British Columbia Direct Current Fast Charging (DCFC) Network Study: Core Network for Geographic Connectivity

An analysis of DCFC stations required for an initial core network to ensure geographic coverage for electric vehicle drivers across all of B.C.

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Introduction

Transportation emissions currently account for 39% of greenhouse gas (GHG) emissions in British Columbia (B.C.). The adoption of zero emission vehicles, including plug-in electric vehicles (EV), is ideally suited to reduce transportation GHG emissions in B.C. as well as air pollutants and noise.

B.C. is a leader in Canada in the electrification of transportation including plug-in electric vehicle adoption and the deployment of Direct Current Fast Charging (DCFC) and Level 2 charging infrastructure. DCFC stations allow EV drivers to rapidly recharge their vehicles and will give them the ability and confidence to safely travel between communities. Plug-in EVs using DCFCs typically achieve an 80 per cent charge in only 30 to 60 minutes, compared to the 4 to 8 hours required to charge a vehicle with a Level 2 charging station (240 V).

The Ministry of Energy, Mines and Petroleum Resources and the Ministry of Transportation and Infrastructure have completed a planning exercise to determine the approximate number of DCFCs needed for an initial core network to connect B.C. transportation routes and support plug-in EV adoption and long-distance travel across the entire province. This planning was informed by modelling completed by a contracted consultant using the Electric Vehicle Infrastructure Planning Assistant tool. While the number and densification of DCFC sites will need to grow with higher EV adoption, the initial base number of geographically dispersed DCFC sites expected to provide a core network to support long-distance travel in BC is approximately 200.

This document is intended as a guide for the next phase of geographic expansion of DCFC infrastructure across the province, whether sites are developed by utilities, the private sector, municipalities, or other entities. The province characterizes a DCFC network as a publicly accessible network open to all vehicle makes and appropriate direct current charging standards.

Purpose

This document is intended to outline the approximate number and location of a core number of DCFC sites required to facilitate safe, convenient EV travel across British Columbia, and general principles for developing these sites. Locations are based on modelled results, are approximate, and are only used to provide a sense of an initial level of connectivity required across the

province. Funders, governments, utilities, agencies, businesses and organizations planning to support or install DCFCs are encouraged to review the principles, map and list of suggested locations when considering supporting or installing DCFC infrastructure, to support a vision of a fully connected province for EVs. As the zero-emission vehicle market in B.C. evolves, this analysis will be updated to address evolving technologies and increasing numbers of EVs.

Charging Types

There are three main levels of charging for EVs, which have different voltages and approximate charging time associated.

Level 1, 120 Volt

- 8 kms of range added per hour on average
- It generally takes 8 to 16 hours to fully charge a vehicle
- Uses a SAE J1772 connector

Level 2, 240 Volt

- 30 kms of range added per hour on average
- It generally takes four to eight hours to fully charge a vehicle
- Uses a SAE J1772 connector

DC fast charging station, typically 480 Volt

- 250 kms of range added per hour on average
- Charging time from a depleted to 80% full battery is approximately 30-60 minutes depending on vehicle battery size
- Uses CHAdeMO, Combined Charging System (CCS), and Supercharger (Tesla) connectors

Current Status of Fast Charging in B.C.

B.C. has one of the largest DCFC networks in Canada. To date, the Clean Energy Vehicle (CEV) Program under the Ministry of Energy and Mines has supported two phases of DCFC station deployment in British Columbia, with future additional phases under development. DCFC site deployment has largely occurred in partnership with utilities, local, regional and federal governments, industry and electrical utilities.

The first phase of DCFC deployment occurred from 2012-2016, through a partnership between BC Hydro, the Province of British Columbia, Natural Resources Canada, local governments, and academic institutions. Phase 1 of the DCFC Network deployment installed 30 DCFCs along major

highway corridors throughout B.C. This network is predominantly based in the Lower Mainland and Southern Vancouver Island region.

In 2015, to inform the Province's second phase of DCFC implementation, a Charging Infrastructure Gap Analysis[1] was undertaken utilizing charging infrastructure funds available under the CEV Program. Included in the results of that analysis was the identification of highest priority gaps in the DCFC network. Based on those priority gaps, phase 2 resulted in the development of a further 33 sites across B.C., extending throughout the Kootenay region and up Vancouver Island, again through the efforts of numerous partners.

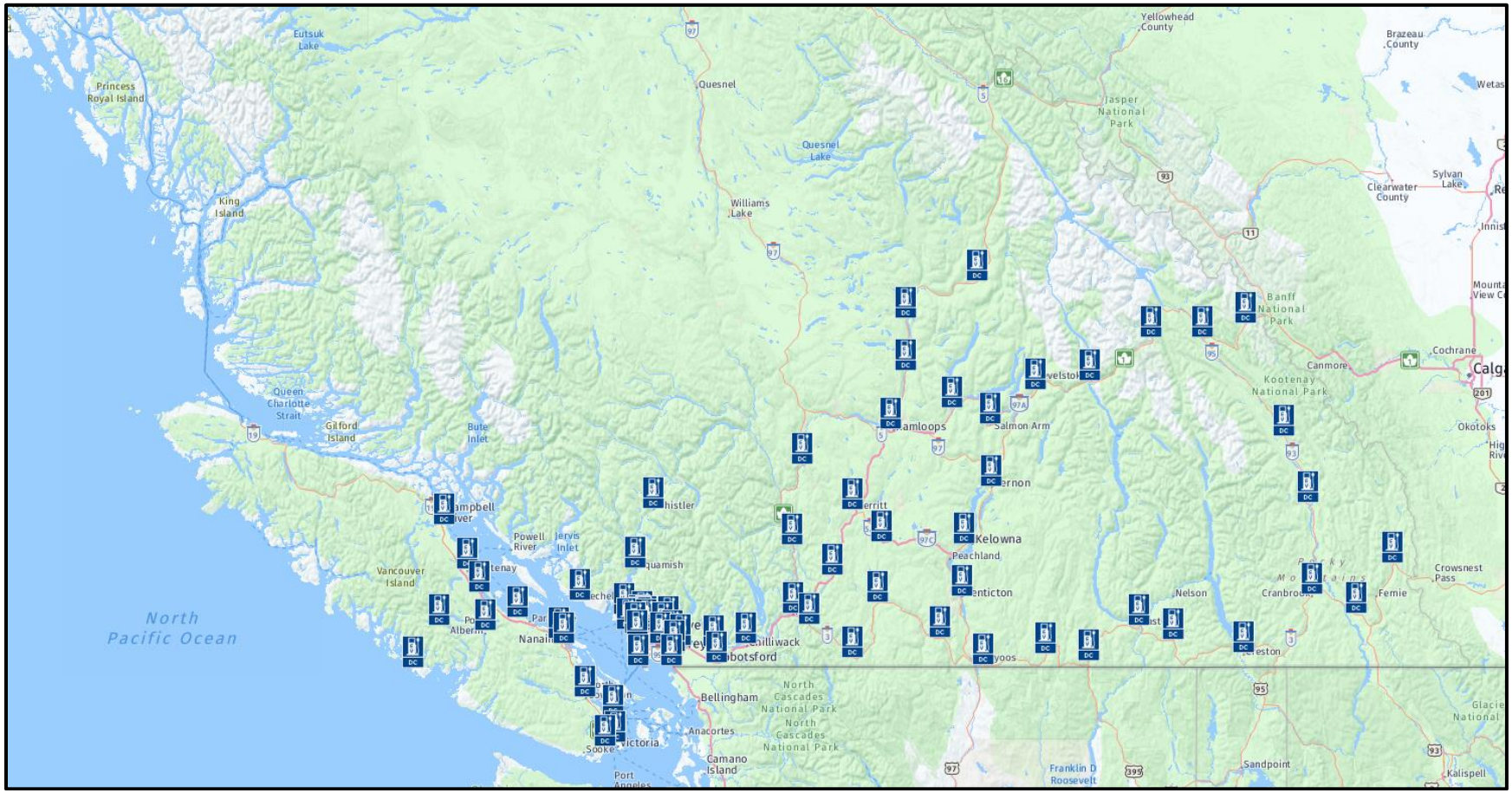
In 2017, the Ministry of Transportation and Infrastructure began planning for deployment of DCFCs in its rest areas along highway routes, including development of an EV Charging in Rest Areas Strategy. The first rest area with charging was commissioned in February 2018, and 7 additional sites are planned for installation in 2018. The Ministry plans to install DCFCs in at least five rest areas per year for the next five years.

There are currently 71 DCFC sites completed or underway. Refer to Plugshare (https://www.plugshare.com) or Chargehub (https://chargehub.com) for the latest information and locations for DCFCs in B.C.

Figure 1 shows the existing and underway DCFC sites throughout B.C.

[1] https://pluginbc.ca/wp/wp-content/uploads/2015/10/BC-DCFC-Gap-Analysis-Report-FBC_Aug-2015.pdf

Figure 1. Map of DCFC sites completed or underway in B.C.



British Columbia Fast Charging Principles

The four principles below guide the planning of new DCFC infrastructure across the province. No principal is mutually exclusive and there is no requirement for all four principles to be met for an installation to occur. However, DCFC planning should aim to maximize the number of principles met.

1. Connect travel corridors across the province, where commuter traffic, cross jurisdictional travel or tourism is supported.

2. Ensure infrastructure deployment allows for safe and convenient travel in the province while planned at a frequency that allows travel under challenging conditions, such as inclement winter weather, including ensuring that site safety and user experience are safeguarded.

3. Support regions with dense EV adoption.

4. Maximize population areas served.

The location selection, site features, and service standards are all important criteria that need to be considered when planning future deployment of DCFC infrastructure. Strategic and well-planned deployment will encourage the continued adoption of EVs and allow for safe EV travel in B.C.

Site development principles that support safe and reliable EV travel throughout the province include:

- Level 2 charging available (co-located or within 100 m of DCFC)
- Dual standard connector options (CHAdeMO and CCS/SAE Combo)
- Accessible for vehicles travelling in both directions
- Accessible year round and 24 hours per day, 7 days per week
- When applicable, near amenities
- Minimum 50 kW power output, or 25 kW where 3 phase power is not available
- Well-lit and safe
- Technology future-proofing, including for future higher-power stations, greater numbers of stations, common standards, payment processes, etc.
- Where possible, for both reliability and anticipated future demand, at least two DCFCs per site

Modelling Methodology

To determine where additional DCFC sites are notionally required in the province to facilitate safe, convenient EV travel along B.C.'s primary and secondary highways, modelling was completed by a consultant under contract with the Ministry of Energy, Mines and Petroleum Resources, using the EV Infrastructure Planning Assistant Tool. The modelling takes into account many aspects that could impact EV range, including:

- Efficiency of the vehicle
- Weight of the vehicle and contents (passengers)
- The terrain the vehicle is travelling on (particularly elevation gain and loss)
- Speed limits of the roads
- Outside air temperature

The modelling parameters used for this analysis are:

- 30 kWh vehicle
- 3 year old vehicle
- 2 individuals in vehicle
- Temperature of -10°C for Vancouver Island and Lower Mainland and -20°C for the rest of B.C.
- Vehicle fully charged at each charging stop

Modelling Results

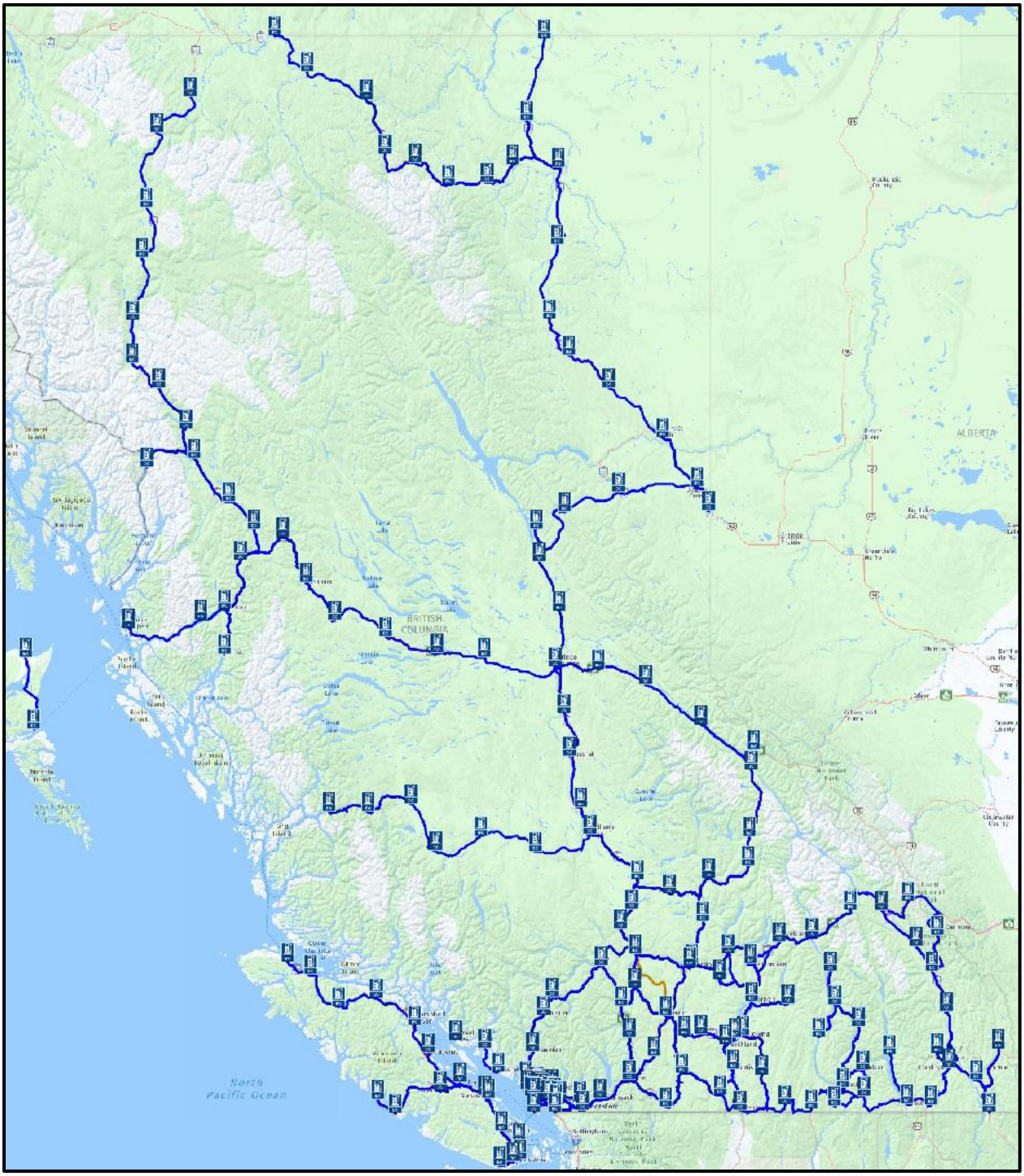
Based on this modelling, it is estimated that a total of approximately 200 DCFC sites are required to provide a base-level core network connecting all of B.C.'s primary and secondary highway routes. This constitutes approximately 130 additional locations beyond those already completed or underway to fill out a core network for geographic connectivity. Additional stations will be needed throughout the province for densification in urban and suburban centres, and redundancy along primary and secondary highway routes, in particular to support higher uptake of EVs.

See Figure 2 for a map of approximate locations for a base-level core network to support geographic connectivity. See Appendix A, Table 1 for a list of these locations. **Please note that these locations are provided for illustrative purposes, based on the mapping tool only, and are provided to give a general sense of the number and high-level distribution of DCFC sites across B.C. needed to provide a base level of geographic connectivity for EV drivers. These should not be viewed as specific sites.**

Additional sites beyond those identified in this study, including along B.C. major roads, within urban areas, and where additional density along highway corridors is an identified need, are also required to support greater EV uptake. The exact number of these additional sites and

charging stations is beyond the scope of this study, which focuses on a core network to support geographic coverage for EV drivers across B.C.

Figure 2. Map of analysis results for core B.C. DCFC network



Next Steps

This study will be used to inform DCFC funding and planning processes in B.C. As the zero-emission vehicle market in B.C. evolves, this analysis will be updated to address evolving technologies and increasing numbers of EVs.

Appendix A

Table 1. List of additional DCFC locations for initial geographic connectivity (approximate locations only)

	Highway Route	Approximate Location (for illustrative purposes only)
1	1	Lytton
2	1	Cache Creek
3	1	North Kamloops
4	2	Dawson Creek
5	2	Swan Lake
6	3	Osoyoos
7	3	Yahk
8	3A	Crawford Bay
9	3A	Nelson
10	3B	Rossland
11	4	Tofino
12	5	Blue River
13	5	Valemount
14	6	Cherryville
15	6	Fauquier
16	6	Nakusp
17	6	New Denver
18	12	Lillooet
19	14	Sooke
20	16	Mount Robson
21	16	McBride
22	16	Dome/Slim Creek
23	16	Bowron River
24	16	Prince George
25	16	Vanderhoof
26	16	Fraser Lake
27	16	Burns Lake
28	16	Houston
29	16	Smithers
30	16	New Hazelton
31	16	Cedarvale
32	16	Terrace
33	16	Exstew
34	16	Prince Rupert
35	16	Massett

36	16	Skidegate
37	17	Tsawwassen
38	19	Sayward
39	19	Woss
40	19	Port McNeil
41	19	Port Hardy
42	20	Hanceville
43	20	Chilanko Forks
44	20	Kleena Kleene
45	20	Anahim Lake
46	20	Atnarko River
47	20	Bella Coola
48	23	Galena Bay
49	24	Bridge Lake
50	33	Beaverdell
51	37	Kitimat
52	37	Kitwancool Lake
53	37	Nisga'a Hwy
54	37	Nass
55	37	Bell 1
56	37	Mehan Lake
57	37	Bob Quinn Lake
58	37	Eastman Creek
59	37	Morchuea Lake
60	37	Dease Lake DCFC
61	37	Cottonwood South
62	37	Beaverdam
63	37A	Stewart
64	39	Mackenzie
65	77	Fort Nelson River
66	77	Soma Rd
67	93	Hwy 93 Border Crossing
68	93	Vermilion Crossing
69	95	Spillimacheen
70	95	Kimberley
71	97	Monte Lake
72	97	Clinton
73	97	70 Mile House
74	97	100 Mile House
75	97	Williams Lake
76	97	McLeese Lake
77	97	Quesnel

78	97	Hixon
79	97	Bear Lake
80	97	McLeod Lake
81	97	West Pine River
82	97	Chetwynd
83	97	Fort St John
84	97	Wonowon
85	97	Pink Mountain
86	97	Buckinghorse River
87	97	Prophet River
88	97	Fort Nelson
89	97	Muskwa River
90	97	Tetsa River
91	97	Summit Lake
92	97	Toad River
93	97	Muncho Lake
94	97	Liard Hotsprings
95	97	Liard River
96	97	Yukon Border
97	97C	Peachland
98	97C	Kelowna
99	97C	Sunset Main (Douglas Lake)
100	99	Pemberton
101	101	Earls Cove
102	101	Powell River