27-4 complete with two (2) 138/25 kV 25/33/42 MVA source transformers and six (6) 25 kV feeder breakers to connect six (6) new 25 kV distribution feeders; and one (1) new 25 kV feeder breaker at the Balzac 391S substation to connect one (1) additional 25 kV distribution feeder.

The proposed development has an estimated distribution capital cost of $8.9 million (2014, ±30%). This does not include the cost for transmission upgrades.

An estimate for the transmission system capital cost will be provided by the Transmission Facility Owner.

The requested in-service date for the proposed facility upgrades is December 1, 2016.

Upon completion of this transmission system upgrade FortisAlberta is prepared to execute a DTS contract for the new POD for 43.7 MW and a DTS contract for the Balzac 391S substation for 28.0 MW.

2. Criteria and Assumptions

The analysis for the proposed development in the Chestermere area has been conducted based upon the following criteria and assumptions.

2.1 Criteria

The maximum normal loading of the FortisAlberta 25 kV distribution feeders is 13 MVA.

FortisAlberta restoration criteria require that back-up supply be available subject only to switching time.

Transmission equipment must not be operated at load levels in excess of the equipment ratings.

2.2 Load Forecast

Table 2-1 provides the FortisAlberta historical and forecast peak load levels for the substations and feeders in the subject area. The load forecast is based on historical data and contracted new loads. This load forecast was used to assess all the alternatives presented in this Need for Development document.

Table 2-1: FortisAlberta Load Forecast: Existing System

SUB No	Feeder	CAPACITY T/R	MVA	PF	W or S	MVA LOADING - RECORDED 2009 Peak MVA	2010 Peak MVA	2011 Peak MVA	2012 Peak MVA	2013 Peak MVA	PREDICTED - MVA LOADING 2014 Year 1 MVA	2015 Year 2 MVA	2016 Year 3 MVA	2017 Year 4 MVA	2018 Year 5 MVA	2019 Year 6 MVA	2020 Year 7 MVA	2021 Year 8 MVA	2022 Year 9 MVA	2023 Year 10 MVA	Fore-cast Growth
151S	Strathmore (T1)	T1	15/20/ 25	99%																	
151S		VR1	15/20/ 25	99%	W	**12.7**	**12.6**	**12.5**	**12.3**	**12.4**	**13.43**	**14.62**	**15.83**	**17.06**	**17.33**	**17.61**	**17.89**	**18.18**	**18.47**	**18.77**	**1.6%**
151S	244LE			98%	W	3.4	2.8	2.9	2.9	2.8	5.19	5.22	5.25	5.28	5.31	5.34	5.37	5.40	5.43	5.46	0.5%
151S	2010L (244LW)			99%	W	10.0	9.9	9.7	9.9	9.8	8.71	9.86	11.04	12.24	12.48	12.73	12.98	13.24	13.50	13.77	2.0%
151S	Strathmore (T2)	T2	15/20/ 25	99%	W	**15.4**	**14.9**	**14.4**	**13.5**	**14.4**	**21.31**	**22.52**	**22.76**	**23.00**	**23.24**	**23.48**	**23.73**	**23.98**	**24.23**	**24.48**	**1.1%**
151S	2183L			99%	W	5.9	5.7	5.6	5.5	6.0	11.49	11.55	11.61	11.67	11.73	11.79	11.85	11.91	11.97	12.03	0.5%
151S	2158L			98%	W	9.9	9.9	8.9	8.3	8.9	10.18	11.34	11.52	11.70	11.89	12.08	12.27	12.47	12.67	12.87	1.6%
151S	Total Station			99%	W	**27.1**	**27.3**	**26.5**	**25.7**	**26.6**	**34.39**	**36.77**	**38.20**	**39.66**	**40.16**	**40.68**	**41.20**	**41.74**	**42.27**	**42.82**	
391S	Balzac (T1)	T1	25/33/ 42	99%	S/W	**7.8**	**7.7**	**3.1**	**2.0**	**7.9**	**18.03**	**17.67**	**19.69**	**21.75**	**22.19**	**22.63**	**23.08**	**23.54**	**24.01**	**24.49**	**2.0%**
391S	316L			99%	S/W	7.5	6.8	2.0	0.1	6.6	11.23	10.26	12.13	14.04	14.32	14.61	14.90	15.20	15.50	15.81	2.0%
391S	397L			72%	W	0.9	0.8	0.0	0.0	0.3	1.99	2.03	2.07	2.11	2.15	2.19	2.23	2.27	2.32	2.37	2.0%
391S	643L			96%	S/W	0.0	0.8	1.3	1.9	2.1	5.73	6.33	6.46	6.59	6.72	6.85	6.99	7.13	7.27	7.42	2.0%
391S	Balzac (T2)	T2	25/33/ 42	98%	S/W	**7.2**	**9.4**	**7.1**	**10.3**	**10.2**	**14.74**	**15.03**	**15.33**	**15.64**	**15.95**	**16.27**	**16.60**	**16.93**	**17.27**	**17.62**	**2.0%**
391S	303L			94%	S	2.4	1.4	1.2	4.0	2.3	5.65	5.76	5.88	6.00	6.12	6.24	6.36	6.49	6.62	6.75	2.0%
391S	326L			93%	S	5.0	7.2	6.8	7.3	7.4	9.40	9.59	9.78	9.98	10.18	10.38	10.59	10.80	11.02	11.24	2.0%
391S	528L			99%	S	0.0	1.1	0.9	1.2	1.3	1.41	1.44	1.47	1.50	1.53	1.56	1.59	1.62	1.65	1.68	2.0%
391S	Total Station			95%	S	**12.3**	**15.1**	**9.9**	**12.3**	**16.8**	**28.51**	**28.45**	**30.47**	**32.53**	**33.18**	**33.84**	**34.52**	**35.21**	**35.91**	**36.64**	
525S	Carseland	T3	15/20/ 22.5	99%																	
525S		VR2	24.2/ 28.9	99%	S/W	**12.8**	**13.9**	**14.8**	**14.4**	**14.6**	**19.13**	**19.96**	**20.36**	**20.77**	**21.19**	**21.61**	**22.04**	**22.48**	**22.93**	**23.39**	**2.0%**
525S	261LN			89%	S	6.8	6.8	7.0	8.2	8.3	12.82	13.14	13.46	13.79	14.13	14.48	14.84	15.21	15.58	15.96	2.5%
525S	265LS			99%	W	8.3	8.3	8.7	8.4	9.2	9.36	9.95	10.10	10.25	10.40	10.56	10.72	10.88	11.04	11.21	1.5%
525S		T2 - Backup ONLY	5																		
EN39S	ENMAX SUB # 39																				
EN39S	2266L			99%	W	**15.2**	**12.6**	**10.9**	**6.4**	**7.5**	**9.10**	**10.61**	**12.16**	**12.42**	**12.68**	**12.95**	**13.22**	**13.50**	**13.78**	**14.07**	**2.1%**
EN24S	ENMAX SUB # 24																				
EN24S	2267L			99%	W	**3.8**	**6.2**	**7.5**	**6.8**	**6.7**	**7.42**	**10.49**	**11.03**	**11.58**	**11.79**	**12.00**	**12.22**	**12.44**	**12.66**	**12.89**	**1.8%**
EN24S	ENMAX SUB # 24																				
EN24S	2278L			99%	W			**0.3**	**5.2**	**6.3**	**7.96**	**8.81**	**9.69**	**10.43**	**10.75**	**11.08**	**11.42**	**11.77**	**12.13**	**12.51**	**3.1%**
Load transferred to 199S-492LE:												**3.00**	**3.06**	**3.12**	**3.18**	**3.24**	**3.30**	**3.37**	**3.44**	**3.51**	**2.0%**
Total Area Load:						**71.2**	**75.1**	**69.9**	**70.8**	**78.5**	**106.5**	**118.1**	**125.0**	**130.5**	**132.9**	**135.4**	**137.9**	**140.5**	**143.1**	**145.8**	
N-1 Contingency 151S				Total Load:		26.6	34.4	36.8	38.2	39.7	40.2	40.7	41.2	41.7	42.3	42.8					
				N-1 Capacity:		25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0					
				Back up from 428S:		8.45	5.20	5.23	5.26	5.29	5.32	5.35	5.38	5.41	5.44	5.60					
				Back up from 391S:		3.10	0.52	--	--	--	--	--	--	--	--	--					
				Back up from 525S:		4.80	3.80	3.00	2.60	2.20	1.80	1.40	1.00	0.50	0.10	0.00					
				N-1 Unsupplied Load:		**0.0**	**0.0**	**3.6**	**5.3**	**7.2**	**8.1**	**9.0**	**9.8**	**10.8**	**11.8**	**12.2**					
N-1 Contingency 525S				Total Load:		14.6	19.1	20.0	20.4	20.8	21.2	21.6	22.0	22.5	22.9	23.4					
				N-1 Capacity:		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0					
				Back up from 151S:		8.50	4.00	3.58	3.16	2.74	2.32	1.90	1.48	1.06	0.64	0.20					
				N-1 Unsupplied Load:		**1.1**	**10.1**	**11.4**	**12.2**	**13.1**	**13.9**	**14.7**	**15.5**	**16.4**	**17.3**	**18.2**					

Enmax has provided N-1 Contingency modeling results shown in Table 2-2:

Table 2-2: Enmax N-1 Contingency: Existing System

N-1 Contingency:		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Enmax 24S	N-1 Unsupplied Load:	0	0	0.6	1.9	2.9	3.6	4.5	5.3	6.2	7
Enmax 39S	N-1 Unsupplied Load:	0	0	0	0	0	0	0	0	0.3	1.8

3. Existing System Assessment

The existing distribution systems in the Chestermere area are shown in Appendix A, Figure A-1. Table 3-1 provides an overview of the existing facilities and capacities for the Altalink substations in the area.

Table 3-1: Overview of Existing Altalink Substation Facilities

Substation	Carseland 525S	Strathmore 151S	Balzac 391S
Transformation Installed Capacity	T3 138/25 kV 15/20/22.5 MVA DETC Transformer with a VR2 25 kV 24.2/28.9 MVA Regulator T2 **BACK-UP ONLY** 23.9/13.8 kV 5 MVA DETC Transformer	T1 138/25 kV 15/20/25 MVA DETC Transformer with a VR1 25 kV 15/20/25 MVA Regulator T2 138/25 kV 15/20/25 MVA LTC Transformer	T1 138/26.5 kV 25/33/42 MVA LTC Transformer T2 138/26.5 kV 25/33/42 MVA LTC Transformer
Peak Station Load (2013/14 winter peak)	14.6 MVA	26.6 MVA	16.6 MVA
Available Capacity (N-0)	22.5 MVA	50 MVA	84 MVA
Firm Transformation Capacity (N-1)	5	25	42
25 kV Feeders	261LN 265LS	244LE 2010L 2158L 2183L	303L 316L 326L 397L 528L 643L

The 22.5 MVA source transformer, 525S-T3, at the Carseland 525S substation is predicted to be overloaded in 2022.

The following 25 kV feeders are predicted to carry load levels in excess of the normal feeder load maximum: 525S-261LN in 2015; 391S-316L in 2017; EN39S-2266L in 2020; 151S-2010L in 2021.

The amount of unsupplied load under contingency exceeds restoration criteria at Strathmore 151S, Carseland 525S, Enmax EN24S, and Enmax EN39S substations.

Further considerations:

- Chestermere is a rapidly growing suburban center with 25% population growth in the past 5 years to its present population of approximately 17,000.
- The Waterbridge Development on the west side of Chestermere has the potential to add up to 46,000 new residents.
- The Altalink substations surrounding Chestermere are located, relative to Chestermere: Balzac 18 km northwest; Carseland 27 km southeast; and Strathmore 31 km east.
- The Enmax distribution system is 30 degrees phase shifted electrically from the FortisAlberta distribution system, and therefore these distribution systems are constructed and operated independently from one another.

4. Alternatives Analysis

The following alternatives were considered:

Alternative 1 **Load Shifting**

Alternative 2 **Upgrades at Enmax substations EN24S and EN39S and Carseland 525S**

Alternative 3 **Install a new 138/25 kV substation at NW8-24-27-4 with one (1) source transformer**

Alternative 4 **Install a new 138/25 kV substation at NW8-24-27-4 with two (2) source transformers**

4.1 Alternative 1: Load Shifting

4.1.1 Description

Restoration ability is one of the concerns being addressed. As a first check to determine if load shifting could be an acceptable alternative, the total area load is compared to the available transformation capacity in the area, under the worst case single contingency. Based on the predicted loads in the final year of the planning horizon, the total area load is approximately 145 MVA. The area transformation capacity under normal conditions is 156.5 MVA. With loss of one of the 42 MVA transformers, 114.5 MVA of load can be supplied (assuming perfect load allocation is possible given the distribution line capacities and load locations). This is a shortfall of 30.5 MVA.

The Enmax distribution system is 30 degrees phase shifted electrically from the FortisAlberta distribution system. The back-up of one distribution feeder with a different, electrically phase shifted distribution feeder, would exceed the restoration time criteria.

As load shifting cannot eliminate the restoration concern, load shifting is not an acceptable alternative.

4.2 Alternative 2: Upgrades at Enmax substations EN24S and EN39S and Carseland 525S

4.2.1 Description

1) the addition of (1) one 50 MVA LTC source transformer and (2) two 25 kV feeder breakers at the Enmax EN24S substation; and

2) the addition of (1) one 50 MVA LTC source transformer and (1) one 25 kV feeder breaker at the Enmax EN39S substation; and

3) the addition of (1) one 42 MVA LTC source transformer and (1) one 25 kV feeder breaker at the Carseland 525S substation; and

4) approximately 36 km of associated distribution feeder construction and upgrades

The addition of source transformers at the Enmax EN24S and Enmax EN39S substations was explored. An additional source transformer at Carseland 525S would still be required to mitigate all of the planning deficiencies within the larger Chestermere area. This alternative retains the operational concerns related to the 30 degree electrical phase shift between the distribution systems of FortisAlberta and Enmax, violating the FortisAlberta operational and restoration criteria noted in Section 2.1. Due to this reason, this option is not technically acceptable.

Consequently, the load forecast and cost for this option have not been included.

4.3 Alternative 3: Install a new 138/25 kV substation at NW8-24-27-4 with one (1) source transformer

4.3.1 Description

1) Install (1) one new substation with one (1) 138/25 kV 25/33/42 MVA LTC transformers at NW8-24-27-4 and two (2) 25 kV feeder breakers; and

2) Install (1) one 50MVA LTC source transformer at the ENMAX EN24S substation; and

3) Add (2) two 25 kV feeder breakers at the Balzac 391S substation; and

4) approximately 49 km of associated distribution feeder construction

The installation of a new 138/25 kV substation at NW8-24-27-4 with one (1) source transformer was explored. This alternative includes the construction of two (2) new 25 kV feeders from the new substation as well as two (2) new feeders from the Balzac 391S substation. However, the addition of this new substation capacity and utilization of existing capacity at Balzac would not be sufficient to transfer all of the load away from Enmax. There would remain a requirement for Enmax to supply EN24S-2278L. Enmax has indicated insufficient substation transformer capacity to supply this load in 2019. An additional transformer at EN24S would be required by Enmax to continue to supply EN24S-2278L in 2019 and beyond. Enmax has indicated a transmission capital cost in the range of $10 – 15 million for the installation of an additional source transformer. Additionally, Enmax has indicated that with only EN24S-2278L remaining, there will no longer be a second Enmax feeder to restore the

FortisAlberta Chestermere area load in the event of a feeder contingency. This alternative retains the operational concerns related to the 30 degree electrical phase shift between the distribution systems of FortisAlberta and Enmax, violating the FortisAlberta operational and restoration criteria noted in Section 2.1. Due to these reasons, this option is not technically acceptable.

Consequently, the load forecast and cost for this option have not been included.

4.4 Alternative 4: Install a new 138/25 kV substation at NW8-24-27-4 with two (2) source transformers

4.4.1 Description

1) Install one (1) new substation with two (2) 138/25 kV 25/33/42 MVA LTC transformers at NW8-24-27-4 and six (6) 25 kV feeder breakers; and

2) Add (1) one 25 kV feeder breaker at the Balzac 391S substation; and

3) Approximately 39 km of associated distribution feeder construction and upgrades

Refer to Appendix B, Figure B-1, for the simplified SLD showing the proposed system development.

All 25 kV overhead conductors exiting the substation and distribution feeder ties shall be 477 MCM. All underground feeder cables shall be 750 MCM. All 25 kV feeder breakers shall be equipped with associated equipment to enable under-frequency load shedding. All transmission components on the secondary side of the 25 kV source transformers shall be appropriately sized to enable the feeders to simultaneously supply 26 MVA per feeder.

Transmission facilities must be equipped with the appropriate equipment for interconnection with FortisAlberta's Automated Metering system. Provisions should be made for interconnecting the substation transformer neutrals with the distribution line neutrals as per the TFO standard.

All 138 kV and 25 kV buses shall have adequate protection to minimize frequency and duration of outages associated with the failure of substation components upstream of the 25 kV bus.

4.4.2 Load Forecast

The load forecast for the distribution facilities resulting from this alternative is provided in Table 4-2.

Table 4-1: FortisAlberta Load Forecast for Alternative 4

Install a new substation at NW8-24-27-4 with two source transformers and six 25 kV feeder breakers

SUB No	Feeder	CAPACITY T/R	MVA	Loading	PF	W or S	MVA LOADING - RECORDED 2009 Peak MVA	2010 Peak MVA	2011 Peak MVA	2012 Peak MVA	2013 Peak MVA	PREDICTED - MVA LOADING 2014 Year 1 MVA	2015 Year 2 MVA	2016 Year 3 MVA	2017 Year 4 MVA	2018 Year 5 MVA	2019 Year 6 MVA	2020 Year 7 MVA	2021 Year 8 MVA	2022 Year 9 MVA	2023 Year 10 MVA	Fore-cast Growth
151S	Strathmore (T1)	T1	15/20/ 25	54%	99%																	
151S		VR1	15/20/ 25	54%	99%	W	**12.7**	**12.6**	**12.5**	**12.3**	**12.4**	**13.43**	**14.62**	**15.83**	**15.61**	**15.86**	**16.11**	**16.37**	**16.63**	**16.90**	**17.17**	**1.6%**
151S	244LE				98%	W	3.4	2.8	2.9	2.9	2.8	5.19	5.22	5.25	5.28	5.31	5.34	5.37	5.40	5.43	5.46	0.5%
151S	2010L (244LW)				99%	W	10.0	9.9	9.7	9.9	9.8	8.71	9.86	11.04	10.74	10.95	11.17	11.39	11.62	11.85	12.09	2.0%
151S	Strathmore (T2)	T2	15/20/ 25	85%	99%	W	**15.4**	**14.9**	**14.4**	**13.5**	**14.4**	**21.31**	**22.52**	**22.76**	**17.62**	**17.81**	**18.00**	**18.19**	**18.38**	**18.57**	**18.76**	**1.1%**
151S	2183L				99%	W	5.9	5.7	5.6	5.5	6.0	11.49	11.55	11.61	9.44	9.49	9.54	9.59	9.64	9.69	9.74	0.5%
151S	2158L				98%	W	9.9	9.9	8.9	8.3	8.9	10.18	11.34	11.52	8.50	8.64	8.78	8.92	9.06	9.20	9.35	1.6%
151S	Total Station				99%	W	**27.1**	**27.3**	**26.5**	**25.7**	**26.6**	**34.39**	**36.77**	**38.20**	**32.90**	**33.33**	**33.77**	**34.21**	**34.66**	**35.12**	**35.57**	
391S	Balzac (T1)	T1	25/33/ 42		99%	S/W	**7.8**	**7.7**	**3.1**	**2.0**	**7.9**	**18.03**	**17.67**	**19.69**	**14.50**	**14.79**	**15.09**	**15.39**	**15.70**	**16.01**	**16.33**	**2.0%**
391S	316L				99%	S/W	7.5	6.8	2.0	0.1	6.6	11.23	10.26	12.13	6.32	6.45	6.58	6.71	6.84	6.98	7.12	2.0%
391S	397L				72%	W	0.9	0.8	0.0	0.0	0.3	1.99	2.03	2.07	2.11	2.15	2.19	2.23	2.27	2.32	2.37	2.0%
391S	643L				96%	S/W	0.0	0.8	1.3	1.9	2.1	5.73	6.33	6.46	6.59	6.72	6.85	6.99	7.13	7.27	7.42	2.0%
391S	Balzac (T2)	T2	25/33/ 42		98%	S/W	**7.2**	**9.4**	**7.1**	**10.3**	**10.2**	**14.74**	**15.03**	**15.33**	**23.19**	**23.65**	**24.12**	**24.60**	**25.09**	**25.59**	**26.10**	**2.0%**
391S	303L				94%	S	2.4	1.4	1.2	4.0	2.3	5.65	5.76	5.88	6.00	6.12	6.24	6.36	6.49	6.62	6.75	2.0%
391S	326L				93%	S	5.0	7.2	6.8	7.3	7.4	9.40	9.59	9.78	9.98	10.18	10.38	10.59	10.80	11.02	11.24	2.0%
391S	528L				99%	S	0.0	1.1	0.9	1.2	1.3	1.41	1.44	1.47	1.50	1.53	1.56	1.59	1.62	1.65	1.68	2.0%
391S	3012L				99%	S/W									7.87	8.03	8.19	8.35	8.52	8.69	8.86	2.0%
391S	Total Station				95%	S	**12.3**	**15.1**	**9.9**	**12.3**	**16.8**	**28.51**	**28.45**	**30.47**	**32.79**	**33.44**	**34.11**	**34.79**	**35.49**	**36.19**	**36.91**	
525S	Carseland	T3	15/20/ 22.5	85%	99%																	
525S		VR2	24.2/ 28.9	66%	99%	S/W	**12.8**	**13.9**	**14.8**	**14.4**	**14.6**	**19.13**	**19.96**	**20.36**	**12.64**	**12.89**	**13.15**	**13.41**	**13.68**	**13.95**	**14.23**	**2.0%**
525S	261LN				89%	S	6.8	6.8	7.0	8.2	8.3	12.82	13.14	13.46	9.94	10.18	10.43	10.69	10.95	11.22	11.50	2.5%
525S	265LS				99%	W	8.3	8.3	8.7	8.4	9.2	9.36	9.95	10.10	4.07	4.13	4.19	4.25	4.31	4.38	4.45	1.5%
525S		T2 - Backup ONLY	5																			
CHS Chestermere	-T1 (Proposed)	T1	25/33/ 42		99%										**26.76**	**27.24**	**27.73**	**28.23**	**28.74**	**29.26**	**29.79**	**1.8%**
CHS	7650L				99%	W									9.06	9.22	9.39	9.56	9.73	9.91	10.09	1.8%
CHS	7652L				99%	W									9.60	9.80	10.01	10.22	10.43	10.65	10.87	2.1%
CHS	7654L				99%	W									8.37	8.50	8.63	8.76	8.89	9.02	9.16	1.5%
CHS Chestermere	-T2 (Proposed)	T2	25/33/ 42		99%										**22.32**	**22.83**	**23.36**	**23.90**	**24.55**	**25.11**	**25.79**	**2.3%**
CHS	7655L				99%	W									9.90	10.21	10.53	10.86	11.20	11.55	11.91	3.1%
CHS	7657L				99%	W									6.15	6.26	6.37	6.48	6.60	6.72	6.84	1.8%
CHS	7659L				99%	W									6.50	6.63	6.76	6.90	7.04	7.18	7.32	2.0%
CHS	Total Station				99%	W									**49.08**	**50.07**	**51.09**	**52.13**	**53.29**	**54.37**	**55.58**	
EN39S	ENMAX SUB # 39																					
EN39S	2266L				99%	W	**15.2**	**12.6**	**10.9**	**6.4**	**7.5**	**9.10**	**10.61**	**12.16**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.1%**
EN24S	ENMAX SUB # 24																					
EN24S	2267L				99%	W	**3.8**	**6.2**	**7.5**	**6.8**	**6.7**	**7.42**	**10.49**	**11.03**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.8%**
EN24S	ENMAX SUB # 24																					
EN24S	2278L				99%	W			**0.3**	**5.2**	**6.3**	**7.96**	**8.81**	**9.69**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.1%**
Load transferred to 199S-492LE:													**3.00**	**3.06**	**3.12**	**3.18**	**3.24**	**3.30**	**3.37**	**3.44**	**3.51**	**2.0%**
Total Area Load:							**71.2**	**75.1**	**69.9**	**70.8**	**78.5**	**106.5**	**118.1**	**125.0**	**130.5**	**132.9**	**135.4**	**137.8**	**140.5**	**143.1**	**145.8**	

Load Transfers (MVA) From:	To:	2017
EN24S-2267L	CHS-7650L	5.9
EN39S-2266L	CHS-7650L	3.7
EN24S-2267L	CHS-7652L	0.9
EN39S-2266L	CHS-7652L	8.7
525S-261LN	CHS-7654L	3.9
525S-265LS	CHS-7654L	5.3
EN24S-2267L	CHS-7655L	0.1
EN24S-2278L	CHS-7655L	9.9
525S-265LS	CHS-7657L	0.5
EN24S-2278L	CHS-7657L	1.0
EN24S-2267L	CHS-7657L	4.7
151S-2010L	CHS-7659L	6.5
525S-265LS	CHS-7659L	0.3
391S-316L	391S-3012L	7.7
151S-2158L	151S-2010L	3.0
151S-2183L	151S-2010L	2.1

N-1 Contingency 151S	Total Load:	26.6	34.4	36.8	38.2	32.9	33.3	33.8	34.2	34.7	35.1	35.6
	N-1 Capacity:	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
	Back up from 428S:	8.45	5.20	5.23	5.26	5.26	5.29	5.32	5.35	5.38	5.41	5.42
	Back up from 391S:	3.10	0.52	--	--	--	--	--	--	--	--	--
	Backup from 199S:	--	--	0.00	0.00	--	--	--	--	--	--	--
	Backup from CHS:	--	--	--	--	10.74	10.63	10.52	10.41	10.30	10.19	10.09
	Back up from 525S:	4.80	3.80	3.00	2.60	1.19	1.18	1.17	1.16	1.15	1.14	1.13
	N-1 Unsupplied Load:	**0.0**	**0.0**	**3.6**	**5.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
N-1 Contingency 525S	Total Load:	14.6	19.1	20.0	20.4	12.6	12.9	13.2	13.4	13.7	14.0	14.2
	N-1 Capacity:	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
	Back up from CHS:	--	--	--	--	14.60	15.09	15.58	16.07	16.56	17.05	17.51
	Back up from 151S:	8.50	4.00	3.58	3.16	5.21	5.26	5.31	5.36	5.41	5.46	5.48
	N-1 Unsupplied Load:	**1.1**	**10.1**	**11.4**	**12.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

+ Feeders from ENMAX substations EN24S & EN39S are no longer in use for the purpose of supplying FortisAlberta load in 2017
+ Predicted feeder 525S-261LN load exceeding 13.0 MVA before 2017 to be addressed as needed through contingency operational means

4.4.3 Cost Estimate

The estimated transmission capital cost for Alternative 4 will be provided by AltaLink.

The distribution capital cost for Alternative 4 is estimated at:

2016 $8.9 million (2014$, ±30%)

5. Alternatives Assessment

The following sections present the technical and economic analysis of the alternatives considered in this Need for Development for the Chestermere area.

5.1 Technical Analysis

5.1.1 Alternative 1 – Load Shifting

As per section 4.1.1, under N-1 contingency the available transformation capacity is not sufficient to supply the area load. As this alternative does not address the reliability concerns, load shifting is not an acceptable technical solution.

5.1.2 Alternative 2 – Upgrades at Enmax substations EN24S and EN39S and Carseland 525S

Alternative 2 would require the interconnection of the FortisAlberta and Enmax distribution systems. The two systems cannot be paralleled due to operational concerns related to the 30 degree electrical phase shift between them, violating the FortisAlberta operational and restoration criteria. Due to this reason, this option is not technically acceptable.

5.1.3 Alternative 3 – Install a new 138/25 kV substation at NW8-24-27-4 with one (1) source transformer

Similarly to Alternative 2, Alternative 3 would require the interconnection of the FortisAlberta and Enmax distribution systems, and would retain the operational concerns related to the 30 degree electrical phase shift between the distribution systems of FortisAlberta and Enmax, violating the FortisAlberta operational and restoration criteria. Due to this reason, this option is not technically acceptable.

5.1.4 Alternative 4 – Install a new 138/25 kV substation at NW8-24-27-4 with two (2) source transformers

Alternative 4 addresses the existing and predicted capacity and reliability concerns for distribution service in the Chestermere area. This alternative is technically acceptable.

5.2 Economic Analysis

Table 5-1 summarizes the capital cost estimates of all alternatives.

Table 5-1: Capital Cost Estimates of Alternatives Considered

Alternative	Transmission Capital Cost * (X millions)	Distribution Capital Cost (X millions, 2014$, ±30%)	Total Capital Cost (X millions, 2014$, ±50%)
Alternative 1 – Load shifting	N/A	N/A	N/A
Alternative 2 – Upgrades at Enmax substations EN24S and EN39S and Carseland 525S	N/A	N/A	N/A
Alternative 3 – Install a new 138/25 kV substation at NW8-24-27-4 with one (1) source transformer	N/A	N/A	N/A
Alternative 4 – Install a new 138/25 kV substation at NW8-24-27-4 with two (2) source transformers	N/A	$8.9	N/A

*Transmission capital costs estimates will be provided by the Transmission Facility Owner as required.

Based on the economic information summarized in Table 5-1 and high-level estimates for the transmission capital costs, Alternative 4 is preferred.

6. Conclusion/Recommendations

After considering the alternatives to address the existing and predicted concerns for distribution service in the greater Chestermere area, a new substation at NW8-24-27-4 is proposed. This involves the creation of a new substation site and the installation of two (2) 138/25 kV 25/33/42 MVA LTC source transformers and six (6) 25 kV feeder breakers, and building six (6) 25 kV distribution feeders from this new substation; as well as the installation of one (1) additional 25 kV feeder breaker at Balzac 391S and building one (1) 25 kV distribution feeder from Balzac 391S.

The proposed development has an estimated distribution capital cost of $8.9 million (2014, ±30%).

AltaLink will prepare a proposal for the required transmission upgrades. This will include an estimate for the transmission capital cost.

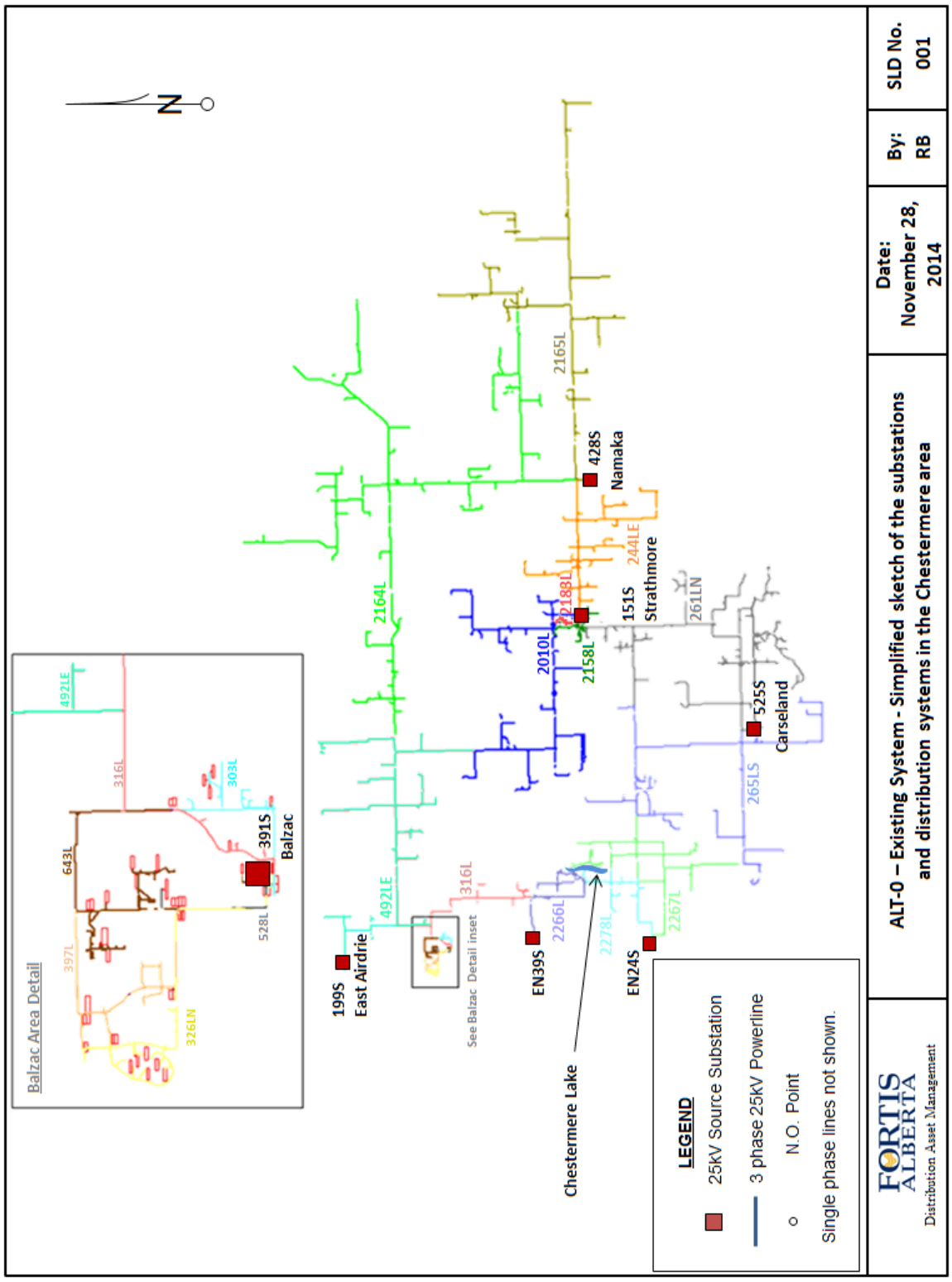
The requested completion date for the proposed facility upgrades is December 1, 2016.

Upon completion of this transmission system upgrade FortisAlberta will execute a DTS contract for the new Chestermere POD for 43.7 MW and a DTS contract for the Balzac 391S substation for 28.0 MW.

Appendices

Appendix A – Existing System

Figure A-1: Existing system



Appendix B – Alternative 4 – Install a new 138/25 kV Substation at NW8-24-27-4 with two (2) source transformers

Figure B-1: Alternative 4 – Install a new 138/25 kV substation at NW8-24-27-4 with two (2) source transformers