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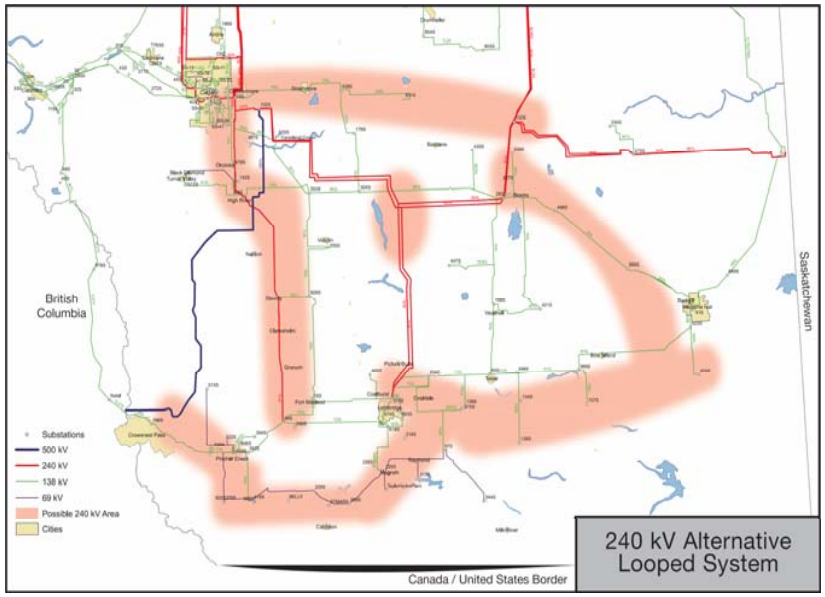
Alternatives for meeting the need for transmission improvement described

240 kV Alternative – Looped System



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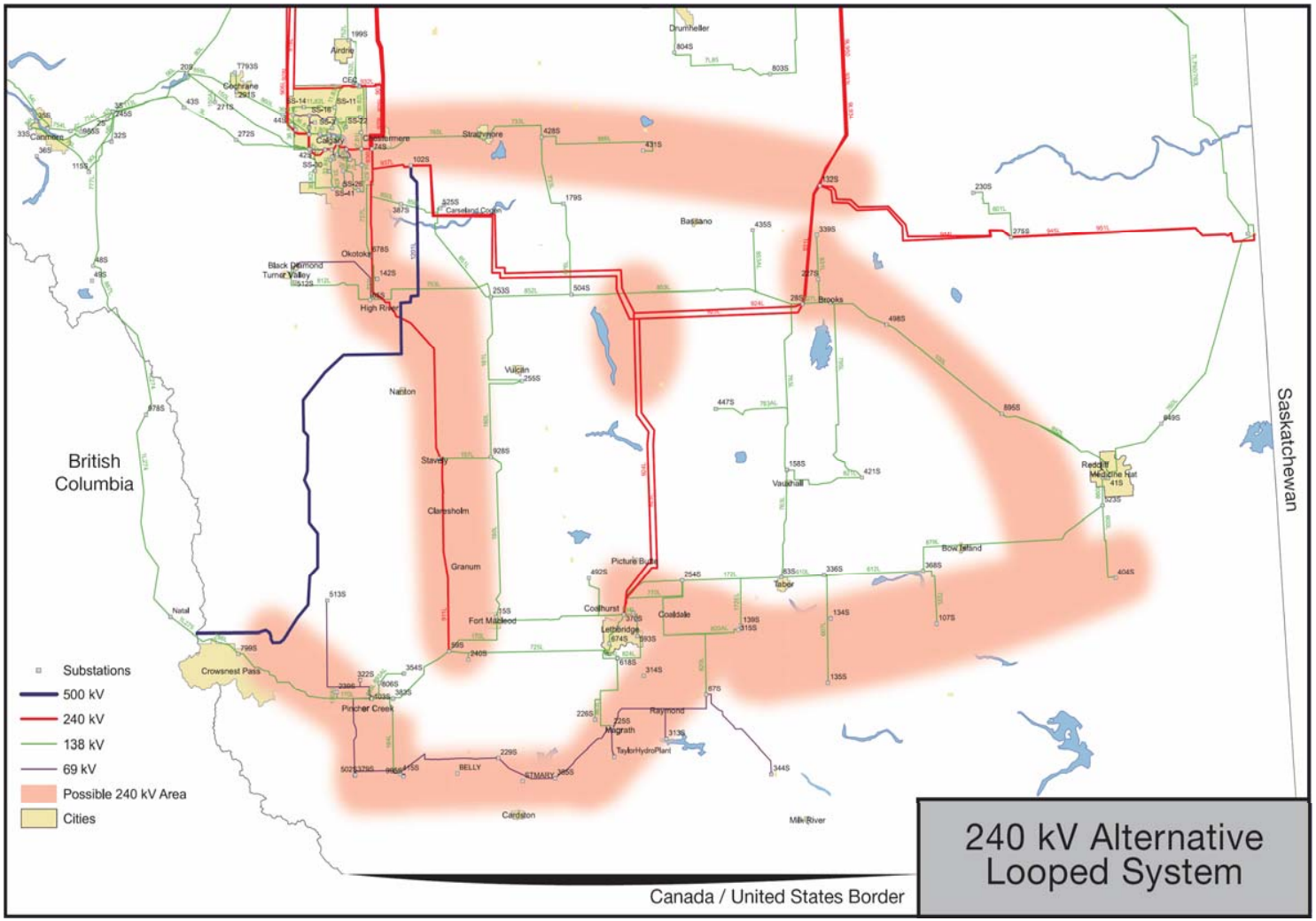
A 240 kV alternative was considered which would create new 240 kV transmission lines in southern Alberta. The new 240 kV lines would be looped into the existing 240 kV substations such as Peigan, Lethbridge and West Brooks. Several new 240 kV switching stations will tie the 240 kV transmission lines together so that the 240 kV transmission lines are fully looped, providing a high level of reliability. The new 240 kV lines in southern Alberta would be used primarily for transferring the wind energy onto the bulk 240 kV System in Alberta where it can then be delivered to major load centres.

An advantage of the 240 kV Alternative – Looped System is that 240 kV is the backbone network voltage of the existing system in southern Alberta. Staying consistent with the 240 kV voltage class eliminates the need for costly voltage transformers. The 240 kV voltage class has the capability to deliver the wind generation interest in southern Alberta when multiple transmission circuits are constructed to share the loading. This 240 kV alternative will meet the planning criteria of the Alberta Electric System Operator and the Western Electricity Coordinating Council (WECC). The looped configuration of the 240 kV transmission lines will provide uninterrupted service during any single outage event on the network.

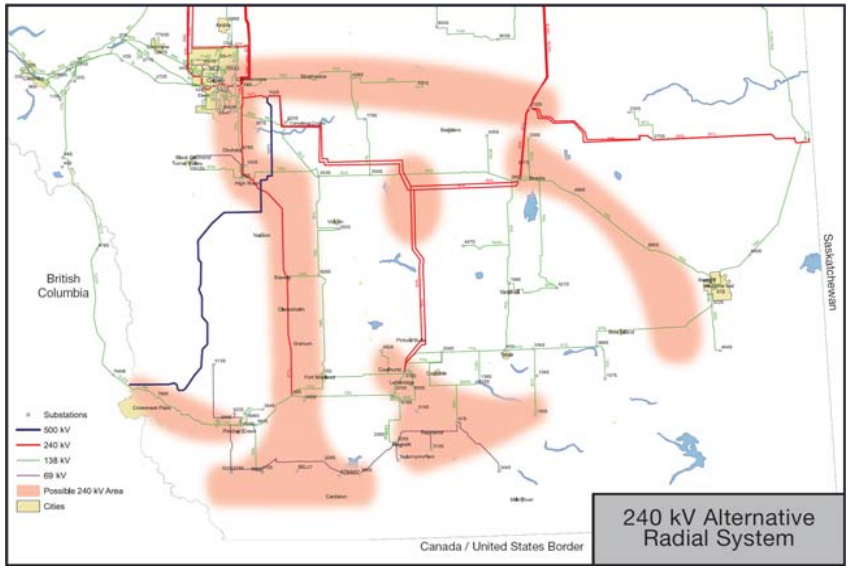
The 240 kV transmission lines will generally require smaller-width rights-of-way than higher voltage alternatives, making a smaller construction footprint (impact on land). Some of the new 240 kV transmission lines will initially be single-circuit capacity. However, the transmission line structures will be constructed to accommodate a second circuit to expand the system capacity when required by wind generation development.

The new 240 kV transmission lines will be of substantial length which will place limitations on the maximum amount of electricity which can be delivered from the southern Alberta region. The looping of the new 240 kV transmission lines will help to avoid the transfer limitations caused by longer lines.

240 kV Alternative – Looped System (enlarged view)



240 kV Alternative – Radial System



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A 240 kV radial alternative was considered which would create new 240 kV transmission lines in southern Alberta. The new 240 kV lines would extend as radial circuits from the existing 240 kV substations such as Peigan, Lethbridge and West Brooks. The radial 240 kV circuits would terminate at new 240 kV switching stations where the wind generators would connect. The radial 240 kV transmission lines would be constructed as double circuits to provide a high level of reliability. The new 240 kV lines in southern Alberta would be used for transferring the wind energy onto the bulk 240 kV system in Alberta, where it can then be delivered to major load centres.

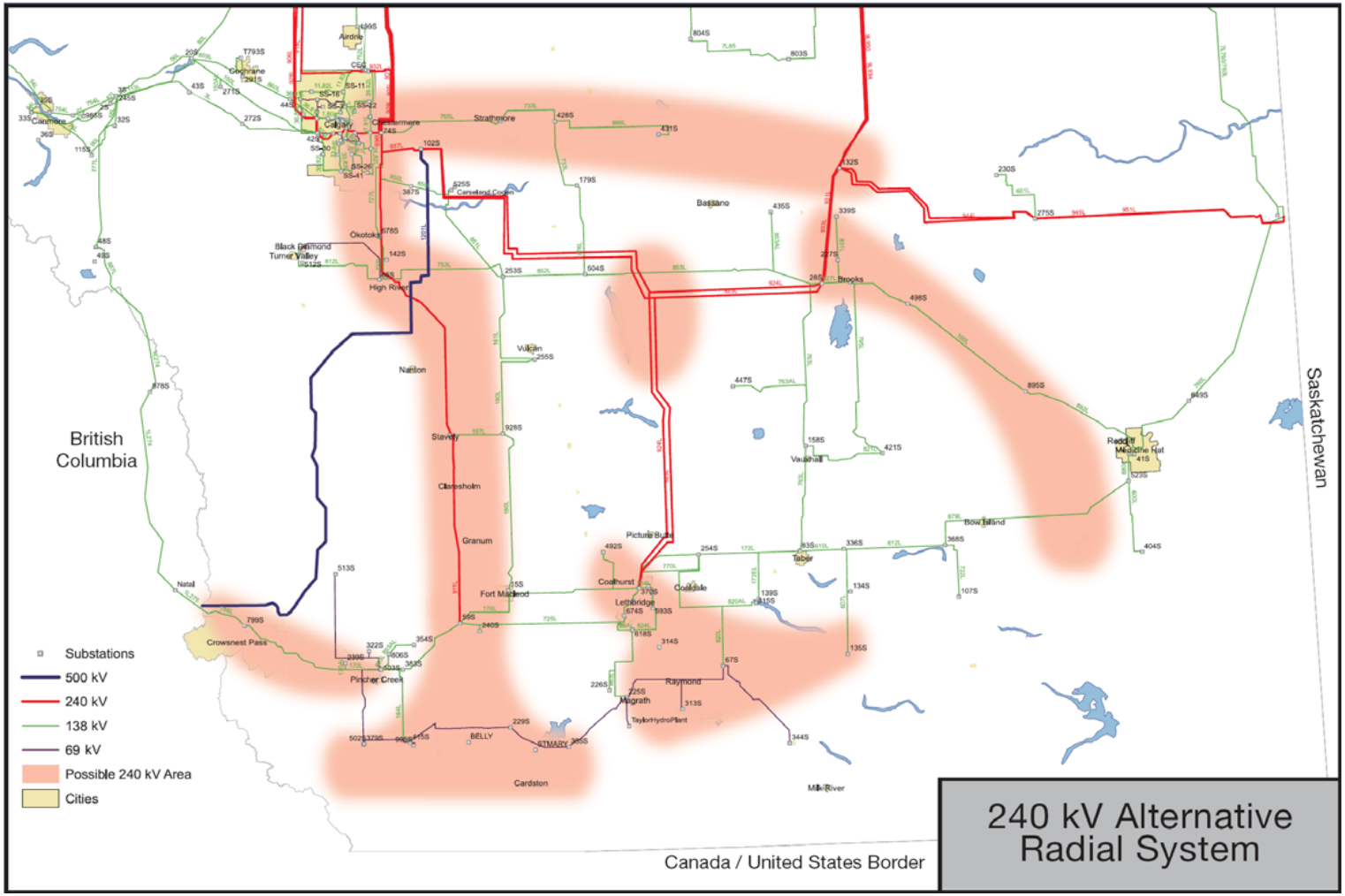
An advantage of the 240 kV radial alternative is that 240 kV is the backbone network voltage of the existing system in southern Alberta. Staying consistent with the 240 kV voltage class eliminates the need for costly voltage transformers. The 240 kV voltage class has the capability to deliver the wind generation interest in southern Alberta when multiple transmission circuits are constructed to share the loading. This 240 kV alternative would meet the planning criteria of the Alberta Electric System Operator and the Western Electricity Coordinating Council (WECC). The looped configuration of the 240 kV transmission lines would provide uninterrupted service during any single outage event on the network.

A significant disadvantage of the 240 kV radial alternative is that there would be less flexibility for future expansion. Future expansion would require either additional 240 kV lines or looping the existing 240 kV system.

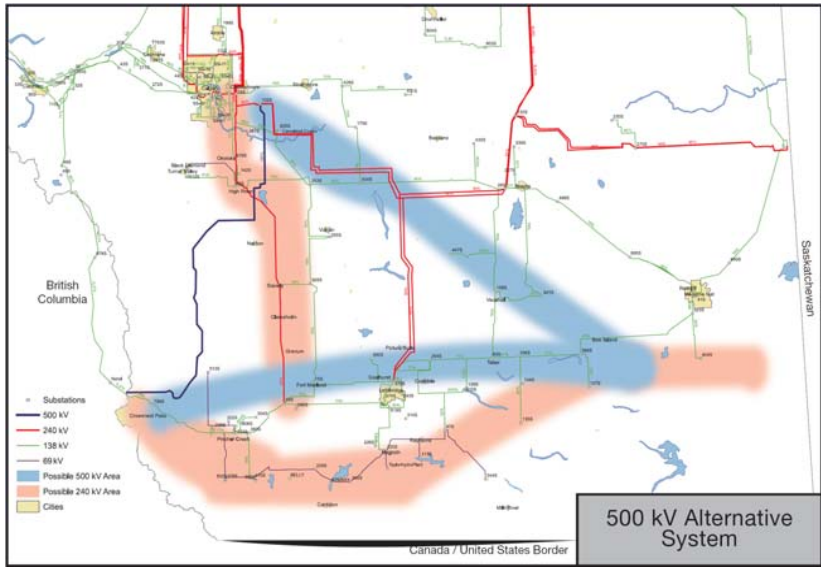
The 240 kV transmission lines would generally require smaller width rights-of-way than higher voltage alternatives, making a smaller construction footprint through new corridors. However, more distance of new 240 kV lines may be required due to that fact that more circuits will be needed to provide capability similar to a higher voltage.

The new 240 kV radial transmission lines will be of substantial length which will place limitations on the maximum amount of electric power which can be delivered from the southern Alberta region.

240 kV Alternative – Radial System (enlarged view)



500 kV Alternative – Looped System



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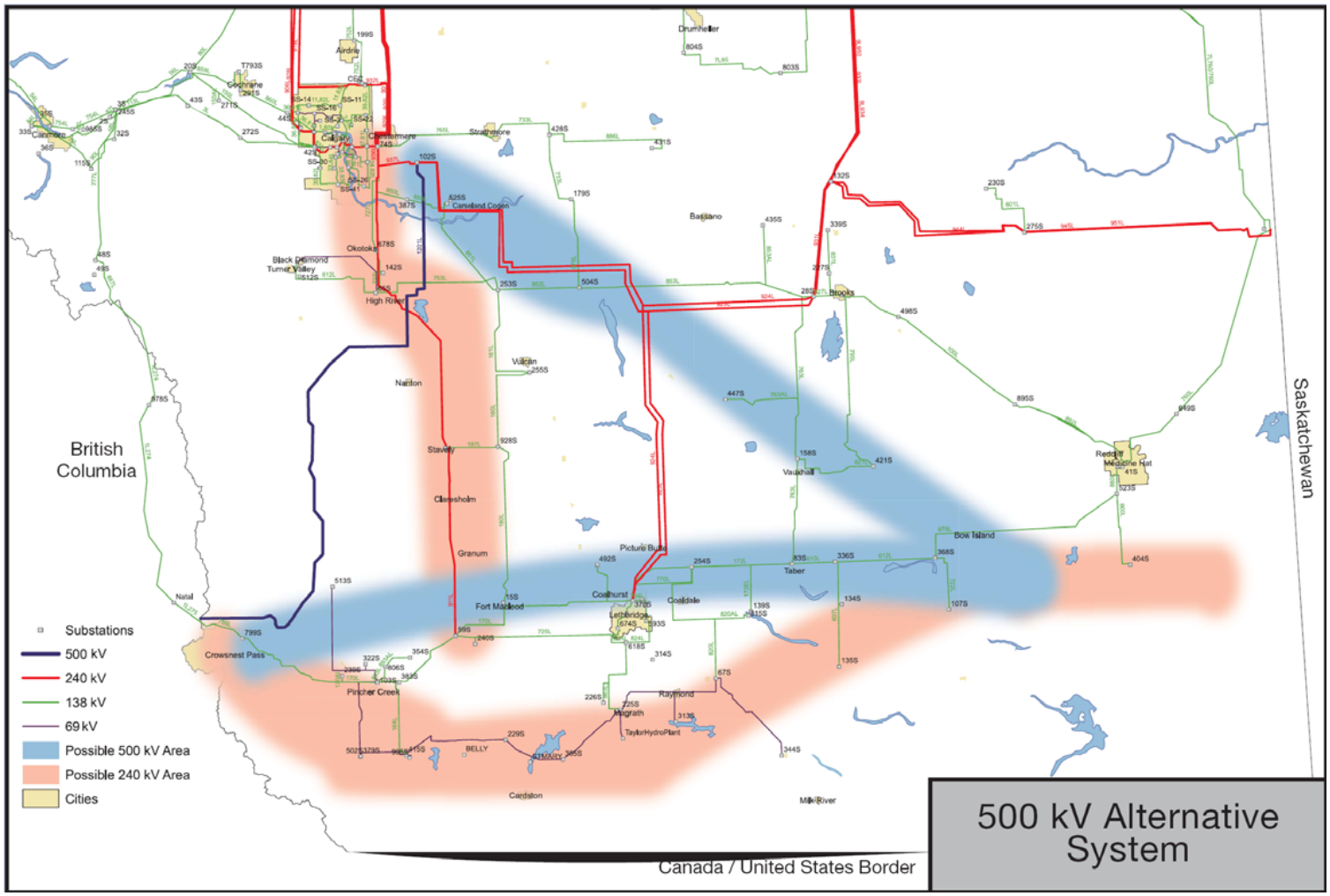
A 500 kV Alternative was considered which would create a new 500 kV transmission backbone loop in southern Alberta. The existing 500 kV line which connects Alberta to British Columbia would be used as part of the new 500 kV loop. The new 500 kV system would be more efficient than 240 kV for transmitting wind energy significant distances across Alberta. The wind generators would be connected through existing and new 240 kV transmission lines to avoid constructing multiple 500 kV loops throughout southern Alberta. Several new 500/240 kV substations would provide points where the collected wind energy can be transformed ("stepped up") to the more efficient 500 kV system. Where possible, the 240 kV transmission lines collecting the wind generation would be looped to provide a high level of reliability. The 240 kV system in southern Alberta would be used primarily for transferring the wind energy to the new bulk 500 kV backbone system.

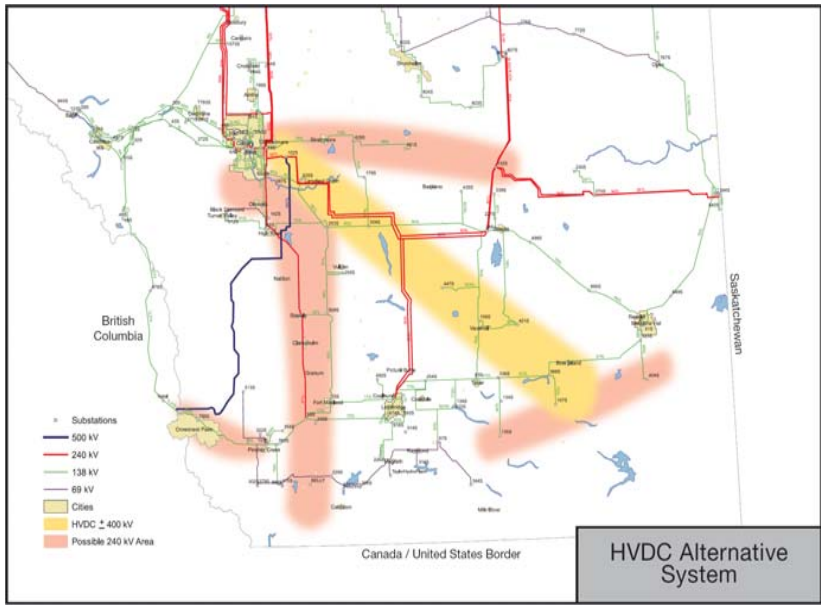
An advantage of the 500 kV Alternative is that 500 kV is the planned backbone network voltage of the future system throughout Alberta. Several new 500 kV lines are currently at various stages of planning and construction in central Alberta. The 500 kV voltage class is a future-looking alternative which anticipates the possibility of system growth exceeding the existing 240 kV network capability. The 500 kV voltage class has the capability to deliver wind generation interest in southern Alberta without constructing as many kilometers of transmission line as would be needed at the 240 kV voltage class. This 500 kV alternative would meet the planning criteria of the Alberta Electric System Operator and the Western Electricity Coordinating Council (WECC). The looped configuration of the 500 kV transmission lines would provide uninterrupted service during any single outage event on the network.

The 500 kV transmission lines would generally require larger width rights-of-way than 240 kV alternatives, making a larger construction footprint through new corridors. Some of the new 500 kV transmission lines could be initially operated at 240 kV voltage until the higher capacity of 500 kV is required by the wind generation development. This approach would delay the need to have costly 500/240 kV transformer equipment purchased and installed until there is a need to expand the system capacity.

500 kV Alternative – Looped System (enlarged view)



High Voltage Direct Current (HVDC) Alternative



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A High Voltage Direct Current (HVDC) Alternative was considered which would create a new HVDC transmission line across southern Alberta. Two new converter substations would be needed at each end of the new HVDC line to convert the electricity between direct current (DC) and alternating current (AC). The new converter substation at the north end of the new HVDC line would be connected to the existing Langdon substation. The new converter substation at the south end of the new HVDC line would be located in southeastern Alberta. The wind generators would be connected to the south converter station through new 240 kV transmission lines. The new HVDC line in southern Alberta would be used for transferring the wind energy to central Alberta, where it can be delivered to the load centres by the existing AC transmission system. The HVDC transmission lines will generally require smaller-width rights-of-way than 240 kV or 500 kV alternatives making a smaller construction footprint through new corridors.

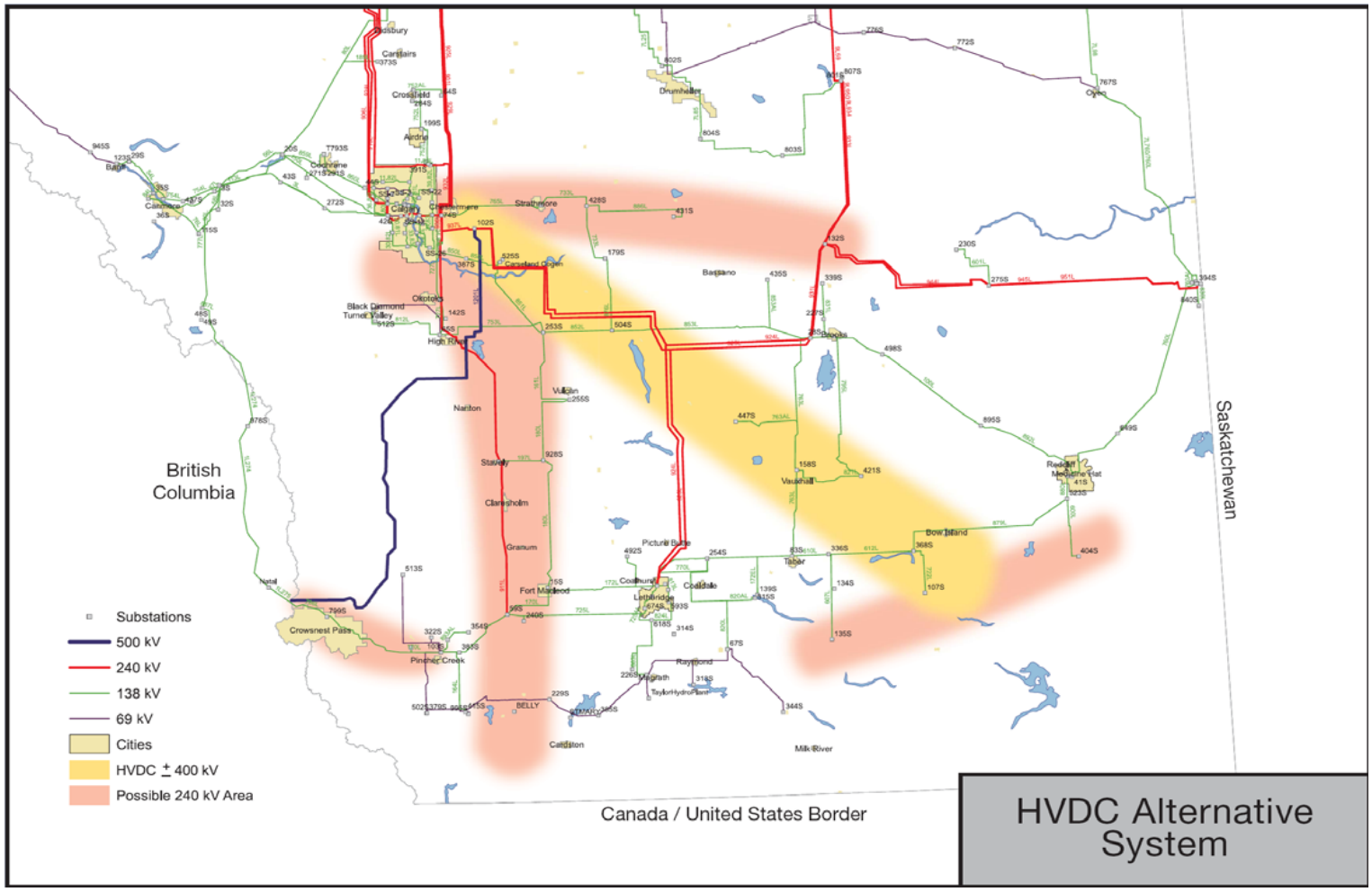
In southwestern Alberta, the existing 240 kV transmission system would be used to connect the wind generation. New 240 kV transmission lines would be needed where wind generation is not close to an existing 240 kV transmission line. A new 500/240 kV substation would connect the 240 kV system to the existing 500 kV line which runs between Alberta and British Columbia. The new 500/240 kV substation would use the 500 kV line to deliver the wind energy to central Alberta.

An advantage of HVDC transmission lines is that these lines are more efficient for transmitting energy over very long distances. However, the distance across southern Alberta is much shorter than normal HVDC transmission line applications. The shorter HVDC transmission line in this case would provide very limited efficiency gains, considering the additional energy losses consumed by the converter stations.

The HVDC transmission line has the capability to deliver the wind generation interest in southern Alberta without constructing as many kilometres of 240 kV transmission lines. The HVDC alternative would meet the planning criteria of the Alberta Electric System Operator and the Western Electricity Coordinating Council (WECC).

A disadvantage of the HVDC alternative is the limited flexibility of the HVDC system. An HVDC transmission line cannot be segmented (or tapped) without construction of very expensive additional converter stations. There is very little flexibility to expand an HVDC system as new wind generation develops in various areas of southern Alberta. Thus, there would still need to be a significant amount of new 240 kV transmission lines to gather wind energy into the HVDC converter station.

HVDC Alternative System (enlarged view)



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