APPENDIX C

Alternatives Detail

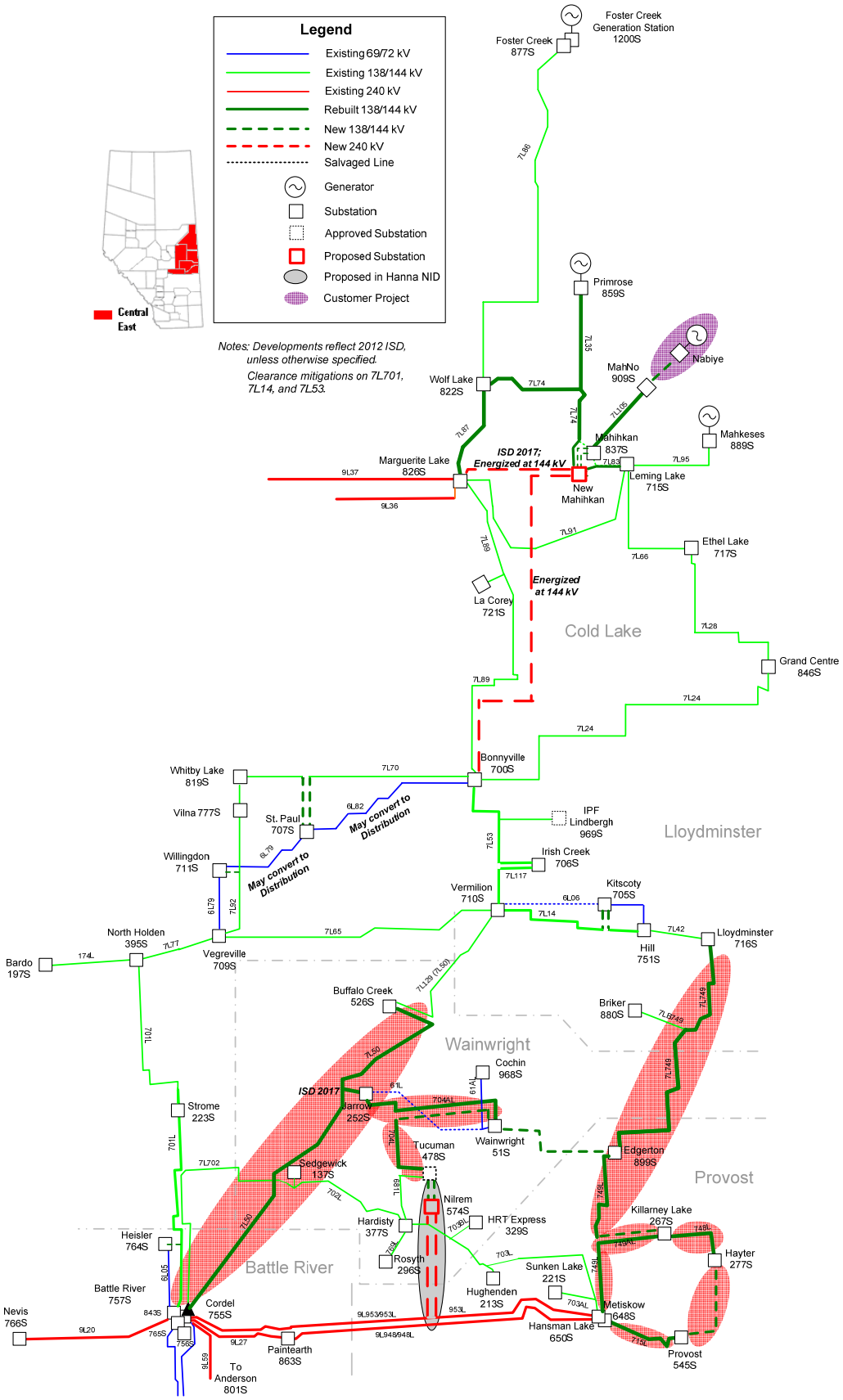
Table of Contents

C1. Regional Alternative 1 Detail (Addition to all common set of local reinforcements in C4) ... 3
C1.1 New and Re-build Transmission Lines ... 4
7L50 Re-build - 2017: ... 4
Provost Area - 2012: ... 4
Wainwright Area - 2012: ... 4
Lloydminster & Wainwright Areas - 2012: ... 4
C1.2 Salvaging Facilities ... 4
C2. Regional Alternative 2 Detail (Addition to all common set of local reinforcements in C4) ... 6
C2.1 New Substations – 2017 ... 7
C2.2 Transformer Additions – 2017 ... 7
C2.3 New and Re-built Transmission Lines ... 7
Vermilion Area - 2017: ... 7
7L50 Re-build - 2012: ... 7
Wainwright Area - 2012: ... 7
Lloydminster & Wainwright Area - 2012: ... 8
C2.4 Salvaging Facilities ... 8
C3. Regional Alternative 3 Detail (Addition to common set of local reinforcements in C4) ... 9
C3.1 New Substations ... 10
C3.2 Transformer Additions – 2017 ... 10
C3.3 Transmission lines ... 10
Provost Area - 2012: ... 10
Provost Area - 2017: ... 10
Wainwright Area - 2012: ... 10
C3.4 Line Clearance Mitigations – 2012 ... 10
C3.5 Salvaging Facilities ... 10
C4. Local Reinforcements Common to All Regional Alternatives ... 11
C4.1 New Substations and Switching Stations - 2012 ... 12
C4.2 Transformer and Capacitor Bank Addition - 2012 ... 12
C4.3 New and Re-build Transmission Lines ... 12
Cold Lake Area - 2012: ... 12
Cold Lake Area - 2017: ... 12
Other Areas - 2012: ... 12
C4.4 Line Clearance Mitigations - 2012 ... 13

C4.5 Salvaging Facilities 13
C4.6 Demobilization 13
C4.7 Converting Facilities to Distribution Assets 13

C1. Regional Alternative 1 Detail (Addition to all common set of local reinforcements in C4)

Figure C-1: Central East Region Transmission Development Regional Alternative 1



C1.1 New and Re-build Transmission Lines

7L50 Re-build - 2017:

- Re-build 144 kV single circuit line 7L50 (~160 km) from Battle River 757S to Buffalo Creek 526S and 138 kV 704L (~0.4 km) from 7L50 tap to Jarrow 252S with 477 kcmil ACSR conductor per phase. (Install teleprotection between Battle River, Buffalo Creek and Jarrow substations.)

Provost Area - 2012:

- Build a new 138 kV single circuit line (~30 km) from Provost 545S to Hayter 277S with 795 kcmil ACSR conductor per phase
- Re-build 138 kV single circuit line 715L (~22 km) from Hansman Lake 650S to Provost 545S with 795 kcmil ACSR conductor per phase
- Re-build 138 kV single circuit line 748L (~21 km) from Killarney Lake 267S to Hayter 277S with 795 kcmil ACSR conductor per phase
- Re-build 138 kV single circuit line 749L (~28 km) from Edgerton 399S to 749AL tap with 795 kcmil ACSR conductor per phase
- Re-build 138 kV single circuit line 749L (~20 km) from Metiskow 648S to 749AL tap with 795 kcmil ACSR conductor per phase
- Re-build 138 kV single circuit line 749AL (~18 km) from Killarney Lake 267S to 749L tap with double circuit line using 795 kcmil ACSR conductor per phase. Killarney Lake will become an in/out connection as 749L is split. (Total length from Metiskow to Killarney Lake will be ~38 km; total length from Edgerton to Killarney Lake will be ~46 km.)

Wainwright Area - 2012:

- Re-build 138 kV single circuit line 704L (~15 km) from Jarrow 252S to 704AL tap with 477 kcmil ACSR conductor per phase
- Re-build 138 kV single circuit line 704L (~22 km) from Tucuman 478S to 704AL tap with 477 kcmil ACSR conductor per phase
- Re-build 138 kV single circuit line 704AL to a double circuit line (~30 km) from Wainwright 51S to 704L tap and convert Wainwright to an in/out with 477 kcmil ACSR conductor per phase. (Total line length from Wainwright to Jarrow will be ~45 km; total line length from Wainwright to Tucuman will be ~52 km.)
- Build a new 138 kV single circuit line (~40 km) from Wainwright 51S to Edgerton 899S with 477 kcmil ACSR conductor per phase

Lloydminster & Wainwright Areas - 2012:

- Re-build 138/144 kV single circuit line 749L/7L749 (~77 km) from Edgerton 899S to Lloydminster 716S with 477 kcmil ACSR conductor per phase.

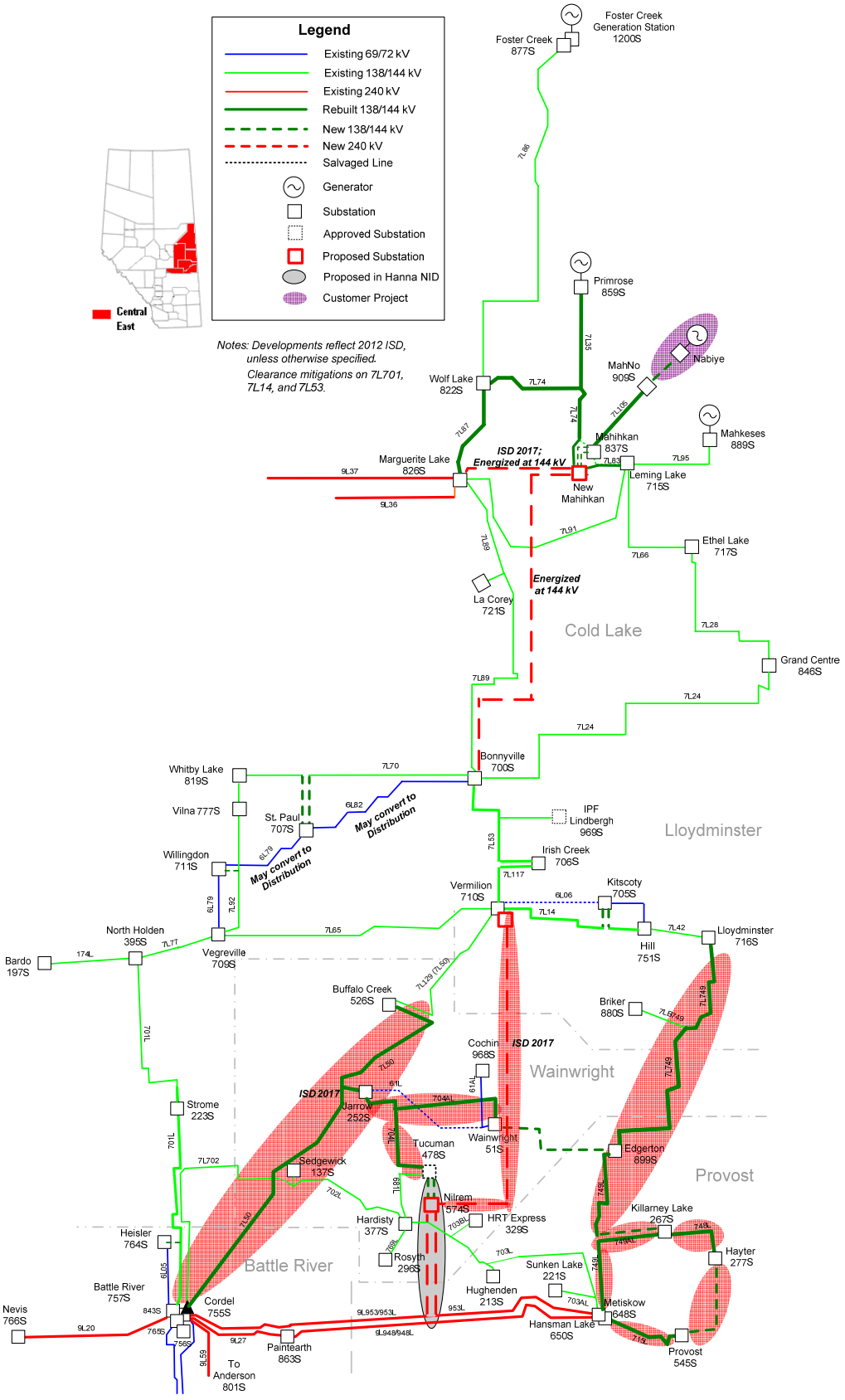
C1.2 Salvaging Facilities

- 144 kV single circuit line 7L50 (100 km) from Battle River 757S to Buffalo Creek 526S
- 138 kV single circuit line 704L from Jarrow 252S to 7L50 tap
- 138 kV single circuit line 715L (22 km) from Hansman Lake 650S to Provost 545S
- 138 kV single circuit line 748L (21 km) from Killarney Lake 267S to Hayter 277S

- 138 kV single circuit line 749L (48 km) from Metiskow 648S to Edgerton 899S
- 138 kV single circuit line 749AL (18 km) from Killarney Lake 267S to 749L tap
- 138 kV single circuit lines 704L & 704AL (67 km) from Wainwright 51S to Jarrow 252S to Tucuman 478S
- 138/144 kV single circuit line 749L/7L749 (77 km) from Edgerton 899S to Lloydminster 716S

C2. Regional Alternative 2 Detail (Addition to all common set of local reinforcements in C4)

Figure C-2: Central East Region Transmission Development Regional Alternative 2



C2.1 New Substations – 2017

- Build a new 240 kV substation near the existing Vermilion 710S

C2.2 Transformer Additions – 2017

- Install a new 180 MVA 240/144 kV transformer at Vermilion 710S

C2.3 New and Re-built Transmission Lines

Vermilion Area - 2017:

- Build a new 240 kV line (~100 km) on double circuit tower, one side strung from new Vermilion substation to Nilrem 574S with twin bundle 795 kcmil ACSR conductors per phase
- Build a new 144 kV double circuit line (~10 km) from new Vermilion substation to existing Vermilion 710S, with 477 kcmil ACSR conductor per phase c/w OPGW
- Re-terminate 144 kV lines 7L14, 7L53, 7L129 and 7L65 from Vermilion 710S to new Vermilion substation.

7L50 Re-build - 2012:

- Re-build 144 kV single circuit line 7L50 (~160 km) from Battle River 757S to Buffalo Creek 526S and 138 kV 704L (~0.4km) from 7L50 tap to Jarrow 252S with 477 kcmil ACSR conductor per phase. (Install teleprotection between Battle River, Buffalo Creek and Jarrow on this three terminal line.)

Wainwright Area - 2012:

- Re-build 138 kV single circuit lines 704L & 704AL (~67 km) from Jarrow 252S to Wainwright 51S to Tucuman 478S with 477 kcmil ACSR conductor per phase c/w OPGW. (Install teleprotection between Jarrow, Wainwright and Tucuman substations for this three terminal line.)
- Build a new 138 kV single circuit line (~40 km) from Wainwright 51S to Edgerton 899S with 477 kcmil ACSR conductor per phase

Provost Area - 2012:

- Build a new 138 kV single circuit line (~30 km) from Provost 545S to Hayter 277S with 795 kcmil ACSR conductor per phase
- Re-build 138 kV single circuit line 715L (~22 km) from Hansman Lake 650S to Provost 545S with 795 kcmil ACSR conductor per phase
- Re-build 138 kV single circuit line 748L (~21 km) from Killarney Lake 267S to Hayter 277S with 795 kcmil ACSR conductor per phase
- Re-build 138 kV single circuit line 749L (~28 km) from Edgerton 399S to 749AL tap with 795 kcmil ACSR conductor per phase
- Re-build 138 kV single circuit line 749L (~20 km) from Metiskow 648S to 749AL tap with 795 kcmil ACSR conductor per phase
- Re-build 138 kV single circuit line 749AL (~18 km) from Killarney Lake 267S to tap with double circuit line using 795 kcmil ACSR conductor per phase. Killarney Lake will become an in/out connection as 749L is split. (Total length from Metiskow to Killarney Lake will be ~38 km; total length from Edgerton to Killarney Lake will be ~46 km.)

Lloydminster & Wainwright Area - 2012:

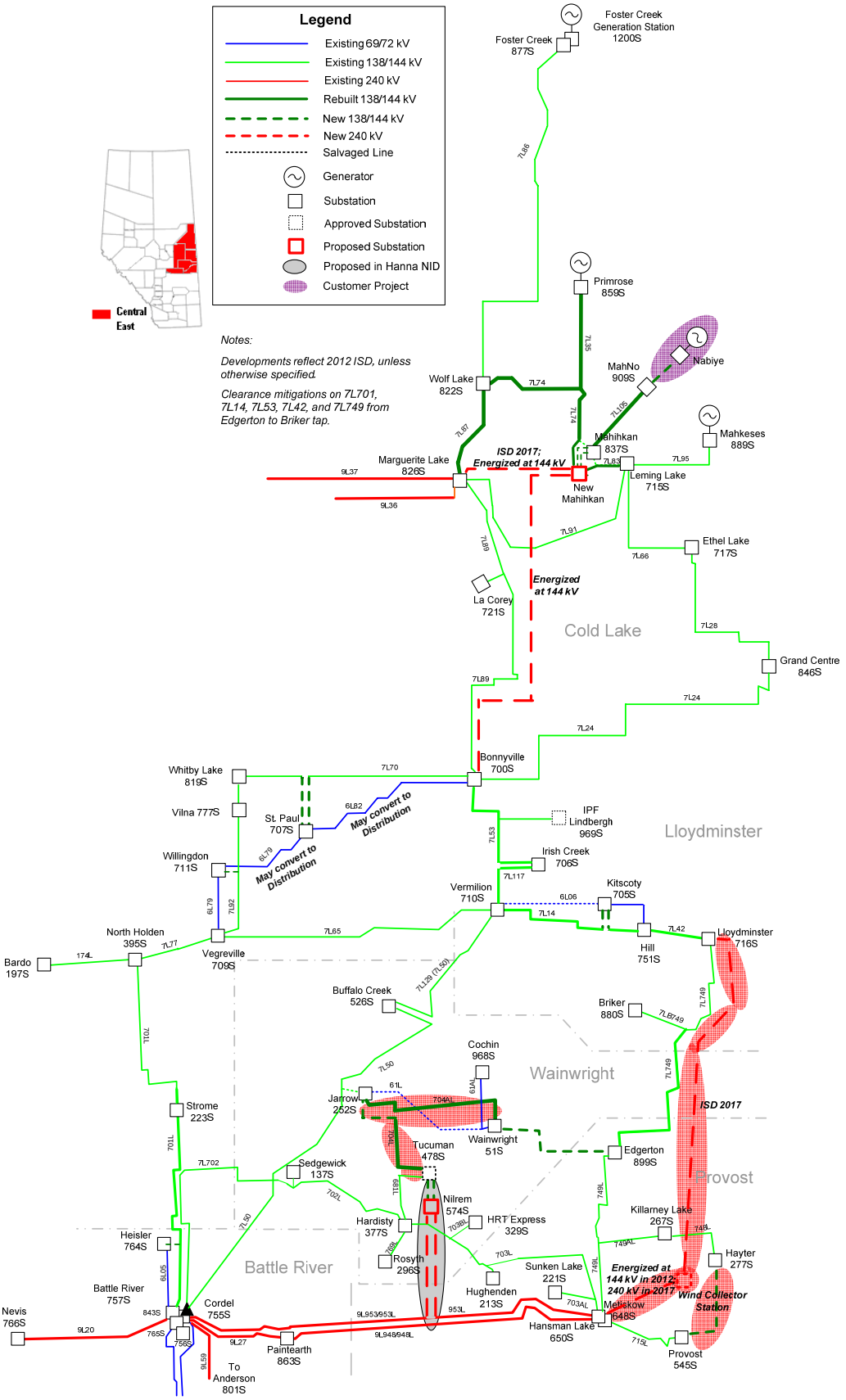
- Re-build 138/144 kV single circuit line 749L/7L749 (~77 km) from Edgerton 899S to Lloydminster 716S with 477 kcmil ACSR conductor per phase.

C2.4 Salvaging Facilities

- 144 kV single circuit line 7L50 (100 km) from Battle River 757S to Buffalo Creek 526S
- 138 kV single circuit line 704L from Jarrow 252S to 7L50 tap.
- 144 kV line sections on 7L14, 7L53, 7L65 and 7L129 to re-terminate from Vermilion 710S to new Vermilion substation
- 138 kV single circuit line 715L (22km) from Hansman Lake 650S to Provost 545S
- 138 kV single circuit line 748L (21 km) from Killarney Lake 267S to Hayter 277S
- 138 kV single circuit line 749L (48 km) from Metiskow 648S to Edgerton 899S
- 138 kV single circuit line 749AL (18 km) from Killarney Lake 267S to 749L tap
- 138 kV single circuit lines 704L & 704AL (67 km) from Wainwright 51S to Jarrow 252S to Tucuman 478S
- 138/144 kV single circuit line 749L/7L749 (77 km) from Edgerton 899S to Lloydminster 716S

C3. Regional Alternative 3 Detail (Addition to common set of local reinforcements in C4)

Figure C-3 Central East Region Transmission Reinforcement Regional Alternative 3



C3.1 New Substations

- Build a new wind collector substation in the Provost area (Energized at 138kV in 2012; converted to 240 kV by 2017)
- Convert existing 144 kV Lloydminster 716S to a 240 kV substation by 2017

C3.2 Transformer Additions – 2017

- Install a new 240/320/400 MVA 240/138 kV transformer at new wind collector substation in Provost area
- Install a new 240/320/400 MVA 240/144 kV transformer at Lloydminster 716S

C3.3 Transmission lines

Provost Area - 2012:

- Build a new 240 kV line (~ 50 km) on double circuit towers, one side strung, from Hansman Lake 650S to new wind collector substation in the Provost area, with twin bundle 795 kcmil ACSR conductors per phase. The line is initially energized at 138 kV.
- Build a new 138 kV single circuit line (~ 30 km) from Provost 545S to Hayter 277S with 477 kcmil ACSR conductor per phase

Provost Area - 2017:

- Convert the line from Hansman Lake 650S to new wind collector substation in the Provost area to 240kV level
- Build a new 240 kV line (~90 km) on double circuit towers, one side strung, from new wind collector substation to Lloydminster 716S with twin bundle 795 kcmil ACSR conductors per phase.

Wainwright Area - 2012:

- Re-build 138 kV single circuit line 704L to a double circuit line (~15 km) from Jarrow 252S to 704AL tap with 477 kcmil ACSR conductor per phase. Convert Jarrow 252S to an in/out substation and remove its connection to 7L50
- Re-build 138 kV single circuit line 704L (~22 km) from Tucuman 478S to 704AL tap with 477 kcmil ACSR conductor per phase
- Re-build 138 kV single circuit line 704AL (~30 km) from Wainwright 51S to 704L tap with 477 kcmil ACSR conductor per phase
- Build a new 138 kV single circuit line (~40 km) from Wainwright 51S to Edgerton 899S with 477 kcmil ACSR conductor per phase

C3.4 Line Clearance Mitigations – 2012

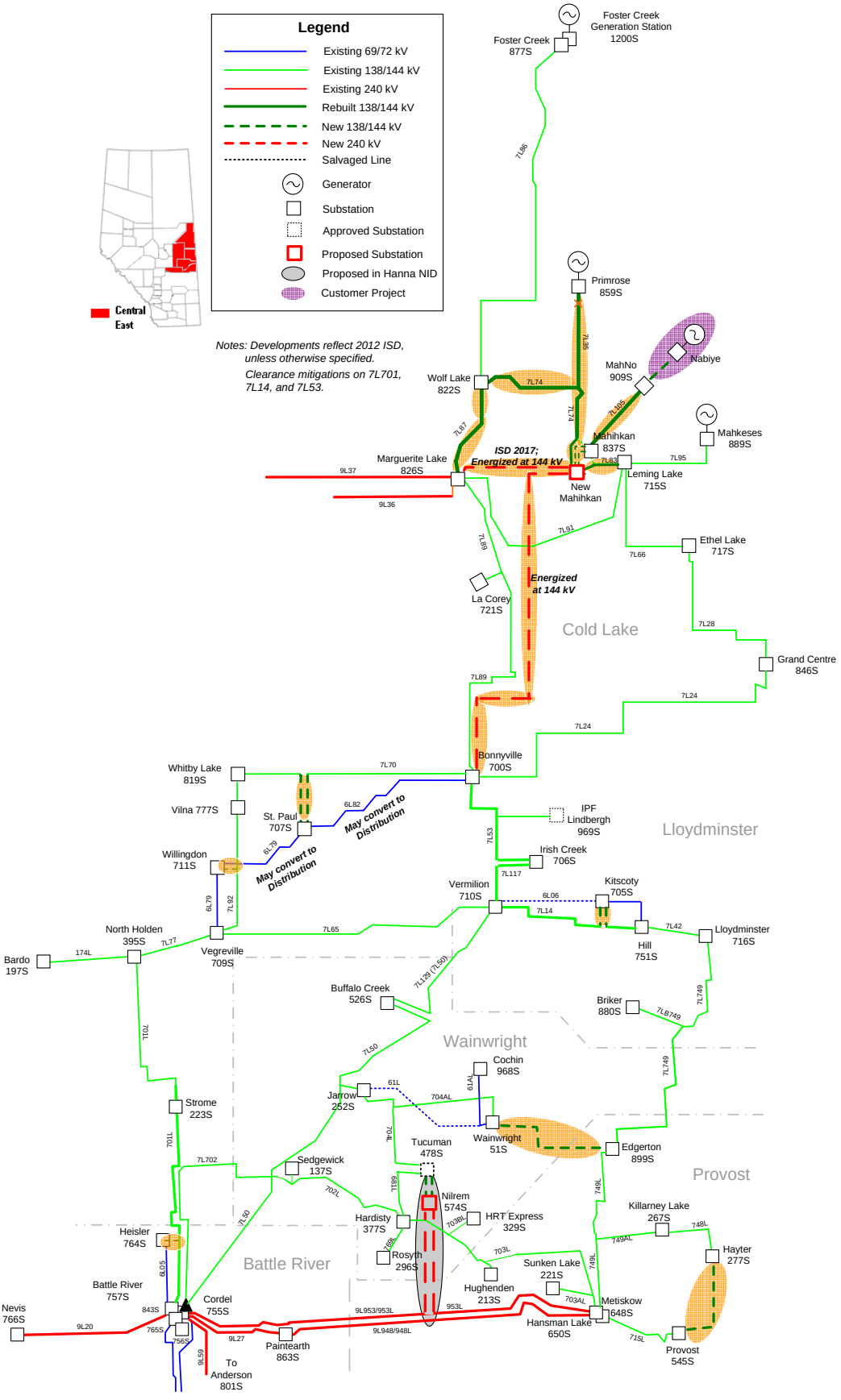
- 138/144 kV single circuit line 749L/7L749 (45 km) from Edgerton 899S to Briker tap
- 144 kV single circuit line 7L42 (6.3 km) from Lloydminster 715S to Hill 751S

C3.5 Salvaging Facilities

- 138 kV single circuit line 704L (0.4 km) from Jarrow 252S to 7L50 tap.
- 138 kV single circuit lines 704L & 704AL (67 km) from Wainwright 51S to Jarrow 252S to Tucuman 478S

C4. Local Reinforcements Common to All Regional Alternatives

Figure C-4: Central East Region Transmission Development – Common to All Regional Alternatives



C4.1 New Substations and Switching Stations - 2012

- Build a new switching station Bourque 970S near the existing Mahihkan 837S substation. The switching station is initially energized at 144 kV.
- Replace existing 72 kV Willingdon 711S with a new 144 kV substation Watt Lake 956S near Willingdon 711S.

C4.2 Transformer and Capacitor Bank Addition - 2012

Transformers:

- St. Paul 707S – two 25/33/41.6 MVA 144/25 kV LTC transformers
- Watt Lake 956S (new Willingdon substation) – one 15/20/25 MVA144/25 kV LTC transformer
- Bonnyville 700S – one 25/33/41.6 MVA 144/25 kV LTC transformer
- Vermilion 710S – one 25/33/41.6 MVA 144/25 kV LTC transformer
- Heisler 764S – one 144/72/25 kV transformer (relocated from Vermilion 710S)
- Kitscoty 705S – one 144/25 kV transformer (relocated from Heisler 764S)

Capacitor Bank:

- 25 MVAr 144 kV capacitor bank at Vermilion 710S

C4.3 New and Re-build Transmission Lines

Cold Lake Area - 2012:

- Build a new 240 kV line (~ 50 km) on double circuit towers, one side strung, from new Bourque 970S switching station to Bonnyville 700S, with twin bundle 795 kcmil ACSR conductors per phase. This line is initially energized at 144 kV.
- Build a new 144 kV double circuit line (< 2 km) from new Bourque 970S switching station to Mahihkan 837S, with 477 kcmil ACSR conductor per phase
- Re-build 144 kV single circuit line 7L83 (~10 km) from new Bourque 970S to Leming Lake 715S with 477 kcmil ACSR conductor per phase c/w OPGW
- Re-build 144 kV single circuit line 7L74 (~20 km) from Wolf Lake 822S to new Bourque 970S with 795 kcmil ACSR conductor per phase c/w dual OPGW
- Re-build 144 kV single circuit line 7L87 (~15 km) from Marguerite Lake 826S to Wolf Lake 822S with 795 kcmil ACSR conductor per phase c/w OPGW
- Re-build customer-owned 144 kV single circuit line 7L35 (~12 km) from Primrose 859S to 7L74 tap point with 795 kcmil ACSR conductor per phase c/w dual OPGW
- Re-build customer-owned 144 kV single circuit line 7L105 (~4 km) from Mahihkan 837S to MahNo 909S

Cold Lake Area - 2017:

- Build a new 240 kV line (~20 km) on double circuit towers, one side strung, from new Bourque 970S switching station to Marguerite Lake 826S, with twin bundle 795 kcmil ACSR conductors per phase. This line is initially energized at 144 kV.

Other Areas - 2012:

- Build a new 144 kV single circuit line (~3 km) from Heisler 764S to 7L701 tap with 397.5

kcmil ACSR conductor per phase
- Build a new 144 kV double circuit line (~10 km) from Kitscoty 705S to 7L14 with 266.8 kcmil ACSR conductor per phase
- Build a new 144 kV double circuit line (~32 km) from St. Paul 707S to 7L70 with 266.8 kcmil ACSR conductor per phase
- Build a new 144 kV single circuit line (~5 km) from Watt Lake 956S (new Willingdon substation) to 7L92 with 266.8 kcmil ACSR conductor per phase

C4.4 Line Clearance Mitigations - 2012

- 144 kV single circuit line 7L14 (63 km) from Vermilion 710S to Hill 751S
- 144 kV single circuit line 7L701 (39 km) from Battle River 757S to Strome 223S
- 144 kV single circuit line 7L117 (58 km) from Vermilion 710S to Irish Creek 706S
- 144 kV single circuit line 7L53 (76 km) from Irish Creek 706S to Bonnyville 700S
- 240 kV single circuit line 9L27 from Cordel 755S to Paintearth Creek 863S (CT ratio change)
- 240 kV single circuit line 9L948 from Paintearth Creek 863S to Hansman Lake 650S (CT ratio change)

C4.5 Salvaging Facilities

- 144 kV single circuit lines 7L83, 7L74, and 7L87 (total length of ~45 km)
- 72 kV single circuit line 6L06 from Vermilion 710S to Kitscoty 705S (~66 km)
- 72 kV Willingdon 711S substation
- Bonnyville 700S SVC
- Cold Lake area thermal protection schemes on 144 kV lines 7L66 and 7L89
- 7L50 thermal protection scheme at Battle River generating station

C4.6 Demobilization

- Demobilize all 72kV equipment from Bonnyville 700S, St. Paul 707S and Vermilion 710S substations

C4.7 Converting Facilities to Distribution Assets

- 72 kV single circuit line 6L79 (74 km) from St. Paul 707S to Willingdon 711S
- 72 kV single circuit line 6L82 (66 km) from St. Paul 707S to Bonnyville 700S