APPENDIX E DFO NEED FOR DEVELOPMENT REPORT

Need for Development
New East Edmonton Area
Transmission Facility Upgrades

November 8, 2016

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1. Background

As part of the Trans Mountain Pipeline Expansion project, TransMountain Pipeline Ltd. (the customer), has requested a 21 MW load addition with the requirement of full reliability under N-1 contingency of a source transformer.

The customer's load location is at their Edmonton pump station terminal at SW05-53-23-W4. The site is 0.5 km east of the East Edmonton 38S substation, and 2.6 km southwest of the Broadmoor 420S substation.

The East Edmonton 38S substation is located at NW32-52-23-W4 and contains two 138/25 kV 93.3 MVA LTC source transformers with four 25 kV busses. There are eleven 25 kV distribution feeders connected to these busses serving area load on the distribution system.

The Broadmoor 420S substation is located at NE04-53-23-W4 and contains two 138/25 kV 42 MVA LTC source transformers. There are seven 25 kV distribution feeders connected to the Broadmoor 420S substation.

There are two 138 kV substations named Baseline 317S and Knightsbridge 216S located at SE05-53-23-W4 that are currently serving single industrial customers. Both Baseline 317S substation and Knightsbridge 216S substation are 0.8 km east of the customer's site.

Three 138 kV transmission lines run in close proximity to the site. Transmission line numbers 731L and 865L run on double-circuit structures immediately south of the load site. Transmission line number 215L runs approximately 0.3 km west of the load site.

2. Criteria

The analysis for the requested development in the East Edmonton and Broadmoor area has been conducted based upon the following criteria:

- The maximum normal loading of FortisAlberta 25 kV distribution feeders is 13.0 MVA.
- Transmission equipment must not be operated at load levels in excess of the equipment nameplate rating.

3. Existing System Assessment

The existing substations and the distribution system in the East Edmonton and the Broadmoor area are shown in Figure A-1 in Appendix A.

3.1 Load Forecast

Table 3-1 provides FortisAlberta historical and forecast peak load levels for the substations and feeders in the study area. The load forecast is based on historical data, expected development trends and contracted new loads. This load forecast was used to assess all the alternatives presented in this Need for Development document.

Table 3-1: FortisAlberta Historic and Forecast Load: Existing System

										PREDICTED - MVA LOADING									
			2011	2012	2013	2014	2015		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SUB No	Feeder	CAPACITY T/R MVA	Peak MVA	Peak MVA	Peak MVA	Peak MVA	Peak MVA	PF	Year 1 MVA	Year 2 MVA	Year 3 MVA	Year 4 MVA	Year 5 MVA	Year 6 MVA	Year 7 MVA	Year 8 MVA	Year 9 MVA	Year 10 MVA
038S	A1&B2+Contr. Load	T3 50/66.7/83.3// 93.3							**49.8**	**50.2**	**50.6**	**51.0**	**51.4**	**51.8**	**52.2**	**52.6**	**53.0**	**53.4**
038S	A1 & B2 Base Load	T3 50/66.7/83.3// 93.3	**26.9**	**23.8**	**27.7**	**22.5**	**27.4**	93%	**41.2**	**41.7**	**42.2**	**42.7**	**43.2**	**43.7**	**44.2**	**44.7**	**45.2**	**45.7**
038S	#A1 East Edmonton with Contract Load	46.6							**33.6**	**33.8**	**34.0**	**34.2**	**34.4**	**34.6**	**34.8**	**35.0**	**35.2**	**35.4**
038S	#A1 East Edmonton Base Load	46.6	**17.7**	**16.5**	**18.6**	**13.4**	**18.6**	95%	**25.0**	**25.3**	**25.6**	**25.9**	**26.2**	**26.5**	**26.8**	**27.1**	**27.4**	**27.7**
038S	107LN	(All feeders use	7.4	7.3	7.7	2.8	7.5	96%	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0
038S	118LN	24.94kV source)	6.9	6.1	6.3	6.0	6.0	91%	12.12	12.24	12.36	12.48	12.60	12.73	12.86	12.99	13.1	13.2
038S	2027L with Contract Load								15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
038S	2027L Base Load		5.5	5.3	6.3	6.1	6.1	95%	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8
038S	#B2 East Edmonton	46.6	**9.2**	**8.3**	**10.4**	**10.1**	**10.9**	93%	**16.2**	**16.4**	**16.6**	**16.8**	**17.0**	**17.2**	**17.4**	**17.6**	**17.8**	**18.0**
038S	28LS	(All feeders use	7.2	6.1	7.3	7.1	7.2	92%	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8
038S	106L	24.94kV source)	2.9	3.1	3.6	4.6	5.0	96%	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
038S	A2&B1+Contr. Load	T2 50/66.7/83.3// 93.3							**56.8**	**57.2**	**57.6**	**58.0**	**58.4**	**58.8**	**59.2**	**59.6**	**60.0**	**60.4**
038S	A2 & B1 Base Load	T2 50/66.7/83.3// 93.3	**29.3**	**35.0**	**41.3**	**37.4**	**34.3**	94%	**49.1**	**49.6**	**50.1**	**50.6**	**51.1**	**51.6**	**52.1**	**52.6**	**53.1**	**53.6**
038S	#A2 East Edmonton	46.6	**19.4**	**24.9**	**25.5**	**26.2**	**19.5**	86%	**26.8**	**27.1**	**27.4**	**27.7**	**28.0**	**28.3**	**28.6**	**28.9**	**29.2**	**29.5**
038S	136LW	(All feeders use	13.1	16.1	16.4	16.4	9.3	80%	9.7	9.8	9.9	10.0	10.1	10.2	10.3	10.4	10.5	10.6
038S	159LW	25.46kV source)	7.8	8.1	8.0	7.1	7.0	83%	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8
038S	222L		3.5	3.5	4.3	4.8	4.8	97%	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0	10.1
038S	#B1 East Edmonton with Contract Loads	46.6							**39.7**	**39.9**	**40.1**	**40.3**	**40.5**	**40.7**	**40.9**	**41.1**	**41.3**	**41.5**
038S	#B1 East Edmonton Base Load	46.6	**13.2**	**14.3**	**13.3**	**14.2**	**18.7**	90%	**22.3**	**22.5**	**22.7**	**22.9**	**23.1**	**23.3**	**23.5**	**23.7**	**23.9**	**24.1**
038S	135LW with 136LW Load							81%	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
038S	135LW (Alt to 136L)	(All feeders use				0.0	7.6	84%	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5
038S	183LE	25.46kV source)	6.8	7.1	7.6	7.2	7.1	93%	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0
038S	2028L w/Contract Load								15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
038S	2028L Base Load		7.1	7.4	7.7	7.9	7.8	92%	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
038S	Total Station		**54.4**	**56.9**	**57.7**	**58.9**	**59.3**	90%	**84.0**	**84.9**	**85.8**	**86.8**	**87.7**	**88.6**	**89.6**	**90.5**	**91.4**	**92.3**
420S	Broadmoor	T1 25/33/ 42.0	**19.6**	**19.9**	**20.8**	**21.0**	**21.5**	99%	**31.8**	**34.8**	**35.6**	**36.2**	**36.8**	**37.4**	**38.0**	**38.6**	**39.3**	**40.0**
420S	2266L (420S-213L)		2.8	2.9	2.9	2.8	3.3	96%	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1
420S	347L		9.2	9.0	8.8	9.7	8.6	99%	9.4	9.5	9.5	9.6	9.6	9.7	9.7	9.8	9.8	9.9
420S	555L		8.0	9.1	9.6	9.7	9.9	99%	8.1	10.8	11.4	11.7	12.1	12.5	12.9	13.3	13.7	14.1
420S	2032L					0.0	0.0	90%	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8	11.9
420S	Broadmoor	T2 25/33/ 42.0						90%	**36.0**	**36.7**	**37.4**	**38.1**	**38.9**	**39.7**	**40.5**	**41.3**	**42.1**	**42.9**
420S	1699L							90%	10.0	10.2	10.4	10.6	10.8	11.0	11.2	11.4	11.6	11.8
420S	3788L							90%	14.9	15.2	15.5	15.8	16.1	16.4	16.7	17.0	17.3	17.6
420S	4466L							90%	11.1	11.3	11.5	11.7	11.9	12.1	12.3	12.5	12.8	13.1
420S	Total Station								**67.1**	**70.8**	**72.4**	**73.7**	**75.1**	**76.5**	**77.9**	**79.3**	**80.8**	**82.3**

N-1 Contingency at 38S Prior to Customer's Load Connection	2015
Total Load	59.3
N-1 Capacity	93.3
Back up from 420S	9.4
N-1 Unsupplied Load	0.0

2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
84.0	84.9	85.8	86.8	87.7	88.6	89.6	90.5	91.4	92.3
93.3	93.3	93.3	93.3	93.3	93.3	93.3	93.3	93.3	93.3
7.0	6.5	6.4	4.9	4.9	3.4	3.4	3.4	2.2	2.0
0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

- Prior to customer's load addition, there is no unsupplied load during N-1 contingency at the East Edmonton 38S substation during the 10 years planning horizon;

- The historic load and load forecast for the Baseline 317S substation and Knightsbridge 216S substation are not available as they are both direct-connect substations providing service to one end-use customer and are not 25 kV distribution PODs.

4. Alternatives Analysis

Based on both technical merit and cost, five alternatives are presented on this document. These alternatives have either the least distribution system development or the lowest estimated distribution capital cost.

4.1 Alternative 1: Distribution Upgrades and Load Shifting

4.1.1 Description

Distribution upgrades and load shifting to accommodate the customer's load were investigated. Potential distribution solutions include:

- Build 0.5 km of double circuit 25 kV feeders from the East Edmonton 38S substation to the customer's site to accommodate the customer's load;
- Build 2.6 km of double circuit 25 kV feeders from the Broadmoor 420S substation to the customer's site to accommodate the customer's load;

As per section 5.1.1, distribution upgrades and load shifting alone is insufficient to accommodate the customer's load. Therefore, the load forecast and cost for this alternative have not been included.

4.2 Alternative 2: Upgrades at the Broadmoor 420S Substation

4.2.1 Description

2019 at the Broadmoor 420S Substation

- Add two 138/25 kV LTC source transformers;
- Add two 25 kV feeder breakers: one 25 kV breaker connected to each new 138/25 kV source transformer;
- Build 2.6 km of double circuit 25 kV distribution feeders from the two new 25 kV breakers to the customer's site.

Refer to Appendix B, Figure B-1 showing Alternative 2 system development.

All 25 kV overhead conductors, new and existing, exiting the substation and distribution feeder ties shall be 477 MCM. All underground feeder cables, new

and existing, shall be 750 MCM. All transmission components on the secondary side of the 25 kV source transformers, new and existing, shall be sized to enable the feeders to simultaneously supply 26 MVA per feeder. All 25 kV feeder breakers shall be equipped with associated equipment to enable under-frequency load shedding.

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 AltaLink Management Limited (AltaLink) standard.

All 138 kV and 25 kV buses shall have adequate switch points and protection to minimize frequency and duration of outages associated with the maintenance or failure of substation components upstream of the 25 kV bus. Failure of such upstream components must not result in a total substation outage.

4.2.2 Load Forecast

The load forecast resulting from Alternative 2 is provided in Table 4-1.

Table 4-1: FortisAlberta Historic and Forecast Load: Alternative 2 – Upgrades at the Broadmoor 420S Substation

										PREDICTED - MVA LOADING									
			2011	2012	2013	2014	2015		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SUB No	Feeder	CAPACITY T/R MVA	Peak MVA	Peak MVA	Peak MVA	Peak MVA	Peak MVA	PF	Year 1 MVA	Year 2 MVA	Year 3 MVA	Year 4 MVA	Year 5 MVA	Year 6 MVA	Year 7 MVA	Year 8 MVA	Year 9 MVA	Year 10 MVA
038S	A1&B2+Contr. Load	T3 50/66.7/83.3// 93.3							**49.8**	**50.2**	**50.6**	**51.0**	**51.4**	**51.8**	**52.2**	**52.6**	**53.0**	**53.4**
038S	A1 & B2 Base Load	T3 50/66.7/83.3// 93.3	**26.9**	**23.8**	**27.7**	**22.5**	**27.4**	93%	**41.2**	**41.7**	**42.2**	**42.7**	**43.2**	**43.7**	**44.2**	**44.7**	**45.2**	**45.7**
038S	#A1 East Edmonton with Contract Load	46.6							**33.6**	**33.8**	**34.0**	**34.2**	**34.4**	**34.6**	**34.8**	**35.0**	**35.2**	**35.4**
038S	#A1 East Edmonton Base Load	46.6	**17.7**	**16.5**	**18.6**	**13.4**	**18.6**	95%	**25.0**	**25.3**	**25.6**	**25.9**	**26.2**	**26.5**	**26.8**	**27.1**	**27.4**	**27.7**
038S	107LN	(All feeders use	7.4	7.3	7.7	2.8	7.5	96%	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0
038S	118LN	24.94kV source)	6.9	6.1	6.3	6.0	6.0	91%	12.12	12.24	12.36	12.48	12.60	12.73	12.86	12.99	13.1	13.2
038S	2027L with Contract Load								15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
038S	2027L Base Load		5.5	5.3	6.3	6.1	6.1	95%	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8
038S	#B2 East Edmonton	46.6	**9.2**	**8.3**	**10.4**	**10.1**	**10.9**	93%	**16.2**	**16.4**	**16.6**	**16.8**	**17.0**	**17.2**	**17.4**	**17.6**	**17.8**	**18.0**
038S	28LS	(All feeders use	7.2	6.1	7.3	7.1	7.2	92%	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8
038S	106L	24.94kV source)	2.9	3.1	3.6	4.6	5.0	96%	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
038S	A2&B1+Contr. Load	T2 50/66.7/83.3// 93.3							**56.8**	**57.2**	**57.6**	**58.0**	**58.4**	**58.8**	**59.2**	**59.6**	**60.0**	**60.4**
038S	A2 & B1 Base Load	T2 50/66.7/83.3// 93.3	**29.3**	**35.0**	**41.3**	**37.4**	**34.3**	94%	**49.1**	**49.6**	**50.1**	**50.6**	**51.1**	**51.6**	**52.1**	**52.6**	**53.1**	**53.6**
038S	#A2 East Edmonton	46.6	**19.4**	**24.9**	**25.5**	**26.2**	**19.5**	86%	**26.8**	**27.1**	**27.4**	**27.7**	**28.0**	**28.3**	**28.6**	**28.9**	**29.2**	**29.5**
038S	136LW	(All feeders use	13.1	16.1	16.4	16.4	9.3	80%	9.7	9.8	9.9	10.0	10.1	10.2	10.3	10.4	10.5	10.6
038S	159LW	25.46kV source)	7.8	8.1	8.0	7.1	7.0	83%	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8
038S	222L		3.5	3.5	4.3	4.8	4.8	97%	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0	10.1
038S	#B1 East Edmonton with Contract Loads	46.6							**39.7**	**39.9**	**40.1**	**40.3**	**40.5**	**40.7**	**40.9**	**41.1**	**41.3**	**41.5**
038S	#B1 East Edmonton Base Load	46.6	**13.2**	**14.3**	**13.3**	**14.2**	**18.7**	90%	**22.3**	**22.5**	**22.7**	**22.9**	**23.1**	**23.3**	**23.5**	**23.7**	**23.9**	**24.1**
038S	135LW with 136LW Load							81%	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
038S	135LW (Alt to 136L)	(All feeders use				0.0	7.6	84%	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5
038S	183LE	25.46kV source)	6.8	7.1	7.6	7.2	7.1	93%	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0
038S	2028L w/Contract Load								15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
038S	2028L Base Load		7.1	7.4	7.7	7.9	7.8	92%	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
038S	Total Station		**54.4**	**56.9**	**57.7**	**58.9**	**59.3**	90%	**84.0**	**84.9**	**85.8**	**86.8**	**87.7**	**88.6**	**89.6**	**90.5**	**91.4**	**92.3**
420S	Broadmoor	T1 25/33/ 42.0	**19.6**	**19.9**	**20.8**	**21.0**	**21.5**	99%	**31.8**	**34.8**	**35.6**	**36.2**	**36.8**	**37.4**	**38.0**	**38.6**	**39.3**	**40.0**
420S	2266L (420S-213L)		2.8	2.9	2.9	2.8	3.3	96%	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1
420S	347L		9.2	9.0	8.8	9.7	8.6	99%	9.4	9.5	9.5	9.6	9.6	9.7	9.7	9.8	9.8	9.9
420S	555L		8.0	9.1	9.6	9.7	9.9	99%	8.1	10.8	11.4	11.7	12.1	12.5	12.9	13.3	13.7	14.1
420S	2032L					0.0	0.0	90%	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8	11.9
420S	Broadmoor	T2 25/33/ 42.0						90%	**36.0**	**36.7**	**37.4**	**38.1**	**38.9**	**39.7**	**40.5**	**41.3**	**42.1**	**42.9**
420S	1699L							90%	10.0	10.2	10.4	10.6	10.8	11.0	11.2	11.4	11.6	11.8
420S	3788L							90%	14.9	15.2	15.5	15.8	16.1	16.4	16.7	17.0	17.3	17.6
420S	4466L							90%	11.1	11.3	11.5	11.7	11.9	12.1	12.3	12.5	12.8	13.1
420S	Broadmoor (New Tx 2019)	T3						90%				**23.0**	**23.0**	**23.0**	**23.0**	**23.0**	**23.0**	**23.0**
420S	NEW FEEDER 1							90%				23.0	23.0	23.0	23.0	23.0	23.0	23.0
420S	Broadmoor (New Tx 2019)	T4(Stand-By)						90%	Transformer will be used as a hot standby to provide full redundancy to the customer's load									
420S	NEW FEEDER 2							90%	during N-1 contingency of Transformer T3 outage at the Broadmoor 420S substation									
420S	Total Station								**67.1**	**70.8**	**72.4**	**96.7**	**98.1**	**99.5**	**100.9**	**102.3**	**103.8**	**105.3**

In 2019 at the Broadmoor 420S substation:
Add two source transformers:
Transformer T3 will accommodate customer's load of 23 MVA
Transformer T4 will be a stand-by transformer to provide customer with full redundancy during N-1 contingeny of Transformer T3 at the Broadmoor 420S substation
Add two 25 kV breakers: one 25 kV breaker under each T3 and T4

4.2.3 Cost Estimate

AltaLink will prepare a facility application associated with the requested transmission upgrade at the Broadmoor 420S substation. This facility application will include an estimate of the transmission capital cost.

The distribution capital cost associated with the transmission upgrade at the Broadmoor 420S substation for Alternative 2 is estimated to be $3.5 million (2019$, ±30%).

4.3 Alternative 3: Upgrades at the East Edmonton 38S Substation

4.3.1 Description

In 2019, transmission upgrades at the East Edmonton 38S substation include:

- Install one 25 kV feeder breaker connected to 25 kV bus B2
- Install one 25 kV feeder breakers connected to 25 kV bus B1
- Build 0.5 km of double circuit 25 kV feeders from the two new 25 kV breakers to the customer's site

As per section 5.1.3, this solution is not a technically acceptable solution.

4.3.2 Load Forecast

The load forecast resulting from Alternative 3 is provided in Table 4-2.

Table 4-2: FortisAlberta Historic and Forecast Load: Alternative 3 – Upgrades at the East Edmonton 38S Substation

									PREDICTED - MVA LOADING									
			2011	2012	2013	2014	2015		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SUB		CAPACITY	Peak	Peak	Peak	Peak	Peak	PF	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
No	Feeder	T/R MVA	MVA	MVA	MVA	MVA	MVA		MVA	MVA	MVA	MVA	MVA	MVA	MVA	MVA	MVA	MVA
038S	A1&B2+Contr. Load	T3 50/66.7/83.3// 93.3							49.8	50.2	50.6	62.4	62.7	63.1	63.5	63.9	64.3	64.7
038S	A1 & B2 Base Load	T3 50/66.7/83.3// 93.3	26.9	23.8	27.7	22.5	27.4	93%	41.2	41.7	42.2	54.0	54.4	54.9	55.3	55.8	56.2	56.7
038S	#A1 East Edmonton with Contract Load	46.6							33.6	33.8	34.0	34.2	34.4	34.6	34.8	35.0	35.2	35.4
038S	#A1 East Edmonton Base Load	46.6	17.7	16.5	18.6	13.4	18.6	95%	25.0	25.3	25.6	25.9	26.2	26.5	26.8	27.1	27.4	27.7
038S	107LN	(All feeders use	7.4	7.3	7.7	2.8	7.5	96%	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0
038S	118LN	24.94kV source)	6.9	6.1	6.3	6.0	6.0	91%	12.12	12.24	12.36	12.48	12.60	12.73	12.86	12.99	13.1	13.2
038S	2027L with Contract Load								15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
038S	2027L Base Load		5.5	5.3	6.3	6.1	6.1	95%	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8
038S	#B2 East Edmonton	46.6	9.2	8.3	10.4	10.1	10.9	93%	16.2	16.4	16.6	28.3	28.5	28.7	28.9	29.1	29.3	29.5
038S	28LS	(All feeders use	7.2	6.1	7.3	7.1	7.2	92%	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8
038S	106L	24.94kV source)	2.9	3.1	3.6	4.6	5.0	96%	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
038S	NEW FEEDER 1 (2019)							90%				11.5	11.5	11.5	11.5	11.5	11.5	11.5
038S	A2&B1+Contr. Load	T2 50/66.7/83.3// 93.3							56.8	57.2	57.6	69.5	69.9	70.3	70.7	71.1	71.5	71.9
038S	A2 & B1 Base Load	T2 50/66.7/83.3// 93.3	29.3	35.0	41.3	37.4	34.3	94%	49.1	49.6	50.1	62.1	62.6	63.1	63.6	64.1	64.6	65.1
038S	#A2 East Edmonton	46.6	19.4	24.9	25.5	26.2	19.5	86%	26.8	27.1	27.4	27.7	28.0	28.3	28.6	28.9	29.2	29.5
038S	136LW	(All feeders use	13.1	16.1	16.4	16.4	9.3	80%	9.7	9.8	9.9	10.0	10.1	10.2	10.3	10.4	10.5	10.6
038S	159LW	25.46kV source)	7.8	8.1	8.0	7.1	7.0	83%	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8
038S	222L		3.5	3.5	4.3	4.8	4.8	97%	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0	10.1
038S	#B1 East Edmonton with Contract Loads	46.6							39.7	39.9	40.1	51.8	52.0	52.2	52.4	52.6	52.8	53.0
038S	#B1 East Edmonton Base Load	46.6	13.2	14.3	13.3	14.2	18.7	90%	22.3	22.5	22.7	34.4	34.6	34.8	35.0	35.2	35.4	35.6
038S	135LW with 136LW Load							81%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
038S	135LW (Alt to 136L)	(All feeders use				0.0	7.6	84%	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5
038S	183LE	25.46kV source)	6.8	7.1	7.6	7.2	7.1	93%	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0
038S	2028L w/Contract Load								15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
038S	2028L Base Load		7.1	7.4	7.7	7.9	7.8	92%	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
038S	NEW FEEDER 2 (2019)							90%				11.5	11.5	11.5	11.5	11.5	11.5	11.5
038S	Total Station		54.4	56.9	57.7	58.9	59.3	90%	84.0	84.9	85.8	108.0	108.8	109.7	110.6	111.5	112.3	113.3
420S	Broadmoor	T1 25/33/ 42.0	19.6	19.9	20.8	21.0	21.5	99%	31.8	34.8	35.6	36.2	36.8	37.4	38.0	38.6	39.3	40.0
420S	2266L (420S-213L)		2.8	2.9	2.9	2.8	3.3	96%	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1
420S	347L		9.2	9.0	8.8	9.7	8.6	99%	9.4	9.5	9.5	9.6	9.6	9.7	9.7	9.8	9.8	9.9
420S	555L		8.0	9.1	9.6	9.7	9.9	99%	8.1	10.8	11.4	11.7	12.1	12.5	12.9	13.3	13.7	14.1
420S	2032L					0.0	0.0	90%	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8	11.9
420S	Broadmoor	T2 25/33/ 42.0						90%	36.0	36.7	37.4	38.1	38.9	39.7	40.5	41.3	42.1	42.9
420S	1699L							90%	10.0	10.2	10.4	10.6	10.8	11.0	11.2	11.4	11.6	11.8
420S	3788L							90%	14.9	15.2	15.5	15.8	16.1	16.4	16.7	17.0	17.3	17.6
420S	4466L							90%	11.1	11.3	11.5	11.7	11.9	12.1	12.3	12.5	12.8	13.1
420S	Total Station								67.1	70.8	72.4	73.7	75.1	76.5	77.9	79.3	80.8	82.3

In 2019 at the East Edmonton 38S substation:

Add one 25 kV breakers under 25 kV bus B2
Add one 25 kV breakers under 25 kV bus B1

N-1 Contingency at 38S after Customer's Load Connection	2015
Total Load	59.3
N-1 Capacity	93.3
Back up from 420S	9.4
N-1 Unsupplied Load	0.0

2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
84.0	84.9	85.8	108.0	108.8	109.7	110.6	111.5	112.3	113.3
93.3	93.3	93.3	93.3	93.3	93.3	93.3	93.3	93.3	93.3
7.0	6.5	6.4	4.9	4.9	3.4	3.4	3.4	2.2	2.0
0.0	0.0	0.0	9.8	10.6	13.0	13.9	14.8	16.8	18.0

- Prior to customer's load addition at year 2019, there is no unsupplied load during N-1 contingency at the East Edmonton 38S substation during the 10 year planning horizon;
- After connecting customer's load at year 2019, the level of unsupplied load during N-1 contingency at the East Edmonton 38S substation is 9.8 MVA in 2019, increasing to 18.0 MVA in year 2025.

4.3.3 Cost Estimate

As per section 5.1.3, this solution is not a technically acceptable solution. Therefore, the cost for this alternative has not been included.

4.4 Alternative 4: New Industrial Substation

4.4.1 Description

- **In 2019, build a new industrial substation at the customer's site named Anthony Henday**
- **In 2019, install two new 138/25 kV LTC source transformers at the Anthony Henday Substation**

Refer to Appendix C, Figure C-1 showing Alternative 4 system development.

4.4.2 Load Forecast

The load forecast resulting from Alternative 4 is provided in Table 4-3.

Table 4-3: FortisAlberta Forecast Load: New Anthony Henday Substation:

									PREDICTED - MVA LOADING									
			2011	2012	2013	2014	2015		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SUB No	Feeder	CAPACITY T/R	MVA	Peak MVA	Peak MVA	Peak MVA	Peak MVA	Peak MVA	PF	Year 1 MVA	Year 2 MVA	Year 3 MVA	Year 4 MVA	Year 5 MVA	Year 6 MVA	Year 7 MVA	Year 8 MVA	Year 9 MVA	Year 10 MVA
Anthony Henday		T1	25.0						90%				23.0	23.0	23.0	23.0	23.0	23.0	23.0
Anthony Henday		T2	25.0						90%	Transformer will be used as a hot standby to provide full redundancy to the customer's load during N-1 contingency of Transformer T1 outage at the Anthony Henday Substation									
Anthony Henday Total Station									90%				23.0	23.0	23.0	23.0	23.0	23.0	23.0

In 2019 at the new Anthony Henday substation:
Add two 138/25 kV source transformers at the Anthony Henday Substation

4.4.3 Cost Estimate

AltaLink will prepare a facility application for the requested transmission upgrades at the Anthony Henday substation. This facility application will include an estimate of the transmission capital cost.

There is no distribution capital associated with Alternative 4 as Anthony Henday substation will serve only one end use customer to connect the customer's facilities.

4.5 Alternative 5: Upgrade Knightsbridge 216S Substation or Baseline 317S Substation

4.5.1 Description

- **In 2019, upgrade either of the 138 kV Knightsbridge 216S substation or Baseline 317S substation to 138/25 kV substation**
- **Install two 138/25 kV LTC source transformers**
- **Install two 25 kV breakers: one 25 kV breaker connected to each new 138/25 kV source transformer**
- **Build 0.8 km of double circuit 25 kV feeders from the two 25 kV breakers to the customer's site**

Refer to Appendix D, Figure D-1 showing Alternative 4 system development.

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

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 AltaLink Management Limited (AltaLink) standard.

All 138 kV and 25 kV buses shall have adequate switch points and protection to minimize frequency and duration of outages associated with the maintenance or failure of substation components upstream of the 25 kV bus. Failure of such upstream components must not result in a total substation outage.

4.5.2 Load Forecast

The load forecast resulting from Alternative 5 is provided in Table 4-4.

Table 4-4: FortisAlberta Forecast Load: Upgrade at Knightsbridge 216S or Baseline 317S Substation:

										PREDICTED - MVA LOADING									
				2011	2012	2013	2014	2015		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SUB No	Feeder	CAPACITY T/R	MVA	Peak MVA	Peak MVA	Peak MVA	Peak MVA	Peak MVA	PF	Year 1 MVA	Year 2 MVA	Year 3 MVA	Year 4 MVA	Year 5 MVA	Year 6 MVA	Year 7 MVA	Year 8 MVA	Year 9 MVA	Year 10 MVA
Knightsbridge 216S/Baseline 317S	T1		15/20/25.0						90%				23.0	23.0	23.0	23.0	23.0	23.0	23.0
Knightsbridge 216S/Baseline 317S	New Feeder 1								90%				23.0	23.0	23.0	23.0	23.0	23.0	23.0
Knightsbridge 216S/Baseline 317S	T2(Stand-by)		15/20/25.0						90%	Transformer will be used as a hot standby to provide full redundancy to the customer's load									
Knightsbridge 216S/Baseline 317S	New Feeder 2								90%	during N-1 contingency of Transformer T3 outage at the Broadmoor 420S substation									
Knightsbridge 216S/Baseline 317S	Total Station								90%				23.0	23.0	23.0	23.0	23.0	23.0	23.0

In 2019 at the Knightbridge 216S/Baseline 317S Substation:
Upgrade the substation to 138/25 kV
Install two 138/25 kV source transformers
Transformer T1 will accommodate customer's load of 23 MVA
Transformer T2 will be a stand-by transformer to provide
customer with full redundancy during N-1 contingeny of Transformer
T1 at the Knightsbridge 216S/Baseline 317S substation
Add two 25 kV breakers: one 25 kV breaker under each T1 and T2

4.5.3 Cost Estimate

AltaLink will prepare a facility application for the requested transmission upgrades at the Knightsbridge 216S Substation or Baseline 317S substation. This facility application will include an estimate of the transmission capital cost.

The distribution capital cost for Alternative 5 is estimated to be $2.8 million (2019$, ±30%).

5. Alternatives Assessment

The following section presents the technical and economic analysis of the alternatives considered in this Need for Development.

5.1 Technical and Economic Analysis

5.1.1 Alternative 1 – Distribution Upgrades and Load Shifting

Distribution upgrades and load shifting alone at the East Edmonton 38S substation and the Broadmoor 420S substation cannot accommodate the customer's load and requested level of reliability due to the following reasons:

- As per Section 2, the maximum normal loading of FortisAlberta 25 kV distribution feeders is 13.0 MVA. The addition of 23 MVA of load on any existing 25 kV feeder at the East Edmonton 38S substation or Broadmoor 420S substation would make the loading level on the 25 kV feeder exceed the limit of 13 MVA.

- If splitting the 23 MVA of load to 11.5 MVA, the additional 11.5 MVA on any 25 kV existing feeder at the East Edmonton 38S substation or Broadmoor 420S substation would make the loading level on the 25 kV feeder exceed the limit of 13 MVA.

Therefore, this alternative violates FortisAlberta's loading level criteria and is not technically acceptable.

5.1.2 Alternative 2 – Upgrades at the Broadmoor 420S Substation

Transmission upgrades at the Broadmoor 420S substation and the associated distribution upgrades could accommodate the customer's load and the customer's requested level of reliability.

Alternative 2 is a technically acceptable solution.

5.1.3 Alternative 3 – Upgrades at the East Edmonton 38S Substation

Transmission upgrades at the East Edmonton 38S substation and the associated distribution upgrades could accommodate the customer's load. However, this alternative could not provide the customer with the requested level of reliability. The total station load at the East Edmonton 38S is 92.3 MVA by year 2025, with each existing transformer size at the East Edmonton 38S being 93.3 MVA, there is no unsupplied load during an N-1 contingency at the East Edmonton 38S substation. After connecting the new 23 MVA load to East Edmonton 38S, by year 2025, there will be 18 MVA of unsupplied load under the N-1 contingency at the East Edmonton 38S substation.

Therefore, as Alternative 3 creates reliability issues in the area, this is not a technically acceptable solution.

5.1.4 Alternative 4 – New industrial substation

The installation of the new industrial Anthony Henday substation with two source transformers could accommodate customer's load and the requested level of reliability.

Therefore, Alternative 4 is a technically acceptable solution.

5.1.5 Alternative 5–Upgrade at the Knightsbridge 216S or Baseline 317S Substation

Upgrades at the Knightsbridge 216S or Baseline 317S could accommodate the customer's load and the customer's requested level of reliability. However, Knightsbridge 216S and Baseline 317S substations are both direct-connect substations providing service to one end-use customer. Both the Knightsbridge 216S and Baseline 317S substations are not distribution PODs, and are located on private land that are not adjacent to a public road allowance. Providing distribution service from either substation to serve the new customer load

would require a substation upgrade and two new 25 kV distribution feeders at approximately 0.8 km. There is a land constraint for both the substation expansions and alignments for distribution feeder egress.

Therefore, Alternative 5 is a technically acceptable solution, but not preferred.

6. Conclusion

After considering the alternatives to accommodate the customer's load. Alternative 2 and Alternative 4 are the technically feasible and preferred solutions.

Alternative 2 includes transmission upgrades and associated distribution upgrades at the Broadmoor 420S substation:

- Add two 138/25 kV LTC source transformers;
- Add two 25 kV feeder breaker: one 25 kV breaker connected to each new 138/25 kV source transformer;
- Build 2.6 km of double circuit 25 kV distribution feeders from the two new 25 kV breakers to the customer's site.

Alternative 4 includes:

- Build a new industrial substation at the customer's site named Anthony Henday;
- Install two new 138/25 kV LTC source transformers at the Anthony Henday Substation.

The distribution capital cost associated with the Alternative 2 is estimated to be $3.5 million (2019$, ±30%).

There is no distribution capital cost that is associated with Alternative 4.

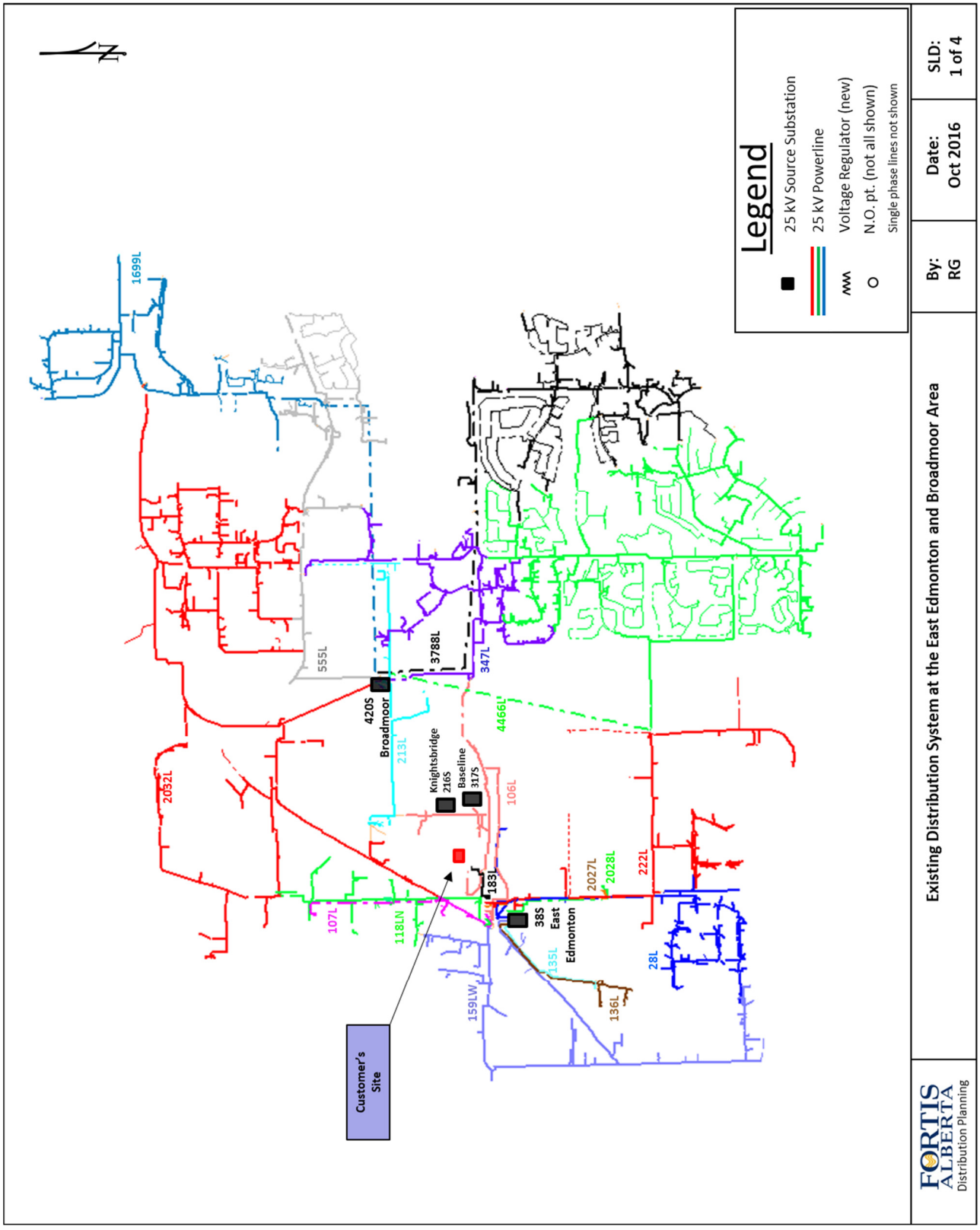
The requested completion date for the transmission upgrade is February 1, 2019.

If Alternative 2 is selected, FortisAlberta will execute a DTS contract of 78.3 MW at the Broadmoor 420S substation.

If Alternative 4 is selected, FortisAlberta will execute a DTS contract of 21 MW at the Anthony Henday Substation.

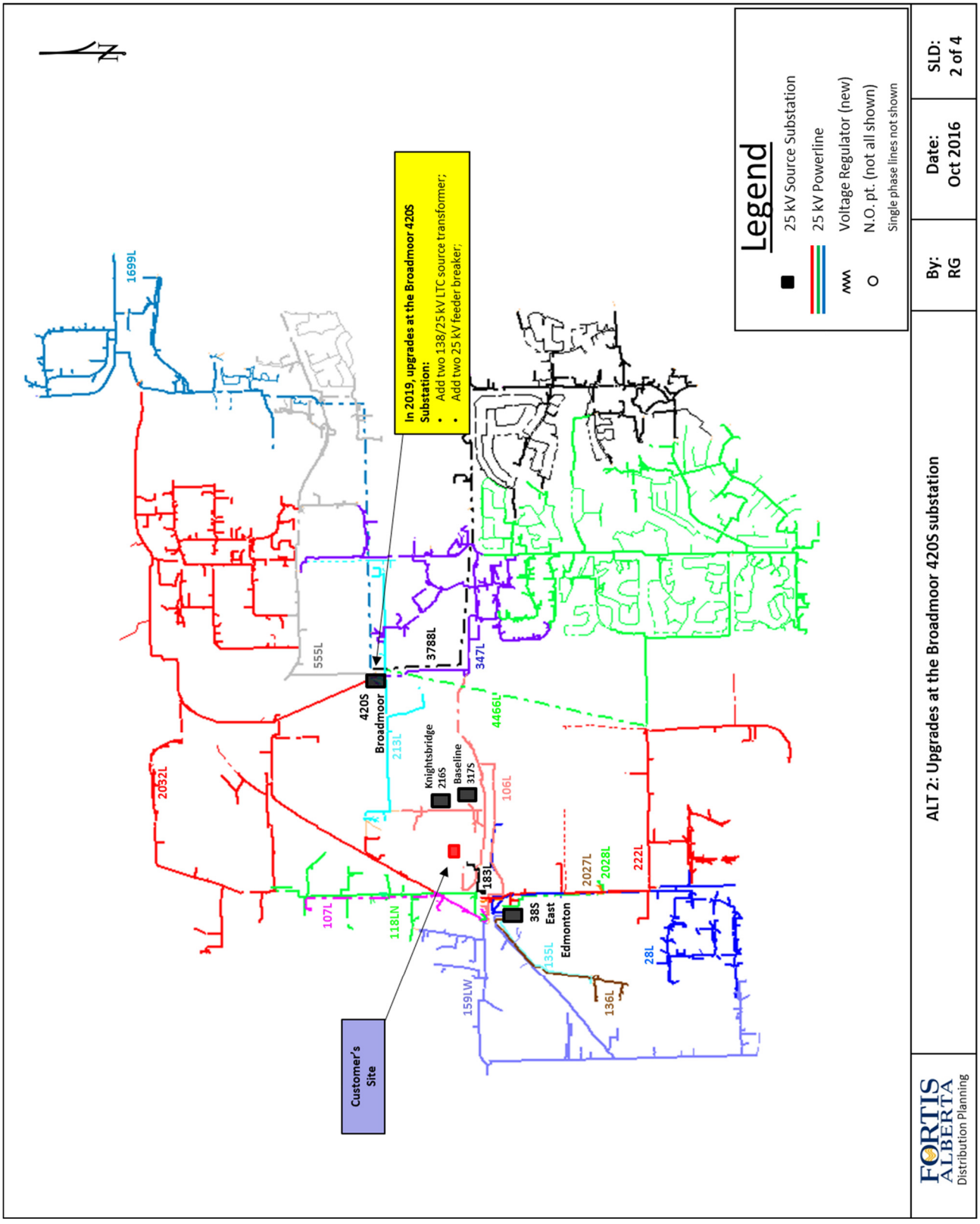
Appendix A – Existing System

Figure A-1: Existing System



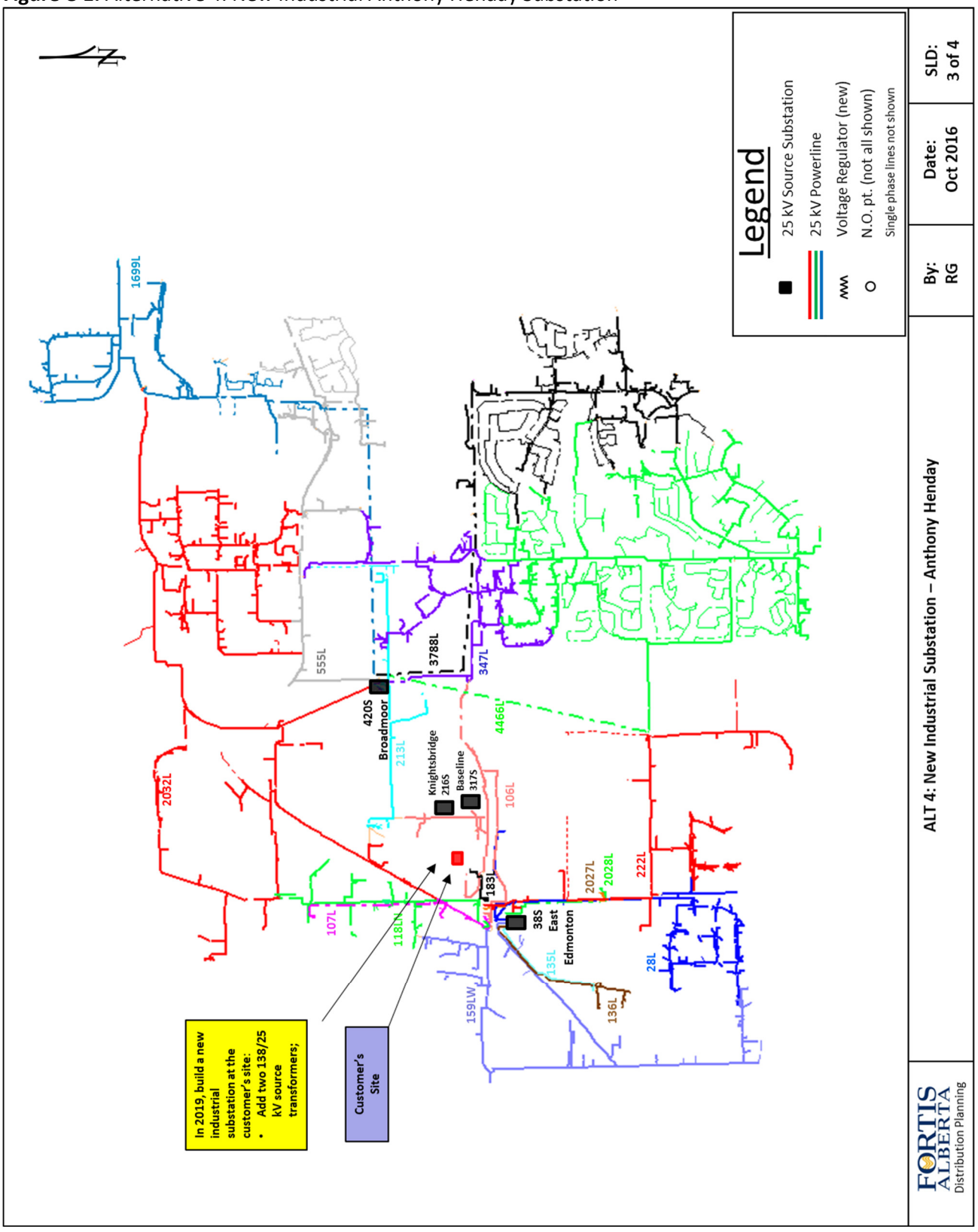
Appendix B – Alternative 2 - Upgrades at the Broadmoor 420S substations

Figure B-1: Alternative 2: Upgrades at the Broadmoor 420S Substation



Appendix C– Alternative 4 – New Industrial Anthony Henday Substation

Figure C-1: Alternative 4: New Industrial Anthony Henday Substation



Appendix D– Alternative 5 – Transmission Upgrades at either the Knightsbridge 216S or Baseline 317S Substation

Figure D-1: Alternative 5: Transmission upgrades at the Knightsbridge 216S or Baseline 317S Substation