



## Final Report Appendices B - S Geothermal Development Decision Matrix

Figure 1: Appendix B: Appendix C: Appendix D: Appendix E: Appendix F: Appendix G: Appendix H: Appendix I: Appendix J: Appendix K: Appendix L: Appendix M: Appendix N: Appendix O: Appendix P: Appendix Q: Appendix R: Appendix S:

Potential Geothermal Resources Canoe Creek – Valemount Geothermal Development Decision Matrix and Figures 2 & 3 Clarke Lake Geothermal Development Decision Matrix and Figures 4 & 5 Clearwater Volcanic Field Geothermal Development Decision Matrix and Figures 6 & 7 Iskut Geothermal Development Decision Matrix and Figures 8 & 9 Jedney Area Geothermal Development Decision Matrix and Figures 10 & 611 King Island Geothermal Development Decision Matrix and Figures 12 & 13 Kootenay Geothermal Development Decision Matrix and Figures 14 & 15 Lakelse Lake Geothermal Development Decision Matrix and Figures 16 & 17 Lower Arrow Lake Geothermal Development Decision Matrix and Figures 18 & 19 Meager Creek – Pebble Creek Geothermal Development Decision Matrix and Figures 20 & 21 Mt. Cayley Geothermal Development Decision Matrix and Figures 22 & 23 Mount Garibaldi Geothermal Development Decision Matrix and Figures 24 & 25 Mount Silverthrone – Knight Inlet Geothermal Development Decision Matrix and Figures 26 & 27 Nazko Cone Geothermal Development Decision Matrix and Figures 28 & 29 Okanagan Geothermal Development Decision Matrix and Figures 30 & 31 Sloquet Creek Geothermal Development Decision Matrix and Figures 32 & 33 Sphaler Creek Geothermal Development Decision Matrix and Figures 34 & 35 Upper Arrow Lake Geothermal Development Decision Matrix and Figures 36 & 37



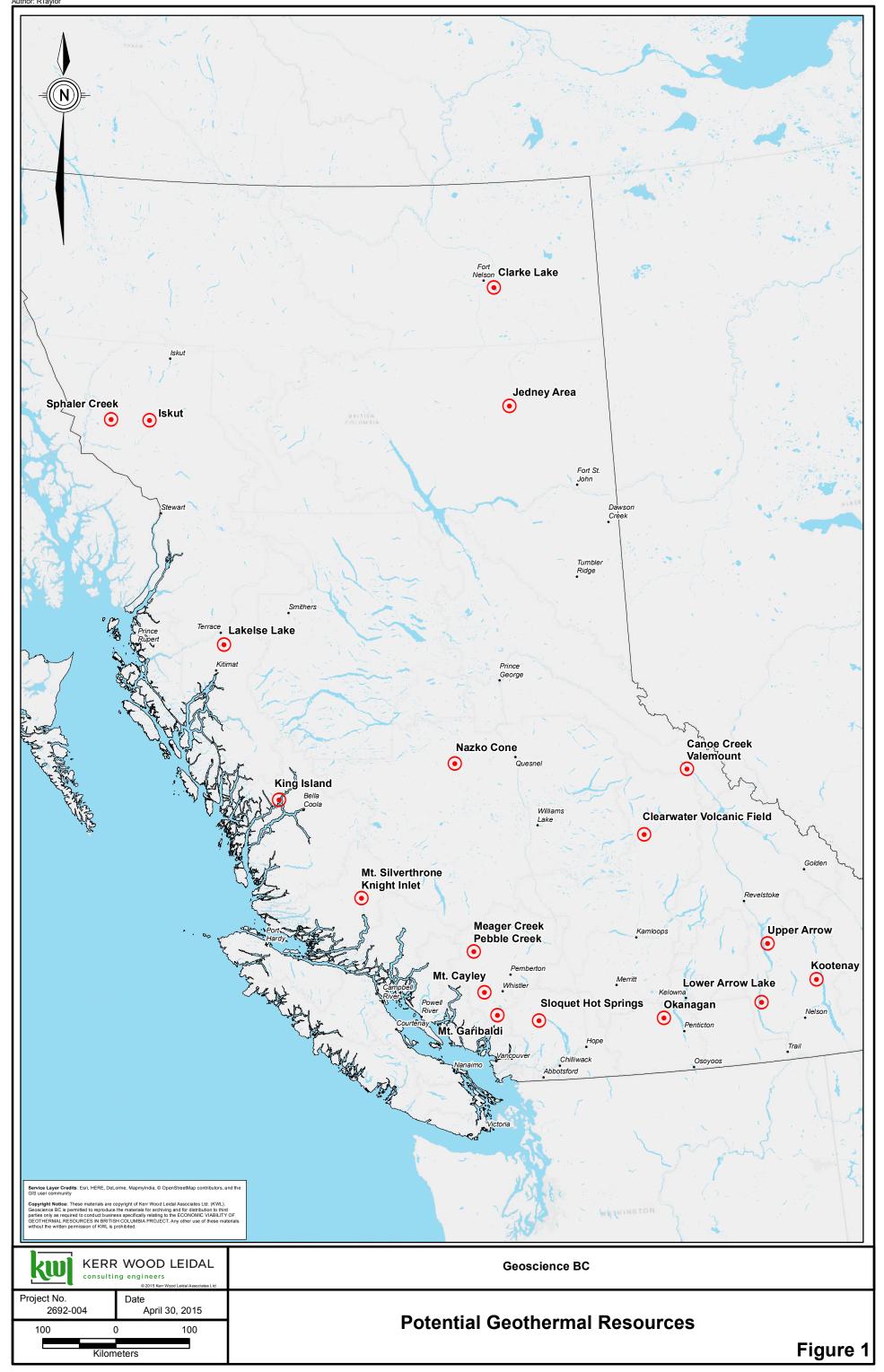
# **Final Report**

An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia Geoscience BC Report 2015-11

Submitted by:









Appendix B

# Canoe Creek – Valemount Geothermal Development Decision Matrix and Figures 2 & 3

kwl.ca

Near Valemount, British Columbia, Canada **Topographical Map Sheet: Figure 2** Geological Map Sheet: Figure 3

Category	Comments
Reservoir Potential	
Size/Potential/Type	<ul> <li>Reservoir size: N/A (no area or depth defined in literature) - therefore, reservoir volume estimated* at: 2.2 km<sup>3</sup> (most-lik assumptions made using Appendix III in GeothermEx, 2004)</li> <li>Potential: 15 MW (Gutierrez-Negrin, 2014)</li> <li>Type: binary or flash (Ghomshei, 2010)</li> </ul>
Temperature/Water and Gas Chemistry/Mineral Indicators	Surface features:         • Separate series of thermal features along banks of Canoe River ~20 km to the south of Canoe River Hot Springs, incluid (submerged since drowned by dam construction - 1973) (Ghomshei et al., 2009)         • Canoe H.S.: 70-80°C (Ghomshei, 2010)         • Canoe River hot springs: 57-60°C (Souther, 1975)         • Canoe River hot springs: 50°C (Fairbank and Faulkner, 1992)         Geothermometry:         • Canoe River hot springs: chemical geothermometers suggest subsurface temperatures as high as 185~190°C. (Souther Deep reservoir temperature is therefore estimated at 210 to 230°C, as inferred by Na-K and Na-Li geothermometers (Genes Na-K-Ca and SiO <sub>2</sub> geothermometry of fluids gives source temperature of 187°C and 129°C, respectively (Fairbank and Exploration drilling:         • Shallow temperature-gradient and deep-core hole drilling was planned to start in 2010 (Ghomshei, 2010), however no corrovided.         Water chemistry:         • Canoe River hot springs: water type is Na-(Cl>SO-) with Cl at a maximum of about 320 mg/L. There is ample evidence         • Water samples collected at 9 locations in 1994 when reservoir was unusually low: fluids considered neutral (pH values have low dissolved oxygen at less than 10% of saturation at local elevation. Springs have medium concentrations of bicard or carbonaceous precipitates were visible in the inspected area. (Ghomshei et al., 2009)         Mineral indicators:       • No information
Surface Flow Rates and Reservoir Recharge	<ul> <li>Canoe River hot springs: temperature of the hot spring fluids (as they appear at the surface) reaches 70°C to 80°C (Gho</li> <li>Canoe River hot springs: flow rate 3 L/s (Fairbank and Faulkner, 1992)</li> </ul>
3D Permeability (heat exchange potential)	"Relatively high surface temperatures and lack of evidence for potassium re-equilibration indicates rapid fluid movement in at depth is controlled by fracture systems. In this case, the reservoir permeability is possibly related to the Purcell fault and area indicates that the reservoir permeability extends to the surface." (Ghomshei et al., 2009)
Recent Magmatism	No recent volcanic activity known. Quaternary basaltic flows present 50 km southeast of springs. (Ghomshei et al., 2009)
Structural Setting	Hot spring area is bounded by three major faults: the normal North Thompson-Alberta Fault to the east (westerly dip), the km north of the hot springs, and the NW-SE striking South Rocky Mountain Trench (SRMT) fault to the west along the Ca provide a conduit to bring thermal waters to the surface (Ghomshei et al., 2009)
Geophysics	Magnetotelluric (MT) survey (2008) showed low resistivity anomalies in the upper 1,000 m corresponding with known hot s observed at greater depths (1,500 to 2,000 m) - may indicate a change in lithology or presence of a large underlying geotharea with no known hot springs was identified (away from the lake shore to the northeast of known surface manifestations

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ikely area: 2 km<sup>2</sup>; most-likely thickness: 1.1 km) (\*Reservoir

uding high-temperature hot springs and mud pools

ner, 1975) Ghomshei et al., 2009) d Faulkner, 1992)

drilling has occurred and no drilling licenses have been

e of mixing. (Souther, 1975) s of 6 to 8) and fairly conductive (1.4 to 1.6 S/cm). Fluids rbonate and sulphate, neutral to slightly basic pH. No silica

omshei, 2010)

in the geothermal system, suggesting that the permeability nd SRMT. Moreover, the spread of the outlets over a large

e E-W striking Purcell fault (southerly dip) located 5 to 10 anoe River (70° dip to SW). The SRMT fault appears to

springs and surface manifestations. The anomaly is also thermal reservoir. An additional low-resistivity zone in an s) (Ghomshei et al., 2009)

Near Valemount, British Columbia, Canada Topographical Map Sheet: Figure 2 Geological Map Sheet: Figure 3

Category	Comments
Reservoir Host Rock	<ul> <li>Cambrian (age unconfirmed) basement gneiss (with radiogenic heat source or rising mantle in the Southern Rocky Moun The basement rocks consist of well-foliated granitic to quartz-dioritic orthogneiss with porphyroblastic potassium feldspar a boulder-conglomerate with normal and graded bedding; contact of the conglomerate with basement unconformity (Ghomsl</li> <li>Deep flow systems within layered sedimentary rocks (Fairbank and Faulkner, 1992)</li> </ul>
Drilling Issues Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	Steep terrain: maximum elevation changes within permitted areas (from lake surface) ~1,850 m. (Dunn, 2013a) Canoe River hot springs are flooded seasonally by reservoir along the Canoe River (Souther, 1975) (Kinebasket Lake is a 2013a)
B. Exploration Uncertainty (Risk)	
Degree of Identification of Resources/Reserves	<ul> <li>Moderate</li> <li>Geochemistry and recent geophysical survey at the Canoe hot springs (a geothermal prospect in the Rockies) show a su this prospect is planned to start in the spring of 2010. (Ghomshei, 2010)</li> <li>MT survey conducted in 2008 to determine depth and extent of reservoir (Ghomshei et al., 2009)</li> <li>Borealis has conducted magnetotelluric geophysics, bio-geochemistry and soil-geochemistry surveys, geologic mapping probe analysis, 3-D mapping and modeling of reservoir. Slim-hole drilling planned for next step (pending funding) (Morphere Additional work was planned for 2013 (Dunn, 2013a and 2013b).</li> </ul>
	Moderate • Borealis GeoPower holds developing permit (Thompson et al., 2015) • One active permit at Canoe Reach; geothermal permit straddle the northern arm of Kinbasket Lake, which lies within the in need of upgrading. (Dunn, 2013a) • Geothermal title tracts do not cover the Canoe River hot spring itself, but they do cover a greater area focused on the the
Expected Authorization Date	As of 2013, Borealis was targeting 2016-2017 (Dunn, 2013b)
	4 years (1 year deep gradient-well drilling + 1 year successful development drilling and testing + 1 year further development drilling finish plant construction)
Degree of Previous Exploration (can be good or bad)	<ul> <li>Moderate</li> <li>Geology, geochemistry, and geophysics have been performed. No slim-hole drilling yet</li> </ul>
a plant?)	High <ul> <li>Assuming the power plant is near the series of thermal features in the south-central portion of the geothermal title tract. Is project was developed near the Canoe River Hot Springs location.</li> </ul>
Exploration to Exploitation: A summary rating of Exploration	Moderate

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untain Trench) (Ghomshei, 2010) and dykes of garnet amphibolite; overlain by a pebble- to shei et al., 2009)

a catch basin for a hydroelectric dam downstream. (Dunn,

substantial geothermal power potential. Slim hole drilling in

g and water sampling, CO<sub>2</sub>/soil degassing, shallow ground et, 2012).

e Rocky Mountain Trench, and near the end of a power line

nermal features to the south along the lake shore.

ng and start plant construction + 1 year drilling wrap-up and

However, this area may need more strategizing than if the

Nations (Shuswap and the Simpcw); additionally have

Near Valemount, British Columbia, Canada Topographical Map Sheet: Figure 2 Geological Map Sheet: Figure 3

	Category	Comments
C.	Environmental Issues	
	Protected Areas	<ul> <li>Cranberry Marsh/Starratt Wildlife Habitat Area is 5 km north of potential transmission connection location.</li> <li>Next nearest protected area approx. 25 km from proposed infrastructure.</li> </ul>
	Endangered Species	Southern Mountain Caribou (Endangered (SARA Schedule 1); red-listed) habitat polygon approx. 2 km from proposed tr
	Geothermal Surface Features	One hotspring close to proposed transmission line.
	Other	<ul> <li>Proposed transmission line crosses one known fish bearing stream, and 9 streams that do not have fish bearing classific</li> <li>Tincup Creek is in a Wildlife Habitat Area that is designated for Grizzly Bear 5 km east of proposed transmission connect Habitat Area for Grizzly Bear and Spotted Owl 20 km north of proposed plant location.</li> <li>Long-term habitat area and managed forest habitat area for Spotted Owl 17 km southeast of proposed plant location.</li> </ul>
D.	Geothermal Area - Bidding and/or Type of Land Holding (private/government/lease/etc.)	
	Bidding Area	Active geothermal title tract. Borealis GeoPower obtained a renewed geothermal exploration permits October 17, 2011 (ht they currently have an exploration permit.
	Other Claim Rights (mining and/or oil)	No known mineral/coal titles within active geothermal tract. Proposed location is not within known oil and gas management

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I transmission line.

fication.

ection and 15 km east of proposed plant location. Wildlife

(http://borealisgeopower.com/projects/canoe-reach/), and

ent area; no known tenures at proposed location.

Near Valemount, British Columbia, Canada **Topographical Map Sheet: Figure 2** Geological Map Sheet: Figure 3

Category	Comments
E. Market	
Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>1. BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through tw <ul> <li>Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propon</li> <li>Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW b against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponen threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply trealistically apply to potential geothermal generation projects).</li> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pa program has no applicability to potential geothermal generation projects.</li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificatie snow melt and stream flow.</li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project le BC Hydro through BC Hydro's competitive calls and/or the SOP, or to other potential customers in Alberta, th generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with congestion issues, affects the economic via</li> <li>Retail access, defined as a market in which electricity is sold directly to consumers by competing suppliers, is genera</li></ul></li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

nents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete nts may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this

tion of BC Hydro's resource mix, making it less reliant on

ren FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

e permitting/environmental assessment phase. The

Near Valemount, British Columbia, Canada **Topographical Map Sheet: Figure 2** Geological Map Sheet: Figure 3

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generatio</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical an considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to seve Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gene other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction were seven projects of a required to drill a geothermal well and construction and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
_		
<u>F.</u>	Transmission Line Infrastructure State of the Infrastructure	Valemount substation is closest available on 138 kV line. The 138 kV line to Valemount from Kamloops is a long radial line km of 138 kV line burned) and already has a number of independent power projects connected. Capacity on the line may b would inform these issues.
	Transmission Route (distance, terrain and costs)	Approx. 20 km of new 138 kV transmission line required via unpaved roads and forested land; moderately sloped, mounta
Н.	Community Issues	
	Indigenous Law and Indigenous Development Areas	<ul> <li>First Nation consultative areas include Neskonlith Indian Band, Secwepemc Nation, Shuswap Indian Band, Lheidli Band,</li> <li>Simpcw First Nation Traditional Territory. See Simpcw First Nation Consultation and Accommodation Guidelines and He accommodation. (Simpcw First Nation Consultation and Accommodation Guidelines - 2006, available from www.simpcw.c</li> <li>Draft Comprehensive Community Plan (CCP) from First Nations BC Website: "Simpcw FN will continue to negotiate conswithin Simpcwulucw.</li> <li>An excerpt from the Borealis website states: "Borealis is also pleased to announce that the Shuswap and the Simpcw Fir Understanding with Borealis Geopower on the development and construction of a geothermal power plant on the Canoe R</li> </ul>
	Community Action	<ul> <li>Columbia. This represents an important milestone in moving the project forward and we welcome our new partners."</li> <li>Valemount Integrated Community Sustainability Plan adopted in 2013 (http://www.valemount.ca/community-sustainability our part in creating socio-cultural and economic conditions that undermine people's ability to meet their basic needs," 2. eli nature," 3. "eliminate our part in the ongoing build-up of synthetic materials," and 4. "eliminate our part in the on-going build (Valemount, ICSP)</li> <li>An excerpt from the Borealis website states: "Borealis would like to thank the Community of Valemount for their continuement agreement that entails using the cooled wastewater (approx. 70 degrees Celsius) coming from the power plant after promunity greenhouse for food growth and possible public hot springs facilities."</li> </ul>
	Surface Rights	<ul> <li>Simpcw cultural heritage areas for traditional use area, sacred and spiritual areas, areas of historical cultural significance</li> </ul>
	Tourism	<ul> <li>Simpcw Natural Resource Dept. references "joint ventures with industry in forestry, mining, tourism and utilities." (www.si</li> <li>Tourism is generally focussed on outdoor and recreational activities. Potential hot springs facilities would complement the</li> </ul>

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ion output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission ven years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

ne that has reliability challenges, forest fire exposure (20 be a concern. An interconnection study from BC Hydro

ainous terrain.

d, Simpcw First Nation

leritage Policy - outlines specific steps for consultation and .com)

nstructive mutually beneficial, investment opportunities

First Nations have entered into a Memorandum of Reach property, located just south of Valemount British

ty) sets out 4 main sustainability objectives: 1. "eliminate eliminate our part in the ongoing physical degradation of ild-up on materials extracted from the earth's crust."

ed support of the project, and we recently signed a direct power generation for purposes such as sustaining a

e, archaeological sites. (www.simpcw.com) simpcw.com) hese activities.

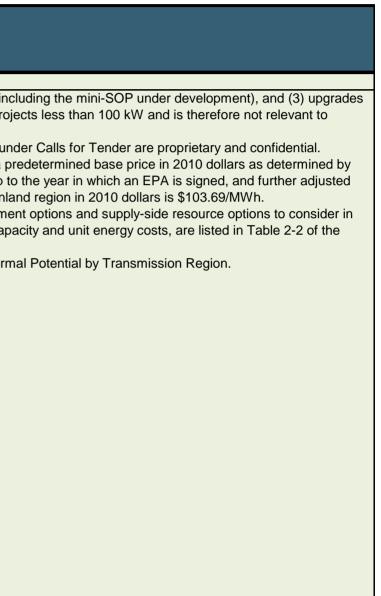
Near Valemount, British Columbia, Canada Topographical Map Sheet: Figure 2 Geological Map Sheet: Figure 3

	Category	Comments
Ι.	Water Rights	
	Availability (for example "air-cooled required")	Plant water requirement estimated approx. 19 L/s for binary plant. Mean Annual Discharge (MAD) for closest streams app side of lake for C-Free Power Corp for purpose of Power-General.
	Availability for Drilling	Drilling requirement of 20 L/s. MAD for closest streams approx. 140 L/s. Currently 2 active water licences on east side of la
J.	Engineering	
	Plant Location and Design	Plant location between Kinbasket Lake and Malton Mountain Range.
	Construction Issues	Plant may be located on sloping terrain with variable construction access on unpaved roads.
	Transportation Issues	Variable access on unpaved road
	Architectural Issues (Blend/hide into environment? Local styles? etc.)	No known requirements (as per Simpcw Land Use Plan review)
	Special Construction Issues (zero emissions)	None found
		•
K.	Non-Electrical Infrastructure (Roads and Habitation)	
	Nearest Large Community > 50,000	Kamloops, BC
	Nearest Community	Valemount, BC
	Nearest Road and Condition	Unpaved road access along Kinbasket Lake
	Current Access Conditions (restrictions)	Unpaved roads - variable conditions. Operational staff can live in Valemount and travel to site daily.
	Terrain and Distance Factor for Road Building	No requirements for new roads expected. Relatively flat terrain; low cost.

prox. 140 L/s. Currently 2 active water licences on east
lake for C-Free Power Corp for purpose of Power-General.

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	Category					Comments	
L.	Finance						
	General Power Prices	BC Hydro acquires power through (1 to its existing facilities or the develop geothermal generation projects). Co • The power price paid by BC Hydro • The power price paid by BC Hydro the region of the point of interconnec based upon the time of day and mor • BC Hydro's current Integrated Res meeting the future demand for elect November 2013 Resource Options F • Table 5-7 of the above-noted Nove	oment of new ge omments on the to independent to independent ction to the BC H ource Plan date ricity. These res Report Update.	eneration facilitie general price of power producer power producer Hydro system, es ergy is delivered d November 20 source options, t That table is rep	es. (Note that the power under early s through Energy s through EPAs scalated at the ( 1. For reference, 13 includes deta together with the produced below	e net metering p ach one are: gy Purchase Agr a under the SOP Consumer Price the base price the ails of both dema eir attributes of the for ready refere	eements (EPAs) un are made up of a p Index annually up to for the Lower Mainla and-side manageme otal energy and cap nce.
		Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)	
		Biomass – Wood Based	9,772	1,226	122 - 276	132 - 306	1
		Biomass – Biogas	134	16	59 - 154	56 - 156	]
		Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204	
		Wind – Onshore	46,165	4,271	90 - 309	115 – 365	
		Wind – Offshore	56,700	3,819	166 - 605	182 – 681	
		Geothermal	5,992	780	91 – 573	90 - 593	
		Run-of-River	24,543	1,149	97 – 493	143 – 1,170	
		Site C <sup>3</sup> Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	4,700 6,103	1,100 774	83 58 – 92	88 57 – 86	
		Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103	
		Wave	2,506	259	440 - 772	453 - 820	
		Tidal	1,426	247	253 - 556	264 - 581	
		Solar	57	12	266 - 746	341 – 954	
		<ol> <li>Notes:</li> <li>The resources and UEC values sl and may not include all possible r</li> <li>The details of how the cost adjust</li> <li>The Site C values presented in th Impact Statement (EIS) submission real discount rate.</li> <li>Representative projects were use the resource potential is generally</li> </ol>	esources that may ters were developed is table are based on filed in January 2 d to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC we natural gas-fired a	expected higher cos rovided in Appendix ded in the Site C En is calculated assum	at. 12. nvironmental ning 5 per cent	



Near Valemount, British Columbia, Canada Topographical Map Sheet: Figure 2 Geological Map Sheet: Figure 3

Category							Co	mments
Market Price (\$/MWhr)	dollars • Whole unfores variety market average on the a • BC Hy	ranges f esale ele seen gen of source data. O e cost fro appropria ydro fore eference	rom \$91/MWH ctricity prices eration outage es. One such f particular rel om 72 trades) ate transmissi casts of mark	h to 573/MWh for trading pu es and ambies source is the levance is the . Access to the ion system (e. tet prices under	at the point of rposes can vaint temperature US Energy Info mid-C trading nat market for g. Bonneville F er various scer	interconnection ry greatly. In the s. A general formation Admin hub in the Non geothermal pro- Power Authority	on to the BC Hyd le Pacific Northw lavour of the who nistration (www. thwest Region ( ojects in BC wou y) in the US.	pdate, the Unit Energy Cost for g ro system. vest, these prices are affected by blesale electricity prices for poter eia.gov/electricity/wholesale/#his one example would be a Mid-C p Id require access on both the BC ember 2013 IRP. Table 5 in Appe
		Liec	Table 5		y Price Forecasts b (Real 2012 US\$/MV			
			1	2	(Real 2012 05\$/M)	4	5	
		Market Scenario	Mid Electricity Mid GHG (Regional) Mid Gas	Low Electricity Low GHG (Regional) Low Gas	High Electricity High GHG (Regional) High Gas	Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	High Electricity High GHG (Regional/Nat'l) High Gas	
		2014	25.0	21.9	31.1	25.0	31.1	
		2015	25.5	21.7	31.9	25.5	31.9	
		2016 2017	25.8 27.1	21.2 22.0	32.0 33.4	25.8 27.1	32.0 33.4	
		2018	27.1	21.7	33.9	27.1	33.9	
		2019	28.0	22.1	35.5	28.0	35.5	
		2020	28.0	21.9	36.0	28.0	36.0	
		2021	29.3	22.5	37.3	29.3	37.3	
		2022 2023	30.1 31.8	22.7 23.2	38.8 41.7	30.9 35.5	41.3 52.1	
		2023	33.0	23.7	43.4	41.8	68.6	
		2025	34.2	24.0	45.4	50.3	91.2	
		2026	34.9	24.1	46.7	52.2	95.1	
		2027	36.0	24.3	48.6	54.7	98.9	
		2028 2029	36.3 37.2	24.0 23.9	50.2 51.1	56.8 58.8	101.8 106.1	
		2030	37.6	23.8	52.7	60.1	109.3	
		2031	38.6	24.0	54.7	62.6	112.0	
		2032	39.9	24.0	57.0	65.6	116.0	
		2033	41.5	24.4	60.1	69.3	122.0	
		2034	42.8	25.1	61.9	71.5	125.7	
		2035 2036	44.6 45.7	26.2 26.9	64.5 66.2	74.5 76.4	131.0 134.3	
		2036	45.7	28.1	69.1	79.8	140.3	
		2038	48.4	28.4	70.0	80.8	142.1	
		2039	48.9	28.7	70.7	81.6	143.5	
		2040	49.3	29.0	71.4	82.4	144.9	
							_	

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geothermal resources at a 7% real discount rate in 2013

by such factors as precipitation/snowfall in the region, ential export of electricity from BC can be obtained from a istory). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted C Hydro transmission system to the Canada/US border, and

pendix 5A – Market Forecast Data is reproduced below for

Near Valemount, British Columbia, Canada Topographical Map Sheet: Figure 2 Geological Map Sheet: Figure 3

Category					Comments
Green Power Premium (\$/MWhr)	<ul> <li>Within British Colur environmentally frien</li> <li>California has a go particularly "bundled"</li> <li>1. The price of electr</li> <li>2. There are large ar</li> </ul>	hbia, there is little dly) from BC Hyd al of 33% of retail green energy wi city is driven by t nounts of renewa	e demand fo dro. BC Hydr I sales by 20 ith Renewab the low cost ables, such a	or the purchase ro's generation 20 to be sour ole Energy Cent of natural gas as wind and so	olar, in California; and
Capacity Price (\$/KW)	<ul><li>There is no price in</li><li>Table 3-27 entitled</li></ul>	\$/kW for capacit 'UCCs of Capaci I storage, simple	ty resource of ity Resource cycle gas tu	options in the Supply Optio urbines and re	e BPA transmission system is generally not available. market at present. ns" in BC Hydro's Integrated Resource Plan dated Novemb source smart projects such as Revelstoke Unit 6). The unit
					ressions have the following meanings:
	inclusive, but excludi	ans the hours co ng British Colum	mmencing a bia statutory	at 06:00 PPT a / holidays.	Peak Hours. Ind ending at 16:00 PPT, and commencing at 20:00 PPT at PPT and ending at 20:00 PPT Monday through Saturday in
	(b) "Peak Hours" me inclusive, but excludi (c) "Super-Peak Hou	ans the hours con ng British Columi rs" means the ho Time of D	mmencing a bia statutory	at 06:00 PPT a holidays. ncing at 16:00 pr (TDF)	nd ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" me inclusive, but excludi (c) "Super-Peak Hou holidays."	ans the hours con ng British Columi rs" means the ho Time of D Super-Peak	mmencing a bia statutory purs comme Delivery Facto Peak	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak	nd ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" me inclusive, but excludi (c) "Super-Peak Hou holidays." <u>Month</u> January	ans the hours con ng British Columi rs" means the ho Time of D Super-Peak 141%	mmencing a bia statutory purs comme Delivery Factor Peak 122%	at 06:00 PPT a holidays. ncing at 16:00 pr (TDF) Off-Peak 105%	nd ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" me inclusive, but excludi (c) "Super-Peak Hou holidays." Month January February	ans the hours com ng British Columb rs" means the ho Time of D Super-Peak 141% 124%	mmencing a bia statutory purs comme Delivery Facto Peak 122% 113%	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101%	nd ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" me inclusive, but excludi (c) "Super-Peak Hou holidays." Month January February March	Time of D Super-Peak 141% 124%	mmencing a bia statutory purs comme Delivery Factor Peak 122% 113% 112%	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101% 99%	nd ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" me inclusive, but excludi (c) "Super-Peak Hou holidays." Month January February March April	Time of D Super-Peak 141% 124% 104%	mmencing a bia statutory purs comme Delivery Facto Peak 122% 113% 112% 95%	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101%	nd ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" me inclusive, but excludi (c) "Super-Peak Hou holidays." Month January February March	Time of D Super-Peak 141% 124%	mmencing a bia statutory purs comme Delivery Factor Peak 122% 113% 112%	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101% 99% 85%	nd ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" me inclusive, but excludi (c) "Super-Peak Hou holidays." Month January February March April May June	Time of D Super-Peak 141% 124% 104% 90%	mmencing a bia statutory purs comme Delivery Factor Peak 122% 113% 112% 95% 82%	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101% 99% 85% 70%	nd ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" me inclusive, but excludi (c) "Super-Peak Hou holidays." Month January February March April May	Time of D Super-Peak 141% 124% 104% 90% 87%	mmencing a bia statutory purs comme Delivery Facto Peak 122% 113% 112% 95% 82% 81%	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69%	nd ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" me inclusive, but excludi (c) "Super-Peak Hou holidays." Month January February March April May June July	ans the hours con ng British Columb rs" means the ho Super-Peak 141% 124% 124% 104% 90% 87% 105%	mmencing a bia statutory purs comme Delivery Facto Peak 122% 113% 112% 95% 82% 81% 96%	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79%	nd ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" me inclusive, but excludi (c) "Super-Peak Hou holidays." Month January February March April May June July August	Time of D Super-Peak 141% 124% 104% 90% 87% 105% 110%	mmencing a bia statutory purs comme Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96% 101%	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86%	nd ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" me inclusive, but excludi (c) "Super-Peak Hou holidays." Month January February March April May June July August September	Time of D Super-Peak 141% 124% 104% 90% 87% 105% 110% 116%	mmencing a bia statutory purs comme Delivery Facto Peak 122% 113% 112% 95% 82% 81% 96% 101% 107%	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86% 91%	nd ending at 16:00 PPT, and commencing at 20:00 PPT a

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

premium for green power. her can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

mber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

inclusive, but excluding British Columbia statutory

Near Valemount, British Columbia, Canada Topographical Map Sheet: Figure 2 Geological Map Sheet: Figure 3

Category	Comments
Estimated Size of Resource	See Section A.
Are there any green power incentives?	<ul> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community is a Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project development of Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include: <ul> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> <li>Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability</li> </ul> </li> </ul>
Grants	See above under green power incentives
Tax Holidays	None listed on federal and provincial websites.
Tax Relief	<ul> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 4 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these assert annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred dur and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the yeldeducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now n entitled Scientific Research and Experimental ity and relevance.
y participation in the clean energy sector. It provides: nent; and
these programs may be active but not currently issuing al technologies/resources, while others may be fully
ity and relevance.
ce energy by using renewable energy sources or fuels from 43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 sets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy year they are incurred, carried forward indefinitely and

Near Valemount, British Columbia, Canada Topographical Map Sheet: Figure 2 Geological Map Sheet: Figure 3

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> </ol>
	3. FNFA loans do not require collateral;
	<ol> <li>4. FNFA loans can be used to refinance existing debt; and</li> <li>5. FNFA's interest rates and terms parallel those available to provincial and local governments.</li> </ol>
	5. THE AS interest rates and terms parallel those available to provincial and local governments.
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infras purchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Bor and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015
	Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribe
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section,
	(b) an amount agreed under this section to be paid instead of royalty, or
	(c) if no royalty or amount has been agreed under this section, the prescribed royalty.
General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "Thi in section 1 (1) [definitions] of the Geothermal Resources Act."
Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners f Proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg State
Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincia</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. s that join as Borrowing Members.

astructure, social and economic development, land

prrowing Members, represented by the First Nation's Chief

ed rent for the permit (Section 5).

pay to the government

nis Act does not apply to geothermal resources as defined

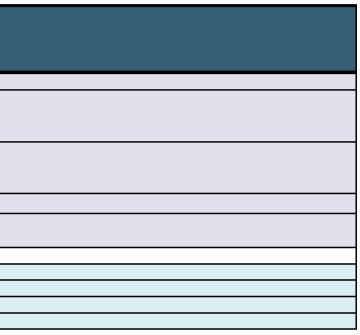
for the geothermal land tract. tutory Right of Way, Licence of Occupation).

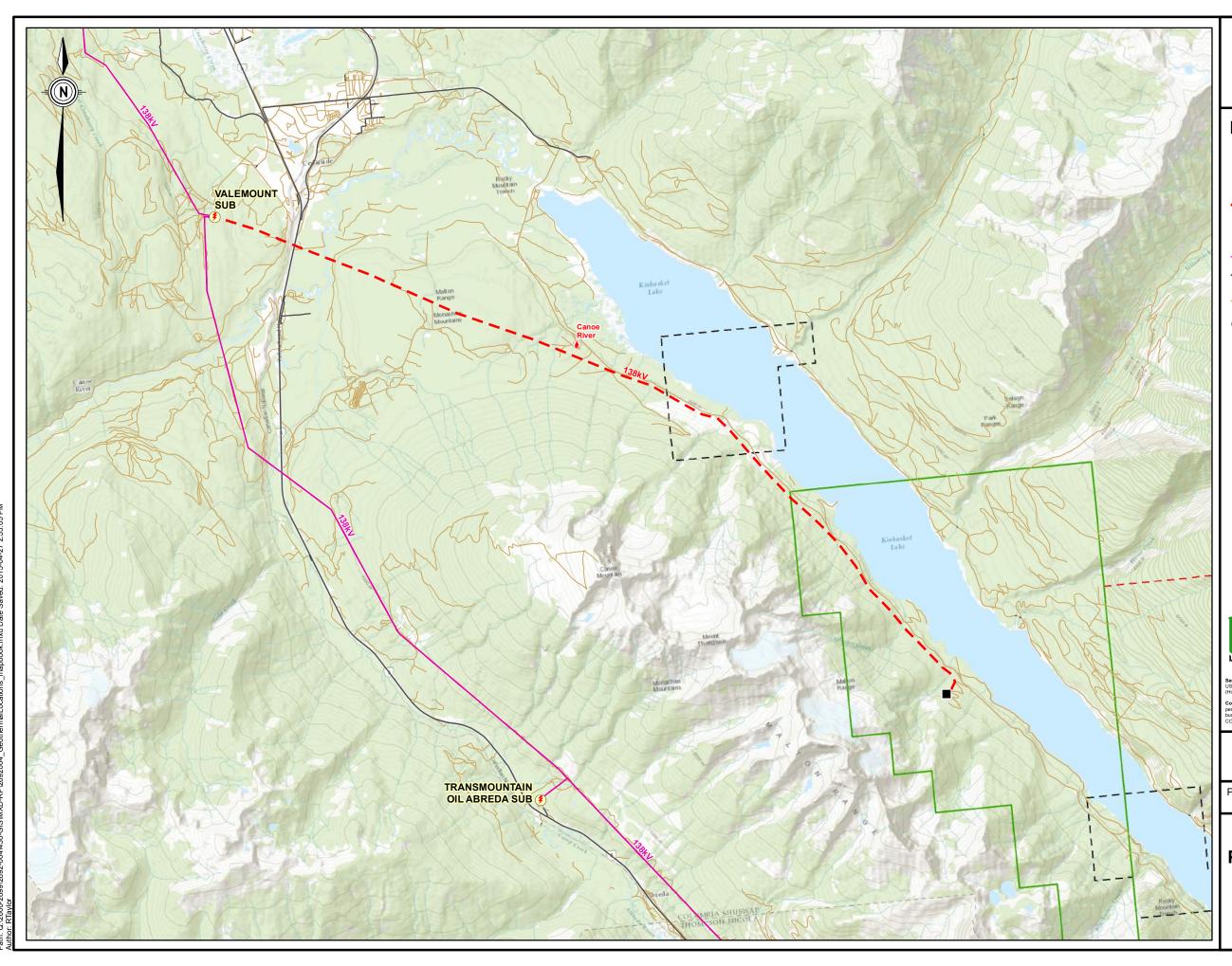
al (British Columbia): 13.5%.

a, the US, or other wholesale customers in BC, the ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power e economic viability of the potential wholesale opportunity.

Near Valemount, British Columbia, Canada Topographical Map Sheet: Figure 2 Geological Map Sheet: Figure 3

	Category	Comments
Μ	Maps	
	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)	
	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 2
	Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 3
	Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 3
N.	Other Issues and Considerations	





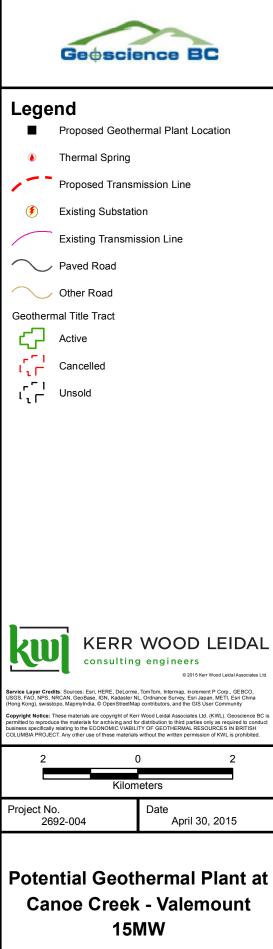
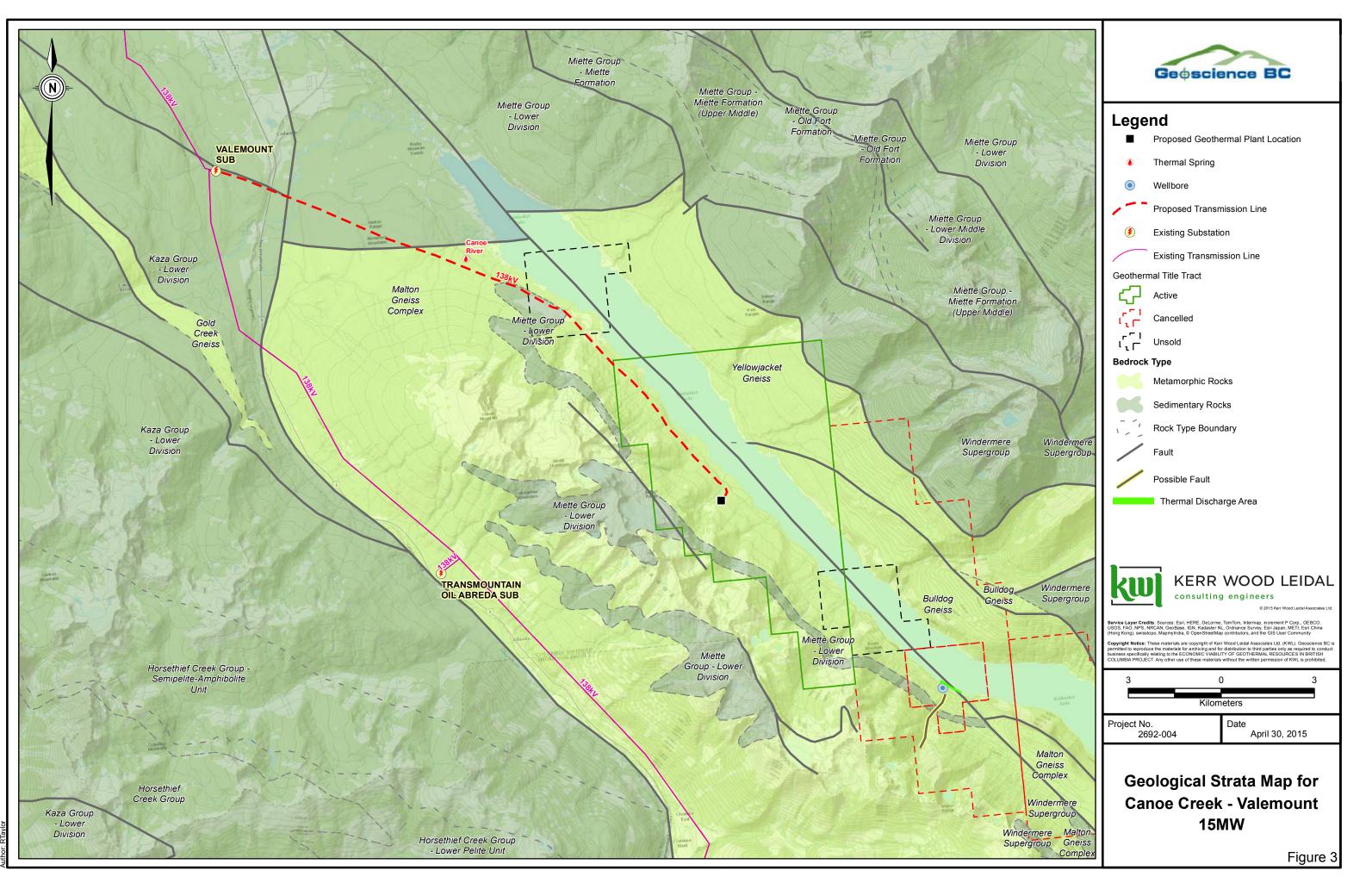


Figure 2



Path: Q:/2600-2699/2692-004430-GIS/MXD-RP/2692004\_GeothermalLocations Geology\_mapbook.mxd Date Saved: 2015-04-27 3:28:41 F



Appendix C

# Clarke Lake Geothermal Development Decision Matrix and Figures 4 & 5

kwl.ca

Near Fort Nelson, British Columbia, Canada Topographical Map Sheet: Figure 4 Geological Map Sheet: Figure 5

	Category	Comments
	Reservoir Potential	
	Size/Potential/Type	<ul> <li>Reservoir size: 6.2 km<sup>3</sup>. This is bulk volume of reservoir for area estimated at 31 km<sup>2</sup> (Arianpoo et al., 2009) and thick</li> <li>Potential: mean 34 MW (range from 12 to 74 MW; standard deviation 10.8 MW) (Walsh 2013).</li> <li>Type: Binary plant for low-temperature resource.</li> </ul>
	Temperature/Water and Gas Chemistry/Mineral Indicators	Reservoir temperatures: • Estimated at 115 °C, based on drill stem test (DST) records from natural gas wells. Range of DST temperatures was 81 Water chemistry:
		<ul> <li>Salinities approximately 35,000 ppm total dissolved solids (Gorell, 1979).</li> <li>Gas chemistry:</li> <li>Natural gas from target formations contains 9.1% carbon dioxide and 0.23% hydrogen sulfide. (Walsh 2013).</li> </ul>
		<ul> <li>Mineral indicators:</li> <li>• NA - temperature estimate is based on direct measurements in DSTs.</li> </ul>
	Surface Flow Rates and Reservoir Recharge	Reported maximum pumped flow of water from deepened natural gas well at Clarke Lake was 1,800 m <sup>3</sup> /day (Walsh, 201 geothermal production is estimated at 8,400 m <sup>3</sup> /day [1,541 gpm]. This rate should be achievable for well with typical geothermal pipe) for wells with the high productivity reported (0.75 m <sup>3</sup> /kPa). Reservoir is reported to have a high water drive (that is, s
	3D Permeability (heat exchange potential)	<ul> <li>High formation permeabilities within dolomitized carbonates (preserved primary porosity and permeability which controlle 2014).</li> <li>Heat-exchange potential is moderate to high, due to porosity up to 25% (Weides &amp; Majorowicz, 2014) and relatively high gradient of 54°C/km [Ghomshei, 2010]).</li> </ul>
ľ	Recent Magmatism	None
	Structural Setting	Reef margin located along the SE edge of the Nahanni Terrane and the NW edge of the Fort Simpson High. Extensional motions. (British Columbia MEM, 2003) (Petrel Robertson, 2003)
	Geophysics	Seismic surveys available in the area. Regional aeromagnetic surveys conducted for gas field - identified main basement
	Reservoir Host Rock	Carbonate reef rocks of the Upper Elk Group and Beaverhill Lake Group [Middle Devonian]: reservoir formations include Point. Reservoir overlain by Woodbend Group shale formations (British Columbia MEM, 2003) (Petrel Robertson, 2003).
	Drilling Issues	A number of natural gas wells are reported to be still open. However, wells with appropriate diameters for pumped produce built," that is, drilled specifically for use as geothermal producers. In addition, approximately as many injectors as produced used as injectors, but from a practical point of view would need to be within 2 kilometers of a production-well cluster.
	Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	<ul> <li>Located in the Western Canadian Sedimentary Basin. The thermal reservoir at Clarke Lake gas field lies within Middle I approximately 2,000 m.</li> <li>The prospect does not appear to have surface thermal features. It is defined based on temperatures observed in wells of the prospect does not appear to have surface thermal features.</li> </ul>

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ckness of 200 m (Walsh, 2013)

81 °C to 123 °C (Walsh, 2013).

013). Productivity of well drilled with larger diameter for othermal completion (e.g., 340-mm [13-3/8-inch] production , strong reservoir recharge).

lled subsequent dolomitization) (Walsh, 2013) (Walsh & Tu,

gh temperature gradients (average measured temperature

al tectonic setting, giving rise to normal and strike-slip fault

nts and fault trends. (British Columbia MEM, 2003)

e Lower and Upper Keg River, Sulphur Point and Slave

luction at geothermal rates would likely need to be "purpose icers would be required. Existing wells could potentially be

e Devonian carbonate formations at an average depth of

drilled for natural gas production.

Near Fort Nelson, British Columbia, Canada Topographical Map Sheet: Figure 4 Geological Map Sheet: Figure 5

Category	Comments
Exploration Uncertainty (Risk)	
Degree of Identification of Resources/Reserves	Moderate Extensive gas drilling in area has defined reservoir area and temperatures. Eighty-four gas wells have been drilled in the included: geologic mapping, stratigraphic mapping, seismic interpretations, aeromagnetics. MW capacity of thermal resour place. Permeability and recharge have been demonstrated by pump tests in natural gas wells. However, no well has actual generation (80-100 kg/sec per production well). Attached plot of net power output for binary plants indicates that 100 kg/se after plant and injection-pump parasitics. This does not take into account power required for production pumps, which wor (British Columbia MEM, 2003) (Petrel Robertson, 2003) (Walsh, 2013) (McKenna, 2006)
Likelihood of Covering Reservoir with Concession	High Reservoir has large areal extent and is well delineated by natural gas drilling. The most likely development scenario would near a cluster of production wells drilled specifically for geothermal development within a relatively small area (on the orde production wells is estimated to produce on the order of 6 to 7.5 MW. (Walsh, 2013) (Walsh & Tu, 2014)
Expected Authorization Date	Unknown
Specific Timing of Exploration (2 + 2 years, BC 8 years, etc.)	5 years for first 5-MW pilot plant (3 years for development well drilling and testing + 2 years to complete and commission 5-MW pilot plant). 4 years per 5-I
Degree of Previous Exploration (can be good or bad)	Moderate There has been significant exploration for natural gas in the area, and reservoir temperatures have been documented. No exploration/exploitation.
Surface Operational Capacity (enough stable area for drilling and a plant?)	Sufficient level ground exists for power plants and well pads. Gas-field operations already provide some infrastructure (su
Exploration to Exploitation: A summary rating of Exploration	Difficult
Uncertainty (risk) on a scale of difficult (high risk) through medium	Existing wells drilled for natural gas production are not likely to be useful for geothermal production due to smaller-diameter
(moderate risk) to easy (low risk)	some wells are already in service as injectors for co-produced water from natural gas operations. Use of such wells for ge case-by-case basis. (Walsh, personal communication [in Geoscience BC conference call,3 March 2015])

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

e Slave Point A natural gas pool. Gas exploration has ource has been estimated by probabilistic analysis of heat in tually been tested at threshold rates cited for economic /sec production at 115°C would yield approximately 1.0 MW would vary based on depth and formation characteristics.

Id consist of several smaller power plants, each located der of 1-2 km<sup>2</sup>). For example, a cluster comprising 5

-MW module thereafter.

No full-diameter wells have been drilled for geothermal

such as roads and well pads).

eter completions. Existing wells may be usable for injection geothermal injection would need to be investigated on a

Near Fort Nelson, British Columbia, Canada Topographical Map Sheet: Figure 4 Geological Map Sheet: Figure 5

	Category	Comments
C	Environmental Issues	
	Protected Areas	<ul> <li>No protected areas located along potential transmission connection routes or proposed site.</li> </ul>
	Endangered Species	<ul> <li>Canada Warbler (Threatened (SARA Schedule 1); blue-listed) habitat polygon approx. 600 m from proposed trasnmissic</li> </ul>
		<ul> <li>Southern Mountain Caribou (Endangered (SARA Schedule 1); red-listed) habitat polygon approx. 2 km from proposed pl</li> </ul>
		<ul> <li>Cape May Warbler (Special Concern (SARA Schedule 1); red-listed) habitat polygon approx 2 km from proposed plant log</li> </ul>
	Geothermal Surface Features	<ul> <li>Nearest hot springs approx 180 km from proposed plant location.</li> </ul>
		<ul> <li>Wildlife Habitat Area that is allotted for for Boreal Caribou 3.5 km south of the proposed transmission line, Winter Type A</li> </ul>
		<ul> <li>Proposed transmission line crosses six streams that do not have fish bearing classification.</li> </ul>
0	. Geothermal Area - Bidding and/or Type of Land Holding	
	(private/government/lease/etc.)	
		No existing active, cancelled, or unsold geothermal title tracts in vicinity
		No existing mineral, coal titles in vicinity; significant natural gas activity in the area. Proposed location is within oil and gas
		proximity to oil and gas tenure area. Overlapping Petroleum and Natural Gas Tenures exist.

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

sion line. plant location. t location.

e A Range.

as management area. Proposed location is in close

Near Fort Nelson, British Columbia, Canada Topographical Map Sheet: Figure 4 Geological Map Sheet: Figure 5

	Category	Comments
E.	Market	
	Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>1. BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through to *Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propones that and in the supply of electricity to BC Hydro, geothermal propones threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply realistically apply to potential geothermal generation projects).</li> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pa program has no applicability to potential geothermal generation projects.</li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificati snow melt and stream flow.</li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project is BC Hydro's competitive calls and/or the SOP, or to other potential customers in Alberta, the generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with congestion issues, affects the economic vie the rates charged under tha tariff.</li> <li>To supple eduricity supplied at a high voltage from BC Hydro under BC Hydro Transmission Rate 1823 of the Elect the rates charged under that tariff.</li> <li>To supple electricity supplied at a high voltage from BC Hydro under BC Hydro Transmission Rate 1823 of the Elect the rates c</li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

nents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this

tion of BC Hydro's resource mix, making it less reliant on

ven FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

ies from the wellhead to the processing plants. Spectra servoir potential and size, there may be an opportunity to

Near Fort Nelson, British Columbia, Canada Topographical Map Sheet: Figure 4 Geological Map Sheet: Figure 5

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation.</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical ar considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to sev Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gene other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction were projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction were projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
F.	Transmission Line Infrastructure	
• •	State of the Infrastructure	Existing 138 kV transmission line with closest substations Wescup substation and Fort Nelson G.S.
	Transmission Route (distance, terrain and costs)	10 km of new 138 kV line required to connection to Wescup substation. Terrain is relatively flat; potential wetland condition
Н.	Community Issues	
	Indigenous Law and Indigenous Development Areas	<ul> <li>First Nation consultative areas include Doig River First Nation, West Moberly First Nation, Prophet River First Nation, Fo Government of BC First Nations Consultative Areas Database. Consultation also required with Acho Dene Koe as per Ge</li> <li>Fort Nelson First Nation Lands Dept. (lands.fnnation.ca) has jurisdiction.</li> </ul>
	Community Action	<ul> <li>BC Hydro completed the Site C Clean Energy Project Community Summary for Dene Tha' First Nation. Extent of area is includes community summary, BCH consultation summary, land use and resource use summary, aboriginal summary; contenergy development on traditional lands. (See Site C Clean Energy Project, volume 5 Appendix A04 published January 20 • Fort Nelson Official Community Plan completed in 2006; community goals include expanding the region's economic base services, protect the environment from pollution of the land, water and air and discourage development in areas that are proficial Community Plan).</li> </ul>
	Surface Rights	<ul> <li>First Nation consultative areas include Doig River First Nation, West Moberly First Nation, Prophet River First Nation, Fo Government of BC First Nations Consultative Areas Database. Consultation also required with Acho Dene Koe as per Ge</li> <li>Fort Nelson First Nation lands department is responsible for ensuring that the "interests of the Fort Nelson First Nation a Natural Resources." (http://www.fortnelsonfirstnation.org/landsresources.html).</li> </ul>
	Tourism	<ul> <li>Tourism is seasonal since winters are very harsh, cold and snowy, however, still a strong tourism industry in the area. For for road-tripping tourists. Fort Nelson tourism website references several hotels and accommodations. (See Northern Road http://www.tourismnorthernrockies.ca/index.php)</li> <li>Although there is significant work underway in the natural gas industry, no reports were found to support a large influx of</li> </ul>
		workers fly-in, fly-out).

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

tion output of less than 15 MW.

he market will be necessary.

and environmental studies, public consultation, transmission even years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while struct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

tions likely. Crossing of Fort Nelson River is necessary.

Fort Nelson First Nation, Dene Tha' First Nation as per Beoscience BC recommendation.

is south of proposed geothermal location, however, report community was generally apprehensive for new large scale 2013)

se, cooperation with agencies in the provision of community potentially hazardous among others (see For Nelson

Fort Nelson First Nation, Dene Tha' First Nation as per Beoscience BC recommendation.

are represented with regard to all matters of Lands and

Fort Nelson is on route to Alaska and serves as stop point ockies Travel Guide, Fort Nelson tourism website:

of temporary workers in the town of Fort Nelson itself (most

Near Fort Nelson, British Columbia, Canada Topographical Map Sheet: Figure 4 Geological Map Sheet: Figure 5

	Category	Comments
L	Water Rights	
<u></u>	Availability (for example "air-cooled required")	Plant water requirement estimated approx. 43 L/s for binary plant. MAD out of Clarke lake 110 L/s; closest stream MAD 14 Closest water licence approx. 12 km away (straight line). Currently 7 existing water licences on the following streams: Fort Bailey Brook, Burbage Creek for purpose of processing, waterworks, and stockwatering.
	Availability for Drilling	Drilling requirement of 20 L/s. MAD out of Clarke lake 110 L/s; closest stream MAD 140 L/s. No existing water licence east km away (straight line). Currently 7 existing water licences on the following streams: Fort Nelson River (300 L/s), Muskwa purpose of processing, waterworks, and stockwatering.
J.	Engineering	
	Plant Location and Design	17 km west of highway 96. Significant existing unpaved road network (actual condition of road is unknown).
	Construction Issues	Potential wetland conditions. May need mat or pile foundations to address muskeg foundation issues.
	Transportation Issues	Possible wetland conditions. Unknown condition of extensive existing unpaved road network.
	Architectural Issues (Blend/hide into environment? Local styles? etc.)	None found
	Special Construction Issues (zero emissions)	None found
K.	Non-Electrical Infrastructure (Roads and Habitation)	
	Nearest Large Community > 50,000	Prince George, BC
	Nearest Community	Fort Nelson, BC
	Nearest Road and Condition	Nearest road is unpaved access road.
	Current Access Conditions (restrictions)	Significant unpaved road network in vicinity. Possible wetland conditions. Construction and operation workers can live in F
	Terrain and Distance Factor for Road Building	Terrain is relatively flat; possible wetland conditions. Extensive unpaved road network already exists.
	•	

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

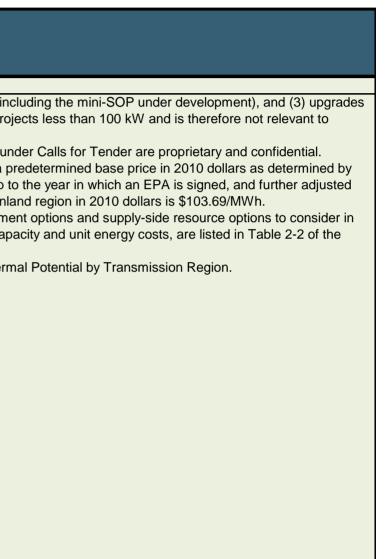
140 L/s. No existing water licence east of Fort Nelson River. ort Nelson River (300 L/s), Muskwa River, Hanson Pond,

ast of Fort Nelson River. Closest water licence approx. 12 va River, Hanson Pond, Bailey Brook, Burbage Creek for

FN and travel to site each day.

Near Fort Nelson, British Columbia, Canada Topographical Map Sheet: Figure 4 Geological Map Sheet: Figure 5

	Category	Comments					
L	Finance						
	General Power Prices	BC Hydro acquires power through to its existing facilities or the devel- geothermal generation projects). C • The power price paid by BC Hydr • The power price paid by BC Hydr the region of the point of interconn based upon the time of day and m • BC Hydro's current Integrated Re meeting the future demand for elec November 2013 Resource Options • Table 5-7 of the above-noted Nov	he net metering each one are: rgy Purchase Ag s under the SOF Consumer Price e, the base price tails of both dem neir attributes of w for ready refer	program targets pro preements (EPAs) ur P are made up of a p e Index annually up t for the Lower Mainla hand-side management total energy and cap ence.			
		Energy Resource	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)				
		Biomass – Wood Based	9,772	1,226	122 – 276	132 - 306	
		Biomass – Biogas	134	16	59 – 154	56 – 156	
		Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204	
		Wind – Onshore	46,165	4,271	90 - 309	115 – 365	
		Wind – Offshore	56,700	3,819	166 - 605	182 – 681	
		Geothermal	5,992	780	91 – 573	90 - 593	
		Run-of-River	24,543	1,149	97 – 493	143 – 1,170	
		Site C <sup>3</sup> Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	4,700 6,103	1,100 774	83 58 – 92	88 57 – 86	
		Coal-fired Generation with Carbon Capture and Sequestration	88	103			
		Wave	2,506	259	440 - 772	453 - 820	
		Tidal	1,426	247	253 - 556	264 - 581	
		Solar	57	12	266 - 746	341 – 954	
		<ol> <li>Notes:</li> <li>The resources and UEC values si and may not include all possible r</li> <li>The details of how the cost adjust</li> <li>The Site C values presented in th Impact Statement (EIS) submission real discount rate.</li> <li>Representative projects were use the resource potential is generally</li> </ol>	esources that may ers were developed is table are based o on filed in January 2 d to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC we natural gas-fired a	xpected higher cos ovided in Appendix ded in the Site C Er is calculated assum	t. 12. nvironmental ing 5 per cent	



Near Fort Nelson, British Columbia, Canada Topographical Map Sheet: Figure 4 Geological Map Sheet: Figure 5

Category							Co	mments
	dollars • Whol unfores variety market averag on the • BC H	ranges f esale ele seen gen of source data. O e cost fro appropria ydro fore reference	rom \$91/MWH ctricity prices eration outages. One such f particular reform 72 trades) ate transmissi casts of mark	h to 573/MWh for trading pu es and ambies source is the levance is the . Access to th ion system (e.	at the point of rposes can var nt temperature US Energy Info mid-C trading nat market for o g. Bonneville F er various scen	interconnection by greatly. In the s. A general floor formation Admin hub in the Nor geothermal pro- Power Authority	on to the BC Hyd e Pacific Northw lavour of the wh nistration (www. thwest Region ( ojects in BC wou y) in the US.	Update, the Unit Energy Cost for g dro system. vest, these prices are affected by olesale electricity prices for poter eia.gov/electricity/wholesale/#his (one example would be a Mid-C p and require access on both the BC ember 2013 IRP. Table 5 in Appe
			Table		y Price Forecasts b (Real 2012 US\$/MV			
			1	2	3	4	5	
		Market Scenario	Mid Electricity Mid GHG (Regional) Mid Gas	Low Electricity Low GHG (Regional) Low Gas	High Electricity High GHG (Regional) High Gas	Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	High Electricity High GHG (Regional/Nat'l) High Gas	
		2014	25.0	21.9	31.1	25.0	31.1	
		2015	25.5	21.7	31.9	25.5	31.9	
		2016 2017	25.8 27.1	21.2 22.0	32.0 33.4	25.8 27.1	32.0 33.4	
		2018	27.1	21.7	33.9	27.1	33.9	
		2019	28.0	22.1	35.5	28.0	35.5	
		2020	28.0	21.9	36.0	28.0	36.0	
		2021	29.3	22.5	37.3	29.3	37.3	
		2022 2023	30.1 31.8	22.7 23.2	38.8 41.7	30.9 35.5	41.3 52.1	
		2023	33.0	23.2	41.7	41.8	68.6	
		2025	34.2	24.0	45.4	50.3	91.2	
		2026	34.9	24.1	46.7	52.2	95.1	
		2027	36.0	24.3	48.6	54.7	98.9	
		2028 2029	36.3 37.2	24.0 23.9	50.2 51.1	56.8 58.8	101.8 106.1	
		2029	37.6	23.9	52.7	60.1	109.3	
		2031	38.6	24.0	54.7	62.6	112.0	
		2032	39.9	24.0	57.0	65.6	116.0	
		2033	41.5	24.4	60.1	69.3	122.0	
		2034	42.8	25.1	61.9	71.5	125.7	
		2035	44.6	26.2 26.9	64.5 66.2	74.5	131.0	
		2036 2037	45.7 47.8	26.9	69.1	76.4 79.8	134.3 140.3	
		2038	48.4	28.4	70.0	80.8	142.1	
		2039	48.9	28.7	70.7	81.6	143.5	
		2040	49.3	29.0	71.4	82.4	144.9	



Near Fort Nelson, British Columbia, Canada Topographical Map Sheet: Figure 4 Geological Map Sheet: Figure 5

Category					Comments			
Green Power Premium (\$/MWhr)	<ul> <li>Within British Columenvironmentally frience</li> <li>California has a goar particularly "bundled"</li> <li>1. The price of electric 2. There are large an electric sector of the sector of th</li></ul>	<ul> <li>BC Hydro's past procurement processes for the acquisition for power from independent power producers has offered a p</li> <li>Within British Columbia, there is little demand for the purchase of "green power certificates" (instruments that a customer environmentally friendly) from BC Hydro. BC Hydro's generation mix is already approximately 93% clean.</li> <li>California has a goal of 33% of retail sales by 2020 to be sourced from eligible renewable energy sources. However, the oparticularly "bundled" green energy with Renewable Energy Certificates (RECs), to compete in that market is low, for a num 1. The price of electricity is driven by the low cost of natural gas;</li> <li>There are large amounts of renewables, such as wind and solar, in California; and</li> <li>Firm transmission access to the California market through the BPA transmission system is generally not available.</li> <li>There is no price in \$/kW for capacity resource options in the market at present.</li> <li>Table 3-27 entitled "UCCs of Capacity Resource Supply Options" in BC Hydro's Integrated Resource Plan dated Novemb options (e.g. pumped storage, simple cycle gas turbines and resource smart projects such as Revelstoke Unit 6). The unit the BC Hydro system in \$2013/kW-year are shown in the table.</li> </ul>						
Capacity Price (\$/KW)	Table 3-27 entitled options (e.g. pumped							
	"1. Definitions: In this (a) "Off-Peak Hours"				ressions have the following meanings:			
	(b) "Peak Hours" mea inclusive, but excludi	ans the hours co ng British Colum rs" means the ho	ommencing a bia statutory ours comme	at 06:00 PPT a / holidays. ncing at 16:00	and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	(b) "Peak Hours" mea inclusive, but excludi (c) "Super-Peak Hou	ans the hours cong British Column rs" means the hours of Time of	ommencing a bia statutory ours comme Delivery Facto	at 06:00 PPT a holidays. ncing at 16:00 or (TDF)	PPT and ending at 20:00 PPT, and commencing at 20:00 PPT a PPT and ending at 20:00 PPT Monday through Saturday i			
	(b) "Peak Hours" mea inclusive, but excludio (c) "Super-Peak Hou holidays." Month	ans the hours co ng British Colum rs" means the ho Time of Super-Peak	ommencing a bia statutory ours comme Delivery Facto Peak	at 06:00 PPT a / holidays. ncing at 16:00 or (TDF) Off-Peak	and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	(b) "Peak Hours" mea inclusive, but excludii (c) "Super-Peak Hou holidays." <u>Month</u> January	Time of Super-Peak	ommencing a bia statutory ours commen Delivery Factor Peak 122%	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak 105%	and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	(b) "Peak Hours" mea inclusive, but excludio (c) "Super-Peak Hou holidays." Month January February	Time of Super-Peak	Delivery Factor Delivery Factor 122% 113%	at 06:00 PPT a / holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101%	and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	(b) "Peak Hours" mea inclusive, but excludii (c) "Super-Peak Hou holidays." Month January February March	Time of Super-Peak	ommencing a bia statutory ours commen Delivery Factor Peak 122%	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak 105%	and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	(b) "Peak Hours" mea inclusive, but excludii (c) "Super-Peak Hou holidays." Month January February March April	Time of Super-Peak 124%	Delivery Factor Peak 122% 113% 112%	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101% 99%	and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	(b) "Peak Hours" mea inclusive, but excludii (c) "Super-Peak Hou holidays." Month January February March	Time of Super-Peak 124% 124% 104%	Delivery Factor Peak 122% 113% 95%	at 06:00 PPT a holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101% 99% 85%	and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	(b) "Peak Hours" mea inclusive, but excludii (c) "Super-Peak Hou holidays." Month January February March April May	Time of Super-Peak 124% 124% 104% 90%	Delivery Factor Peak 122% 113% 95% 82%	at 06:00 PPT a / holidays. ncing at 16:00 or (TDF) 0ff-Peak 105% 101% 99% 85% 70%	and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	(b) "Peak Hours" mea inclusive, but excludii (c) "Super-Peak Hou holidays." Month January February March April May June	Time of Super-Peak 141% 124% 104% 90% 87%	Delivery Factor Peak 122% 113% 112% 95% 82% 81%	at 06:00 PPT a / holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69%	and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	(b) "Peak Hours" mea inclusive, but excludii (c) "Super-Peak Hou holidays." Month January February March April May June July	Time of Super-Peak 141% 124% 104% 90% 87% 105%	Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96%	at 06:00 PPT a / holidays. ncing at 16:00 or (TDF) 0ff-Peak 105% 101% 99% 85% 70% 69% 79%	and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	(b) "Peak Hours" mea inclusive, but excludii (c) "Super-Peak Hou holidays." Month January February March April May June July August	Time of Super-Peak 141% 124% 104% 90% 87% 110%	Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96% 101%	at 06:00 PPT a / holidays. ncing at 16:00 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86%	and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	(b) "Peak Hours" mea inclusive, but excludii (c) "Super-Peak Hou holidays." Month January February March April May June July August September	Time of Super-Peak 141% 124% 104% 90% 87% 105% 110% 116%	Permencing a           bia statutory           burs commendation           Delivery Factor           Peak           122%           113%           112%           95%           82%           81%           96%           101%           107%	at 06:00 PPT a / holidays. ncing at 16:00 or (TDF) 0ff-Peak 105% 101% 99% 85% 70% 69% 79% 86% 91%	and ending at 16:00 PPT, and commencing at 20:00 PPT a			

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

a premium for green power. ner can purchase to be assured that the electricity used is

ne opportunity for geothermal power from British Columbia, number of reasons

mber 2013 provided a summary of capacity resource init capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

y inclusive, but excluding British Columbia statutory

Near Fort Nelson, British Columbia, Canada Topographical Map Sheet: Figure 4 Geological Map Sheet: Figure 5

Category	Comments
Estimated Size of Resource	See Section A.
Is there any green power incentives?	<ul> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p o Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project development o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include: <ul> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Sustainable Development Technology Canada funds;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> <li>Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability</li> </ul> </li> </ul>
Grants	See above under green power incentives
Tax Holidays	None listed on federal and provincial websites.
Tax Relief	<ul> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 43 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred during and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the ye deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now entitled Scientific Research and Experimental ty and relevance. participation in the clean energy sector. It provides: ent; and these programs may be active but not currently issuing al technologies/resources, while others may be fully ity and relevance. ce energy by using renewable energy sources or fuels from 43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 ets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy year they are incurred, carried forward indefinitely and

Near Fort Nelson, British Columbia, Canada Topographical Map Sheet: Figure 4 Geological Map Sheet: Figure 5

Category	Comments
	The following is an excerpt from http://www.fnfa.ca/en/fnfa/ "The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities The advantages of joining the FNFA as a Borrowing Member are: 1. Access to low rate, below bank prime, loans with repayment terms up to 30 years; 2. First Nations choose the repayment terms that work best for their budget; 3. FNFA loans do not require collateral; 4. FNFA loans can be used to refinance existing debt; and 5. FNFA's interest rates and terms parallel those available to provincial and local governments. Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infras purchases, independent power projects, community housing and rolling stock/heavy equipment. FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Borr and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015 Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribed Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section, (b) an amount agreed under this section to be paid instead of royalty, or (c) if no royalty or amount has been agreed under this section, the prescribed royalty.

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. s that join as Borrowing Members.

astructure, social and economic development, land

orrowing Members, represented by the First Nation's Chief

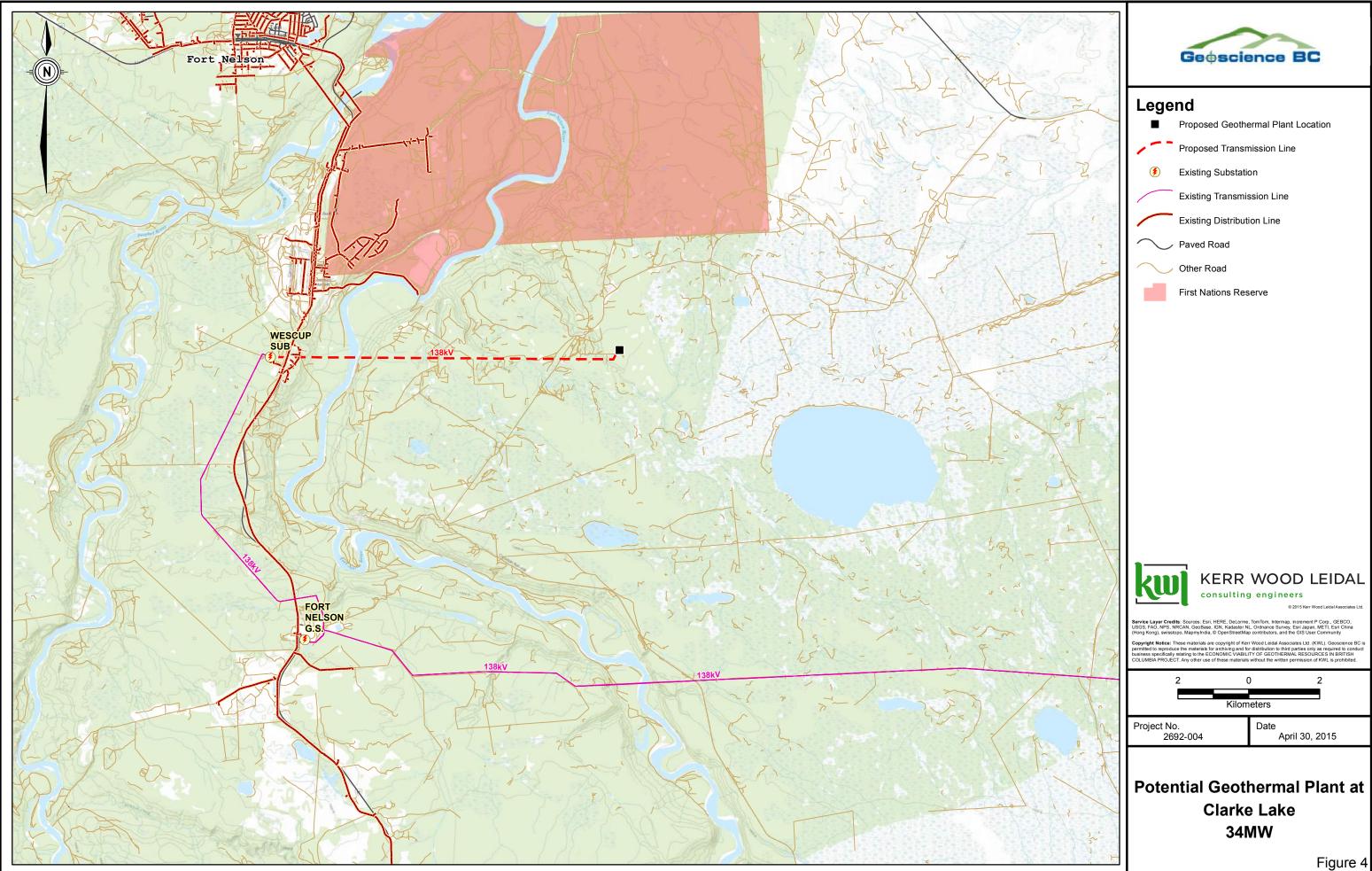
ed rent for the permit (Section 5).

pay to the government

Near Fort Nelson, British Columbia, Canada Topographical Map Sheet: Figure 4 Geological Map Sheet: Figure 5

	Category	Comments
	General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "Thi in section 1 (1) [definitions] of the Geothermal Resources Act."
	Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners for Proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg State
	Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincia</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
	Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the
M.	Maps	
	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)	Topographical Map Sheet: Figure 4
	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 4
	Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 5
	Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 5
N.	Other Issues and Considerations	

nis Act does not apply to geothermal resources as defined	
for the geothermal land tract. tutory Right of Way, Licence of Occupation).	
al (British Columbia): 13.5%. %	
a, the US, or other wholesale customers in BC, the ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power e economic viability of the potential wholesale opportunity.	







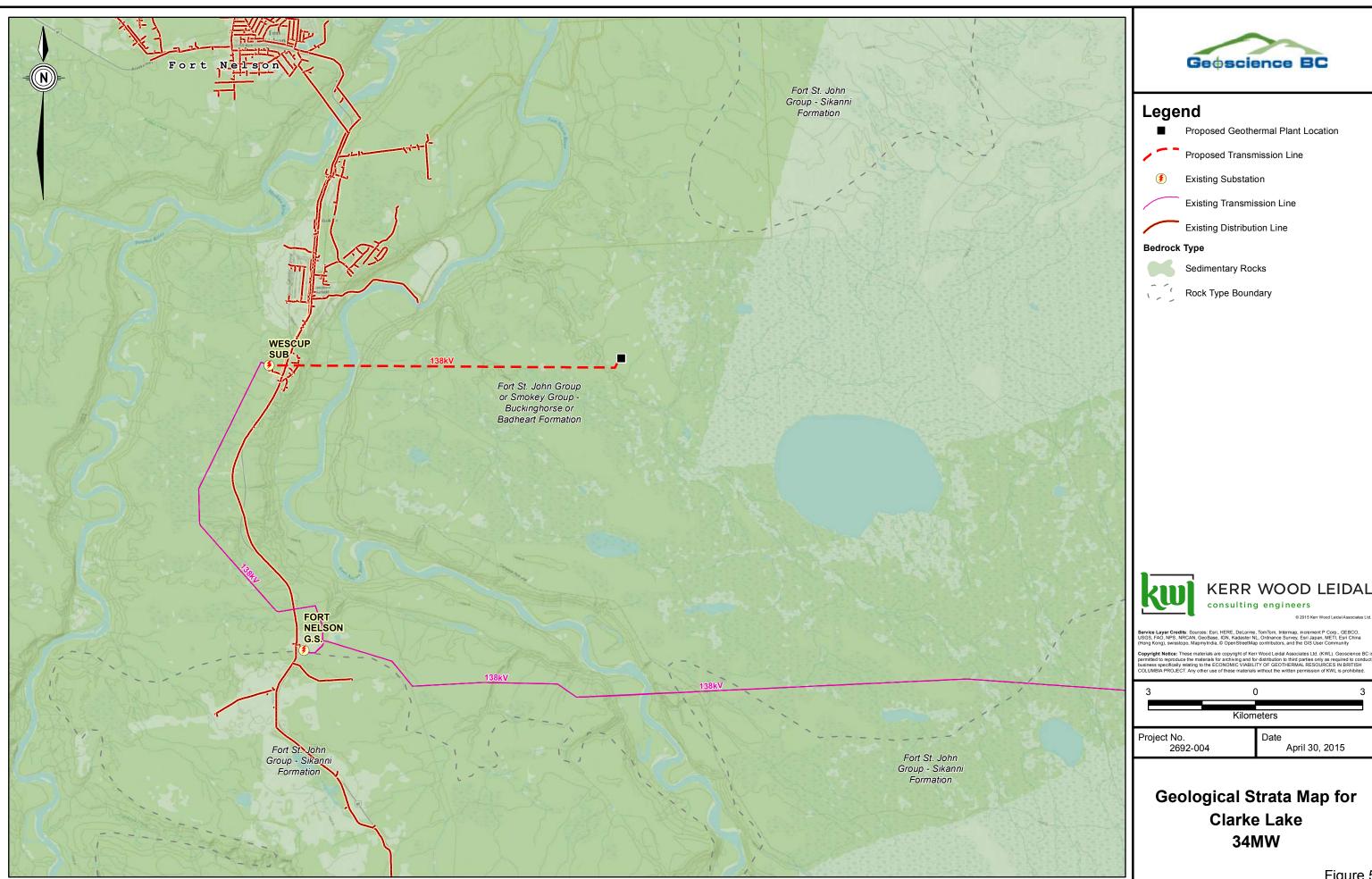


Figure 5



Appendix D

## Clearwater Volcanic Field Geothermal Development Decision Matrix and Figures 6 & 7

kwl.ca

Near Clearwater, British Columbia, Canada **Topographical Map Sheet: Figure 6** Geological Map Sheet: Figure 7

	Category	Comments
A.	Reservoir Potential	
	Size/Potential/Type	<ul> <li>Reservoir size: N/A (no area or depth defined in literature) - therefore, reservoir volume estimated* at: 2.2 km<sup>3</sup> assuming km<sup>2</sup>; most-likely thickness: 1.1 km) (*Reservoir assumptions made using Appendix III in GeothermEx, 2004)</li> <li>Potential: Assume 10 MW, compatible with generic reservoir volume (above) in vicinity of single spring, for reservoir terr</li> <li>Type: unknown, likely binary</li> </ul>
	Temperature/Water and Gas Chemistry/Mineral Indicators	<ul> <li>Surface features:</li> <li>Two springs are in the area: Clearwater Springs and Ray's Mineral Spring. Both lie within the Clearwater Depression (CL the southwest flank of McLeod Hill (a tuya, or flat-topped subglacially-erupted mound, in the east-central portion of the CD) north on the north side of a drainage valley between Kilpill Mountain and Jack's Jump (7.5km SW of Kostal Cone).</li> <li>Surface discharge temperatures (Souther, 1975):</li> <li>Clearwater spring: 14°C</li> <li>Ray's Mineral Spring: 10°C</li> <li>Geothermometry (Souther, 1975):</li> <li>Clearwater spring: Na-K-Ca 72°C</li> <li>Ray's Mineral Spring: Na-K-Ca 49°C</li> <li>SiO<sub>2</sub> (chalcedony) temperatures for both: 112°C</li> <li>Water chemistry:</li> <li>Clearwater Spring and Ray's Mineral Spring are both cold, (Ca&gt;Na)-HCO<sub>3</sub> type waters with high Mg and low cation temper Mineral indicators:</li> <li>Ray's Mineral Spring: small carbonated spring that bubbles forth out of a small volcano-like cone (tufa mound) (Wells Gra</li> </ul>
	Surface Flow Rates and Reservoir Recharge	Unknown
	3D Permeability (heat exchange potential)	No information
	Recent Magmatism	<ul> <li>Potentially active field of numerous small basaltic cinder cones and extensive lava flows</li> <li>Volcanic activity dates back to ~3 mya.</li> <li>Most recent eruption took place from Kostal cone around 1,550 AD, thus being one of the most recent volcanic eruptions Kostal cone is about 30 km north of the developable prospect area.</li> </ul>
	Structural Setting	The Wells Gray-Clearwater area appears to be the locus of transition from northerly-trending large-scale structures (Frase northwesterly directed ones. The distribution of metamorphic core complexes culminate in a wedge at this point. Active u (where the Premier Range has some of the highest elevations). Normal faults (west-side down) developed in response to the Clearwater and North Thompson Rivers. The faults running the length of the Clearwater River system form an en-ech Depression, with the north and south sides of the depression paralleling other faults in the region. (Hickson, 1987)

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ing the equivalent of a single spring (most-likely area: 2

emperatures in range of 150°C to 200°C.

CD, aka Murtle Plateau), with Clearwater Springs located on CD) and Ray's Mineral Spring is located ~11 km almost due

nperatures (maximum about 50°C)

Gray Park, 2015)

ns in Canada (Global Volcanism Program, 2015). The

ser Fault Zone) and major north-south trending valleys to uplift may extend to the north in the Cariboo Mountains to this uplift and are coincident with Clearwater Lake and chelon set which overlap in the vicinity of the Clearwater

Near Clearwater, British Columbia, Canada Topographical Map Sheet: Figure 6 Geological Map Sheet: Figure 7

	Category	Comments
Geophysics		No information
Reservoir Host Ro	ock	<ul> <li>The Wells Gray-Clearwater volcanic field is located at the western margin of the Columbia Mountains (Omineca Crystalli rocks that straddles the boundary between accreted terranes of the Interior Plateau (Hickson et al., 1995).</li> <li>The Wells Gray Park is underlain by Hadrynian and possibly younger metamorphic rocks of the Kaza Group and Shuswa</li> <li>The Wells Gray-Clearwater area includes a succession of late Cenozoic, alkali-olivine basalt flows that lie east of the ext Anahim Volcanic Belt. The rocks are petrographically similar to (but less altered than) the Chilcotin basalts (Hickson &amp; Sou</li> <li>The Wells Gray-Clearwater Volcanic Field (WGCVF) is the site of transitional- to alkali-olivine basaltic volcanism erupted</li> </ul>
		magmas (<1 km <sup>3</sup> ) erupted along pre-existing normal faults related to late-stage terrane amalgamation (Hickson and Vigou crustal thinning.
		<ul> <li>McLeod Hill volcanics date to ~3.5 mya; however, the majority of volcanic activity likely occurred in the last 600,000 years northwest and west portions of the Clearwater Depression. (Hickson, 1987)</li> </ul>
Drilling Issues		Springs are located within Wells Gray Provincial Park
	of Geological Setting of Thermal Features (i.e., from fluvial gravels; beside a river, etc.)	Exposures of the basal surfaces of the flows are commonly associated with springs and seepages. Extensive tufa deposit the upper Hemp Creek valley and at Red Spring, Ray's Mineral Spring, Meadow Falls, and 3rd Canyon Creek. Where spri around the seepage has formed large grottos in the cliff face (The Shadden is an example). (Hickson, 1987)
B. Exploration Unc	ortainty (Disk)	
	cation of Resources/Reserves	Low
ů		No focused definition of resource location to date.
Likelihood of Cov	ering Reservoir with Concession	Low Both cold springs are located within Wells Gray Provincial Park (Pynn, 2010), so development near the springs is unlikely. km long and 4 km wide) extending northward from the park's southern boundary. The prospect location based on coordina end of this tract, but still 10 km south of the closest spring (Clearwater).
Expected Authoriz	zation Date	Unknown
Specific Timing of	f Exploration (2 + 2 years, BC 8 years, etc.)	5-6 years Assuming a viable prospect can be identified within non-park land, expect at least 1-2 years for permitting and surface exp holes) + 1 year of deep gradient-well drilling + 1 year for development drilling and testing + 1 year for further development of wrap-up and completion of plant construction.
Degree of Previou	us Exploration (can be good or bad)	Low Geological studies of the area describe regional setting. Nearest geochemical data are from springs at a distance of 10 km geophysical or temperature-gradient data.
a plant?)		There is potentially enough space for well pads and a power plant within the non-park tract, but there is not much evidence geothermal resource.
	on a scale of difficult (high risk) through medium	Difficult Constraints on accessible land will likely be a serious impediment to locating and developing geothermal power in this area indications of source temperatures will be available only by drilling. Geophysical studies and temperature-gradient wells co require a relatively high threshold of investment for a prospect about which not much is known.

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

alline Terrane), an uplifted belt of metamorphic and granitic	
wap Complex (Canil and Scarfe, 1989) extensive Chilcotin lavas and define the eastern end of the Souther, 1984). ed over the last three million years. The small-volume ouroux, 2014). Origin of volcanism may be a result of local	
ouroux, 2014). Origin of volcariisin may be a result of local	
ars, with areas of Holocene volcanism located in the east,	
sits have been built around some springs, such as those in prings exit from the base of a cliff, centralized erosion	
ly. There is an elongated tract of non-park land (about 15 inates provided by Geoscience BC is toward the northern	
inates provided by Geoscience BC is toward the northern	
exploration (possibly including shallow temperature-gradient of drilling and start of plant construction + 1 year for drilling	

area. Since there are no nearby springs, geochemical s could potentially provide more encouragement, but these

### CLEARWATER VOLCANIC

Near Clearwater, British Columbia, Canada Topographical Map Sheet: Figure 6 Geological Map Sheet: Figure 7

	Category	Comments
(	C. Environmental Issues	
	Protected Areas	<ul> <li>Proposed transmission line is approx. 2 km from Wells Gray Provincial Park. Site location is within Park.</li> </ul>
	Endangered Species	<ul> <li>Coast Mountain Draba (blue-listed plant) habitat polygon in proposed transmission line location.</li> </ul>
		<ul> <li>Oregon Willowherb (blue-listed plant) habitat polygon approx. 2.7 km from proposed transmission line.</li> </ul>
		• Southern Mountain Caribou (Endangered (SARA Schedule 1), red-listed) habitat polygon approx. 9.5 km from proposed
	Geothermal Surface Features	<ul> <li>Clearwater Hotsprings approx. 11 km north of proposed plant location.</li> </ul>
	Other	<ul> <li>Rainbow Trout in Fage Creek, located along proposed transmission line.</li> </ul>
		<ul> <li>Coho Salmon present and Chinook Salmon spawning location in Clearwater River, 1.3 km west of proposed transmission</li> </ul>
	D. Geothermal Area - Bidding and/or Type of Land Holding	
	(private/government/lease/etc.)	
	Bidding Area	No known existing active, cancelled or unsold geothermal title tracts
	Other Claim Rights (mining and/or oil)	No known coal or mineral titles. Proposed location is not within known oil and gas management area; no known tenures a

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

d plant location.
on line.
at proposed location.

Near Clearwater, British Columbia, Canada **Topographical Map Sheet: Figure 6** Geological Map Sheet: Figure 7

	Category	Comments
E		
	Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>1. BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through tw • Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propon • Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW b against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponen threshold for the SOP (BC Hydro is developing a mini-SOP' component within the overall SOP. This mini-SOP will apply realistically apply to potential geothermal generation projects).</li> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pa program has no applicability to potential geothermal generation projects.</li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificati snow melt and stream flow.</li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project to BC Hydro through BC Hydro's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>Wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta, th generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission acc 4. Retail access, defined as a market in which electricity is old directly to consumers by competing planets to large customers • To</li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

nents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete nts may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this

tion of BC Hydro's resource mix, making it less reliant on

ven FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

environmental assessment phase. The potential operations

arwater site.

e permitting or environmental assessment phase. The

Near Clearwater, British Columbia, Canada **Topographical Map Sheet: Figure 6** Geological Map Sheet: Figure 7

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical and considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to sever Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will generation other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction years, the key uncertainties inherent in the environmental review, public consultation, transmission arrangements (either with permitting and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
-	Transmission Line Inforetune	
F.	Transmission Line Infrastructure State of the Infrastructure	Closest transmission line is 138 kV via Clearwater substation. The 138 kV line to Valemount from Kamloops is a long radia
		and already has a number of IPPs connected. Capacity on the line may be a concern. Interconnection study is available from the line may be a concern.
	Transmission Route (distance, terrain and costs)	New transmission line approx. 30 km via existing paved road (minimal routing with non-existing or unpaved roads) to Clear elevation changes through the remote location.
Η.	Community Issues	
	Indigenous Law and Indigenous Development Areas	<ul> <li>First Nation Consultative areas include Canim Lake Indian Band, Simpcw First Nation, Nekonlith Indian Band.</li> <li>Simpcw First Nation Traditional Territory. See Simpcw First Nation Consultation and Accommodation Guidelines and He accommodation. (Simpcw First Nation Consultation and Accommodation Guidelines - 2006, available from www.simpcw.cd</li> <li>Draft Comprehensive Community Plan (CCP) from First Nations BC Website: "Simpcw FN will continue to negotiate conswithin Simpcwulucw."</li> </ul>
	Community Action	<ul> <li>Clearwater, BC is carbon neutral BC Climate Action Community 2012. (http://www.districtofclearwater.com/news/407-cleared 2012).</li> <li>Clearwater, BC official community plan is currently under public consultation. Vision includes a carbon-neutral community alternatives, power productions and new construction. (Clearwater Official Community Plan).</li> </ul>
	Surface Rights	<ul> <li>First Nation Consultative areas include Canim Lake Indian Band, Simpcw First Nation, Nekonlith Indian Band.</li> <li>Simpcw cultural heritage areas for traditional use area, sacred and spiritual areas, areas of historical cultural significance.</li> </ul>
	Tourism	<ul> <li>Simpcw Natural Resource Dept. references "joint ventures with industry in forestry, mining, tourism and utilities." (www.sinternetwork) or constraints a large industry along with the major forestry industry in Clearwater. Tourism includes outdoor recreational act on Clearwater's tourism website. (http://www.districtofclearwater.com/visitors/tourism)</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ion output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission ven years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

dial line that has reliability challenges, forest fire exposure from BC Hydro.

arwater Substation. Terrain is moderate with minimal

leritage Policy - outlines specific steps for consultation and .com)

nstructive mutually beneficial, investment opportunities

earwater-is-a-carbon-neutral-bc-climate-action-community-

nity achieved through the use of innovative energy

ce, archaeological sites. (www.simpcw.com) simpcw.com)

ctivities, advertised as "more than just a stop over location"

### **CLEARWATER VOLCANIC**

Near Clearwater, British Columbia, Canada Topographical Map Sheet: Figure 6 Geological Map Sheet: Figure 7

		Category	Comments
	I.	Water Rights	
		Availability (for example "air-cooled required")	Plant water requirement estimated approx. 13 L/s for binary plant. Closest river Hemp Creek has MAD of 4900 L/s. 33 curr geothermal point location with purposes including domestic, irrigation, land improve, stockwatering and enterprise. No exist buffer.
		Availability for Drilling	Drilling requirement of 20 L/s. Closest river Hemp Creek has MAD of 4900 L/s. 33 current water licences applications withi purposes including domestic, irrigation, land improve, stockwatering and enterprise. No existing energy/hydro power wate
	J.	Engineering	
Ī		Plant Location and Design	Remote location with three sides of geothermal point location surrounded by existing provincial park.
		Construction Issues	Close proximity to existing provincial parks and protected areas.
		Transportation Issues	Existing 2 km unpaved road section from plant location to paved road to Clearwater substation. Unknown condition of exist
		Architectural Issues (Blend/hide into environment? Local styles? etc.)	Location is remote surrounded on three sides with existing provincial park.
		Special Construction Issues (zero emissions)	none found
	K.	Non-Electrical Infrastructure (Roads and Habitation)	
		Nearest Large Community > 50,000	Kamloops, BC
		Nearest Community	Clearwater, BC
		Nearest Road and Condition	Approx. 2 km of unpaved road to existing paved road from plant location.
		Current Access Conditions (restrictions)	Three sides of geothermal point location is surrounded with existing protected area provincial park.
		Terrain and Distance Factor for Road Building	Existing paved road from approx. 2 km from geothermal point location to Clearwater substation.

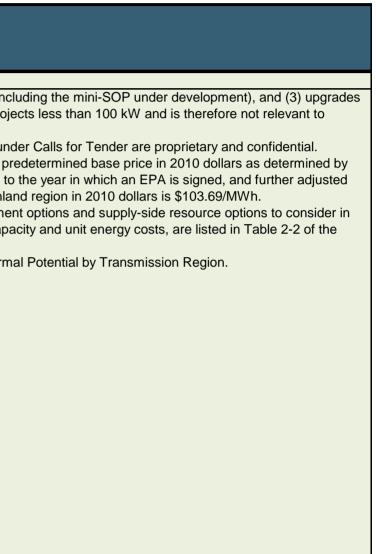
#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

urrent water licences applications within 5 km of existing existing energy/hydro power water licences within 5 km thin 5 km of existing geothermal point location with ter licences within 5 km buffer. xisting unpaved road.

Near Clearwater, British Columbia, Canada **Topographical Map Sheet: Figure 6** Geological Map Sheet: Figure 7

	Category					Comments	
<u>L.</u>	Finance General Power Prices	BC Hydro acquires power through ( to its existing facilities or the develo geothermal generation projects). Co • The power price paid by BC Hydro • The power price paid by BC Hydro the region of the point of interconne based upon the time of day and mo • BC Hydro's current Integrated Res meeting the future demand for elect November 2013 Resource Options • Table 5-7 of the above-noted Nove	e net metering p ach one are: gy Purchase Agr a under the SOP Consumer Price the base price f ails of both dema eir attributes of to for ready referen	eements (EPAs) und are made up of a pr Index annually up to for the Lower Mainla and-side management otal energy and capa nce.			
		Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)	
		Biomass – Wood Based	9,772	1,226	122 – 276	132 – 306	
		Biomass – Biogas	134	16	59 – 154	56 – 156	
		Biomass – Municipal Solid Waste	425	50	85 – 184	83 – 204	
		Wind – Onshore	46,165	4,271	90 - 309	115 – 365	
		Wind – Offshore	56,700	3,819	166 - 605	182 – 681	
		Geothermal	5,992	780	91 – 573	90 – 593	
		Run-of-River	24,543	1,149	97 – 493	143 – 1,170	
		Site C <sup>3</sup> Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	4,700 6,103	1,100 774	83 58 – 92	88 57 – 86	1
		Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103	
		Wave	2,506	259	440 – 772	453 - 820	
		Tidal	1,426	247	253 - 556	264 – 581	
		Solar	57	12	266 - 746	341 – 954	
		<ol> <li>Notes:</li> <li>The resources and UEC values s and may not include all possible</li> <li>The details of how the cost adjus</li> <li>The Site C values presented in th Impact Statement (EIS) submissi real discount rate.</li> <li>Representative projects were use the resource potential is general</li> </ol>	resources that may ters were developed his table are based of on filed in January 2 ed to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC e natural gas-fired a	xpected higher cos ovided in Appendix ded in the Site C Er is calculated assum	t. 12. nvironmental ning 5 per cent	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015



Near Clearwater, British Columbia, Canada **Topographical Map Sheet: Figure 6** Geological Map Sheet: Figure 7

Category							Comments
Market Price (\$/MWhr)	dollars rang • Wholesale unforeseen variety of sc market data average cos on the appro- • BC Hydro ready referen	es from \$9 electricity generation burces. One burces. One to partice to partice to priate tran forecasts o ence.	1/MWh to 5 prices for tra outages an e such sourc ular relevan rades). Acc smission sy	73/MWh at t ading purpos d ambient te ce is the US ce is the mic sess to that r stem (e.g. E ces under va	the point of ses can var emperatures Energy Info d-C trading market for g Bonneville P	interconnectio y greatly. In th s. A general flormation Admin hub in the Nor eothermal pro ower Authority	Options Report Update, the Unit Energy Cost for g on to the BC Hydro system. e Pacific Northwest, these prices are affected by lavour of the wholesale electricity prices for poten nistration (www.eia.gov/electricity/wholesale/#hist thwest Region (one example would be a Mid-C p ojects in BC would require access on both the BC y) in the US. vided in the November 2013 IRP. Table 5 in Appe
		Table	5 Electricit	y Price Forecasts b (Real 2012 US\$/MV			
	Market Scenario	1 Mid Electricity Mid GHG (Regional) Mid Gas	2 Low Electricity Low GHG (Regional) Low Gas	3 High Electricity High GHG (Regional) High Gas	4 Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	5 High Electricity High GHG (Regional/Nat'l) High Gas	
	2014	25.0	21.9	31.1	25.0	31.1	
	2015	25.5	21.7	31.9	25.5	31.9	
	2016	25.8 27.1	21.2 22.0	32.0 33.4	25.8 27.1	32.0 33.4	
	2017	27.1	22.0	33.9	27.1	33.9	
	2019	28.0	22.1	35.5	28.0	35.5	
	2020	28.0	21.9	36.0	28.0	36.0	
	2021	29.3	22.5	37.3	29.3	37.3	
	2022	30.1 31.8	22.7 23.2	38.8 41.7	30.9 35.5	41.3 52.1	
	2023 2024	33.0	23.2	41.7	41.8	68.6	
	2025	34.2	24.0	45.4	50.3	91.2	
	2026	34.9	24.1	46.7	52.2	95.1	
	2027	36.0	24.3	48.6	54.7	98.9	
	2028	36.3 37.2	24.0 23.9	50.2 51.1	56.8 58.8	101.8 106.1	
	2029	37.6	23.9	52.7	60.1	109.3	
	2031	38.6	24.0	54.7	62.6	112.0	
	2032	39.9	24.0	57.0	65.6	116.0	
	2033	41.5	24.4	60.1	69.3	122.0	
	2034	42.8	25.1	61.9	71.5	125.7	
	2035	44.6 45.7	26.2 26.9	64.5 66.2	74.5 76.4	131.0 134.3	
	2030	45.7	28.1	69.1	79.8	140.3	
	2038	48.4	28.4	70.0	80.8	142.1	
	2039	48.9	28.7	70.7	81.6	143.5	
	2040	49.3	29.0	71.4	82.4	144.9	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

geothermal resources at a 7% real discount rate in 2013

by such factors as precipitation/snowfall in the region, ential export of electricity from BC can be obtained from a istory). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted C Hydro transmission system to the Canada/US border, and

pendix 5A – Market Forecast Data is reproduced below for

Near Clearwater, British Columbia, Canada Topographical Map Sheet: Figure 6 Geological Map Sheet: Figure 7

Category					Comments	
Green Power Premium (\$/MWhr)	<ul> <li>Within British Co environmentally free California has a particularly "bund 1. The price of ele 2. There are large</li> </ul>	olumbia, there is iendly) from BC goal of 33% of re ed" green energ ectricity is driven amounts of ren	solar, in California; and			
Capacity Price (\$/KW)	<ul> <li>There is no price</li> <li>Table 3-27 entitle</li> <li>options (e.g. pum)</li> </ul>	<ul> <li>3. Firm transmission access to the California market through the BPA transmission system</li> <li>There is no price in \$/kW for capacity resource options in the market at present.</li> <li>Table 3-27 entitled "UCCs of Capacity Resource Supply Options" in BC Hydro's Integra options (e.g. pumped storage, simple cycle gas turbines and resource smart projects such the BC Hydro system in \$2013/kW-year are shown in the table.</li> </ul>				
		this Appendix 4	, the following	g words and e	pressions have the following meanings: Hours and Peak Hours.	
	inclusive, but exc	means the hours uding British Col lours" means the	s commencin lumbia statut e hours comr	ng at 06:00 PP ory holidays. mencing at 16:		
	inclusive, but exc (c) "Super-Peak H	means the hours uding British Col lours" means the Time of	s commencin lumbia statut e hours comr Delivery Facto	g at 06:00 PP ory holidays. mencing at 16: or (TDF)	Γ and ending at 16:00 PPT, and commencing at 20:00 PPT at 00 PPT and ending at 20:00 PPT Monday through Saturday in	
	inclusive, but exc (c) "Super-Peak H holidays." Month	means the hours uding British Col lours" means the Time of Super-Peak	s commencin lumbia statut e hours comr Delivery Facto Peak	g at 06:00 PP ory holidays. mencing at 16: or (TDF) Off-Peak		
	inclusive, but exc (c) "Super-Peak H holidays." Month January	means the hours uding British Col lours" means the Time of	s commencin lumbia statut e hours comr Delivery Facto	g at 06:00 PP ory holidays. mencing at 16: or (TDF)		
	inclusive, but exc (c) "Super-Peak H holidays." Month	means the hours uding British Col lours" means the <b>Time of</b> Super-Peak 141%	s commencin lumbia statut e hours comr Delivery Facto Peak 122%	g at 06:00 PP ory holidays. mencing at 16: or (TDF) Off-Peak 105%		
	inclusive, but exc (c) "Super-Peak H holidays." Month January February	Time of Super-Peak 141% 124%	s commencin lumbia statut e hours comr Delivery Facto Peak 122% 113%	g at 06:00 PP ory holidays. mencing at 16: or (TDF) Off-Peak 105% 101%		
	inclusive, but exc (c) "Super-Peak H holidays." Month January February March	Time of Super-Peak 141% 124%	s commencin lumbia statut e hours comr Delivery Facto Peak 122% 113% 112%	g at 06:00 PP ory holidays. mencing at 16: or (TDF) Off-Peak 105% 101% 99%		
	inclusive, but exc (c) "Super-Peak H holidays." Month January February March April	Time of Super-Peak 141% 124% 104%	s commencin lumbia statut e hours comr Delivery Facto Peak 122% 113% 112% 95%	g at 06:00 PP ory holidays. mencing at 16: or (TDF) Off-Peak 105% 101% 99% 85%		
	inclusive, but exc (c) "Super-Peak H holidays." Month January February March April May	Time of Super-Peak 141% 124% 104% 90%	s commencin lumbia statut e hours comr Delivery Facto Peak 122% 113% 112% 95% 82%	g at 06:00 PP ory holidays. mencing at 16: or (TDF) Off-Peak 105% 101% 99% 85% 70%		
	inclusive, but exc (c) "Super-Peak H holidays." Month January February March April May June	Time of Super-Peak 141% 124% 124% 90% 87%	s commencin lumbia statut e hours com Delivery Facto Peak 122% 113% 112% 95% 82% 81%	g at 06:00 PP ory holidays. mencing at 16: or (TDF) Off-Peak 105% 101% 99% 85% 70% 69%		
	inclusive, but exc (c) "Super-Peak H holidays." Month January February March April May June July	means the hours uding British Col lours" means the Super-Peak 141% 124% 124% 104% 90% 87% 105%	s commencin lumbia statut e hours comr Delivery Facto Peak 122% 113% 112% 95% 82% 81% 96%	g at 06:00 PP ory holidays. mencing at 16: or (TDF) 0ff-Peak 105% 101% 99% 85% 70% 69% 79%		
	inclusive, but exc (c) "Super-Peak H holidays." Month January February March April May June July August	Time of Super-Peak 141% 124% 124% 104% 90% 87% 105% 110%	s commencin lumbia statut e hours com Peak 122% 113% 112% 95% 82% 81% 96% 101%	g at 06:00 PP ory holidays. mencing at 16: or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 70% 69% 86%		
	inclusive, but exc (c) "Super-Peak H holidays." Month January February March April May June July August September	means the hours uding British Col lours" means the Super-Peak 141% 124% 124% 104% 90% 87% 105% 110% 116%	s commencin lumbia statut e hours comr Delivery Facto Peak 122% 113% 112% 95% 82% 81% 96% 101% 107%	g at 06:00 PP ory holidays. mencing at 16: or (TDF) 0ff-Peak 105% 101% 99% 85% 70% 69% 79% 86% 91%		

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

premium for green power. er can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

nber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

inclusive, but excluding British Columbia statutory

Near Clearwater, British Columbia, Canada Topographical Map Sheet: Figure 6 Geological Map Sheet: Figure 7

Category	Comments
Estimated Size of Resource Is there any green power incentives?	<ul> <li>See Section A.</li> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program expanded to include a broad range of energy efficiency and conservation projects.</li> </ul>
	<ul> <li>Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p o Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project development o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include: <ul> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Sustainable Development Technology Canada funds;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> <li>Green Infrastructure Fund</li> </ul> </li> </ul>
Grants	See above under green power incentives
Tax Holidays	None listed on federal and provincial websites.
Tax Relief	<ul> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 43 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 22 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred duri and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the year deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now n entitled Scientific Research and Experimental ity and relevance.
<pre>/ participation in the clean energy sector. It provides: ent; and</pre>
these programs may be active but not currently issuing al technologies/resources, while others may be fully
ity and relevance.
ce energy by using renewable energy sources or fuels from

43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 sets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy year they are incurred, carried forward indefinitely and

Near Clearwater, British Columbia, Canada **Topographical Map Sheet: Figure 6** Geological Map Sheet: Figure 7

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly. The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities.
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> <li>FNFA loans do not require collateral;</li> </ol>
	<ol> <li>4. FNFA loans can be used to refinance existing debt; and</li> <li>5. FNFA's interest rates and terms parallel those available to provincial and local governments.</li> </ol>
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infra purchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Bor and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015 Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribe
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section,
	(b) an amount agreed under this section to be paid instead of royalty, or
General Idea of Royalties	(c) if no royalty or amount has been agreed under this section, the prescribed royalty. With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "This paction 1 (4) Idefinitional of the Casthormal Bacaurage Act."
Private Land Owner or Government Land	in section 1 (1) [definitions] of the Geothermal Resources Act." Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners f Proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg Stat
Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincia</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. es that join as Borrowing Members.

astructure, social and economic development, land

orrowing Members, represented by the First Nation's Chief

ed rent for the permit (Section 5).

pay to the government

his Act does not apply to geothermal resources as defined

for the geothermal land tract. atutory Right of Way, Licence of Occupation). ial (British Columbia): 13.5%.

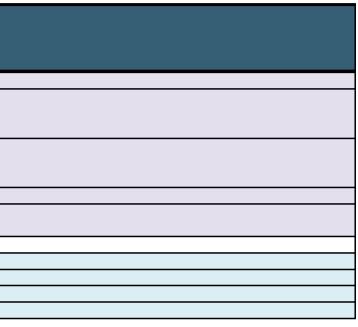
ta, the US, or other wholesale customers in BC, the nission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power ne economic viability of the potential wholesale opportunity.

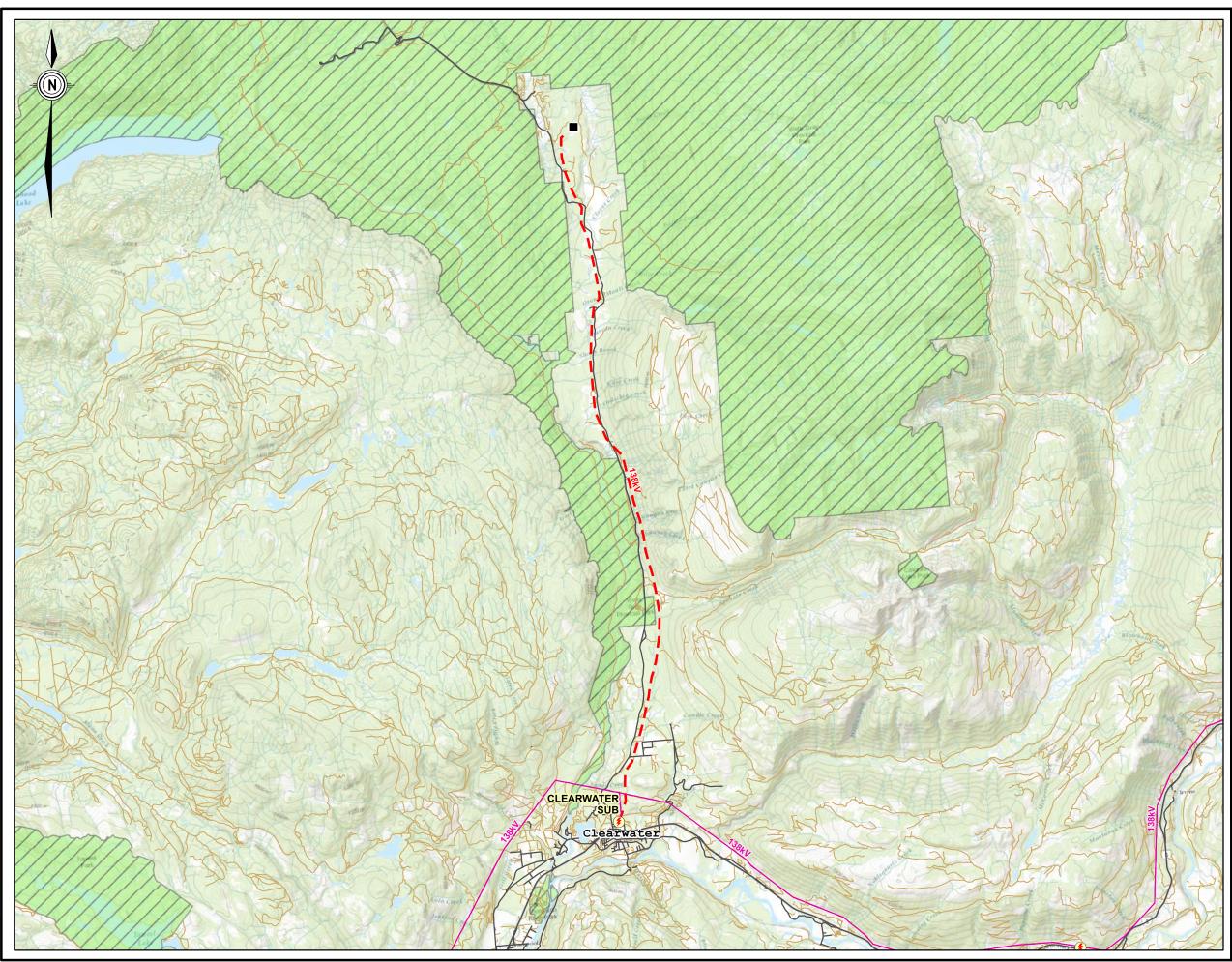
### CLEARWATER VOLCANIC

Near Clearwater, British Columbia, Canada Topographical Map Sheet: Figure 6 Geological Map Sheet: Figure 7

	Category	Comments
N	M. Maps	
	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)	
	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 6
	Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 7
	Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 7
N	N. Other Issues and Considerations	

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015







## Legend

 $\overline{}$ 

	Proposed Geothermal Plant Location
	Proposed Transmission Line
۶	Existing Substation
	Existing Transmission Line
$\sim$	Paved Road
$\sim$	Other Road

Park, Eco-Reserve, Protected Area



KERR WOOD LEIDAL consulting engineers

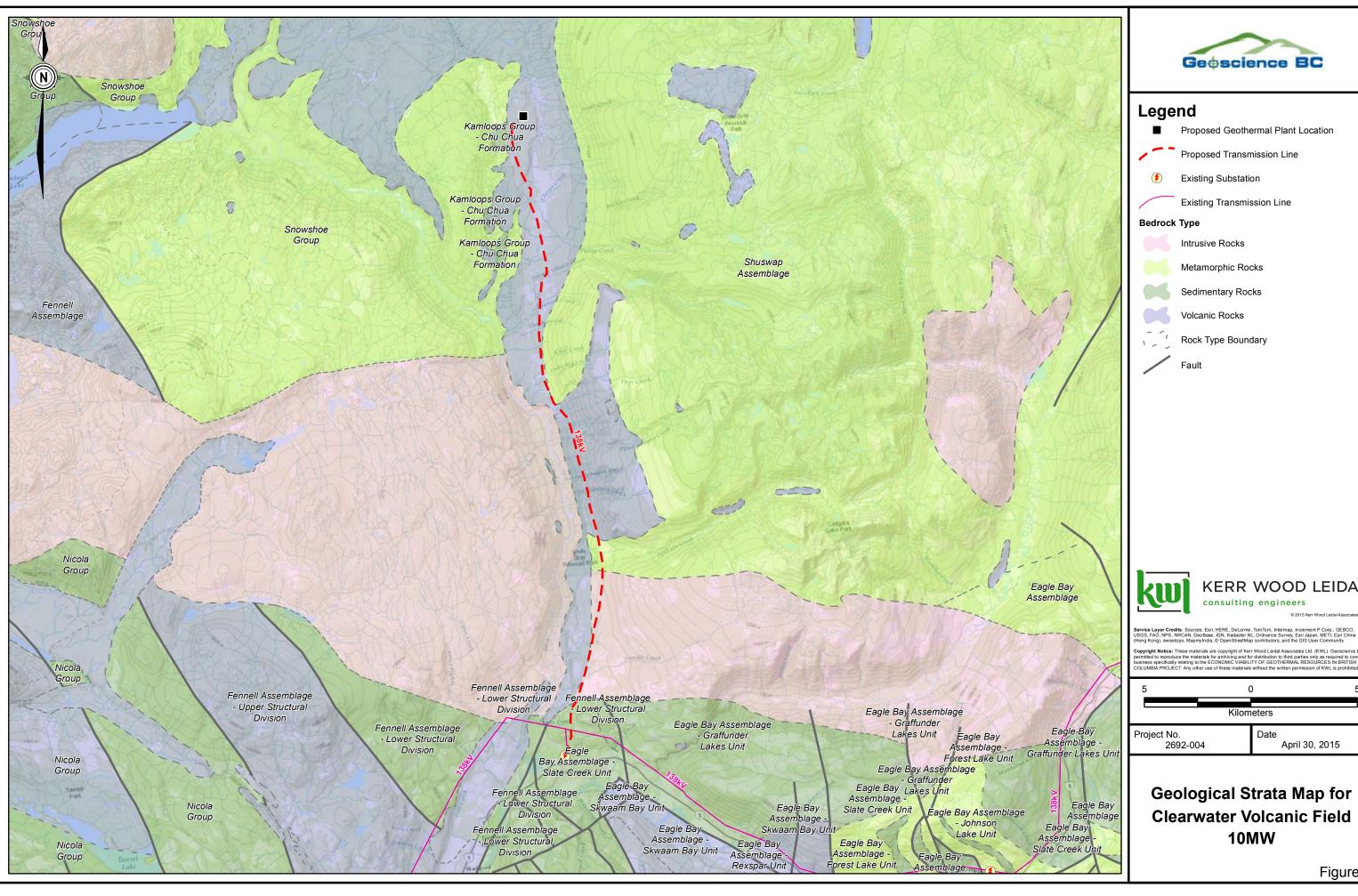
rvice Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, Increment P Corp., GEBCO, GGS, FAO, NPS, NRCAN, GeoBase, GN, Kadaster NL, Ordnance Survey, Esri Japan, METT, Esri China ong Kong), swissipo, MagmyIndia, © OpenStreetMap Contributors, and the GIS User Community

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4	(	) 4	
	Kilom	ieters	
Project No. 2692-004		Date April 30, 2015	

## Potential Geothermal Plant at Clearwater Volcanic Field 10MW

Figure 6



KERR WOOD LEIDAL

urces: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, I, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri Chin

# **Geological Strata Map for Clearwater Volcanic Field**

Figure 7

5



Appendix E

# Iskut Geothermal Development Decision Matrix and Figures 8 & 9

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Near Iskut, British Columbia, Canada **Topographical Map Sheet: Figure 8** Geological Map Sheet: Figure 9

	Category	Comments
Re	eservoir Potential	
Siz	ze/Potential/Type	<ul> <li>Reservoir size: N/A (no area or depth defined in literature) - therefore, reservoir volume estimated* at: 2.2 km<sup>3</sup> (most-lik assumptions made using Appendix III in GeothermEx, 2004)</li> <li>Potential: Assume 10 MW, compatible with generic reservoir volume (above) in vicinity of single spring, for reservoir ten</li> <li>Type: unknown, likely binary</li> </ul>
Te	emperature/Water and Gas Chemistry/Mineral Indicators	Surface features: • Extremely hot water (noted on various online hot spring sites as "too hot" to bathe in unless mixed with cold river water) so the Iskut River at Iskut River Hot Springs Provincial Park (park covers an area of 4 hectares). This "bathing water" criterio 45°C. Geothermometry: • None available Exploration drilling: • None known
		Water chemistry: • None available Mineral indicators: • No information
Su	urface Flow Rates and Reservoir Recharge	No information. Water percolates from a cliff face and runs directly into the fast flowing Iskut River - no pooling of water.
3D	D Permeability (heat exchange potential)	Unknown
Re	ecent Magmatism	Most recent Miocene volcanism in the Spectrum Range ~ 40 km NW of the springs (Souther, 1992). Eocene plutonic rocl spring (Alldrick, 2006).
Sti	ructural Setting	<ul> <li>Major structures in the hot spring area include the NW-SE-trending left-lateral Northmore Fault as it intersects a major Northeast and appears to be related to a string of small plutons (Alldrick et al., 2003).</li> <li>Locally, several N-S, NE-SW and NW-SE left-lateral faults are mapped in the vicinity. Iskut River Hot Spring is located n River valley and a set of NE-SW trending faults that splay off to the southwest cutting the Triassic Stuhini Group volcanics and Jurassic Lower Hazelton Group to the northwest of the spring faults are mapped.</li> </ul>
Ge	eophysics	None available
Re	eservoir Host Rock	Uncertain
Dr	illing Issues	Access to the park is very limited. Foot access is difficult and there is no developed trail. Helicopter and boat access are p available for bathing. Iskut River Hot Springs Park lies within the asserted traditional territory of the Tahltan First Nation.
	ief Description of Geological Setting of Thermal Features (i.e., brings emanate from fluvial gravels; beside a river, etc.)	<ul> <li>The Cenozoic Stikine Volcanic Belt is considered to be the most recently active of the volcanic belts in British Columbia, been basaltic in nature. The volcanic activity is likely the result of extensional fracturing (Piteau and Associates, 1988).</li> <li>The Iskut River valley is bounded to the east by the Bowser sedimentary basin (Alldrick et al., 2003).</li> <li>Iskut River Hot Spring is located ~20 km to the SW of Hankin Peak, which is composed of Mesozoic sedimentary and plu (Souther, 1992).</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ikely area: 2 km<sup>2</sup>; most-likely thickness: 1.1 km) (\*Reservoir

emperatures in range of 150°C to 200°C.

seeps out of a rocky embankment along the west bank of ion implies a surface discharge temperature of at least

cks outcropping ~1 km to the SW - possibly underlying the

N-S-trending fault. The Northmore Fault has significant

near the apparent intersection of a N-S fault along Iskut s and the Eocene Hyder Plutonic Suite. Additional NW-SEpring possibly intersect in this area as well (Alldrick, 2006).

possible. Several springs are present but no pools are (CanGEA, 2015)

, and most of the recent volcanism in the Stikine Belt has

olutonic rocks at the southern end of the Edziza Complex

### ISKUT

Near Iskut, British Columbia, Canada Topographical Map Sheet: Figure 8 Geological Map Sheet: Figure 9

	Category	Comments
В.	Exploration Uncertainty (Risk)	
	Degree of Identification of Resources/Reserves	Low Geologic mapping has been done; no known geophysical or geochemical studies have been conducted. No drilling in area
	Likelihood of Covering Reservoir with Concession	Moderate The spring itself lies within a provincial park. There is potential to have a concession that spans the resource if suitable ten outside the small park area. Potential competition with mineral tracts if resource lies to the east of the river.
	Expected Authorization Date	Unknown
	Specific Timing of Exploration (2 + 2 years, BC 8 years, etc.)	5-6 years (1 year deep gradient-well drilling + 2 year successful development drilling and testing + 1 year further development drilling finish plant construction). Possible delays due to issues of access and competing use (mining and park land).
	Degree of Previous Exploration (can be good or bad)	Low Geologic mapping comprises the only known exploration in the area.
	Surface Operational Capacity (enough stable area for drilling and a plant?)	Likely Area has very little infrastructure. Any work would involve construction of roads and clearing areas for well pads/drilling. An
		Difficult Little resource information, compounded by difficult access. Area only accessible by Galore Creek Mine Road.
	Environmental Issues	
	Protected Areas	<ul> <li>Iskut River Hot Springs Provincial Park located 2.6 km north of proposed plant location. Iskut River Hot Springs Park prot</li> </ul>
	Fiblected Areas	<ul> <li>Iskut River not Springs Provincial Park located 2.6 km north of proposed plant location. Iskut River not Springs Park plot where extremely hot water weeps out of a rocky embankment. Several springs are present but no pools are available for b</li> <li>Mount Edziza Provincial Park located 42 km north of proposed transmission line.</li> </ul>
	Endangered Species	<ul> <li>Snow Pearlwort (blue-listed plant) occurrence polygon located approx. 50 m of proposed transmission line.</li> <li>Northern Mountain Caribou (Endangered (SARA Schedule 1); red-listed) habitat polygon located approx. 110 km northea</li> </ul>
	Geothermal Surface Features	<ul> <li>Iskut Hotsprings (surface feature) located at the site.</li> <li>Mess Creek Hotsprings is approx. 50-60 km west of the Iskut site.</li> </ul>
	Other	<ul> <li>Proposed transmission line crosses approximately 10 streams.</li> <li>Stream crossings that contain observed fish include Devil Creek that contains Rainbow Trout and More Creek which con</li> <li>Proposed transmission line runs through Cassiar Proposed Wildlife Habitat Area allotted for Grizzly Bear.</li> </ul>
	Geothermal Area - Bidding and/or Type of Land Holding (private/government/lease/etc.)	
	Bidding Area	No known existing active, cancelled or unsold geothermal title tracts
1	Other Claim Rights (mining and/or oil)	No existing mineral, coal titles in vicinity. Proposed location is not within known oil and gas management area; no known te

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ea known.

emperature and permeability can be discovered to be

ng and start plant construction + 1 year drilling wrap-up and

Area for surface operations would need to be assessed.

otects a small area on the west bank of the Iskut River bathing.

east of proposed plant.

ontains Dolly Varden.

tenures at proposed location.

Near Iskut, British Columbia, Canada **Topographical Map Sheet: Figure 8 Geological Map Sheet: Figure 9** 

	Category	Comments
E.	Market	
	Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through to Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propone standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW b against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponer threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply realistically apply to potential geothermal generation projects).</li> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pa program has no applicability to potential geothermal generation projects.</li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificati snow melt and stream flow.</li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project I BC Hydro through BC Hydro's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>Wholesale wheeling (whereby electricity is transmitted from electricity generation sizes, alfects the economic via Authority for wheeling to a US customer). This 'pancaking' of rates, along with congestion issues, alfects the economic via the rates charged under that tariff.</li> <li>To supplace the electricity supplied at a high voltage from BC Hydro industrial facility directly from a geothermal properties for laterata arrangements to large customers?</li> <li>Retali access, defined as a market</li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

- nents can bid into those competitive calls.
- but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not
- ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this
- tion of BC Hydro's resource mix, making it less reliant on
- en FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to
- he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.
- ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given
- ant located in close proximity to the facility, thereby
- sment phase. The potential operations are located
- Galore Creek access road). However, the location is over
- km from the geothermal site. The gold/copper project

### ISKUT

Near Iskut, British Columbia, Canada **Topographical Map Sheet: Figure 8** Geological Map Sheet: Figure 9

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation.</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical and considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to sever Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will generative projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
_		
F.	Transmission Line Infrastructure	
	State of the Infrastructure	Existing 287 kV line to Bob Quinn substation.
	Transmission Route (distance, terrain and costs)	New powerline 69 kV line to existing Bob Quinn substation (need to add 69 to 287 kV transformation. Powerline approx. 2 Creek Mine Road.
Н.	Community Issues	
	Indigenous Law and Indigenous Development Areas	First Nation Consultative Areas include Tahltan Indian Band, Iskut Band, Tahltan Central Council.
		<ul> <li>Proposed plant location is within Tahltan territory. (http://www.tahltan.org/welcome)</li> </ul>
		• Tahltan Nation plan is in development (started 2011); broad issues that have been identified include better community inf
		managing social-culture growth. (http://www.tahltan.org/news/tahltan-nation-plan-community-vision-our-future)
		Iskut Band Council (http://iskut.org/) does not provide any specific community/environmental planning agendas
	Community Action	• Tahltan Heritage Resources Environmental Assessment Team (THREAT) established in 2005 to support protection of the
		interests. (http://www.tahltan.org/administration/threat)
		<ul> <li>2005 community action stopped Shell Canada test well activities</li> </ul>
		Tahltan activists block Red Chris Mine site in 2014
	Surface Rights	<ul> <li>First Nation Consultative Areas include Tahltan Indian Band, Iskut Band, Tahltan Central Council.</li> </ul>
		• Tahltan Nation Development Council is business council owned by the people of Tahltan Iskut bands and ensures First N
		within Tahltan territory. (http://www.tahltan.org/nation/economy/economic-development)
	Tourism	Bob Quinn Lake Airport is near proposed project location.
		Schoquette Hot Springs is near Stikine, BC.
		• Proposed project location is remote; no significant infrastructure in within extents of project, although Bob Quinn Lake is a

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ion output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission ven years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

25 km via existing transmission line corridor and Galore

nfrastructure (particularly Bob Quinn and Dease Lake),

the environmental, social, cultural, heritage and economic

Nation consultation, involvement in economic ventures

a recreational outdoors park.

### ISKUT

Near Iskut, British Columbia, Canada Topographical Map Sheet: Figure 8 Geological Map Sheet: Figure 9

	Category	Comments
I	Water Rights	
	Availability (for example "air-cooled required")	Plant water requirement estimated approx. 13 L/s for binary plant. MAD of 89000 L/s in closest stream. Very few water lice
		Lake 2L/s for purpose of Ministry of Transportation and Infrastructure.
	Availability for Drilling	Drilling requirement of 20 L/s. MAD of 89000 L/s in closest stream. Very few water licences in area; only active water licen
		Transportation and Infrastructure.
	. Engineering	
	Plant Location and Design	Remote plant location, on flats west of Highway 37. Proposed plant location is in close proximity to several creeks and lak
	Construction Issues	Generally flat terrain accessible via existing mining roads.
	Transportation Issues	Access via the Galore Creek mine road. Several creek crossings, remote access.
	Architectural Issues (Blend/hide into environment? Local styles?	None found.
	etc.)	
	Special Construction Issues (zero emissions)	None found.
ł	K. Non-Electrical Infrastructure (Roads and Habitation)	
	Nearest Large Community > 50,000	Prince George, BC
	Nearest Community	Iskut, BC (approx. 100 km)
	Nearest Road and Condition	Galore Creek Mine Road; road condition is unknown.
	Current Access Conditions (restrictions)	Remote access via mining roads.
	Terrain and Distance Factor for Road Building	No new road requirements expected contingent on location and condition of existing Galore Creek Mine Road.

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

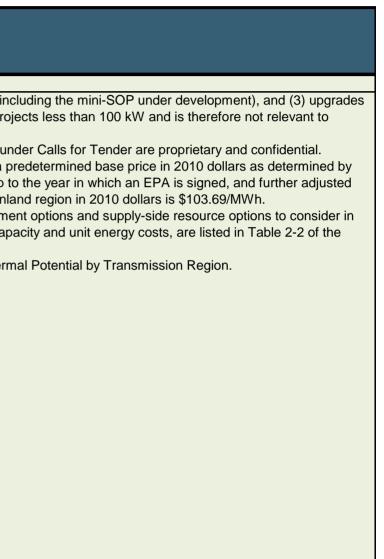
licences in area; only active water licence at Bob Quinn
ence at Bob Quinn Lake 2L/s for purpose of Ministry of
ikes.

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

### ISKUT

Near Iskut, British Columbia, Canada Topographical Map Sheet: Figure 8 Geological Map Sheet: Figure 9

	Category					Comments	
<u>L.</u>	Finance General Power Prices	BC Hydro acquires power through to its existing facilities or the develo geothermal generation projects). C • The power price paid by BC Hydro • The power price paid by BC Hydro the region of the point of interconne based upon the time of day and mo • BC Hydro's current Integrated Re meeting the future demand for elect November 2013 Resource Options • Table 5-7 of the above-noted Nov	opment of new g omments on the o to independent o to independent ection to the BC onth when the e source Plan dat ctricity. These re Report Update	eneration faciliti e general price of t power produce t power produce Hydro system, energy is delivere ed November 20 esource options, That table is re	es. (Note that the f power under every through Energy ers through EPA escalated at the d. For reference 013 includes det together with the produced below	he net metering ach one are: rgy Purchase Ag s under the SOF Consumer Price a, the base price tails of both dem neir attributes of v for ready refere	program targets proj reements (EPAs) un P are made up of a p e Index annually up to for the Lower Mainla and-side management total energy and cap ence.
		Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)	
		Biomass – Wood Based	9,772	1,226	122 - 276	132 - 306	
		Biomass – Biogas	134	16	59 – 154	56 – 156	
		Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204	
		Wind – Onshore	46,165	4,271	90 - 309	115 – 365	
		Wind – Offshore	56,700	3,819	166 - 605	182 – 681	
		Geothermal	5,992	780	91 – 573	90 - 593	
		Run-of-River	24,543	1,149	97 – 493	143 – 1,170	
		Site C <sup>3</sup> Combined Cycle Gas Turbine and	4,700 6,103	1,100 774	83 58 – 92	88 57 – 86	
		Cogeneration <sup>4</sup> Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103	
		Wave	2,506	259	440 - 772	453 - 820	
		Tidal	1,426	247	253 - 556	264 - 581	
		Solar	57	12	266 - 746	341 – 954	
		<ol> <li>Notes:</li> <li>The resources and UEC values si and may not include all possible r</li> <li>The details of how the cost adjust</li> <li>The Site C values presented in th Impact Statement (EIS) submission real discount rate.</li> <li>Representative projects were use the resource potential is generally</li> </ol>	esources that may ters were developed is table are based on filed in January 2 id to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC e natural gas-fired a	expected higher cos rovided in Appendix ded in the Site C Er is calculated assum	t. 12. nvironmental ning 5 per cent	



Near Iskut, British Columbia, Canada **Topographical Map Sheet: Figure 8** Geological Map Sheet: Figure 9

Category							Comments
Market Price (\$/MWhr)	dollars rat • Wholesa unforeseevariety of market da average of on the ap • BC Hydr ready refe	nges from \$91/ ngeneration of sources. One sta. Of particul ost from 72 tra propriate transporter transporter of forecasts of rence.	MWh to 573/I ices for tradir utages and an such source is ar relevance i des). Access mission system market prices	WWh at the p ag purposes of mbient tempe is the US Ener is the mid-C tr is to that mark in (e.g. Bonne under variou	oint of interco can vary great gratures. A ge rgy Informatio rading hub in et for geother eville Power A s scenarios v	onnection to the tly. In the Pacific eneral flavour of an Administration the Northwest rmal projects in Authority) in the	Report Update, the Unit Energy Cost for g e BC Hydro system. fic Northwest, these prices are affected by of the wholesale electricity prices for poter on (www.eia.gov/electricity/wholesale/#his t Region (one example would be a Mid-C p n BC would require access on both the BC e US. n the November 2013 IRP. Table 5 in Appe
		Tab	Scenario	ty Price Forecasts (Real 2012 US\$/M	by Market Wh at Mid-C)		
		rket Mid Electricit Mid GHG (Regional) Mid Gas	2 Low Electricity Low GHG (Regional) Low Gas	3 High Electricity High GHG (Regional) High Gas	4 Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	5 High Electricity High GHG (Regional/Nat'I) High Gas	
	20	14 25.0	21.9	31.1	25.0	31.1	
		15 25.5	21.7	31.9	25.5	31.9	
		16 25.8	21.2	32.0	25.8	32.0	
		17 27.1 18 27.1	22.0 21.7	33.4 33.9	27.1 27.1	33.4 33.9	
		19 28.0	21.7	35.5	28.0	35.5	
		20 28.0	21.9	36.0	28.0	36.0	
	20	21 29.3	22.5	37.3	29.3	37.3	
	20	22 30.1	22.7	38.8	30.9	41.3	
	I –	23 31.8	23.2	41.7	35.5	52.1	
		24 33.0	23.7	43.4	41.8	68.6	
		25 34.2 26 34.9	24.0 24.1	45.4 46.7	50.3	91.2	
		26 34.9 27 36.0	24.1	48.6	52.2 54.7	95.1 98.9	
		28 36.3	24.0	50.2	56.8	101.8	
	. –	29 37.2	23.9	51.1	58.8	106.1	
	20	30 37.6	23.8	52.7	60.1	109.3	
	20	31 38.6	24.0	54.7	62.6	112.0	
		32 39.9	24.0	57.0	65.6	116.0	
		33 41.5	24.4	60.1	69.3	122.0	
		34 42.8	25.1	61.9	71.5	125.7	
		35 44.6 36 45.7	26.2 26.9	64.5 66.2	74.5 76.4	131.0 134.3	
	I –	37 47.8	28.1	69.1	79.8	140.3	
		38 48.4	28.4	70.0	80.8	142.1	
		39 48.9	28.7	70.7	81.6	143.5	
	20	40 49.3	29.0	71.4	82.4	144.9	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

geothermal resources at a 7% real discount rate in 2013

by such factors as precipitation/snowfall in the region, ential export of electricity from BC can be obtained from a history). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted C Hydro transmission system to the Canada/US border, and

ppendix 5A – Market Forecast Data is reproduced below for

Near Iskut, British Columbia, Canada **Topographical Map Sheet: Figure 8** Geological Map Sheet: Figure 9

Category					Comments			
Green Power Premium (\$/MWhr)	<ul> <li>Within British Co environmentally fri</li> <li>California has a g particularly "bundle 1. The price of ele 2. There are large</li> </ul>	lumbia, there is endly) from BC I goal of 33% of re ed" green energy ctricity is driven I amounts of rene	ittle demand Hydro. BC Hy tail sales by with Renew by the low co wables, suc	for the purcha ydro's generati 2020 to be source able Energy C ost of natural ga h as wind and	solar, in California; and			
Capacity Price (\$/KW)	There is no price     Table 3-27 entitle     options (e.g. pump	<ul> <li>3. Firm transmission access to the California market through the BPA transmission system is generally not available.</li> <li>There is no price in \$/kW for capacity resource options in the market at present.</li> <li>Table 3-27 entitled "UCCs of Capacity Resource Supply Options" in BC Hydro's Integrated Resource Plan dated Nove options (e.g. pumped storage, simple cycle gas turbines and resource smart projects such as Revelstoke Unit 6). The u the BC Hydro system in \$2013/kW-year are shown in the table.</li> </ul>						
	(a) "Off-Peak Hou	<ul> <li>the following excerpt is taken from BC Hydro's SOP:</li> <li>"1. Definitions: In this Appendix 4, the following words and expressions have the following meanings:</li> <li>(a) "Off-Peak Hours" means all hours other than Super-Peak Hours and Peak Hours.</li> <li>(b) "Peak Hours" means the hours commencing at 06:00 PPT and ending at 16:00 PPT, and commencing at 20:00 inclusive, but excluding British Columbia statutory holidays.</li> <li>(c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20:00 PPT Monday through Satholidays."</li> </ul>						
	inclusive, but exclu (c) "Super-Peak H	uding British Colo ours" means the	umbia statuto hours comn	bry holidays. nencing at 16:0				
	inclusive, but exclu (c) "Super-Peak H	uding British Colo ours" means the Time of	umbia statuto hours comn Delivery Fact	ory holidays. nencing at 16:0				
	inclusive, but exclu (c) "Super-Peak H holidays." Month	uding British Colu ours" means the Time of Super-Peak	umbia statuto hours comn Delivery Fact Peak	ory holidays. nencing at 16:0 or (TDF) Off-Peak				
	inclusive, but exclu (c) "Super-Peak H holidays." Month January	uding British Colo ours" means the Time of	umbia statuto hours comn Delivery Fact	ory holidays. nencing at 16:0				
	inclusive, but exclu (c) "Super-Peak H holidays." Month	Time of Super-Peak	umbia statuto hours comn Delivery Facto Peak 122%	or (TDF) Off-Peak				
	inclusive, but exclu (c) "Super-Peak H holidays." Month January February	Time of Super-Peak 141% 124%	Delivery Fact Peak 122% 113%	ory holidays. nencing at 16:0 or (TDF) Off-Peak 105% 101%				
	inclusive, but exclu (c) "Super-Peak H holidays." Month January February March	Time of Super-Peak 141% 124%	Delivery Fact Peak 122% 113% 112%	or (TDF) Off-Peak 105% 101% 99%				
	inclusive, but exclu (c) "Super-Peak H holidays." Month January February March April	Time of Super-Peak 141% 124% 104%	Delivery Fact Peak 122% 113% 95%	ory holidays. nencing at 16:0 or (TDF) Off-Peak 105% 101% 99% 85%				
	inclusive, but exclu (c) "Super-Peak H holidays." Month January February March April May	Time of Super-Peak 141% 124% 104% 90%	Delivery Fact Peak 122% 113% 112% 95% 82%	or (TDF) Off-Peak 105% 101% 99% 85% 70%				
	inclusive, but exclu (c) "Super-Peak H holidays." Month January February March April May June	Time of Super-Peak 141% 124% 104% 90% 87%	Delivery Fact Peak 122% 113% 112% 95% 82% 81%	Ory holidays.           nencing at 16:0           Or (TDF)           Off-Peak           105%           101%           99%           85%           70%           69%				
	inclusive, but exclu (c) "Super-Peak H holidays." Month January February March April May June July	Iding British Coluours" means the           Time of           Super-Peak           141%           124%           104%           90%           87%           105%	Umbia statute hours comm Delivery Fact Peak 122% 113% 112% 95% 82% 81% 96%	Ory holidays.           nencing at 16:0           Off-Peak           105%           101%           99%           85%           70%           69%           79%				
	inclusive, but exclu (c) "Super-Peak H holidays." Month January February March April May June July August	Iding British Coluct           Time of           Super-Peak           141%           124%           104%           90%           87%           105%           110%	umbia statuto hours comm Delivery Fact Peak 122% 113% 112% 95% 82% 81% 96% 101%	Ory holidays.           nencing at 16:0           Off-Peak           105%           101%           99%           85%           70%           69%           79%           86%				
	inclusive, but exclu (c) "Super-Peak H holidays." Month January February March April May June July August September	Iding British Coluours" means the           Time of           Super-Peak           141%           124%           124%           104%           90%           87%           105%           110%           116%	umbia statute hours comm Delivery Fact Peak 122% 113% 112% 95% 82% 81% 96% 101% 107%	Ory holidays.           nencing at 16:0           Off-Peak           105%           101%           99%           85%           70%           69%           79%           86%           91%				

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

premium for green power. her can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

mber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

inclusive, but excluding British Columbia statutory

Near Iskut, British Columbia, Canada Topographical Map Sheet: Figure 8 Geological Map Sheet: Figure 9

Category	Comments
Estimated Size of Resource Is there any green power incentives?	<ul> <li>See Section A.</li> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community procapacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project development o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include: <ul> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> <li>Green Infrastructure Fund</li> </ul> </li> <li>Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability</li> </ul>
Grants Tax Holidays Tax Relief	<ul> <li>See above under green power incentives</li> <li>None listed on federal and provincial websites.</li> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 4 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred dur and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the ye deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now n entitled Scientific Research and Experimental ity and relevance.
<pre>/ participation in the clean energy sector. It provides: ent; and</pre>
these programs may be active but not currently issuing al technologies/resources, while others may be fully
ity and relevance.
ce energy by using renewable energy sources or fuels from 43.1, eligible equipment may be written-off at 30 percent

y 22, 2005 and before year 2020 may be written-off at 50 sets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy year they are incurred, carried forward indefinitely and

Near Iskut, British Columbia, Canada Topographical Map Sheet: Figure 8 Geological Map Sheet: Figure 9

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/ "The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities t The advantages of joining the FNFA as a Borrowing Member are: 1. Access to low rate, below bank prime, loans with repayment terms up to 30 years; 2. First Nations choose the repayment terms that work best for their budget; 3. FNFA loans do not require collateral; 4. FNFA loans can be used to refinance existing debt; and 5. FNFA's interest rates and terms parallel those available to provincial and local governments. Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infras purchases, independent power projects, community housing and rolling stock/heavy equipment. FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Borr and Council appointee. The FNFA is for First Nations, by First Nations."

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. s that join as Borrowing Members.

astructure, social and economic development, land

orrowing Members, represented by the First Nation's Chief

Near Iskut, British Columbia, Canada **Topographical Map Sheet: Figure 8** Geological Map Sheet: Figure 9

Category	Comments
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015 Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribed
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section,
	(b) an amount agreed under this section to be paid instead of royalty, or
	(c) if no royalty or amount has been agreed under this section, the prescribed royalty.
General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "Thi
	in section 1 (1) [definitions] of the Geothermal Resources Act."
Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners for proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg State
Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincial</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	<ul> <li>Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Albert generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission acc Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the</li> <li>Tariff Supplement 37, approved by the BC Utilities commission on April 10, 2013, sets out the contributions from future c and mine developments that will connect to the Northwest Transmission Line (NTL). This contribution, in general terms, ec intended to offset the ratepayer contributions for the cost of building NTL.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ed rent for the permit (Section 5).

pay to the government

his Act does not apply to geothermal resources as defined

for the geothermal land tract. atutory Right of Way, Licence of Occupation). al (British Columbia): 13.5%.

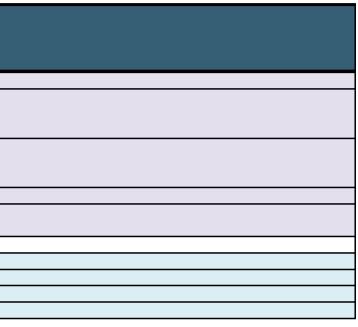
rta, the US, or other wholesale customers in BC, the ission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power e economic viability of the potential wholesale opportunity. clean, renewable energy projects (such as geothermal) equates to about \$10/MWh. These contributions are

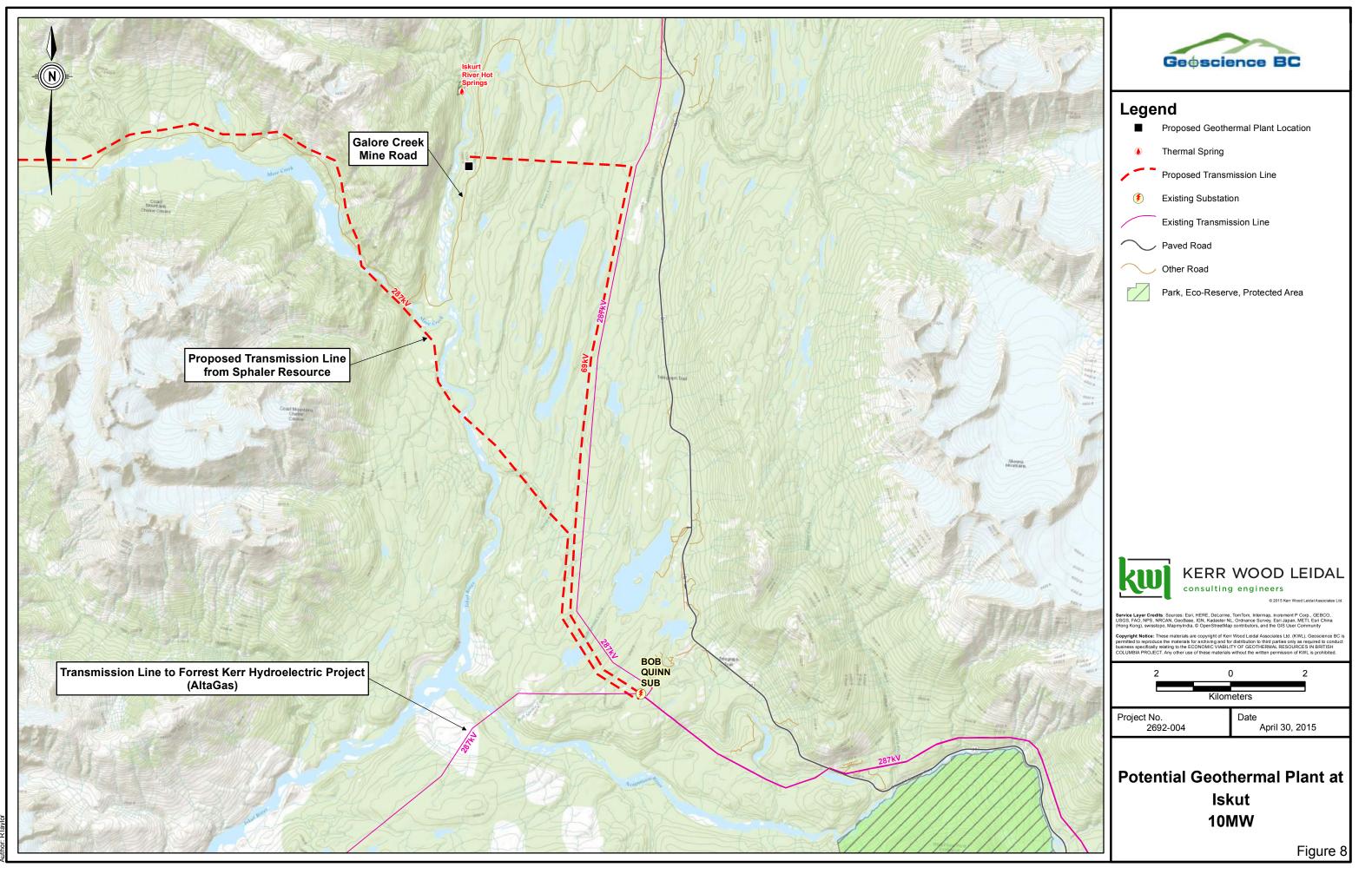
### ISKUT

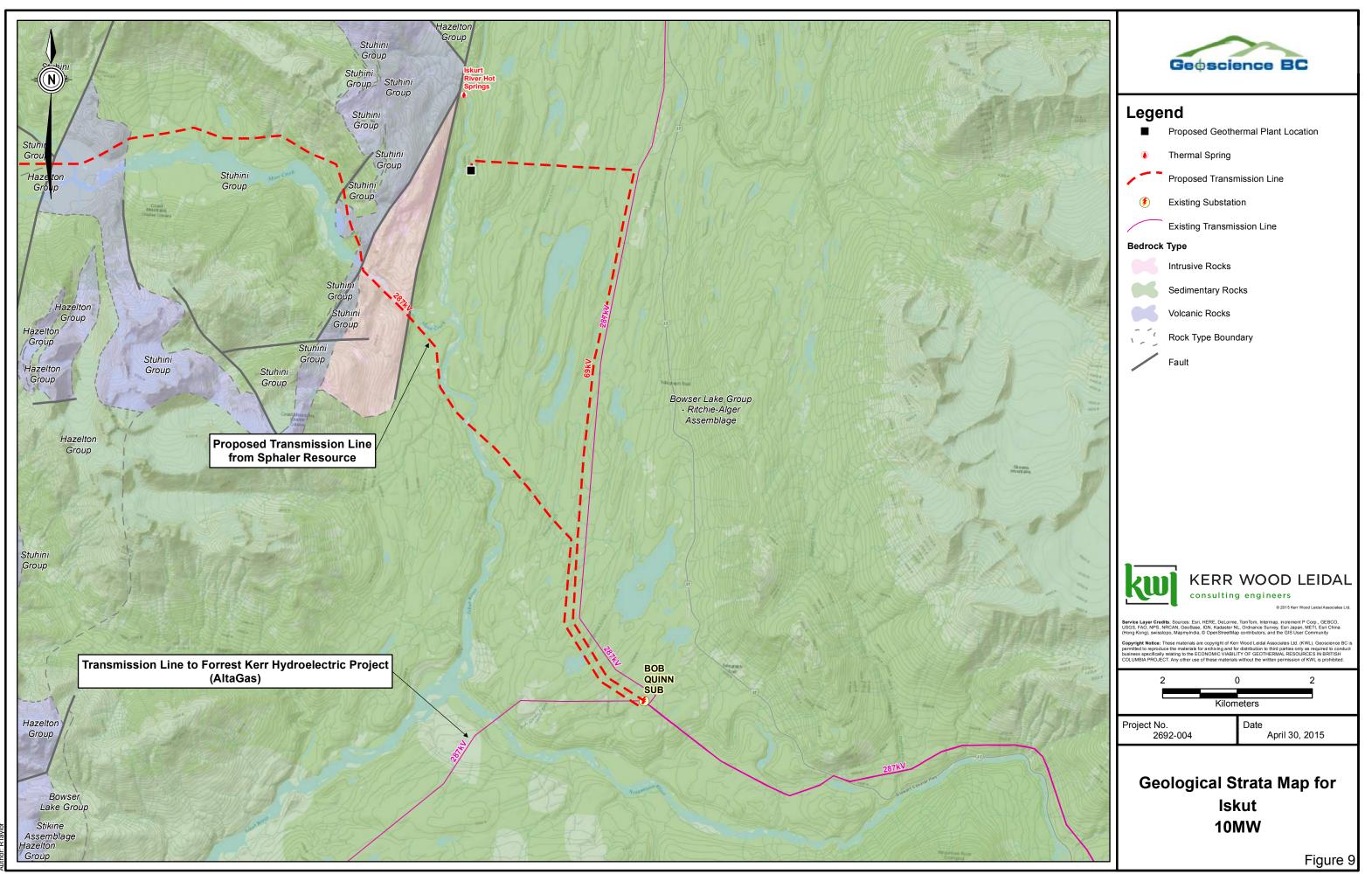
Near Iskut, British Columbia, Canada Topographical Map Sheet: Figure 8 Geological Map Sheet: Figure 9

		Category	Comments
P		Maps	
		Regional topographic map showing population centres, roads and	
		other infrastructure including electrical grid and nearest substation	
		and/or generating station. (1:500,000?)	
		Regional map showing land tenure in area – geothermal	Topographical Map Sheet: Figure 8
		concessions, mining concessions, private land holds, public or	
		national lands (parks). (1:500,000?)	Castaginal Man Shaati Figura 0
			Geological Map Sheet: Figure 9 Geological Map Sheet: Figure 9
		Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet. Figure 9
r	۷.	Other Issues and Considerations	

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015









Appendix F

Jedney Area Geothermal Development Decision Matrix and Figures 10 & 11

kwl.ca

Near Fort St. John, British Columbia, Canada **Topographical Map Sheet: Figure 10** Geological Map Sheet: Figure 11

	Category	Comments
Α.	Reservoir Potential	
	Size/Potential/Type	• Reservoir size: 2.1 km <sup>3</sup> . The Jedney Area outlined on the CDL (2015) project maps is approximately 300 km <sup>2</sup> - actual
		assumed to consists of the areas with dolomite development, approximately 7% of total Jedney Project area (21 km <sup>2</sup> ) (CE Productive reservoir thickness has not been defined. Core logs show at least 30-50 m of carbonates, and it is noted that toward the southern edge of the study area, (CDL, 2015). A moderate value of 100 m is therefore used for reservoir size • Potential: Assume 15 MW (based on geologic similarity to Clarke Lake and drill stem temperatures from CDL [2015]) • Type: Binary plant for low-temperature resource.
	Temperature/Water and Gas Chemistry/Mineral Indicators	Geothermometry:
		No information available.
		Exploration drilling:
		<ul> <li>Formation temperatures were available for drill stem tests and production tests from the IHS database. Reservoir temperatured) in the Jedney Area range from 142° in the SE of the Jedney Area to 149°C in the NW. The temperature at the 130°C to 140°C in the deeper southwestern part of the study area (CDL, 2015).</li> <li>Averagetemperature gradient in Jedney Area ~0.045°C/m (45°C/km) (CDL, 2015).</li> </ul>
		<ul> <li>Petroleum well gradients 30-40°C/km in project area (Fairbank and Faulkner, 1992).</li> </ul>
		Water chemistry:
		<ul> <li>Project area located within Salinity Domain 1 (salinities less than 100,000 mg/L Total Dissolved Solids (TDS) and an average of the Slave Point reservoir on the MDC bank is sour, containing gas with H<sub>2</sub>S levels that range from 0.1% to near 3% (COM)</li> </ul>
		aquifer, and not the gas dissolved in the formation water) (CDL, 2015).
	Surface Flow Rates and Reservoir Recharge	Recharge in the area likely from mountains in the SW, flowing to the NE, (CDL, 2015).
	3D Permeability (heat exchange potential)	<ul> <li>Temperature gradients varied from slightly more than 0.040 °C/m in the western and southwestern part of the study area</li> <li>Qualitative permeability groups 1, 2 and 6 found within Jedney Area (Group 1: High Rate Gas/High Permeability; Group 2 tests show little to no permeability). Permeability is noted to be significantly increased in samples having a grain density in (CDL, 2015).</li> </ul>
	Recent Magmatism	None
	Structural Setting	No faults apparent in area. Prooject area part of carbonate reef complex with edge of reef complex to the north of project
	Geophysics	No information available.
	Reservoir Host Rock	<ul> <li>Carbonate reef rocks of the Mid-Devonian Carbonate aquifer system: reservoir formations include Keg River, Muskeg ar System of the Woodbend Group shale formations. In general, if the MDCAS aquifer has hydrothermal dolomite present, the dolomitized reservoir. (CDL, 2015).</li> <li>The higher given Slave Point formation temperatures in the NW of the Jedney Area are coincidental with areas of dolom a base dolomite present between 2,200,2,250 m, and limeature from 2,200,2,200 m, (CDL, 2015).</li> </ul>
	Drilling Issues	<ul> <li>show dolomite present between 3,300-3,350 m, and limestone from 3,330-3,360 m, (CDL, 2015).</li> <li>A number of natural gas wells are shown on maps of the project area and provided data for the CDL (2015) report, though appropriate diameters for pumped production at geothermal rates would likely need to be "purpose built," that is, drilled sp approximately as many injectors as producers would be required. Existing wells could potentially be used as injectors, bu</li> </ul>
		kilometers of a production-well cluster.

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

al reservoir area has not been defined. Reservoir area is CDL, 2015).

t thickness of the Slave Point formation slowly decreases e estimate.

peratures (from Slave Point formation temperatures he top of the Slave Point Formation varied from around

verage salinity of 50,000 mg/L) (CDL, 2015). CO<sub>2</sub> and H<sub>2</sub>S percentages are for gas produced from the

ea (CDL, 2015). p 2: High Rate Water/High Permeability; Group 6: drill stem in the range of dolomite compared to limestone samples,

ect area.

and Slave Point. Reservoir overlain by the Ireton Aquitard , there will be an interval of high permeability within the

mite development. Two drilling logs from the Jedney Area

gh it is unknown if these are still open. However, wells with specifically for use as geothermal producers. In addition, out from a practical point of view would need to be within 2

Near Fort St. John, British Columbia, Canada **Topographical Map Sheet: Figure 10** Geological Map Sheet: Figure 11

Category	Comments
Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	<ul> <li>Located in the Western Canadian Sedimentary Basin, approximately 160 km SSE of Clarke Lake, but with apprent simila</li> <li>Large Mid-Devonian Carbonate thermal aquifer system consists of the following formations in the project area: Slave Poin River and Chinchaga. The edge of the Sulphur Point/Presqu'ile bank/reef complex is dolomitzed, and the Wyatt Mountain act as aquicludes (barrier) in the greater area, are present in the project area, but do not appear to be effective barriers. (C</li> <li>The prospect does not appear to have surface thermal features. It is defined based on temperatures observed in wells d</li> </ul>
Fundamentian Uncontainty (Diala)	
Exploration Uncertainty (Risk) Degree of Identification of Resources/Reserves	Moderate
ů (martine) V (martine) V (martine)	Gas drilling in area has provided subsurface data and temperatures. Gas exploration appears to have included geologic ar evaluated for temperature gradient, downhole pressures and gas content, (CDL, 2015).
Likelihood of Covering Reservoir with Concession	High Reservoir likely has large areal extent. The most likely development scenario would consist of several smaller power plants specifically for geothermal development within a relatively small area (on the order of 1-2 km <sup>2</sup> ).
Expected Authorization Date	Unknown
Specific Timing of Exploration (2 + 2 years, BC 8 years, etc.)	5 years for first 5-MW pilot plant (3 years for development well drilling and testing + 2 years to complete and commission 5-MW pilot plant). 4 years per 5-N
Degree of Previous Exploration (can be good or bad)	Moderate There has been significant exploration for natural gas in the area, and formation temperatures have been documented from for geothermal exploration/exploitation.
Surface Operational Capacity (enough stable area for drilling and a plant?)	Sufficient level ground exists for power plants and well pads. Gas-field operations may already provide some infrastructure
	Difficult
	Full-diameter wells are likely to cost several million dollars each. It will be a challenge to make this economic for an output
(moderate risk) to easy (low risk)	drilled for natural gas production are not likely to be useful for geothermal production due to smaller-diameter completions. wells for geothermal injection would need to be investigated on a case-by-case basis.

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ilar subsurface geology.

oint, Sulphur Point/Presqu'ile, Watt Mountain, Muskeg, Keg n and Muskeg evaporites, which commonly are known to (CDL, 2015)

drilled for natural gas production.

and stratigraphic mapping. Larger area has been

nts, each located near a cluster of production wells drilled

-MW module thereafter.

om drill stem tests. No full-diameter wells have been drilled

ure (such as roads and well pads).

out on the order of 1 MW per production well. Existing wells s. Existing wells may be usable for injection. Use of such

Near Fort St. John, British Columbia, Canada Topographical Map Sheet: Figure 10 Geological Map Sheet: Figure 11

<ul> <li>Connecticut Warbler (blue-listed bird) occurrence polygon located approx. 4 km from proposed transmission line.</li> <li>Boreal Mountain Caribou (Endangered (SARA Schedule 1); red-listed) habitat polygon approx. 30 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx. 4 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx. 34 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx. 45 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx. 45 km from proposed plant.</li> <li>Nearest hotsprings approx. 125 km from proposed infrastructure.</li> <li>Other</li> <li>Transmission line crosses approx. 12 streams that contain various species of concern:         <ul> <li>North Aitken Creek contains Longnose Dace, White Suckers, Lognose Suckers, Troutperch and Lake Chub.</li> <li>Blueberry River contains Nedside Shiner, Lake Chub, Longnose Sucker, Spoonhe Fox Creek contains Nedside Shiner, Lake Chub, Longnose Sucker, Spoonhe Sucker, Creek contains Peamouth Chub;</li> <li>Nearest Wildlife Habitat Area for Boreal Caribou approx. 50 km from proposed transmission line.</li> <li>Little Beaverdam Wildlife Habitat Area for Boreal Caribou approx. 50 km from proposed transmission line.</li> <li>West Milligan Wildlife Habitat Area for Boreal Caribou approx. 70 km from proposed transmission line.</li> <li>West Milligan Wildlife Habitat Area for Boreal Caribou approx. 70 km from proposed transmission line.</li> <li>West Milligan Wildlife Habitat Area for Boreal Caribou approx. 70 km from proposed transmission line.</li> </ul> </li> <li>Bidding Area</li> <li>No known existing active, cancelled or unsold geothermal title tracts</li> </ul>	Category	Comments
Endangered Species <ul> <li>Black-throated Green Warbler (blue-listed bird) occurrence polygon located approx. 1 km from proposed transmission line.</li> <li>Connecticut Warbler (blue-listed bird) occurrence polygon located approx. 4 km from proposed transmission line.</li> <li>Boreal Mountain Caribou (Endangered (SARA Schedule 1); red-listed) habitat polygon approx. 30 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx. 4 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx. 34 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx. 4 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx. 4 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx. 4 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx. 4 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx. 4 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx. 4 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx. 4 km from proposed plant.</li> <li>Siberian Polypod (red-listed plant) occurrence polygon located approx.</li> <li>Siberian Polyp</li></ul>	C. Environmental Issues	
Connecticut Warbler (blue-listed bird) occurrence polygon located approx. 4 km from proposed transmission line.         Boreal Mountain Caribou (Endangered (SARA Schedule 1); red-listed) habitat polygon approx. 30 km from proposed plant.         Boreal Mountain Caribou (Endangered (SARA Schedule 1); red-listed) habitat polygon approx. 34 km from proposed plant.         Siberian Polypod (red-listed plant) occurrence polygon located approx. 45 km from proposed plant.         Geothermal Surface Features       • Nearest hotsprings approx. 125 km from proposed infrastructure.         Other       Transmission line crosses approx. 12 streams that contain various species of concern:         • North Aitken Creek contains Longnose Dace, White Suckers, Lognose Suckers, Troutperch and Lake Chub.         • Blueberry River contains Redside Shiner, Lake Chub, Longnose Sucker, Troutperch and Lake Chub.         • Buick Creek contains Redside Shiner, Lake Chub, Longnose Sucker, Troutperch         • Buick Creek contains Peamouth Chub;         • Nearest Wildlife Habitat Area for Mountain Goat, approx. 27 km from proposed transmission line.         • Little Beaverdam Wildlife Habitat Area for Boreal Caribou approx. 70 km from proposed transmission line.         • West Milligan Wildlife Habitat Area for Boreal Caribou approx. 70 km from proposed transmission line.         • Utest Milligan Wildlife Habitat Area for Boreal Caribou approx. 70 km from proposed transmission line.         • Utest Milligan Wildlife Habitat Area for Boreal Caribou approx. 70 km from proposed transmission line.         • West M	Protected Areas	Nearest Provincial Park, Sikanni Chief Canyon Park, approx. 40 km from proposed plant location.
Other       Transmission line crosses approx. 12 streams that contain various species of concern:         North Aitken Creek contains Longnose Dace, White Suckers, Lognose Suckers, Troutperch and Lake Chub.         Blueberry River contains Longnose Dace, Redside Shiner, White Sucker, Lake Chub, Longnose Sucker, Spoonhe         Fox Creek contains Redside Shiner, Lake Chub, Longnose Sucker, Troutperch         Buick Creek contains Redside Shiner, Lake Chub, Longnose Sucker, Troutperch         Buick Creek contains Peamouth Chub;         Nearest Wildlife Habitat Area, for Mountain Goat, approx. 27 km from proposed transmission line.         Little Beaverdam Wildlife Habitat Area for Boreal Caribou approx. 50 km from proposed transmission line.         West Milligan Wildlife Habitat Area for Boreal Caribou approx. 70 km from proposed transmission line.         West Milligan Wildlife Habitat Area for Boreal Caribou approx. 70 km from proposed transmission line.         West Milligan Wildlife Habitat Area for Boreal Caribou approx. 70 km from proposed transmission line.         West Milligan Wildlife Habitat Area for Boreal Caribou approx. 70 km from proposed transmission line.         West Milligan Wildlife Habitat Area for Boreal Caribou approx. 70 km from proposed transmission line.         Bidding Area       No known existing active, cancelled or unsold geothermal title tracts	Endangered Species	
Transmission line crosses approx. 12 streams that contain various species of concern:         North Aitken Creek contains Longnose Dace, White Suckers, Lognose Suckers, Troutperch and Lake Chub.         Blueberry River contains Longnose Dace, Redside Shiner, White Sucker, Lake Chub, Longnose Sucker, Spoonhole         Fox Creek contains Redside Shiner, Lake Chub, Longnose Sucker, Troutperch         Buick Creek contains Redside Shiner, Lake Chub, Longnose Sucker, Troutperch         Buick Creek contains Peamouth Chub;         Image: Point Creek Contains Peamouth Point Peamouth Chub;         Image: Point Creek Contains Peamouth Chub;         Image:	Geothermal Surface Features	<ul> <li>Nearest hotsprings approx. 125 km from proposed infrastructure.</li> </ul>
(private/government/lease/etc.)           Bidding Area         No known existing active, cancelled or unsold geothermal title tracts	Other	<ul> <li>North Aitken Creek contains Longnose Dace, White Suckers, Lognose Suckers, Troutperch and Lake Chub.</li> <li>Blueberry River contains Longnose Dace, Redside Shiner, White Sucker, Lake Chub, Longnose Sucker, Spoonhead Sci</li> <li>Fox Creek contains Redside Shiner, Lake Chub, Longnose Sucker, Troutperch</li> <li>Buick Creek contains White Sucker;</li> <li>Jedney Creek contains Peamouth Chub;</li> <li>Nearest Wildlife Habitat Area, for Mountain Goat, approx. 27 km from proposed transmission line.</li> <li>Little Beaverdam Wildlife Habitat Area for Boreal Caribou approx. 50 km from proposed transmission line.</li> </ul>
Other Claim Dights (mining and/or ail)		
To the Gain Rights (mining and/or oii) Two known coar or minerar titles. Proposed location is within known oil and gas management area. Proposed icoation	Other Claim Rights (mining and/or oil)	No known coal or mineral titles. Proposed location is within known oil and gas management area. Proposed location is within known oil and gas management area.

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

line.

lant location.

Sculpin, Troutperch, Leopard Dace, Flathead Chub

within natural gas tenure area.

Near Fort St. John, British Columbia, Canada **Topographical Map Sheet: Figure 10** Geological Map Sheet: Figure 11

	Category	Comments
Ε	Market	
	Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>1. BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through tw • Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propon • Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW bu against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponen threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply t realistically apply to potential geothermal generation projects).</li> <li>• In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to par program has no applicability to potential geothermal generation projects. The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificativ snow melt and stream flow.</li> <li>2. Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project to BC Hydro through BC Hydro's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>3. Wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta, th generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission acc Authority for wheeling to a US customer). This 'pancaking' of rates, along with congestion issues, affects the economic via 4. R</li></ul>
		<ul> <li>To supply electricity to a remote facility (e.g. a mine, LNG plant or other industrial facility) directly from a geothermal plant precluding the need for a lengthy transmission line to connect to the BC Hydro electrical grid.</li> <li>A potential electricity customer, Spectra Energy Jedney 1 Gas Plant, located approximately 15 km the proposed site.</li> <li>A potential electricity customer, West Coast Sikanni Gas Plant, located approximately 20 km southeast of the proposed site. line.</li> </ul>
		<ul> <li>A potential electricity customer, Tervita Silverberry Treatment Recovery and Disposal Facility, located approximately 30 f</li> <li>A potential electricity customer, Daiber Gas Plant, located approximately 100 km from proposed transmission line.</li> <li>A potential electricity customer, Canfor Pulp mill located approximately 190 km southeast of the proposed site in Taylor,</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

nents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete nts may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this

tion of BC Hydro's resource mix, making it less reliant on

en FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

site and approximately 10 km from proposed transmission

from proposed transmission line.

, BC.

# JEDNEY AREA

Near Fort St. John, British Columbia, Canada Topographical Map Sheet: Figure 10 Geological Map Sheet: Figure 11

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation.</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical an considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to seve Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gene other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction years, the key uncertainties inherent in the environmental review, public consultation, transmission arrangements (either w permitting and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
5	Transmission Line Infrastructure	
•••	State of the Infrastructure	Closest transmission line is 138 kV to Foxcreek Substation.
	Transmission Route (distance, terrain and costs)	New transmission line approx. 116 km via existing unpaved roads from proposed plant location to Foxcreek substation.
Н.	Community Issues	
	Indigenous Law and Indigenous Development Areas	• First Nation consultative areas include Doig First Nation, Prophet First Nation, West Moberly First Nations, Treaty 8 Land First Nations, Dene Tha' First Nations.
	Community Action	<ul> <li>Treaty 8 First Nations demonstrate against BC Hydro Dam in Fort St. John.</li> <li>No existing land use plan found related to the proposed plant location.</li> </ul>
	Surface Rights	• First Nation consultative areas include Doig First Nation, Prophet First Nation, West Moberly First Nations, Treaty 8 Land First Nations, Dene Tha' First Nations.
	Tourism	<ul> <li>Due to remote location of proposed plant, no significant tourism activity is noted in the area.</li> <li>Sikanni Chief Provincial Park is close to proposed plant location.</li> <li>Proposed plant location is off the Alaska Highway; potential to create new recreational access.</li> </ul>

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ion output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission even years depending on the specifics of each project. herally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

nds Office, Halkfway River First Nation, Blueberry River

nds Office, Halkfway River First Nation, Blueberry River

# JEDNEY AREA

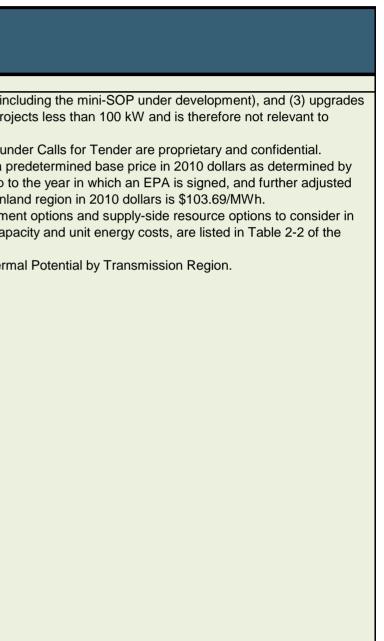
Near Fort St. John, British Columbia, Canada Topographical Map Sheet: Figure 10 Geological Map Sheet: Figure 11

		Category	Comments
[	I.	Water Rights	
		Availability (for example "air-cooled required")	Plant water requirement estimated approx. 25 L/s for binary plant. Closest River has MAD of 250 L/s. No known water licer
			is approx. 18 km away on Holman spring for 1.3 L/s for purpose of work camps.
		Availability for Drilling	Drilling requirement of 20 L/s. Closest River has MAD of 250 L/s. No known water licences near proposed plant location.
			spring for 1.3 L/s for purpose of work camps.
	J.	Engineering	
		Plant Location and Design	Remote plant location; significant distance of new transmission line required.
		Construction Issues	Access to location is limited. Closest town in Fort St. John approx. 230 km via road. Likely requirement for temporary wor
		Transportation Issues	Proposed plant location is approx. 230 km via road from closest town of Fort St. John.
		Architectural Issues (Blend/hide into environment? Local styles?	
		etc.)	None found.
		Special Construction Issues (zero emissions)	None found.
	K.	Non-Electrical Infrastructure (Roads and Habitation)	
		Nearest Large Community > 50,000	Prince George, BC
		Nearest Community	Fort St. John, BC
		Nearest Road and Condition	Significant network of existing unpaved access roads.
		Current Access Conditions (restrictions)	None found.
		Terrain and Distance Factor for Road Building	No requirement for new road anticipated.

ences near proposed plant location. Closest water licence
Closest water licence is approx. 18 km away on Holman
ork camp and fly-in access.

Near Fort St. John, British Columbia, Canada Topographical Map Sheet: Figure 10 Geological Map Sheet: Figure 11

	Category					Comme	nts
L	Finance						
	Seneral Power Prices	BC Hydro acquires power throug to its existing facilities or the deve geothermal generation projects). • The power price paid by BC Hyd • The power price paid by BC Hyd • The power price paid by BC Hyd the region of the point of intercombased upon the time of day and r • BC Hydro's current Integrated F meeting the future demand for el November 2013 Resource Option • Table 5-7 of the above-noted N Energy Resource Biomass – Wood Based Biomass – Biogas Biomass – Municipal Solid Waste Wind – Onshore Wind – Offshore Geothermal Run-of-River Site C <sup>3</sup> Combined Cycle Gas Turbine and Cogeneration <sup>4</sup> Coal-fired Generation with Carbon Capture and Sequestration Wave Tidal Solar Notes: 1. The resources and UEC values s	elopment of ner Comments on dro to independ mection to the l month when the Resource Plan ectricity. These ns Report Upda ovember 2013 Total FELCC Energy (GWh/year) 9,772 134 425 46,165 56,700 5,992 24,543 4,700 6,103 3,896 2,506 1,426 57 hown for each cates	w generation faithe general prident power producent power producent power produced with the general pride state. That table resource optimate. The	acilities. (Note a ce of power un ducers through ducers through em, escalated a vered. For refe er 2013 include ons, together w is reproduced ons Report Upo UEC at POI @ 7% Real (\$2013/MWh) 122 - 276 59 - 154 85 - 184 90 - 309 166 - 605 91 - 573 97 - 493 83 58 - 92 88 440 - 772 253 - 556 266 - 746	that the net met der each one and Energy Purcha EPAs under the at the Consumer rence, the base as details of both with their attribut below for ready date provides a Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh) 132 - 306 56 - 156 83 - 204 115 - 365 182 - 681 90 - 593 143 - 1,170 88 57 - 86 103 453 - 820 264 - 581 341 - 954	ering program targets proj re: se Agreements (EPAs) un e SOP are made up of a p r Price Index annually up to price for the Lower Mainla n demand-side manageme es of total energy and cap reference.
		<ul> <li>and may not include all possible r</li> <li>2. The details of how the cost adjust</li> <li>3. The Site C values presented in the Impact Statement (EIS) submission real discount rate.</li> <li>4. Representative projects were used the resource potential is generally</li> </ul>	esources that may ters were developed is table are based o on filed in January 2 ed to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC e natural gas-fired a	expected higher cos rovided in Appendix ded in the Site C Er is calculated assum	t. 12. nvironmental ning 5 per cent	



Near Fort St. John, British Columbia, Canada Topographical Map Sheet: Figure 10 Geological Map Sheet: Figure 11

Category							Comments
Market Price (\$/MWhr)	dollars range • Wholesale unforeseen g variety of sommarket data. average cost on the appro • BC Hydro f ready referen	es from \$91/N electricity pri generation ou urces. One si Of particula t from 72 trac priate transmorecasts of n nce.	MWh to 573/I ces for tradir utages and an uch source is r relevance i des). Access nission system	WWh at the p ng purposes of mbient tempe is the US Ener is the mid-C to is to that mark im (e.g. Bonne under variou	oint of interco can vary greater aratures. A georgy Information rading hub in et for geother eville Power A	onnection to th tly. In the Pacifi eneral flavour on Administration the Northwest rmal projects in Authority) in the	Report Update, the Unit Energy Cost for g e BC Hydro system. fic Northwest, these prices are affected by of the wholesale electricity prices for poten on (www.eia.gov/electricity/wholesale/#hist t Region (one example would be a Mid-C p n BC would require access on both the BC e US. n the November 2013 IRP. Table 5 in Appe
		Table	5 Electricit	y Price Forecasts I (Real 2012 US\$/MV			
		1	2	3	4	5	
	Market Scenario	Mid Electricity Mid GHG (Regional) Mid Gas	Low Electricity Low GHG (Regional) Low Gas	High Electricity High GHG (Regional) High Gas	Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	High Electricity High GHG (Regional/Nat'l) High Gas	
	2014	25.0	21.9	31.1	25.0	31.1	
	2015	25.5	21.7	31.9	25.5	31.9	
	2016	25.8	21.2	32.0	25.8	32.0 33.4	
	2017	27.1 27.1	22.0 21.7	33.4 33.9	27.1 27.1	33.9	
	2010	28.0	22.1	35.5	28.0	35.5	
	2020	28.0	21.9	36.0	28.0	36.0	
	2021	29.3	22.5	37.3	29.3	37.3	
	2022	30.1	22.7	38.8	30.9	41.3	
	2023	31.8	23.2	41.7	35.5	52.1	
	2024 2025	33.0 34.2	23.7 24.0	43.4 45.4	41.8 50.3	68.6 91.2	
	2025	34.9	24.0	46.7	52.2	95.1	
	2027	36.0	24.3	48.6	54.7	98.9	
	2028	36.3	24.0	50.2	56.8	101.8	
	2029	37.2	23.9	51.1	58.8	106.1	
	2030	37.6	23.8	52.7	60.1	109.3	
	2031	38.6	24.0 24.0	54.7 57.0	62.6 65.6	112.0	
	2032	39.9 41.5	24.0	60.1	69.3	116.0 122.0	
	2034	42.8	25.1	61.9	71.5	125.7	
	2035	44.6	26.2	64.5	74.5	131.0	
	2036	45.7	26.9	66.2	76.4	134.3	
	2037	47.8	28.1	69.1	79.8	140.3	
	2038	48.4	28.4	70.0	80.8	142.1	
	2039	48.9	28.7	70.7	81.6	143.5	
	2040	49.3	29.0	71.4	82.4	144.9	

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

geothermal resources at a 7% real discount rate in 2013

by such factors as precipitation/snowfall in the region, ential export of electricity from BC can be obtained from a istory). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted C Hydro transmission system to the Canada/US border, and

pendix 5A – Market Forecast Data is reproduced below for

Near Fort St. John, British Columbia, Canada Topographical Map Sheet: Figure 10 Geological Map Sheet: Figure 11

Category	Comments
Green Power Premium (\$/MWhr)	<ul> <li>BC Hydro's past procurement processes for the acquisition for power from independent power producers has offered a p</li> <li>Within British Columbia, there is little demand for the purchase of "green power certificates" (instruments that a custome environmentally friendly) from BC Hydro. BC Hydro's generation mix is already approximately 93% clean.</li> <li>California has a goal of 33% of retail sales by 2020 to be sourced from eligible renewable energy sources. However, the particularly "bundled" green energy with Renewable Energy Certificates (RECs), to compete in that market is low, for a numl. The price of electricity is driven by the low cost of natural gas;</li> <li>There are large amounts of renewables, such as wind and solar, in California; and</li> <li>Firm transmission access to the California market through the BPA transmission system is generally not available.</li> </ul>
Capacity Price (\$/KW)	<ul> <li>There is no price in \$/kW for capacity resource options in the market at present.</li> <li>Table 3-27 entitled "UCCs of Capacity Resource Supply Options" in BC Hydro's Integrated Resource Plan dated Novemal options (e.g. pumped storage, simple cycle gas turbines and resource smart projects such as Revelstoke Unit 6). The unit the BC Hydro system in \$2013/kW-year are shown in the table.</li> </ul>

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

a premium for green power. ner can purchase to be assured that the electricity used is

ne opportunity for geothermal power from British Columbia, number of reasons

mber 2013 provided a summary of capacity resource init capacity costs (UCCs) at the point of interconnection to

# JEDNEY AREA

Near Fort St. John, British Columbia, Canada Topographical Map Sheet: Figure 10 Geological Map Sheet: Figure 11

Category						Comments
	the "1. [ (a) ' (b) ' inclu (c) "	following excer Definitions: In t "Off-Peak Hour "Peak Hours" m usive, but exclu	pt is taken from his Appendix 4, s" means all ho neans the hours ding British Col	BC Hydro's the following urs other that commencin umbia statut	SOP: g words and ex n Super-Peak g at 06:00 PPT ory holidays.	o BC Hydro and furthermore the price paid for baseload pow αpressions have the following meanings: Hours and Peak Hours. Γ and ending at 16:00 PPT, and commencing at 20:00 PPT a 00 PPT and ending at 20:00 PPT Monday through Saturday
	ſ		Time of	Delivery Facto	or (TDF)	
		Month	Super-Peak	Peak	Off-Peak	
		January	141%	122%	105%	
		February	124%	113%	101%	
		March	124%	112%	99%	
		April	104%	95%	85%	
		May	90%	82%	70%	
		June	87%	81%	69%	
		July	105%	96%	79%	
		August	110%	101%	86%	
		September	116%	107%	91%	
		October	127%	112%	93%	
		November	129%	112%	99%	
		December	142%	120%	104%	

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ower varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

ay inclusive, but excluding British Columbia statutory

Near Fort St. John, British Columbia, Canada **Topographical Map Sheet: Figure 10** Geological Map Sheet: Figure 11

Category	Comments
Estimated Size of Resource	See Section A.
Is there any green power incentives?	<ul> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercia expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p o Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project development o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include: <ul> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Sustainable Development Technology Canada funds;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> <li>Green Infrastructure Fund</li> </ul> </li> <li>Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability</li> </ul>
Grants	See above under green power incentives
Tax Holidays	None listed on federal and provincial websites.
Tax Relief	<ul> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 43 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred durin and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the ye deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now entitled Scientific Research and Experimental ty and relevance. participation in the clean energy sector. It provides: ent; and these programs may be active but not currently issuing al technologies/resources, while others may be fully ity and relevance.

ce energy by using renewable energy sources or fuels from 43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 ets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy vear they are incurred, carried forward indefinitely and

# JEDNEY AREA

Near Fort St. John, British Columbia, Canada Topographical Map Sheet: Figure 10 Geological Map Sheet: Figure 11

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/ "The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly. The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities t The advantages of joining the FNFA as a Borrowing Member are: 1. Access to low rate, below bank prime, loans with repayment terms up to 30 years; 2. First Nations choose the repayment terms that work best for their budget; 3. FNFA loans do not require collateral; 4. FNFA loans do not require collateral; 5. FNFA's interest rates and terms parallel those available to provincial and local governments. Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infras purchases, independent power projects, community housing and rolling stock/heavy equipment. FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Borr and Council appointee. The FNFA is for First Nations, by First Nations."

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. s that join as Borrowing Members.

astructure, social and economic development, land

orrowing Members, represented by the First Nation's Chief

Near Fort St. John, British Columbia, Canada Topographical Map Sheet: Figure 10 Geological Map Sheet: Figure 11

Category	Comments
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015 Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribe
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must p (a) a royalty established by agreement under this section,
	<ul><li>(b) an amount agreed under this section to be paid instead of royalty, or</li><li>(c) if no royalty or amount has been agreed under this section, the prescribed royalty.</li></ul>
eneral Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "The in section 1 (1) [definitions] of the Geothermal Resources Act."
rivate Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners Proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg Sta
Fax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincia</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmi Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

bed rent for the permit (Section 5).

pay to the government

his Act does not apply to geothermal resources as defined

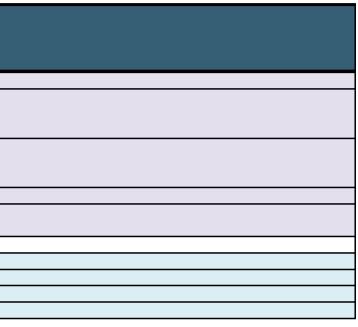
for the geothermal land tract. atutory Right of Way, Licence of Occupation). ial (British Columbia): 13.5%.

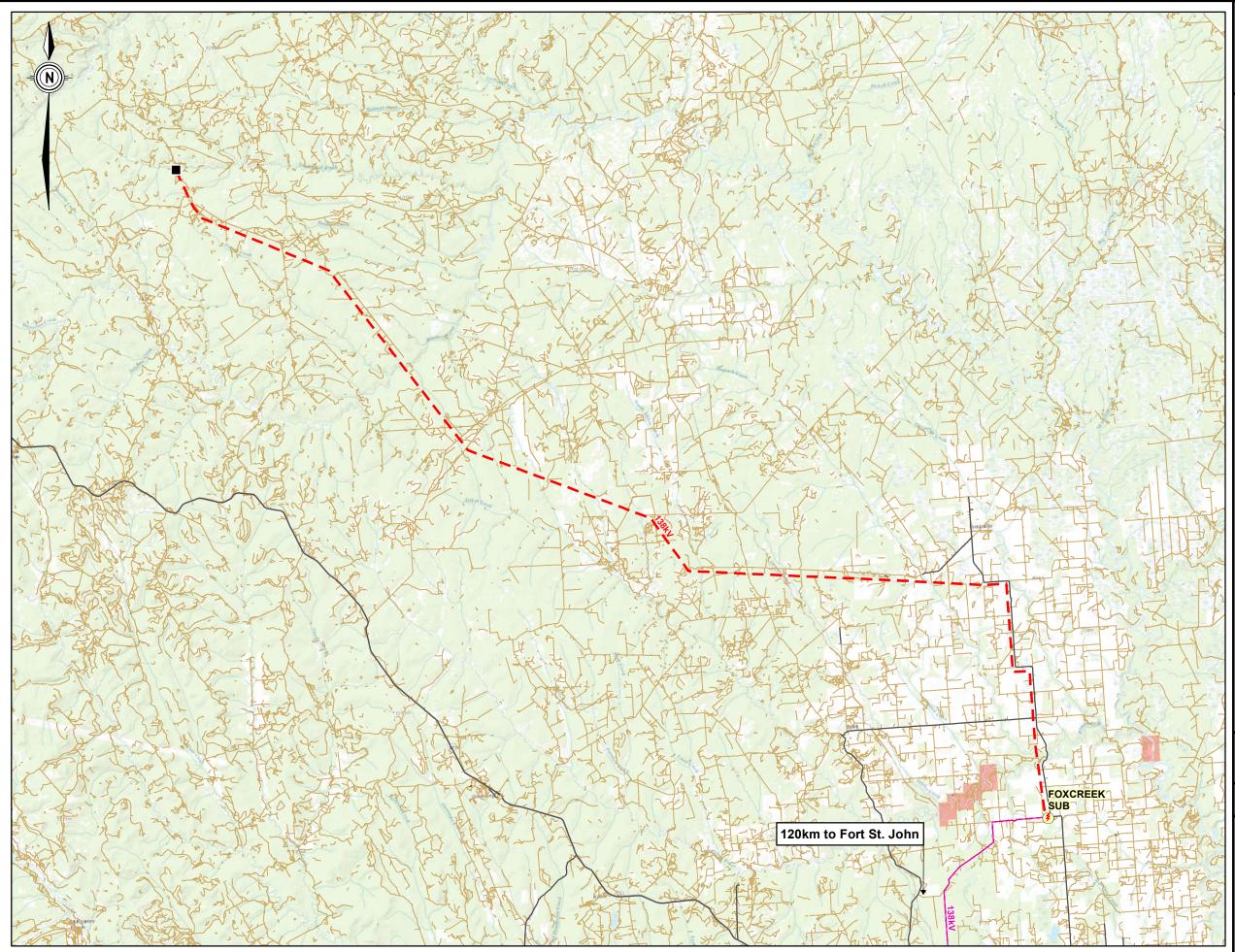
rta, the US, or other wholesale customers in BC, the nission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power he economic viability of the potential wholesale opportunity.

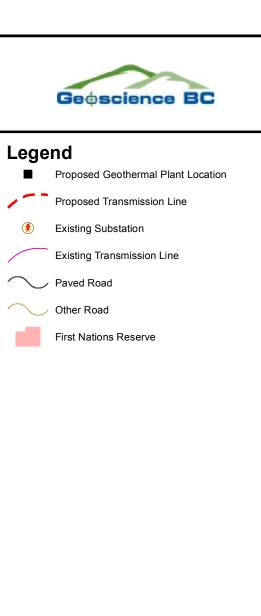
# JEDNEY AREA

Near Fort St. John, British Columbia, Canada Topographical Map Sheet: Figure 10 Geological Map Sheet: Figure 11

		Category	Comments
N	Λ.	Maps	
		Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)	Topographical Map Sheet: Figure 10
			Topographical Map Sheet: Figure 10
			Geological Map Sheet: Figure 11
		Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 11
N	I. (	Other Issues and Considerations	









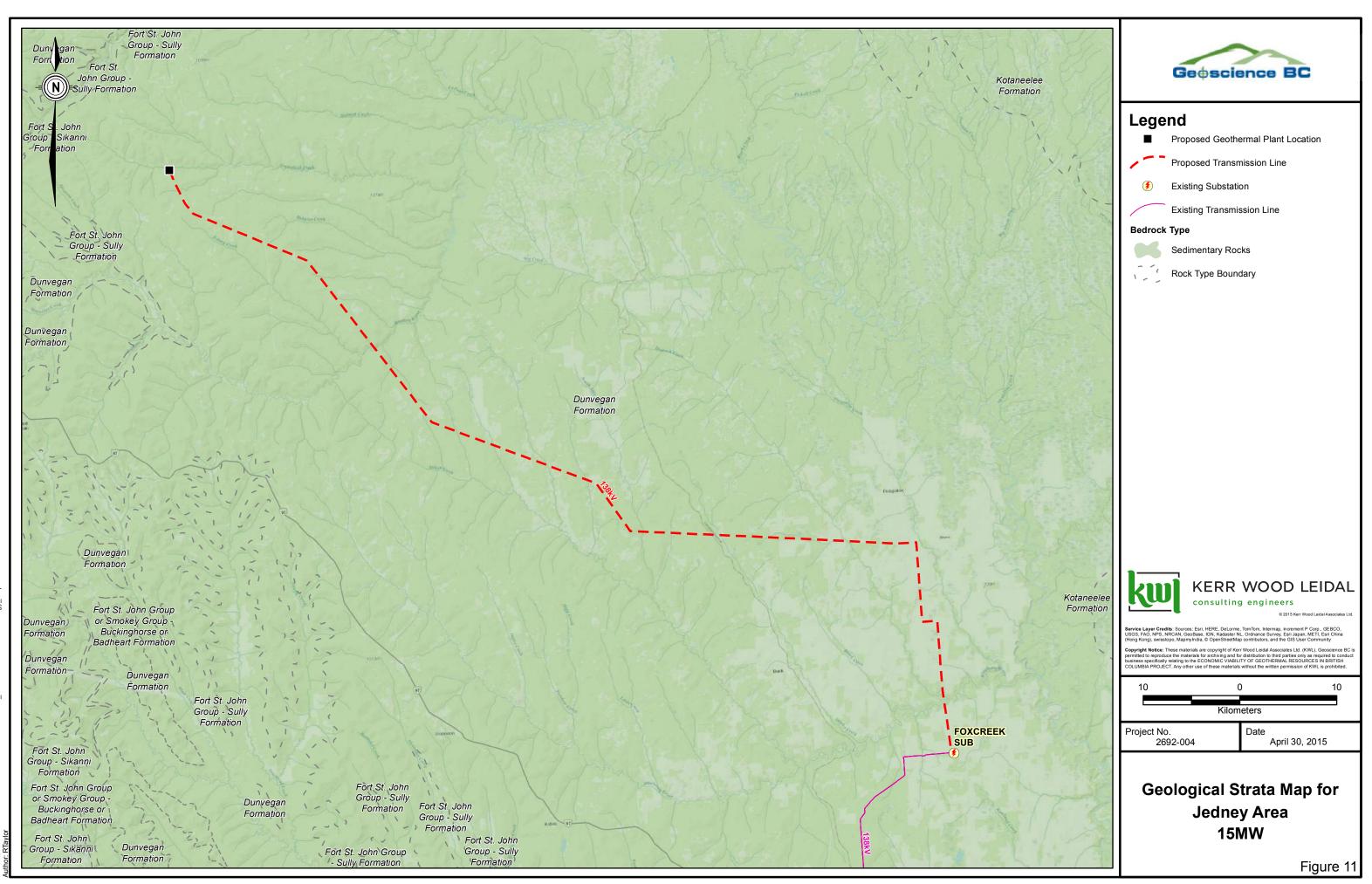
rvice Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, GGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China ong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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8	C	)	8
	Kilom	eters	
Project No. 2692-004		Date April	30, 2015

# Potential Geothermal Plant at Jedney Area 15MW

Figure 10





Appendix G

King Island Geothermal Development Decision Matrix and Figures 12 & 13

kwl.ca

Near Bella Coola, British Columbia, Canada **Topographical Map Sheet: Figure 12** Geological Map Sheet: Figure 13

Category	Comments
Reservoir Potential	
Size/Potential/Type	<ul> <li>Reservoir size: No clearly defined area or thickness in literature, but description of multiple springs warrants an area est estimated at: 5.5 km<sup>3</sup> (most-likely area: 5 km<sup>2</sup>; most-likely thickness*: 1.1 km) (*Reservoir thickness assumption based on</li> <li>Potential: 20 MW (WREZ, 2009)</li> <li>Type: low-temperature resource, suitable for binary plant.</li> </ul>
Temperature/Water and Gas Chemistry/Mineral Indicators	Surface features:         • Hot springs in this area (also known as the Dean Channel group of springs) have temperatures from warm to 64°C (Fairle         • Eucott Bay Spring: 41.5°C and 54°C (BC Hydro, 1981); 41.5-54°C (Souther, 1975)         • Nascall Bay Spring: 43.4°C (BC Hydro, 1981); warm (Souther and Halstead, 1973)         • Ram Bluff Spring: warm (Souther and Halstead, 1973)         • Bella Coola Spring: warm (Souther and Halstead, 1973)         • Talheo Hot Spring: 46°C to 64°C (BC Hydro, 1981); 46-54°C (Souther, 1975); warm (Souther and Halstead, 1973)         • Talheo Hot Spring: Na-K-Ca 88.6°C; SiO <sub>2</sub> 112.8°C (Fairbank and Faulkner, 1992); convergence of geothermometers at 8         • Talheo Hot Spring: Na-K-Ca 88.6°C; SiO <sub>2</sub> 141.2°C (Fairbank and Faulkner, 1992); cations and silica combine to indicate to be present (Souther, 1975)         • Talheo Hot Spring: Na-K-Ca 98.3°C; SiO <sub>2</sub> 141.2°C (Fairbank and Faulkner, 1992); cations and silica combine to indicate to be present (Souther, 1975)         • Talheo Hot Spring: Na-K-Ca 98.3°C; SiO <sub>2</sub> 141.2°C (Fairbank and Faulkner, 1992); cations and silica combine to indicate to be present (Souther, 1975)         • Talheo Hot Spring: Na-K-Ca 98.3°C; SiO <sub>2</sub> 141.2°C (Fairbank and Faulkner, 1992); cations and silica combine to indicate to be present (Souther, 1975)         • Talheo Hot Spring: Na-K-Ca 98.3°C; SiO <sub>2</sub> 141.2°C (Fairbank and Faulkner, 1992); cations and silica combine to indicate to be grower (Souther, 1975)         • Catott Bay Spring: (Na>Ca)-Cl type; Cl at 1,600~1,800 mg/l and high Ca combine to suggest that the water could be abo (Souther, 1975); the largest spring in the area; wate
Surface Flow Rates and Reservoir Recharge	Up to 10 L/s (Fairbank and Faulkner, 1992) • Eucott Bay spring: 2 - 7.5 L/s (Souther, 1975); 634 L/min (BC Hydro, 1981) • Talheo hot spring: 2 L/s (Souther, 1975) • Nascall Bay: 46 L/min (BC Hydro, 1981)
3D Permeability (heat exchange potential)	Heat exchange potential appears good, associated with fracturing in plutonic and metamorphic rocks.
Recent Magmatism	Bella Bella and King Island volcanic centers range in age from 14 10.3 million years old (Bevier, 1989).
Structural Setting	<ul> <li>Heat source is likely to be the Anaheim Volcanic Belt (Fairbank and Faulkner, 1992).</li> <li>The late Cenozoic Anahim Volcanic Belt (AVB) crosses the Coast Plutonic Complex in the greater project area. Typically volcanic features, alkaline and peralkaline in composition, except in the western end of the belt where it crosses the Coast and plutons in the King Island area are exposed due to differential uplift of the Coast Mountains. The Bella Bella dike swar and plutonic parts, respectively, of an alkaline to peralkaline magmatic fractionation system similar to those found elsewhere</li> </ul>
Geophysics	No information

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

estimate of about 5 km<sup>2</sup>) - therefore, reservoir volume on most-likely value from Appendix III in GeothermEx, 2004) rbank and Faulkner, 1992). t 80° to 90°C (Souther, 1975) e that temperatures at depth of 100°C to ~120°C are likely bout 10% seawater, heated either before or after mixing alstead, 1973). lly the AVB volcanic centers are predominantly subaerial

st Mountains (at King Island). Dike swarms near Bella Bella arms and King Island pluton may represent the subvolcanic nere in AVB (Bevier, 1989).

Near Bella Coola, British Columbia, Canada Topographical Map Sheet: Figure 12 Geological Map Sheet: Figure 13

	Category	Comments
	Reservoir Host Rock	The Dean Channel group of springs all discharge from fissures in quartz diorite of the Coast Crystalline complex. In general migmatite, gneiss and schist that forms nearly vertical pendants within the more uniform granitic rock (Souther and Halster
	Drilling Issues	Eucott Bay, Nascall Bay, and Talheo springs all lie within Conservancy lands; Bella Coola appears to lie on the boundary o Unknown road access/conditions. Best access to sites for exploration drilling is likely to be by boat.
		<ul> <li>The Dean Channel group of springs consists of six widely separated springs clustered around the head of Dean and Burk into the center of the Coast Range. All of the springs are near sea-level and all of them discharge from fissures, with the n highly fractured than the surrounding quartz diorite (may account for the localization of hot springs in the area) (Souther ar</li> <li>The main spring at Eucott Bay issues from boulders near the high-tide mark (BC Hydro, 1981).</li> <li>Hot water at Nascall Bay percolates from the ground near the high-tide mark and from the middle of a cold stream (BC H</li> <li>There are 16 springs along 400 m of shoreline at Talheo Hot Spring, and many seeps below high tide (BC Hydro, 1981).</li> </ul>
В.	Exploration Uncertainty (Risk)	•
	Degree of Identification of Resources/Reserves	Low Only moderate geologic mapping done, no known geophysical or geochemical studies conducted. No drilling in area know
	Likelihood of Covering Reservoir with Concession	Unknown Resource location not identified; multiple springs in the area along linear structural feature with patches of Conservancy la
	Expected Authorization Date	Unknown
		<ul> <li>6-7 years</li> <li>(2 years deep gradient-well drilling + 2 years successful development drilling and testing + 1 year further development drilli and finish plant construction). Possible delays due to issues of access (conservancy, infrastructure).</li> </ul>
	Degree of Previous Exploration (can be good or bad)	Low Geologic mapping is the only known exploration in the area.
	Surface Operational Capacity (enough stable area for drilling and	Unknown
		Area for surface operations would need to be assessed once surface exploration and temperature-gradient drilling has been
		Difficult
	Uncertainty (risk) on a scale of difficult (high risk) through medium	Area appears to be accessible just by boat or helicopter at present. Proximity to conservancy lands could be a problem. The
	(moderate risk) to easy (low risk)	(Talheo) is about 60 km away from the cluster of springs near Eucott Bay.

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

eral, they fall within a broad northwesterly trending zone of ead, 1973).

of the conservancy lands.

urke Channels, part of a system of narrow fiords that extend e metamorphic rocks tending to be more porous and more and Halstead, 1973).

Hydro, 1981).

wn.

and throughout.

illing and start plant construction + 1 year drilling wrap-up

een performed.

The most promising spring based on geothermometry

Near Bella Coola, British Columbia, Canada Topographical Map Sheet: Figure 12 Geological Map Sheet: Figure 13

	Category	Comments
C.	Environmental Issues	
	Protected Areas	<ul> <li>Cascade-Sutslem Conservancy is close to the proposed plant location.</li> </ul>
		<ul> <li>Bella Coola Estuary Conservancy is close to the proposed power line.</li> </ul>
		<ul> <li>Nooseseck Convervancy approx. 6 km from proposed power line.</li> </ul>
		<ul> <li>Tweedsmuir Provincial Park is approx. 60 km from proposed transmission line.</li> </ul>
	Endangered Species	• Proposed transmission line connection inside the occurrence polygons of Chamisso's Montia (blue-listed plant) and Less
	Geothermal Surface Features	• Proposed plant location is approx. 6 km from Eucott Bay Hot Springs, and approx. 7 km from Nascall Bay Hot Springs.
		Proposed transmission line is close to the Bella Coola Hot Springs, and 2 km from Ram Bluff Hotsprings.
	Other	• Transmission line crosses Nooseseck River which contains spawning locations for Pink and Chum Salmon. Nooseseck
		• Transmission line crosses Necleetsconnay River which contains Coho, Pink and Chumb Salmon and Cutthroat Trout.
		Transmission line crosses unnamed river which contains Pink and Chum Salmon.
		• Transmission line crosses the Bella Coola River which contains Coho, Sockeye, Chinook, Pink, and Chum Salmon and
		Nearest Wildlife Habitat Area allotted for Grizzly Bear is approx. 10 km south of the proposed transmission line.
D.	Geothermal Area - Bidding and/or Type of Land Holding	
	(private/government/lease/etc.)	
	Bidding Area	No known existing active, cancelled or unsold geothermal title tracts
	Other Claim Rights (mining and/or oil)	No known coal or mineral titles. Proposed location is not within known oil and gas management area; no known tenures a

ser Saltmarsh Sedge (blue-listed plant).
River also contains Coho Salmon.
Steelhead Trout.
Steemeau Hout.
at around location
at proposed location.

Near Bella Coola, British Columbia, Canada **Topographical Map Sheet: Figure 12** Geological Map Sheet: Figure 13

	Category	Comments
E.	Market	
	Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>1. BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through tw • Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propone • Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW bi against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponen threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply t realistically apply to potential geothermal generation projects).</li> <li>• In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution, Stem. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pai program has no applicability to potential geothermal generation projects.</li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificatif snow melt and stream flow.</li> <li>2. Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project lc BC Hydro through BC Hydro's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>3. Wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta, the generation supplier must request service on the appropriate BC Hydro tonsumission line under the Open Access Transmiss Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission acc Authority for wheeling to a US customer). This 'pancaking' of rates, along with congestion issues, affects the econom</li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

nents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this

tion of BC Hydro's resource mix, making it less reliant on

en FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows:

ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

Near Bella Coola, British Columbia, Canada **Topographical Map Sheet: Figure 12** Geological Map Sheet: Figure 13

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation.</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical an considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to sever Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gene other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
<u>F.</u>	Transmission Line Infrastructure State of the Infrastructure	Bella Coola is a non integrated community (not connected to the main transmission grid). It has a 25kV distribution system
		located 5 km west of Bella Coola at Clayton Falls and a 7.8 MW diesel station (Ah-Sin-Heek) located 3 km east of Bella Co stored when the community load is less than the hydro plant can produce. The hydrogen is used to reduce diesel use duri
	Transmission Route (distance, terrain and costs)	New 69 kV transmission line 57 km to Bella Coola substation. Routing includes 5 km of submerged submarine transmissi treed, remote terrain with limited or no land access (accessible by barge).
	Community Issues	
п.	Indigenous Law and Indigenous Development Areas	First Nation Consultative Areas include Heiltsuk Nation, Nuxalk Nation.
	indigenous Law and indigenous Development Areas	<ul> <li>Heiltsuk Economic Development Corporation established by the Heiltsuk Tribal Council to enhance existing businesses a (http://www.heiltsukdevco.com/). Area of concentration is Bella Bella.</li> <li>Nuxalk First Nation territory;</li> </ul>
	Community Action	<ul> <li>Nuxalk Nation Smayusta summary of action is documented against logging, mining, fish farms from 1995 to 2003. (http://www.nuxalk.net/html/enbridge_rejected.html).</li> <li>Demonstration against Enbridge at Bella Bella in 2012 (http://www.nuxalk.net/html/enbridge_rejected.html).</li> <li>Nuxalk activists and supporters blockaded logging roads on King Island to protect the Great Bear Rainforest in 1995 (http://www.firstnations.eu/fo</li> <li>Other community action related to fish farming, logging and mining documented up to 2003 (http://www.firstnations.eu/fo</li> <li>Bella Coola Residents protested ferry cuts in 2014. (http://www.coastmountainnews.com/news/252922161.html)</li> <li>Bella Coola Food Action Plan developed with Vancouver Coastal Health in 2006 with goal for community food security an Bella Coola Food Action Plan).</li> <li>Bella Coola pilot power project Clayton Falls run-of-river generating station (http://www.canadianconsultingengineer.com/</li> </ul>
	Surface Rights	First Nation Consultative Areas include Heiltsuk Nation, Nuxalk Nation
	Tourism	• Bella Coola is a vacation destination for outdoor recreation including camping, hiking, kayaking. It is advertised as the "G (http://bellacoola.ca/).
		No significant tourism industry found on King Island.

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ion output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission ven years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

em with power supplied by a 2 MW run-of river hydro project Coola. At the diesel station hydrogen is generated and iring peak periods.

sion line; remaining new routing follows shoreline via steep,

s and pursue new business opportunities.

p://www.nuxalk.net/)

ttp://www.firstnations.eu/forestry/nuxalk.htm) forestry/nuxalk.htm)

and access for all healthy sustainable food system (see

n/features/storing-power-at-bella-coola/).

'Gateway to the Great Bear Rainforest."

# **KING ISLAND**

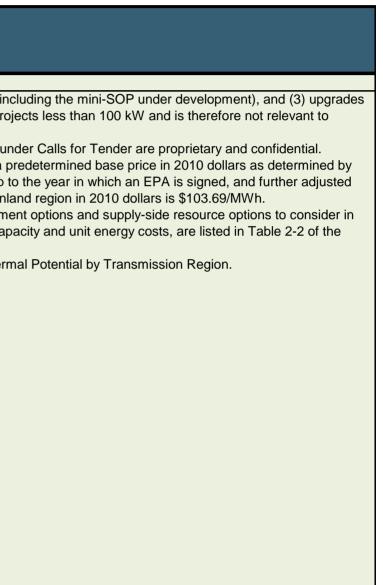
Near Bella Coola, British Columbia, Canada Topographical Map Sheet: Figure 12 Geological Map Sheet: Figure 13

	Category	Comments
I.	Water Rights	
	Availability (for example "air-cooled required")	Plant water requirement estimated approx. 25 L/s for binary plant. MAD of 49000 L/s. No current water licences at the pro water licences for purpose of power with max licence requirement of 75000 L/s.
	Availability for Drilling	Drilling requirement of 20 L/s. MAD of 49000 L/s. No current water licences at the proposed plant location. 3 existing activ with max licence requirement of 75000 L/s.
J.	Engineering	
	Plant Location and Design	Plant location sited near existing industrial renewable energy infrastructure.
	Construction Issues	Extremely remote access; construction labour and materials must be barged to proposed plant location.
	Transportation Issues	Barge access only. No access roads from mainland BC.
	Architectural Issues (Blend/hide into environment? Local styles? etc.)	None found.
	Special Construction Issues (zero emissions)	None found.
Κ.	Non-Electrical Infrastructure (Roads and Habitation)	
	Nearest Large Community > 50,000	Prince George, BC
	Nearest Community	Bella Coola, BC (50 km by boat)
	Nearest Road and Condition	No road access to proposed plant location.
	Current Access Conditions (restrictions)	Only barge access.
	Terrain and Distance Factor for Road Building	Not applicable, only barge/marine access.
	·	•

roposed plant location. 3 existing active applications for
ive applications for water licences for purpose of power

Near Bella Coola, British Columbia, Canada **Topographical Map Sheet: Figure 12** Geological Map Sheet: Figure 13

	Category	Comments						
L.	Finance							
	General Power Prices	<ul> <li>BC Hydro acquires power through (1) competitive processes (Calls for Tender), (2) the Standing Offer Program (not incluto its existing facilities or the development of new generation facilities. (Note that the net metering program targets projece geothermal generation projects). Comments on the general price of power under each one are:</li> <li>The power price paid by BC Hydro to independent power producers through Energy Purchase Agreements (EPAs) under the region of the point of interconnection to the BC Hydro system, escalated at the Consumer Price Index annually up to based upon the time of day and month when the energy is delivered. For reference, the base price for the Lower Mainlai</li> <li>BC Hydro's current Integrated Resource Plan dated November 2013 includes details of both demand-side management meeting the future demand for electricity. These resource options, together with their attributes of total energy and capa November 2013 Resource Options Report Update. That table is reproduced below for ready reference.</li> <li>Table 5-7 of the above-noted November 2013 Resource Options Report Update provides a summary of the Geothermal</li> </ul>						
		Energy Resource						
		Biomass – Wood Based	9,772	(MW) 1,226	122 - 276	132 - 306		
		Biomass – Biogas	134	16	59 – 154	56 - 156	56	
		Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204	1	
		Wind – Onshore	46,165	4,271	90 - 309	115 – 365		
		Wind – Offshore	56,700	3,819	166 - 605	182 – 681		
		Geothermal	5,992	780	91 – 573	90 - 593		
		Run-of-River	24,543	1,149	97 – 493	143 – 1,170		
		Site C <sup>3</sup>	4,700	1,100	83	88		
		Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	6,103	774	58 – 92	57 – 86		
		Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103		
		Wave	2,506	259	440 - 772	453 - 820		
		Tidal	1,426	247	253 - 556	264 - 581		
		Solar	57	12	266 – 746	341 – 954		
		<ul> <li>and may not include all possible</li> <li>2. The details of how the cost adjus</li> <li>3. The Site C values presented in the Impact Statement (EIS) submission real discount rate.</li> </ul>	resources that may ters were developed his table are based of on filed in January 2 ed to characterize th	In for each category in the table reflect the resource potential analyzed urces that may be available at an expected higher cost. were developed and applied are provided in Appendix 12. able are based on information provided in the Site C Environmental iled in January 2013, and the UEC is calculated assuming 5 per cent o characterize the natural gas-fired and coal-fired resource options, and nsidered to be unlimited.				



Near Bella Coola, British Columbia, Canada **Topographical Map Sheet: Figure 12** Geological Map Sheet: Figure 13

Category								Comments
Market Price (\$/MWhr)	<ul> <li>As noted in the above Table 2-2 from the November 2013 Resource Options Report Update, the Unit Energy Cost for gedollars ranges from \$91/MWh to 573/MWh at the point of interconnection to the BC Hydro system.</li> <li>Wholesale electricity prices for trading purposes can vary greatly. In the Pacific Northwest, these prices are affected by unforeseen generation outages and ambient temperatures. A general flavour of the wholesale electricity prices for potent variety of sources. One such source is the US Energy Information Administration (www.eia.gov/electricity/wholesale/#hist market data. Of particular relevance is the mid-C trading hub in the Northwest Region (one example would be a Mid-C per average cost from 72 trades). Access to that market for geothermal projects in BC would require access on both the BC on the appropriate transmission system (e.g. Bonneville Power Authority) in the US.</li> <li>BC Hydro forecasts of market prices under various scenarios was provided in the November 2013 IRP. Table 5 in Apper ready reference.</li> </ul>							
			Table 5		y Price Forecasts b (Real 2012 US\$/MV			
	Г		1	2	3	4	5	
		Market Scenario	Mid Electricity Mid GHG (Regional) Mid Gas	Low Electricity Low GHG (Regional) Low Gas	High Electricity High GHG (Regional) High Gas	Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	High Electricity High GHG (Regional/Nat'l) High Gas	
		2014	25.0	21.9	31.1	25.0	31.1	
		2015	25.5	21.7	31.9	25.5	31.9	
		2016 2017	25.8 27.1	21.2 22.0	32.0 33.4	25.8 27.1	32.0 33.4	
		2017	27.1	21.7	33.9	27.1	33.9	
		2019	28.0	22.1	35.5	28.0	35.5	
		2020	28.0	21.9	36.0	28.0	36.0	
		2021	29.3	22.5	37.3	29.3	37.3	
		2022	30.1	22.7	38.8	30.9	41.3	
		2023	31.8	23.2 23.7	41.7	35.5 41.8	52.1 68.6	
		2024 2025	33.0 34.2	23.7	43.4 45.4	41.8 50.3	91.2	
		2026	34.9	24.1	46.7	52.2	95.1	
		2027	36.0	24.3	48.6	54.7	98.9	
		2028	36.3	24.0	50.2	56.8	101.8	
		2029	37.2	23.9	51.1	58.8	106.1	
		2030 2031	37.6 38.6	23.8 24.0	52.7 54.7	60.1 62.6	109.3 112.0	
		2031	39.9	24.0	57.0	65.6	116.0	
		2033	41.5	24.4	60.1	69.3	122.0	
		2034	42.8	25.1	61.9	71.5	125.7	
		2035	44.6	26.2	64.5	74.5	131.0	
		2036	45.7	26.9	66.2	76.4	134.3	
	-	2037	47.8	28.1	69.1	79.8	140.3	
	-	2038 2039	48.4 48.9	28.4 28.7	70.0 70.7	80.8 81.6	142.1 143.5	
		2039	49.3	29.0	71.4	82.4	144.9	
						•	•	

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

geothermal resources at a 7% real discount rate in 2013

by such factors as precipitation/snowfall in the region, ential export of electricity from BC can be obtained from a istory). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted C Hydro transmission system to the Canada/US border, and

pendix 5A – Market Forecast Data is reproduced below for

Near Bella Coola, British Columbia, Canada Topographical Map Sheet: Figure 12 Geological Map Sheet: Figure 13

	Category	Comments
		<ul> <li>BC Hydro's past procurement processes for the acquisition for power from independent power producers has offered a p</li> <li>Within British Columbia, there is little demand for the purchase of "green power certificates" (instruments that a custome environmentally friendly) from BC Hydro. BC Hydro's generation mix is already approximately 93% clean.</li> <li>California has a goal of 33% of retail sales by 2020 to be sourced from eligible renewable energy sources. However, the particularly "bundled" green energy with Renewable Energy Certificates (RECs), to compete in that market is low, for a nur 1. The price of electricity is driven by the low cost of natural gas;</li> <li>There are large amounts of renewables, such as wind and solar, in California; and</li> <li>Firm transmission access to the California market through the BPA transmission system is generally not available.</li> </ul>
		<ul> <li>There is no price in \$/kW for capacity resource options in the market at present.</li> <li>Table 3-27 entitled "UCCs of Capacity Resource Supply Options" in BC Hydro's Integrated Resource Plan dated Noveml options (e.g. pumped storage, simple cycle gas turbines and resource smart projects such as Revelstoke Unit 6). The unit the BC Hydro system in \$2013/kW-year are shown in the table.</li> </ul>

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

a premium for green power. ner can purchase to be assured that the electricity used is

ne opportunity for geothermal power from British Columbia, number of reasons

mber 2013 provided a summary of capacity resource init capacity costs (UCCs) at the point of interconnection to

Near Bella Coola, British Columbia, Canada Topographical Map Sheet: Figure 12 Geological Map Sheet: Figure 13

Category					Comments	
	<ul> <li>In general, baseload power (ie firm power) is more valuable to BC Hydro and furthermore the price paid for baseload power the following excerpt is taken from BC Hydro's SOP:</li> <li>"1. Definitions: In this Appendix 4, the following words and expressions have the following meanings:</li> <li>(a) "Off-Peak Hours" means all hours other than Super-Peak Hours and Peak Hours.</li> <li>(b) "Peak Hours" means the hours commencing at 06:00 PPT and ending at 16:00 PPT, and commencing at 20:00 PPT inclusive, but excluding British Columbia statutory holidays.</li> <li>(c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20:00 PPT Monday through Saturday holidays."</li> </ul>					
	-	Time of				
	Month	Super-Peak	Peak	Off-Peak		
	January	141%	122%	105%		
	February	124%	113%	101%		
	March	124%	112%	99%		
	April	104%	95%	85%		
	May	90%	82%	70%		
		87%	81%	69%		
	July	105%	96%	79%		
	August	110%	101%	86%		
	September	116%	107%	91%		
	October	127%	112%	93%		
	November	129%	112%	99%		
	December	142%	120%	104%		

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ower varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

y inclusive, but excluding British Columbia statutory

# **KING ISLAND**

Near Bella Coola, British Columbia, Canada Topographical Map Sheet: Figure 12 Geological Map Sheet: Figure 13

Category	Comments
Estimated Size of Resource Is there any green power incentives?	<ul> <li>See Section A.</li> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program e Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p o Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project developmer o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of th calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include: o Natural Resources Canada ecoEnergy for Renewable Power program; o Sustainable Development Technology Canada funds; o Clean Energy Fund; o Industrial Research Assistance Program; and o Green Infrastructure Fund</li> <li>Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability</li> </ul>
Grants Tax Holidays Tax Relief	<ul> <li>See above under green power incentives</li> <li>None listed on federal and provincial websites.</li> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 43 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred duri and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the ye deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now n entitled Scientific Research and Experimental ity and relevance.
<pre>/ participation in the clean energy sector. It provides: ent; and</pre>
these programs may be active but not currently issuing al technologies/resources, while others may be fully
ity and relevance.
ce energy by using renewable energy sources or fuels from

43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 sets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy year they are incurred, carried forward indefinitely and

### **KING ISLAND**

Near Bella Coola, British Columbia, Canada Topographical Map Sheet: Figure 12 Geological Map Sheet: Figure 13

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> <li>FNFA loans do not require collateral;</li> </ol>
	<ol> <li>FNFA loans can be used to refinance existing debt; and</li> <li>FNFA's interest rates and terms parallel those available to provincial and local governments.</li> </ol>
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infrast purchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Born and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015
	Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribed
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section,
	(b) an amount agreed under this section to be paid instead of royalty, or
	(c) if no royalty or amount has been agreed under this section, the prescribed royalty.
General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "This in section 1 (1) [definitions] of the Geothermal Resources Act."
Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners for Proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg Statu

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. s that join as Borrowing Members.

astructure, social and economic development, land

orrowing Members, represented by the First Nation's Chief

ed rent for the permit (Section 5).

pay to the government

his Act does not apply to geothermal resources as defined

for the geothermal land tract. tutory Right of Way, Licence of Occupation).

# **KING ISLAND**

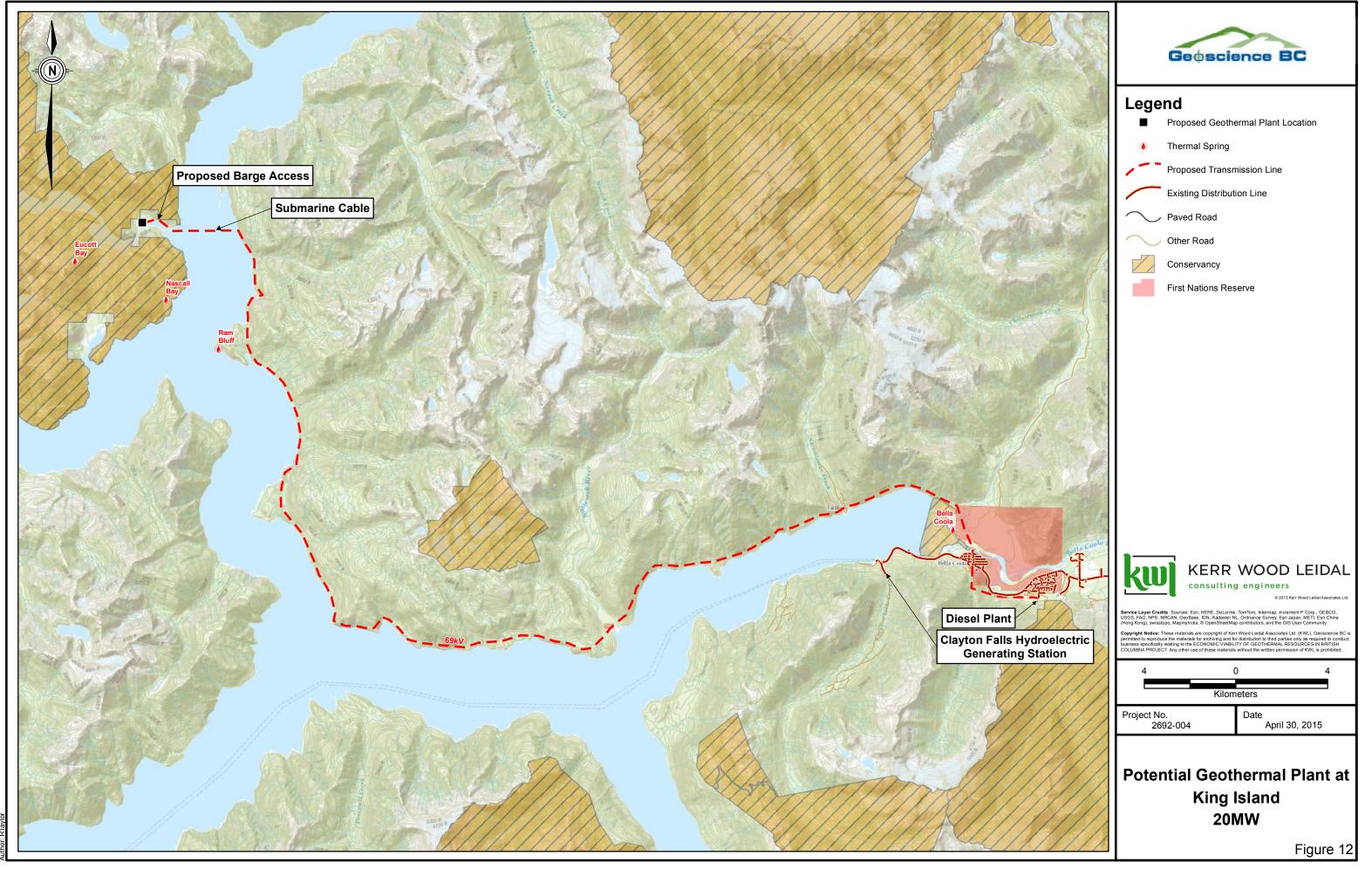
Near Bella Coola, British Columbia, Canada Topographical Map Sheet: Figure 12 Geological Map Sheet: Figure 13

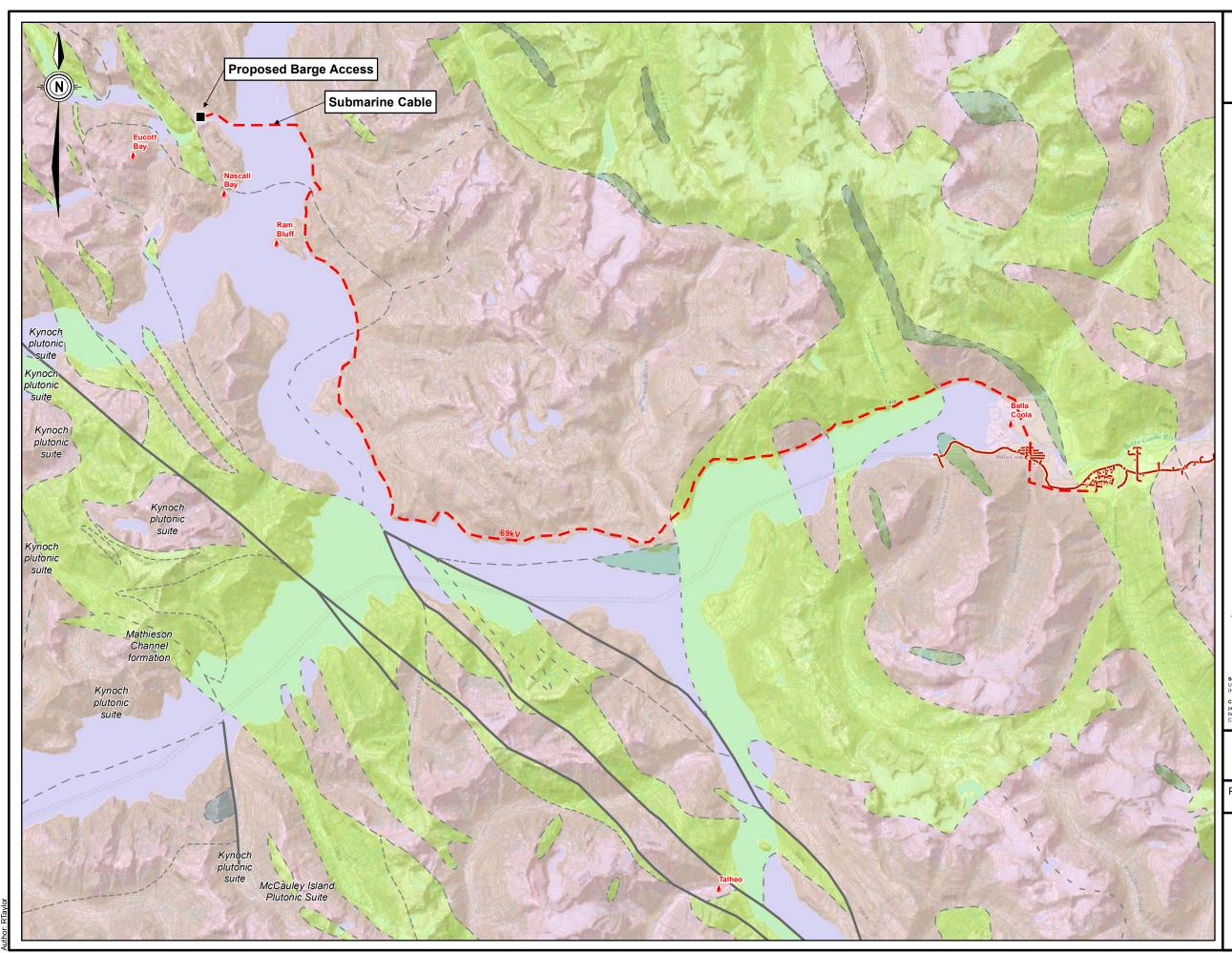
	Category	Comments
	Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincial</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
	Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission access Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the
N	Maps	
	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)	
	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 12
	Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 13
	Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 13
Ν	Other Issues and Considerations	

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ial (British Columbia): 13.5%.

ta, the US, or other wholesale customers in BC, the nission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power he economic viability of the potential wholesale opportunity.





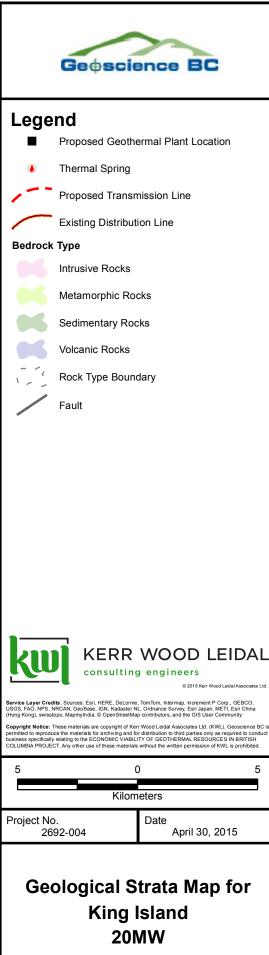


Figure 13



Appendix H

**Kootenay Geothermal Development Decision Matrix and Figures 14 & 15** 

kwl.ca

Near Ainsworth Hotsprings, British Columbia, Canada Topographical Map Sheet: Figure 14 Geological Map Sheet: Figure 15

	Category	Comments
Α.	Reservoir Potential	
	Size/Potential/Type	<ul> <li>Reservoir size: N/A (no area or depth defined in literature) - therefore, reservoir volume estimated* at between: 2.2 km<sup>3</sup> spring of 2 km<sup>2</sup> and most-likely thickness of 1.1 km. The minimum estimate is calculated for a single spring, and the maxim [Ainsworth and Riondel, based on temperature and fluids chemistry] and a separation of 4.4 km). (*Reservoir assumptions</li> <li>Potential: 20 MW gross (WREZ, 2009)</li> <li>Type: binary (low temperature)</li> </ul>
	Temperature/Water and Gas Chemistry/Mineral Indicators	<ul> <li>Surface features:</li> <li>Several springs in the Kootenay area: Ainsworth and Riondel Hot Springs are located near the west and east shores of K Creek HS and Kaslo Creek Spring (50 km east and 20 west of the Kootenay database location, respectively); Crawford Creet Ainsworth HS: 48°C discharge temperature (Fairbank &amp; Faulkner, 1992 for all spring temps listed)</li> <li>Riondel HS: 48°C</li> <li>Dewar Creek HS: 83°C discharge temperature</li> <li>Kaslo Creek Spring: 11°C (cold spring)</li> <li>Crawford Creek HS: ~30-32°C</li> </ul>
		<ul> <li>Geothermometry:</li> <li>Ainsworth HS: Na-K-Ca and Na-K-Ca-Mg temperatures of all samples ~ 90°C (Souther, 1975; Grasby et al, 2000); Chalce sulfate-water oxygen isotope temperature given as 119°C (Grasby et al, 2000)</li> <li>Dewar Creek HS: Na-K-Ca and Na-K-Ca-Mg temperature is 149°C (Souther, 1975; Grasby et al, 2000);</li> <li>Crawford Creek HS: geothermometers indicate uniformly cool conditions (Souther, 1975; Grasby et al, 2000)</li> <li>Exploration drilling:</li> <li>Local geothermal gradient average: 34°C/km along the Purcell Trench (Grasby &amp; Hutcheon, 2001)</li> </ul>
		<ul> <li>Local geothermal gradient average: 34*C/km along the Purceit Trench (Grasby &amp; Hutcheon, 2001)</li> <li>Riondel mining operations: encountered fluids ranging between 21 - 40°C. Expected depth to resource ~530 m (Desrocher Water chemistry: (Souther, 1975; Grasby et al, 2000 for ALL except Riondel)</li> <li>Ainsworth HS: type is (Na&gt;Ca)-HCO<sub>3</sub>, with alkalinity at about 1,050 mg/l, Mg between 0.4 to ~5 mg/l, and Cl at about 45 million encoded with CO<sub>2</sub>. (Desrochers, 1992)</li> <li>Dewar HS: Water type is Na-(SO<sub>4</sub>&gt;HCO<sub>3</sub>) with HCO<sub>3</sub> at 149 mg/l, Mg at 0.3 mg/l and Cl at 54 mg/l.</li> <li>Kaslo Creek Spring: Ca-HCO<sub>3</sub> type with geothermometers all cool.</li> <li>Crawford Creek HS: Water type is mixed cation-HCO3 but extremely dilute (2); low mineral content (65 ppm TDS) (Desroc Mineral indicators:</li> <li>No information</li> </ul>

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

<sup>3</sup> and 10.6 km<sup>3</sup> (with a most-likely area for any single ximum estimate is calculated using two hot springs ns made using Appendix III in GeothermEx, 2004)

Kootenay Lake, respectively. Also in the area are Dewar Creek HS (14 km SE of Riondel).

Icedony and Quartz temperatures from 142 to 165°C, but

hers, 1992)

5 mg/l.

srochers, 1992).

Near Ainsworth Hotsprings, British Columbia, Canada **Topographical Map Sheet: Figure 14** Geological Map Sheet: Figure 15

Category	Comments
Surface Flow Rates and Reservoir Recharge	<ul> <li>Various:</li> <li>Ainsworth Hot Springs: low to moderate flow rate of 7 L/s (Fairbank &amp; Faulkner, 1992)</li> <li>Riondel: "large" flow rate (Fairbank &amp; Faulkner, 1992); potential production rates of up to 150 L/s (Desrochers, 1992)</li> <li>Dewar Creek: unknown flow rate</li> <li>Kaslo Creek: 2 L/s flow rate</li> <li>Crawford Creek: "0" flow rate (Fairbank &amp; Faulkner, 1992); flow rate of 0.2 L/s (Desrochers, 1992)</li> <li>All of the hot springs in this region lie on the stable isotope meteoric water line (Ainsworth may be an exception)</li> </ul>
3D Permeability (heat exchange potential)	No information
Recent Magmatism	N/A
Structural Setting	<ul> <li>The primary structures in the area are the Purcell Anticlinorium east of the lake (broad, northerly plunging fold cut by long of rift-related sedimentary rocks of the Proterozoic Windermere [sandstone, conglomerate, carbonates] and Purcell Super (characterized by north-trending isoclinal to tight folds, increasing in metamorphic grade from greenschist to amphibolites The Kootenay Arc merges on the east with the Purcell Anticlinorium (Webster &amp; Pattison, 2013).</li> <li>The Nelson batholith (composite pluton of granodiorite to quartz monzonite) lies to the west of Kootenay Lake, and is bour (a N-S trending Eocene normal fault dipping eastward 30°) and on east by the Purcell Trench Fault (PTF) (Sweetkind &amp; Du on the PTF is an Eocene, east-dipping, crustal scale extensional (normal) fault, the trace of which is largely covered by the 2013).</li> <li>Riondel area: Steep cross-fractures trending WNW, dipping 80-90°N containing tabular ore bodies which plunge to the we fault underlies the Badshot marble in the mining area (Hoy, 1980).</li> </ul>
Geophysics	No information
Reservoir Host Rock	<ul> <li>Springs likely issuing from fractures or faults in granitic or metamorphic rocks (non-volcanic) (Souther, 1975 and Souther</li> <li>Riondel: host rock westward dipping Badshot formation (limestone ~40 m thick, dipping 35°W) (Desrochers, 1992).</li> <li>Crawford: possibly hosted by same Badshot formation, on east side of Crawford Antiform; low temperature and flow (Desrochers, 2000).</li> </ul>
Drilling Issues Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	Riondel: Scale Buildup and high CO <sub>2</sub> gas content - Rapid precipitation of CaMgCO <sub>3</sub> when pumping out fluid from mining of Intrusive bodies (ranging in age from Middle Jurassic to Eocene) cover the west side of Kootenay Lake, including the Nels (granodiorite to monzonite) to the south (these two bodies are separated by the Eocene normal Midge Creek Fault); grano part of the Windermere stratigraphic unit; and McGregor Intrusives as massive/porphyritic syenite plutons (Webster & Patt • Riondel: located in the central part of the Kootenay Arc and seemingly at the structural culmination (as the arc plunges no (2) CO <sub>2</sub> charged thermal waters flowed from fissures at the Bluebell Mine in the Riondel area (area has thick marble units Ag]). Deposits of CaCO <sub>3</sub> were also produced in associated caves and adits (Hoy, 1980; Desrochers, 1992). • Ainsworth and Crawford: occur near the northern termination of the Purcell Trench Fault (PTF)(Grasby & Hutcheon, 2007 • Dewer: The hottest recorded thermal spring in the southern Canadian Cordillera occurs east of the Purcell Trench, along the Hall Lake Fault (another major crustal feature) (Grasby & Hutcheon, 2001).

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ngitudinal and transverse faults, with extensive exposures ergroups) and the Kootenay Arc west of the lake a facies to the east) to the west of the Purcell Anticlinorium.

unded on the west by the Slocan Lake Fault Zone (SLFZ) Duncan, 1989) (Grasby & Hutcheon, 2001). e lake (Grasby & Hutcheon, 2001; Webster & Pattison,

west along fractures in the marbles. A major N-trending

er & Halstead 1973).

esrochers, 1992).

operation (Desrochers, 1992).

Ison batholith to the north and the Bayonne batholith odiorite Wall and Mine stocks which truncate the upper attison, 2013).

north to the north, and south to the south of this point). (1) ts containing ore bodies of sulphide minerals [Zn, Pb, Cu,

01).

g a steeply dipping unnamed fault between the PTF and

### Geothermal Development Decision Matrix

# KOOTENAY

Near Ainsworth Hotsprings, British Columbia, Canada Topographical Map Sheet: Figure 14 Geological Map Sheet: Figure 15

	Category	Comments
В.	Exploration Uncertainty (Risk)	
	Degree of Identification of Resources/Reserves	<ul> <li>Low</li> <li>Largely based on presence of hot springs and thermal waters in Riondel mine. Only geologic reconnaissance and mappi efforts.</li> <li>Ainsworth/Riondel area may have commercial potential (geothermometer up to 165°C). Possibly also Dewar Creek HS (Wilderness Conservancy Provincial Park.</li> </ul>
	Likelihood of Covering Reservoir with Concession	Moderate (Varied) <ul> <li>Aisnworth: commercial spa; mineral title tracts along west shore of Kootenay Lake surrounding Ainsworth HS</li> <li>Riondel: seemingly likely; located lake-ward of town of Riondel</li> <li>Dewar Creek: lies within the Purcell Wilderness Conservancy Provincial Park, hence unlikely to be within concession.</li> <li>Crawford Creek: mineral title tracts surround Crawford on 3 sides</li> </ul>
	Expected Authorization Date	Unknown
		<ul> <li>5-6 years</li> <li>(1 year deep gradient-well drilling + 2 year successful development drilling and testing + 1 year further development drilling finish plant construction). Possible delays due to issues of access and competing use (mining, resorts).</li> </ul>
	Degree of Previous Exploration (can be good or bad)	Low to moderate Geology in area is well defined. Geothermometry has been performed on springs. No temperature gradient wells drilled. No
	Surface Operational Capacity (enough stable area for drilling and a plant?)	Likely (Varied) - Ainsworth: located in resort town, stable area appears sufficient Riondel: appears sufficient Dewar Creek: appears sufficient Crawford Creek: appears sufficient
		Moderate to difficult Potential for lease/permitting issues with mine leases/conservancy areas/hot-spring resorts.
C.	Environmental Issues	
	Protected Areas	<ul> <li>Kokanee Lake Provincial Park less than 500 m from proposed transmission line.</li> <li>Cody Caves Provincial Park approx. 3.5 km from proposed plant location.</li> </ul>
	Endangered Species	<ul> <li>Blunt-sepaled starwort (blue-listed plant) occurrence polygon approx. 5 km from proposed infrastructure.</li> <li>White Sturgeon, Kootenay River population (Endangered (SARA Schedule 1); red-listed) habitat polygon in river, approx.</li> <li>Westslope Cutthroat Trout, British Columbia Population (Special Concern (SARA Schedule 1); blue-listed) observed in Ki crosses.</li> </ul>
	Geothermal Surface Features	<ul> <li>Ainsworth Hotsprings is close to proposed plant location.</li> <li>Riondel hotsprings approx. 7 km from proposed plant location.</li> </ul>
	Other	<ul> <li>Proposed transmission line makes one crossing over a stream (Krao Creek).</li> <li>Nearest Wildlife Habitat Area allotted for Grizzly Bear is located approx. 100 km from proposed infrastructure.</li> </ul>

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ping done in area. No reported development or exploration G (geothermometer up to 149°C), but it is within Purcell

ng and start plant construction + 1 year drilling wrap-up and

No other surface-based exploration surveys known.

ox. 0.5 km from proposed transmission line connection. Krao Creek, over which proposed transmission line

#### **Geothermal Development Decision Matrix**

### KOOTENAY

Near Ainsworth Hotsprings, British Columbia, Canada **Topographical Map Sheet: Figure 14** Geological Map Sheet: Figure 15

	Category	Comments
D.	Geothermal Area - Bidding and/or Type of Land Holding (private/government/lease/etc.)	
	Bidding Area	No known existing active, cancelled or unsold geothermal title tracts
	Other Claim Rights (mining and/or oil)	Existing mineral, coal title at plant location and along proposed power line route. Many mineral/coal titles within 30 km radi
		management area; no known tenures at proposed location.
_		
Ε.	Market Main Electricity Consumers (direct sales and/or government)	General Overview
		<ol> <li>BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through t         <ul> <li>Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propor             Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW t             against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponer             threshold for the SOP (BC Hydro is developing a "mini-SOP" component within the overall SOP. This mini-SOP will apply             realistically apply to potential geothermal generation projects).</li> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect             distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pa             program has no applicability to potential geothermal generation projects.         </li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificat         snow melt and stream flow.</li> </ul> </li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give         under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project I         BC Hydro through BC Hydro's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>Wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta, tf         generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmi         Depending on the end customer, the generation supplier will have to make simila</li></ol>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

dius. Proposed location is not within known oil and gas

two main processes:

nents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this

tion of BC Hydro's resource mix, making it less reliant on

ren FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

Kootenay Lake.

Near Ainsworth Hotsprings, British Columbia, Canada **Topographical Map Sheet: Figure 14** Geological Map Sheet: Figure 15

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generatio</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical an considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to seve Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gene other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction were seven projects of a required to drill a geothermal well and construction and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
_		
F.	Transmission Line Infrastructure	Oleanet eutreteine is FartisDO Orffan Oracle autotation an CO UV/transmission line
	State of the Infrastructure	Closest substation is FortisBC Coffee Creek substation on 63 kV transmission line.
	Transmission Route (distance, terrain and costs)	Approx. 7 km of new 63 kV transmission line via existing roads and powerline corridor to FortisBC Coffee Creek substation
Н.	Community Issues	
Н.	Community Issues Indigenous Law and Indigenous Development Areas	<ul> <li>Nicola Indian Band, Penticton Indian Band, Adams Lake Indian Band, Ktunaxa Nation Council, Akisqnuk First Nation, Low Plains Indian Band.</li> <li>Lower Kootenay Band (part of Ktunaxa Nation) is responsible for the stewardship of the lands and resources within the st (http://lowerkootenay.com/departments/lands-and-resources/).</li> <li>The Lower Kootenay Band's vision for economic development incudes a large majority of business interests currently in for the lands and resources.</li> </ul>
<u>H.</u>	Indigenous Law and Indigenous Development Areas	<ul> <li>Lower Kootenay Band (part of Ktunaxa Nation) is responsible for the stewardship of the lands and resources within the st (http://lowerkootenay.com/departments/lands-and-resources/).</li> <li>The Lower Kootenay Band's vision for economic development incudes a large majority of business interests currently in f "always open to discuss potential business partnerships or economic development on our community lands." (http://lowerk</li> <li>Ainsworth Town-site Local Area Plan examines the introduction of commercial services to promote full time residents</li> </ul>
н.		<ul> <li>Nicola Indian Band, Penticton Indian Band, Adams Lake Indian Band, Ktunaxa Nation Council, Akisqnuk First Nation, Low Plains Indian Band.</li> <li>Lower Kootenay Band (part of Ktunaxa Nation) is responsible for the stewardship of the lands and resources within the st (http://lowerkootenay.com/departments/lands-and-resources/).</li> <li>The Lower Kootenay Band's vision for economic development incudes a large majority of business interests currently in f "always open to discuss potential business partnerships or economic development on our community lands." (http://lowerko.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ion output of less than 15 MW.

ne market will be necessary.

and environmental studies, public consultation, transmission even years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while struct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

ion.

nlith Indian Band, Lower Similkameen Indian Band, Upper ower Kootenay Band, St. Mary's Indian Band, Tobacco

stewardship area that includes the proposed plant location.

forestry, agriculture, energy and tourism; the band is rkootenay.com/departments/economic-development/)

nlith Indian Band, Lower Similkameen Indian Band, Upper wer Kootenay Band, St. Mary's Indian Band, Tobacco

### Geothermal Development Decision Matrix

## KOOTENAY

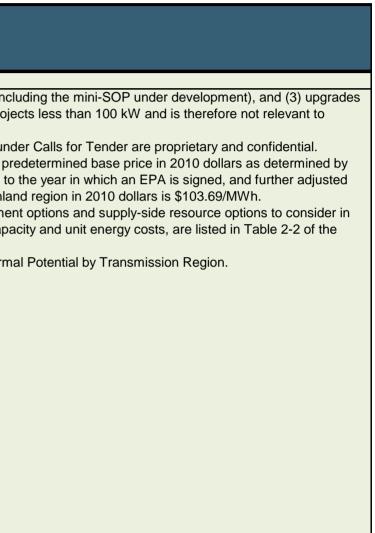
Near Ainsworth Hotsprings, British Columbia, Canada Topographical Map Sheet: Figure 14 Geological Map Sheet: Figure 15

		Category	Comments
I.		Water Rights	
		Availability (for example "air-cooled required")	Plant water requirement estimated approx. 25 L/s for binary plant. MAD of 130 L/s. Approx. 70 active water licences within domestic and mineral trading - bath.
		Availability for Drilling	Drilling requirement of 20 L/s. MAD of 130 L/s. Approx. 70 active water licences within 5 km of proposed plant location; ma
J	J.	Engineering	
		Plant Location and Design	Plant location near to existing paved roads, moderate terrain.
		Construction Issues	Moderately sloped terrain.
		Transportation Issues	Paved, existing road less than 1 km to plant location.
		Architectural Issues (Blend/hide into environment? Local styles?	
		etc.)	None found.
		Special Construction Issues (zero emissions)	None found.
ł	Κ.	Non-Electrical Infrastructure (Roads and Habitation)	
		Nearest Large Community > 50,000	Kelowna, BC
		Nearest Community	Ainsworth Hot Springs, BC
		Nearest Road and Condition	Nearest road is existing paved road to FortisBC Coffee Creek substation less than 1 km from plant location.
		Current Access Conditions (restrictions)	Access via existing paved road.
		Terrain and Distance Factor for Road Building	Terrain is relatively flat; no requirement for new roads expected.

in 5 km of proposed plant location; main purpose is
nain purpose is domestic and mineral trading - bath.

Near Ainsworth Hotsprings, British Columbia, Canada **Topographical Map Sheet: Figure 14** Geological Map Sheet: Figure 15

	Category					Comments	
L.	Finance						
	General Power Prices	BC Hydro acquires power through to its existing facilities or the devel geothermal generation projects). C • The power price paid by BC Hydr • The power price paid by BC Hydr the region of the point of interconn based upon the time of day and m • BC Hydro's current Integrated Re meeting the future demand for ele November 2013 Resource Options • Table 5-7 of the above-noted No	opment of new g Comments on the ro to independer ection to the BC onth when the e esource Plan da ctricity. These r s Report Update	generation facilit e general price on t power produce t power produce Hydro system, nergy is delivered ted November 2 esource options . That table is re	ies. (Note that the point of power under each start ough Energiers through EPA escalated at the ed. For reference of 13 includes de together with the produced below.	the net metering each one are: rgy Purchase Ag s under the SO consumer Price e, the base price tails of both dem heir attributes of w for ready refer	program targets proj greements (EPAs) un P are made up of a pr e Index annually up to a for the Lower Mainla hand-side manageme total energy and capa ence.
		Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)	
		Biomass – Wood Based	9,772	1,226	122 – 276	132 – 306	
		Biomass – Biogas	134	16	59 – 154	56 – 156	
		Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204	
		Wind – Onshore	46,165	4,271	90 - 309	115 – 365	
		Wind – Offshore	56,700	3,819	166 - 605	182 – 681	
		Geothermal	5,992	780	91 – 573	90 - 593	
		Run-of-River	24,543	1,149	97 – 493	143 – 1,170	
		Site C <sup>3</sup> Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	4,700 6,103	1,100 774	83 58 – 92	88 57 – 86	
		Cogeneration Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103	
		Wave	2,506	259	440 - 772	453 - 820	
		Tidal	1,426	247	253 - 556	264 - 581	
		Solar	57	12	266 - 746	341 – 954	
		<ol> <li>Notes:</li> <li>The resources and UEC values s and may not include all possible of the details of how the cost adjustions.</li> <li>The details of how the cost adjustion of the limpact statement (EIS) submission real discount rate.</li> <li>Representative projects were used the resource potential is generally</li> </ol>	esources that may ters were developed is table are based o on filed in January 2 ed to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC e natural gas-fired a	xpected higher cos ovided in Appendix ded in the Site C Er is calculated assum	t. 12. nvironmental ning 5 per cent	



Near Ainsworth Hotsprings, British Columbia, Canada **Topographical Map Sheet: Figure 14** Geological Map Sheet: Figure 15

Category								Comments
Market Price (\$/MWhr)	dollars ra • Wholes unforese variety o market o average on the ap • BC Hyo ready ref	anges fro sale elec een gene f source lata. Of cost from ppropriation dro forect ference.	om \$91/N ctricity price aration ou s. One su particula m 72 trad te transmicasts of m	Wh to 573/I ces for tradir tages and a uch source is r relevance i les). Access ission syste	MWh at the p ng purposes of mbient tempe s the US Ener s the mid-C to s to that mark m (e.g. Bonne under variou	oint of interco can vary grea gratures. A g rgy Informatio rading hub in et for geothe eville Power	onnection to the tly. In the Pace eneral flavour on Administrate the Northwes rmal projects Authority) in the	s Report Update, the Unit Energy Cost for g he BC Hydro system. iffic Northwest, these prices are affected by of the wholesale electricity prices for poten tion (www.eia.gov/electricity/wholesale/#his at Region (one example would be a Mid-C p in BC would require access on both the BC he US. in the November 2013 IRP. Table 5 in Appe
			Table 5		y Price Forecasts b (Real 2012 US\$/MV			
		nario N	1 I Electricity Mid GHG Regional) Mid Gas	2 Low Electricity Low GHG (Regional) Low Gas	3 High Electricity High GHG (Regional) High Gas	4 Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	5 High Electricity High GHG (Regional/Nat'l) High Gas	
	20	014	25.0 25.5 25.8	21.9 21.7 21.2	31.1 31.9 32.0	25.0 25.5 25.8	31.1 31.9 32.0	
	20	016 017 018	27.1 27.1	21.2 22.0 21.7	32.0 33.4 33.9	25.8 27.1 27.1	32.0 33.4 33.9	
	20	019 020	28.0 28.0	22.1 21.9	35.5 36.0	28.0 28.0	35.5 36.0	
	20	021 022	29.3 30.1	22.5 22.7	37.3 38.8	29.3 30.9	37.3 41.3	
	20	023 024 025	31.8 33.0 34.2	23.2 23.7 24.0	41.7 43.4 45.4	35.5 41.8 50.3	52.1 68.6 91.2	
	20	026	34.9 36.0	24.0 24.1 24.3	45.4 46.7 48.6	52.2 54.7	95.1	
		028 029	36.3 37.2	24.0 23.9	50.2 51.1	56.8 58.8	101.8 106.1	
	I —	030 031	37.6 38.6	23.8 24.0	52.7 54.7	60.1 62.6	109.3 112.0	
	20	032	39.9 41.5	24.0 24.4	57.0 60.1	65.6 69.3	116.0 122.0	
	20	034 035 036	42.8 44.6 45.7	25.1 26.2 26.9	61.9 64.5 66.2	71.5 74.5 76.4	125.7 131.0 134.3	
	20	037	45.7 47.8 48.4	28.1 28.4	69.1 70.0	79.8 80.8	134.3 140.3 142.1	
	20	039 040	48.9 49.3	28.7 29.0	70.7	81.6 82.4	143.5 144.9	

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

geothermal resources at a 7% real discount rate in 2013

by such factors as precipitation/snowfall in the region, ential export of electricity from BC can be obtained from a istory). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted C Hydro transmission system to the Canada/US border, and

pendix 5A – Market Forecast Data is reproduced below for

Near Ainsworth Hotsprings, British Columbia, Canada **Topographical Map Sheet: Figure 14** Geological Map Sheet: Figure 15

Category					Comments	
Green Power Premium (\$/MWhr)	<ul> <li>Within British C environmentally</li> <li>California has a particularly "bund 1. The price of e 2. There are large</li> </ul>	olumbia, there is iriendly) from BC goal of 33% of r lled" green energ ectricity is driven e amounts of ren	little demand Hydro. BC H retail sales by gy with Renew by the low c newables, suc	d for the purch lydro's genera y 2020 to be so wable Energy ost of natural ch as wind and	l solar, in California; and	
Capacity Price (\$/KW)	<ul> <li>There is no prio</li> <li>Table 3-27 ention</li> <li>options (e.g. pur</li> </ul>	<ul> <li>3. Firm transmission access to the California market through the BPA transmission system is generally not avain the end of the system is generally not avain the end of the system is generally not avain the end of the system in the system is generally not avain the end of the system in the system is generally not avain the end of the system in the table.</li> </ul>				
	"1. Definitions: I				xpressions have the following meanings:	
	(b) "Peak Hours' inclusive, but ex	means the hours cluding British Co Hours" means th	s commencir Iumbia statu e hours com	ng at 06:00 PP tory holidays. mencing at 16	Hours and Peak Hours. T and ending at 16:00 PPT, and commencing at 20:00 PPT a :00 PPT and ending at 20:00 PPT Monday through Saturday in	
	(b) "Peak Hours' inclusive, but ex (c) "Super-Peak	means the hours cluding British Co Hours" means th Time of	s commencir Iumbia statu e hours com Delivery Facto	ng at 06:00 PP tory holidays. mencing at 16	T and ending at 16:00 PPT, and commencing at 20:00 PPT a	
	(b) "Peak Hours" inclusive, but exe (c) "Super-Peak holidays." Month	means the hours cluding British Co Hours" means th Time of Super-Peak	s commencir Iumbia statu e hours com Delivery Facto Peak	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak	T and ending at 16:00 PPT, and commencing at 20:00 PPT a	
	(b) "Peak Hours' inclusive, but exe (c) "Super-Peak holidays." Month January	means the hours cluding British Co Hours" means the Time of Super-Peak 141%	s commencir Iumbia statu e hours com Delivery Facto Peak 122%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a	
	(b) "Peak Hours" inclusive, but exe (c) "Super-Peak holidays." Month January February	means the hours cluding British Co Hours" means th Time of Super-Peak 141% 124%	s commencir lumbia statu e hours com Delivery Facto Peak 122% 113%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a	
	(b) "Peak Hours" inclusive, but exe (c) "Super-Peak holidays." Month January February March	means the hours cluding British Co Hours" means the Time of Super-Peak 141%	s commencir Iumbia statu e hours com Delivery Facto Peak 122%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a	
	(b) "Peak Hours" inclusive, but exe (c) "Super-Peak holidays." Month January February March April	Time of Super-Peak 141% 124%	s commencir lumbia statu e hours com Delivery Facto Peak 122% 113% 112%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a	
	(b) "Peak Hours" inclusive, but exe (c) "Super-Peak holidays." Month January February March	Time of Super-Peak 141% 124% 104%	s commencir lumbia statu e hours com Delivery Facto Peak 122% 113% 112% 95%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a	
	(b) "Peak Hours" inclusive, but exe (c) "Super-Peak holidays." Month January February March April May	Time of Super-Peak 141% 124% 104% 90%	s commencir lumbia statu e hours com Delivery Facto Peak 122% 113% 112% 95% 82%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a	
	(b) "Peak Hours" inclusive, but exe (c) "Super-Peak holidays." Month January February March April May June	means the hours cluding British Co Hours" means the Super-Peak 141% 124% 124% 104% 90% 87%	s commencir lumbia statu e hours com Delivery Facto Peak 122% 113% 112% 95% 82% 81%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a	
	(b) "Peak Hours" inclusive, but exe (c) "Super-Peak holidays." Month January February March April May June July	means the hours cluding British Co Hours" means the Super-Peak 141% 124% 124% 104% 90% 87% 105%	s commencir lumbia statur e hours com Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a	
	(b) "Peak Hours" inclusive, but exe (c) "Super-Peak holidays." Month January February March April May June July August	means the hours cluding British Co Hours" means the Super-Peak 141% 124% 124% 104% 90% 87% 105% 110%	s commencir lumbia statut e hours com Delivery Facto Peak 122% 113% 112% 95% 82% 81% 96% 101%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) 0ff-Peak 105% 101% 99% 85% 70% 69% 79% 86%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a	
	(b) "Peak Hours" inclusive, but exe (c) "Super-Peak holidays." Month January February March April May June July August September	means the hours cluding British Co Hours" means the Super-Peak 141% 124% 124% 104% 90% 87% 105% 110% 116%	s commencir lumbia statur e hours com Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96% 101% 107%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86% 91%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a	

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

premium for green power. er can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

nber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

inclusive, but excluding British Columbia statutory

Near Ainsworth Hotsprings, British Columbia, Canada Topographical Map Sheet: Figure 14 Geological Map Sheet: Figure 15

Category	Comments
Estimated Size of Resource Is there any green power incentives?	<ul> <li>See Section A.</li> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercia</li> </ul>
	expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program e Development Tax credit (SR&ED). Geothermal proponents could keep a watching brief on these programs for applicability
	• The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p
	o Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project developmer o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.
	<ul> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the</li> </ul>
	calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal
	subscribed and even inactive but are noted in terms of completeness. Some of these programs include: o Natural Resources Canada ecoEnergy for Renewable Power program;
	o Sustainable Development Technology Canada funds;
	o Clean Energy Fund;
	o Industrial Research Assistance Program; and
	o Green Infrastructure Fund
Grants	Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability See above under green power incentives
Tax Holidays	None listed on federal and provincial websites.
Tax Relief	• Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce
	waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 43
	per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 22 percent per year on a declining balance basis under Class 42.2 Without these percentage write offer many of these accest
	percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.
	<ul> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred duri</li> </ul>
	and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the year
	deducted in future years, or transferred to investors through a flow-through share agreement.

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now n entitled Scientific Research and Experimental ity and relevance.
<pre>/ participation in the clean energy sector. It provides: ent; and</pre>
these programs may be active but not currently issuing al technologies/resources, while others may be fully
ity and relevance.
ce energy by using renewable energy sources or fuels from 43.1, eligible equipment may be written-off at 30 percent

22, 2005 and before year 2020 may be written-off at 50 ets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy year they are incurred, carried forward indefinitely and

Near Ainsworth Hotsprings, British Columbia, Canada **Topographical Map Sheet: Figure 14** Geological Map Sheet: Figure 15

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly. The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities.
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> <li>FNFA loans do not require collateral;</li> </ol>
	<ol> <li>FNFA loans can be used to refinance existing debt; and</li> <li>FNFA's interest rates and terms parallel those available to provincial and local governments.</li> </ol>
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infra- purchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Bor and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015
	Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribe
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section,
	(b) an amount agreed under this section to be paid instead of royalty, or
	(c) if no royalty or amount has been agreed under this section, the prescribed royalty.
General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "Thi
Private Land Owner or Government Land	in section 1 (1) [definitions] of the Geothermal Resources Act." Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners f
	Proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg Stati
Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincia</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. es that join as Borrowing Members.

astructure, social and economic development, land

orrowing Members, represented by the First Nation's Chief

ed rent for the permit (Section 5).

pay to the government

his Act does not apply to geothermal resources as defined

for the geothermal land tract. atutory Right of Way, Licence of Occupation). ial (British Columbia): 13.5%.

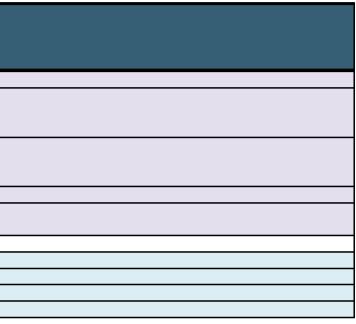
ta, the US, or other wholesale customers in BC, the nission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power ne economic viability of the potential wholesale opportunity.

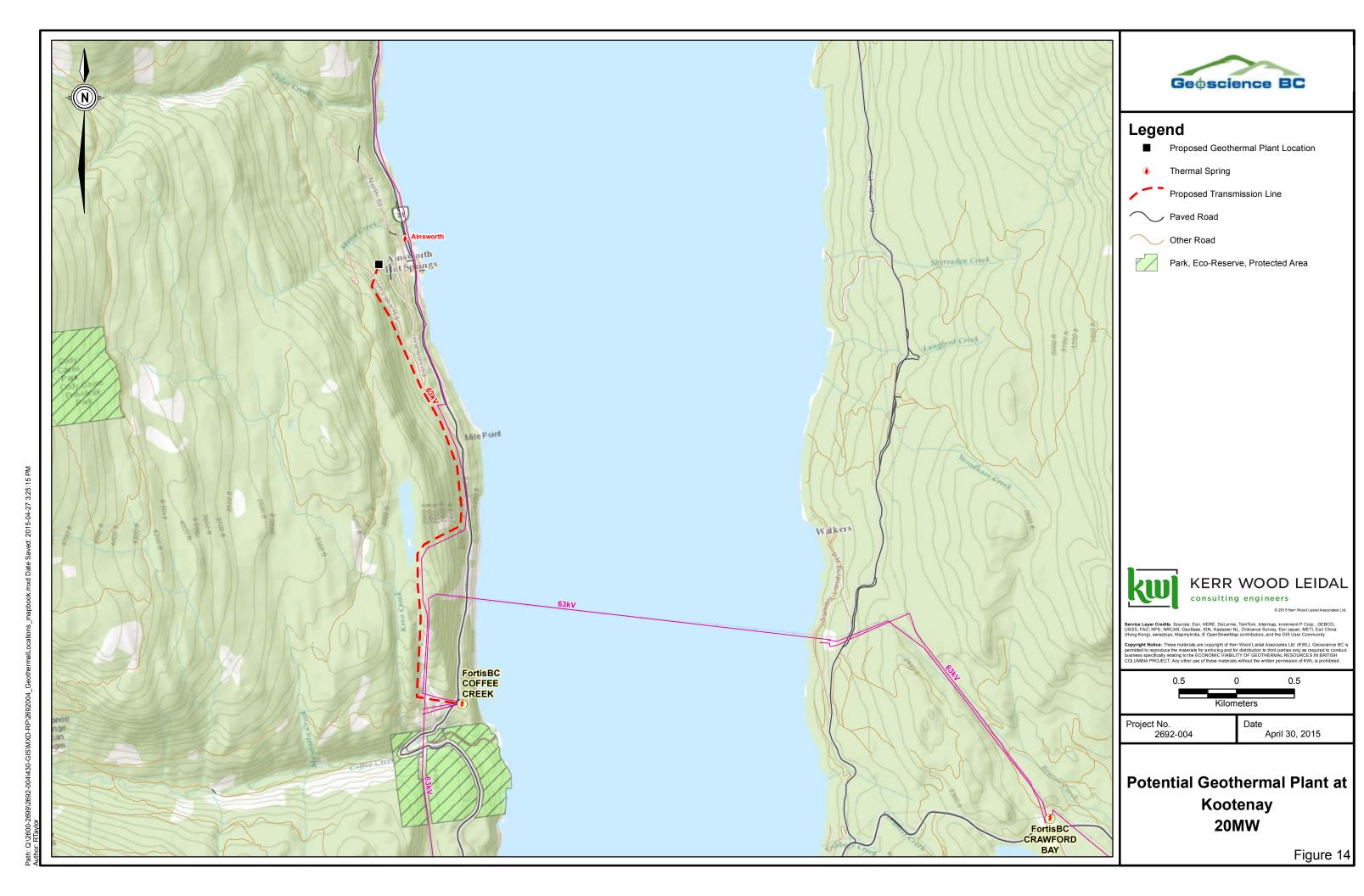
### Geothermal Development Decision Matrix

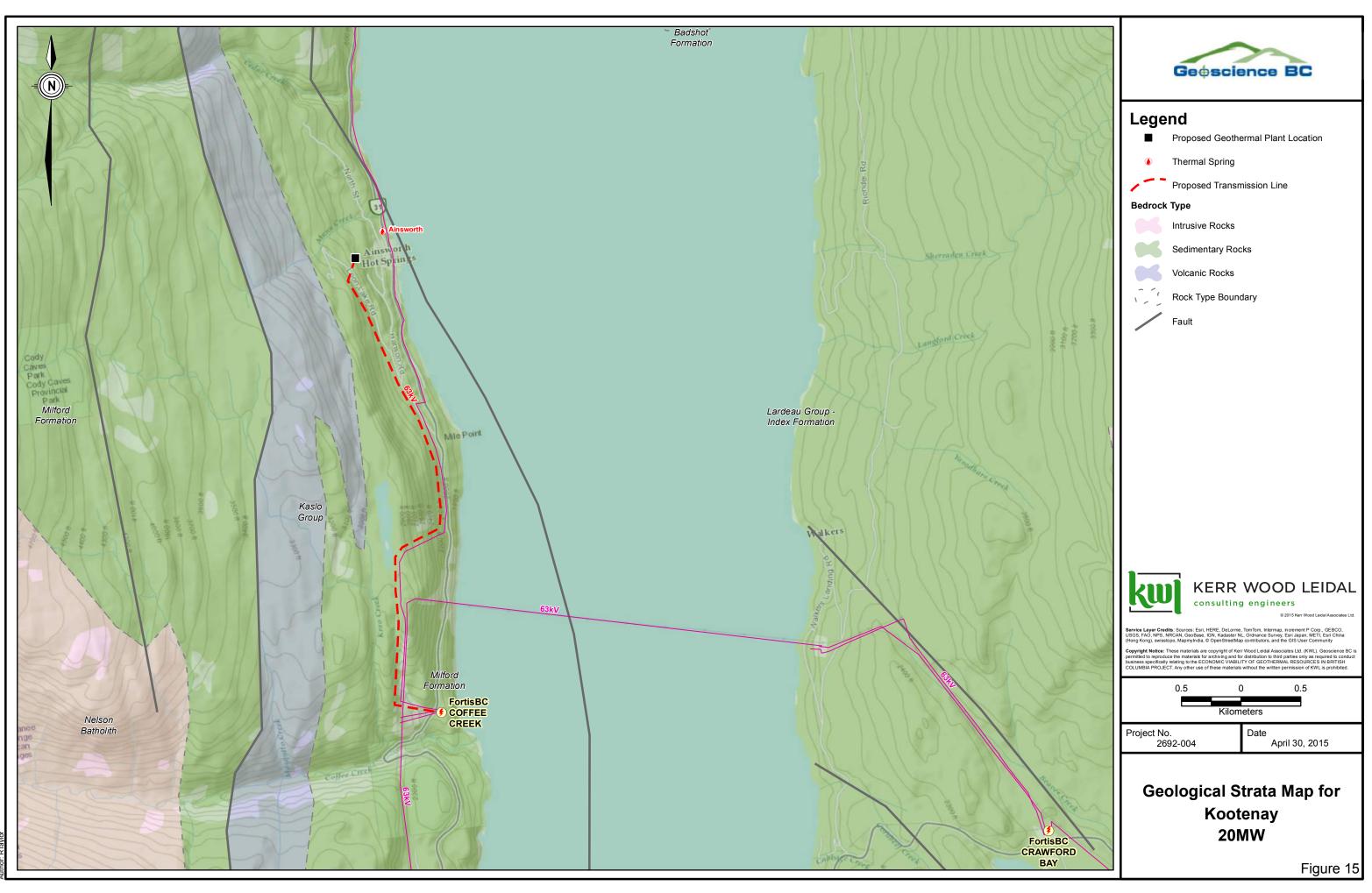
# KOOTENAY

Near Ainsworth Hotsprings, British Columbia, Canada Topographical Map Sheet: Figure 14 Geological Map Sheet: Figure 15

	Category	Comments
Ν	M. Maps	
	Regional topographic map showing population centres, roads an other infrastructure including electrical grid and nearest substatio and/or generating station. (1:500,000?)	
	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 14
	Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 15
	Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 15
Ν	N. Other Issues and Considerations	









Appendix I

# Lakelse Lake Geothermal Development Decision Matrix and Figures 16 & 17

kwl.ca

Near Terrace, British Columbia, Canada Topographical Map Sheet: Figure 16 Geological Map Sheet: Figure 17

	Category	Comments
Α.	Reservoir Potential	
	Size/Potential/Type	<ul> <li>Reservoir size: No clearly defined area or thickness in literature, but description of multiple springs warrants an area esti estimated at: 5.5 km<sup>3</sup> (most-likely area: 5 km<sup>2</sup>; most-likely thickness*: 1.1 km) (*Reservoir thickness assumption based on</li> <li>Potential: 20 MW (WREZ, 2009)</li> <li>Type: low-temperature resource, suitable for binary plant.</li> </ul>
	Temperature/Water and Gas Chemistry/Mineral Indicators	Surface features: • There are nine springs with an average temperature of 85°C (Souther and Halstead, 1973). • Hot springs are between 52.0-73.5°C (MEM, 2015).
		<ul> <li>There are at least four springs in addition to Lakelse Hot Spring, including one on the east side of the highway at 73.5°C (</li> <li>Lakelse hot spring: 85°C (Fairbank and Faulkner, 1992); 54°C (Souther, 1975).</li> <li>Geothermometry:</li> </ul>
		<ul> <li>Na-K-Ca 78.7°C; SiO<sub>2</sub> 117.0°C (Fairbank and Faulkner, 1992).</li> <li>Geothermometers converge at 85°C (Souther, 1975).</li> </ul>
		Exploration drilling: • None to date for commercial power development. Water chemistry:
		<ul> <li>Na-SO<sub>4</sub>-Cl composition, with Cl at ~200 mg/l, Mg less than 0.1 mg/l and not particularly high SiO<sub>2</sub> (about 70 mg/l) (Souther</li> <li>Water is of the sodium-sulphate type with a total of 1,109.6 ppm dissolved mineral salts. It differs from other Canadian the (Souther and Halstead, 1973).</li> </ul>
		• The springs have a continuous gas discharge and a high content of lithium has been reported (10.2 ppm) (MEM, 2015).
	Surface Flow Rates and Reservoir Recharge	<ul> <li>6 L/s (Fairbank and Faulkner, 1992); 8.3 L/s (Souther, 1975).</li> <li>The hot springs flow at a rate of 457 liters per minute (MEM, 2015)</li> <li>The hot spring on the east side of the highway has a low flow (BC Hydro, 1981)</li> </ul>
	3D Permeability (heat exchange potential)	Heat source likely a shallow pluton with fluid flow along graben faults (Fairbank and Faulkner, 1992).
	Recent Magmatism	A basaltic cinder cone and flow reported to be about 300 years old is located 56 km to the north (Souther and Halstead, 19
	Structural Setting	The springs are situated in a broad northerly-trending valley on the eastern margin of the Coast Range mountains. The vall trending Terrace Graben) (Souther and Halstead, 1973).

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

estimate of about 5 km<sup>2</sup> - therefore, reservoir volume on most-likely value from Appendix III in GeothermEx, 2004)

C (BC Hydro, 1981).

her, 1975). thermal springs in the relatively high content of lithium

1973).

alley is part of a major fault-controlled lineament (the N-S-

Near Terrace, British Columbia, Canada Topographical Map Sheet: Figure 16 Geological Map Sheet: Figure 17

Category	Comments
Geophysics	Regional Bouger gravity survey conducted (Geoscience BC, 2010a); electrical resistivity survey conducted in 1983 (Shore
Reservoir Host Rock	<ul> <li>The spring probably issues from fractured granites (quartz diorite) (Geoscience BC, 2010b; Souther and Halstead, 1973)</li> <li>The Lakelse Hot Spring issues from a 30.5 m cavern at the resort in the nearby swamp (BC Hydro, 1981).</li> </ul>
Drilling Issues	<ul> <li>Commercial development of the hot springs as a resort began in 1958, and includes a popular recreational pool/slide at s Halstead, 1973; Fairbank and Faulkner, 1992).</li> <li>Historically, the resort owner has not supported geothermal development for electricity generation at the Lakelse prospect 2004).</li> </ul>
Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	<ul> <li>Economic mineralization in the Terrace–Kitimat area is concentrated along the intrusive boundary between the eastern n crustal rocks of Stikinia. Devonian–Permian arc-volcanic rocks and platform carbonate rocks form the basement to Stikinia and Lower Jurassic marine sedimentary and volcanic-arc rocks. These supra-crustal assemblages are intruded by Jurass (Pignotta et al., 2009)</li> <li>The major fault/lineament cuts granitic rocks (Coast Crystalline complex) near Lakelse and extends northward into sedim north of Lakelse the lineament is occupied by a basaltic cinder cone and flow that are reported to be about 300 years old (</li> <li>Quaternary sediments overlie granodiorite of the Cretaceous to Tertiary Coast Plutonic Complex (MEM, 2015).</li> <li>Resistivity and seismic surveys show a clay-capped deep sedimentary-filled graben - indicates a confined, laterally-externary</li> </ul>
. Exploration Uncertainty (Risk)	
Degree of Identification of Resources/Reserves	Moderate Borealis has planned an exploration program that is currently in progress. The Borealis exploration program was planned modelling; (2) slim-hole drilling; (3) drilling of a small number of production wells). The first phase was to begin in June 207 MW potential not yet clearly defined.
Likelihood of Covering Reservoir with Concession	Moderate Consortium of Borealis GeoPower, Enbridge and Kitselas First Nations hold developing permits for Mount Layton Hot Spri
Expected Authorization Date	Unknown
Specific Timing of Exploration (2 + 2 years, BC 8 years, etc.)	4 years (1 year deep gradient-well drilling + 1 year successful development drilling and testing + 1 year further development drilling finish plant construction)
Degree of Previous Exploration (can be good or bad)	Moderate Exploration efforts are ongoing.
Surface Operational Capacity (enough stable area for drilling and a plant?)	Yes A power plant would be located to the south of the resort (BC Hydro, 2004).
Exploration to Exploitation: A summary rating of Exploration	Moderate

ore, 1984).
73).
at spring near Mt. Layton Hot Springs Resort (Souther and
pect, and the spring vents are on private land (BC Hydro,
n margin of the Coast Plutonic Complex (CPC) and supra- inia in the Terrace-Kitimat area, and are overlain by Triassic assic, Late Cretaceous and Eocene plutonic rocks of the CPC
dimentary and volcanic rocks of the Interior System. 56 km d (Souther and Halstead, 1973)
tensive thermal aquifer (Fairbank and Faulkner, 1992).
ed in three phases: (1) biochemical analyses, data-gathering, 2014 on a 2,800-hectare area. (Killen, 2014) (Massey, 2014).
2014 on a 2,800-hectare area. (Killen, 2014) (Massey, 2014).
2014 on a 2,800-hectare area. (Killen, 2014) (Massey, 2014).
2014 on a 2,800-hectare area. (Killen, 2014) (Massey, 2014).
2014 on a 2,800-hectare area. (Killen, 2014) (Massey, 2014).

Near Terrace, British Columbia, Canada Topographical Map Sheet: Figure 16 Geological Map Sheet: Figure 17

	Category	Comments
C.	Environmental Issues	
	Protected Areas	• Northern section of proposed transmission line crosses near Lakelse Provincial Park. Route realignment to preclude park
	Endangered Species	<ul> <li>Northern reach of transmission line is in Bog Rush (blue-listed plant) occurrence polygon.</li> </ul>
		• Southern reach of transmission line enters into White Adder's-mouth Orchid (blue-listed plant) occurrence polygon.
	Geothermal Surface Features	Lakelse Hotsprings is close to proposed transmission line.
	Other	• Transmission line crosses approx. 6 creeks that contain Sockeye Salmon, Coho Salmon, and Steelhead Trout.
		<ul> <li>Transmission line crosses approximately 15 streams in total.</li> </ul>
		<ul> <li>Kalum proposed Wildlife Habitat Area is 3 km east of proposed plant location.</li> </ul>
D.	Geothermal Area - Bidding and/or Type of Land Holding	
	(private/government/lease/etc.)	
	Bidding Area	LL Geothermal, of whom Borealis Geopower is a joint venture partner, obtained a geothermal exploration permit for approx
		2014. Existing geothermal title tract; exploration through Kitselas First Nation-led consortium (also includes Enbridge and E
		(http://www.terracestandard.com/news/251196971.html)
	Other Claim Rights (mining and/or oil)	No existing mineral, coal titles at plant location, several existing titles in vicinity. Proposed location is not within known oil at
		location.

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ark during detailed route selection.

roximately 2,800 hectares in the Lakelse area in January d Borealis) began in spring 2014.

and gas management area; no known tenures at proposed

Near Terrace, British Columbia, Canada **Topographical Map Sheet: Figure 16** Geological Map Sheet: Figure 17

	Category	Comments
E.	Market	
	Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through tw • Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propon • Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW bi against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponen threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply to realistically apply to potential geothermal generation projects).</li> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pai program has no applicability to potential geothermal generation projects.</li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificatio snow melt and stream flow.</li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project to BC Hydro's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>Wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta, th generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmiss Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission are 4. Retail access, defined as a market in which electricity is sold directly to consumers by competing uppliers, is generally opportunities for bi</li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

nents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this

tion of BC Hydro's resource mix, making it less reliant on

en FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

otential customer may be challenging.

ountainous terrain.

Near Terrace, British Columbia, Canada **Topographical Map Sheet: Figure 16** Geological Map Sheet: Figure 17

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation.</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical and considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to sever Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gener other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction years, the key uncertainties inherent in the environmental review, public consultation, transmission arrangements (either w permitting and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
F.	Transmission Line Infrastructure	
	State of the Infrastructure	Existing 287 kV transmission line within 1 km of proposed plant location; however, closest substation is Skeena substation
	Transmission Route (distance, terrain and costs)	New 69 kV transmission line approx. 22 km via existing transmission corridor routing with interconnection at Skeena substa
Н.	Community Issues	
	Indigenous Law and Indigenous Development Areas	<ul> <li>First Nation Consultative Areas include Kitsumkalum First Nation, Lax Kwalaams Band Council, Kitselas First Nation, Met</li> <li>Kitselas Reserves Land Management Act was developed in 2005 with concentration on existing reserve land, but include: Kitselas Land Management Act and Kitselas Land Interests Law pdf, http://www.kitselas.com/index.php/government/laws/)</li> <li>Kitselas Land Management Office provides stewardship of the lands and resources within Kitselas Traditional Territory (http://www.kitselas.com/index.php/government/laws/)</li> </ul>
	Community Action	<ul> <li>City of Terrace Official Community Plan GHG emissions reduction targets 80% by 2050 (http://www.terrace.ca/)</li> <li>Borealis has made presentations to the Terrace City Council.</li> </ul>
	Surface Rights	<ul> <li>First Nation Consultative Areas include Kitsumkalum First Nation, Lax Kwalaams Band Council, Kitselas First Nation, Met</li> <li>Terrace Official Community Plan includes GHG reduction target of 80% below 2007 level by 2050. Economic developme smelter modernization and major mining proposals. Objective 6 of Official Community Plan to work towards community en heat generation resources such as geothermal and waste heat recovery.</li> </ul>
	Tourism	<ul> <li>Proposed transmission line routing follows boundary of Lakelse Lake Provincial Park. Transmission line routing is also cl and Lakelse Lake Wetlands Provincial Park. Lakelse Lake Park offers hiking, swimming, fishing, biking, winter activities, a (http://www.env.gov.bc.ca/bcparks/explore/parkpgs/lakelse_lk/)</li> <li>Terrace, BC has significant eco tourism industry that is punctuated by Lakelse Lake Provincial Park (http://www.visitterrac parks/lakelse-lake-prov-park)</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

on output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission ven years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

on approx. 20 km away. station. Treed, moderate terrain.

letlakatla First Nation.

des development of regulations for traditional territory. (See

(http://www.kitselas.com/index.php/resources/lands/)

letlakatla First Nation.

nent includes Northwest Transmission Line, Rio-Tinto Alcan energy self-sufficiency includes evaluation of alternative

close to existing Hai Lake - Mount Herman Provincial Park and camping

ace.com/stage.php/places/cabins-campgrounds-rv-

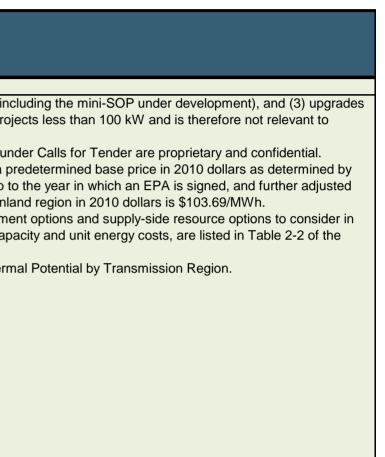
Near Terrace, British Columbia, Canada Topographical Map Sheet: Figure 16 Geological Map Sheet: Figure 17

	Category	Comments
Ι.	Water Rights	
	Availability (for example "air-cooled required")	Plant water requirement estimated approx. 25 L/s for binary plant. MAD of 100-200 L/s in surrounding low-lying areas. No More than 50 water licences on east side of Lakelse Lake for domestic purpose.
	Availability for Drilling	Drilling requirement of 20 L/s. MAD of 100-200 L/s in surrounding low-lying areas. No water licences within 5 km of proposiside of Lakelse Lake for domestic purpose.
J.	Engineering	
	Plant Location and Design	Plant location in flat location south of Lakelse Lake close to existing Highway 37 and transmission line corridor.
	Construction Issues	Location accessible via paved Highway 37. Proposed plant location is within 40 km of Terrace, BC. Services for tempora
	Transportation Issues	Accessible via existing Highway 37.
	Architectural Issues (Blend/hide into environment? Local styles? etc.)	None found. Proposed plant location and proposed new transmission line routing skirts Lakelse Lake Wetlands provincial
	Special Construction Issues (zero emissions)	None found.
Κ.	Non-Electrical Infrastructure (Roads and Habitation)	
	Nearest Large Community > 50,000	Prince George, BC
	Nearest Community	Terrace, BC
	Nearest Road and Condition	Highway 37, existing paved highway.
	Current Access Conditions (restrictions)	None noted.
	Terrain and Distance Factor for Road Building	No new road requirements.
		•

o water licences within 5 km of proposed plant location.
osed plant location. More than 50 water licences on east
ary workers (food, accommodation) are available here.
al park and Lakelse Lake Provincial Park.

Near Terrace, British Columbia, Canada **Topographical Map Sheet: Figure 16** Geological Map Sheet: Figure 17

	Category	Comments								
L	Finance									
	General Power Prices	<ul> <li>BC Hydro acquires power through (1) competitive processes (Calls for Tender), (2) the Standing Offer Program (not inc to its existing facilities or the development of new generation facilities. (Note that the net metering program targets proje geothermal generation projects). Comments on the general price of power under each one are:</li> <li>The power price paid by BC Hydro to independent power producers through Energy Purchase Agreements (EPAs) under the region of the point of interconnection to the BC Hydro system, escalated at the Consumer Price Index annually up to based upon the time of day and month when the energy is delivered. For reference, the base price for the Lower Mainla</li> <li>BC Hydro's current Integrated Resource Plan dated November 2013 includes details of both demand-side management meeting the future demand for electricity. These resource options, together with their attributes of total energy and capa November 2013 Resource Options Report Update. That table is reproduced below for ready reference.</li> <li>Table 5-7 of the above-noted November 2013 Resource Options Report Update provides a summary of the Geotherm</li> </ul>								
		Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)				
		Biomass – Wood Based	9,772	1,226	122 - 276	132 - 306				
		Biomass – Biogas	134	16	59 – 154	56 – 156				
		Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204				
		Wind – Onshore	46,165	4,271	90 - 309	115 – 365				
		Wind – Offshore	56,700	3,819	166 - 605	182 – 681				
		Geothermal	5,992	780	91 – 573	90 - 593				
		Run-of-River	24,543	1,149	97 – 493	143 – 1,170				
		Site C <sup>3</sup>	4,700	1,100	83	88				
		Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	6,103	774	58 – 92	57 – 86				
		Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103				
		Wave	2,506	259	440 – 772	453 - 820				
		Tidal	1,426	247	253 – 556	264 – 581				
		Solar	57	12	266 - 746	341 – 954				
		<ol> <li>Notes:</li> <li>The resources and UEC values shown for each category in the table reflect the resource potential analyzed and may not include all possible resources that may be available at an expected higher cost.</li> <li>The details of how the cost adjusters were developed and applied are provided in Appendix 12.</li> <li>The Site C values presented in this table are based on information provided in the Site C Environmental Impact Statement (EIS) submission filed in January 2013, and the UEC is calculated assuming 5 per cent real discount rate.</li> <li>Representative projects were used to characterize the natural gas-fired and coal-fired resource options, and the resource potential is generally considered to be unlimited.</li> </ol>								



Near Terrace, British Columbia, Canada Topographical Map Sheet: Figure 16 Geological Map Sheet: Figure 17

Category							Com	iments
Market Price (\$/MWhr)	<ul> <li>As noted in the above Table 2-2 from the November 2013 Resource Options Report Update, the Unit Energy Cost for dollars ranges from \$91/MWh to 573/MWh at the point of interconnection to the BC Hydro system.</li> <li>Wholesale electricity prices for trading purposes can vary greatly. In the Pacific Northwest, these prices are affected b unforeseen generation outages and ambient temperatures. A general flavour of the wholesale electricity prices for poter variety of sources. One such source is the US Energy Information Administration (www.eia.gov/electricity/wholesale/#hi market data. Of particular relevance is the mid-C trading hub in the Northwest Region (one example would be a Mid-C average cost from 72 trades). Access to that market for geothermal projects in BC would require access on both the BC on the appropriate transmission system (e.g. Bonneville Power Authority) in the US.</li> <li>BC Hydro forecasts of market prices under various scenarios was provided in the November 2013 IRP. Table 5 in Appready reference.</li> </ul>							
		LICO	Table :	5 Electricity	y Price Forecasts b (Real 2012 US\$/MV	by Market		
			1	2	3	A A	5	
		Market Scenario	Mid Electricity Mid GHG (Regional) Mid Gas	Low Electricity Low GHG (Regional) Low Gas	High Electricity High GHG (Regional) High Gas	Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	High Electricity High GHG (Regional/Nat'l) High Gas	
		2014	25.0	21.9	31.1	25.0	31.1	
		2015	25.5	21.7	31.9	25.5	31.9	
		2016	25.8 27.1	21.2 22.0	32.0 33.4	25.8 27.1	32.0 33.4	
		2017 2018	27.1	22.0	33.4	27.1	33.4	
		2010	28.0	22.1	35.5	28.0	35.5	
		2020	28.0	21.9	36.0	28.0	36.0	
		2021	29.3	22.5	37.3	29.3	37.3	
		2022	30.1	22.7	38.8	30.9	41.3	
		2023	31.8	23.2	41.7	35.5	52.1	
		2024 2025	33.0 34.2	23.7 24.0	43.4 45.4	41.8 50.3	68.6 91.2	
		2025	34.9	24.0	46.7	52.2	95.1	
		2027	36.0	24.3	48.6	54.7	98.9	
		2028	36.3	24.0	50.2	56.8	101.8	
		2029	37.2	23.9	51.1	58.8	106.1	
		2030	37.6	23.8	52.7	60.1	109.3	
		2031 2032	38.6 39.9	24.0 24.0	54.7 57.0	62.6 65.6	112.0 116.0	
		2032	41.5	24.0	60.1	69.3	122.0	
		2034	42.8	25.1	61.9	71.5	125.7	
		2035	44.6	26.2	64.5	74.5	131.0	
		2036	45.7	26.9	66.2	76.4	134.3	
		2037	47.8	28.1	69.1	79.8	140.3	
		2038	48.4	28.4	70.0	80.8	142.1	
		2039	48.9	28.7 29.0	70.7	81.6 82.4	143.5 144.9	
		2040	49.3	29.0	/1.4	o2.4	144.9	

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

geothermal resources at a 7% real discount rate in 2013

by such factors as precipitation/snowfall in the region, ential export of electricity from BC can be obtained from a istory). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted C Hydro transmission system to the Canada/US border, and

pendix 5A – Market Forecast Data is reproduced below for

Near Terrace, British Columbia, Canada Topographical Map Sheet: Figure 16 Geological Map Sheet: Figure 17

Category					Comments
Green Power Premium (\$/MWhr)	<ul> <li>Within British C environmentally</li> <li>California has a particularly "bund 1. The price of e 2. There are larg</li> </ul>	olumbia, there is riendly) from BC goal of 33% of lled" green energe ectricity is driver e amounts of re	s little deman Hydro. BC H retail sales b gy with Rene by the low o newables, su	d for the purch Hydro's genera y 2020 to be s wable Energy cost of natural ch as wind an	n for power from independent power producers has offered a p nase of "green power certificates" (instruments that a customer ation mix is already approximately 93% clean. ourced from eligible renewable energy sources. However, the Certificates (RECs), to compete in that market is low, for a nur gas; d solar, in California; and n the BPA transmission system is generally not available.
Capacity Price (\$/KW)	<ul><li>There is no price</li><li>Table 3-27 entities</li></ul>	e in \$/kW for ca led "UCCs of Ca nped storage, sir	pacity resour apacity Reso nple cycle ga	ce options in t urce Supply O as turbines and	he market at present. ptions" in BC Hydro's Integrated Resource Plan dated Noveml d resource smart projects such as Revelstoke Unit 6). The unit
	(a) "Off-Peak Ho	<ul> <li>the following excerpt is taken from BC Hydro's SOP:</li> <li>"1. Definitions: In this Appendix 4, the following words and expressions have the following meanings:</li> <li>(a) "Off-Peak Hours" means all hours other than Super-Peak Hours and Peak Hours.</li> <li>(b) "Peak Hours" means the hours commencing at 06:00 PPT and ending at 16:00 PPT, and commencing at 20 inclusive, but excluding British Columbia statutory holidays.</li> <li>(c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20:00 PPT Monday through holidays."</li> </ul>			
	inclusive, but exe (c) "Super-Peak	luding British Co Hours" means th	olumbia statu ne hours com	tory holidays. mencing at 16	
	inclusive, but exe (c) "Super-Peak	Hours" means the Time of	olumbia statu ne hours com Delivery Facto	tory holidays. mencing at 16	
	inclusive, but exe (c) "Super-Peak holidays." Month	Hours" means the Time of Super-Peak	olumbia statu ne hours com Delivery Facto Peak	tory holidays. mencing at 16 or (TDF) Off-Peak	
	inclusive, but exe (c) "Super-Peak holidays." Month January	Hours" means the Control of Contr	olumbia statu ne hours com Delivery Facto	tory holidays. mencing at 16	
	inclusive, but exe (c) "Super-Peak holidays." Month	Hours" means the Time of Super-Peak	Delivery Factor Pelivery Factor 122%	tory holidays. mencing at 16 pr (TDF) Off-Peak 105%	
	inclusive, but exe (c) "Super-Peak holidays." Month January February	Luding British Co Hours" means th Time of Super-Peak 141% 124%	Delivery Facto Peak 122% 113%	or (TDF) Off-Peak 105% 101%	
	inclusive, but exe (c) "Super-Peak holidays." Month January February March	Time of Super-Peak 141% 124%	Delivery Factor Pelak 122% 113% 112%	tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99%	
	inclusive, but exe (c) "Super-Peak holidays." Month January February March April	Cluding British Co         Hours" means th         Time of         Super-Peak         141%         124%         124%         104%	Delivery Factor Peak 122% 113% 95%	or (TDF) Off-Peak 105% 101% 99% 85%	
	inclusive, but exe (c) "Super-Peak holidays." Month January February March April May	Luding British Co Hours" means th Super-Peak 141% 124% 124% 104% 90%	Delivery Factor Peak 122% 113% 112% 95% 82%	tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70%	
	inclusive, but exe (c) "Super-Peak holidays." Month January February March April May June	Cluding British Co         Hours" means th         Time of         Super-Peak         141%         124%         104%         90%         87%	Delivery Factor Peak 122% 113% 112% 95% 82% 81%	tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69%	
	inclusive, but exe (c) "Super-Peak holidays." Month January February March April May June July	Luding British Co Hours" means th Super-Peak 141% 124% 104% 90% 87% 105%	Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96%	tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79%	
	inclusive, but exe (c) "Super-Peak holidays." Month January February March April May June July August	Cluding British Co           Hours" means th           Time of           Super-Peak           141%           124%           104%           90%           87%           105%           110%	Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96% 101%	tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86%	
	inclusive, but exe (c) "Super-Peak holidays." Month January February March April May June July August September	Cluding British Content           Time of           Super-Peak           141%           124%           104%           90%           87%           105%           110%           116%	Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96% 101% 107%	tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86% 91%	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

premium for green power. er can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

nber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

inclusive, but excluding British Columbia statutory

Near Terrace, British Columbia, Canada Topographical Map Sheet: Figure 16 Geological Map Sheet: Figure 17

Category	Comments
Estimated Size of Resource Is there any green power incentives?	<ul> <li>See Section A.</li> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p o Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project development o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include:</li> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Sustainable Development Technology Canada funds;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> <li>Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability</li> </ul>
Grants Tax Holidays Tax Relief	See above under green power incentives         None listed on federal and provincial websites.         • Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 4 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.         • In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred dur and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the ye deducted in future years, or transferred to investors through a flow-through share agreement.

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now n entitled Scientific Research and Experimental ity and relevance. y participation in the clean energy sector. It provides: nent; and
these programs may be active but not currently issuing al technologies/resources, while others may be fully
ity and relevance.
ce energy by using renewable energy sources or fuels from

43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 sets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy year they are incurred, carried forward indefinitely and

Near Terrace, British Columbia, Canada **Topographical Map Sheet: Figure 16** Geological Map Sheet: Figure 17

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> <li>FNFA loans do not require collateral;</li> </ol>
	<ul><li>4. FNFA loans can be used to refinance existing debt; and</li><li>5. FNFA's interest rates and terms parallel those available to provincial and local governments.</li></ul>
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infrast purchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Bor and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015
	Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribed Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section, (b) an amount agreed under this section to be paid instead of royalty, or
General Idea of Royalties	<ul> <li>(c) if no royalty or amount has been agreed under this section, the prescribed royalty.</li> <li>With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "Thi in section 1 (1) [definitions] of the Geothermal Resources Act."</li> </ul>
Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners for proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg State
Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincia</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission access Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. s that join as Borrowing Members.

astructure, social and economic development, land

prrowing Members, represented by the First Nation's Chief

ed rent for the permit (Section 5).

pay to the government

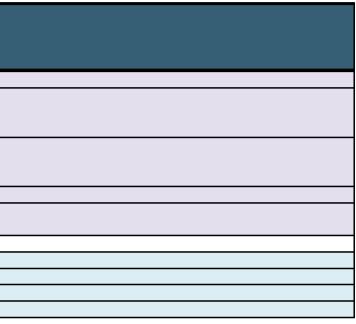
nis Act does not apply to geothermal resources as defined

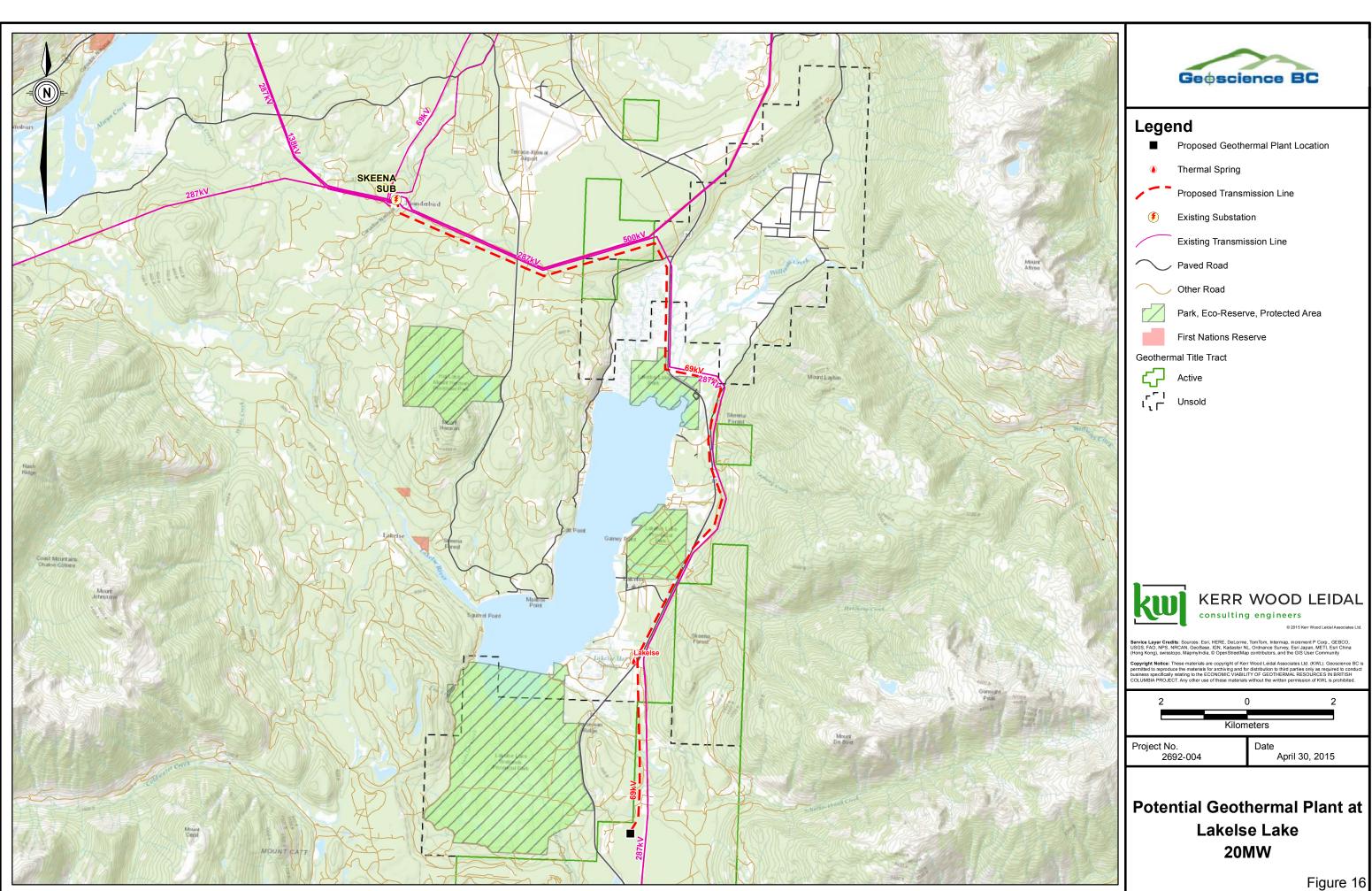
for the geothermal land tract. atutory Right of Way, Licence of Occupation). ial (British Columbia): 13.5%.

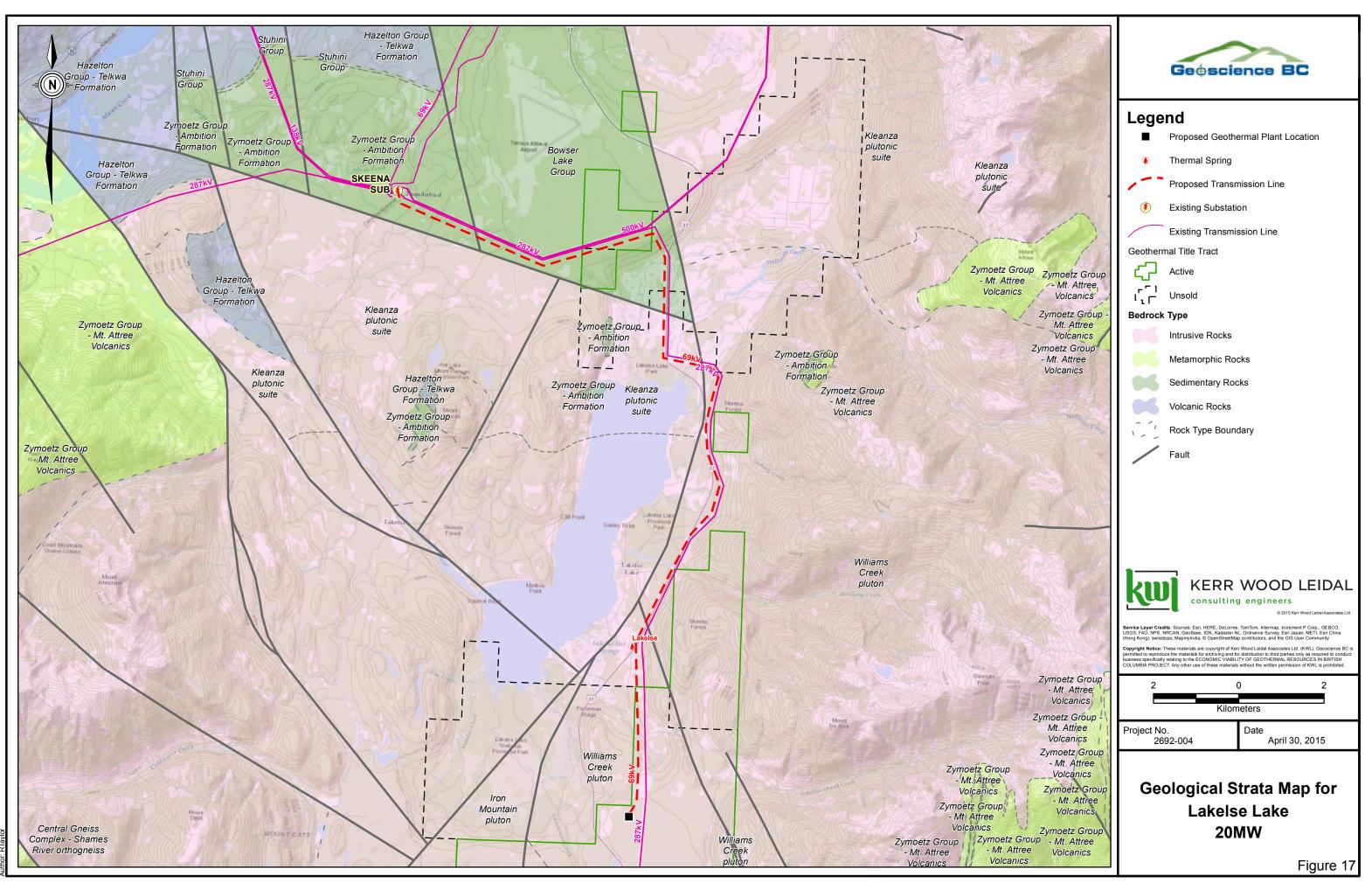
a, the US, or other wholesale customers in BC, the ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power e economic viability of the potential wholesale opportunity.

Near Terrace, British Columbia, Canada Topographical Map Sheet: Figure 16 Geological Map Sheet: Figure 17

	Category	Comments
N	M. Maps	
	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)	
	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 16
		Geological Map Sheet: Figure 17
	Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 17
N	N. Other Issues and Considerations	









Appendix J

Lower Arrow Lake Geothermal Development Decision Matrix and Figures 18 & 19

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Near Fauquier, British Columbia, Canada Topographical Map Sheet: Figure 18 Geological Map Sheet: Figure 19

Category	Comments
Reservoir Potential	
Size/Potential/Type	<ul> <li>Reservoir size: No clearly defined area or thickness in literature, but description of multiple springs warrants an area est estimated at: 5.5 km<sup>3</sup> (most-likely area: 5 km<sup>2</sup>; most-likely thickness*: 1.1 km) (*Reservoir thickness assumption based on</li> <li>Potential: 20 MW (WREZ, 2009)</li> <li>Type: low-temperature resource, suitable for binary plant.</li> </ul>
	<ul> <li>Surface features:</li> <li>Octopus Creek spring: 49°C (Fairbank and Faulkner, 1992) (Grasby &amp; Hutcheon, 2001) (cooling likely) (Souther, 1975)</li> <li>Jordan Ranch spring: 12°C (Fairbank and Faulkner, 1992) (Grasby &amp; Hutcheon, 2001) cold spring</li> <li>Snowshoe Rabbit spring: N/A</li> <li>Taylor spring: 25°C (Grasby &amp; Hutcheon, 2001) possible minor cooling (Souther, 1975)</li> <li>Geothermometry:</li> <li>Octopus Creek: Na-K-Ca temperature is 87°C (Souther, 1975)</li> <li>Jordan Ranch: Na-K-Ca temperature is 154°C (Souther, 1975)</li> <li>Jordan Ranch: Na-K-Ca temperature is 154°C (Souther, 1975)</li> <li>Taylor: Na-K-Ca temperature is 49°C (Souther, 1975)</li> <li>Taylor: Na-K-Ca temperature is 49°C (Souther, 1975)</li> <li>Exploration drilling:</li> <li>No information</li> <li>Water chemistry: hot springs in this region lie on the stable isotope meteoric water line. (Souther, 1975)</li> <li>Octopus Creek: pH 7.56; Cl 44.25 mg/L; water type is Na-(HCO<sub>3</sub>&gt;SO<sub>4</sub>). (Souther, 1975)</li> <li>Jordan Ranch: pH 6.41; cold spring with Na-HCO<sub>3</sub> composition, elevated Mg (35 mg/l), HCO<sub>3</sub> 1,400 mg/L and Cl at 92 r</li> <li>Taylor: pH 7.98; Cl 6.1 mg/L; dilute (Na&gt;Ca)-(SO<sub>4</sub>=HCO<sub>3</sub>) composition (Souther, 1975)</li> <li>Mineral indicators:</li> <li>No information</li> </ul>
Surface Flow Rates and Reservoir Recharge	Octopus Creek: small; Jordan Ranch: small (Fairbank and Faulkner, 1992)
3D Permeability (heat exchange potential)	
Recent Magmatism	N/A
Structural Setting	Located at southern end of Columbia River Fault along eastern margin of regional extension complex; characterized by m fracturing. (Grasby & Hutcheon, 2001)
Geophysics	
Reservoir Host Rock	Unknown (area by Jordan Ranch/Octopus Creek has regional Cretaceous granites intruded by Eocene Coryell intrusions ( granite suite (Parrish et al, 1988)
Drilling Issues	Possible hot dry rock project. (Fairbank and Faulkner, 1992)
Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	<ul> <li>Valhalla complex lies to the east of the lake on the other side of the Valkyr Shear zone (Hoy, 2014)</li> <li>To the west of the central portion of Lower Arrow Lake lies the northern extension of the Grand Forks Complex, a metam southern Omineca Belt), appears to be related to Eocene faulting and extension (Hoy, 2013)</li> </ul>
	• Eocene Coryell intrusions (dikes, plugs, batholiths) between Greenwood and Lower Arrow Lake provide radiogenic heat (Fairbank and Faulkner, 1992)

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

estimate of about 5 km<sup>2</sup> - therefore, reservoir volume on most-likely value from Appendix III in GeothermEx, 2004) 2 mg/L. (Souther, 1975) mylonite zone up to 1 km wide, intense folding and s (Hoy, T. and W. Jackaman, 2015) and Eocene Ladybird

amorphic core complexes (one of many that make up the

at source. Regional heat flow calculated at 4.8 µW/m<sup>3</sup>

Near Fauquier, British Columbia, Canada Topographical Map Sheet: Figure 18 Geological Map Sheet: Figure 19

		Category	Comments
	В.	Exploration Uncertainty (Risk)	
		Degree of Identification of Resources/Reserves	Low
		Likelihood of Covering Reservoir with Concession	Unknown
			Looks possible (not within national park/restricted area)
		Expected Authorization Date	Unknown
		Specific Timing of Exploration (2 + 2 years, BC 8 years, etc.)	5 years
			(1 year permitting and surface exploration, possibly drilling shallow temperature gradient holes + 1 year deep gradient-well
			testing + 1 year further development drilling and start plant construction + 1 year drilling wrap-up and finish plant construction
		Degree of Previous Exploration (can be good or bad)	Low
		Surface Operational Capacity (enough stable area for drilling and	Yes
		a plant?)	
		Exploration to Exploitation: A summary rating of Exploration	Moderate
		Uncertainty (risk) on a scale of difficult (high risk) through medium	A lot of unknowns, but no items identified as high risk.
		(moderate risk) to easy (low risk)	
(	C.	Environmental Issues	
		Protected Areas	Arrow Lakes Provincial Park is located approx. 8 km west across the Columbia River.
		Endangered Species	• Three-leaved Lewisia (blue-listed plant) is the closest known endangered species occurrence, and can be found approx.
		Geothermal Surface Features	Octopus Creek Hotsprings is located 1.4 km southeast of proposed plant location.
		Other	<ul> <li>Proposed transmission line crosses approx. 3 streams that do not have observed fish data.</li> </ul>
			<ul> <li>Nearest Wildlife Habitat Area allotted for Grizzly Bear approx. 7 km west, and over Columbia River, of proposed plant loc</li> </ul>
	D.	Geothermal Area - Bidding and/or Type of Land Holding	
		(private/government/lease/etc.)	
		Bidding Area	No known existing active, cancelled or unsold geothermal title tracts
		Other Claim Rights (mining and/or oil)	No known coal or mineral titles. Proposed location is not within known oil and gas management area; no known tenures at

ell drilling + 1 year successful development drilling and ction)
x. 40 km from the proposed plant location.
ocation.
at proposed location.

Near Fauquier, British Columbia, Canada **Topographical Map Sheet: Figure 18** Geological Map Sheet: Figure 19

	Category	Comments
E.	Market	
	Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>1. BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through tw</li> <li>Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propon</li> <li>Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW bi against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponent threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply to realistically apply to potential geothermal generation projects).</li> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to par program has no applicability to potential geothermal generation projects.</li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificatie snow melt and stream flow.</li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project to BC Hydro through BC Hydro's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>Wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta, the generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmission acc Authority for wheeling to a US customer). This 'pancaking' of rates, along with congestion issues, affects the economic via 4. Retail access, defined as a market in which electricity is sold directly to consumers by compet</li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

nents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this

tion of BC Hydro's resource mix, making it less reliant on

en FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

ower Arrow Lake proposed site. roposed site.

Near Fauquier, British Columbia, Canada Topographical Map Sheet: Figure 18 Geological Map Sheet: Figure 19

Category	Comments
	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation.</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical an considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to seve Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gene other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ion output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission even years depending on the specifics of each project. herally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

Near Fauquier, British Columbia, Canada **Topographical Map Sheet: Figure 18** Geological Map Sheet: Figure 19

	Category	Comments
Ξ.	Transmission Line Infrastructure	
	State of the Infrastructure	500 KV and 138 KV transmission line approx. 3.5 km from point location. Monashee substation is closest substation.
	Transmission Route (distance, terrain and costs)	Tie in to 138 kV transmission line via 6 km of new 138 kV transmission line via existing unpaved roads. Assume that a new the Figure.
1.	Community Issues	
	Indigenous Law and Indigenous Development Areas	<ul> <li>First Nation consultative areas include Secwepemc Nation, Westbank First Nation, Okanagan Indian Band, Splats'in First Lower Similkameen Indian Band, Upper Nicola Indian Band, Penticton Indian Band, Adams Lake Indian Band, Ktunaxa Na Band, Mt. Mary's Indian Band, Tobacco Plains Indian Band.</li> </ul>
		• Many of the consultative areas have community or land use plans however none are found to be near the proposed plant
		• Sinixt Nation (Arrow Lakes) is most relevant to plant location (http://sinixtnation.org/content/sinixt-territory). Requirement
		their agents and employees consult with the Sinixt Nation is regards to development and business operations and land use
	Community Action	Perry Ridge Wilderness Initiative - united campaign with Perry Ridge Water Users Association to protect Perry Ridge in the ridge/overview/)
		<ul> <li>2010 - Injunction against Sinixt protest for Perry Ridge overturned by Vancouver court</li> </ul>
		<ul> <li>2013 Sinixt Nation receives notice of trespass at Perry Ridge</li> <li>Challenge to Pass Creek logging</li> </ul>
	Surface Rights	<ul> <li>First Nation consultative areas include Secwepemc Nation, Westbank First Nation, Okanagan Indian Band, Splats'in First Lower Similkameen Indian Band, Upper Nicola Indian Band, Penticton Indian Band, Adams Lake Indian Band, Ktunaxa Na Band, Mt. Mary's Indian Band, Tobacco Plains Indian Band.</li> </ul>
		<ul> <li>Many of the consultative areas have community or land use plans however none are found to be near the proposed plant</li> <li>Sinixt Nation (Arrow Lakes) is most relevant to plant location (http://sinixtnation.org/content/sinixt-territory). Requirement their agents and employees consult with the Sinixt Nation is regards to development and business operations and land use</li> </ul>
	Tourism	Lower Arrow Lakes-Needle Ferry, outdoor recreation area. Most activities are centralized near Fauguier, BC. (http://www.

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ew substation will be required for connection as shown on

rst Nation, Shuswap Indian Band, Neskonlith Indian Band, Nation Council, Akisgnuk First Nation, Lower Kootenay

Int location.

nt for "corporations, provincial and federal governments and use and resource extraction with the territory."

the Slocan Valley (http://www.perryridge.org/about-perry-

irst Nation, Shuswap Indian Band, Neskonlith Indian Band, Nation Council, Akisqnuk First Nation, Lower Kootenay

Int location.

nt for "corporations, provincial and federal governments and use and resource extraction with the territory."

vw.kootenayseh.com/nakusp/fauquier.html)

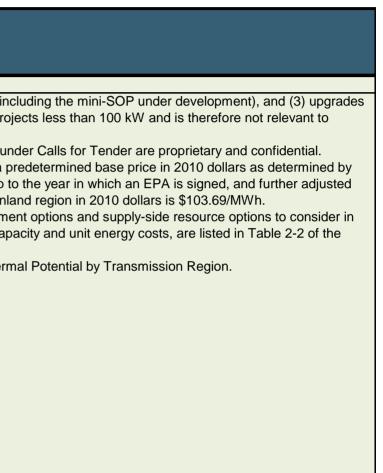
Near Fauquier, British Columbia, Canada Topographical Map Sheet: Figure 18 Geological Map Sheet: Figure 19

	Category	Comments
Ι.	Water Rights	
	Availability (for example "air-cooled required")	Plant water requirement estimated approx. 25 L/s for binary plant. MAD of 700 L/s in valley; significant flow in lake. 4 curre plant location on east bank of Arrow Lake across from Edgemont. Purposes include domestic, and irrigation, with average
	Availability for Drilling	Drilling requirement of 20 L/s. MAD of 700 L/s in valley; significant flow in lake. 4 current water licences within 5 km of poin Lake across from Edgemont. Purposes include domestic, and irrigation, with average mean 0.03 L/s quantity.
1	Engineering	
J.	Engineering Plant Location and Design	Remote location, steep, mountainous terrain. Plant sited high on the Valhalla range to avoid steep valley access.
	Construction Issues	Plant location on Valhalla Range. Existing rough, unpaved road access,
	Transportation Issues	Existing rough, unpaved road access.
	Architectural Issues (Blend/hide into environment? Local styles? etc.)	none found
	Special Construction Issues (zero emissions)	non found
K.	Non-Electrical Infrastructure (Roads and Habitation)	
	Nearest Large Community > 50,000	Kelowna, BC
	Nearest Community	Fauquier, BC
	Nearest Road and Condition	Unpaved existing logging road.
	Current Access Conditions (restrictions)	Unpaved road access to plant location.
	Terrain and Distance Factor for Road Building	No requirement for new roads expected. Road access up the Valhalla Range to approx. 5400 ft.

rent water licences within 5 km of point location, all north of ge mean 0.03 L/s quantity.
int location, all north of plant location on east bank of Arrow

Near Fauquier, British Columbia, Canada **Topographical Map Sheet: Figure 18** Geological Map Sheet: Figure 19

	Category					Comments	
L.	Finance						
	General Power Prices	BC Hydro acquires power through to its existing facilities or the develo geothermal generation projects). C • The power price paid by BC Hydr • The power price paid by BC Hydr the region of the point of interconne based upon the time of day and me • BC Hydro's current Integrated Re meeting the future demand for elect November 2013 Resource Options • Table 5-7 of the above-noted Nove	comment of new g comments on the o to independer o to independer ection to the BC onth when the e source Plan dat ctricity. These n ctricity. These n	generation facilit e general price of the power produce the power produce Hydro system, nergy is delivered ted November 2 esource options . That table is re	ies. (Note that the of power under enders through Eners through EPA escalated at the ed. For reference 013 includes de , together with the produced below	he net metering each one are: rgy Purchase Ag s under the SOI Consumer Price e, the base price tails of both dem neir attributes of w for ready refer	program targets proj greements (EPAs) un P are made up of a p e Index annually up to for the Lower Mainla hand-side management total energy and cap ence.
		Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)	
		Biomass – Wood Based	9,772	1,226	122 – 276	132 – 306	
		Biomass – Biogas	134	16	59 – 154	56 – 156	
		Biomass – Municipal Solid Waste	425	50	85 – 184	83 – 204	
		Wind – Onshore	46,165	4,271	90 - 309	115 – 365	
		Wind – Offshore	56,700	3,819	166 - 605	182 – 681	
		Geothermal	5,992	780	91 – 573	90 - 593	
		Run-of-River Site C <sup>3</sup>	24,543	1,149	97 - 493	143 – 1,170	
		Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	4,700 6,103	1,100 774	83 58 – 92	88 57 - 86	
		Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103	
		Wave	2,506	259	440 - 772	453 - 820	
		Tidal	1,426	247	253 - 556	264 - 581	
		Solar	57	12	266 - 746	341 – 954	
		<ol> <li>Notes:</li> <li>The resources and UEC values si and may not include all possible r</li> <li>The details of how the cost adjust</li> <li>The Site C values presented in th Impact Statement (EIS) submission real discount rate.</li> <li>Representative projects were use the resource potential is generally</li> </ol>	esources that may ters were developed is table are based on filed in January 2 ed to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC he natural gas-fired	expected higher cos rovided in Appendix ded in the Site C Er is calculated assum	t. 12. nvironmental ning 5 per cent	



Near Fauquier, British Columbia, Canada Topographical Map Sheet: Figure 18 Geological Map Sheet: Figure 19

Category								Comments
Market Price (\$/MWhr)	dollars • Who unfore variety marke average on the • BC H	s ranges f blesale ele eseen ger y of sourc et data. C ge cost fr appropri Hydro fore reference	from \$91/MV ectricity price heration outa ces. One suc of particular r om 72 trades fate transmis ecasts of ma	Vh to 573/MV s for trading p ges and amb h source is th elevance is th s). Access to sion system (	Vh at the poin purposes can pient temperat ne US Energy he mid-C trad that market f (e.g. Bonnevil nder various s	t of interconne vary greatly. I ures. A gene Information A ing hub in the or geotherma le Power Auth	ection to the BC In the Pacific Nor ral flavour of the dministration (we Northwest Regin I projects in BC we nority) in the US.	rt Update, the Unit Energy Cost for g Hydro system. rthwest, these prices are affected by wholesale electricity prices for poten ww.eia.gov/electricity/wholesale/#hist on (one example would be a Mid-C p would require access on both the BC November 2013 IRP. Table 5 in Appe
		LICCI	Table	5 Electricit	y Price Forecasts I (Real 2012 US\$/MV			
			1	2	3	4	5	
		Market Scenario	Mid Electricity Mid GHG (Regional) Mid Gas	Low Electricity Low GHG (Regional) Low Gas	High Electricity High GHG (Regional) High Gas	Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	High Electricity High GHG (Regional/Nat'l) High Gas	
		2014	25.0	21.9	31.1	25.0	31.1	
		2015	25.5	21.7	31.9	25.5	31.9	
		2016 2017	25.8 27.1	21.2 22.0	32.0 33.4	25.8 27.1	32.0 33.4	
		2017	27.1	22.0	33.9	27.1	33.9	
		2019	28.0	22.1	35.5	28.0	35.5	
		2020	28.0	21.9	36.0	28.0	36.0	
		2021	29.3	22.5	37.3	29.3	37.3	
		2022	30.1	22.7	38.8	30.9	41.3	
		2023	31.8	23.2	41.7	35.5	52.1	
		2024 2025	33.0 34.2	23.7 24.0	43.4 45.4	41.8 50.3	68.6 91.2	
		2025	34.9	24.0	46.7	52.2	95.1	
		2027	36.0	24.3	48.6	54.7	98.9	
		2028	36.3	24.0	50.2	56.8	101.8	
		2029	37.2	23.9	51.1	58.8	106.1	
		2030	37.6	23.8	52.7	60.1	109.3	
		2031 2032	38.6 39.9	24.0 24.0	54.7 57.0	62.6 65.6	112.0 116.0	
		2032	41.5	24.0	60.1	69.3	122.0	
		2033	42.8	25.1	61.9	71.5	125.7	
		2035	44.6	26.2	64.5	74.5	131.0	
		2036	45.7	26.9	66.2	76.4	134.3	
		2037	47.8	28.1	69.1	79.8	140.3	
		2038	48.4	28.4	70.0	80.8	142.1	
		2039	48.9	28.7	70.7	81.6	143.5	
		2040	49.3	29.0	71.4	82.4	144.9	

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geothermal resources at a 7% real discount rate in 2013

by such factors as precipitation/snowfall in the region, ential export of electricity from BC can be obtained from a istory). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted C Hydro transmission system to the Canada/US border, and

pendix 5A – Market Forecast Data is reproduced below for

Near Fauquier, British Columbia, Canada **Topographical Map Sheet: Figure 18** Geological Map Sheet: Figure 19

Category					Comments
Green Power Premium (\$/MWhr)	<ul> <li>Within British C environmentally f</li> <li>California has a particularly "bund 1. The price of el 2. There are large</li> </ul>	olumbia, there is riendly) from BC goal of 33% of r led" green energ ectricity is driven e amounts of rer	ittle demand Hydro. BC H retail sales by y with Renew by the low c newables, suc	d for the purch lydro's genera / 2020 to be so wable Energy ( ost of natural g ch as wind and	for power from independent power producers has offered a p ase of "green power certificates" (instruments that a customer tion mix is already approximately 93% clean. burced from eligible renewable energy sources. However, the Certificates (RECs), to compete in that market is low, for a nur gas; I solar, in California; and the BPA transmission system is generally not available.
Capacity Price (\$/KW)	<ul> <li>There is no pric</li> <li>Table 3-27 entit</li> </ul>	e in \$/kW for cap led "UCCs of Ca ped storage, sin	pacity resourd pacity Resou nple cycle ga	ce options in th arce Supply Op s turbines and	ne market at present. otions" in BC Hydro's Integrated Resource Plan dated Novemb resource smart projects such as Revelstoke Unit 6). The unit
	(a) "Off-Peak Ho	urs" means all ho	ours other that	an Super-Peak	xpressions have the following meanings: Hours and Peak Hours.
	inclusive, but exc	luding British Co Hours" means th	lumbia statut e hours com	tory holidays. mencing at 16	
	inclusive, but exc (c) "Super-Peak	luding British Co Hours" means th	lumbia statut e hours com Delivery Facto	tory holidays. mencing at 16	T and ending at 16:00 PPT, and commencing at 20:00 PPT ar
	inclusive, but exc (c) "Super-Peak holidays." Month	luding British Co Hours" means th Time of Super-Peak	olumbia statut e hours com Delivery Facto Peak	tory holidays. mencing at 16 pr (TDF) Off-Peak	
	inclusive, but exc (c) "Super-Peak holidays." Month January	luding British Co Hours" means th Time of Super-Peak 141%	olumbia statut e hours com Delivery Facto Peak 122%	or (TDF) Off-Peak	
	inclusive, but exc (c) "Super-Peak holidays." Month	luding British Co Hours" means th Time of Super-Peak	Delivery Factor Peak 122% 113%	tory holidays. mencing at 16 pr (TDF) Off-Peak	
	inclusive, but exc (c) "Super-Peak holidays." Month January February	Iuding British Co Hours" means th Time of Super-Peak 141% 124%	olumbia statut e hours com Delivery Facto Peak 122%	tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101%	
	inclusive, but exc (c) "Super-Peak holidays." Month January February March	Time of         Super-Peak         141%         124%	Delivery Factor Peak 122% 113% 112%	or (TDF) Off-Peak 105% 101% 99%	
	inclusive, but exc (c) "Super-Peak holidays." Month January February March April	Iuding British Collection         Time of         Super-Peak         141%         124%         124%         104%	Delivery Factor Peak 122% 113% 112% 95%	tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85%	
	inclusive, but exc (c) "Super-Peak holidays." Month January February March April May	Time of         Super-Peak         141%         124%         104%         90%	Delivery Factor Peak 122% 113% 112% 95% 82%	tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70%	
	inclusive, but exc (c) "Super-Peak holidays." Month January February March April May June	Iuding British Co- Hours" means the         Time of Super-Peak         141%         124%         104%         90%         87%	Delivery Factor Peak 122% 113% 112% 95% 82% 81%	tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69%	
	inclusive, but exc (c) "Super-Peak holidays." Month January February March April May June July	Time of         Super-Peak         141%         124%         104%         90%         87%         105%	Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96%	tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79%	
	inclusive, but exc (c) "Super-Peak holidays." Month January February March April May June July August	Iuding British Co- Hours" means th           Time of Super-Peak           141%           124%           104%           90%           87%           105%           110%	Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96% 101%	tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86%	
	inclusive, but exc (c) "Super-Peak holidays." Month January February March April May June July August September	Time of           Super-Peak           141%           124%           104%           90%           87%           105%           110%           116%	Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96% 101% 107%	tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86% 91%	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

premium for green power. er can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

nber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

inclusive, but excluding British Columbia statutory

Near Fauquier, British Columbia, Canada Topographical Map Sheet: Figure 18 Geological Map Sheet: Figure 19

Category	Comments
Estimated Size of Resource	See Section A.
Is there any green power incentives?	<ul> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p o Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project development o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include:</li> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> <li>Green Infrastructure Fund</li> <li>Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability</li> </ul>
Grants	See above under green power incentives
Tax Holidays	None listed on federal and provincial websites.
Tax Relief	<ul> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 43 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred during and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the ye deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now n entitled Scientific Research and Experimental ity and relevance.
<pre>/ participation in the clean energy sector. It provides: ent; and</pre>
these programs may be active but not currently issuing al technologies/resources, while others may be fully
ity and relevance.
ce energy by using renewable energy sources or fuels from 43.1, eligible equipment may be written-off at 30 percent

22, 2005 and before year 2020 may be written-off at 50 sets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy year they are incurred, carried forward indefinitely and

Near Fauquier, British Columbia, Canada **Topographical Map Sheet: Figure 18** Geological Map Sheet: Figure 19

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> <li>FNFA loans do not require collateral;</li> </ol>
	<ol> <li>4. FNFA loans can be used to refinance existing debt; and</li> <li>5. FNFA's interest rates and terms parallel those available to provincial and local governments.</li> </ol>
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infra- purchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Bor and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015 Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribe
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section,
	<ul><li>(b) an amount agreed under this section to be paid instead of royalty, or</li><li>(c) if no royalty or amount has been agreed under this section, the prescribed royalty.</li></ul>
General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "This in section 1 (1) [definitions] of the Geothermal Resources Act."
Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners f Proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg Stat
Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincia</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. s that join as Borrowing Members.

astructure, social and economic development, land

prrowing Members, represented by the First Nation's Chief

ed rent for the permit (Section 5).

pay to the government

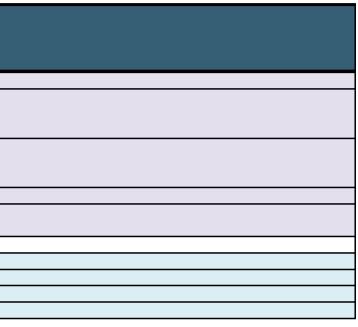
his Act does not apply to geothermal resources as defined

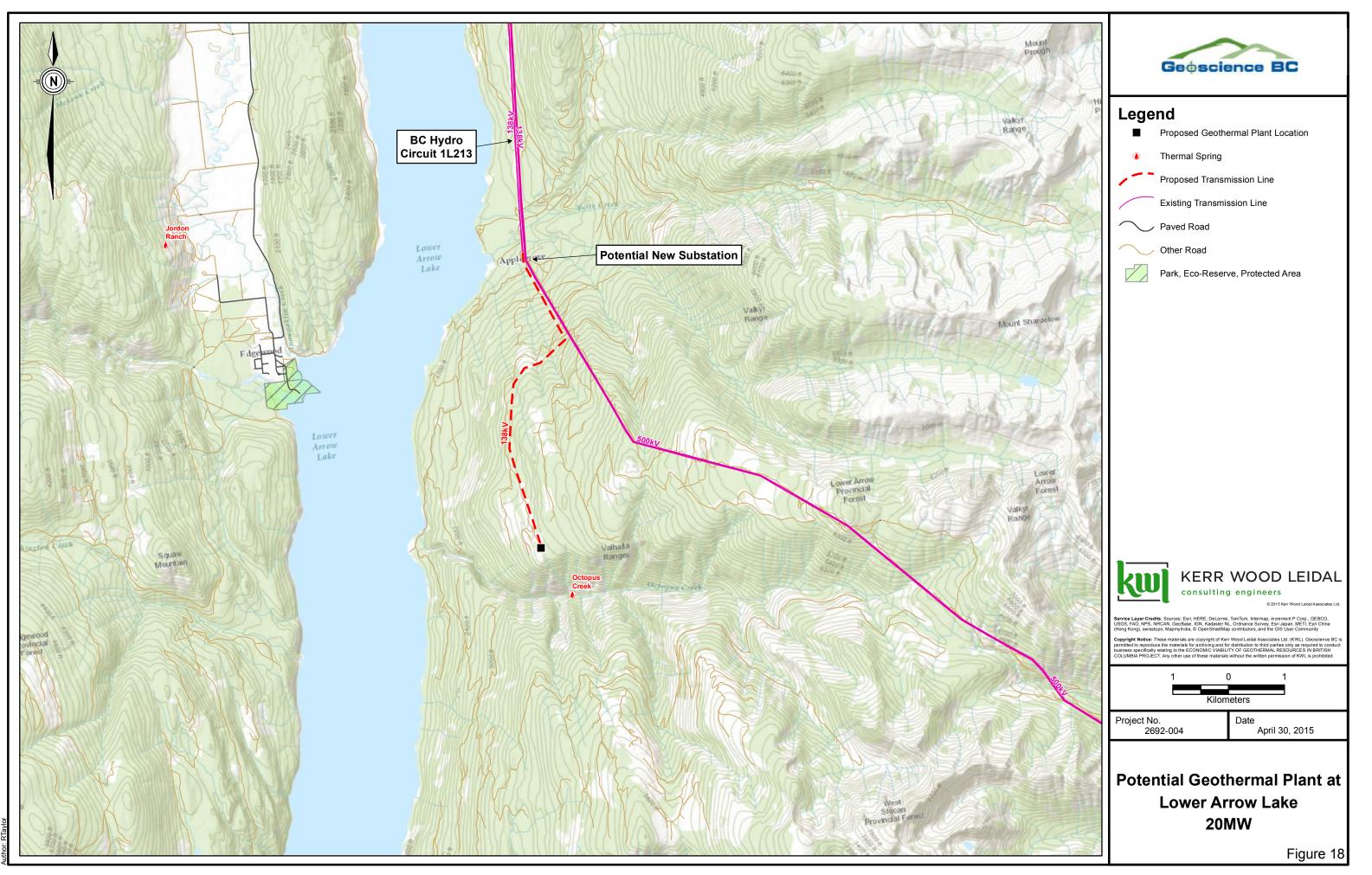
for the geothermal land tract. atutory Right of Way, Licence of Occupation). ial (British Columbia): 13.5%.

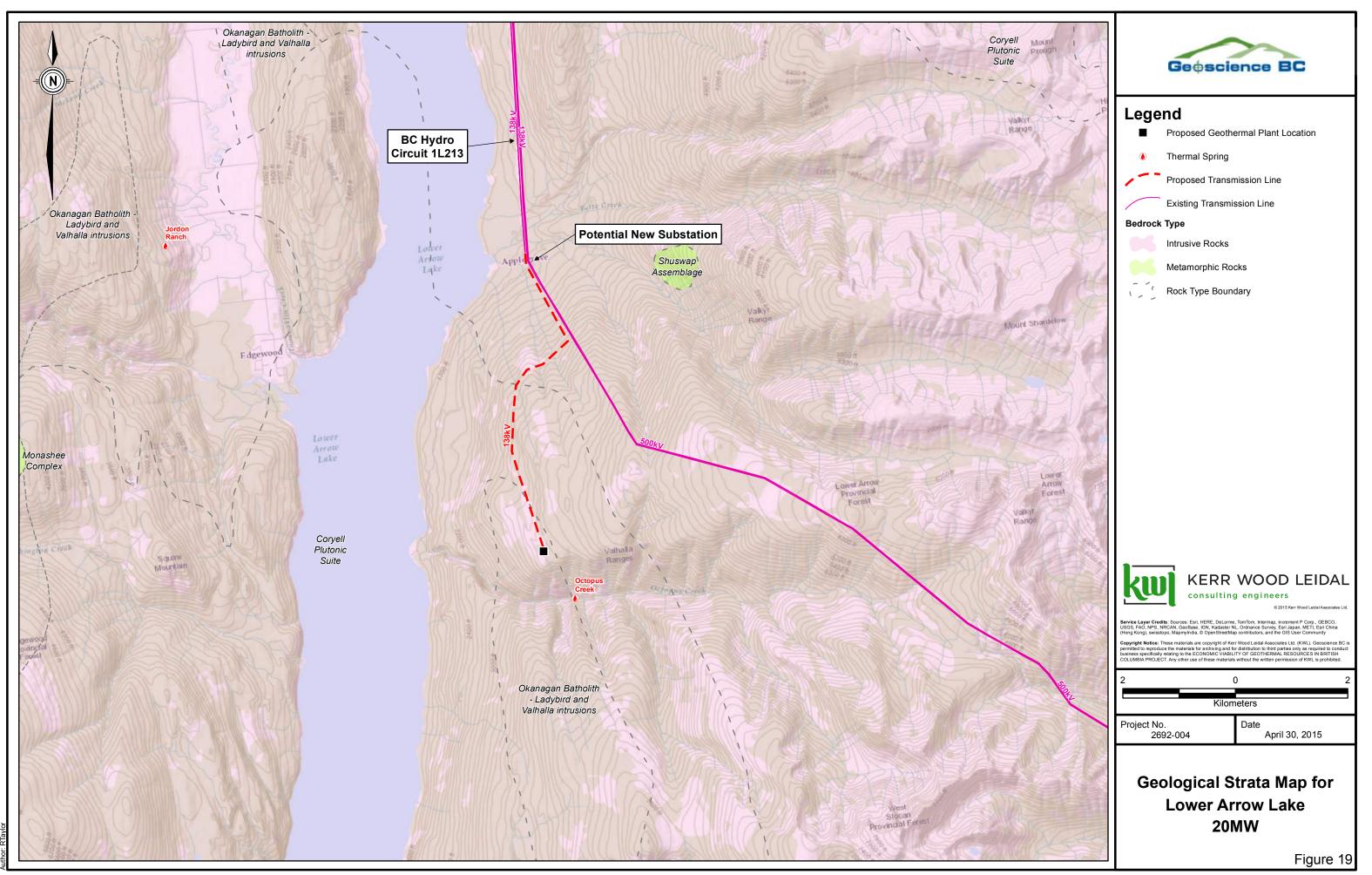
ta, the US, or other wholesale customers in BC, the ission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power e economic viability of the potential wholesale opportunity.

Near Fauquier, British Columbia, Canada Topographical Map Sheet: Figure 18 Geological Map Sheet: Figure 19

		Category	Comments
N	Λ.	Maps	
		Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)	
		Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 18
		Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 19
		Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 19
N	<b>I</b> .	Other Issues and Considerations	









Appendix K

# Meager Creek – Pebble Creek Geothermal Development Decision Matrix and Figures 20 & 21

kwl.ca

Near Pemberton, British Columbia, Canada Topographical Map Sheet: Figure 20 Geological Map Sheet: Figure 21

	Category	Comments
Α	Reservoir Potential           Size/Potential/Type	
	Size/Polential/Type	• Reservoir size: Meager Creek (MC): 15 km <sup>3</sup> (area = 600 Ha; thickness = 2,500 m). Pebble Creek (PC): assumed equal • Potential: 100 - 200 MW combined
		• Type: Assume similar temperatures for both prospects ==> Conventional (Flash Plant)
	Temperature/Water and Gas Chemistry/Mineral Indicators	Surface features:
		Meager Creek H.S.: 45-55°C     No Good Warm Springs: 20-40°C
		Pebble Creek H.S.: 55-60°C
		Geothermometry:
		• MC: up to 280°C (Ghomshei, 2004)
		PC: estimated to be 200°C based on chemical geothermometry determinations of hot spring water samples (Sadlier-Brow
		<ul> <li>Exploration drilling:</li> <li>MC: 200 - 270°C (measured at 1,200 - 3,000 meters); Two wells (MC-6 and -8) encountered significant permeability at detto be in close communication with MC-6, as an extended injection test into MC-6 in July and August 2005 caused a signific took over a year to recover. This suggested the presence of through-going fractures extending over 700 meters between the only minor losses of circulation during drilling, and it appeared to be unaffected by injection testing in the other two wells. (Communications of the communication at ~600 meters); 10 shallow TG wells, drilled to depths of 421 to 1,279 m. One gradient of 210 well L1-78D measured 103°C at 602 m. (Nevin 1992b)</li> <li>Water chemistry:</li> </ul>
		<ul> <li>Primarily sodium-chloride composition, with Cl at 3,000 ±50 mg/kg. Alkalinity (at 12 to 47 mg/kg as HCO<sub>3</sub>) and sulfate (S0 mixing or contamination by near-surface waters or any significant amount of injected water from drilling and/or testing. (Ge</li> <li>All geothermal fluids show a near-neutral pH.</li> <li>Average chloride of the deep fluids ~2000 mg/l.</li> <li>Stable isotope data from wells and hot springs suggest a single regional origin.</li> <li>PC shows mixed outflow of dilute sodium-carbonate (spring 6 km downstream from TG wells) (Nevin, 1992b)</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

al to MC ==>  $30 \text{ km}^3$  combined

own, 2012)

depth. A major loss-zone near the bottom of MC-8 proved ficant drop in the bottom-hole temperature of MC-8 that the bottom-hole locations of MC-6 and MC-8. MC-7 had (GeothermEx, 2009) 210°C/km (12°F/100 ft) was measured (Nevin, 1992a); TG

SO<sub>4</sub> at 89 to 93 mg/kg) are both low, with no indication of GeothermEx, 2009)

Near Pemberton, British Columbia, Canada Topographical Map Sheet: Figure 20 Geological Map Sheet: Figure 21

Category	Comments
Surface Flow Rates and Reservoir Recharge	<ul> <li>Meager Creek H.S.: discharge rate ~40 L/s</li> <li>No Good Warm Springs: &lt; 4 L/s</li> <li>Pebble Creek H.S.: between 5-10 L/s</li> <li>Recharge via meteoric infiltration; residence time &gt;30 years.</li> </ul>
3D Permeability (heat exchange potential)	<ul> <li>Low formation permeabilities; natural fractures and faults are likely source of permeability in the area.</li> <li>Heat exchange potential is unclear because commercial-grade permeability has yet to be demonstrated.</li> </ul>
Recent Magmatism	<ul> <li>Various periods of volcanic activity from 1.9 Ma to Recent.</li> <li>Last known eruption ~2,340 years before present.</li> </ul>
Structural Setting	<ul> <li>Located near intersection of Garibaldi Belt and Pemberton Belt.</li> <li>Meager Creek fault zone: E-W striking normal fault, dips to N ~50°.</li> <li>Fracturing of basement in volcanic vent areas by rhyodacite volcanism (1.9 Ma - Recent) is likely source of permeability.</li> <li>Normal faulting is likely responsible for springs seepage.</li> <li>No Good fault zone trending N-S may be the western boundary of the MC thermal anomaly ("carbonate fault" encountered.</li> </ul>
Geophysics	Resistivity survey of Meager Creek Area shows low-resistivity anomaly extending north of Meager Creek; magnetotelluric further north (closer to Pylon Peak); temperature model combined with MT data indicate central upflow zone near Pylon P
Reservoir Host Rock	Basement complex Mesozoic quartz diorite.
Drilling Issues	Hard and abrasive formation (plutonic crystalline rock).
Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	<ul> <li>Late Tertiary to Quaternary andesitic to rhyodacitic volcanic centers (north end of N-S trending Garibaldi Volcanic Belt [Q to Cretaceous age (quartz diorite basement rock [Mesozoic])</li> <li>Meager and Pebble Creek hot springs issue from the basement rock (near volcanic vents).</li> <li>Meager Creek H.S. issues into sinter-lined pools in coarse fluvial sand and gravel deposits on the south bank of Meager</li> <li>No Good Warm Springs consists of 6 vents issuing from N side of Meager Creek (on bank closest to exploration wells d</li> <li>Pebble Creek H.S. issues into ochre- and sinter-lined pool on bedrock bench of NE side of Lillooet River, along with severe the severe term of term</li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ered by hole M8). ic (MT) survey conducted in 2001 shows core of anomaly Peak outflowing to the south.

[Quaternary]) intruding overlying plutonic rocks of Jurassic

er Creek. s drilled by BC Hydro and Western GeoPower). everal thermal seeps and associated calcite/algae deposits.

Near Pemberton, British Columbia, Canada Topographical Map Sheet: Figure 20 Geological Map Sheet: Figure 21

Category	Comments
Exploration Uncertainty (Risk)	
	<ul> <li>MC: High Field reconnaissance, MT survey, several slim holes (diamond-drill) and full-diameter exploratory wells.</li> <li>20-kW plant operated by BC Hydro in 1980s; additional wells drilled by Western Geocoder in 2004-2005, with well tests ex</li> <li>PC: Moderate Geologic mapping, resistivity/MT/seismic surveys; infrastructure development; 10 diamond-drill holes.</li> </ul>
Likelihood of Covering Reservoir with Concession	MC: High     PC: High
Expected Authorization Date	MC: Unknown     PC: Unknown
	<ul> <li>MC: 3 years</li> <li>(2 years further development drilling and start plant construction [including re-construction of access road destroyed in 20 construction)</li> <li>PC: 5 years</li> <li>(1 year deep gradient-well drilling + 2 years successful development drilling and testing + 1 year further development drilling</li> </ul>
Degree of Previous Exploration (can be good or bad)	<ul> <li>finish plant construction)</li> <li>MC: High</li> <li>Significant previous exploration; commercial productivity not yet demonstrated. Wellbore simulation indicates that a well ta 8 but from a lower wellhead elevation could flow at the equivalent of over 6 MW of electrical output (GeothermEx, 2009)</li> <li>PC: Moderate</li> <li>Through slim-hole stage; no full-diameter wells yet.</li> </ul>
Surface Operational Capacity (enough stable area for drilling and a plant?)	<ul> <li>MC: Sufficient level ground for power plant on north bank of Meager Creek. Several existing well pads (some close to M Areas of identified potential instability (located to west of project area) still leave room for plant and pad development.</li> <li>PC: Sufficient level ground for power plant and well pads on SW bank of Lillooet River. Additional well pads at higher elements.</li> </ul>
Exploration to Exploitation: A summary rating of Exploration Uncertainty (risk) on a scale of difficult (high risk) through medium (moderate risk) to easy (low risk)	<ul> <li>MC: Easy         A plausible resource development strategy has been defined (that is, targeting the permeability encountered in MC-6 and I on confirmation of commercial permeability. The site has a history of previous work, and generally good access (except fo     <li>PC: Moderate         Less advanced than Meager Creek, but potentially a shared heat source and similar structural style. Viable resource rema     </li> </li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

extending to 2008.

010 landslide] + 1 year drilling wrap-up and finish plant

ling and start plant construction + 1year drilling wrap-up and

targeting the permeable zone encountered in MC-6 and MC-

Meager Creek, some higher on slopes of Pylon Peak).

elevations are possible.

d MC-8 but from a lower wellhead elevation), still contingent for slide area).

nains to be confirmed by full-diameter drilling.

Near Pemberton, British Columbia, Canada Topographical Map Sheet: Figure 20 Geological Map Sheet: Figure 21

Category	Comments
C. Environmental Issues	
Protected Areas	Nearest protected area, Upper Lillooet Provincial Park is approx. 2 km from active title tracts; no protected areas located
Endangered Species	<ul> <li>Vivid Dancer (red-listed dragonfly), Grizzly Bear (blue-listed), 2 red-listed and 3 blue-listed plants within or in vicinity of ac</li> <li>Spotted Owl (Endangered (SARA Schedule 1); red-listed) habitat polygon extends down lower Lillooet River valley throug</li> </ul>
Geothermal Surface Features	<ul> <li>Both Meager Creek and Pebble Creek are on the lower slopes of the Mt. Meager volcano, a Holocene Cascade volcanic</li> <li>Several active hotsprings along Meager Creek and Upper Lillooet rivers.</li> </ul>
Other	<ul> <li>Active title tracts contain six approved Wildlife Habitat Areas allotted for Grizzly Bear and five ungulate winter range areas Spotted Owl are located down lower Lillooet River valley.</li> </ul>
D. Geothermal Area - Bidding and/or Type of Land Holding (private/government/lease/etc.)	
Bidding Area	<ul> <li>Geothermal Lease (GIS) owned by RAM Power expiring 2017 (ram-power.com)</li> <li>Tecto Pebble Creek project prospect update released in 2013.</li> </ul>
Other Claim Rights (mining and/or oil)	Mineral/Coal title north of Mt. Meager, minimal overlap with active geothermal tract. Proposed location is not within known or proposed location.

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ed along potential transmission connection routes.

active title tracts; ugh Pemberton Meadows area along transmission route.

ic centre.

as for Mountain Goat; Wildlife Habitat Areas allotted for

n oil and gas management area; no known tenures at

Near Pemberton, British Columbia, Canada **Topographical Map Sheet: Figure 20** Geological Map Sheet: Figure 21

Category		Comments			
Ε.	Market				
	Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through tu <ul> <li>Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propon</li> <li>Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW biagainst each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponen threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply i realistically apply to potential geothermal generation projects).</li> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pa program has no applicability to potential geothermal generation projects.</li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificati snow meit and stream flow.</li> </ul> </li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project to BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission access, the economic via 4. Retail access, defined as a market in which electricity is sold directly to consumers by competing plants to large customers. To replace the electricity supplied at high voltage from BC Hydro transmission line under the Qpen Access Transmis Deporting to replace the electricity supplied at high voltage from BC Hydro under BC Hydro Transmission acces. To supply electricit to a remote fa</li></ul>			

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

nents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this

tion of BC Hydro's resource mix, making it less reliant on

en FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

thermal site. Meager Creek site. are and maintenance mode as of 2014; exploration drilling

Near Pemberton, British Columbia, Canada **Topographical Map Sheet: Figure 20** Geological Map Sheet: Figure 21

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical and considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to sever Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gener other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction years, the key uncertainties inherent in the environmental review, public consultation, transmission arrangements (either with permitting and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
F.	Transmission Line Infrastructure	
	State of the Infrastructure	New 230 kV (500 MW max. capacity) transmission line for Upper Lillooet Hydro Project to Pemberton with interconnection
	Transmission Route (distance, terrain and costs)	MC: New 230 kV transmission line 12 km to interconnection with existing 230 kV line for Upper Lillooet Hydro Project; routil existing or new road. PC: New 230 kV transmission line 2 km to interconnection with existing 230 kV line for Upper Lillooet Hydro Project; routing
н.	Community Issues	
	Indigenous Law and Indigenous Development Areas	• First Nation Consultative Areas include Mount Currie Band (Lil'wat First Nation), St'at'imc Chiefs Council, Lillooet Tribal Co St'at'imc Law applies; follows 11 principles that respect cultural traditions, respects nature and serves the St'at'imc communications.
	Community Action	<ul> <li>2010 threatened community action over suspected infrastructure trespasses.</li> </ul>
		• 2011 St'at'imc Hydro Agreement covers all past, present and future impacts, grievances and claims of the St'at'imc relate
		operation of existing BC Hydro facilities within territory.
		• 2006 St'at'imc action (temporary closure of Hwy 1, camp "held the line for 5 years between Lillooet and Pemberton" again
		Lillooet).
	Surface Rights	Significant protected habitat with St'at'imc Land and Resources Authority - SLRA (www.statimc.net) but doesn't cover exter
	Tourism	Significant tourism area close to the sea to sky corridor. Active hot springs in the area and lots of recreational hiking/active data build for an attention of the sea of
		due to road wash-out (2010). Road re-build for geothermal may increase tourism in the area. St'at'imc development plant
		economic opportunity assessment names tourism as potential opportunity.

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

on output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission ven years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

n near Rutherford Creek IPP

uting through existing slide debris area, valley Creek via

ing generally via existing road through valley.

Council. nunities.

ted to the planning, placement, construction, and ongoing

ainst plans for mega ski resort between Pemberton and

xtent of Meager Creek in St'at'imc Territory tivities. Currently there is no access to Meager Hot Springs nt does not specifically target tourism. Lillooet and area

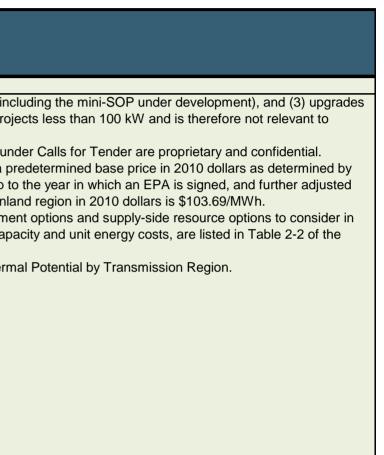
Near Pemberton, British Columbia, Canada Topographical Map Sheet: Figure 20 Geological Map Sheet: Figure 21

	Category	Comments
Ι.	Water Rights	
	Availability (for example "air-cooled required")	Estimated approx. 0.5 L/s for flash plant (for each of Meager and Pebble). Meager MAD approx. 10000 L/s; Pebble MAD a Creek. No active water licences within 5 km of point of potential geothermal location. Closest Active WL approx. 6.2 km a General on Boulder Creek.
	Availability for Drilling	Drilling requirement of 20 L/s. Meager MAD approx. 10000 L/s; Pebble MAD approx. 37000 L/s. No active water licences of point of potential geothermal location. Closest Active WL approx. 6.2 km away for quantity of 31500 L/s for purpose of R
_		
J.	Engineering	
	Plant Location and Design	<ul> <li>MC: Plant location in cleared area near to existing drill sites.</li> <li>PC: Plant location north of existing Upper Lillooet Hydro.</li> </ul>
	Construction Issues	<ul> <li>MC: Land slide on access road in 2010, washed out approx. 6 km of road, currently no access to Meager hot springs via</li> <li>PC: Remote access available via new hydro power project infrastructure and exploratory drilling sites.</li> </ul>
	Transportation Issues	<ul> <li>MC: no access road into site (approx. location) and existing road is inaccessible after 2010 Meager Creek Landslide.</li> <li>PC: Access via unpaved road for existing exploratory drilling and Upper Lillooet Hydro Project.</li> </ul>
	Architectural Issues (Blend/hide into environment? Local styles? etc.)	Conform with St'at'imc Law and meet requirements of the St'at'imc Land and Resource Authority
	Special Construction Issues (zero emissions)	none found
K.	Non-Electrical Infrastructure (Roads and Habitation)	
	Nearest Large Community > 50,000	North Vancouver, BC
	Nearest Community	Pemberton, BC
	Nearest Road and Condition	<ul> <li>MC: Unpaved access road for logging and geothermal drilling. A portion of the access road and bridges for MC wiped out</li> <li>PC: Unpaved Lillooet River Forestry Road approx 1 km from plant location</li> </ul>
	Current Access Conditions (restrictions)	<ul> <li>PC: Limited access; plant location across Lillooet River from existing road.</li> <li>MC: No existing road to Meager Creek location point</li> </ul>
	Terrain and Distance Factor for Road Building	PC: 1 km of new road required includes Lillooet River crossing
		• MC: Approximately 3 km of new road required for access through exiting slide area; moderately steep, mountainous terra

D approx. 37000 L/s. No active water licences on Meager a away for quantity of 31500 L/s for purpose of Power-
es on Meager Creek. No active water licences within 5 km f Power-General on Boulder Creek.
a Pemberton Valley or any existing road.
ut hu Operationer Operationalities (0040)
out by Capricorn Creek slide (2010).
rrain.

Near Pemberton, British Columbia, Canada **Topographical Map Sheet: Figure 20** Geological Map Sheet: Figure 21

	Category	Comments						
L.	Finance							
	General Power Prices	BC Hydro acquires power through (1) competitive processes (Calls for Tender), (2) the Standing Offer Program (not ind to its existing facilities or the development of new generation facilities. (Note that the net metering program targets proj geothermal generation projects). Comments on the general price of power under each one are: • The power price paid by BC Hydro to independent power producers through Energy Purchase Agreements (EPAs) un • The power price paid by BC Hydro to independent power producers through EPAs under the SOP are made up of a p the region of the point of interconnection to the BC Hydro system, escalated at the Consumer Price Index annually up to based upon the time of day and month when the energy is delivered. For reference, the base price for the Lower Mainla • BC Hydro's current Integrated Resource Plan dated November 2013 includes details of both demand-side management meeting the future demand for electricity. These resource options, together with their attributes of total energy and cap November 2013 Resource Options Report Update. That table is reproduced below for ready reference. • Table 5-7 of the above-noted November 2013 Resource Options Report Update provides a summary of the Geotherm						
		Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)		
		Biomass – Wood Based	9,772	1,226	122 – 276	132 – 306		
		Biomass – Biogas	134	16	59 – 154	56 – 156		
		Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204		
		Wind – Onshore	46,165	4,271	90 - 309	115 – 365		
		Wind – Offshore	56,700	3,819	166 - 605	182 – 681		
		Geothermal	5,992	780	91 – 573	90 - 593		
		Run-of-River	24,543	1,149	97 – 493	143 – 1,170		
		Site C <sup>3</sup> Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	4,700 6,103	1,100 774	83 58 – 92	88 57 – 86		
		Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103		
		Wave	2,506	259	440 - 772	453 - 820		
		Tidal	1,426	247	253 - 556	264 - 581		
		Solar	57	12	266 - 746	341 – 954		
		<ol> <li>Notes:</li> <li>The resources and UEC values s and may not include all possible</li> <li>The details of how the cost adjus</li> <li>The Site C values presented in th Impact Statement (EIS) submissive real discount rate.</li> <li>Representative projects were us the resource potential is generally</li> </ol>	resources that may sters were developed his table are based of ion filed in January 2 ed to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC he natural gas-fired a	expected higher cos rovided in Appendix ded in the Site C Er is calculated assum	t. 12. nvironmental ning 5 per cent		



Near Pemberton, British Columbia, Canada Topographical Map Sheet: Figure 20 Geological Map Sheet: Figure 21

Category							Co	omments
Market Price (\$/MWhr)	dollar • Who unfor variet mark avera on the • BC	s ranges f blesale ele eseen ger y of sourc et data. C ige cost fru e appropri Hydro fore r reference	From \$91/MW ectricity prices heration outages. One such of particular re- om 72 trades ate transmiss ecasts of market ecasts of market ecasts of market ecasts of market	th to 573/MWH for trading purges and ambien a source is the elevance is the elevance is the ). Access to the ision system (elevance ket prices und ce Data Tal	a at the point o urposes can va ent temperature US Energy Inite mid-C trading hat market for .g. Bonneville er various sce	f interconnecti iry greatly. In the se. A general formation Adm hub in the No geothermal pr Power Authoriti narios was pro	on to the BC Hyd he Pacific Northy flavour of the wh inistration (www orthwest Region ojects in BC woo ty) in the US.	Jpdate, the Unit Energy Cost for g dro system. west, these prices are affected by nolesale electricity prices for poten .eia.gov/electricity/wholesale/#hist (one example would be a Mid-C p uld require access on both the BC vember 2013 IRP. Table 5 in Appe
			Table 5		/ Price Forecasts b (Real 2012 US\$/MV	y Market Vh at Mid-C)		
			1	2	3	4	5	
		Market Scenario	Mid Electricity Mid GHG (Regional) Mid Gas	Low Electricity Low GHG (Regional) Low Gas	High Electricity High GHG (Regional) High Gas	Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	High Electricity High GHG (Regional/Nat'l) High Gas	
		2014	25.0	21.9	31.1	25.0	31.1	
		2015	25.5	21.7	31.9	25.5	31.9	
		2016 2017	25.8 27.1	21.2 22.0	32.0 33.4	25.8 27.1	32.0 33.4	
		2017	27.1	22.0	33.9	27.1	33.9	
		2010	28.0	22.1	35.5	28.0	35.5	
		2020	28.0	21.9	36.0	28.0	36.0	
		2021	29.3	22.5	37.3	29.3	37.3	
		2022	30.1	22.7	38.8	30.9	41.3	
		2023 2024	31.8 33.0	23.2 23.7	41.7 43.4	35.5 41.8	52.1 68.6	
		2024	34.2	24.0	45.4	50.3	91.2	
		2026	34.9	24.1	46.7	52.2	95.1	
		2027	36.0	24.3	48.6	54.7	98.9	
		2028	36.3	24.0	50.2	56.8	101.8	
		2029	37.2	23.9	51.1	58.8	106.1	
		2030 2031	37.6 38.6	23.8 24.0	52.7 54.7	60.1 62.6	109.3 112.0	
		2032	39.9	24.0	57.0	65.6	116.0	
		2033	41.5	24.4	60.1	69.3	122.0	
		2034	42.8	25.1	61.9	71.5	125.7	
		2035	44.6	26.2	64.5	74.5	131.0	
		2036	45.7	26.9	66.2	76.4	134.3	
		2037 2038	47.8 48.4	28.1 28.4	69.1 70.0	79.8 80.8	140.3 142.1	
		2038	48.4	28.4	70.0	80.8	142.1	
		2000	49.3	29.0	71.4	82.4	144.9	
							·	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

geothermal resources at a 7% real discount rate in 2013

by such factors as precipitation/snowfall in the region, ential export of electricity from BC can be obtained from a istory). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted C Hydro transmission system to the Canada/US border, and

pendix 5A – Market Forecast Data is reproduced below for

Near Pemberton, British Columbia, Canada Topographical Map Sheet: Figure 20 Geological Map Sheet: Figure 21

Category					Comments
Green Power Premium (\$/MWhr)	<ul> <li>BC Hydro's past procurement processes for the acquisition for power from inde</li> <li>Within British Columbia, there is little demand for the purchase of "green power environmentally friendly) from BC Hydro. BC Hydro's generation mix is already a</li> <li>California has a goal of 33% of retail sales by 2020 to be sourced from eligible particularly "bundled" green energy with Renewable Energy Certificates (RECs),</li> <li>1. The price of electricity is driven by the low cost of natural gas;</li> <li>2. There are large amounts of renewables, such as wind and solar, in California,</li> <li>3. Firm transmission access to the California market through the BPA transmission</li> </ul>				hase of "green power certificates" (instruments that a custome ation mix is already approximately 93% clean. ourced from eligible renewable energy sources. However, the Certificates (RECs), to compete in that market is low, for a nur gas; d solar, in California; and
Capacity Price (\$/KW)	<ul> <li>There is no price</li> <li>Table 3-27 entities</li> </ul>	e in \$/kW for ca led "UCCs of Co ped storage, si	pacity resour apacity Resou mple cycle ga	ce options in t urce Supply O is turbines and	he market at present. ptions" in BC Hydro's Integrated Resource Plan dated Noveml I resource smart projects such as Revelstoke Unit 6). The unit
	<ul><li>(a) "Off-Peak Hours" means all h</li><li>(b) "Peak Hours" means the hou inclusive, but excluding British C</li></ul>		4, the followin ours other that rs commencin olumbia statu	ng words and e an Super-Pea ng at 06:00 PF	expressions have the following meanings: k Hours and Peak Hours. PT and ending at 16:00 PPT, and commencing at 20:00 PPT a
	.,	1			:00 PPT and ending at 20:00 PPT Monday through Saturday i
	.,	Time of	Delivery Facto	or (TDF)	:00 PPT and ending at 20:00 PPT Monday through Saturday i
	holidays."	Time of Super-Peak	Delivery Facto Peak	or (TDF) Off-Peak	:00 PPT and ending at 20:00 PPT Monday through Saturday i
	holidays." Month January	Time of Super-Peak 141%	Delivery Facto Peak 122%	or (TDF) Off-Peak 105%	:00 PPT and ending at 20:00 PPT Monday through Saturday i
	holidays." Month January February	Time of           Super-Peak           141%           124%	Delivery Facto Peak 122% 113%	or (TDF) Off-Peak 105% 101%	:00 PPT and ending at 20:00 PPT Monday through Saturday i
	holidays." Month January February March	Time of Super-Peak 141%	Delivery Facto Peak 122%	or (TDF) Off-Peak 105%	:00 PPT and ending at 20:00 PPT Monday through Saturday i
	holidays." Month January February March April	Time of           Super-Peak           141%           124%           124%	Delivery Facto Peak 122% 113% 112%	or (TDF) Off-Peak 105% 101% 99%	:00 PPT and ending at 20:00 PPT Monday through Saturday i
	holidays." Month January February March	Time of Super-Peak           141%           124%           124%           104%	Delivery Facto Peak 122% 113% 112% 95%	or (TDF) Off-Peak 105% 101% 99% 85%	:00 PPT and ending at 20:00 PPT Monday through Saturday i
	holidays." Month January February March April May June	Time of Super-Peak           141%           124%           124%           104%           90%	Delivery Facto Peak 122% 113% 112% 95% 82%	or (TDF) Off-Peak 105% 101% 99% 85% 70%	:00 PPT and ending at 20:00 PPT Monday through Saturday i
	holidays." Month January February March April May	Time of Super-Peak           141%           124%           124%           104%           90%           87%	Delivery Facto Peak 122% 113% 112% 95% 82% 81%	or (TDF) Off-Peak 105% 101% 99% 85% 70% 69%	:00 PPT and ending at 20:00 PPT Monday through Saturday i
	holidays." Month January February March April May June July	Time of Super-Peak           141%           124%           124%           104%           90%           87%           105%	Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96%	or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79%	:00 PPT and ending at 20:00 PPT Monday through Saturday i
	holidays." Month January February March April May June July August	Time of Super-Peak           141%           124%           124%           104%           90%           87%           105%           110%	Delivery Facto Peak 122% 113% 112% 95% 82% 81% 96% 101%	or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86%	:00 PPT and ending at 20:00 PPT Monday through Saturday i
	holidays." Month January February March April May June July August September	Time of Super-Peak           141%           124%           124%           104%           90%           87%           105%           110%	Delivery Facto Peak 122% 113% 112% 95% 82% 81% 96% 101% 107%	or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86% 91%	:00 PPT and ending at 20:00 PPT Monday through Saturday i

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

premium for green power. er can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

nber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

inclusive, but excluding British Columbia statutory

Near Pemberton, British Columbia, Canada Topographical Map Sheet: Figure 20 Geological Map Sheet: Figure 21

Category	Comments
Estimated Size of Resource Is there any green power incentives?	<ul> <li>See Section A.</li> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p o Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project development o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include:</li> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Sustainable Development Technology Canada funds;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> <li>Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability</li> </ul>
Grants Tax Holidays Tax Relief	See above under green power incentives         None listed on federal and provincial websites.         • Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 43.1 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.         • In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred duri and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the ye deducted in future years, or transferred to investors through a flow-through share agreement.

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now n entitled Scientific Research and Experimental ity and relevance. y participation in the clean energy sector. It provides: nent; and
these programs may be active but not currently issuing al technologies/resources, while others may be fully
ity and relevance.
ce energy by using renewable energy sources or fuels from

43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 ets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy year they are incurred, carried forward indefinitely and

Near Pemberton, British Columbia, Canada **Topographical Map Sheet: Figure 20** Geological Map Sheet: Figure 21

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> <li>FNFA loans do not require collateral;</li> </ol>
	<ul><li>4. FNFA loans can be used to refinance existing debt; and</li><li>5. FNFA's interest rates and terms parallel those available to provincial and local governments.</li></ul>
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infras purchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Bor and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015 Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribe
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section,
	(b) an amount agreed under this section to be paid instead of royalty, or
	(c) if no royalty or amount has been agreed under this section, the prescribed royalty.
General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "Thi in section 1 (1) [definitions] of the Geothermal Resources Act."
Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners for Proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg State
Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincia</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmission access Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission access Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. s that join as Borrowing Members.

astructure, social and economic development, land

prrowing Members, represented by the First Nation's Chief

ed rent for the permit (Section 5).

pay to the government

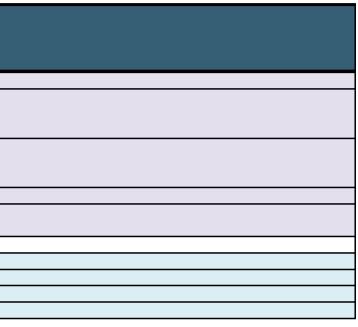
his Act does not apply to geothermal resources as defined

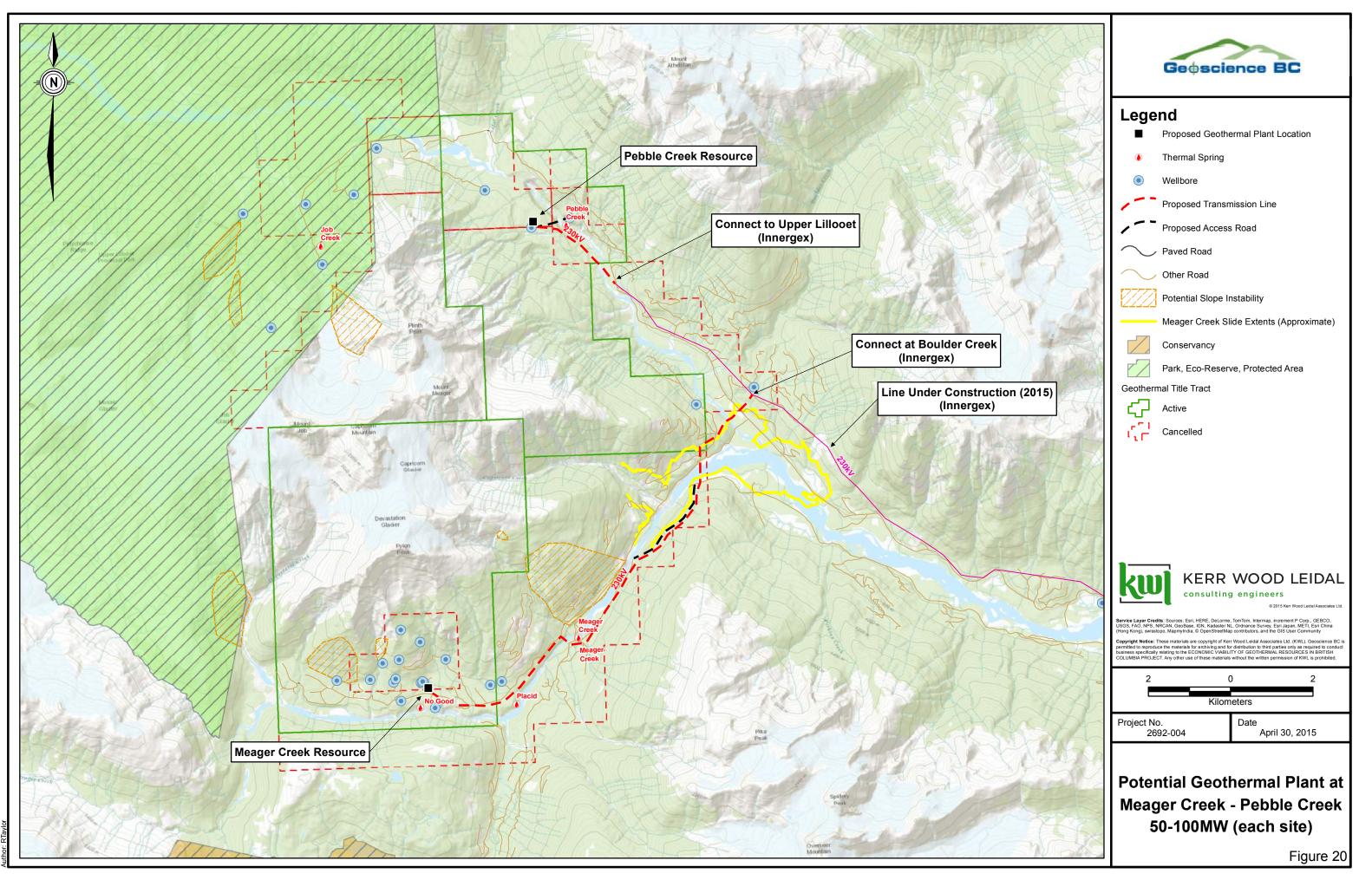
for the geothermal land tract. atutory Right of Way, Licence of Occupation). ial (British Columbia): 13.5%.

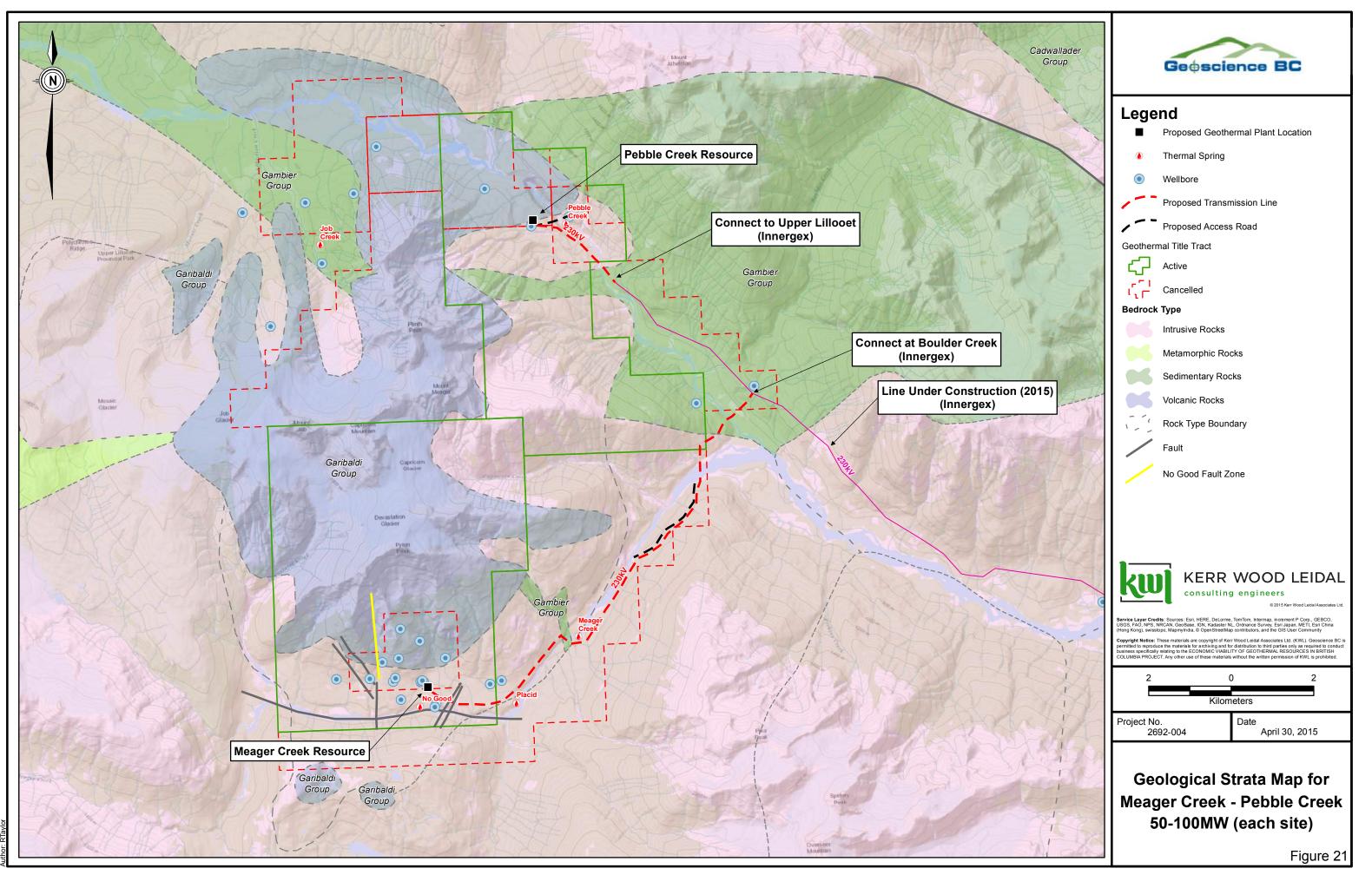
ta, the US, or other wholesale customers in BC, the ission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power e economic viability of the potential wholesale opportunity.

Near Pemberton, British Columbia, Canada Topographical Map Sheet: Figure 20 Geological Map Sheet: Figure 21

		Category	Comments
P		Maps	
		Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)	Topographical Map Sheet: Figure 20
		Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 20
		Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 21
		Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 21
		· · · · · · · · · · · · · · · · · · ·	
٦	۷.	Other Issues and Considerations	









Appendix L

Mt. Cayley Geothermal Development Decision Matrix and Figures 22 & 23

kwl.ca

Near Whistler, British Columbia, Canada **Topographical Map Sheet: Figure 22** Geological Map Sheet: Figure 23

d 2 km <sup>2</sup> and most-likely hickness of 1.1 km. The minimum estimate is calculated for a single spring, and the maximum e and Turbid Creek springs, based on temperature and fluids chemistry and a separation of 2.1 km). ("Reservoir assumptic " Potential: 50 MW (Lovekin & Pleka, 2009). This MW capacity was based on the size of the volcanic complex, and may "Type: Low-temperature resource (based on limited geothermometry data), suitable for binary power plant.         Temperature/Water and Gas Chemistry/Mineral Indicators       Surface features: Surface fea		Category	Comments
of 2 km <sup>2</sup> and most-likely thickness of 1.1 km. The minimum estimate is calculated for a single spring, and the maximum e and Turbid Creek springs, based on themporature and fluids chemistry) and a separation of 2.1 km). ("Reservoir assumptic e Potential: 50 MV (Lovekin & Pletka, 2009). This MV capacity was based on the vicanic complex, and may "Type: Low-temperature resource (based on limited geothermometry data), suitable for binary power plant.         Temperature/Water and Gas Chemistry/Mineral Indicators       Surface features:       •Shovelnose: 30°C (Faitbank & Faulkner, 1992)         • Turbid Creek hot springs: Base (Ryder, 1983)       •The main thermal springs (Shovelnose/Turbid) have built extensive tufa and sinter deposits, whereas the cold seeps are •EMR Seep: 17°C (Ryder, 1983) <b>Geothermometry</b> •Shovelnose: 30°C (Ard 115.7°C in two samples (Reader and Croft, 1983)         Exploration drilling by Natural Resources Canada (Souther and Dellechaie, 1984):       •Squamish Valley (304-1): 210 m total depoint (TG)         •Squamish Valley (304-1): 210 m total depoint (TG)       •Squamish Valley (304-1): 210 m total depoint (TG)       •Squamish Valley (304-2): or CA: 44 97°C BHT, 450 m TD; 105°C/km TG;         •Shovelnose (344) or BN-2: 48.9°C BHT, 450 m TD; 105°C/km TG;       •Shovelnose (440 m downslope       •Shovelnose (340 m D): 48°C/km TG;         •Shovelnose (344) or BN-2: 48.9°C BHT, 450 m TD; 105°C/km TG;       •Shovelnose (440 m downslope (340 m D): 48°C/km TG;       •Shovelnose (440 m downslope (340 m D): 48°C/km TG;         •Shovelnose (340 or BN-2: 48.9°C BHT, 450 m TD; 105°C/km TG;       •Shovelnose (341 or SN-2: 48.9°C BHT, 450 m TD; 105	Α.		
<ul> <li>Shovelnose: 30°C (Farbiank &amp; Faulkner, 1992)</li> <li>Turbid Creek hot springs: 28.8°C (Ryder, 1983)</li> <li>The main thermal springs (Shovelnose/Turbid) have built extensive tufa and sinter deposits, whereas the cold seeps are EMR Seep: 17°C (Ryder, 1983)</li> <li>Geothermometry:</li> <li>SN-2: SiO<sub>2</sub> 85.3°C and 115.7°C in two samples (Reader and Croft, 1983)</li> <li>Exploration drilling by Natural Resources Canada (Souther and Dellechaie, 1984):</li> <li>Squamish Valley (304-1): 210 m total depth (TD); 33°C/km temperature gradient (TG)</li> <li>Squamish Valley (304-2): 210 m total depth (TD); 33°C/km temperature gradient (TG)</li> <li>Squamish Valley (304-2): 240 m TD; 65°C/km TG;</li> <li>Cayley (309-2) or CA-2: 445 m TD; 59°C/km TG;</li> <li>Brandywine (343) or SN-2: 48.9°C BHT; 450 m TD; 59°C/km TG;</li> <li>Brandywine (344) or SN-2: 48.9°C BHT; 450 m TD; 50°C/km TG;</li> <li>Brandywine (344) or SN-2: 48.9°C BHT; 450 m TD; 50°C/km TG;</li> <li>Near-neutral pH sodium-bicarbonate waters at high elevations (SN-2), sodium chloride/bicarbonate/sulphate waters at T EMR (304-2) (Souther and Dellechaie, 1984):</li> <li>Near-neutral pH sodium-bicarbonate waters at high elevations (SN-2), sodium chloride/bicarbonate/sulphate waters at T EMR (304-2) (Souther, 1980)</li> <li>A variety of mixed cation and mixed anion compositions which include HCO<sub>3</sub> alkalinity as high as ~2,300 mg/L, SO<sub>4</sub> as h Hydrogeochemistry and geothermometry studies of spring, surface and borehole waters and isotope hydrology confirm th eminating from the Wi. Cayle reservoir. (Souther &amp; Bollechaie, 1984)</li> <li>SN-2: highly saline with Na., CI-, Mg++, HCO<sub>3</sub>- being the dominant ions (Reader and Croft, 1983)</li> <li>Mineral indicators:         <ul> <li>SN-2: minor to moderate degree of hydrothermal alteration consistent with the proximity to units of the Mount Cayley vold indice terma alteration.</li> <li>SN-2: minor to moderate degree of</li></ul></li></ul>		Size/Potential/Type	<ul> <li>Reservoir size: N/A (no area or depth defined in literature) - therefore, reservoir volume estimated* at between: 2.2 km<sup>3</sup> of 2 km<sup>2</sup> and most-likely thickness of 1.1 km. The minimum estimate is calculated for a single spring, and the maximum estand Turbid Creek springs, based on temperature and fluids chemistry] and a separation of 2.1 km). (*Reservoir assumptio</li> <li>Potential: 50 MW (Lovekin &amp; Pletka, 2009). This MW capacity was based on the size of the volcanic complex, and may</li> <li>Type: Low-temperature resource (based on limited geothermometry data), suitable for binary power plant.</li> </ul>
<ul> <li>Turbid Creek hot springs: 28.8°C (Ryder, 1983)</li> <li>The main thermal springs (Shovelnose/Turbid) have built extensive tufa and sinter deposits, whereas the cold seeps are EMR Seep: 17°C (Ryder, 1983)</li> <li>Geothermometry:</li> <li>SN-2: SiO<sub>2</sub> 55.3°C and 115.7°C in two samples (Reader and Croft, 1983)</li> <li>Exploration drilling by Natural Resources Canada (Souther and Dellechaie, 1984):</li> <li>Squamish Valley (304-1): 210 m total depth (TD); 33°C/km temperature gradient (TG)</li> <li>Squamish Valley (304-2): 240 m TD; 65°C/km TG;</li> <li>Cayley (309-1) or CA-1: 49.8°C BHT; 450 m TD; 95°C/km TG;</li> <li>Cayley (309-1) or CA-2: 445 m TD; 59°C/km TG;</li> <li>Cayley (309-2) or CA-2: 445 m TD; 59°C/km TG;</li> <li>Brandynine (343) or SN-2: 48.9°C BHT; 455 m TD; 105°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 455 m TD; 105°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 455 m TD; 105°C/km TG;</li> <li>Naer-neutral pH sodium-bicarbonate waters at high elevations (SN-2), sodium chloride/bicarbonate/sulphate waters at TEMR (304-2) (Souther, 1980)</li> <li>A variety of mixed cation and mixed anion compositions which include HCO<sub>2</sub> alkalinity as high as ~2,300 mg/L, SO, as h Hydrogeochemistry and geothermometry studies of spring, surface and borehole waters and isotope hydrology confirm the eminating from the M. Cayley reservoir. (Souther &amp; Dellechaie, 1984)</li> <li>SN-2: highly saline with NA. Cl-N, Me++, HCO<sub>3</sub>- being the dominant ions (Reader and Croft, 1983)</li> <li>Mineral indicators:</li> <li>SN-2: minor to moderate degree of hydrothermal alteration consistent with the proximity to units of the Mount Cayley vole of the maching interview of the mount Cayley vole of the maching interview in granitic host rock. Unclear how extensive this fracturing i and hydrothermal alteration.</li> </ul>		Temperature/Water and Gas Chemistry/Mineral Indicators	Surface features:
<ul> <li>The main thermal springs (Shovelnose/Turbid) have built extensive tufa and sinter deposits, whereas the cold seeps are • EMR Seep: 17°C (Ryder, 1983)</li> <li>Geothermometry:</li> <li>SN-2: Slog 85.3°C and 115.7°C in two samples (Reader and Croft, 1983)</li> <li>Exploration drilling by Natural Resources Canada (Souther and Dellechaie, 1984):</li> <li>Squarnish Valley (304-1): 210 m total depth (TD); 33°C/km temperature gradient (TG)</li> <li>Squarnish Valley (304-1): c10 m total depth (TD); 33°C/km TG;</li> <li>Cayley (309-1) or CA-1: 48.9°C BHT; 450 m TD; 55°C/km TG;</li> <li>Cayley (309-2) or CA-2: 445 m TD; 55°C/km TG;</li> <li>Showlonse (344) or SN-2: 48.9°C BHT; 450 m TD; 105°C/km TG;</li> <li>Showlonse (344) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG;</li> <li>Near-Ineutral pH sodium-bicarbonate waters at high levations (SN-2), sodium chloride/bicarbonate/sulphate waters at T EMR (304-2) (Souther, 1980)</li> <li>A variet of mixed cation and mixed anion compositions which include HCO<sub>3</sub> alkalinity as high as -2,300 mg/L, SQ, as h Hydrogeochemistry and geothermometry studies of spring, surface and borehole waters and isotope hydrology confirm the eminating from the Mt. Cayley reservoir. (Souther &amp; Dellechaie, 1984)</li>     &lt;</ul>			
<ul> <li>SN-2: SiO<sub>2</sub> 85.3°C and 115.7°C in two samples (Reader and Croft, 1983)</li> <li>Exploration drilling by Natural Resources Canada (Souther and Dellechaie, 1984):         <ul> <li>Squamish Valley (304-1): 210 m total depth (TD); 33°C/km temperature gradient (TG)</li> <li>Squamish Valley (304-2): 240 m TD; 65°C/km TG;</li> <li>Cayley (309-1) or CA-1: 448 m TD; 59°C/km TG;</li> <li>Cayley (309-2) or CA-2: 446 m TD; 59°C/km TG;</li> <li>Brandywine (343) or BW-1: 49.0°C BHT; 450 m TD; 105°C/km TG;</li> <li>Brandywine (343) or SW-1: 440 m TD; 48°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 455 m TD; 105°C/km TG; located at the head of Shovelnose creek at the easter and HCO<sub>3</sub> water.</li> </ul> </li> <li>Water chemistry (Souther and Dellechaie, 1984):         <ul> <li>Near-neutral PH sodium-bicarbonate waters at high elevations (SN-2), sodium chloride/bicarbonate/sulphate waters at T EMR (304-2) (Souther, 1980)</li> <li>A variety of mixed cation and mixed anion compositions which include HCO<sub>3</sub> alkalinity as high as ~2,300 mg/L, SO<sub>4</sub> as h Hydrogeochemistry and geothermometry studies of spring, surface and borehole waters and isotope hydrology confirm the eminating from the Mt. Cayley reservoir. (Souther &amp; Dellechaie, 1984)</li> <li>SN-2: highly saline with Na, CI-, Mg++, HCO<sub>3</sub>- being the dominant ions (Reader and Croft, 1983)</li> <li>Mineral indicators:                 <ul> <li>SN-2: ninor to moderate degree of hydrothermal alteration consistent with the proximity to units of the Mount Cayley volve and and hydrothermal alteration.</li> </ul> </li> </ul> </li></ul>			• The main thermal springs (Shovelnose/Turbid) have built extensive tufa and sinter deposits, whereas the cold seeps are
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<ul> <li>Squamish Valley (304-2): 240 m TD; 65°C/km TG;</li> <li>Cayley (309-1) or CA-1: 49.8°C BHT; 450 m TD; 95°C/km TG; small fluid entries in borehole; located 460 m downslope</li> <li>Cayley (309-2) or CA-2: 445 m TD; 59°C/km TG;</li> <li>Brandywine (343) or BW-1: 440 m TD; 48°C/km TG;</li> <li>Brandywine (343) or BW-1: 440 m TD; 48°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG; located at the head of Shovelnose creek at the easter and HCO<sub>3</sub> water.</li> <li>Water chemistry (Souther and Dellechaie, 1984):         <ul> <li>Near-neutral pH sodium-bicarbonate waters at high elevations (SN-2), sodium chloride/bicarbonate/sulphate waters at T EMR (304-2) (Souther, 1980)</li> <li>A variety of mixed cation and mixed anion compositions which include HCO<sub>3</sub> alkalinity as high as ~2,300 mg/L, SO<sub>4</sub> as h Hydrogeochemistry and geothermometry studies of spring, surface and borehole waters and isotope hydrology confirm the eminating from the Mt. Cayley reservoir. (Souther &amp; Dellechaie, 1984)</li> <li>SN-2: highly saline with Na , CI-, Mg++, HCO<sub>3</sub>- being the dominant ions (Reader and Croft, 1983)</li> </ul> </li> <li>Surface Flow Rates and Reservoir Recharge</li> <li>Well EMR 304-2: observed artesian flow ~10 L/min from a depth of 140 m. (Ryder, 1983)</li> <li>Permeability (heat exchange potential)</li> <li>Permeability (heat exchange potential)</li> </ul>			
<ul> <li>Cayley (309-1) or CA-1: 49.8°C BHT; 450 m TD; 95°C/km TG; small fluid entries in borehole; located 460 m downslope</li> <li>Cayley (309-2) or CA-2: 445 m TD; 55°C/km TG;</li> <li>Brandywine (343) or BW-1: 440 m TD; 48°C/km TG;</li> <li>Shovelnose (344) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG; located at the head of Shovelnose creek at the easter and HCO<sub>3</sub> water.</li> <li>Water chemistry (Souther and Dellechaie, 1984):</li> <li>Near-neutral pH sodium-bicarbonate waters at high elevations (SN-2), sodium chloride/bicarbonate/sulphate waters at T EMR (304-2) (Souther, 1980)</li> <li>A variety of mixed cation and mixed anion compositions which include HCO<sub>3</sub> alkalinity as high as ~2,300 mg/L, SO<sub>4</sub> as h Hydrogeochemistry and geothermometry studies of spring, surface and borehole waters and isotope hydrology confirm the eminating from the Mt. Cayley reservoir. (Souther &amp; Dellechaie, 1984)</li> <li>SN-2: highly saline with Na, CI-, Mg++, HCO<sub>3</sub>- being the dominant ions (Reader and Croft, 1983)</li> <li>Mineral indicators:</li> <li>SN-2: minor to moderate degree of hydrothermal alteration consistent with the proximity to units of the Mount Cayley vold</li> <li>Surface Flow Rates and Reservoir Recharge</li> <li>Well EMR 304-2: observed artesian flow ~10 L/min from a depth of 140 m. (Ryder, 1983)</li> <li>Permeability (heat exchange potential)</li> </ul>			
<ul> <li>Cayley (309-2) or CA-2: 445 m TD; 59°C/km TG;</li> <li>Brandywine (343) or BW-1: 440 m TD; 48°C/km TG;</li> <li>Brandywine (343) or SN-2: 48.9°C BHT; 465 m TD; 105°C/km TG; located at the head of Shovelnose creek at the easter and HCO<sub>3</sub> water.</li> <li>Water chemistry (Souther and Dellechaie, 1984):</li> <li>Near-neutral pH sodium-bicarbonate waters at high elevations (SN-2), sodium chloride/bicarbonate/sulphate waters at T EMR (304-2) (Souther, 1980)</li> <li>A variety of mixed cation and mixed anion compositions which include HCO<sub>3</sub> alkalinity as high as ~2,300 mg/L, SO<sub>4</sub> as h Hydrogeochemistry and geothermometry studies of spring, surface and borehole waters and isotope hydrology confirm the eminating from the Mt. Cayley reservoir. (Souther &amp; Dellechaie, 1984)</li> <li>SN-2: highly saline with Na , Cl-, Mg++, HCO<sub>3</sub>- being the dominant ions (Reader and Croft, 1983)</li> <li>Mineral indicators:</li> <li>SN-2: minor to moderate degree of hydrothermal alteration consistent with the proximity to units of the Mount Cayley vold</li> <li>Surface Flow Rates and Reservoir Recharge</li> <li>Well EMR 304-2: observed artesian flow ~10 L/min from a depth of 140 m. (Ryder, 1983)</li> <li>Permeability (heat exchange potential)</li> </ul>			
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and HCO3 water.         Water chemistry (Souther and Dellechaie, 1984):         • Near-neutral pH sodium-bicarbonate waters at high elevations (SN-2), sodium chloride/bicarbonate/sulphate waters at T EMR (304-2) (Souther, 1980)         • A variety of mixed cation and mixed anion compositions which include HCO3 alkalinity as high as ~2,300 mg/L, SO4 as h Hydrogeochemistry and geothermometry studies of spring, surface and borehole waters and isotope hydrology confirm the eminating from the Mt . Cayley reservoir. (Souther & Dellechaie, 1984)         • SN-2: highly saline with Na , Cl-, Mg++, HCO3- being the dominant ions (Reader and Croft, 1983)         Mineral indicators:         • SN-2: minor to moderate degree of hydrothermal alteration consistent with the proximity to units of the Mount Cayley volc         Surface Flow Rates and Reservoir Recharge         Well EMR 304-2: observed artesian flow ~10 L/min from a depth of 140 m. (Ryder, 1983)         Permeability (where present) is likely associated with fractures in granitic host rock. Unclear how extensive this fracturing i and hydrothermal alteration.			
Water chemistry (Souther and Dellechaie, 1984):         • Near-neutral pH sodium-bicarbonate waters at high elevations (SN-2), sodium chloride/bicarbonate/sulphate waters at T EMR (304-2) (Souther, 1980)         • A variety of mixed cation and mixed anion compositions which include HCO <sub>3</sub> alkalinity as high as ~2,300 mg/L, SO <sub>4</sub> as h Hydrogeochemistry and geothermometry studies of spring, surface and borehole waters and isotope hydrology confirm the eminating from the Mt . Cayley reservoir. (Souther & Dellechaie, 1984)         • SN-2: highly saline with Na , Cl-, Mg++, HCO <sub>3</sub> - being the dominant ions (Reader and Croft, 1983)         Mineral indicators:         • SN-2: minor to moderate degree of hydrothermal alteration consistent with the proximity to units of the Mount Cayley volo         Surface Flow Rates and Reservoir Recharge         Well EMR 304-2: observed artesian flow ~10 L/min from a depth of 140 m. (Ryder, 1983)         Permeability (heat exchange potential)			
<ul> <li>Near-neutral pH sodium-bicarbonate waters at high elevations (SN-2), sodium chloride/bicarbonate/sulphate waters at T EMR (304-2) (Souther, 1980)</li> <li>A variety of mixed cation and mixed anion compositions which include HCO<sub>3</sub> alkalinity as high as ~2,300 mg/L, SO<sub>4</sub> as h Hydrogeochemistry and geothermometry studies of spring, surface and borehole waters and isotope hydrology confirm the eminating from the Mt. Cayley reservoir. (Souther &amp; Dellechaie, 1984)</li> <li>SN-2: highly saline with Na , Cl-, Mg++, HCO<sub>3</sub>- being the dominant ions (Reader and Croft, 1983)</li> <li>Mineral indicators:</li> <li>SN-2: minor to moderate degree of hydrothermal alteration consistent with the proximity to units of the Mount Cayley vold</li> <li>Surface Flow Rates and Reservoir Recharge</li> <li>Well EMR 304-2: observed artesian flow ~10 L/min from a depth of 140 m. (Ryder, 1983)</li> <li>Permeability (heat exchange potential)</li> <li>Permeability (where present) is likely associated with fractures in granitic host rock. Unclear how extensive this fracturing i and hydrothermal alteration.</li> </ul>			
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Hydrogeochemistry and geothermometry studies of spring, surface and borehole waters and isotope hydrology confirm the         eminating from the Mt . Cayley reservoir. (Souther & Dellechaie, 1984)         • SN-2: highly saline with Na , Cl-, Mg++, HC0 <sub>3</sub> - being the dominant ions (Reader and Croft, 1983)         Mineral indicators:         • SN-2: minor to moderate degree of hydrothermal alteration consistent with the proximity to units of the Mount Cayley volc         Surface Flow Rates and Reservoir Recharge         Well EMR 304-2: observed artesian flow ~10 L/min from a depth of 140 m. (Ryder, 1983)         Permeability (heat exchange potential)         Permeability (where present) is likely associated with fractures in granitic host rock. Unclear how extensive this fracturing i and hydrothermal alteration.			EMR (304-2) (Souther, 1980)
eminating from the Mt . Cayley reservoir. (Souther & Dellechaie, 1984)         • SN-2: highly saline with Na , Cl-, Mg++, HCO <sub>3</sub> - being the dominant ions (Reader and Croft, 1983)         Mineral indicators:         • SN-2: minor to moderate degree of hydrothermal alteration consistent with the proximity to units of the Mount Cayley vold         Surface Flow Rates and Reservoir Recharge         Well EMR 304-2: observed artesian flow ~10 L/min from a depth of 140 m. (Ryder, 1983)         3D Permeability (heat exchange potential)         Permeability (where present) is likely associated with fractures in granitic host rock. Unclear how extensive this fracturing i and hydrothermal alteration.			
<ul> <li>SN-2: highly saline with Na , Cl-, Mg++, HCO<sub>3</sub>- being the dominant ions (Reader and Croft, 1983) Mineral indicators:         <ul> <li>SN-2: minor to moderate degree of hydrothermal alteration consistent with the proximity to units of the Mount Cayley vold</li> </ul> </li> <li>Surface Flow Rates and Reservoir Recharge Well EMR 304-2: observed artesian flow ~10 L/min from a depth of 140 m. (Ryder, 1983)</li> <li>3D Permeability (heat exchange potential) Permeability (where present) is likely associated with fractures in granitic host rock. Unclear how extensive this fracturing in and hydrothermal alteration.</li> </ul>			
Mineral indicators:       • SN-2: minor to moderate degree of hydrothermal alteration consistent with the proximity to units of the Mount Cayley vold         Surface Flow Rates and Reservoir Recharge       Well EMR 304-2: observed artesian flow ~10 L/min from a depth of 140 m. (Ryder, 1983)         3D Permeability (heat exchange potential)       Permeability (where present) is likely associated with fractures in granitic host rock. Unclear how extensive this fracturing is and hydrothermal alteration.			
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3D Permeability (heat exchange potential) Permeability (where present) is likely associated with fractures in granitic host rock. Unclear how extensive this fracturing i and hydrothermal alteration.			<ul> <li>SN-2: minor to moderate degree of hydrothermal alteration consistent with the proximity to units of the Mount Cayley volc</li> </ul>
and hydrothermal alteration.		¥	
Recent Magmatism Mt. Cayley Complex consists of three eruptive episodes between 2.5 and 0.31 Ma (Fairbank & Faulkner, 1992)			
		Recent Magmatism	Mt. Cayley Complex consists of three eruptive episodes between 2.5 and 0.31 Ma (Fairbank & Faulkner, 1992)

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

<sup>3</sup> and 6.5 km<sup>3</sup> (with a most-likely area for any single spring estimate is calculated using two hot springs [Shovelnose ions made using Appendix III in GeothermEx, 2004) ay be overly optimistic.

re precipitating bright red ferruginous ochre (Souther, 1980)

e from Turbid Creek hot springs

tern edge of the resistivity anomaly, near seeps of high SO<sub>4</sub>

Turbid Creek hot springs, and sodium sulphate waters at

high as 1,260 mg/L, and Cl as high as ~1,200 mg/L. he presence of a chemically distinctive hydrothermal fluid

Icanic complex (Reader and Croft, 1983)

is, or whether permeability may be diminished by gouge

Near Whistler, British Columbia, Canada **Topographical Map Sheet: Figure 22** Geological Map Sheet: Figure 23

Category	Comments
Structural Setting	Cretaceous granite beneath volcanic unis intersected by many conjugate faults (BC Hydro, 1974) Observed basement structures that appear to be related to the volcanic belt are north-northwesterly trending, gouge-filled fractures and are associated with hydrothermal alteration at Mt. Cayley (Souther, 1980)
Geophysics	<ul> <li>Thermal anomaly detected by thermal infrared flight at base of ash lens where maximum thickness ~300 m (on west side In 1980 a DC resistivity survey (using dipole-dipole array) was carried out along two lines parallel to upper Shovelnose Cred defined a zone of lower resistivity (100~500 ohm-m) along the central portion of the survey line. The Geological Survey corpole-pole array, which defined the eastern edge of a conductive anomaly (~150 ohmmeters) that is open westward, toward Creek warm springs (west of the dipole-dipole coverage, and with north and south boundaries firmly identified, [Shore, 198 Geophysics Ltd. in 1983 suggested that resistivity at depth is an order of magnitude lower beneath the central part of the of Dellechaie, 1984)</li> <li>A deep seismic reflection study across the southern Canadian Cordillera shows a midcrustal "bright spot" under the vicin horizontal position uncertain). The interpretation of the feature is uncertain - possibly a fossil sill complex (plutonic rocks in melted rock or of aqueous fluid (Hammer and Clowes, 1996).</li> <li>Beneath the eastern side of Mount Cayley are shallow (100-500 m) zones of enhanced electrical conductivity due to a cla alteration mineral, interpreted to be an electrically conductive sealing cap rock (low resistivity/low permeability) above a ge</li> </ul>
Reservoir Host Rock	<ul> <li>Likely the basement complex - springs issue from the volcanic-basement contact (BC Hydro, 1982).</li> <li>Temperature-gradient holes penetrated quartz diorite, numerous dykes of dacitic and andesitic composition visible throug.</li> <li>The basement rocks at Mt. Cayley can be divided into distinct assemblages: The oldest (unit 1) is a large pendant of meta amphibolite gneiss and (intensely deformed) crystalline limestone; a hornblende-rich complex (unit 2) of quartz diorite, dior numerous mafic inclusions and dyke swarms, and locally have distinct gneissic layering); hornblende, biotite granodiorite (underlies much of the northern part of the Garibaldi Volcanic Belt. Unit 3 is cut by a large pluton of clean, pinkish white, con 1980).</li> </ul>
Drilling Issues Brief Description of Geological Setting of Thermal Features (i.e.,	<ul> <li>The slopes of Mt. Cayley are known to be poorly consolidated - two major historical debris avalanches (1963, 1984) (Kelr</li> <li>Risk of landslides, flash floods and avalanches present in young volcanic terrane, where poorly consolidated and intense comparable slopes on competent rock (Souther, 1980)</li> <li>Severe terrain noted for restricting access in multiple papers.</li> <li>Volcanic complex composed of dacitic flows, tuffs and breccias (Fairbank &amp; Faulkner, 1992)</li> </ul>
springs emanate from fluvial gravels; beside a river, etc.)	<ul> <li>Mt Cayley is a composite volcano comprised of poorly lithified pyroclastic rocks and lavas which erupted during most received (Souther and Dellechaie, 1984) years ago.</li> <li>Cayley volcanics are andesitic to dacitic in composition, flow and ash unit thicknesses up to 90 m, generally lens-shaped, enhanced permeability (basal dacite with columnar joining and andesite on western slope with numerous lava tubes); num along Shovelnose Creek and Turbid Creek are granodiorite with overlying metasediments (gneiss, schist, crystalline limes) (Kelman et al., 2001).</li> <li>Springs: A group of three springs and numerous seeps in upper Turbid Creek are associated with cupolas of Vulcan's The zones of the cupolas). The group of two springs and associated seeps in Shovelnose Creek issue from basement rocks ne endogenous dome (Souther, 1980).</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ide in gorge of Turbid Creek) (BC Hydro, 1974) Creek with penetration to a depth of about 600 m, which conducted a more detailed survey in 1982 using a multiple ard the zone of intense alteration surrounding the Turbid 983]). Magnetotelluric (MT) data collected by Phoenix complex than around its periphery. (Souther and

inity of Mt. Cayley at a depth of approximately 13 km (exact intruded in a horizontal layer) or one or more lenses of

clay layer with montmorillonite as the dominant clay geothermal reservoir (Jones and Dumas, 1993).

ughout core. (Reader and Croft, 1983) netasediments including quartz mica schist, greenstone, iorite and minor amphibolite (commonly foliated, contain e (unit 3) that is relatively uniform, poorly foliated and coarse- to medium-grained quartz monzonite (Souther,

elman et al., 2001) sely fractured flows and tephra are much less stable than

ecently between 310,000 (Kelman et al., 2001) and 180,000

ed, and can range up to 300 m thick; two units with merous volcanic vents; (BC Hydro, 1974) basement rocks estone) that extend to elevations as high as 1,200 m as

Thumb dacite (each issuing from fractures in the contact near the southern intrusive margin of the Shovelnose

Near Whistler, British Columbia, Canada Topographical Map Sheet: Figure 22 Geological Map Sheet: Figure 23

B.       Exploration Uncertainty (Risk)         Degree of Identification of Resources/Reserves       Low         No clearly identified development target, despite geochemical sampling of springs, several geophysical	
Degree of Identification of Resources/Reserves Low No clearly identified development target, despite geochemical sampling of springs, several geophysica	
No clearly identified development target, despite geochemical sampling of springs, several geophysica	
	al surveys, and sevel
Likelihood of Covering Reservoir with Concession Moderate	
Current concession largely covers explored areas of Mount Cayley resource. Concession largely on ne	on-conservancy land
conservancy as well. Some land titles in-held in vicinity of Cayley wells.         Expected Authorization Date       Unknown	
Specific Timing of Exploration (2 + 2 years, BC 8 years, etc.) 5 years	
(1 year additional drilling of shallow temperature-gradient holes + 1 year deep gradient-well drilling + 1	l vear successful dev
drilling and start plant construction + 1 year drilling wrap-up and finish plant construction)	year succession dev
Degree of Previous Exploration (can be good or bad) Moderate	
• Several temperature gradient wells drilled, geochemical sampling and analysis of springs, and a num	nber of geophysical s
surveys, MT survey, seismic reflection survey) conducted in area.	see of geopergered of
<ul> <li>No deep exploration wells drilled or tested. Resource area location not fully defined/identified. Further</li> </ul>	er exploration needed
Surface Operational Capacity (enough stable area for drilling and Not likely in vicinity of Turbid Creek or Shovelnose hot springs due to remote location and potential for	
a plant?)	
Exploration to Exploitation: A summary rating of Exploration Moderate	
Uncertainty (risk) on a scale of difficult (high risk) through medium Successful identification of the reservoir (location/boundaries) needed.	
(moderate risk) to easy (low risk)	
C.       Environmental Issues         Protected Areas       • Callaghan Lake Provincial Park 23 km northeast of proposed plant.	
Protected Areas     • Callaghan Lake Provincial Park 23 km northeast of proposed plant.     • Brandywine Falls Provincial Park 25 km east of proposed plant.	
Tantalus Provincial Park 6 km south of proposed transmission connection.	
Garibaldi Provincial Park 18 km east of proposed transmission connection.	
Endangered Species • Nodding Semaphoregrass (blue-listed plant) occurrence polygon in Callaghan Lake Provincial Park,	23 km northeast of r
Peacock Vinyl (red-listed plant) occurrence polygon in Brandywine Falls Provincial Park, approx. 25	
Coastal Tailed Frog (Special Concern (SARA Schedule 1; blue-listed) occurrence polygon approx. 20	
Geothermal Surface Features • Proposed plant location is approx. 4 km from EMR Seep Hotsprings, approx. 6 km from Turbid Cree	
expected to be located on or near the lower slope of a Quarternary Cascade volcanic centre.	
Shallow wells drilled in the area by EMR produced low flows of warm water. Drill sites were selected	on the basis of limite
Other  • Proposed powerline crosses two creeks draining into of the Squamish River.	
Northern unnamed creek contains Coho Salmon, Sockeye Salmon, Chinook Salmon, Chum Salmon	and Steelhead Trou
<ul> <li>Southern unnamed creek contains Coho Salmon, Chinook Salmon and Steelhead Trout.</li> </ul>	
<ul> <li>Squamish River flows parallel to the proposed powerline route and contains Coho Salmon, Sockeye</li> </ul>	Salmon, Chinook Sa

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

eral temperature-gradient wells drilled.

nd, all previously drilled wells and springs lie outside of

evelopment drilling and testing + 1 year further development

surveys (dipole-dipole and multiple pole-pole resistivitiy

Auch more likely in area of the EMR Seep near Squamish

proposed plant. ed plant. proposed plant location. pprox. 8 km from Shovelnose Hotsprings. The site is

ited geophysical data.

out.

Salmon, Chum Salmon and Steelhead Trout.

Near Whistler, British Columbia, Canada **Topographical Map Sheet: Figure 22** Geological Map Sheet: Figure 23

	Category	Comments
D.	Geothermal Area - Bidding and/or Type of Land Holding (private/government/lease/etc.)	
	Bidding Area	Location within cancelled geothermal tract area. Protected conservancy area north-east of point location.
	Other Claim Rights (mining and/or oil)	Mineral/coal title south-west of location. Proposed location is not within known oil and gas management area; no known te
E.	Market	
	Main Electricity Consumers (direct sales and/or government)	<ol> <li>General Overview</li> <li>BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through th Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propone Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW b against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponer threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply realistically apply to potential geothermal generation projects).</li> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connec distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pa program has no applicability to potential geothermal generation projects.</li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificati snow melt and stream flow.</li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project I BC Hydro through BC Hydro's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>Wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta, th generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with congeston issues, affects the economi</li></ol>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

enures at proposed location.

two main processes:

nents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this

tion of BC Hydro's resource mix, making it less reliant on

en FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

se, is located approximately 50 km from the Mt. Cayley ucts for the Woodfibre site.

Near Whistler, British Columbia, Canada **Topographical Map Sheet: Figure 22** Geological Map Sheet: Figure 23

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation.</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical an considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to seve Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gene other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
-	Transmission Line Infrastructure	
<u>F.</u>	State of the Infrastructure	230 kV and 500 kV existing transmission lines are located at approximately 15 km east site location. The closest accessible hydroelectric generating station (HGS).
	Transmission Route (distance, terrain and costs)	New 230 kV transmission line 20 km to Cheakamus HGS via existing unpaved road.
Н.	Community Issues	
	Indigenous Law and Indigenous Development Areas	<ul> <li>First Nation consultative areas include Squamish Nation.</li> <li>Governed by Squamish Nation (16 councilors). (http://www.squamish.net/about-us/governance/)</li> <li>In 2001, Squamish Nation developed the sacred land use plan that identifies four types of land use zones: forest steward spirit places. (http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/) No actual maps or PDF</li> <li>Squamish Community Development Plan provides priority development areas along with method of funding. (httpsquami</li> <li>Government of BC provided funding in 2013 to assess renewable energy potential in the Traditional Territory of Squamis energy-opportunities-for-11-first-nations-communities.html).</li> </ul>
	Community Action	<ul> <li>Whistler (closest community) Community Plan boundaries include only Resort Municipality development areas; however, to reduce GHG emissions (Whistler Official Community Plan).</li> <li>Squamish and Lil'wat First Nation want Whistler Official Community Plan overturned because it does not provided Lil'wat</li> </ul>
	Surface Rights	First Nation consultative areas include Squamish Nation.
	Tourism	• Squamish Nation traditional territory encompasses significant existing tourism areas. The majority of tourism opportunities sites such as the popular hiking area of Stawamus Chief. The Squamish Nation Land use plan emphasizes the "need for need for Squamish Nation Members, especially from forestry and Tourism" (http://www.squamish.net/about-us/our-land/xay-term)

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ion output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission ven years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

ible transmission line is a 230 kV line to Cheakamus

rdship zones, sensitive areas, restoration areas and wild Fs of the plan are provided.

nishfamilymeeting.com)

ish Nation. (http://www.newsroom.gov.bc.ca/2013/03/clean-

r, plan includes guidelines for water and energy efficiency

at any opportunity to participate in future economic growth

ties are related to outdoor recreation and includes sacred more training and meaningful employment opportunities mixw-sacred-land-land-use-plan/)

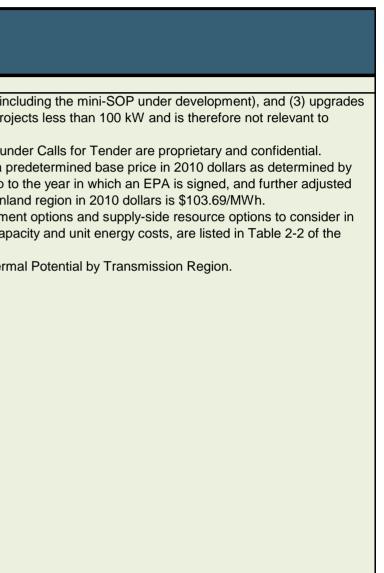
Near Whistler, British Columbia, Canada Topographical Map Sheet: Figure 22 Geological Map Sheet: Figure 23

		Category	Comments
[	I.	Water Rights	
		Availability (for example "air-cooled required")	Plant water requirement estimated approx. 63 L/s for binary plant. MAD of 150,000 L/s in closest Elaho River. Few current within 10 km radius: 1 on Shovelnose Creek for purpose of conservation, construction works filed under Forest, Lands and
		Availability for Drilling	Drilling requirement of 20 L/s. MAD of 150,000 L/s in closest Elaho River. Few current water licences in area. Only 1 existi Creek for purpose of conservation, construction works filed under Forest, Lands and Natural Resources Operations.
	-	Engineering	
	J.	Engineering Plant Location and Design	Remote location accessed via existing unpaved roads.
		Construction Issues	Plant location in proximity to river.
		Transportation Issues	No new road requirements expected; existing unpaved road.
		Architectural Issues (Blend/hide into environment? Local styles? etc.)	None found.
		Special Construction Issues (zero emissions)	None found.
	K.	Non-Electrical Infrastructure (Roads and Habitation)	
		Nearest Large Community > 50,000	North Vancouver, BC
		Nearest Community	Whistler, BC by straight distance; Squamish, BC by road
		Nearest Road and Condition	Unpaved logging/access road.
		Current Access Conditions (restrictions)	Moderately sloped terrain, remote unpaved road conditions.
		Terrain and Distance Factor for Road Building	No new road requirements expected; existing unpaved road. Moderately sloped terrain.

nt water licences in area. Only 1 existing water licence ad Natural Resources Operations.
sting water licence within 10 km radius: 1 on Shovelnose

Near Whistler, British Columbia, Canada **Topographical Map Sheet: Figure 22** Geological Map Sheet: Figure 23

	Category					Comments	
L	Finance						
	General Power Prices	BC Hydro acquires power through (1) competitive processes (Calls for Tender), (2) to to its existing facilities or the development of new generation facilities. (Note that the geothermal generation projects). Comments on the general price of power under ea • The power price paid by BC Hydro to independent power producers through Energ • The power price paid by BC Hydro to independent power producers through EPAs the region of the point of interconnection to the BC Hydro system, escalated at the C based upon the time of day and month when the energy is delivered. For reference, • BC Hydro's current Integrated Resource Plan dated November 2013 includes deta meeting the future demand for electricity. These resource options, together with the November 2013 Resource Options Report Update. That table is reproduced below for • Table 5-7 of the above-noted November 2013 Resource Options Report Update pr					program targets program targets program targets program targets program of a program and and and side managements total energy and capence.
		Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)	
		Biomass – Wood Based	9,772	1,226	122 – 276	132 – 306	
		Biomass – Biogas	134	16	59 – 154	56 – 156	
		Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204	
		Wind – Onshore	46,165	4,271	90 - 309	115 – 365	
		Wind – Offshore	56,700	3,819	166 - 605	182 – 681	
		Geothermal	5,992	780	91 – 573	90 - 593	
		Run-of-River	24,543	1,149	97 – 493	143 – 1,170	
		Site C <sup>3</sup>	4,700	1,100	83	88	
		Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	6,103	774	58 – 92	57 – 86	
		Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103	
		Wave	2,506	259	440 – 772	453 - 820	
		Tidal	1,426	247	253 - 556	264 – 581	
		Solar	57	12	266 - 746	341 – 954	
		<ol> <li>Notes:</li> <li>The resources and UEC values si and may not include all possible r</li> <li>The details of how the cost adjust</li> <li>The Site C values presented in th Impact Statement (EIS) submission real discount rate.</li> <li>Representative projects were use the resource potential is generally</li> </ol>	esources that may ers were developed is table are based o on filed in January 2 d to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC e natural gas-fired a	expected higher cos rovided in Appendix ded in the Site C Er is calculated assum	t. 12. nvironmental ning 5 per cent	



Near Whistler, British Columbia, Canada Topographical Map Sheet: Figure 22 Geological Map Sheet: Figure 23

Category							Com	nments
Market Price (\$/MWhr)	dollars • Whol unfores variety market averag on the • BC H	ranges lesale ele seen gen of source t data. C ge cost fr appropr lydro fore reference	from \$91/MW ectricity prices neration outag ces. One such Of particular re- rom 72 trades iate transmiss ecasts of mark e.	h to 573/MWh for trading pu ges and ambien source is the elevance is the ). Access to the sion system (e. ket prices under	at the point of rposes can var nt temperatures US Energy Info mid-C trading nat market for g g. Bonneville P er various scen	interconnection y greatly. In the s. A general fla prmation Admir hub in the Nort geothermal proj ower Authority	n to the BC Hydro e Pacific Northwe avour of the whol histration (www.ei hwest Region (or jects in BC would ) in the US.	date, the Unit Energy Cost for go o system. est, these prices are affected by lesale electricity prices for poten ia.gov/electricity/wholesale/#his ne example would be a Mid-C p d require access on both the BC mber 2013 IRP. Table 5 in App
		Elect	Table 5		y Price Forecasts b	y Market		
	<b></b>	Market Scenario	1 Mid Electricity Mid GHG (Regional) Mid Gas	2 Low Electricity Low GHG (Regional) Low Gas	(Real 2012 US\$/MV 3 High Electricity High GHG (Regional) High Gas	Mid Electricity Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	5 High Electricity High GHG (Regional/Nat'l) High Gas	
		2014	25.0	21.9	31.1	25.0	31.1	
		2015	25.5	21.7	31.9	25.5	31.9	
		2016	25.8	21.2	32.0	25.8	32.0	
	I -	2017	27.1	22.0	33.4	27.1	33.4	
	I -	2018 2019	27.1 28.0	21.7 22.1	33.9 35.5	27.1 28.0	33.9 35.5	
		2019	28.0	22.1	36.0	28.0	36.0	
		2021	29.3	22.5	37.3	29.3	37.3	
		2022	30.1	22.7	38.8	30.9	41.3	
		2023	31.8	23.2	41.7	35.5	52.1	
		2024	33.0	23.7	43.4	41.8	68.6	
	-	2025 2026	34.2 34.9	24.0 24.1	45.4 46.7	50.3 52.2	91.2 95.1	
	F	2020	36.0	24.1	48.6	54.7	98.9	
		2028	36.3	24.0	50.2	56.8	101.8	
		2029	37.2	23.9	51.1	58.8	106.1	
		2030	37.6	23.8	52.7	60.1	109.3	
		2031	38.6	24.0	54.7	62.6	112.0	
	-	2032	39.9	24.0	57.0	65.6	116.0	
	-	2033 2034	41.5 42.8	24.4 25.1	60.1 61.9	69.3 71.5	122.0 125.7	
	-	2034	42.8	26.2	64.5	74.5	125.7	
		2036	45.7	26.9	66.2	76.4	134.3	
		2037	47.8	28.1	69.1	79.8	140.3	
		2038	48.4	28.4	70.0	80.8	142.1	
		2039	48.9	28.7	70.7	81.6	143.5	
	I L	2040	49.3	29.0	71.4	82.4	144.9	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

geothermal resources at a 7% real discount rate in 2013

by such factors as precipitation/snowfall in the region, ential export of electricity from BC can be obtained from a history). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted C Hydro transmission system to the Canada/US border, and

ppendix 5A – Market Forecast Data is reproduced below for

Near Whistler, British Columbia, Canada Topographical Map Sheet: Figure 22 Geological Map Sheet: Figure 23

Category					Comments
Green Power Premium (\$/MWhr)	<ul> <li>Within British C environmentally f</li> <li>California has a particularly "bund 1. The price of el 2. There are large</li> </ul>	olumbia, there is riendly) from BC goal of 33% of ro led" green energ ectricity is driven e amounts of ren	little deman Hydro. BC H etail sales by y with Rener by the low o ewables, su	d for the purch Hydro's genera y 2020 to be so wable Energy cost of natural ch as wind and	d solar, in California; and
Capacity Price (\$/KW)	There is no pric     Table 3-27 entit	e in \$/kW for cap led "UCCs of Ca ped storage, sim	acity resour pacity Reso ple cycle ga	rce options in t urce Supply Op as turbines and	the BPA transmission system is generally not available he market at present. ptions" in BC Hydro's Integrated Resource Plan dated Novem I resource smart projects such as Revelstoke Unit 6). The uni ple.
	(a) "Off-Peak Hours" (b) "Peak Hours" inclusive, but exc	this Appendix 4 urs" means all ho means the hours luding British Co	, the followin ours other the commencial umbia statu	ng words and e an Super-Peal ng at 06:00 PP itory holidays.	expressions have the following meanings: K Hours and Peak Hours. T and ending at 16:00 PPT, and commencing at 20:00 PPT a 0:00 PPT and ending at 20:00 PPT Monday through Saturday
	Time of Delivery Factor (TDF)			or (TDF)	1
	Month	Super-Peak	Peak	Off-Peak	
	January	141%	122%	105%	-
	February	124%	113%	101%	
	March	124%	112%	99%	
	April	104%	95%	85%	-
	May	90%	82%	70%	
	June	87%	81%	69%	
	July	105%	96%	79%	
	August	110%	101%	86%	
	September	116%	107%	91%	
	October	127%	112%	93%	
	November	129%	112%	99%	
	December	142%	120%	104%	
				1.	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

premium for green power. her can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

mber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

vinclusive, but excluding British Columbia statutory

Near Whistler, British Columbia, Canada Topographical Map Sheet: Figure 22 Geological Map Sheet: Figure 23

	Category	Comments
Is there any greer	n power incentives?	<ul> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community processing of up to \$500,000 per applicant to cover the early stages (e.g. feasibility studies) of project development of Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include: <ul> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> <li>Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability.</li> </ul> </li> </ul>
Grants		See above under green power incentives
Tax Holidays		None listed on federal and provincial websites.
Tax Relief		<ul> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 44 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred durand energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the ye deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now n entitled Scientific Research and Experimental ity and relevance.
<pre>/ participation in the clean energy sector. It provides: ent; and</pre>
these programs may be active but not currently issuing al technologies/resources, while others may be fully
ity and relevance.
ce energy by using renewable energy sources or fuels from 43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 ets would be depreciated for income tax purposes at

during the development and start-up of renewable energy year they are incurred, carried forward indefinitely and

Near Whistler, British Columbia, Canada **Topographical Map Sheet: Figure 22** Geological Map Sheet: Figure 23

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> <li>FNFA loans do not require collateral;</li> </ol>
	<ol> <li>4. FNFA loans can be used to refinance existing debt; and</li> <li>5. FNFA's interest rates and terms parallel those available to provincial and local governments.</li> </ol>
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infra- purchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Bor and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015 Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribe
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section,
	(b) an amount agreed under this section to be paid instead of royalty, or
Concret labor of Develtion	(c) if no royalty or amount has been agreed under this section, the prescribed royalty.
General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "Thi in section 1 (1) [definitions] of the Geothermal Resources Act."
Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners f
Tax Rate in the Country	<ul> <li>Proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg Stat</li> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincia</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. es that join as Borrowing Members.

astructure, social and economic development, land

orrowing Members, represented by the First Nation's Chief

ed rent for the permit (Section 5).

pay to the government

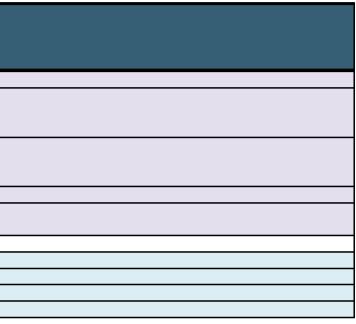
his Act does not apply to geothermal resources as defined

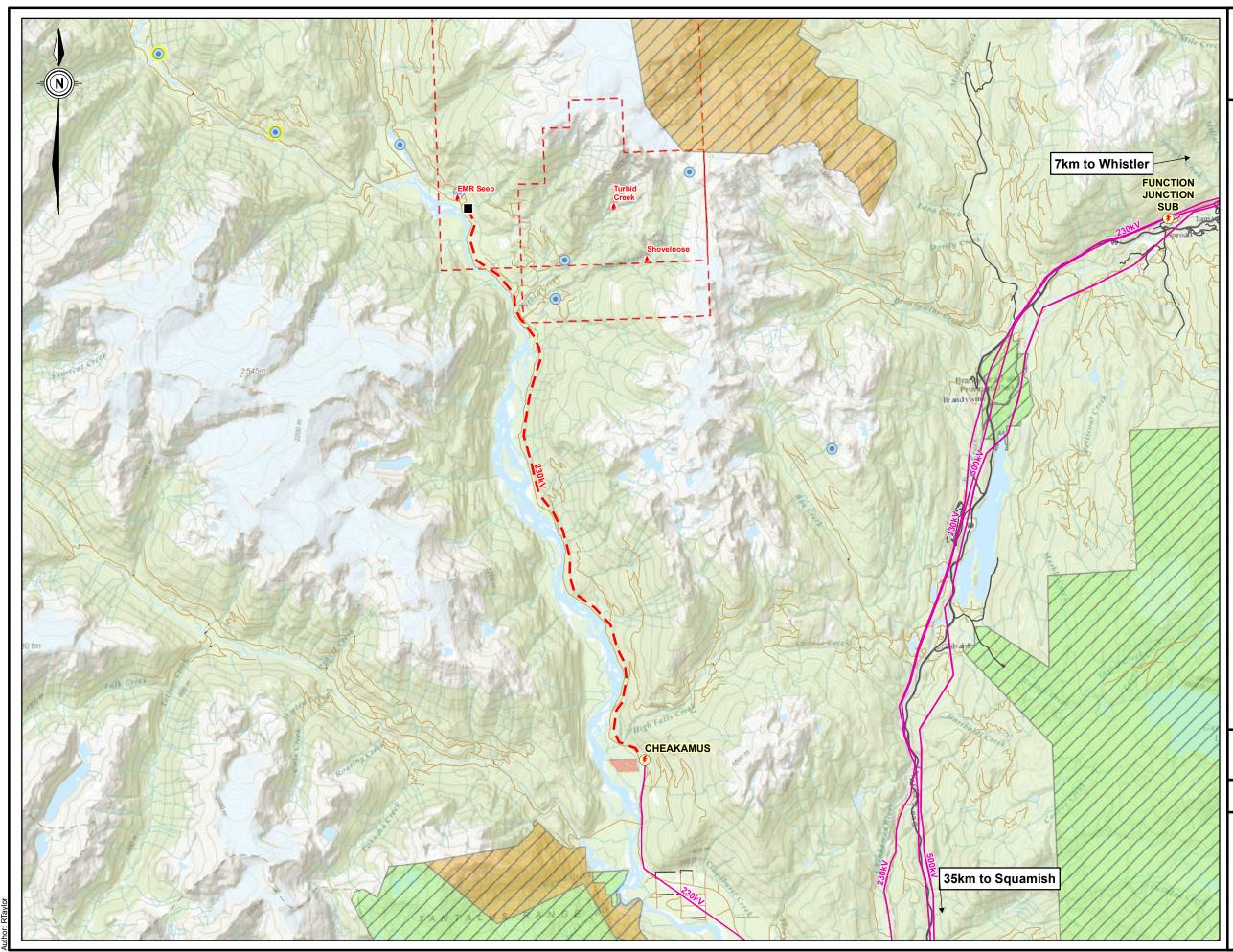
for the geothermal land tract. atutory Right of Way, Licence of Occupation). ial (British Columbia): 13.5%.

ta, the US, or other wholesale customers in BC, the nission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power ne economic viability of the potential wholesale opportunity.

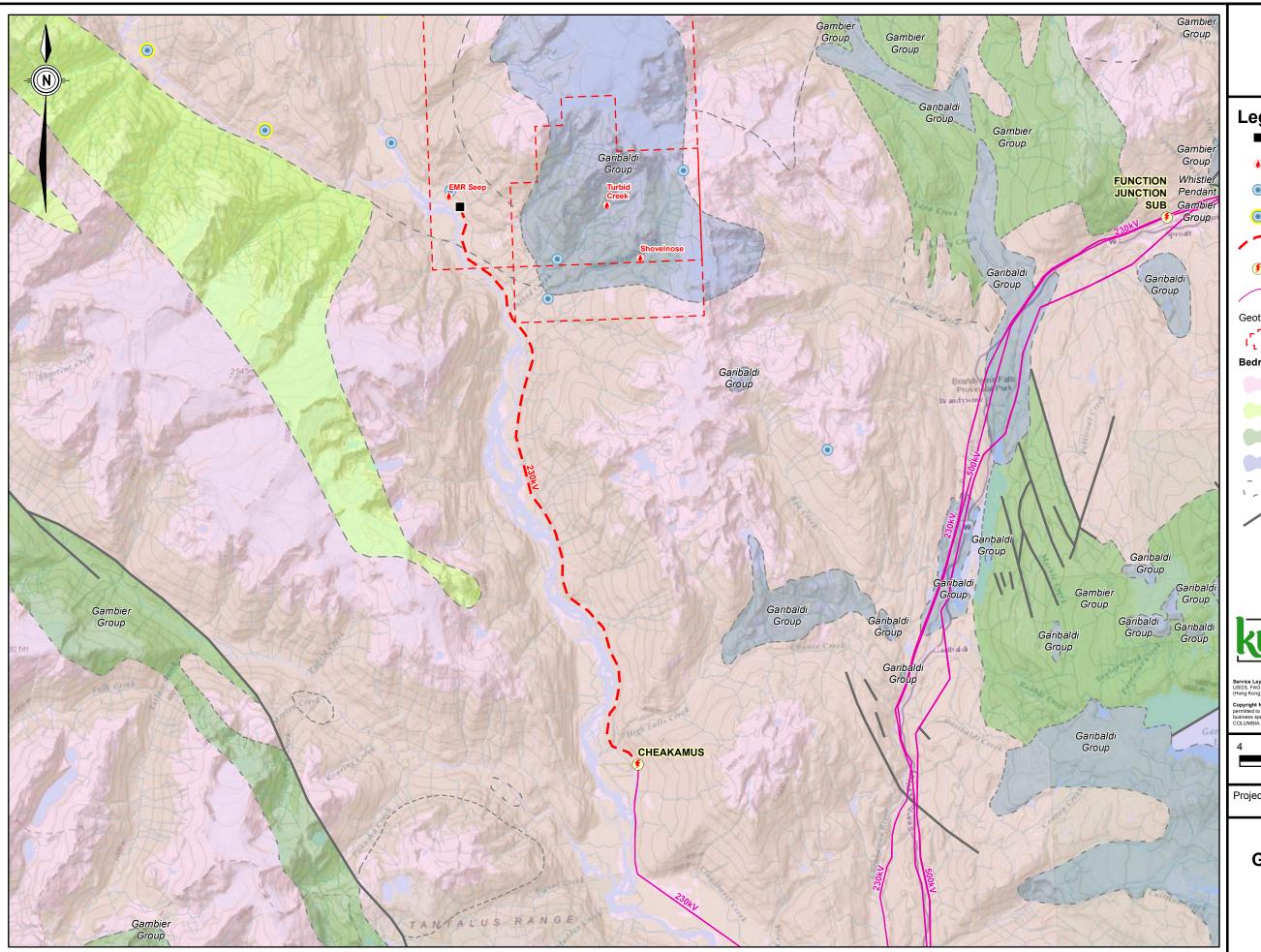
Near Whistler, British Columbia, Canada Topographical Map Sheet: Figure 22 Geological Map Sheet: Figure 23

	Category	Comments
N	M. Maps	
	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)	
	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 22
	Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 23
	Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 23
Ν	N. Other Issues and Considerations	





	Ge¢science BC			
Lege	nd			
	Proposed Geothermal Plant Location			
۲	Thermal Spring			
	Wellbore			
0	Wellbore (Shallow)			
1	Proposed Transmission Line			
۶	Existing Substation			
	Existing Transmission Line			
$\sim$	Paved Road			
$\sim$	Other Road			
	Conservancy			
	Park, Eco-Reserve, Protected Area			
	First Nations Reserve			
Geothern	nal Title Tract			
671	Cancelled			
<b>EXERCISE VALUES</b> IN A CONSTRUCTION OF THE ADDRESS OF A CONSTRUCTION OF A CONSTRUCTI				
3 0 3				
Droissth	Kilometers			
Project No. Date 2692-004 April 30, 2015				
Potential Geothermal Plant at Mt. Cayley 50MW Figure 22				



	Geéscience BC
Lege	nd
	Proposed Geothermal Plant Location
۲	Thermal Spring
	Wellbore
0	Wellbore (Shallow)
/	Proposed Transmission Line
۶	Existing Substation
	Existing Transmission Line
Geothern	nal Title Tract
	Cancelled
Bedrock	Туре
	Intrusive Rocks
	Metamorphic Rocks
•	Sedimentary Rocks
	Volcanic Rocks
	Rock Type Boundary
/	Fault
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	consulting engineers © 2015 Kerr Wood Leidal Associates Ltd.
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1	0 4
	Kilometers
roject No 269	Date 92-004 April 30, 2015
Geo	blogical Strata Map for Mt. Cayley 50MW Eigure 23
	Figure 23



Appendix M

# Mount Garibaldi Geothermal Development Decision Matrix and Figures 24 & 25

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Near Squamish, British Columbia, Canada **Topographical Map Sheet: Figure 24** Geological Map Sheet: Figure 25

	Category	Comments
Α.	Reservoir Potential	
	Size/Potential/Type	<ul> <li>Reservoir size: unknown</li> <li>Potential: 50 MW (Lovekin &amp; Pletka, 2009). This MW capacity was based on the size of the volcanic complex, and may</li> <li>Type: Possible blind geothermal system (no surface manifestations). In absence of any clear evidence of high temperate binary power plant.</li> </ul>
	Temperature/Water and Gas Chemistry/Mineral Indicators	<ul> <li>Surface features:</li> <li>No known springs or other thermal features (BC Hydro, 1974)</li> <li>Geothermometry:</li> <li>No information</li> <li>Exploration drilling:</li> <li>No information</li> <li>Water chemistry:</li> <li>Fluids emanating from bedrock fractures east of Brohm Lake show highest conductivity in Garibaldi area (BC Hydro, 198</li> <li>Mineral indicators:</li> <li>High soil values for arsenic and mercury were measured in the same area as the Brohm Lake fluid fractures, below cliffs</li> </ul>
	Surface Flow Rates and Reservoir Recharge	Fluids emanating at ~1,000 L/min from bedrock fractures east of Brohm Lake on the east side of Hwy 99 (BC Hydro, 1982
	3D Permeability (heat exchange potential)	Permeability (where present) is likely associated with fractures in plutonic and metamorphic rocks. Unclear how extensive diminished by gouge and hydrothermal alteration.
	Recent Magmatism	<ul> <li>Recent cinder cones present with older Pleistocene (age unconfirmed) necks (BC Hydro, 1974)</li> <li>Youngest volcanic activity likely the post-glacial Ring Creek lava flow (erupted around 10,700 years ago) (Brooks and Fri</li> <li>There is evidence of anomalously high heat flow in Table Meadows (near the southern flank of Mount Price) and elsewhere</li> </ul>
	Structural Setting	Much of the basement rock, even at considerable distances from known volcanic centers (within the Garbaldi Mountain comembers of the Garibaldi Group, and these dykes were subject to moderately intense alteration (BC Hydro, 1982).
	Geophysics	No information
	Reservoir Host Rock	Unknown - no thermal features at surface. Possibly similar to other similar volcanic settings in the Garibaldi Complex (Mea
	Drilling Issues	The Garibaldi at Squamish Project was planned as a ski resort development in the late 1990s on the slopes of Mt Garibald geothermal heating as part of the development (Garibaldi Alpen Resorts, 1997). (This project does not appear to have been The modern Cheekye River channel is most likely to be affected by future debris flows in this area caused by instabilities of 2003).

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ay be overly optimistic. ratures, assume low-temperature resource, suitable for

982).

fs of quartz diorite (BC Hydro, 1982).

982).

ve this fracturing is, or whether permeability may be

-riele, 1992). where (Woodsworth, 2003).

complex) are subject to diking by andesitic and dacitic

leager, Cayley). aldi. At that time, there were plans for an investigation of

een constructed)

s on the western slopes of Mt. Garibaldi (Clague et al.,

Near Squamish, British Columbia, Canada **Topographical Map Sheet: Figure 24** Geological Map Sheet: Figure 25

Category	Comments
Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	<ul> <li>The central Garibaldi Belt is underlain by plutonic rocks (mainly quartz diorite) and metamorphic rocks of the Mesozoic to overlain by Cenozoic volcanic rocks that consist of lava flows and pyroclastics of variable composition (basalt, andesite, da</li> <li>The basement in the Mt. Garibaldi area largely of variably altered and foliated quartz diorite (upper Cretaceous) with lesse (BC Hydro, 1982).</li> <li>The overlying Mt. Garibaldi Volcanic Complex is composed of mainly andesitic flows and domes (some lesser basalt, daci than 10,000 years (BC Hydro, 1982).</li> <li>Numerous Pleistocene-Holocene volcanic complexes constructed on eroded surface of basement rock (foliated to massiv monzonites). Only the most recent eruptive complexes contain basalt and basaltic-andesite lavas. Most recent activity is at 1990).</li> <li>The western slopes of Mt Garibaldi (immediately east of the project location) are composed of interbedded dacitic and and sequence overlies hydrothermally altered metamorphic rocks. Pyroclastic deposits and lava flows on the western flank of th Valley about 12,800 years ago. As the ice melted, volcanic materials collapsed and were reworked by glacial streams flowid deposited along the lower reaches of Cheekye River. (Clague et al., 2003).</li> <li>Chekamus Valley basalts (along Hwy 99 west of Mt. Garibaldi) are composed of a sequence of episodic lavas, from an unpresent throughout and is horizontal along steep sides of lavas and vertical beneath blocky flows. Several outcrops show p are relatively thin with fine-scale jointing. (Stelling and Tucker, 2007)</li> </ul>
B. Exploration Uncertainty (Risk)	
B. Exploration Uncertainty (Risk) Degree of Identification of Resources/Reserves	Low Exploration in area includes water conductivity measurements, soil sampling and analysis (BC Hydro, 1982)
Likelihood of Covering Reservoir with Concession	Low

	Exploration in area includes water conductivity measurements, soil sampling and analysis (DC right), 1902
Likelihood of Covering Reservoir with Concession	Low
	Mt. Garibaldi itself is located within the Garibaldi Provincial Park, as is the majority of the Mt. Garibaldi Volcanic Complex. The park boundary is at higher elevations
	surrounding valleys (outside of the park boundary) are the focus of interest (BC Hydro, 1982). However, lack of a clear resource target makes it uncertain where co
	boundaries should be.
Expected Authorization Date	Unknown
Specific Timing of Exploration (2 + 2 years, BC 8 years, etc.)	7 years
	(2 years permitting and surface exploration, possibly drilling shallow temperature-gradient holes + 2 years deep gradient-well drilling + 1 year successful development
	testing + 1 year further development drilling and start plant construction + 1 year drilling wrap-up and finish plant construction)
Degree of Previous Exploration (can be good or bad)	Low
	No surface features in area. Possible blind geothermal system. Would need to drill TG holes or slim holes to collect further data.
Surface Operational Capacity (enough stable area for drilling and	Likely
a plant?)	As there are no surface features to guide exploration, one could in principal conduct resource development from a favorable surface location - assuming a resource
	there.
Exploration to Exploitation: A summary rating of Exploration	Difficult
Uncertainty (risk) on a scale of difficult (high risk) through medium	Very little is known to guide geothermal exploration of resource. Absence of surface features entails higher reliance on drilling to define subsurface temperatures.
(moderate risk) to easy (low risk)	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

to early Tertiary Coast Plutonic Complex (Ryder, 1983), dacite, rhyodacite) (BC Hydro, 1974). ser amounts of younger quartz monzonite and granodiorite acite, rhyodacite), some of which is believed to be younger sive Cretaceous quartz diorite, granodiorite and quartz at Opal Cone on southeast slope of Mt. Garibaldi. (Green, andesitic flows and pyroclastic rocks, and the volcanic the volcano were built out onto a glacier filling Cheakamus wing along the eastern side of Cheakamus Valley and reunknown (likely sub-glacial) vent. Columnar jointing is pillow-like features and some hyaloclastic breccia. Lavas . The park boundary is at higher elevations, and the esource target makes it uncertain where concession well drilling + 1 year successful development drilling and ction) er data. able surface location - assuming a resource is actually

### Geothermal Development Decision Matrix

## MT. GARIBALDI

Near Squamish, British Columbia, Canada Topographical Map Sheet: Figure 24 Geological Map Sheet: Figure 25

	Category	Comments
C.	Environmental Issues	
	Protected Areas	<ul> <li>Brackendale Eagles Provincial park approx. 2 km from proposed transmission connection.</li> </ul>
		<ul> <li>Garibaldi Provincial Park approx. 8 km east of proposed plant location.</li> </ul>
	Endangered Species	<ul> <li>Roell's Brotherella (red-listed plant) approximately 3.8 km south of proposed transmission connection.</li> </ul>
		<ul> <li>Nodding Semaphoregrass (blue-listed plant) approx. 9.8 km from proposed plant location.</li> </ul>
	Geothermal Surface Features	Nearest hot springs approximately 48 km east of proposed plant location.
		This is a Cascade Volcanic centre with evidence of Quaternary or maybe Holocene activity.
	Other	Wildlife Habitata Area allotment for Marbled Murrelet is approx. 2 km east of proposed plant location.
		• Proposed power line makes approximately four major stream crossings. The Brohm River contains Sockeye Salmon, C
		Sockeye Salmon, Coho Salmon, Chinook Salmon and Steelhead Trout.
D.	Geothermal Area - Bidding and/or Type of Land Holding	
	(private/government/lease/etc.)	
	Bidding Area	No existing geothermal tracts.
	Other Claim Rights (mining and/or oil)	No existing mineral or coal titles at plant location. Proposed location is not within known oil and gas management area; no

Coho Salmon and Steelhead trout. The Cheekye contains
o known tenures at proposed location.

Near Squamish, British Columbia, Canada **Topographical Map Sheet: Figure 24** Geological Map Sheet: Figure 25

	Category	Comments
Ε.	Market	
	Main Electricity Consumers (direct sales and/or government)	<ol> <li>General Overview         <ol> <li>BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through ts             <li>Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propon             <li>Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW b             against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponer             threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply             realistically apply to potential geothermal generation projects).             <ul> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect             distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pa             program has no applicability to potential geothermal generation projects.             The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificati             snow melt and stream flow.         </li> </ul> </li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give         under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project le             BC Hydro is competitive calls and/or the SOP, or to other potential customers as noted below.         </li> </li> <li>Wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta, th         generating on the end customer, the generation supplier will have to make similar arrangements to cover transmission ac         Authorit</li></li></ol></li></ol>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

- nents can bid into those competitive calls.
- but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not
- ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this
- tion of BC Hydro's resource mix, making it less reliant on
- en FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to
- he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.
- ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given
- ant located in close proximity to the facility, thereby
- se, is located approximately 25km from the Mt. Garibaldi ucts for the Woodfibre site.

Near Squamish, British Columbia, Canada **Topographical Map Sheet: Figure 24** Geological Map Sheet: Figure 25

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical and considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to sever Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will generation other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
F	Transmission Line Infrastructure	
<b>r</b> .	State of the Infrastructure	Nearest transmission lines are 500 KV and 230 kV. Closest substation is Cheekye 500 kV and Cheekye 230 kV.
	Transmission Route (distance, terrain and costs)	A new 138 kV transmission line from 230 kV Cheekye substation to plant location via existing transmission line corridor. T over moderate to steep terrain.
L	Community Issues	
H.	Community Issues	First Nation consultative areas include Squamish Nation
Н.	Community Issues Indigenous Law and Indigenous Development Areas	<ul> <li>First Nation consultative areas include Squamish Nation.</li> <li>Governed by Squamish Nation (16 councilors) (http://www.squamish.net/about-us/governance/)</li> </ul>
4.		<ul> <li>Governed by Squamish Nation (16 councilors). (http://www.squamish.net/about-us/governance/)</li> </ul>
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4.		<ul> <li>Governed by Squamish Nation (16 councilors). (http://www.squamish.net/about-us/governance/)</li> <li>In 2001, Squamish Nation developed the sacred land use plan that identifies four types of land use zones: forest stewards spirit places. (http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/) No actual maps or PDF</li> </ul>
н.		<ul> <li>Governed by Squamish Nation (16 councilors). (http://www.squamish.net/about-us/governance/)</li> <li>In 2001, Squamish Nation developed the sacred land use plan that identifies four types of land use zones: forest steward spirit places. (http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/) No actual maps or PDF</li> <li>Squamish Community Development Plan provides priority development areas along with method of funding. (httpsquamish</li> </ul>
Η.		<ul> <li>Governed by Squamish Nation (16 councilors). (http://www.squamish.net/about-us/governance/)</li> <li>In 2001, Squamish Nation developed the sacred land use plan that identifies four types of land use zones: forest stewards spirit places. (http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/) No actual maps or PDF</li> <li>Squamish Community Development Plan provides priority development areas along with method of funding. (httpsquamis</li> <li>Government of BC provided funding in 2013 to assess renewable energy potential in the Traditional Territory of Squamish</li> </ul>
Η.	Indigenous Law and Indigenous Development Areas	<ul> <li>Governed by Squamish Nation (16 councilors). (http://www.squamish.net/about-us/governance/)</li> <li>In 2001, Squamish Nation developed the sacred land use plan that identifies four types of land use zones: forest stewards spirit places. (http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/) No actual maps or PDF</li> <li>Squamish Community Development Plan provides priority development areas along with method of funding. (httpsquamis</li> <li>Government of BC provided funding in 2013 to assess renewable energy potential in the Traditional Territory of Squamish energy-opportunities-for-11-first-nations-communities.html).</li> </ul>
н.		<ul> <li>Governed by Squamish Nation (16 councilors). (http://www.squamish.net/about-us/governance/)</li> <li>In 2001, Squamish Nation developed the sacred land use plan that identifies four types of land use zones: forest steward spirit places. (http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/) No actual maps or PDF</li> <li>Squamish Community Development Plan provides priority development areas along with method of funding. (httpsquamister of BC provided funding in 2013 to assess renewable energy potential in the Traditional Territory of Squamister energy-opportunities-for-11-first-nations-communities.html).</li> <li>Squamish Official Community Plan vision includes being leaders in fostering social integrity, economic development, and</li> </ul>
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Н.	Indigenous Law and Indigenous Development Areas Community Action Surface Rights	<ul> <li>Governed by Squamish Nation (16 councilors). (http://www.squamish.net/about-us/governance/)</li> <li>In 2001, Squamish Nation developed the sacred land use plan that identifies four types of land use zones: forest stewards spirit places. (http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/) No actual maps or PDF</li> <li>Squamish Community Development Plan provides priority development areas along with method of funding. (httpsquamise</li> <li>Government of BC provided funding in 2013 to assess renewable energy potential in the Traditional Territory of Squamish energy-opportunities-for-11-first-nations-communities.html).</li> <li>Squamish Official Community Plan vision includes being leaders in fostering social integrity, economic development, and Community Plan).</li> <li>Squamish CAN (Climate Action Network) is a community action group that operates many environmental projects related (http://squamishcan.net/category/projects/completed-projects/energy/).</li> <li>First Nation consultative areas include Squamish Nation.</li> </ul>
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Η.	Indigenous Law and Indigenous Development Areas Community Action Surface Rights	<ul> <li>Governed by Squamish Nation (16 councilors). (http://www.squamish.net/about-us/governance/)</li> <li>In 2001, Squamish Nation developed the sacred land use plan that identifies four types of land use zones: forest stewards spirit places. (http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/) No actual maps or PDF</li> <li>Squamish Community Development Plan provides priority development areas along with method of funding. (httpsquamise</li> <li>Government of BC provided funding in 2013 to assess renewable energy potential in the Traditional Territory of Squamish energy-opportunities-for-11-first-nations-communities.html).</li> <li>Squamish Official Community Plan vision includes being leaders in fostering social integrity, economic development, and Community Plan).</li> <li>Squamish CAN (Climate Action Network) is a community action group that operates many environmental projects related (http://squamishcan.net/category/projects/completed-projects/energy/).</li> <li>First Nation consultative areas include Squamish Nation.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ion output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission ven years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

The transmission line length would be approximately 5km

rdship zones, sensitive areas, restoration areas and wild Fs of the plan are provided.

nishfamilymeeting.com)

ish Nation. (http://www.newsroom.gov.bc.ca/2013/03/clean-

nd environmental sustainability (Squamish Official

ed to energy, food, transportation

ties are related to outdoor recreation and includes sacred more training and meaningful employment opportunities mixw-sacred-land-land-use-plan/)

Near Squamish, British Columbia, Canada Topographical Map Sheet: Figure 24 Geological Map Sheet: Figure 25

		Category	Comments
	Ι.	Water Rights	
		Availability (for example "air-cooled required")	Plant water requirement estimated approx. 63 L/s for binary plant. MAD of 2100 L/s on Cheekeye River. Few water licences Cheakamus River. Water licences within 5 km and not on Cheakamus river include 2 current water licences with 8 active snowmaking, watering, irrigation respectively.
		Availability for Drilling	Drilling requirement of 20 L/s. MAD of 2100 L/s on Cheekeye River. Few water licences on Mt Garibaldi; several existing water and not on Cheakamus river include 2 current water licences with 8 active applications for domestic, power-general and
	J.	Engineering	
		Plant Location and Design	Plant location proposed on moderately sloped, forested mountain terrain.
		Construction Issues	Unpaved, switchback roads up
		Transportation Issues	Unpaved, switchback roads to plant location; forested mountain terrain.
		Architectural Issues (Blend/hide into environment? Local styles? etc.)	None found. Proposed plant location is within 2 km of popular outdoor recreation area Cat Lake and Alice Lake Provincial
		Special Construction Issues (zero emissions)	None found.
		•••	
	K.	Non-Electrical Infrastructure (Roads and Habitation)	
		Nearest Large Community > 50,000	North Vancouver, BC
		Nearest Community	Squamish, BC
		Nearest Road and Condition	Unpaved mountain access road.
		Current Access Conditions (restrictions)	Location is surround by several BC Parks protected areas (Alice Lake, Garibaldi) on the north, east and south.)
		Terrain and Distance Factor for Road Building	No new road requirement expected. Extensive existing unpaved road network.
[			

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

nces on Mt Garibaldi; several existing water licences ve applications for domestic, power-general and

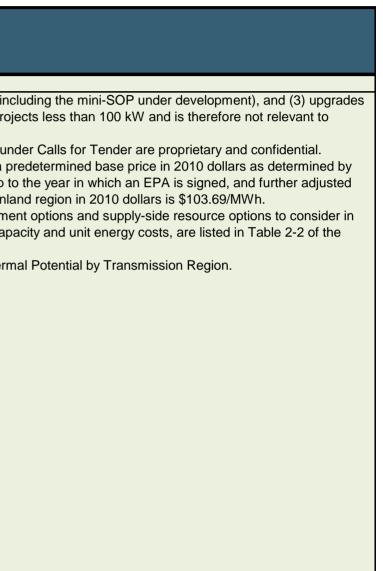
water licences Cheakamus River. water licences within 5 and snowmaking, watering, irrigation respectively.

al Park.

Near Squamish, British Columbia, Canada **Topographical Map Sheet: Figure 24** Geological Map Sheet: Figure 25

	Category					Comments	
L.	Finance						
	General Power Prices	BC Hydro acquires power through (1) competitive processes (Calls for Tender), (2) the Star to its existing facilities or the development of new generation facilities. (Note that the net me geothermal generation projects). Comments on the general price of power under each one a • The power price paid by BC Hydro to independent power producers through Energy Purch • The power price paid by BC Hydro to independent power producers through EPAs under the region of the point of interconnection to the BC Hydro system, escalated at the Consum- based upon the time of day and month when the energy is delivered. For reference, the bas • BC Hydro's current Integrated Resource Plan dated November 2013 includes details of bo meeting the future demand for electricity. These resource options, together with their attribut November 2013 Resource Options Report Update. That table is reproduced below for read • Table 5-7 of the above-noted November 2013 Resource Options Report Update provides a					g program targets prog greements (EPAs) un P are made up of a p ce Index annually up t e for the Lower Mainla nand-side management f total energy and cap rence.
		Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)	]
		Biomass – Wood Based	9,772	1,226	122 – 276	132 - 306	
		Biomass – Biogas	134	16	59 – 154	56 – 156	
		Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204	]
		Wind – Onshore	46,165	4,271	90 – 309	115 – 365	
		Wind – Offshore	56,700	3,819	166 - 605	182 – 681	
		Geothermal	5,992	780	91 – 573	90 - 593	
		Run-of-River	24,543	1,149	97 – 493	143 – 1,170	4
		Site C <sup>3</sup> Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	4,700 6,103	1,100 774	83 58 – 92	88 57 – 86	1
		Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103	1
		Wave	2,506	259	440 - 772	453 - 820	1
		Tidal	1,426	247	253 - 556	264 - 581	1
		Solar	57	12	266 - 746	341 – 954	1
		<ol> <li>Notes:</li> <li>The resources and UEC values s and may not include all possible r</li> <li>The details of how the cost adjust</li> <li>The Site C values presented in th Impact Statement (EIS) submission real discount rate.</li> <li>Representative projects were use the resource potential is generally</li> </ol>	esources that may ers were developed is table are based o on filed in January 2 d to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC i e natural gas-fired a	xpected higher cos ovided in Appendix ded in the Site C Er is calculated assum	t. 12. nvironmental ning 5 per cent	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015



Near Squamish, British Columbia, Canada Topographical Map Sheet: Figure 24 Geological Map Sheet: Figure 25

Category							Comments
Market Price (\$/MWhr)	dollars rang • Wholesald unforeseen variety of some market data average co on the appr • BC Hydro ready refer	ges from \$9 e electricity generation burces. One a. Of particu st from 72 tr opriate tran forecasts o ence.	1/MWh to 5 prices for tra outages an e such sourc ular relevand rades). Acc smission sy f market price ce Data Tal	73/MWh at t ading purpos d ambient te e is the US ce is the mic ess to that r stem (e.g. E ces under va	the point of i ses can vary emperatures Energy Info d-C trading h market for g Bonneville Po arious scena	nterconnectio y greatly. In the c. A general fl rmation Admin hub in the Nor eothermal pro power Authority	ptions Report Update, the Unit Energy Cost for g n to the BC Hydro system. e Pacific Northwest, these prices are affected by avour of the wholesale electricity prices for poten nistration (www.eia.gov/electricity/wholesale/#hist thwest Region (one example would be a Mid-C p jects in BC would require access on both the BC r) in the US. vided in the November 2013 IRP. Table 5 in Appe
		Table		y Price Forecasts b (Real 2012 US\$/MV	by Market Wh at Mid-C)		
	Market	1 Mid Electricity Mid GHG	2 Low Electricity Low GHG	3 High Electricity High GHG	4 Mid Electricity Mid GHG	5 High Electricity High GHG	
	Scenario	(Regional) Mid Gas	(Regional) Low Gas	(Regional) High Gas	(Regional/Nat'l) Mid Gas	(Regional/Nat'l) High Gas	
	2014	25.0 25.5	21.9 21.7	31.1 31.9	25.0 25.5	31.1 31.9	
	2015	25.8	21.7	32.0	25.8	32.0	
	2017	27.1	22.0	33.4	27.1	33.4	
	2018	27.1	21.7	33.9	27.1	33.9	
	2019	28.0	22.1	35.5	28.0	35.5	
	2020	28.0	21.9	36.0	28.0	36.0	
	2021	29.3 30.1	22.5 22.7	37.3 38.8	29.3 30.9	37.3 41.3	
	2022	31.8	23.2	41.7	35.5	52.1	
	2024	33.0	23.7	43.4	41.8	68.6	
	2025	34.2	24.0	45.4	50.3	91.2	
	2026	34.9	24.1	46.7	52.2	95.1	
	2027	36.0 36.3	24.3 24.0	48.6 50.2	54.7 56.8	98.9 101.8	
	2028	36.3	23.9	50.2	58.8	101.8	
	2030	37.6	23.8	52.7	60.1	109.3	
	2031	38.6	24.0	54.7	62.6	112.0	
	2032	39.9	24.0	57.0	65.6	116.0	
	2033	41.5	24.4	60.1	69.3	122.0	
	2034	42.8	25.1	61.9	71.5	125.7	
	2035	44.6 45.7	26.2 26.9	64.5 66.2	74.5 76.4	131.0 134.3	
	2030	47.8	28.1	69.1	79.8	140.3	
	2038	48.4	28.4	70.0	80.8	142.1	
	2039	48.9	28.7	70.7	81.6	143.5	
	2040	49.3	29.0	71.4	82.4	144.9	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

geothermal resources at a 7% real discount rate in 2013 by such factors as precipitation/snowfall in the region, ential export of electricity from BC can be obtained from a istory). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted

C Hydro transmission system to the Canada/US border, and

pendix 5A – Market Forecast Data is reproduced below for

Near Squamish, British Columbia, Canada Topographical Map Sheet: Figure 24 Geological Map Sheet: Figure 25

Category	Comments
Green Power Premium (\$/MWhr)	<ul> <li>BC Hydro's past procurement processes for the acquisition for power from independent power producers has offered a p</li> <li>Within British Columbia, there is little demand for the purchase of "green power certificates" (instruments that a custome environmentally friendly) from BC Hydro. BC Hydro's generation mix is already approximately 93% clean.</li> <li>California has a goal of 33% of retail sales by 2020 to be sourced from eligible renewable energy sources. However, the particularly "bundled" green energy with Renewable Energy Certificates (RECs), to compete in that market is low, for a numl. The price of electricity is driven by the low cost of natural gas;</li> <li>There are large amounts of renewables, such as wind and solar, in California; and</li> <li>Firm transmission access to the California market through the BPA transmission system is generally not available.</li> </ul>
Capacity Price (\$/KW)	<ul> <li>There is no price in \$/kW for capacity resource options in the market at present.</li> <li>Table 3-27 entitled "UCCs of Capacity Resource Supply Options" in BC Hydro's Integrated Resource Plan dated Novemal options (e.g. pumped storage, simple cycle gas turbines and resource smart projects such as Revelstoke Unit 6). The unit the BC Hydro system in \$2013/kW-year are shown in the table.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

a premium for green power. ner can purchase to be assured that the electricity used is

ne opportunity for geothermal power from British Columbia, number of reasons

mber 2013 provided a summary of capacity resource init capacity costs (UCCs) at the point of interconnection to

Near Squamish, British Columbia, Canada Topographical Map Sheet: Figure 24 Geological Map Sheet: Figure 25

	Category					Comments
Is the	Is there a higher price for base load power?	the following excer "1. Definitions: In t (a) "Off-Peak Hour (b) "Peak Hours" m inclusive, but exclu	pt is taken from this Appendix 4, f s" means all hou neans the hours iding British Colu	BC Hydro's the following rs other that commencing mbia statuto	SOP: g words and ex n Super-Peak I g at 06:00 PPT pry holidays.	DBC Hydro and furthermore the price paid for baseload pow pressions have the following meanings: Hours and Peak Hours. and ending at 16:00 PPT, and commencing at 20:00 PPT a 00 PPT and ending at 20:00 PPT Monday through Saturday
			Time of	Delivery Fact	or (TDF)	
		Month	Super-Peak	Peak	Off-Peak	
		January	141%	122%	105%	
		February	124%	113%	101%	
		March	124%	112%	99%	
		April	104%	95%	85%	
		May	90%	82%	70%	
		June	87%	81%	69%	
		July	105%	96%	79%	
		August	110%	101%	86%	
		September	116%	107%	91%	
		October	127%	112%	93%	
		November	129%	112%	99%	
		December	142%	120%	104%	

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ower varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

ay inclusive, but excluding British Columbia statutory

Near Squamish, British Columbia, Canada Topographical Map Sheet: Figure 24 Geological Map Sheet: Figure 25

Category	Comments
Estimated Size of Resource	See Section A.
Is there any green power incentives?	<ul> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p o Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project developmen o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include: <ul> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> <li>Green Infrastructure Fund</li> </ul> </li> </ul>
Grants	See above under green power incentives
Tax Holidays	None listed on federal and provincial websites.
Tax Relief	<ul> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 4 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these assert annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred dur and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the ye deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

cialization of emerging clean energy technologies (now n entitled Scientific Research and Experimental lity and relevance.
ty participation in the clean energy sector. It provides: nent; and
f these programs may be active but not currently issuing nal technologies/resources, while others may be fully
ility and relevance.
ace energy by using renewable energy sources or fuels from s 43.1, eligible equipment may be written-off at 30 percent y 22, 2005 and before year 2020 may be written-off at 50 sets would be depreciated for income tax purposes at

luring the development and start-up of renewable energy year they are incurred, carried forward indefinitely and

Near Squamish, British Columbia, Canada **Topographical Map Sheet: Figure 24** Geological Map Sheet: Figure 25

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most important The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> <li>FNFA loans do not require collateral;</li> </ol>
	<ol> <li>4. FNFA loans can be used to refinance existing debt; and</li> <li>5. FNFA's interest rates and terms parallel those available to provincial and local governments.</li> </ol>
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infra purchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Bor and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015 Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribe
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must p (a) a royalty established by agreement under this section,
	(b) an amount agreed under this section to be paid instead of royalty, or
General Idea of Royalties	<ul> <li>(c) if no royalty or amount has been agreed under this section, the prescribed royalty.</li> <li>With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "Th in section 1 (1) [definitions] of the Geothermal Resources Act."</li> </ul>
Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg Stat
Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincia</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmission access Transmission and Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ler the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. es that join as Borrowing Members.

rastructure, social and economic development, land

orrowing Members, represented by the First Nation's Chief

bed rent for the permit (Section 5).

pay to the government

his Act does not apply to geothermal resources as defined

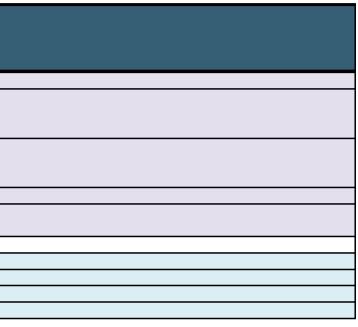
for the geothermal land tract. atutory Right of Way, Licence of Occupation). cial (British Columbia): 13.5%.

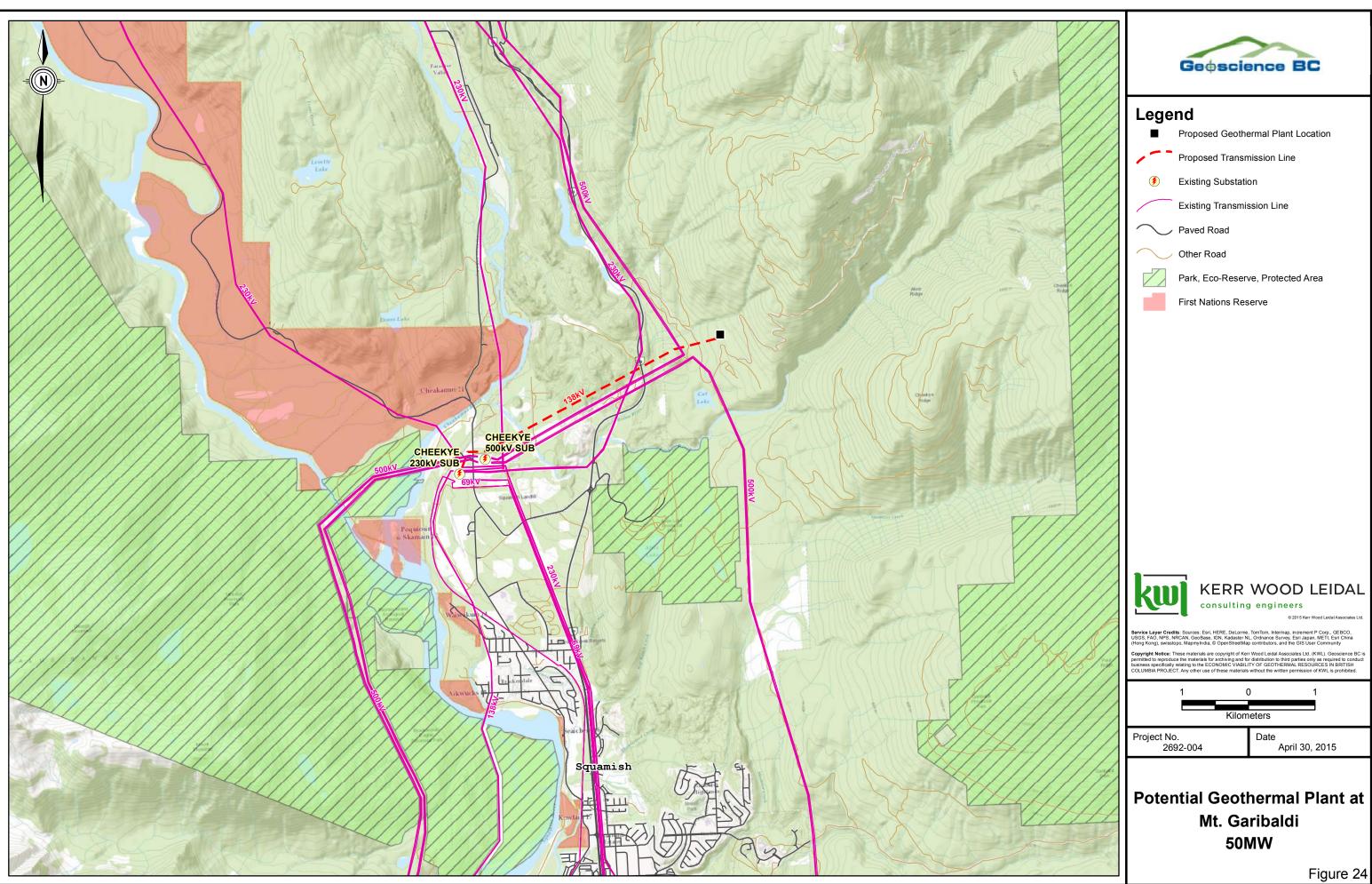
ta, the US, or other wholesale customers in BC, the nission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power he economic viability of the potential wholesale opportunity.

Near Squamish, British Columbia, Canada Topographical Map Sheet: Figure 24 Geological Map Sheet: Figure 25

	Category	Comments
Ν	M. Maps	
	Regional topographic map showing population centres, roads a other infrastructure including electrical grid and nearest substat and/or generating station. (1:500,000?)	
	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 24
	Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 25
	Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 25
Ν	N. Other Issues and Considerations	

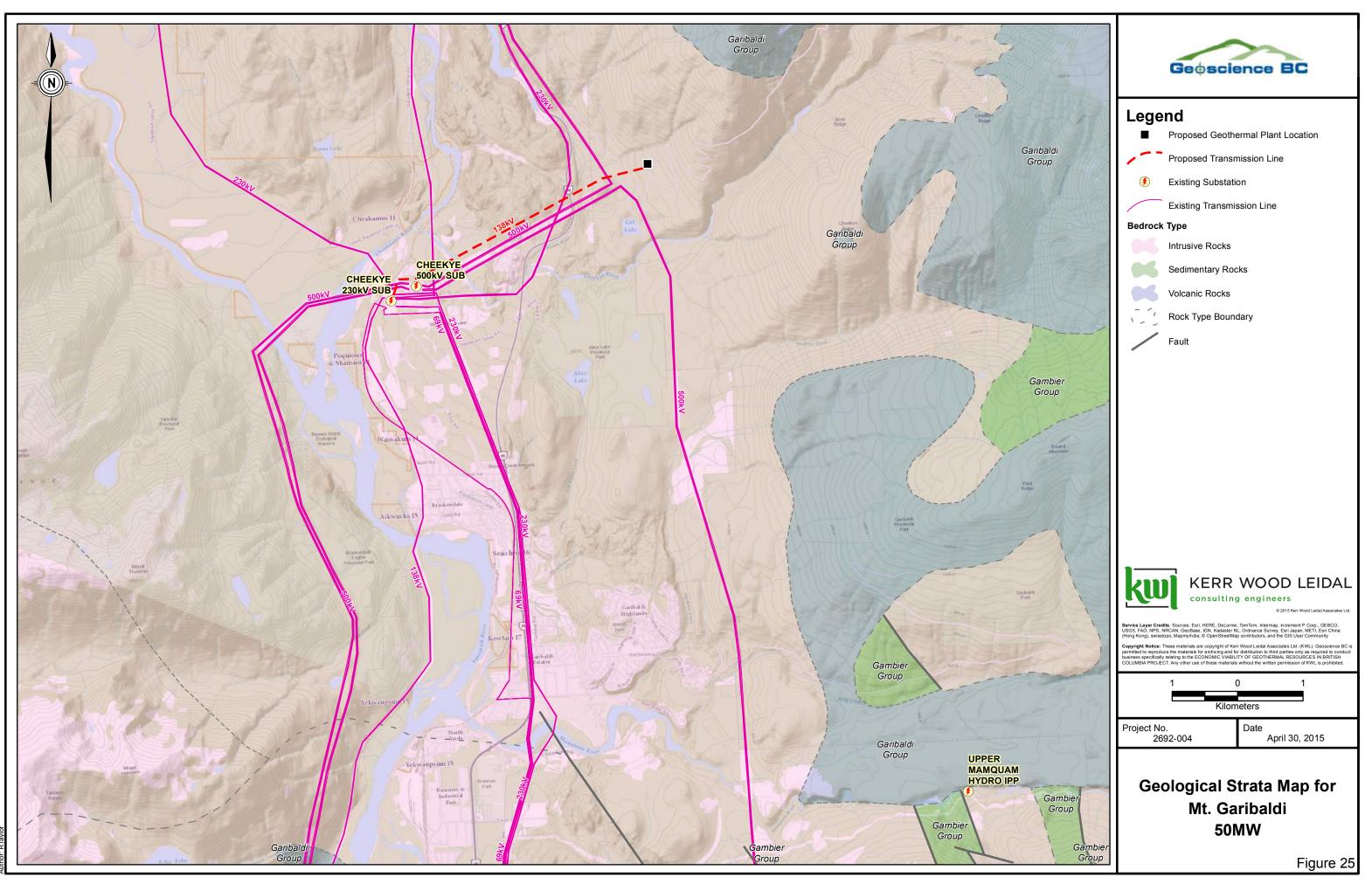
### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015







Proposed Geothermal Plant Location
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Appendix N

# Mount Silverthrone – Knight Inlet Geothermal Development Decision Matrix and Figures 26 & 27

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Near Kleena Kleene, British Columbia, Canada **Topographical Map Sheet: Figure 26** Geological Map Sheet: Figure 27

	Category	Comments
A. Reservo	bir Potential	
Size/Pot	ential/Type	<ul> <li>Reservoir size: N/A (no area or depth defined in literature) - therefore, reservoir volume estimated* at between: 2.2 km<sup>3</sup> of 2 km<sup>2</sup> and most-likely thickness of 1.1 km). The minimum estimate is calculated for a single spring, and the maximum e and Pinter springs) and a separation of 2.4 km. (*Reservoir assumptions made using Appendix III in GeothermEx, 2004)</li> <li>Potential: 50 MW (Lovekin &amp; Pletka, 2009). This MW capacity was based on the size of the volcanic complex, and may</li> <li>Type: Most likely a low-temperature resource, suitable for binary power plant.</li> </ul>
Tempera	ature/Water and Gas Chemistry/Mineral Indicators	Surface features: • Canyon Lake Spring: 58°C - spring seeps from the ground over a large area (MacDonald, 1978) • Pinter Spring: unknown • Hoodoo Creek Spring: unknown Geothermometry: • No information Exploration drilling: • None performed Water chemistry: • No information Mineral indicators: • No information
Surface	Flow Rates and Reservoir Recharge	Canyon Lake spring: ~2 L/s from a spring, forms a small stream and flows down into the southeast end of the lake (MacDo
3D Perm	neability (heat exchange potential)	Permeability is likely related to faulting, with good heat-exchange potential.
	Magmatism	The lava flows that form Mt. Silverthrone date to between 80,000 and 750,000 years old (Orr and Orr, 2006). Tertiary volcanic outcroppings have also been mapped ~65 km to the west and north of the project area (Roddick and Tip
Structura	al Setting	A NNW-SSE trending fault runs along the east side of the Klinaklini River valley, forming a chain of lakes along the range f 2013). On the NW flank of Lancers Mountain (about 15 km east of Canyon Lake Spring), there is a mapped dike swarm tree
Geophys	sics	No information
Reservo	ir Host Rock	Unknown - possibly fractured/faulted plutonic or metamorphosed units.
Drilling Is	ssues	<ul> <li>Road access to the area is limited - any existing roads would likely need improvement to handle drilling equipment. No ap of Lancers Mountain.</li> <li>A water-rafting company advertises that it makes a stop for soaking in the natural hot springs in the area, although the sp Travel Guide, 2015).</li> <li>The Dzawadi/Upper Klinaklini River Conservancy lands begin ~ 10 km north of the present geothermal title tract boundar head of Knight Inlet where it meets the river. It is not apparent whether either would affect access to the Mt. Silverthrone p</li> </ul>

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

 $1^{3}$  and 7.0 km<sup>3</sup> (with a most-likely area for any single spring estimate is calculated using two hot springs (Canyon Lake

ay be overly optimistic.

Donald, 1978)

ipper, 1985).

e front (Devereux, Laura, and Canyon Lakes) (BC MEM, trending NW-SE.

apparent roads to Hoodoo Creek spring in the valley north

specific spring and its location are not noted (Gordon's

ary. The Dzawadi/Klinaklini Estuary Conservancy lies at the prospect.

Near Kleena Kleene, British Columbia, Canada **Topographical Map Sheet: Figure 26** Geological Map Sheet: Figure 27

Category	Comments
Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	<ul> <li>Mt. Silverthrone lies within the Coast Plutonic Complex, a complex plutonic and metamorphic belt Triassic to Tertiary in a caldera is part of the Pemberton Volcanic Belt, which is circumscribed by a group of epizonal intrusions (Jessop, 1991). At Glacier Volcano (FGV), the Pemberton Volcanic Belt merges with the Garibaldi Volcanic Belt at its NW-most end.</li> <li>The granites of the Franklin Glacier volcanic complex underlie an area of ~130 km<sup>2</sup>, near Mt. Silverthrone and were intrude and Orr, 2006).</li> <li>The Silverthrone volcanics range in composition from basaltic andesite to rhyolite, and the Franklin Glacier volcanics are</li> <li>The springs are located in the valley immediately west of the FGV and ESE of Mt. Silverthrone.</li> <li>The Canyon Lake spring and Pinter spring are all mapped within the Central Gneiss Complex, with Canyon Lake Spring r Creek in siliceous granitoid gneiss. The dioritic complex (which Canyon Lake Spring lies within) dips steeply to moderately to the east. Central Gneiss Complex exhibits steep structural dips, and likely much isoclinal folding, which appears to be read of Tipper, 1985).</li> </ul>
D Evaluation Uncertainty (Dials)	
B. Exploration Uncertainty (Risk)	-
Degree of Identification of Resources/Reserves	<ul> <li>Low</li> <li>Only moderate geologic mapping done, no known geophysical or geochemical studies conducted. No drilling in area know</li> <li>In 2009, Sierra Geothermal signed an MOU with the Da'naxda'xw/Awaetlala Nation to develop geothermal power projects 800,000 hectares at Knight Inlet (Richter, 2009).</li> <li>In 2010, Sierra Geothermal Power Corp. submitted the winning bid in the BC Ministry of Energy, Mines, &amp; Petroleum Res</li> </ul>
Likelihood of Covering Reservoir with Concession	Moderate Concession covers Canyon Lake and Pinter Springs which are about 2.4 km apart. Hoodoo Creek Spring (about 15 km NI concession.
Expected Authorization Date	Unknown
Specific Timing of Exploration (2 + 2 years, BC 8 years, etc.)	5-6 years (1 year deep gradient-well drilling + 2 year successful development drilling and testing + 1 year further development drilling finish plant construction). Possible delays due to issues of access.
Degree of Previous Exploration (can be good or bad)	Low Geologic mapping only known exploration in area.
Surface Operational Capacity (enough stable area for drilling and a plant?)	Unknown Area has little infrastructure. Any work would involve construction of roads and clearing areas for well pads/drilling. Area for unclear if river valley would be suitable or if area uphill would need to be constructed for a suitable plant location.
Exploration to Exploitation: A summary rating of Exploration Uncertainty (risk) on a scale of difficult (high risk) through medium (moderate risk) to easy (low risk)	Difficult Area may largely only accessible by boat or helicopter at present. Roads conditions in lower river valley unknown.

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

age (Monger and Journeay, 1994). The Silverthrone At another deeply eroded caldera complex called Franklin

ded in two phases between 8 and 2 million years ago (Orr

e dacitic and andesitic (Smellie and Chapman, 2003).

g more specifically in dioritic granitoid gneiss, and Hoodoo ely beneath the main body of the Central Gneiss Complex related to movement along the faults in the area (Roddick

own.

cts on their traditional lands, covering approximately

esources permit auction for the Knight Inlet parcel of 8,000

NE of Canyon Lake Spring) is about 5 km east of the

ng and start plant construction + 1 year drilling wrap-up and

for surface operations would need to be assessed -

Near Kleena Kleene, British Columbia, Canada Topographical Map Sheet: Figure 26 Geological Map Sheet: Figure 27

	Category	Comments
C.	Environmental Issues	
	Protected Areas	<ul> <li>Proposed transmission line in section of Elk Falls Provincial Park.</li> <li>Rock bay Marine Provincial Park is less than 1km from proposed transmission line.</li> <li>Thurston Bay Marine Provincial Park, the next nearest protected area, is approx. 12 km away.</li> </ul>
	Endangered Species	<ul> <li>Northern Red-legged Frog (Special Concern (SARA Schedule 1); blue-listed) occurrence polygon located directly under a Approximately eight plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line and proposed plant species at risk located within a 5 km radius of the proposed transmission line at the proposed plant species at risk located within a 5 km radius of the proposed transmission line at the proposed plant species at the proposed plant</li></ul>
	Geothermal Surface Features	<ul> <li>Canyon Lake Hostsprings approx. 2 km from proposed plant location.</li> <li>Pinter Hotsprings approx. 3 km from proposed plant location.</li> <li>Franklin Hotsprings approx. 7 km from proposed transmission line.</li> <li>Phillips Arm Hotsprings approx. 18 km from transmission line.</li> </ul>
	Other	<ul> <li>Proposed transmission line crosses approximately 9 water bodies with observed fish. Campbell River contains Coho Sa Devereux contains Coho Salmon, Sockeye Salmon, Chinook Salmon, Pink Salmon, Chum Salmon and Steelhead Trout. Chum Salmon and Coho Salmon. Frazer Creek contains Pink Salmon, Chum Salmon, and Coho Salmon. Grassy Creek Chum Salmon.</li> <li>Proposed Wildlife Habitat Area allotment for Marbled Murrelet is approx 2.7 km form proposed transmission line.</li> </ul>
D.	Geothermal Area - Bidding and/or Type of Land Holding (private/government/lease/etc.)	
	Bidding Area	Site location within existing cancelled geothermal tract.
	Other Claim Rights (mining and/or oil)	No existing mineral or coal titles at plant location. Proposed location is not within known oil and gas management area; no

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

r proposed transmission line. olant.

Salmon, Chinook Salmon, Pink Salmon and Steelhead trout. Franklin River which has observed Chinook Salmon, ek and Gray Creek contain Coho Salmon, Pink Salmon and

no known tenures at proposed location.

Near Kleena Kleene, British Columbia, Canada **Topographical Map Sheet: Figure 26** Geological Map Sheet: Figure 27

	Category	Comments
E	. Market	
	Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through tw</li> <li>Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propone</li> <li>Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW bi against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponen threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply trealistically apply to potential geothermal generation projects).</li> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to par program has no applicability to potential geothermal generation projects.</li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversification snow melt and stream flow.</li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project Ic BC Hydro's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>Wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta, th generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmission acce and stream generation supplier will have to make similar arrangements to cover transmission acce and the electricity is project le coverting suppliers, is generally opportunities for bilateral arrangements for direct sales of electricity from</li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

- nents can bid into those competitive calls.
- but not more than 15 MW. Proponents do not compete nts may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not
- ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this
- tion of BC Hydro's resource mix, making it less reliant on
- en FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to
- he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power ability of the potential wholesale opportunity.
- ly not permitted in BC. However there may be s (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given
- ant located in close proximity to the facility, thereby

Near Kleena Kleene, British Columbia, Canada Topographical Map Sheet: Figure 26 Geological Map Sheet: Figure 27

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical and considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to sever Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gene other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
F.	Transmission Line Infrastructure	
	State of the Infrastructure	Closest Substation is Island Cogen substation near Campbell River.
	Transmission Route (distance, terrain and costs)	New 138 kV transmission line 165 km with interconnection at Island Cogen Substation. Extremely remote, routing followin unpaved roads where possible.

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ion output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission even years depending on the specifics of each project. herally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

ing shoreline for majority of routing and following existing

Near Kleena Kleene, British Columbia, Canada Topographical Map Sheet: Figure 26 Geological Map Sheet: Figure 27

	Category	Comments
Н.	Community Issues	
	Indigenous Law and Indigenous Development Areas	<ul> <li>First Nation Consultative Areas include Da'naxda'xw/Awaetlala First Nation, Nanwakolas First Nation, Toosey Indian Bar Government, Tl'etinqox-T'in Government Office (Anaham Indian Band).</li> <li>Powerline routing will impact We Wai Kai and We Wai Kum First Nation as well.</li> <li>The Kwakiutl District Council is a political organization ensuring the "Kwakwaka'wakw are the rightful owners and manag territory. (http://danaxdaxw.com/index.php/page,7.html)</li> </ul>
	Community Action	<ul> <li>Da'naxda'xw First Nation is challenging BC Ministry of Mines and Natural Gas in relation to a hydro-electric power projec (http://www.blg.com/en/newsandpublications/publication_3667)</li> <li>Campbell River Official Community Plan includes community energy and emissions plan reference to reduce greenhouse explore renewable energy opportunities in Campbell River; includes renewable energy under economic development (Can</li> </ul>
	Surface Rights	<ul> <li>First Nation Consultative Areas include Da'naxda'xw/Awaetlala First Nation, Nanwakolas First Nation, Toosey Indian Bar Government, Tl'etingox-T'in Government Office (Anaham Indian Band)</li> </ul>
	Tourism	<ul> <li>Knight Inlet Special Management Zone provides grizzly bear viewing potential; grizzly tours are available from a number</li> <li>Ecotourism area includes hiking, kayaking, wildlife tours.</li> </ul>
 _	Water Rights	
I.	Water Rights Availability (for example "air-cooled required")	Plant water requirement estimated approx. 63 L/s for binary plant. MAD of 355.000 L/s in Klinaklini River. No Existing wate
<u>I.</u>	Water Rights         Availability (for example "air-cooled required")         Availability for Drilling	Plant water requirement estimated approx. 63 L/s for binary plant. MAD of 355,000 L/s in Klinaklini River. No Existing water Drilling requirement of 20 L/s. MAD of 355,000 L/s in Klinaklini River. No Existing water licences in vicinity of plant.
<u>I.</u>	Availability (for example "air-cooled required") Availability for Drilling	Plant water requirement estimated approx. 63 L/s for binary plant. MAD of 355,000 L/s in Klinaklini River. No Existing water Drilling requirement of 20 L/s. MAD of 355,000 L/s in Klinaklini River. No Existing water licences in vicinity of plant.
I. J.	Availability (for example "air-cooled required") Availability for Drilling Engineering	Drilling requirement of 20 L/s. MAD of 355,000 L/s in Klinaklini River. No Existing water licences in vicinity of plant.
I. J.	Availability (for example "air-cooled required")         Availability for Drilling         Engineering         Plant Location and Design	Drilling requirement of 20 L/s. MAD of 355,000 L/s in Klinaklini River. No Existing water licences in vicinity of plant.
I. J.	Availability (for example "air-cooled required")         Availability for Drilling         Engineering         Plant Location and Design         Construction Issues	Drilling requirement of 20 L/s. MAD of 355,000 L/s in Klinaklini River. No Existing water licences in vicinity of plant. Very remote plant location. Binary geothermal plant design. Access via 165 km of existing unpaved logging roads with unknown condition. Requirement for camp for workers likely du
I. J.	Availability (for example "air-cooled required")         Availability for Drilling         Engineering         Plant Location and Design	Drilling requirement of 20 L/s. MAD of 355,000 L/s in Klinaklini River. No Existing water licences in vicinity of plant.
I. J.	Availability (for example "air-cooled required")         Availability for Drilling         Engineering         Plant Location and Design         Construction Issues         Transportation Issues         Architectural Issues (Blend/hide into environment? Local styles?	Drilling requirement of 20 L/s. MAD of 355,000 L/s in Klinaklini River. No Existing water licences in vicinity of plant. Very remote plant location. Binary geothermal plant design. Access via 165 km of existing unpaved logging roads with unknown condition. Requirement for camp for workers likely de Access via boat/barge and 40 km of unpaved logging roads with unknown conditions.
I. J.	Availability (for example "air-cooled required")         Availability for Drilling         Engineering         Plant Location and Design         Construction Issues         Transportation Issues         Architectural Issues (Blend/hide into environment? Local styles? etc.)	Drilling requirement of 20 L/s. MAD of 355,000 L/s in Klinaklini River. No Existing water licences in vicinity of plant.
I. J.	Availability (for example "air-cooled required")         Availability for Drilling         Engineering         Plant Location and Design         Construction Issues         Transportation Issues         Architectural Issues (Blend/hide into environment? Local styles? etc.)         Special Construction Issues (zero emissions)	Drilling requirement of 20 L/s. MAD of 355,000 L/s in Klinaklini River. No Existing water licences in vicinity of plant.
I. J.	Availability (for example "air-cooled required")         Availability for Drilling         Engineering         Plant Location and Design         Construction Issues         Transportation Issues         Architectural Issues (Blend/hide into environment? Local styles? etc.)         Special Construction Issues (zero emissions)	Drilling requirement of 20 L/s. MAD of 355,000 L/s in Klinaklini River. No Existing water licences in vicinity of plant.
I. J.	Availability (for example "air-cooled required")         Availability for Drilling         Engineering         Plant Location and Design         Construction Issues         Transportation Issues         Architectural Issues (Blend/hide into environment? Local styles? etc.)         Special Construction Issues (zero emissions)	Drilling requirement of 20 L/s. MAD of 355,000 L/s in Klinaklini River. No Existing water licences in vicinity of plant. Very remote plant location. Binary geothermal plant design. Access via 165 km of existing unpaved logging roads with unknown condition. Requirement for camp for workers likely du Access via boat/barge and 40 km of unpaved logging roads with unknown conditions. None found. None found. None found. Nanaimo, BC
I. J.	Availability (for example "air-cooled required")         Availability for Drilling         Engineering         Plant Location and Design         Construction Issues         Transportation Issues         Architectural Issues (Blend/hide into environment? Local styles? etc.)         Special Construction Issues (zero emissions)         Non-Electrical Infrastructure (Roads and Habitation)         Nearest Large Community > 50,000	Drilling requirement of 20 L/s. MAD of 355,000 L/s in Klinaklini River. No Existing water licences in vicinity of plant. Very remote plant location. Binary geothermal plant design. Access via 165 km of existing unpaved logging roads with unknown condition. Requirement for camp for workers likely du Access via boat/barge and 40 km of unpaved logging roads with unknown conditions. None found. None found.
I. J. K.	Availability (for example "air-cooled required")         Availability for Drilling         Engineering         Plant Location and Design         Construction Issues         Transportation Issues         Architectural Issues (Blend/hide into environment? Local styles? etc.)         Special Construction Issues (zero emissions)         Non-Electrical Infrastructure (Roads and Habitation)         Nearest Large Community > 50,000         Nearest Community	Drilling requirement of 20 L/s. MAD of 355,000 L/s in Klinaklini River. No Existing water licences in vicinity of plant. Very remote plant location. Binary geothermal plant design. Access via 165 km of existing unpaved logging roads with unknown condition. Requirement for camp for workers likely du Access via boat/barge and 40 km of unpaved logging roads with unknown conditions. None found. None found. Nanaimo, BC Kleena Kleene, BC by distance, Campbell River is most accessible closest community by boat.

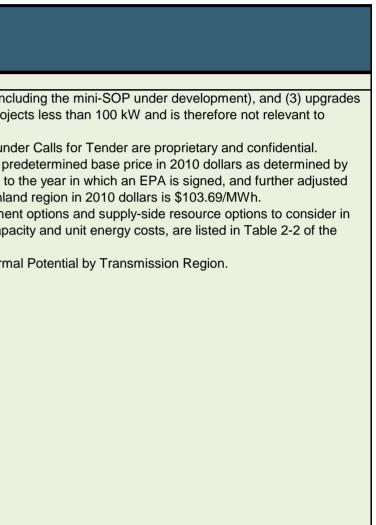
### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

and, Ulkatcho First Nations, Tsilhqot'in National
agers of the lands, waters and natural resources" of the
ect within traditional territory (2015)
se gas emissions, more sustainably manage energy and ampbell River Official Community Plan)
and, Ulkatcho First Nations, Tsilhqot'in National
er of tour companies (http://grizzlycanada.com/knightinlet/)
ter licences in vicinity of plant.
during construction.
k and water crossings possible.

Near Kleena Kleene, British Columbia, Canada **Topographical Map Sheet: Figure 26** Geological Map Sheet: Figure 27

	Category					Comments	
L.	Finance						
	General Power Prices BC Hydro acquires power through (1) competitive processes (Calls for Tender), (2) the S to its existing facilities or the development of new generation facilities. (Note that the net geothermal generation projects). Comments on the general price of power under each or • The power price paid by BC Hydro to independent power producers through EPAs under the region of the point of interconnection to the BC Hydro system, escalated at the Consultated upon the time of day and month when the energy is delivered. For reference, the b • BC Hydro's current Integrated Resource Plan dated November 2013 includes details of meeting the future demand for electricity. These resource options, together with their attra November 2013 Resource Options Report Update. That table is reproduced below for reference. • Table 5-7 of the above-noted November 2013 Resource Options Report Update provide			the net metering each one are: ergy Purchase A As under the SO e Consumer Price ce, the base price etails of both der their attributes of ow for ready refe	g program targets proj greements (EPAs) un P are made up of a pro- ce Index annually up to e for the Lower Mainla mand-side manageme f total energy and capa rence.		
		Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)	
		Biomass – Wood Based	9,772	1,226	122 - 276	132 - 306	
		Biomass – Biogas	134	16	59 – 154	56 - 156	
		Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204	
		Wind – Onshore	46,165	4,271	90 - 309	115 – 365	
		Wind – Offshore	56,700	3,819	166 - 605	182 – 681	
		Geothermal	5,992	780	91 – 573	90 - 593	
		Run-of-River	24,543	1,149	97 – 493	143 – 1,170	
		Site C <sup>3</sup>	4,700	1,100	83	88	
		Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	6,103	774	58 – 92	57 – 86	
		Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103	
		Wave	2,506	259	440 – 772	453 - 820	
		Tidal	1,426	247	253 - 556	264 - 581	
		Solar	57	12	266 - 746	341 – 954	
		<ol> <li>Notes:</li> <li>The resources and UEC values s and may not include all possible r</li> <li>The details of how the cost adjust</li> <li>The Site C values presented in th Impact Statement (EIS) submission real discount rate.</li> <li>Representative projects were use the resource potential is generally</li> </ol>	esources that may ters were developed is table are based of on filed in January 2 id to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC e natural gas-fired a	xpected higher cos ovided in Appendix ded in the Site C Er s calculated assum	t. 12. nvironmental ing 5 per cent	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015



Near Kleena Kleene, British Columbia, Canada Topographical Map Sheet: Figure 26 Geological Map Sheet: Figure 27

Category						C	Comments
<ul> <li>Market Price (\$/MWhr)</li> <li>As noted in the above Table 2-2 from the November 2013 Resource Options Report I dollars ranges from \$91/MWh to 573/MWh at the point of interconnection to the BC Hy</li> <li>Wholesale electricity prices for trading purposes can vary greatly. In the Pacific North unforeseen generation outages and ambient temperatures. A general flavour of the wh variety of sources. One such source is the US Energy Information Administration (www market data. Of particular relevance is the mid-C trading hub in the Northwest Region average cost from 72 trades). Access to that market for geothermal projects in BC wor on the appropriate transmission system (e.g. Bonneville Power Authority) in the US.</li> <li>BC Hydro forecasts of market prices under various scenarios was provided in the Norteady reference.</li> </ul>				lydro system. thwest, these prices are affected by wholesale electricity prices for poten w.eia.gov/electricity/wholesale/#hist n (one example would be a Mid-C p rould require access on both the BC			
		Table		y Price Forecasts b (Real 2012 US\$/MV			
	Market Scenario	1 Mid Electricity Mid GHG (Regional) Mid Gas	2 Low Electricity Low GHG (Regional) Low Gas	3 High Electricity High GHG (Regional) High Gas	4 Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	5 High Electricity High GHG (Regional/Nat'l) High Gas	
	2014	25.0	21.9	31.1	25.0	31.1	
	2015	25.5	21.7	31.9	25.5	31.9	
	2016	25.8 27.1	21.2 22.0	32.0 33.4	25.8 27.1	32.0 33.4	
	2017 2018	27.1	22.0	33.4	27.1	33.4	
	2010	28.0	22.1	35.5	28.0	35.5	
	2020	28.0	21.9	36.0	28.0	36.0	
	2021	29.3	22.5	37.3	29.3	37.3	
	2022	30.1	22.7	38.8	30.9	41.3	
	2023	31.8	23.2	41.7	35.5	52.1	
	2024 2025	33.0 34.2	23.7 24.0	43.4 45.4	41.8 50.3	68.6 91.2	
	2026	34.9	24.1	46.7	52.2	95.1	
	2027	36.0	24.3	48.6	54.7	98.9	
	2028	36.3	24.0	50.2	56.8	101.8	
	2029	37.2	23.9	51.1	58.8	106.1	
	2030	37.6	23.8	52.7	60.1	109.3	
	2031	38.6 39.9	24.0 24.0	54.7 57.0	62.6 65.6	112.0 116.0	
	2032	41.5	24.4	60.1	69.3	122.0	
	2034	42.8	25.1	61.9	71.5	125.7	
	2035	44.6	26.2	64.5	74.5	131.0	
	2036	45.7	26.9	66.2	76.4	134.3	
	2037	47.8	28.1	69.1	79.8	140.3	
	2038	48.4	28.4	70.0	80.8	142.1	
	2039	48.9 49.3	28.7 29.0	70.7 71.4	81.6 82.4	143.5 144.9	
	2040	43.3	29.0	/1.4	02.4	144.9	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

geothermal resources at a 7% real discount rate in 2013

by such factors as precipitation/snowfall in the region, ential export of electricity from BC can be obtained from a istory). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted C Hydro transmission system to the Canada/US border, and

pendix 5A – Market Forecast Data is reproduced below for

Near Kleena Kleene, British Columbia, Canada **Topographical Map Sheet: Figure 26** Geological Map Sheet: Figure 27

Category Comments Comments Green Power Premium (\$/MWhr) • BC Hydro's past procurement processes for the acquisition for power from independent power producers h				Comments	
Green Power Premium (\$/MWhr)	<ul> <li>Within British Collenvironmentally frie</li> <li>California has a g particularly "bundle</li> <li>The price of election</li> <li>There are large a</li> </ul>	umbia, there is li endly) from BC H oal of 33% of ret d" green energy tricity is driven b amounts of renew	ttle demand lydro. BC Hy ail sales by 2 with Renewa y the low cos wables, such	for the purcha vdro's generation 2020 to be source able Energy Co st of natural ga n as wind and so	se of "green power certificates" (instruments that a customer on mix is already approximately 93% clean. Inced from eligible renewable energy sources. However, the ertificates (RECs), to compete in that market is low, for a nur is; solar, in California; and
Capacity Price (\$/KW)	<ul> <li>3. Firm transmission access to the California market through the BPA transmission so • There is no price in \$/kW for capacity resource options in the market at present.         • Table 3-27 entitled "UCCs of Capacity Resource Supply Options" in BC Hydro's Internet options (e.g. pumped storage, simple cycle gas turbines and resource smart projects the BC Hydro system in \$2013/kW-year are shown in the table.         In general, baseload power (ie firm power) is more valuable to BC Hydro and furthernet the following excerpt is taken from BC Hydro's SOP:         "1. Definitions: In this Appendix 4, the following words and expressions have the follow (a) "Off-Peak Hours" means all hours other than Super-Peak Hours and Peak Hours.         (b) "Peak Hours" means the hours commencing at 06:00 PPT and ending at 16:00 PF inclusive, but excluding British Columbia statutory holidays.         (c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20 holidays."         (c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20 holidays."         (c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20 holidays."         (c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20 holidays."         (c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20 holidays."         (c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20 holidays."         (c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20 holidays."         (c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20 holidays."         (c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20 holidays."         (c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20 holidays."         (c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20 holidays."         (c) "Super-Peak Hours" means the hours com</li></ul>			e market at present. ions" in BC Hydro's Integrated Resource Plan dated Novemb esource smart projects such as Revelstoke Unit 6). The unit	
				n Super-Peak I	Hours and Peak Hours.
	(c) "Super-Peak Ho	ours" means the	hours comm	bry holidays. nencing at 16:0	
	(c) "Super-Peak Ho	ours" means the Time of	hours comm Delivery Fact	ory holidays. hencing at 16:0	
	(c) "Super-Peak Ho holidays." Month	Time of Super-Peak	hours comm Delivery Fact Peak	ory holidays. nencing at 16:0 for (TDF) Off-Peak	
	(c) "Super-Peak Ho holidays." Month January	Time of Super-Peak	hours comm Delivery Fact Peak 122%	ory holidays. hencing at 16:0 for (TDF) Off-Peak 105%	
	(c) "Super-Peak Ho holidays." Month January February	Time of Super-Peak 141% 124%	hours comm Delivery Fact Peak 122% 113%	tor (TDF) Off-Peak 105% 101%	
	(c) "Super-Peak Ho holidays." Month January February March	Time of Super-Peak 141% 124% 124%	hours comm Delivery Fact Peak 122% 113% 112%	ory holidays. hencing at 16:0 for (TDF) Off-Peak 105% 101% 99%	
	(c) "Super-Peak Ho holidays." Month January February March April	Time of           Super-Peak           141%           124%           124%           104%	hours comm Delivery Fact Peak 122% 113% 112% 95%	Ory holidays.           bencing at 16:0           tor (TDF)           Off-Peak           105%           101%           99%           85%	
	(c) "Super-Peak Ho holidays." Month January February March	Time of Super-Peak 141% 124% 124%	hours comm Delivery Fact Peak 122% 113% 112%	ory holidays. hencing at 16:0 for (TDF) Off-Peak 105% 101% 99%	
	(c) "Super-Peak Ho holidays." Month January February March April May	Time of           Super-Peak           141%           124%           104%           90%	hours comm Delivery Fact Peak 122% 113% 112% 95% 82%	Ory holidays.           nencing at 16:0           Off-Peak           105%           101%           99%           85%           70%	
	(c) "Super-Peak Ho holidays." Month January February March April May June	Time of           Super-Peak           141%           124%           104%           90%           87%	hours comm Delivery Fact Peak 122% 113% 112% 95% 82% 81%	bry holidays. hencing at 16:0 tor (TDF) Off-Peak 105% 101% 99% 85% 70% 69%	
	(c) "Super-Peak Ho holidays." Month January February March April May June July	Time of           Super-Peak           141%           124%           104%           90%           87%           105%	hours comm Delivery Fact Peak 122% 113% 112% 95% 82% 81% 96%	Ory holidays.           nencing at 16:0           Off-Peak           105%           101%           99%           85%           70%           69%           79%	
	(c) "Super-Peak Ho holidays." Month January February March April May June July August	Time of           Super-Peak           141%           124%           104%           90%           87%           105%           110%	hours comm Delivery Fact Peak 122% 113% 112% 95% 82% 81% 96% 101%	bry holidays. hencing at 16:0 tor (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86%	
	(c) "Super-Peak Ho holidays." Month January February March April May June July August September	Time of           Super-Peak           141%           124%           104%           90%           87%           105%           110%           116%	hours comm Delivery Fact Peak 122% 113% 112% 95% 82% 81% 96% 101% 107%	bry holidays. hencing at 16:0 tor (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 70% 69% 79% 86% 91%	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

premium for green power. er can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

nber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

inclusive, but excluding British Columbia statutory

Near Kleena Kleene, British Columbia, Canada Topographical Map Sheet: Figure 26 Geological Map Sheet: Figure 27

Category	Comments
	<ul> <li>See Section A.</li> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial</li> </ul>
	<ul> <li>expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p o Capacity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include: <ul> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Sustainable Development Technology Canada funds;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> <li>Green Infrastructure Fund</li> </ul> </li> </ul>
Grants	See above under green power incentives
	None listed on federal and provincial websites.
Tax Relief	<ul> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 43 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 22 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these assets annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred duri and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the year deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now n entitled Scientific Research and Experimental ity and relevance. y participation in the clean energy sector. It provides: nent; and
these programs may be active but not currently issuing al technologies/resources, while others may be fully
ity and relevance.
ce energy by using renewable energy sources or fuels from

43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 ets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy year they are incurred, carried forward indefinitely and

Near Kleena Kleene, British Columbia, Canada **Topographical Map Sheet: Figure 26** Geological Map Sheet: Figure 27

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> <li>FNFA loans do not require collateral;</li> </ol>
	<ol> <li>FNFA loans can be used to refinance existing debt; and</li> <li>FNFA's interest rates and terms parallel those available to provincial and local governments.</li> </ol>
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infras purchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Bor and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015
	Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribed
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section,
	(b) an amount agreed under this section to be paid instead of royalty, or
	(c) if no royalty or amount has been agreed under this section, the prescribed royalty.
General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "Thi in section 1 (1) [definitions] of the Geothermal Resources Act."
Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners for proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg State
Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincia</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission acc Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. s that join as Borrowing Members.

astructure, social and economic development, land

prrowing Members, represented by the First Nation's Chief

ed rent for the permit (Section 5).

pay to the government

nis Act does not apply to geothermal resources as defined

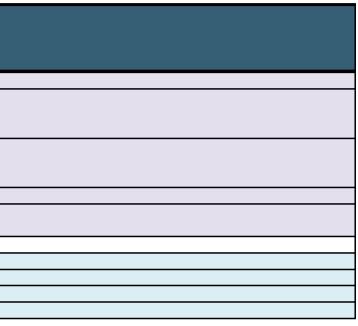
for the geothermal land tract. atutory Right of Way, Licence of Occupation). ial (British Columbia): 13.5%.

a, the US, or other wholesale customers in BC, the ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power e economic viability of the potential wholesale opportunity.

Near Kleena Kleene, British Columbia, Canada Topographical Map Sheet: Figure 26 Geological Map Sheet: Figure 27

		Category	Comments
Ν			
	other	onal topographic map showing population centres, roads and infrastructure including electrical grid and nearest substation or generating station. (1:500,000?)	
	Regio conce	onal map showing land tenure in area – geothermal essions, mining concessions, private land holds, public or nal lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 26
	Regio	onal geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 27
		iled geological map of the immediate area of the essions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 27
Ν	I. Other	r Issues and Considerations	

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015



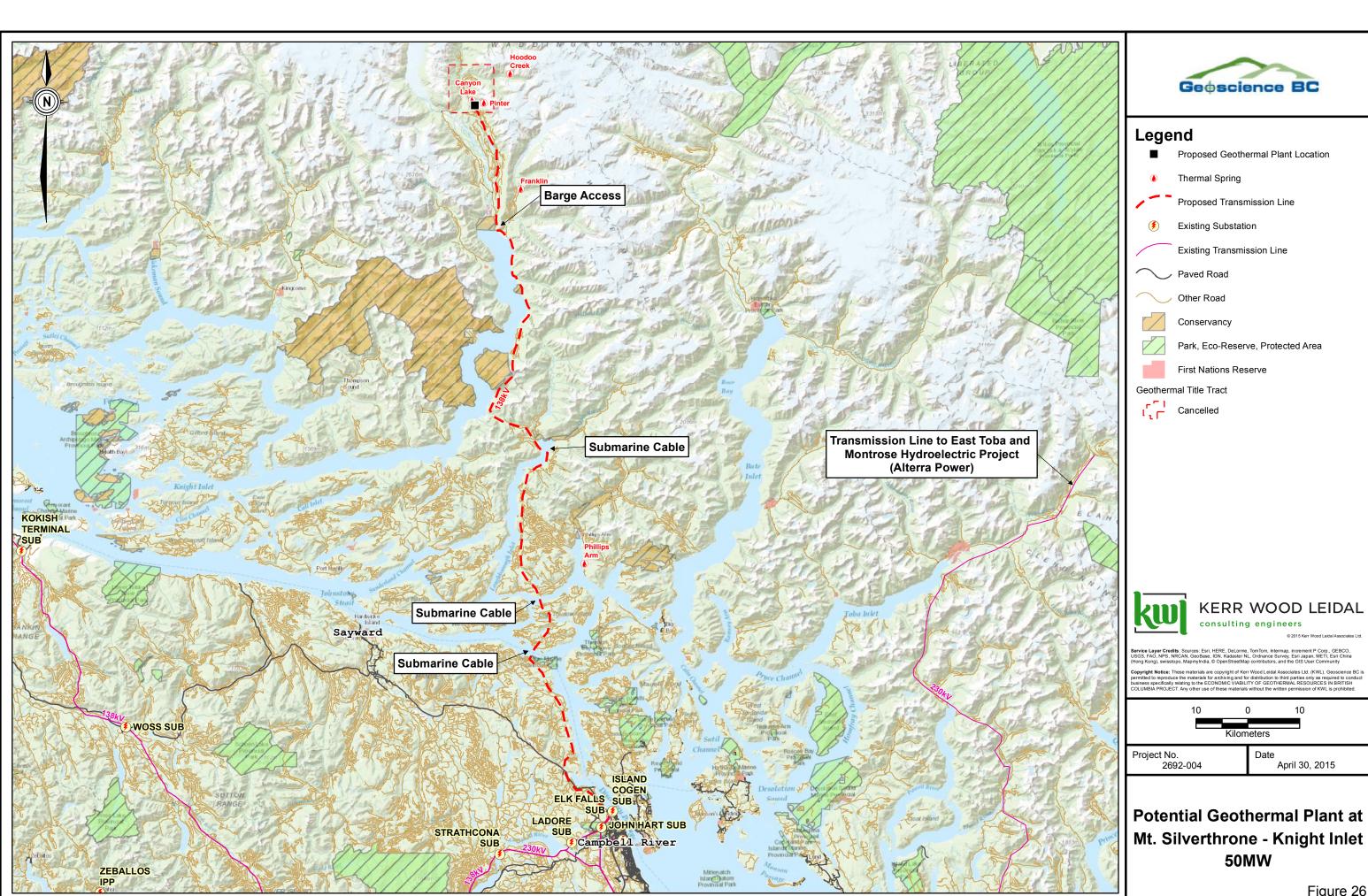
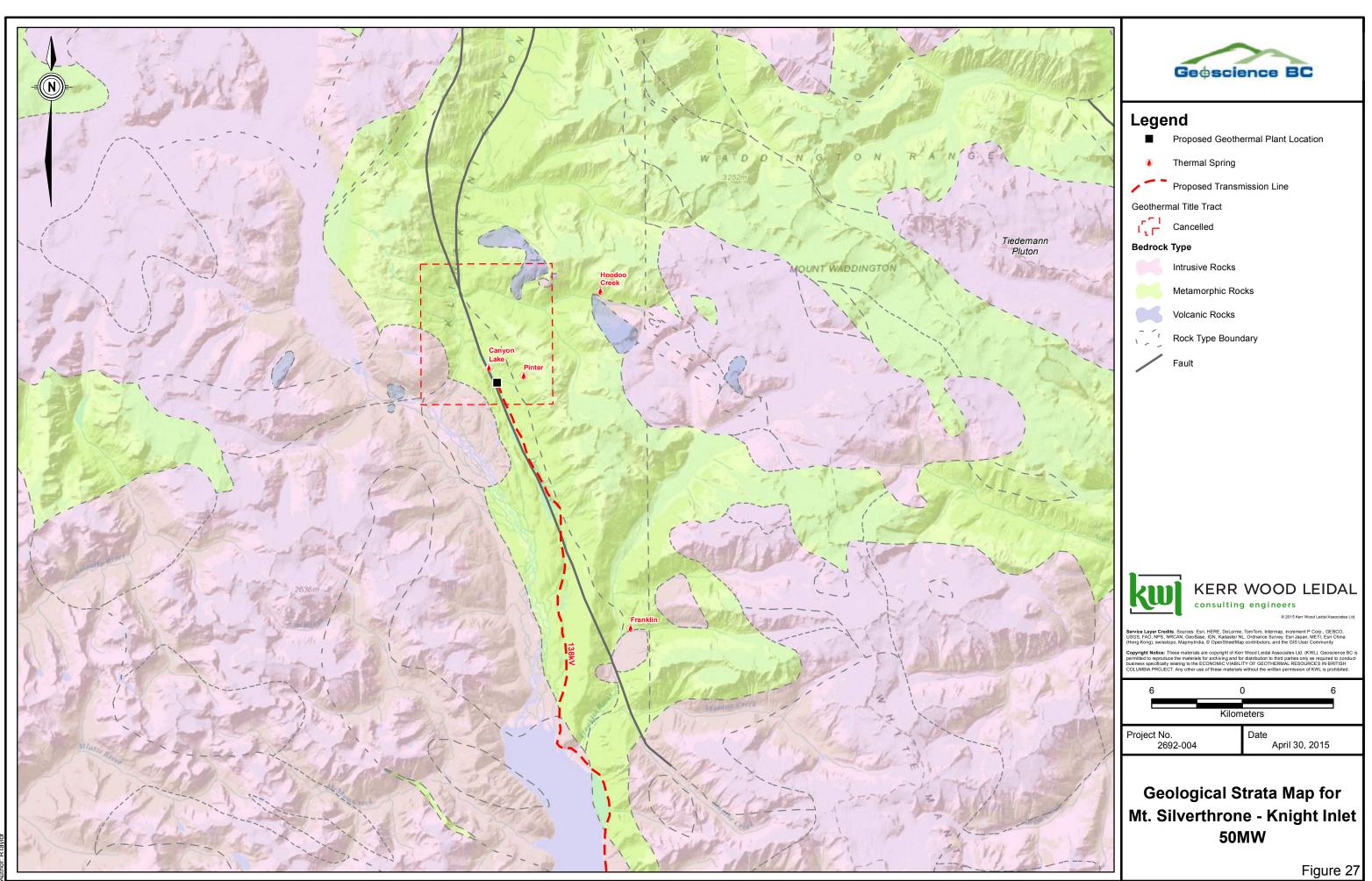


Figure 26





Appendix O

Nazko Cone Geothermal Development Decision Matrix and Figures 28 & 29

kwl.ca

Near Quesnel, British Columbia, Canada **Topographical Map Sheet: Figure 28** Geological Map Sheet: Figure 29

	Category	Comments
Α.	Reservoir Potential	
	Size/Potential/Type	<ul> <li>Reservoir size: N/A (no area or depth defined in literature) - therefore, reservoir volume estimated* at: 2.2 km<sup>3</sup> (most-lik assumptions made using Appendix III in GeothermEx, 2004)</li> <li>Potential: Assume 10 MW, compatible with generic reservoir volume (above) in vicinity of single spring, for reservoir ten</li> <li>Type: unknown, likely binary</li> </ul>
	Temperature/Water and Gas Chemistry/Mineral Indicators	<ul> <li>Surface features:</li> <li>Surface features include travertine deposits, soil gas seepages, organic soil mixed with calcium carbonate mud and pool observed in two wetlands (the North and South bogs) NW of the Nazko cone. In the carbonate-mud-dominated parts of th seeping through the bottom sediment of stagnant ponds and a calcium-carbonate (possibly aragonite) precipitate often oc white-colored rubble forming small, isolated and elevated areas in the bogs. Near the northern edge of the North bog, the deposit concealed by undergrowth. This cone encloses a partially submerged vent from which there is a steady flow of car from another vent on a rusty travertine mound close to the east edge of the South bog. The area also experiences snow-f Geothermometry:</li> <li>None available.</li> <li>Exploration drilling:</li> <li>No known drilling or boreholes in or around Nazko cone (closest known borehole ~ 60 km SW).</li> <li>Water chemistry:</li> <li>Previous sampling by Alterra Power Corp of gas seepage in the bogs revealed that CO<sub>2</sub> had negative <sup>5</sup>13C values in add possibly geothermal source for the gas. However, median bog-water temperatures of 14.5°C, measured in 2013, suggest unlikely (Lett &amp; Jackaman, 2015).</li> <li>Mineral indicators:</li> <li>Analysis of the carbonate mud in the bogs revealed a dominance of aragonite (66%), with equal parts remaining of calcit surface water (Lett &amp; Jackaman, 2014).</li> </ul>
	Surface Flow Rates and Reservoir Recharge	Unknown
	3D Permeability (heat exchange potential)	Unknown
	Recent Magmatism	<ul> <li>Nazko cone was formed by at least 3 episodes of Quaternary volcanic activity (Middle Pleistocene to Holocene)with the later A seismic swarm occurred in 2007-8 near Nazko cone (the first recorded seismicity in this region), with initial indications cone, at a depth of 25-35 km. Over 1,000 earthquakes were observed within three weeks of 2007 Oct 2007, with reported the quakes are due to brittle failure of rock at the tip of a dike and/or by the activation of nearby faults from changes in the nearby magma. Several temporary seismometers were deployed from September 2007 to June 2008 and showed signific earthquakes observed within one six-hour period). (Hutchinson, 2009)</li> <li>The seismic events were likely initiated by the migration and expansion of magma bodies at the base of the crust as a re</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ikely area: 2 km<sup>2</sup>; most-likely thickness: 1.1 km) (\*Reservoir

emperatures in range of 150°C to 200°C.

ols of stagnant or slow-flowing water. These features the bog, carbon dioxide can be observed as bubbles occurs on the water surface. Travertine is typically a rusty to nere is a small, 35-cm-high inverted cone-shaped travertine arbon dioxide. There is a less active carbon dioxide seep *i*-free wetland areas in winter. (Lett & Jackaman, 2014).

ddition to traces of CH₄ and He, suggesting a magmatic and ested that surface upwelling of thermal water from depth is

ite and dolomite, precipitated from the carbon-enriched

last eruption ~ 7,200 years ago (Souther et al., 1987). s that these earthquakes originated ~30 km west of Nazko ed magnitudes between 0 and 3. It is unresolved whether ne local stress regime by the expansion and movement of icantly larger numbers of earthquakes (with 597

result of underplating (Hutchinson, 2012).

Near Quesnel, British Columbia, Canada **Topographical Map Sheet: Figure 28 Geological Map Sheet: Figure 29** 

Category	Comments
Structural Setting	<ul> <li>Quaternary drift thickness in Nazko area: ~20-30 m. Chilcotin Group basalts thickness in Nazko area: likely &lt;30 m (Andri The thickest accumulations of the underlying Eocene Ootsa Lake Group (OLG) rocks range from 1000 to 2000 m and are (Bordet et al., 2013). In the immediate area around Nazko, the OLG is likely between 100 and 1,000 m thick.</li> <li>The Cretaceous to Early Cenozoic regional structure in the area is characterized by a series of north-trending horsts and northwest- and north-trending dextral strike-slip faults, the Yalakom and Fraser faults, respectively. In the immediate area trending nearly N-S, and just north of the cone is a NNW-trending normal fault (Bordet et al., 2013).</li> </ul>
Geophysics	<ul> <li>Many geophysical studies have been carried out in the Nechako Basin, including magnetotelluric (MT) surveys, seismic, (reduction to pole) magnetic.</li> <li>Regional tomography shows a low-velocity anomaly is visible to a depth of ~400 km directly beneath Nazko Cone, sugge source of magmatism in the Anahim volcanic belt and Chilcotin Basalt group, and that a mantle-scale process rather than (model favors an origin for the hotspot track in the form of a mantle plume over slab edge flow) (Mercier et al., 2009).</li> </ul>
Reservoir Host Rock	Unknown - potentially basement rock in the general area or sedimentary layers beneath the cone
Drilling Issues	None apparent - pumice/lava rock operations in area ongoing, exiting infrastructure likely adequate. Land ownership at dril (ranchers and first-nations bands control lands in area)
Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	<ul> <li>The Nazko cone is located in the Nechako basin, which is largely composed of basaltic flows of the Neogene Chilcotin C Eocene Endako and Ootsa Lake Groups (Farquharson et al., 2010). Eocene OLG strata (comprised mainly of rhyolite and occurrences and also overlie Mesozoic volcanic and sedimentary successions containing mineral and hydrocarbon resour</li> <li>The basement rocks in the area include accreted terrane successions of the Stikine (volcanic arc) and Cache Creek terra as postaccretion Jurassic to Cretaceous rock packages. In particular, Cretaceous strata of the Skeena Group (Stikine terrate 1., 2013)</li> <li>The Nechako basin has several possible magmatic sources, including a hot spot, the edge-effects of a slab window, or e</li> <li>The 120-m tall Nazko cone is a polygenic cinder cone located at the far eastern end of the Anahim Volcanic Belt, with the Hancock, 1995). It is the result of at least 3 episodes of Quaternary volcanic activity (Middle Pleistocene to Holocene). Ar is overlain by a subglacial mound of hyaloclastite that is, in turn, partly covered by a younger composite pyroclastic cone a with a hot-spot model for the Anahim Belt and radiocarbon dating suggests the last eruption was ~ 7,200 years ago (South pyroclastic mound at its base (a subaerial, flow-layered, nonvesicular basalt), which is partially covered by a blocky, highly of the cone. Postglacial deposition of red pyroclastic ash, lapilli and volcanic bombs ejected from vents in the cone create two olivine basalt lava streams flowed for several hundred meters from the volcano to the south and west) (Lett &amp; Jackam.</li> <li>The contact between Nazko tephra and underlying glacial deposits is well exposed in numerous road cuts. The contact is glaciofluvial sediments (Souther et al., 1987).</li> <li>Canada Pumice Corp has mined three areas of the cone for various types of scoria and pumice (Hora &amp; Hancock, 1995)</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

drews & Russel, 2006). re imaged in the Chilcotin Plateau southwest of Nazko

nd grabens that occupy a region between two regional-scale a around Nazko, to the south of the cone, lie normal faults

, airborne electromagnetic, vibroseis, bouger, and RTP

jesting that a deep-seated low-velocity anomaly is the n lithospheric-scale process controls surface volcanism

rilling site needs to be evaluated for necessary permissions

Group basalts unconformably overlie volcanic rocks of the nd dacite lavas) host low-sulphidation epithermal Au-Ag urces (Bordet et al., 2013).

rranes (subduction-related accretionary complex), as well errane) occur in the Chilcotin Plateau near Nazko. (Bordet

extension (Hutchinson, 2012).

he base of the cone ~1,000 m in diameter (Hora & An eroded Pleistocene subaerial flow at the base of the pile and associated lava flows. The oldest flow is consistent uther et al., 1987). The Nazko cone is comprised of a ly vesicular basalt and tuff breccia forming the western part ted the present-day edifice (also during this eruption event, man, 2014).

is sharp: basal tephra fragments rest directly on till and

5).

Near Quesnel, British Columbia, Canada Topographical Map Sheet: Figure 28 Geological Map Sheet: Figure 29

	Category	Comments
В.	Exploration Uncertainty (Risk)	
	Degree of Identification of Resources/Reserves	Low Location and size of geothermal resource has not been identified or defined. Alterra Power Corp. conducted preliminary geothermal exploration in the wetlands to the NW of the cone in 2012 (Lett & Ja
	Likelihood of Covering Reservoir with Concession	Moderate Existing Crown quarry for black pumice and vesicular basalt on flanks of Nazko (Pynn, 2010). Ranchers and three first-nations bands, the Chuntezni'i, Euchinico and Lhoosk'uzt'en, control most land in the Nazko Valle 2007).
	Expected Authorization Date	Unknown
	Specific Timing of Exploration (2 + 2 years, BC 8 years, etc.)	5 years (1 year permitting and surface exploration, possibly drilling shallow temperature-gradient holes + 1 year deep gradient-well testing + 1 year further development drilling and start plant construction + 1 year drilling wrap-up and finish plant constructi
	Degree of Previous Exploration (can be good or bad)	Moderate Numerous geophysical/geological studies conducted in the area; little known/published exploration data specifically for geo cone.
	Surface Operational Capacity (enough stable area for drilling and a plant?)	
		Moderate Recent research and exploration conducted in area shows high level of interest and activity. Efforts focused on temperatur
	(moderate risk) to easy (low risk)	geothermal resource need to be conducted.
C.	Environmental Issues	
	Protected Areas	<ul> <li>Nearest protected area, Puntchesakut Lake Provincial Park, approx. 2 km from proposed transmission line.</li> <li>Pinnacles Provincial Park approx. 2 km from proposed transmission line.</li> </ul>
	Endangered Species	<ul> <li>Proposed transmission line crosses the Fraser River which contains White Sturgeon, Upper Fraser River population (End</li> <li>Proposed transmission line and connection in Sprengel's Sedge (red-listed plant) and Riverbank Anemone (blue-listed plant)</li> </ul>
	Geothermal Surface Features	<ul> <li>Nearest surface feature hotsprings (Riske Hotsprings) are approx. 200 km from proposed infrastructure.</li> </ul>
	Other	<ul> <li>Transmission line crosses approx. 20 stream crossings including the Fraser River, Nazko River and Snakin River and U</li> <li>Fraser River contains Sockeye Salmon, Chinook Salmon, Pink Salmon, Coho Salmon, Rainbow Trout, Dolly Varden.</li> <li>Nazko River contains Chinook Salmon and Rainbow Trout.</li> </ul>
		<ul> <li>Snaking River contains Chinook Salmon and Rainbow Trout.</li> <li>Uddy Creek contains Rainbow Trout.</li> </ul>
		Nearest Wildlife Habitat Area is approx. 6 km from proposed transmission line.
D.	Geothermal Area - Bidding and/or Type of Land Holding	
	(private/government/lease/etc.)	
	Bidding Area Other Claim Rights (mining and/or oil)	No known existing active, cancelled or unsold geothermal title tracts Proposed geothermal plant location is within existing mineral/coal title. Proposed location is not within known oil and gas m

### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

Jackaman, 2014).

lley, though the area is still fairly isolated (Adderly et al.,

ell drilling + 1 year successful development drilling and ction).

eothermal. Closest known well drilled ~60 km SW of Nazko

ture gradient or slim-hole drilling to establish/define

ndangered (SARA Schedule 1); red-listed). plant) occurrence polygons.

Uddy Creek.

management area; no known tenures at proposed location.

Near Quesnel, British Columbia, Canada **Topographical Map Sheet: Figure 28** Geological Map Sheet: Figure 29

	Category	Comments
_	Market	
<u>E.</u>	Market Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through to Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propones Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW b against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponer threshold for the SOP (BC Hydro is developing a 'min'SOP' component within the overall SOP. This mini-SOP will apply realistically apply to potential geothermal generation projects).</li> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to parogram has no applicability to potential geothermal generation projects.</li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificati snow melt and stream flow.</li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project Is BC Hydro through BC Hydro's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>Wholesale wheeling (whereby electricity is transmitted from electricity generators to cuilities) to customers in Alberta, th generation supplier must request service on the appropriate BC Hydro under BC Hydro Transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with congestion issues, affects the economic via 4. Retail access, defined as a market in which electricity is sold directly to consumers by competing suppliers, is generalit opportunities for bilateral</li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

- onents can bid into those competitive calls.
- but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW y to projects in the 0.1 MW to 1 MW range, but would not

ect a small electricity generating unit to the BC Hydro participate in the program. Given the small size, this

ation of BC Hydro's resource mix, making it less reliant on

ven FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

the US, or other wholesale customer in BC is allowed. The nission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power viability of the potential wholesale opportunity.

ally not permitted in BC. However there may be ers (e.g. pulp mills, large sawmills, mines) as follows: ectric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

t Fraser Timber Co. Ltd. The operations are approximately

cated approximately 110 km from the Nazko Cone site.

Near Quesnel, British Columbia, Canada **Topographical Map Sheet: Figure 28** Geological Map Sheet: Figure 29

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generatio</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical an considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to seve Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gene other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction years, the key uncertainties inherent in the environmental review, public consultation, transmission arrangements (either w permitting and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
E	Transmission Line Infrastructure	
г.	State of the Infrastructure	Closest transmission line is 69 kV and 230 kV line and Red Bluff substation.
	Transmission Route (distance, terrain and costs)	New 69 kV transmission line 97 km with interconnection at existing Red Bluff substation. Routing follows existing paved ro proposed plant location then follows existing unpaved logging access roads. Varying terrain.
	Community logues	
<u></u>	Community Issues Indigenous Law and Indigenous Development Areas	<ul> <li>First Nation consultative areas include Tsilhqot'in National Government, Toosey Indian Band, Lhoosk'uz Dene Nation, Ca</li> <li>Nazko First Nation is reliant of forestry activities to provide employment, development and revenue. Nazko entered into t implementation of traditional law and governing policies that reflect the culture of the southern Carrier people. Nazko is de (http://nazkoband.ca/) Note that no official community plan is currently available online.</li> <li>Nazko Economic Development Corporation develops and implements economic development strategies (http://www.nazko.ex/)</li> </ul>
	Community Action	Quesnel Climate Change Group was developed in 2007 to mitigate the effects of climate change in their environment (htt City of Quesnel CHP community energy system feasibility study (http://www.toolkit.bc.ca/success-story/city-quesnel-cond system-north-cariboo)
	Surface Rights	First Nation consultative areas include Tsilhqot'in National Government, Toosey Indian Band, Lhoosk'uz Dene Nation, Ca
	Tourism	Several Provincial Parks surround Quesnel and the proposed project location. Significant ecotourism industry including f     (http://www.tourismquesnel.com/home/)

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ion output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission ven years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

road until turn off to Nazko Indian Reserve 20 km before

Carrier Chilcotin Tribal Council, Nazko First Nation. treaty agreement in 1994 to "have self-government, and dedicated to long term community planning."

zkoecdev.ca/).

http://www.bakercreek.org/Climate-Change-Group.html). nducts-final-feasiblity-study-innovative-community-energy-

Carrier Chilcotin Tribal Council, Nazko First Nation

fly-fishing, canoeing, cross-country skiing, kayaking

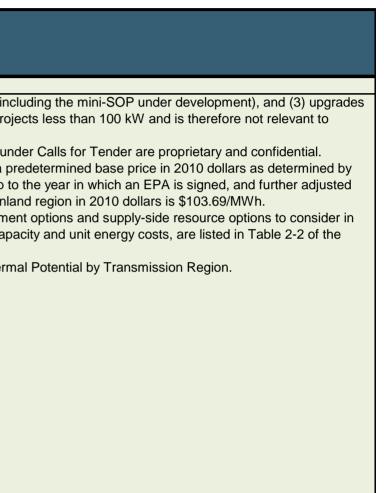
Near Quesnel, British Columbia, Canada Topographical Map Sheet: Figure 28 Geological Map Sheet: Figure 29

		Category	Comments
	I.	Water Rights	
		Availability (for example "air-cooled required")	Plant water requirement estimated approx. 13 L/s for binary plant. 1 current water licence at plant location for .15 L/s for p Corp.).
		Availability for Drilling	Drilling requirement of 20 L/s. MAD of approx. 3000 L/s in Baker Creek. 1 current water licence at plant location for 0.15 L Corp.).
ſ		·	
[	J.	Engineering	
Ī		Plant Location and Design	Plant located in flat terrain outside of surrounding reserve land, within reasonable distance from existing paved road.
		Construction Issues	Significant distance of new transmission line to be built; no existing transmission line corridor.
		Transportation Issues	Plant location is approx. 100 km from nearest significate population centre: Quesnel.
		Architectural Issues (Blend/hide into environment? Local styles? etc.)	None found.
		Special Construction Issues (zero emissions)	None found.
	K.	Non-Electrical Infrastructure (Roads and Habitation)	
		Nearest Large Community > 50,000	Prince George, BC
		Nearest Community	Quesnel, BC
		Nearest Road and Condition	Unpaved logging road; condition is unknown.
		Current Access Conditions (restrictions)	Approx. 100 km from closest significant population of Quesnel.
		Terrain and Distance Factor for Road Building	No new road requirement is expected.

purpose of processing (licencee is Can Lava Mining
L/s for purpose of processing (licencee is Can Lava Mining

Near Quesnel, British Columbia, Canada **Topographical Map Sheet: Figure 28** Geological Map Sheet: Figure 29

	Category					Comments	
L.	Finance						
	General Power Prices	BC Hydro acquires power through to its existing facilities or the develo geothermal generation projects). C • The power price paid by BC Hydro • The power price paid by BC Hydro the region of the point of interconne based upon the time of day and mo • BC Hydro's current Integrated Re meeting the future demand for elect November 2013 Resource Options • Table 5-7 of the above-noted Nov	opment of new g omments on the o to independen o to independen ection to the BC onth when the er source Plan dat ctricity. These re Report Update.	eneration faciliti e general price o t power produce t power produce Hydro system, e nergy is delivere ed November 20 esource options, That table is re	es. (Note that the f power under every through Energy ers through EPA escalated at the d. For reference 013 includes det together with the produced below	he net metering p ach one are: gy Purchase Ag s under the SOF Consumer Price a, the base price ails of both dema eir attributes of t of ready refere	program targets pro reements (EPAs) ur are made up of a p Index annually up t for the Lower Mainla and-side manageme total energy and cap ence.
		Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)	
		Biomass – Wood Based	9,772	1,226	122 - 276	132 - 306	
		Biomass – Biogas	134	16	59 – 154	56 - 156	
		Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204	
		Wind – Onshore	46,165	4,271	90 - 309	115 – 365	
		Wind – Offshore	56,700	3,819	166 - 605	182 – 681	
		Geothermal	5,992	780	91 – 573	90 - 593	
		Run-of-River	24,543	1,149	97 – 493	143 – 1,170	
		Site C <sup>3</sup>	4,700	1,100	83	88	
		Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	6,103	774	58 – 92	57 – 86	
		Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103	
		Wave	2,506	259	440 - 772	453 - 820	
		Tidal	1,426	247	253 - 556	264 - 581	
		Solar	57	12	266 - 746	341 – 954	
		<ol> <li>Notes:</li> <li>The resources and UEC values s and may not include all possible r</li> <li>The details of how the cost adjust</li> <li>The Site C values presented in the Impact Statement (EIS) submission real discount rate.</li> <li>Representative projects were use the resource potential is generally</li> </ol>	esources that may ters were developed is table are based of on filed in January 2 ed to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC he natural gas-fired a	expected higher cos rovided in Appendix ded in the Site C Er is calculated assum	t. 12. nvironmental ning 5 per cent	



Near Quesnel, British Columbia, Canada Topographical Map Sheet: Figure 28 Geological Map Sheet: Figure 29

Category								Comments
<ul> <li>Market Price (\$/MWhr)</li> <li>As noted in the above Table 2-2 from the November 2013 Resource Options Republication of the source (\$/MWhr)</li> <li>As noted in the above Table 2-2 from the November 2013 Resource Options Republication of the source (\$/MWhr)</li> <li>As noted in the above Table 2-2 from the November 2013 Resource Options Republication of the source (\$/MWhr)</li> <li>As noted in the above Table 2-2 from the November 2013 Resource Options Republication (\$/MWhr)</li> <li>As noted in the above Table 2-2 from the November 2013 Resource Options Republication (\$/MWhr)</li> <li>Wholesale electricity prices for trading purposes can vary greatly. In the Pacific Network of sources. One such source is the US Energy Information Administration (\$/Wmarket data. Of particular relevance is the mid-C trading hub in the Northwest Regaverage cost from 72 trades). Access to that market for geothermal projects in BC on the appropriate transmission system (e.g. Bonneville Power Authority) in the US BC Hydro forecasts of market prices under various scenarios was provided in the ready reference.</li> <li>Electricity Price Data Tables</li> </ul>						BC Hydro system. ic Northwest, these prices are affected by of the wholesale electricity prices for pote on (www.eia.gov/electricity/wholesale/#his Region (one example would be a Mid-C BC would require access on both the BC e US.		
		LICOL	Table 5	5 Electricity	y Price Forecasts b (Real 2012 US\$/MV	y Market		
			1	2	(Real 2012 US\$/MN	vn at Mid-C)	5	
		Market Scenario	Mid Electricity Mid GHG (Regional) Mid Gas	Low Electricity Low GHG (Regional) Low Gas	High Electricity High GHG (Regional) High Gas	Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	High Electricity High GHG (Regional/Nat'l) High Gas	
		2014	25.0	21.9	31.1	25.0	31.1	
		2015	25.5	21.7	31.9	25.5	31.9	
		2016	25.8	21.2 22.0	32.0	25.8 27.1	32.0	
		2017 2018	27.1 27.1	22.0	33.4 33.9	27.1	33.4 33.9	
		2010	28.0	22.1	35.5	28.0	35.5	
		2020	28.0	21.9	36.0	28.0	36.0	
		2021	29.3	22.5	37.3	29.3	37.3	
		2022	30.1	22.7	38.8	30.9	41.3	
		2023	31.8	23.2	41.7	35.5	52.1	
		2024 2025	33.0 34.2	23.7 24.0	43.4 45.4	41.8 50.3	68.6 91.2	
		2026	34.9	24.0	46.7	52.2	95.1	
		2027	36.0	24.3	48.6	54.7	98.9	
		2028	36.3	24.0	50.2	56.8	101.8	
		2029	37.2	23.9	51.1	58.8	106.1	
		2030	37.6	23.8	52.7	60.1	109.3	
		2031 2032	38.6 39.9	24.0 24.0	54.7 57.0	62.6 65.6	112.0 116.0	
		2033	41.5	24.4	60.1	69.3	122.0	
		2034	42.8	25.1	61.9	71.5	125.7	
		2035	44.6	26.2	64.5	74.5	131.0	
		2036	45.7	26.9	66.2	76.4	134.3	
		2037	47.8	28.1	69.1	79.8	140.3	
		2038	48.4 48.9	28.4 28.7	70.0	80.8 81.6	142.1 143.5	
		2039 2040	48.9	28.7	70.7	81.6	143.5 144.9	
		2010	10.0	20.0	71.7	72.7		

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

r geothermal resources at a 7% real discount rate in 2013

by such factors as precipitation/snowfall in the region, tential export of electricity from BC can be obtained from a history). This source provides current and historical electricity C peak price on March 17, 2015 of \$19.87US weighted BC Hydro transmission system to the Canada/US border, and

ppendix 5A – Market Forecast Data is reproduced below for

Near Quesnel, British Columbia, Canada **Topographical Map Sheet: Figure 28** Geological Map Sheet: Figure 29

Category					Comments	
Green Power Premium (\$/MWhr)	<ul> <li>Within British Content</li> <li>environmentally for the california has a particularly "bund 1. The price of electron 2. There are large</li> </ul>	<ul> <li>BC Hydro's past procurement processes for the acquisition for power from independent power producers has offered a</li> <li>Within British Columbia, there is little demand for the purchase of "green power certificates" (instruments that a custome environmentally friendly) from BC Hydro. BC Hydro's generation mix is already approximately 93% clean.</li> <li>California has a goal of 33% of retail sales by 2020 to be sourced from eligible renewable energy sources. However, the particularly "bundled" green energy with Renewable Energy Certificates (RECs), to compete in that market is low, for a nu 1. The price of electricity is driven by the low cost of natural gas;</li> <li>There are large amounts of renewables, such as wind and solar, in California; and</li> <li>Firm transmission access to the California market through the BPA transmission system is generally not available.</li> <li>There is no price in \$/kW for capacity resource options in the market at present.</li> <li>Table 3-27 entitled "UCCs of Capacity Resource Supply Options" in BC Hydro's Integrated Resource Plan dated Novem options (e.g. pumped storage, simple cycle gas turbines and resource smart projects such as Revelstoke Unit 6). The un the BC Hydro system in \$2013/kW-year are shown in the table.</li> </ul>				
Capacity Price (\$/KW)	<ul> <li>There is no pric</li> <li>Table 3-27 entit options (e.g. pum)</li> </ul>					
	(a) "Off-Peak Hou (b) "Peak Hours" inclusive, but exc	irs" means all ho means the hours	urs other that commencin	in Super-Peak g at 06:00 PP1	xpressions have the following meanings: Hours and Peak Hours. Γ and ending at 16:00 PPT, and commencing at 20:00 PPT a	
	(c) "Super-Peak F holidays."		hours comr	mencing at 16:	00 PPT and ending at 20:00 PPT Monday through Saturday in	
	.,	Time of 1	hours comr	or (TDF)	00 PPT and ending at 20:00 PPT Monday through Saturday i	
	holidays."	Time of Super-Peak	hours comr Delivery Facto Peak	or (TDF)	00 PPT and ending at 20:00 PPT Monday through Saturday i	
	holidays." Month January	Time of 1	hours comr	or (TDF)	00 PPT and ending at 20:00 PPT Monday through Saturday i	
	holidays."	Time of 3 Super-Peak 141%	bours comr Delivery Facto Peak 122%	or (TDF) Off-Peak	00 PPT and ending at 20:00 PPT Monday through Saturday i	
	holidays." Month January February	Time of 1           Super-Peak           141%           124%	bours comr Delivery Factor Peak 122% 113%	or (TDF) Off-Peak 105% 101%	00 PPT and ending at 20:00 PPT Monday through Saturday i	
	holidays." Month January February March	Time of 1           Super-Peak           141%           124%           124%	Pelivery Factor Peak 122% 113% 112%	nencing at 16: or (TDF) Off-Peak 105% 101% 99%	00 PPT and ending at 20:00 PPT Monday through Saturday i	
	holidays." Month January February March April	Time of 1           Super-Peak           141%           124%           124%           104%	hours comr Delivery Factor Peak 122% 113% 112% 95%	nencing at 16: or (TDF) Off-Peak 105% 101% 99% 85%	00 PPT and ending at 20:00 PPT Monday through Saturday i	
	holidays." Month January February March April May	Time of 1           Super-Peak           141%           124%           124%           104%           90%	hours comr           Delivery Factor           Peak           122%           113%           112%           95%           82%	nencing at 16: or (TDF) Off-Peak 105% 101% 99% 85% 70%	00 PPT and ending at 20:00 PPT Monday through Saturday i	
	holidays." Month January February March April May June	Time of 3           Super-Peak           141%           124%           124%           104%           90%           87%	hours comr           Delivery Factor           Peak           122%           113%           112%           95%           82%           81%	Off-Peak           105%           101%           99%           85%           70%           69%	00 PPT and ending at 20:00 PPT Monday through Saturday i	
	holidays." Month January February March April May June July	Time of 1           Super-Peak           141%           124%           124%           104%           90%           87%           105%	hours comr           Delivery Factor           Peak           122%           113%           112%           95%           82%           81%           96%	nencing at 16: or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79%	00 PPT and ending at 20:00 PPT Monday through Saturday i	
	holidays." Month January February March April May June July August	Time of 3           Super-Peak           141%           124%           124%           104%           90%           87%           105%           110%	hours comr Pelivery Factor Peak 122% 113% 112% 95% 82% 81% 96% 101%	Off-Peak           105%           101%           99%           85%           70%           69%           79%           86%	00 PPT and ending at 20:00 PPT Monday through Saturday i	
	holidays." Month January February March April May June July August September	Time of 1           Super-Peak           141%           124%           124%           104%           90%           87%           105%           110%           116%	hours comr Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96% 101% 107%	nencing at 16: or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 70% 69% 79% 86% 91%	00 PPT and ending at 20:00 PPT Monday through Saturday i	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

premium for green power. her can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

mber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

inclusive, but excluding British Columbia statutory

Near Quesnel, British Columbia, Canada Topographical Map Sheet: Figure 28 Geological Map Sheet: Figure 29

Category	Comments
Estimated Size of Resource	See Section A.
Is there any green power incentives?	<ul> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p o Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project development o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include:</li> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Sustainable Development Technology Canada funds;</li> <li>Industrial Research Assistance Program; and</li> <li>Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability</li> </ul>
Grants	See above under green power incentives
Tax Holidays	None listed on federal and provincial websites.
Tax Relief	<ul> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 43 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred duri and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the year deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now n entitled Scientific Research and Experimental ity and relevance. y participation in the clean energy sector. It provides: nent; and
these programs may be active but not currently issuing al technologies/resources, while others may be fully
ity and relevance.
ce energy by using renewable energy sources or fuels from

43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 sets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy year they are incurred, carried forward indefinitely and

Near Quesnel, British Columbia, Canada **Topographical Map Sheet: Figure 28** Geological Map Sheet: Figure 29

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly. The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities.
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> <li>FNFA loans do not require collateral;</li> </ol>
	<ul> <li>4. FNFA loans can be used to refinance existing debt; and</li> <li>5. FNFA's interest rates and terms parallel those available to provincial and local governments.</li> </ul>
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infra- purchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Bor and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015
	Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribe
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must p (a) a royalty established by agreement under this section,
	(b) an amount agreed under this section to be paid instead of royalty, or
	(c) if no royalty or amount has been agreed under this section, the prescribed royalty.
General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "This in section 1 (1) [definitions] of the Geothermal Resources Act."
Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners f Proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg Stat
Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincia</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. es that join as Borrowing Members.

astructure, social and economic development, land

orrowing Members, represented by the First Nation's Chief

ed rent for the permit (Section 5).

pay to the government

his Act does not apply to geothermal resources as defined

for the geothermal land tract. atutory Right of Way, Licence of Occupation). ial (British Columbia): 13.5%.

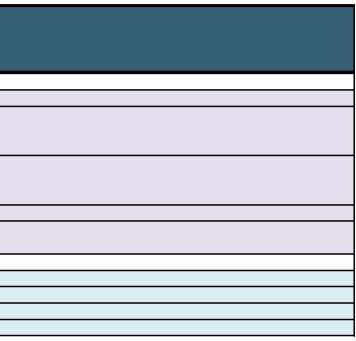
ta, the US, or other wholesale customers in BC, the nission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power ne economic viability of the potential wholesale opportunity.

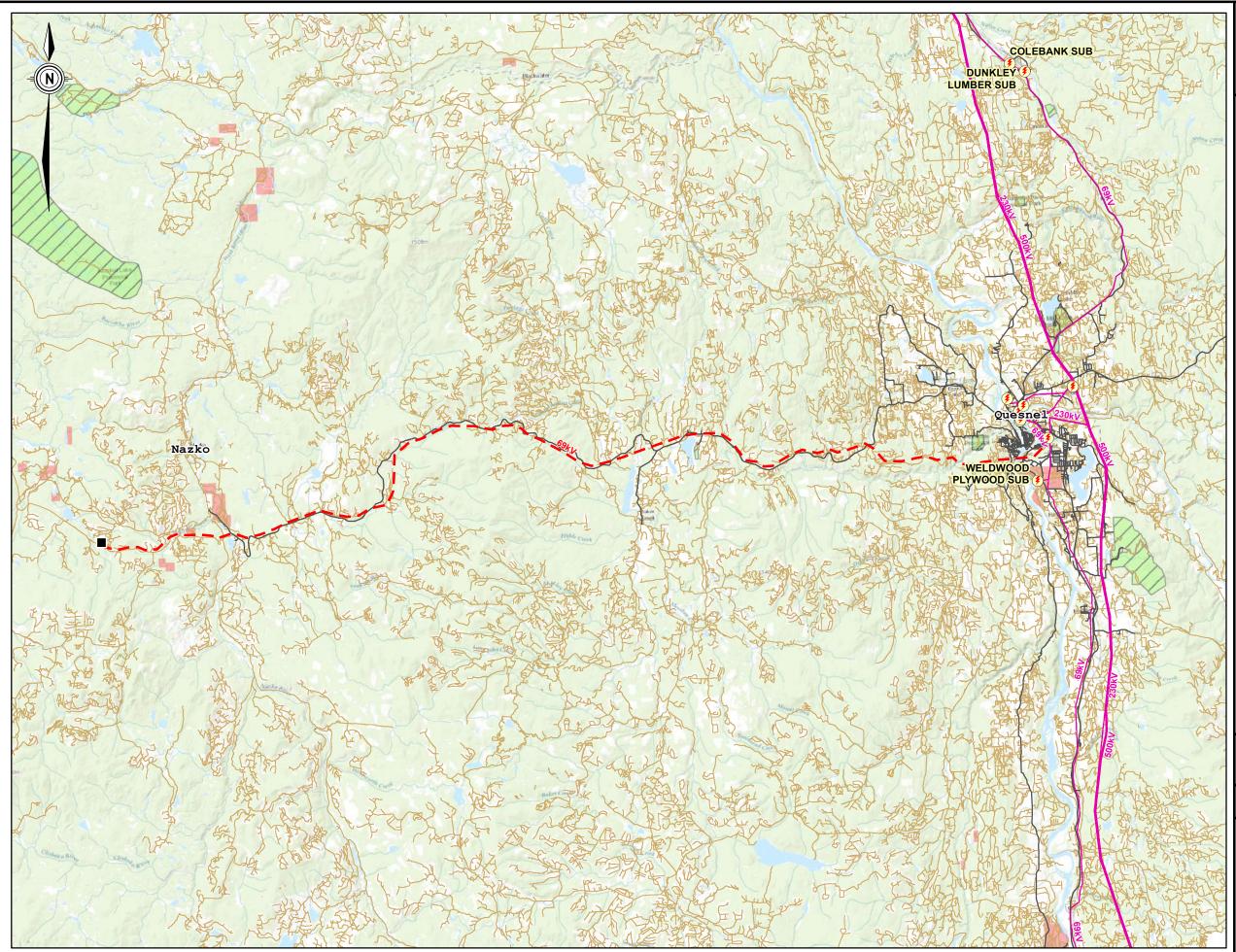
#### Geothermal Development Decision Matrix

# NAZKO CONE

Near Quesnel, British Columbia, Canada Topographical Map Sheet: Figure 28 Geological Map Sheet: Figure 29

		Category	Comments
Γ		Maps	
		Regional topographic map showing population centres, roads and	Topographical Map Sheet: Figure 28
		other infrastructure including electrical grid and nearest substation	
		and/or generating station. (1:500,000?)	
		Regional map showing land tenure in area – geothermal	Topographical Map Sheet: Figure 28
		concessions, mining concessions, private land holds, public or	
		national lands (parks). (1:500,000?)	
		Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 29
		Detailed geological map of the immediate area of the	Geological Map Sheet: Figure 29
		concessions. (1:50,000 or 100,000)	
1	N.	Other Issues and Considerations	







# Legend

- Proposed Geothermal Plant Location
- Proposed Transmission Line
- Existing Substation
  - Existing Transmission Line
- Paved Road
- Other Road
- Park, Eco-Reserve, Protected Area
- First Nations Reserve



KERR WOOD LEIDAL

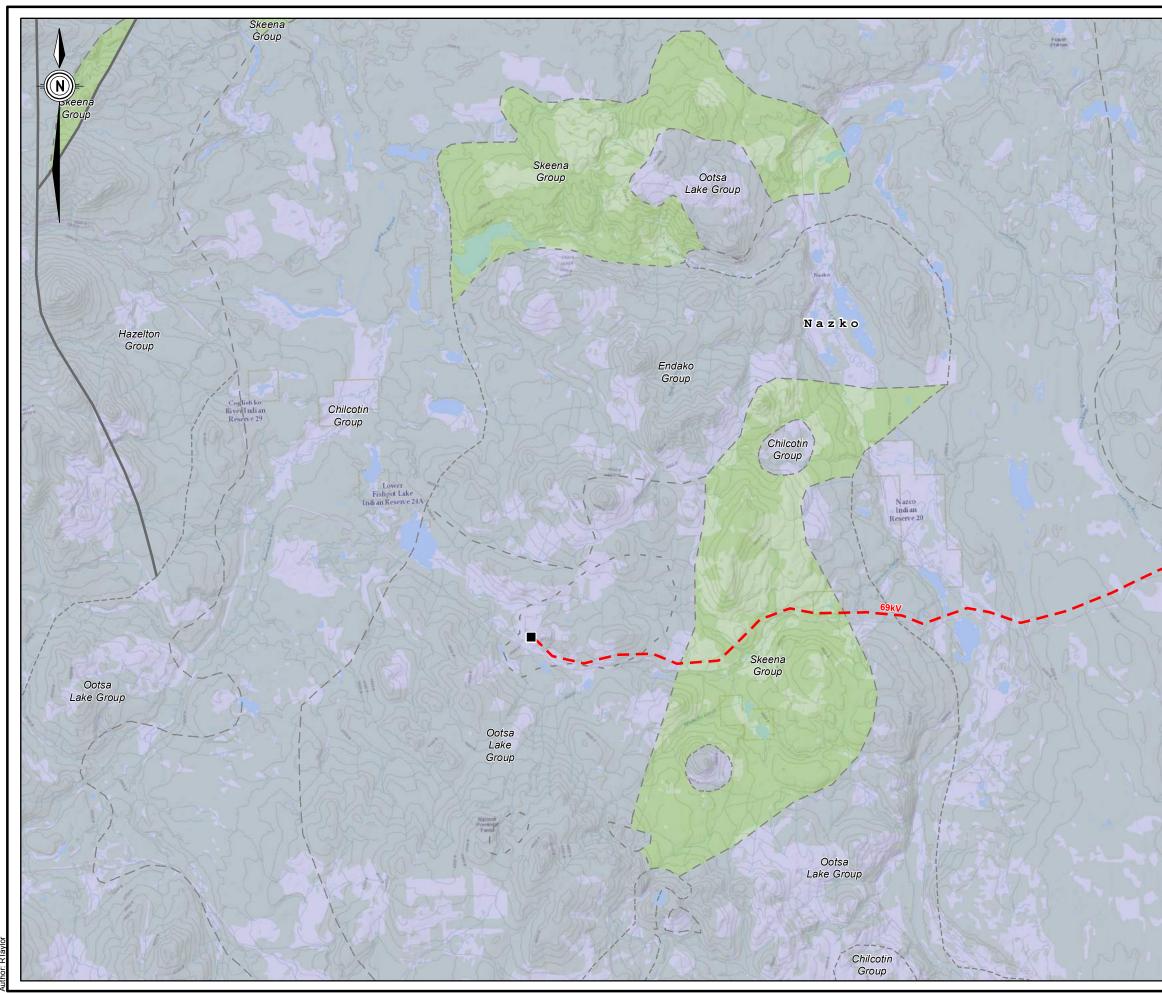
rvice Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Internap, Increment P Corp., GEBCO, GS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METT, Esri China ong Kong), swisstop, Mapyindia, © OpenStreetMap contributors, and the GIS User Community

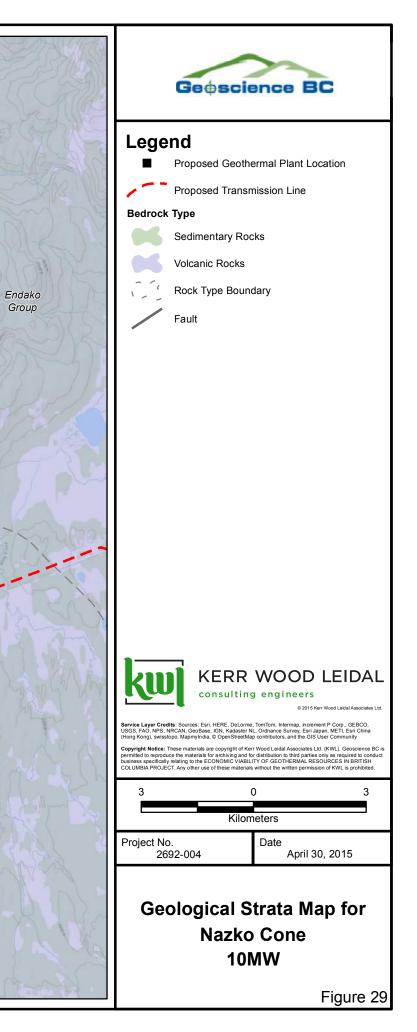
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	Kilome	eters	
Project No. 2692-0	004	Date April 30, 2	015

# Potential Geothermal Plant at Nazko Cone 10MW

Figure 28







Appendix P

**Okanagan Geothermal Development Decision Matrix and Figures 30 & 31** 

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Near Peachland, British Columbia, Canada **Topographical Map Sheet: Figure 30** Geological Map Sheet: Figure 31

Category	Comments
Reservoir Potential	
Size/Potential/Type	<ul> <li>Reservoir size: Springbook Formation (basal conglomerate within White Lake basin ~40 km south of Summerland) esti</li> <li>Potential: 20 MW (Lovekin &amp; Pletka, 2009)</li> <li>Type: low-temperature resource, suitable for binary plant</li> </ul>
Temperature/Water and Gas Chemistry/Mineral Indicators	<ul> <li>Surface features:</li> <li>Angel spring (aka KLO): 22.7°C (Grasby et al., 2000); located 50 km NE of Summerland borehole EPB/GSC 495 Geothermometry:</li> <li>Angel (KLO): Maximum temperature given as 137°C (Grasby et al., 2000)</li> <li>Exploration drilling:</li> <li>One diamond-drilled borehole drilled as part of Geothermal Energy Program (1982) (originally intended to test geophysic et al., 1991)</li> <li>Mraz Well (second hole) drilled to 200 m in southern part of the basin (to test bedded Tertiary rocks) (Church et al., 1997)</li> <li>Hole No. EPB/GSC 495 (1990) west of town of Summerland, on Boreboon farm just south of Eneas Creek on the west BHT 33°C (at 706 m) (Church et al., 1991); basal conglomerate not reached. Well deepened in 1992 to 956 m, bedding d ~41°C; no aquifer intersected (Jessop, 2008)</li> <li>Two other wells drilled in granitic rock to determine heat flow at Paynter Lake and Trout Creek with observed geotherma (Jessop, 2008)</li> <li>Geothermal potential of Summerland caldera tested via drilling in 1992 with heat-flow values as follows: Penticton outlier south end of Lake Okanagan): 72 mW/m<sup>2</sup>; 70°C/km; Summerland caldera: 85 mW/m<sup>2</sup>. Geothermal gradient estimated a Water chemistry:</li> <li>Hot spring lies on the stable isotope meteoric water line; water type is (Ca&gt;Na)-HCO<sub>3</sub> with HCO<sub>3</sub> at 815 mg/L, Mg at 27 m</li> </ul>
Surface Flow Rates and Reservoir Recharge	<ul> <li>Fluids in basin driven by artesian conditions. (Fairbank &amp; Faulkner, 1992)</li> <li>Fluid moves down-dip/down-structure into the structural trough. Stream entering basin terminates &amp; likely is a component al., 1990)</li> <li>Piteau and Associates (1984) concluded that "a geothermal well drilled to the base of the Summerland Basin should have of groundwater." (Jessop, 2008)</li> </ul>
3D Permeability (heat exchange potential)	<ul> <li>Conduction or deep fluid flow systems within sedimentary and volcanic formations. (Fairbank &amp; Faulkner, 1992)</li> <li>Fluid conduits likely thin permeable interbedded layers, the tops of the basic lavas, the basal conglomerate and along fair</li> </ul>
Recent Magmatism	N/A - Volcanics of White Lake Basin region ~ 50 million years old. (Lewis, 1982)
Structural Setting	<ul> <li>Beds are uplifted and tilted into a synclinal trough. Fluid moves down-dip/down-structure, likely through fractures, into the Fault, which juxtaposes the dacitic domes and breccias against the impermeable granitic basement. (Church et al., 1991)</li> <li>Northerly trending faults control structures in the Penticton Outlier - controlled by NS stress scheme responsible for num 2002a)</li> <li>Vertical movement on graben-type faults is commonly hundreds of meters for these Tertiary basins. Folds and fractures responsible for the many graben-like structures and overall basin-and-range style of this region. (Lewis, 1984)</li> </ul>

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stimated at 60 m thick, over area of 100 km<sup>2</sup> (Lewis, 1982) ical & geological properties of granitic basement). (Church 91) limb of the basin - drilled to total depth 712 m, preliminary dipping ~50°; highest temperature observed at 946.5 m al gradients of 29.6 mK/m and 30.0 mK/m, respectively. er (Tertiary volcanics WSW of the town of Penticton at at 50°C/km (Fairbank & Faulkner, 1992). mg/L and Cl at 4 mg/L (Grasby et al., 2000). ent of recharge for the resource (% unknown). (Church et

ave a reasonable chance of producing between 3 and 10 L/s

aults. (Lewis, 1982)

ne structural trough towards the Summerland (normal) I) (Jessop & Church, 1991) merous N-trending grabens in southern BC. (Church,

s are the result of NS-directed stress thought to be

Near Peachland, British Columbia, Canada Topographical Map Sheet: Figure 30 Geological Map Sheet: Figure 31

Category	Comments						
Geophysics	Unknown						
Reservoir Host Rock	<ul> <li>Likely the basal conglomerate, also possibly in breccia lenses in fault zones. Some fluid accumulation possible in sandsto carbonate cement likely reducing porosity (Church et al., 1991).</li> <li>Silicate hosted (Grasby et al., 2000)</li> </ul>						
Drilling Issues	Naturally radioactive (heavy metal) minerals present in area previously detected in groundwater (Church et al., 1991).						
Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	<ul> <li>Southeastern Cordillera was affected by a regional extension in the Eocene that exposed a core zone of high-grade meta western margins of the metamorphosed zone tend to be low-angle (20-30°) and have kilometers of displacement. The Oka western margin, is a 1 to 2 km thick shear zone characterized by mylonite and micro-breccia.</li> <li>Only one known thermal spring (KLO or Angel) is associated with the OVF. (Grasby &amp; Hutcheon, 2001)</li> <li>The last known volcanism in the region (~ 50 million years old) is closely associated with block faulting, and many deposit subsidence complexes (Lewis, 1984). These three basins (Tertiary Kelowna and Penticton outliers and Summerland calder porosity, permeability and thermal conductivity (Fairbank &amp; Faulkner, 1992), have thicknesses of over 1 km, and are of the possibility of significant hot-water resources (Lewis, 1984)</li> <li>Summerland basin is an Eocene volcanic caldera (previously part of larger contiguous mass of volcanic and sedimentary Tertiary Outlier aka White Lake Basin {Lewis, 1982}]). A granitic basement is overlain by the Penticton Group which is corr lavas and ash flows, dacitic domes and breccias, and fluvial and lacustrine sedimentary rocks (&gt;1,000 m total thickness). (</li> </ul>						
B. Exploration Uncertainty (Risk)							
Degree of Identification of Resources/Reserves	Low Small Tertiary basins in the Okanagan area showed a good probability of containing usable low-grade geothermal resource						

Degree of Identification of Resources/Reserves	Low
	Small Tertiary basins in the Okanagan area showed a good probability of containing usable low-grade geothermal resource
	viable aquifers found (Jessop, 2008)
Likelihood of Covering Reservoir with Concession	Low
	Angel spring is located within the Myra-Bellevue Provincial Park. Other areas appear to be available (for instance, near Su
	identified in drilling as deep as 956 meters near Summerland. This leads to uncertainty as to just what concession bounda
Expected Authorization Date	Unknown
Specific Timing of Exploration (2 + 2 years, BC 8 years, etc.)	5 years
	(1 year permitting and surface exploration, possibly drilling shallow temperature gradient holes + 1 year deep gradient-well
	testing + 1 year further development drilling and start plant construction + 1 year drilling wrap-up and finish plant construction
Degree of Previous Exploration (can be good or bad)	Low
	Few gradient/exploration wells drilled - widely dispersed throughout basin areas
Surface Operational Capacity (enough stable area for drilling and	Likely
a plant?)	No obvious impediments
Exploration to Exploitation: A summary rating of Exploration	Moderate to Difficult
Uncertainty (risk) on a scale of difficult (high risk) through medium	Lack of resource definition is biggest impediment, though additional exploration (geophysics and slim-hole drilling) could im
(moderate risk) to easy (low risk)	

Istone formations, but presence of interstitial ash and
etamorphic rocks. The bounding faults on the eastern and Dkanagan Valley Fault (OVF), a bounding fault on the
osits are preserved in grabens, half grabens, and cauldron - aldera) contain sedimentary and volcanic beds with varying the porous, permeable type of formation which allows the ary rocks known as the Penticton Tertiary Outlier" [Penticton composed of basal conglomerates, massive volcanic beds, ). (Church et al., 1991) (Jessop & Church, 1991)
irces. Anomalous temperature gradient measured, no
Summerland), but permeable formations have not been ndaries should be.
rell drilling + 1 year successful development drilling and uction)
improve this picture.

#### Geothermal Development Decision Matrix

# OKANAGAN

Near Peachland, British Columbia, Canada Topographical Map Sheet: Figure 30 Geological Map Sheet: Figure 31

	Category	Comments
(	C. Environmental Issues	
	Protected Areas	• Wildlife Habitat Area (#365770, labelled for a "Data Sensitive" species) is approx 3 km from proposed transmission line.
		<ul> <li>Nearest provincial park, Darke Lake Provincial Park, approx. 9 km from proposed plant location.</li> </ul>
	Endangered Species	<ul> <li>Proposed transmission line crosses through American Badger (Endangered (SARA Schedule 1); red-listed), Western Sc</li> </ul>
		Schedule 1); red-listed) and Prairie Gentian (blue-listed plant) occurrence polygons.
		• Flammulated Owl (Special Concern (SARA Schedule 1); blue-listed) is less than 1 km from proposed transmission line.
	Geothermal Surface Features	<ul> <li>Nearest hotsprings approx. 70 km from proposed infrastructure.</li> </ul>
	Other	<ul> <li>Proposed transmission line crosses Darke Creek which contains Rainbow Trout. Proposed creek crosses Trout Creek, I</li> </ul>
		have unnamed fish observations.
0	D. Geothermal Area - Bidding and/or Type of Land Holding	
	(private/government/lease/etc.)	
	Bidding Area	No existing geothermal title tract
	Other Claim Rights (mining and/or oil)	Several mineral/coal titles in surrounding area. Proposed location is not within known oil and gas management area; no kr

creech-Owl, macfarlanei subspecies (Endangered (SARA
, Bull Creek, Bearpaw Creek, and Isintok Creek, all which
known tenures at proposed location.

Near Peachland, British Columbia, Canada **Topographical Map Sheet: Figure 30** Geological Map Sheet: Figure 31

	Category	Comments
Ε.	Market	
	Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>1. BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through th Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal proponent • Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW bi- against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponer threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply realistically apply to potential geothermal generation projects. In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pa program has no applicability to potential geothermal generation projects. The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificati snow melt and stream flow.</li> <li>2. Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project I- BC Hydro's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>3. Wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta, th generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with congestion issues, affects the economic via 4. Retail access, de</li></ul>

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two main processes:

onents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW y to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro participate in the program. Given the small size, this

ation of BC Hydro's resource mix, making it less reliant on

ren FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

the US, or other wholesale customer in BC is allowed. The nission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

lly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

the Okanagan site.

#### **Geothermal Development Decision Matrix**

## OKANAGAN

Near Peachland, British Columbia, Canada **Topographical Map Sheet: Figure 30** Geological Map Sheet: Figure 31

Category		Comments						
Time Limits? ( deadlines?)	business agreements, operating/generating-by	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation.</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical an considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to sever Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gene other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction years, the key uncertainties inherent in the environmental review, public consultation, transmission arrangements (either w permitting and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>						
	Line Infrastructure							
State of the Int		Closest transmission line is 500 kV. Closest transmission line with accessibility for interconnection is 63 kV line to FortisB						
Iransmission	Route (distance, terrain and costs)	Routing to FortisBC Summerland substation via new 63 kV transmission line approx. 23 km along existing paved road to p						
H. Community Is								
	w and Indigenous Development Areas	<ul> <li>First Nation consultative areas include Nlaka'pamux Nation, Nicola Tribal Association, Lower Nicola Indian Band, Lytton F Ferry Indian Band, Siska Indian Band, Coldwater Indian Band, Nooaitch Indian Band, Westbank First Nation, Okanagan Indian Band.</li> <li>Okanagan Nation Alliance include South Upper Nicola Band, Okanagan Indian Band, Westbank First Nation, Penticton Ir Similkameen Indian Band, Osoyoos Indian Band and Solville Confederation Tribes; First Nations government in the Okana (http://www.syilx.org/who-we-are/).</li> <li>The Okanagan Nation Alliance is developing processes to ensure "communities are not mere stakeholders to a resource (http://www.syilx.org/operations/natural-resourcesland-use/).</li> <li>Westbank First Nation provides Land Use Plan for communities including Summerland</li> <li>Westbank First Nation Community Plan supports the protection and enhancement of sensitive natural environmental area</li> </ul>						
Community Ac	tion	• Summerland created Climate Action Plan in 2011 and signed onto the BC Climate Action Charter (http://www.summerlan						
Surface Rights		<ul> <li>First Nation consultative areas include Nlaka'pamux Nation, Nicola Tribal Association, Lower Nicola Indian Band, Lytton Ferry Indian Band, Siska Indian Band, Coldwater Indian Band, Nooaitch Indian Band, Westbank First Nation, Okanagan In Indian Band.</li> <li>Summerland Official Community Plan provides growth areas (See Summerland Official Community Plan and maps)</li> </ul>						
		Summerland has a significant ecotourism industry; four Provincial Park protected areas are within 6 km of the location of						

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ion output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission ven years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

BC Summerland substation. plant location.

First Nation, Oregon Jack Creek Indian Band, Cook's Indian Band, Lower Similkameen Indian Band, Penticton

Indian Band, Upper Similkameen Indian Band, Lower nagan to represent tribes in areas of concern

ce...[but] are stewards of our lands and waters."

eas

and.ca/planning-building/climate-action)

First Nation, Oregon Jack Creek Indian Band, Cook's Indian Band, Lower Similkameen Indian Band, Penticton

of the proposed plant and transmission line.

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	Category	Comments					
I.	Water Rights						
	Availability (for example "air-cooled required")	Plant water requirement estimated approx. 25 L/s for binary plant. MAD of 2100 L/s in Trout Creek. No existing water licer proposed location.					
	Availability for Drilling	Drilling requirement of 20 L/s. MAD of 2100 L/s in Trout Creek. No existing water licences in vicinity. Closest water licence					
J.	Engineering						
	Plant Location and Design	Adequate footprint, low to moderately sloping, forested terrain.					
	Construction Issues	New road (approx. 500 m ) from nearest road to plant location.					
	Transportation Issues	Access via existing paved roads and unpaved access roads (less than 1 km).					
	Architectural Issues (Blend/hide into environment? Local styles? etc.)	None found.					
	Special Construction Issues (zero emissions)	None found.					
K.	Non-Electrical Infrastructure (Roads and Habitation)						
	Nearest Large Community > 50,000	Kelowna, BC					
	Nearest Community	Peachland, BC					
	Nearest Road and Condition	Unpaved logging/access road; gently sloping terrain.					
	Current Access Conditions (restrictions)	Access via existing paved roads and unpaved access roads (less than 1 km).					
	Terrain and Distance Factor for Road Building	Remote, forested terrain, gently to moderately sloped.					

nces in vicinity. Closest water licences approx. 7 km from
ces approx. 7 km from proposed location.

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Category					Commer	nts
E Finance General Power Prices	BC Hydro acquires power throug to its existing facilities or the devi- geothermal generation projects). • The power price paid by BC Hy • The power price paid by BC Hy the region of the point of intercor- based upon the time of day and r • BC Hydro's current Integrated F meeting the future demand for el November 2013 Resource Optio • Table 5-7 of the above-noted N	ering program targets proj e: se Agreements (EPAs) un e SOP are made up of a p Price Index annually up to price for the Lower Mainla demand-side manageme es of total energy and cap reference.				
	Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)	
	Biomass – Wood Based	9,772	1,226	122 - 276	132 - 306	
	Biomass – Biogas	134	16	59 – 154	56 - 156	
	Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204	
	Wind – Onshore	46,165	4,271	90 - 309	115 – 365	
	Wind – Offshore	56,700	3,819	166 - 605	182 - 681	
	Geothermal	5,992	780	91 – 573	90 - 593	
	Run-of-River	24,543	1,149	97 – 493	143 – 1,170	
	Site C <sup>3</sup>	4,700	1,100	83	88	
	Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	6,103	774	58 – 92	57 – 86	
	Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103	
	Wave	2,506	259	440 - 772	453 - 820	
	Tidal	1,426	247	253 - 556	264 - 581	
	Solar	57	12	266 - 746	341 – 954	
	<ol> <li>Notes:</li> <li>The resources and UEC values shand may not include all possible r</li> <li>The details of how the cost adjust</li> <li>The Site C values presented in th Impact Statement (EIS) submission real discount rate.</li> <li>Representative projects were use the resource potential is generally</li> </ol>	esources that may ers were developed is table are based o on filed in January 2 d to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC e natural gas-fired a	xpected higher cos ovided in Appendix ded in the Site C Er s calculated assum	t. 12. nvironmental ing 5 per cent	

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ncluding the mini-SOP under development), and (3) upgrades rojects less than 100 kW and is therefore not relevant to

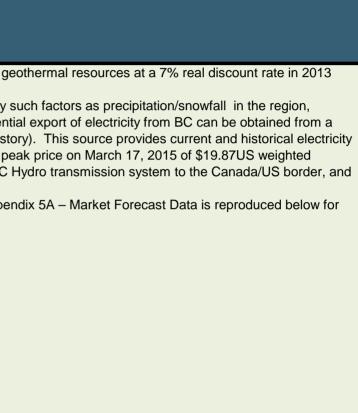
under Calls for Tender are proprietary and confidential. predetermined base price in 2010 dollars as determined by to the year in which an EPA is signed, and further adjusted nland region in 2010 dollars is \$103.69/MWh.

nent options and supply-side resource options to consider in apacity and unit energy costs, are listed in Table 2-2 of the

rmal Potential by Transmission Region.

Near Peachland, British Columbia, Canada Topographical Map Sheet: Figure 30 Geological Map Sheet: Figure 31

Category							Comments
Market Price (\$/MWhr)	dollars range • Wholesale - unforeseen g variety of sou market data. average cost on the approp • BC Hydro for ready referen	s from \$91/W electricity price eneration out inces. One sur- Of particular from 72 trad priate transm precasts of m	Wh to 573/M ces for tradin- tages and an uch source is r relevance is es). Access ission system arket prices	Wh at the po g purposes can bient temper the US Energes the mid-C tra- to that marked n (e.g. Bonne under various	an vary greatly ratures. A get gy Information ading hub in the t for geothern ville Power Au	nnection to the y. In the Pacific neral flavour of Administration he Northwest F nal projects in uthority) in the	Report Update, the Unit Energy Cost for ge BC Hydro system. c Northwest, these prices are affected by s f the wholesale electricity prices for potent n (www.eia.gov/electricity/wholesale/#histo Region (one example would be a Mid-C pe BC would require access on both the BC US. the November 2013 IRP. Table 5 in Appen
		Table 5	Scenario	y Price Forecasts I (Real 2012 US\$/M)			
	Market Scenario	1 Mid Electricity Mid GHG (Regional) Mid Gas	2 Low Electricity Low GHG (Regional) Low Gas	3 High Electricity High GHG (Regional) High Gas	4 Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	5 High Electricity High GHG (Regional/Nat'l) High Gas	
	2014	25.0	21.9	31.1	25.0	31.1	
	2015	25.5	21.7	31.9	25.5	31.9	
	2016	25.8 27.1	21.2 22.0	32.0 33.4	25.8 27.1	32.0 33.4	
	2018	27.1	21.7	33.9	27.1	33.9	
	2019	28.0	22.1	35.5	28.0	35.5	
	2020	28.0	21.9	36.0	28.0	36.0	
	2021	29.3	22.5	37.3	29.3	37.3	
	2022	30.1	22.7	38.8	30.9	41.3	
	2023	31.8 33.0	23.2 23.7	41.7 43.4	35.5 41.8	52.1 68.6	
	2025	34.2	24.0	45.4	50.3	91.2	
	2026	34.9	24.1	46.7	52.2	95.1	
	2027	36.0	24.3	48.6	54.7	98.9	
	2028	36.3	24.0	50.2	56.8	101.8	
	2029	37.2 37.6	23.9 23.8	51.1 52.7	58.8 60.1	106.1 109.3	
	2030	38.6	24.0	54.7	62.6	112.0	
	2032	39.9	24.0	57.0	65.6	116.0	
	2033	41.5	24.4	60.1	69.3	122.0	
	2034	42.8	25.1	61.9	71.5	125.7	
	2035	44.6	26.2	64.5	74.5	131.0	
	2036	45.7	26.9	66.2	76.4	134.3	
	2037	47.8 48.4	28.1 28.4	69.1 70.0	79.8 80.8	140.3 142.1	
	2038	48.4	28.4	70.0	80.8	142.1	
	2039	49.3	29.0	71.4	82.4	144.9	
		•		•	•		



Near Peachland, British Columbia, Canada Topographical Map Sheet: Figure 30 Geological Map Sheet: Figure 31

Category					Comments					
Green Power Premium (\$/MWhr)	<ul> <li>Within British ( environmentally</li> <li>California has particularly "bun 1. The price of e 2. There are lare</li> </ul>	Columbia, there is friendly) from BC a goal of 33% of dled" green ener electricity is driver ge amounts of re	s little deman Hydro. BC H retail sales by gy with Rener by the low c newables, su	d for the purch lydro's genera y 2020 to be s wable Energy ost of natural ch as wind and	d solar, in California; and					
Capacity Price (\$/KW)	<ul> <li>There is no pri</li> <li>Table 3-27 ent</li> <li>options (e.g. pu</li> <li>the BC Hydro sy</li> </ul>	B. Firm transmission access to the California market through the BPA transmission system is generally not available. There is no price in \$/kW for capacity resource options in the market at present. Table 3-27 entitled "UCCs of Capacity Resource Supply Options" in BC Hydro's Integrated Resource Plan dated November options (e.g. pumped storage, simple cycle gas turbines and resource smart projects such as Revelstoke Unit 6). The unit of the BC Hydro system in \$2013/kW-year are shown in the table. In general, baseload power (ie firm power) is more valuable to BC Hydro and furthermore the price paid for baseload power								
	<ul><li>(a) "Off-Peak He</li><li>(b) "Peak Hours</li><li>inclusive, but ex</li></ul>	ours" means all h " means the hou cluding British Co Hours" means th	ours other the rs commencin blumbia statu ne hours com	an Super-Peal ng at 06:00 PF tory holidays. mencing at 16	expressions have the following meanings: k Hours and Peak Hours. PT and ending at 16:00 PPT, and commencing at 20:00 PPT a B:00 PPT and ending at 20:00 PPT Monday through Saturday in 1					
	Month	Super-Peak	Delivery Factor Peak	Off-Peak						
	January	141%	122%	105%						
	February	124%	113%	101%						
	March	124%	112%	99%						
	April	104%	95%	85%						
	May	90%	82%	70%						
	June	87%	81%	69%						
	July	105%	96%	79%						
	August	110%	101%	86%						
	September	116%	107%	91%						
	October	127%	112%	93%						
	November	129%	112%	99%						
	December	142%	120%	104%						

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premium for green power. er can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

mber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

v inclusive, but excluding British Columbia statutory

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Category	Comments
Estimated Size of Resource	See Section A.
Is there any green power incentives?	<ul> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community proceeding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project development of Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include: <ul> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> <li>Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability</li> </ul> </li> </ul>
Grants	See above under green power incentives
Tax Holidays	None listed on federal and provincial websites.
Tax Relief	<ul> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 43 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred during and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the ye deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now entitled Scientific Research and Experimental ty and relevance.

participation in the clean energy sector. It provides: ent; and

these programs may be active but not currently issuing al technologies/resources, while others may be fully

itv and relevance.

ce energy by using renewable energy sources or fuels from 43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 ets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy vear they are incurred, carried forward indefinitely and

Near Peachland, British Columbia, Canada Topographical Map Sheet: Figure 30 Geological Map Sheet: Figure 31

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> <li>FNFA loans do not require collateral;</li> </ol>
	<ol> <li>FNFA loans do not require conateral,</li> <li>FNFA loans can be used to refinance existing debt; and</li> <li>FNFA's interest rates and terms parallel those available to provincial and local governments.</li> </ol>
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infraspurchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Bor and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015 Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribe
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section, (b) an amount agreed under this section to be paid instead of royalty, or (c) if no royalty or amount has been agreed under this section, the prescribed royalty.
General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "Thi in section 1 (1) [definitions] of the Geothermal Resources Act."
Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners for Proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg State
Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincia</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmiss Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission access Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. s that join as Borrowing Members.

astructure, social and economic development, land

prrowing Members, represented by the First Nation's Chief

ed rent for the permit (Section 5).

pay to the government

nis Act does not apply to geothermal resources as defined

for the geothermal land tract. tutory Right of Way, Licence of Occupation). al (British Columbia): 13.5%.

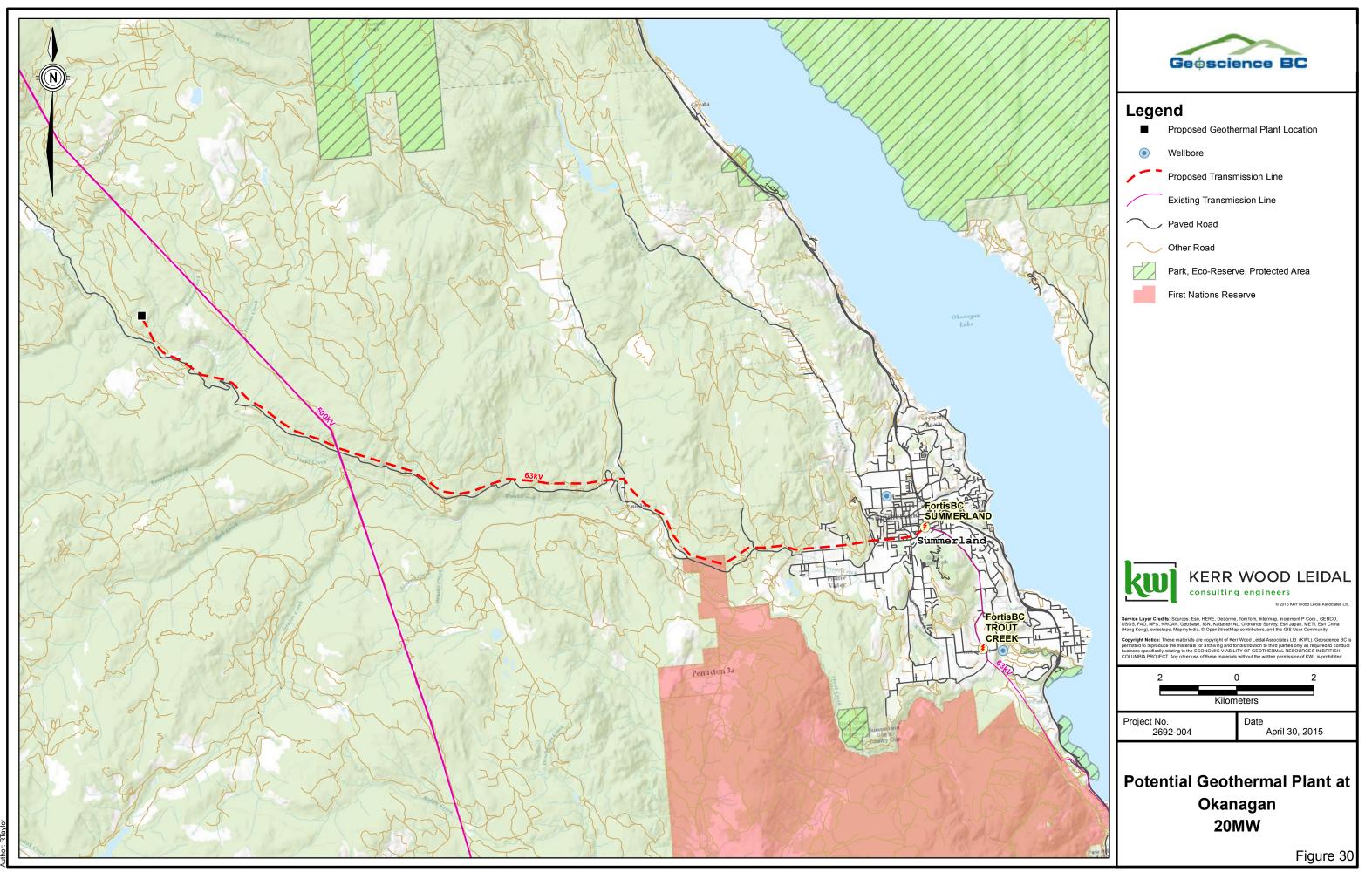
a, the US, or other wholesale customers in BC, the ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power e economic viability of the potential wholesale opportunity.

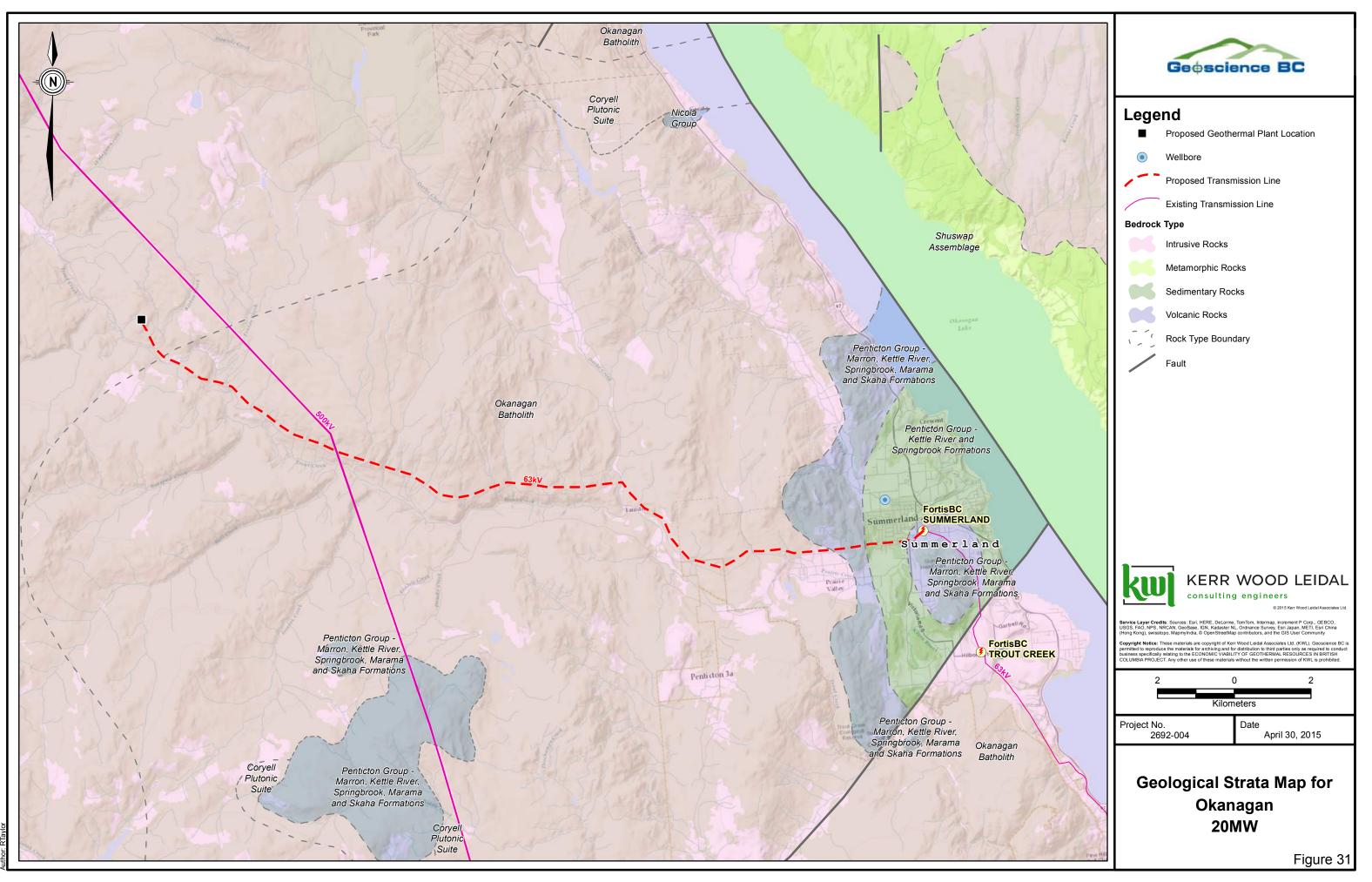
#### **Geothermal Development Decision Matrix**

# OKANAGAN

Near Peachland, British Columbia, Canada Topographical Map Sheet: Figure 30 Geological Map Sheet: Figure 31

	Category	Comments
	Maps	
	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)	
	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 30
	Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 31
	Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 31
Ν.	Other Issues and Considerations	







Appendix Q

# Sloquet Creek Geothermal Development Decision Matrix and Figures 32 & 33

kwl.ca

Near Mission, British Columbia, Canada Topographical Map Sheet: Figure 32 Geological Map Sheet: Figure 33

Category	Comments
Reservoir Potential	
Size/Potential/Type	<ul> <li>Reservoir size: N/A (no area or depth defined in literature) - therefore, reservoir volume estimated* at: 2.2 km<sup>3</sup> (most-like assumptions made using Appendix III in GeothermEx, 2004)</li> <li>Potential: Assume 10 MW, compatible with generic reservoir volume (above) in vicinity of single spring, for reservoir term</li> <li>Type: unknown, likely binary</li> </ul>
Temperature/Water and Gas Chemistry/Mineral Indicators	<ul> <li>Surface features:</li> <li>Sloquet Creek: 64°C (BC Hydro, 1974); 71°C (Souther and Halstead, 1973); 60.8°C (Grasby &amp; Hutcheon, 2001)</li> <li>August Jacob's Creek: 49°C (Souther and Halstead, 1973; Grasby &amp; Hutcheon, 2001)</li> <li>Geothermometry:</li> <li>Sloquet Creek: Na-K-Ca 135°C; SiO<sub>2</sub> 110°C (BC Hydro, 1974); SiO<sub>2</sub> 121°C; Na-K-Ca 105°C (Grasby et al., 2000)</li> <li>SiO<sub>2</sub> geothermometry indicates 113°C (BC Hydro, 1982)</li> <li>Exploration drilling:</li> <li>7 shallow holes and an additional 11 holes along the axis of the ridge (aggregate length of 1,951 meters) were drilled alor</li> </ul>
	<ul> <li>zones of higher-grade gold mineralization associated with dikes.</li> <li>Water chemistry:</li> <li>Sloquet Creek: 440 ppm SO<sub>4</sub> (BC Hydro, 1974); pH 8.6, 375 mg/L SO<sub>4</sub></li> <li>Water chemistry indicates high silica, sodium, calcium, bicarbonate and sulphate ions (BC Hydro, 1982)</li> <li>Sloquet has (Na&gt;Ca)-SO<sub>4</sub> composition with Cl at about 60 mg/l. Springs tend to be Na rich and show a wide range of anio Mineral indicators:</li> <li>Sloquet Creek: opal and gypsum present (BC Hydro, 1974)</li> </ul>
Surface Flow Rates and Reservoir Recharge	<ul> <li>Sloquet Creek: 100 L/min (BC Hydro, 1974); large flow from Jurassic sedimentary strata (Souther and Halstead, 1973); is km (Grasby &amp; Hutcheon, 2001).</li> <li>August Jacob's Creek: low flow issuing from between large bodies of granodiorite (Souther and Halstead, 1973).</li> <li>Water flowing from vertical fractures parallel to Sloquet Creek, accompanied by sulfurous odor and substantial sinter dependent of the strategy of the strateg</li></ul>
3D Permeability (heat exchange potential)	No information
Recent Magmatism	Pemberton Belt - 18-7.9 million-year-old calc-alkaline epizonal plutons and caldera complexes. (Fairbank and Faulkner, 19
Structural Setting	<ul> <li>Two phases of thrusting related to Late Cretaceous oblique convergence along the continental margin and Tertiary dextra The gold mineralization in the area is related to Tertiary-age major faulting along Harrison Lake Fracture Zone. The Harris northeast-striking trans-current faults. These northeast-striking trans-current faults may also be important structures in con (Shearer, 1998).</li> <li>A major dextral northeast-trending fault controls the orientation of Sloquet Creek and cuts the nose of the ridge between I Sloquet Creek may be related to this fault. Several sub-parallel northeast- to north-trending faults may lie to the west. One and mineralized. Several southwest dipping structures have also been recognized in the area (Shearer, 1998).</li> </ul>
Geophysics	Resistivity survey ran in two parallel lines along a 4.5 km (2.8 mile) profile - results at the time indicated there was nothing

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ikely area: 2 km<sup>2</sup>; most-likely thickness: 1.1 km) (\*Reservoir

emperatures in range of 150°C to 200°C.

ong the ridge within the Quet Mineral Property looking for

nion compositions (Grasby et al., 2000).

issuing at rate of 100 L/sec from calculated depth of 2.3

eposits. Most fractures sealed by sinter. (BC Hydro, 1982)

#### 1992)

tral/normal dip-slip faulting are the major structural events. rison Lake shear zone is offset to the north by younger ontrolling the emplacement of Late Tertiary plutons

n North Sloquet and Simpson Creeks. The hot springs in e such structure exposed by trenching is strongly altered

g of note (BC Hydro, 1974).

Near Mission, British Columbia, Canada **Topographical Map Sheet: Figure 32** Geological Map Sheet: Figure 33

	Category	Comments
	Reservoir Host Rock	Reservoir host rock unknown. The springs issue from Jurassic sedimentary strata at the surface (Souther and Halstead, 19 rich, and show a wide range of anion compositions (Grasby et al., 2000), which may indicate a volcanic host rock.
	Drilling Issues	Recreational pools built at the springs along the river - used by tourists and hikers. This could present a challenge to findir
	Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	<ul> <li>Sloquet Springs: Flow issues from Jurassic sedimentary strata along Sloquet Creek (Souther and Halstead, 1973). Wate accompanied by sulfurous odor and substantial sinter deposits (BC Hydro, 1982). Location of springs possibly controlled by (Shearer, 1998). Airborne magnetic data at the Quet Mineral Property suggest the volcanic Gambier Group package is uncleased.</li> </ul>
		August Jacob's Creek: Flow issues from between large bodies of granodiorite (Souther and Halstead, 1973).
E	B. Exploration Uncertainty (Risk)	
	Degree of Identification of Resources/Reserves	<ul> <li>Low</li> <li>Geological, geochemical and geophysical surveys in area (including shallow drilling) have been for gold exploration, not for includes water conductivity measurements, soil sampling and analysis, springs geochemistry (BC Hydro, 1982).</li> <li>For the Quet mineral property along Sloquet Creek (and along the ridge on the north side of the creek) - airborne geophyst drilled 7 shallow holes into a gold occurrence. Additional surveys were later conducted, and 11 additional diamond-drilled h zones of higher-grade gold mineralization associated with dikes (MEM, 1997).</li> <li>Ongoing gold exploitation/exploration by Electra Gold Ltd. (Electra Gold, Ltd., 2015)</li> </ul>
	Likelihood of Covering Reservoir with Concession	Moderate Mineral titles held to the north and east of the hot spring by gold exploration company. Possible availability of land for geot located within protected park areas.
	Expected Authorization Date	Unknown
	Specific Timing of Exploration (2 + 2 years, BC 8 years, etc.)	5 years (1 year permitting and surface exploration, possibly drilling shallow temperature gradient holes + 1 year deep gradient-well testing + 1 year further development drilling and start plant construction + 1 year drilling wrap-up and finish plant construction
	Degree of Previous Exploration (can be good or bad)	Moderate Exploration in area has focused on the gold deposits to the north of the springs. Higher amount of exploration data availabl hydrothermal mechanisms or reservoir definition.
	Surface Operational Capacity (enough stable area for drilling and	Highly likely
	a plant?)	River valley is heavily forested. Logging activity in area may provide cleared location opportunities and access roads.
	Exploration to Exploitation: A summary rating of Exploration	Moderate
	Uncertainty (risk) on a scale of difficult (high risk) through medium (moderate risk) to easy (low risk)	Already have mineral exploration ongoing in area, access and community acceptance should be largely established (deper reservoir still needs to be defined and confirmed.

## An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

1973). However, volcanic hosted springs tend to be Na

ding drilling locations acceptable to spring users

ter flowing from vertical fractures parallel to Sloquet Creek, by dextral, northeast-trending fault along trend of creek inderlain by plutonic rocks at relatively shallow depth (MEM,

focused on geothermal potential. Exploration in area

hysical survey, geophysical and geochemical sampling and holes were drilled along the axis of the ridge looking for

othermal development on SW side of hot springs. Not

ell drilling + 1 year successful development drilling and ction)

able for that area, but also focused on mineral deposits, not

endent on proximity to recreational thermal pools);

Near Mission, British Columbia, Canada Topographical Map Sheet: Figure 32 Geological Map Sheet: Figure 33

Category	Comments
Environmental Issues	
Protected Areas	<ul> <li>Garibaldi Provincial Park approx. 8 km west of proposed plant location</li> <li>Golden Ears Provincial Park is approx. 8 km west of proposed plant location</li> <li>Mehatl Creek Provincial Park 44 km northeast of proposed plant location</li> </ul>
Endangered Species	<ul> <li>Pygmy Longfin Smelt (red-listed fish) 8 km from proposed transmission line connection.</li> </ul>
Geothermal Surface Features	<ul> <li>Sloquet Hot Springs 3.1 km from proposed plant location.</li> <li>Glacier Creek Hotsprings approx. 23 km from proposed plant location.</li> <li>August Jacob's Hot Spring approx. 26 km from proposed plant location.</li> <li>The hotsprings appear to be related to a northeast striking fault, which is one of a series in a general Lillooet Valley Area Jacob's Hot Spring which is northeast along its general strike.</li> </ul>
Other	<ul> <li>Nearest Wildlife Habitat Area (#367461, allotted for Spotted Owl) is approx. 14 km from proposed infrastructure.</li> <li>Proposed plant location approx. 50 m from Sloquet Creek which contains spawning locations for Coho, Sockeye, Chinoo</li> <li>Transmission line crosses Sloquet Creek twice and three other unnamed creeks.</li> <li>Winter ungulate range habitat polygon for Mountain Goat approx. 2 km northwest of proposed plant location.</li> <li>Multiple winter ungulate ranges for Mule Deer approx. 2-10 km from proposed transmission line and plant.</li> </ul>
Geothermal Area - Bidding and/or Type of Land Holding	
Bidding Area	No known existing active, cancelled or unsold geothermal title tracts
Other Claim Rights (mining and/or oil)	Proposed geothermal plant location is within existing mineral/coal title. Proposed location is not within known oil and gas m
	Environmental Issues         Protected Areas         Endangered Species         Geothermal Surface Features         Other         Geothermal Area - Bidding and/or Type of Land Holding (private/government/lease/etc.)         Bidding Area

# An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ea. The strike may also control the location of the August

ook, Pink and Chum salmon.

s management area; no known tenures at proposed location.

Near Mission, British Columbia, Canada **Topographical Map Sheet: Figure 32** Geological Map Sheet: Figure 33

	Category	Comments
E. Ma	rket	
Mai	in Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through to</li> <li>Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propon</li> <li>Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW b</li> <li>against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponer</li> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pa program has no applicability to potential geothermal generation projects.</li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificati snow melt and stream flow.</li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project le BC Hydro through BC Hydro's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>Wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta, th generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis portunities for bilateral arrangements for direct sales of electricity from geothermal generating plants to carge customers in Cautomers. This 'pancaking' of rates, along with congestion issues, affects the economic viz 4. Retail access, defined as a market in which electricity is sold directly to consumers by competing suppliers, is generally opportunities for bilateral arrangements for direct sales of electrici</li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

nents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this

tion of BC Hydro's resource mix, making it less reliant on

ren FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

Near Mission, British Columbia, Canada Topographical Map Sheet: Figure 32 Geological Map Sheet: Figure 33

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generatio</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical an considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to sever Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gene other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction years, the key uncertainties inherent in the environmental review, public consultation, transmission arrangements (either w permitting and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
-	Trenewissien Line Infraction	
г.	Transmission Line Infrastructure State of the Infrastructure	Closest transmission line is 138 kV to Upper Stave Hydroelectric Project. Closest substation is Upper Harrison Terminal.
	Transmission Route (distance, terrain and costs)	Connects to 138 kV Innergex transmission line running by site via <1 km new 138 kV transmission line.
		Connects to 156 kV innergex transmission line fulling by site via <1 km new 156 kV transmission line.
Н.	Community Issues	
	Indigenous Law and Indigenous Development Areas	<ul> <li>First Nation consultative areas include St'at'imc Chiefs Council, Lillooet Tribal Council, Sto:lo Nation, Seabird Island Band Nations, Kwantlen First Nation, Douglas First Nation, Sts'ailes.</li> <li>St'at'imc Law applies; follows 11 principles that respect cultural traditions, respects nature and serves the St'at'imc comm</li> </ul>
	Community Action	<ul> <li>Sloquet Hot Springs is run as a joint venture between the Government of BC and First Nations. In 2010 improvement be investigated.</li> <li>St'at'imc community upgrades to the hot springs are ongoing (http://www.indigenousworkforce.org/projects/weekend-war</li> </ul>
		• Mission Official Community Plan completed in 2008 includes goal to achieve sustainable growth; balancing economic, en Community Plan).
	Surface Rights	<ul> <li>First Nation consultative areas include St'at'imc Chiefs Council, Lillooet Tribal Council, Sto:lo Nation, Seabird Island Band Nations, Kwantlen First Nation, Douglas First Nation, Sts'ailes.</li> <li>Significant protected habitat with St'at'imc Land and Resources Authority - SLRA (www.statimc.net)</li> </ul>
	Tourism	<ul> <li>Sloquest Hot Springs is an existing tourist destination with campground and hiking trails. (http://whistlerhiatus.com/driving</li> <li>Proposed location is accessed via remote forest service roads, however, is relatively close to densely populated greater viroads.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ion output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission ven years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

nd, Samahquam First Nation, In-SHUCK-ch Nation, Skatin

munities.

enefits to the Harrison West Forest Service Road were

arrior-projects/) environmental and social principals (Mission Official

nd, Samahquam First Nation, In-SHUCK-ch Nation, Skatin

ng/sloquet-hot-springs-126k.html) r Vancouver; potential for more use pending reliable access

Near Mission, British Columbia, Canada Topographical Map Sheet: Figure 32 Geological Map Sheet: Figure 33

		Category	Comments
	Ι.	Water Rights	
		Availability (for example "air-cooled required")	Plant water requirement estimated approx. 13 L/s for binary plant. MAD of 10,900 L/s in Sloquet Creek. No water licences
		Availability for Drilling	Drilling requirement of 20 L/s. MAD of 10,900 L/s in Sloquet Creek. No water licences in vicinity of plant.
	J.	Engineering	
		Plant Location and Design	Plant located near Sloquet Creek on relatively flat terrain in treed area.
		Construction Issues	Access via existing unpaved logging roads of unknown condition. Mission BC is closest community with all necessities re
			of-river projects access is largely fly-in and out from Spring Creek at the head of Harrison Lake.
		Transportation Issues	Access via existing unpaved logging roads of unknown condition.
		Architectural Issues (Blend/hide into environment? Local styles?	None found.
		etc.)	
		Special Construction Issues (zero emissions)	None found.
		••••••••••••••••••••••••••••••••••••••	
	K.	Non-Electrical Infrastructure (Roads and Habitation)	
		Nearest Large Community > 50,000	Maple Ridge, BC
		Nearest Community	Mission, BC
		Nearest Road and Condition	Nearest road is unpaved logging/access road within 1 km of proposed plant location; condition is unknown.
		Current Access Conditions (restrictions)	Construction access via existing unpaved logging roads of unknown condition.
		Terrain and Distance Factor for Road Building	No new road construction required.
Ī			

s in vicinity of plant.
required for temporary workers. Workers for existing run-
required for temporary workers, workers for existing fun

Near Mission, British Columbia, Canada Topographical Map Sheet: Figure 32 Geological Map Sheet: Figure 33

	Category						Comments	
<u>L.</u>	Finance General Power Prices	to ge th ba •   m N	BC Hydro acquires power through (1) competitive processes (Calls for Tender), (2) the Standing Offer Program (not incluto its existing facilities or the development of new generation facilities. (Note that the net metering program targets proje geothermal generation projects). Comments on the general price of power under each one are: • The power price paid by BC Hydro to independent power producers through Energy Purchase Agreements (EPAs) und • The power price paid by BC Hydro to independent power producers through EPAs under the SOP are made up of a pre- the region of the point of interconnection to the BC Hydro system, escalated at the Consumer Price Index annually up to based upon the time of day and month when the energy is delivered. For reference, the base price for the Lower Mainlar • BC Hydro's current Integrated Resource Plan dated November 2013 includes details of both demand-side management meeting the future demand for electricity. These resource options, together with their attributes of total energy and capac November 2013 Resource Options Report Update. That table is reproduced below for ready reference. • Table 5-7 of the above-noted November 2013 Resource Options Report Update provides a summary of the Geothermatical processing the future demand for electricity.					
			Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)	
			Biomass – Wood Based	9,772	1,226	122 – 276	132 – 306	
			Biomass – Biogas	134	16	59 – 154	56 – 156	
			Biomass – Municipal Solid Waste	425	50	85 – 184	83 – 204	
			Wind – Onshore	46,165	4,271	90 - 309	115 – 365	
			Wind – Offshore	56,700	3,819	166 - 605	182 – 681	
			Geothermal	5,992	780	91 – 573	90 - 593	
			Run-of-River	24,543	1,149	97 – 493	143 – 1,170	
			Site C <sup>3</sup>	4,700	1,100	83	88	
			Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	6,103	774	58 – 92	57 – 86	
			Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103	
			Wave	2,506	259	440 - 772	453 - 820	
			Tidal	1,426	247	253 - 556	264 - 581	
			Solar	57	12	266 - 746	341 – 954	
			<ol> <li>Notes:</li> <li>The resources and UEC values si and may not include all possible r</li> <li>The details of how the cost adjust</li> <li>The Site C values presented in th Impact Statement (EIS) submission real discount rate.</li> <li>Representative projects were use the resource potential is generally</li> </ol>	resources that may ters were developed is table are based of on filed in January 2 ed to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC e natural gas-fired a	expected higher cos rovided in Appendix ded in the Site C Er is calculated assum	t. 12. nvironmental ng 5 per cent	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ncluding the mini-SOP under development), and (3) upgrades pjects less than 100 kW and is therefore not relevant to

Inder Calls for Tender are proprietary and confidential. predetermined base price in 2010 dollars as determined by to the year in which an EPA is signed, and further adjusted land region in 2010 dollars is \$103.69/MWh.

nent options and supply-side resource options to consider in pacity and unit energy costs, are listed in Table 2-2 of the

mal Potential by Transmission Region.

Near Mission, British Columbia, Canada Topographical Map Sheet: Figure 32 Geological Map Sheet: Figure 33

Category							Comments
Market Price (\$/MWhr)	dollars range • Wholesal unforeseen variety of s market dat average co on the apple • BC Hydro ready refer	ges from \$91 e electricity p generation o ources. One a. Of particu st from 72 tra- ropriate trans forecasts of ence	/MWh to 573 prices for trac putages and such source lar relevance ades). Acces mission syst market price ce Data Tal	3/MWh at the ling purposes ambient tem is the US Er is the mid-C ss to that ma is to that ma is em (e.g. Bor is under varia	e point of inte s can vary gr peratures. A nergy Informa C trading hub arket for geot neville Powe ous scenario	arconnection to reatly. In the Para A general flavor ation Administronian the Northwe hermal project er Authority) in	Ins Report Update, the Unit Energy Cost for ge to the BC Hydro system. Acific Northwest, these prices are affected by sur of the wholesale electricity prices for potent ration (www.eia.gov/electricity/wholesale/#histo est Region (one example would be a Mid-C per s in BC would require access on both the BC I the US. d in the November 2013 IRP. Table 5 in Apper
		Table		(Real 2012 US\$/M)	Wh at Mid-C)		
	Market Scenario	1 Mid Electricity Mid GHG (Regional) Mid Gas	2 Low Electricity Low GHG (Regional) Low Gas	3 High Electricity High GHG (Regional) High Gas	4 Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	5 High Electricity High GHG (Regional/Nat'l) High Gas	
	2014	25.0	21.9	31.1	25.0	31.1	
	2015	25.5	21.7	31.9	25.5	31.9	
	2016	25.8 27.1	21.2 22.0	32.0 33.4	25.8 27.1	32.0 33.4	
	2017	27.1	22.0	33.9	27.1	33.9	
	2019	28.0	22.1	35.5	28.0	35.5	
	2020	28.0	21.9	36.0	28.0	36.0	
	2021	29.3	22.5	37.3	29.3	37.3	
	2022	30.1	22.7	38.8	30.9	41.3	
	2023	31.8 33.0	23.2 23.7	41.7 43.4	35.5 41.8	52.1 68.6	
	2025	34.2	24.0	45.4	50.3	91.2	
	2026	34.9	24.1	46.7	52.2	95.1	
	2027	36.0	24.3	48.6	54.7	98.9	
	2028	36.3	24.0	50.2	56.8	101.8	
	2029	37.2 37.6	23.9 23.8	51.1 52.7	58.8 60.1	106.1 109.3	
	2030	38.6	23.8	54.7	62.6	112.0	
	2032	39.9	24.0	57.0	65.6	116.0	
	2033	41.5	24.4	60.1	69.3	122.0	
	2034	42.8	25.1	61.9	71.5	125.7	
	2035	44.6	26.2	64.5	74.5	131.0	
	2036	45.7 47.8	26.9 28.1	66.2 69.1	76.4 79.8	134.3 140.3	
	2037	47.8	28.4	70.0	80.8	140.3	
	2039	48.9	28.7	70.7	81.6	143.5	
	2040	49.3	29.0	71.4	82.4	144.9	

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geothermal resources at a 7% real discount rate in 2013 y such factors as precipitation/snowfall in the region, ntial export of electricity from BC can be obtained from a story). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted C Hydro transmission system to the Canada/US border, and endix 5A – Market Forecast Data is reproduced below for

Near Mission, British Columbia, Canada Topographical Map Sheet: Figure 32 Geological Map Sheet: Figure 33

Category		Comments					
Green Power Premium (\$/MWhr)	<ul> <li>Within British Co environmentally fr</li> <li>California has a particularly "bundl</li> <li>The price of ele</li> <li>There are large</li> </ul>	lumbia, there is litt iendly) from BC Hy goal of 33% of reta ed" green energy w ctricity is driven by amounts of renew	tle demand ydro. BC Hy ail sales by with Renew y the low co vables, sucl	for the purcha /dro's generat 2020 to be so able Energy C st of natural g h as wind and	solar, in California; and		
Capacity Price (\$/KW)	There is no price     Table 3-27 entitl     options (e.g. pum	e in \$/kW for capac ed "UCCs of Capa	city resource acity Resour le cycle gas	e options in th ce Supply Op turbines and	the BPA transmission system is generally not available. e market at present. ions" in BC Hydro's Integrated Resource Plan dated Novemb resource smart projects such as Revelstoke Unit 6). The unit		
	(a) "Off-Peak Hou (b) "Peak Hours" inclusive, but excl	rs" means all hour neans the hours c uding British Colur lours" means the h	rs other that commencing mbia statuto hours comm	n Super-Peak g at 06:00 PPT ory holidays. nencing at 16:			
	(a) "Off-Peak Hou (b) "Peak Hours" inclusive, but excl (c) "Super-Peak H	rs" means all hour means the hours c uding British Colur lours" means the h	rs other than commencing mbia statuto nours comm elivery Facto	n Super-Peak g at 06:00 PPT ory holidays. nencing at 16:			
	(a) "Off-Peak Hours" (b) "Peak Hours" inclusive, but excl (c) "Super-Peak H holidays."	rs" means all hour neans the hours c uding British Colur lours" means the h	rs other that commencing mbia statuto nours comm elivery Facto Peak	n Super-Peak g at 06:00 PPT ory holidays. nencing at 16: or (TDF) Off-Peak	Hours and Peak Hours. and ending at 16:00 PPT, and commencing at 20:00 PPT ar		
	(a) "Off-Peak Hou (b) "Peak Hours" inclusive, but excl (c) "Super-Peak H holidays."	rs" means all hour means the hours c uding British Colur lours" means the h Time of Do Super-Peak	rs other than commencing mbia statuto nours comm elivery Facto	n Super-Peak g at 06:00 PPT ory holidays. nencing at 16:	Hours and Peak Hours. and ending at 16:00 PPT, and commencing at 20:00 PPT at		
	(a) "Off-Peak Hours" (b) "Peak Hours" inclusive, but excl (c) "Super-Peak H holidays." Month January	rs" means all hour means the hours c uding British Colur lours" means the h Time of Do Super-Peak 141%	rs other than commencing mbia statuto hours comm elivery Facto Peak 122%	n Super-Peak g at 06:00 PPT ory holidays. hencing at 16: or (TDF) Off-Peak 105%	Hours and Peak Hours. and ending at 16:00 PPT, and commencing at 20:00 PPT at		
	(a) "Off-Peak Hours" (b) "Peak Hours" inclusive, but excl (c) "Super-Peak H holidays." Month January February	rs" means all hour neans the hours c uding British Colur lours" means the h Time of Do Super-Peak 141% 124%	rs other that commencing mbia statuto hours comm elivery Facto Peak 122% 113%	n Super-Peak g at 06:00 PP ory holidays. hencing at 16: or (TDF) Off-Peak 105% 101%	Hours and Peak Hours. and ending at 16:00 PPT, and commencing at 20:00 PPT a		
	(a) "Off-Peak Hours" (b) "Peak Hours" inclusive, but excl (c) "Super-Peak H holidays." Month January February March	rs" means all hour means the hours c uding British Colur lours" means the h Time of Do Super-Peak 141% 124% 124%	rs other than commencing mbia statuto hours comm elivery Facto Peak 122% 113% 112%	n Super-Peak g at 06:00 PP ory holidays. hencing at 16: or (TDF) Off-Peak 105% 101% 99%	Hours and Peak Hours. and ending at 16:00 PPT, and commencing at 20:00 PPT at		
	(a) "Off-Peak Hours" inclusive, but excl (c) "Super-Peak Holidays." Month January February March April May June	rs" means all hour means the hours c uding British Colur lours" means the h Super-Peak 141% 124% 124% 104% 90% 87%	elivery Factor Peak 122% 113% 112% 95% 82% 81%	n Super-Peak g at 06:00 PPT bry holidays. hencing at 16: or (TDF) Off-Peak 105% 101% 99% 85% 70% 69%	Hours and Peak Hours. and ending at 16:00 PPT, and commencing at 20:00 PPT a		
	(a) "Off-Peak Hours" inclusive, but excl (c) "Super-Peak Holidays." Month January February March April May June July	rs" means all hour neans the hours c uding British Colur lours" means the h Super-Peak 141% 124% 124% 104% 90% 87% 105%	rs other than commencing mbia statuto nours comm elivery Facto Peak 122% 113% 112% 95% 82% 81% 96%	n Super-Peak g at 06:00 PPT ory holidays. hencing at 16: or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79%	Hours and Peak Hours. and ending at 16:00 PPT, and commencing at 20:00 PPT a		
	(a) "Off-Peak Hours" inclusive, but excl (c) "Super-Peak Holidays." Month January February March April May June July August	rs" means all hour means the hours c uding British Colur lours" means the h Super-Peak 141% 124% 124% 104% 90% 87% 105% 110%	rs other than commencing mbia statuto hours comm elivery Facto Peak 122% 113% 112% 95% 82% 81% 96% 101%	n Super-Peak g at 06:00 PPT bry holidays. hencing at 16: or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86%	Hours and Peak Hours. and ending at 16:00 PPT, and commencing at 20:00 PPT a		
	(a) "Off-Peak Hours" inclusive, but excl (c) "Super-Peak Holidays." Month January February March April May June July August September	rs" means all hour neans the hours c uding British Colur lours" means the h Super-Peak 141% 124% 124% 104% 90% 87% 105% 110% 116%	rs other that commencing mbia statuto hours commencing relivery Factor Peak 122% 113% 112% 95% 82% 81% 96% 101% 107%	n Super-Peak g at 06:00 PPT ory holidays. hencing at 16: or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86% 91%	Hours and Peak Hours. and ending at 16:00 PPT, and commencing at 20:00 PPT at		
	(a) "Off-Peak Hours" inclusive, but excl (c) "Super-Peak Holidays." Month January February March April May June July August	rs" means all hour means the hours c uding British Colur lours" means the h Super-Peak 141% 124% 124% 104% 90% 87% 105% 110%	rs other than commencing mbia statuto hours comm elivery Facto Peak 122% 113% 112% 95% 82% 81% 96% 101%	n Super-Peak g at 06:00 PPT bry holidays. hencing at 16: or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86%	Hours and Peak Hours. and ending at 16:00 PPT, and commencing at 20:00 PPT ar		

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

premium for green power. er can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

mber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

v inclusive, but excluding British Columbia statutory

Near Mission, British Columbia, Canada Topographical Map Sheet: Figure 32 Geological Map Sheet: Figure 33

Category	Comments
Estimated Size of Resource Is there any green power incentives?	<ul> <li>See Section A.</li> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p o Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project development o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include:         <ul> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Sustainable Development Technology Canada funds;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> </ul> </li> </ul>
	o Green Infrastructure Fund Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability
Grants	See above under green power incentives
Tax Holidays Tax Relief	<ul> <li>None listed on federal and provincial websites.</li> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 43 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred duri and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the year deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now entitled Scientific Research and Experimental ty and relevance.

participation in the clean energy sector. It provides: ent; and

these programs may be active but not currently issuing al technologies/resources, while others may be fully

ity and relevance.

ce energy by using renewable energy sources or fuels from 43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 ets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy vear they are incurred, carried forward indefinitely and

Near Mission, British Columbia, Canada Topographical Map Sheet: Figure 32 Geological Map Sheet: Figure 33

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> <li>FNFA loans do not require collateral;</li> </ol>
	<ul><li>4. FNFA loans can be used to refinance existing debt; and</li><li>5. FNFA's interest rates and terms parallel those available to provincial and local governments.</li></ul>
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infrast purchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Bor and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015
	Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribed
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section,
	(b) an amount agreed under this section to be paid instead of royalty, or
	(c) if no royalty or amount has been agreed under this section, the prescribed royalty.
General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "This in section 1 (1) [definitions] of the Geothermal Resources Act."
Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners for proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg Statu
Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincial</li> </ul>
Transmission Tariffs	<ul> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> <li>Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission access Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. s that join as Borrowing Members.

astructure, social and economic development, land

prrowing Members, represented by the First Nation's Chief

ed rent for the permit (Section 5).

pay to the government

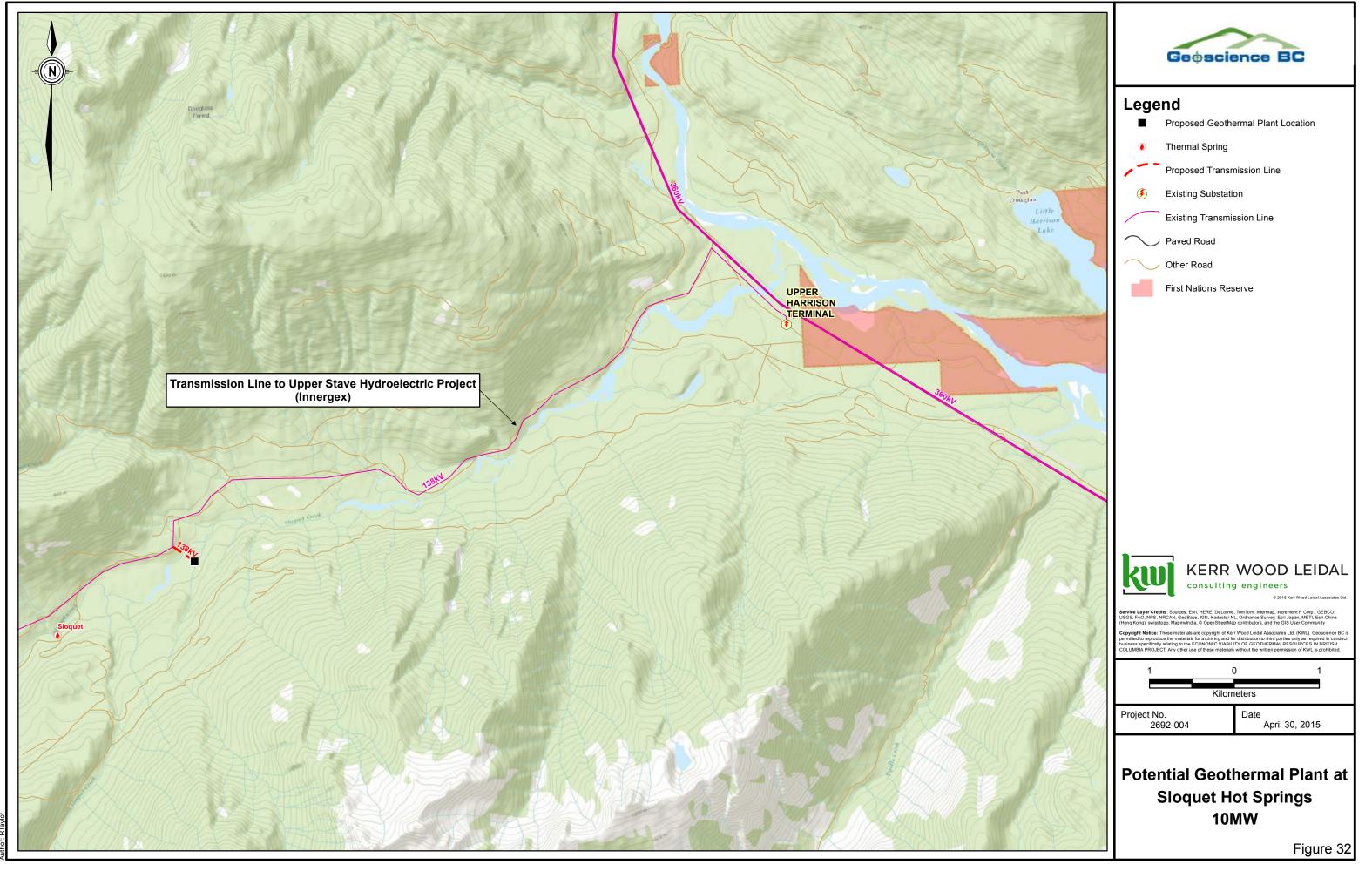
his Act does not apply to geothermal resources as defined

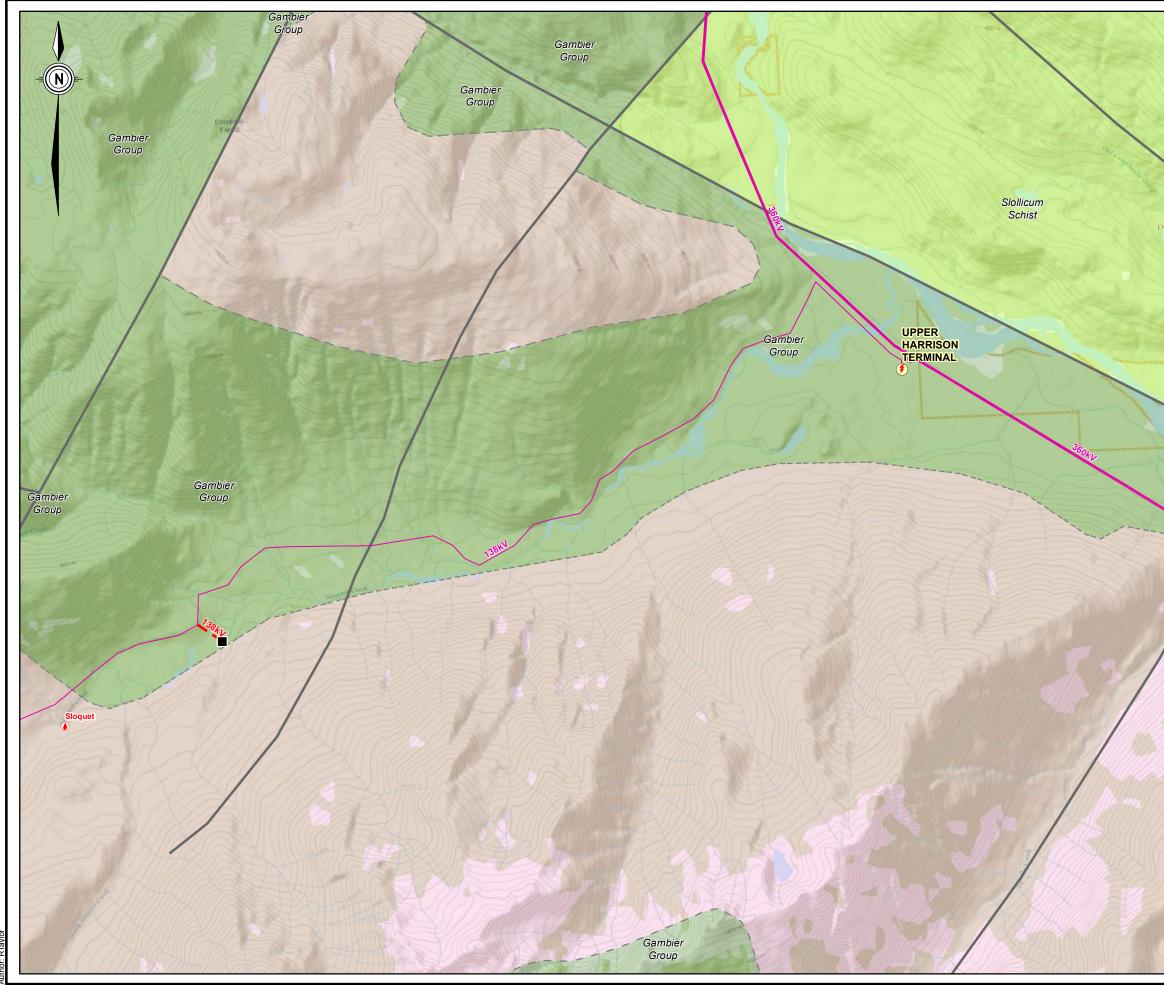
for the geothermal land tract. atutory Right of Way, Licence of Occupation). al (British Columbia): 13.5%.

a, the US, or other wholesale customers in BC, the ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power e economic viability of the potential wholesale opportunity.

Near Mission, British Columbia, Canada Topographical Map Sheet: Figure 32 Geological Map Sheet: Figure 33

	Category	Comments
N	. Maps	
	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)	
	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 32
	Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 33
	Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 33
Ν	. Other Issues and Considerations	





Med	Geéscience BC
	Legend
	Proposed Geothermal Plant Location
	Thermal Spring
	Proposed Transmission Line
	Existing Substation
Little	Existing Transmission Line
Luke	Bedrock Type
	Intrusive Rocks
20115	Metamorphic Rocks
Ser 1	Sedimentary Rocks
- Com	Rock Type Boundary
	Fault
	-
	KERR WOOD LEIDAL
	consulting engineers 0 2015 Kerr Wood Leidal Associates Ltd.
	Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, Increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swissipo, Magmvindia, © OpenSterkMap contributions, and the GIS User Community Copyright Notice: These materials are copyright of Kerr Wood Leidal Associates Ltd. (KWL). Geoscience BC is permitted to reproduce the materials for archiving and for distribution to third parties only as required to conduct business specifically relating to the ECONOMIC VIABILITY OF ECOTHERMAL RESOLICES IN IRATTISH COLUMBIA PROJECT. Any other use of these materials without the written permission of KWL is prohibited.
	1 0 1
	Kilometers
A BAL	Project No. Date 2692-004 April 30, 2015
	Geological Strata Map for Sloquet Hot Springs 10MW
	Figure 33



Appendix R

# Sphaler Creek Geothermal Development Decision Matrix and Figures 34 & 35

kwl.ca

Near Stikine, British Columbia, Canada **Topographical Map Sheet: Figure 34** Geological Map Sheet: Figure 35

	Category	Comments
Α.	Reservoir Potential	
	Size/Potential/Type	<ul> <li>Reservoir size: N/A (no area or depth defined in literature) - therefore, reservoir volume estimated* at: 2.2 km<sup>3</sup> (most-lik assumptions made using Appendix III in GeothermEx, 2004)</li> <li>Potential: Assume 10 MW, compatible with generic reservoir volume (above) in vicinity of single spring, for reservoir ten</li> <li>Type: unknown, likely binary</li> </ul>
	Temperature/Water and Gas Chemistry/Mineral Indicators	<ul> <li>Surface features:</li> <li>Sphaler Creek spring: small hot spring discharges into Sphaler Creek, approximately 11 kilometers southwest of Round Geothermometry:</li> <li>No information</li> <li>Exploration drilling:</li> <li>None</li> <li>Water chemistry:</li> <li>No information</li> <li>Mineral indicators:</li> <li>Sphaler Creek spring has deposited calcareous tufa up to I meter thick. The smell of hydrogen sulphide is easily detectal and Kovanagi. 1989).</li> <li>unknown</li> </ul>
	3D Permeability (heat exchange potential)	unknown
	Recent Magmatism	Most recent volcanic activity ~ 50 km south at Hoodoo Mountain
	Structural Setting	Complicated structures have resulted in part from polyform deformation (Paleozoic strata), but also from the contrasting consedimentary units. Four main sets of faults have produced a mosaic of fault-bounded blocks. The youngest faults in the mosaic of Sphaler Creek follow these steep to vertical structures and at one location one fault shows evidence of 1200 m north-trending structure which flanks the west side of the Hickman batholith. Folds in the area of the springs have NS-trends of Sphaler Creek. Further east, upstream towards Round Lake, Paleozoic rocks have been uplifted along steep west-
	Geophysics	Unknown
	Reservoir Host Rock	Unknown - volcanic or sedimentary (carbonate) likely
	Drilling Issues	Remote location - mining active in area, possible existing infrastructure.
	Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	<ul> <li>The Cenozoic Stikine Volcanic Belt is considered to be the most recently active of the volcanic belts in British Columbia, been basaltic in nature. The volcanic activity is likely the result of extensional fracturing (Piteau and Associates, 1988).</li> <li>Locally, the volcanic Stikine assemblage comprises lava flows and volcanoclastics, interbedded with carbonates and min Tertiary age intrude this complex stratigraphy, with porphyry copper-silver-gold deposits in the area. Along Sphaler Creek found, and are in contact with Permian calcareous sedimentary layers and andesitic volcanic rocks of the Stikine Assembl for gold) north of Sphaler Creek (Sphal-17 claim) near the spring (~7 km west along the river valley), the area is underlain breccias and crystal tuffs. Prominent north-northeast-trending faults have localized intrusions of Tertiary (age unconfirmed At Sphal-17 disseminated copper mineralization occurs in altered and brecciated zones in volcanics and felsite intrusives. breccia measuring 50 by 18 meters at surface; pyrite, chalcopyrite and magnetite fill the matrix. Faulting has broken the br 1989).</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

likely area: 2 km<sup>2</sup>; most-likely thickness: 1.1 km) (\*Reservoir

emperatures in range of 150°C to 200°C.

d Lake (Logan and Koyanagi, 1989).

table. Tufa was sampled for geochemical analysis (Logan

competence of Triassic and Jurassic volcanic and map area strike north-northeast to northeast. The upper meters of left-lateral offset. The spring is located on a major ending axes and have been mapped on the north and south st-dipping reverse faults (Logan and Koyanagi, 1989).

, and most of the recent volcanism in the Stikine Belt has

ninor chert and shale. Plutonic rocks of Mesozoic and k valley, Triassic Stuhini Group andesites and basalts are blage in the area of the springs. At a mining claim (possibly in by Upper Triassic pyroxene-porphyry flows, andesitic ed) monzonite and felsite bodies as well as mineralization. s. The main mineralized zone is hosted by an intrusive breccia into discontinuous sections (Logan and Koyanagi,

Near Stikine, British Columbia, Canada Topographical Map Sheet: Figure 34 Geological Map Sheet: Figure 35

	Category	Comments
В.	Exploration Uncertainty (Risk)	
	Degree of Identification of Resources/Reserves	Low Some geologic mapping done, no known geophysical or geochemical studies conducted. No drilling in area known. Appar
	Likelihood of Covering Reservoir with Concession	Moderate Potential competition with mineral tracts if resource lies to the east of the river.
	Expected Authorization Date	Unknown
		5-6 years (1 year deep gradient-well drilling + 2 year successful development drilling and testing + 1 year further development drilling finish plant construction). Possible delays due to issues of access and competing use (mining).
	Degree of Previous Exploration (can be good or bad)	Low Geologic mapping comprises the only known exploration in the area.
	Surface Operational Capacity (enough stable area for drilling and a plant?)	Likely Mining operations in area; possible need for additional infrastructure to springs site
		Difficult
	Uncertainty (risk) on a scale of difficult (high risk) through medium	Risk is considered high due to lack of information about resource characteristics. Mitigating factor is that mining activity in
<b> </b>	(moderate risk) to easy (low risk)	Spring is located ~100 m from an older mining road and power line (Galore Mine) - Active mining operation ~4 km down-r
C.	Environmental Issues	
<u>.</u>	Protected Areas	<ul> <li>Nigunsaw River Ecological Reserve approx. 12.5 km from proposed transmission line connection.</li> </ul>
		Nigunsaw Provincial Park approx. 15 km from proposed transmission line connection.
1		Mount Edziza Provincial Park 65 km north of proposed plant location.
	Endangered Species	Pygmy Longfin Smelt (red-listed fish) habitat polygon 7.3 km from proposed transmission line connection.
		• Northern Mountain Caribou (Endangered (SARA Schedule 1); red-listed) habitat polygon approx. 65 km north of propose
	Geothermal Surface Features	Sphaler Creek Hot Springs 1.4 km from proposed transmission line and 3.2 km from proposed plant location.
	Other	• Spotted Owl Wildlife Habitat Area is approx. 6.5 km east and 11 km southeast of proposed transmission line connection
		<ul> <li>Proposed transmission line crosses through Cassiar proposed Wildlife Area allotment for Grizzly Bear.</li> </ul>
		<ul> <li>Transmission line crosses approx. 20 streams, including More Creek and Devil Creek.</li> </ul>
		More Creek contains Dolly Varden.
		Devil Creek contains Dolly Varden and Rainbow Trout.
L		
D.	Geothermal Area - Bidding and/or Type of Land Holding	
	(private/government/lease/etc.)	
	Bidding Area	No known existing active, cancelled or unsold geothermal title tracts
	Other Claim Rights (mining and/or oil)	Existing coal and mineral titles. Proposed location is not within known oil and gas management area; no known tenures at

rent mining exploration in area.
ng and start plant construction + 1 year drilling wrap-up and
n the area makes access somewhat easier. Sphaler Creek river to the west.
ed plant location.
٦.
1.
t proposed location.

Near Stikine, British Columbia, Canada **Topographical Map Sheet: Figure 34** Geological Map Sheet: Figure 35

	Category	Comments
Ε.	Market	
	Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>1. BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through to Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal proponents) against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponer threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply realistically apply to potential geothermal generation projects).</li> <li>In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connect distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pa program has no applicability to potential geothermal generation projects.</li> <li>The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificati snow melt and stream flow.</li> <li>Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project I/BC Hydro 's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>Wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta, the generation supplier will have to make similar arrangements to cover transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with congestion issues, affects the economic vic the rates charged under that tariff.</li> <li>Retail access, defined as a market in which electricity is sold directly to consumers by competing plants to large customers' to replace the electricity supplied at a high voltage from BC Hydro electricit agrid.</li> <li>Retail access, defined as a</li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

nents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro articipate in the program. Given the small size, this

tion of BC Hydro's resource mix, making it less reliant on

ren FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

he US, or other wholesale customer in BC is allowed. The ission Tariff (OATT) at a regulated cost for that service. ccess in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

ly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

Galore Creek access road). sment phase. The potential operations are located

km from the geothermal site. The gold/copper project

Near Stikine, British Columbia, Canada **Topographical Map Sheet: Figure 34** Geological Map Sheet: Figure 35

	Category	Comments
	Time Limits? (business agreements, operating/generating-by deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation.</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical ar considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to sev Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gene other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction were projects with less investigative work will realistically result in a further two years at a minimum for these activities.</li> </ul>
_		
۲.	Transmission Line Infrastructure	
	State of the Infrastructure	Closest transmission line is 287 kV line to Bob Quinn substation.
	Transmission Route (distance, terrain and costs)	New 68 km 287 kV transmission line with interconnection at Bob Quinn substation. Difficult routing through steep, forested available. Approx. 30 km of route following only natural valleys and creeks.
Н.	Community Issues	
	Indigenous Law and Indigenous Development Areas	First Nation consultative areas include Tahltan Indian Band, Iskut Band.
		Proposed plant location is within Tahltan territory. (http://www.tahltan.org/welcome)
		• Tahltan Nation plan is in development (started 2011); broad issues that have been identified include better community inf
		managing social-culture growth. (http://www.tahltan.org/news/tahltan-nation-plan-community-vision-our-future)
		Iskut Band Council (http://iskut.org/) does not provide any specific community/environmental planning agendas
	Community Action	• Tahltan Heritage Resources Environmental Assessment Team (THREAT) established in 2005 to support protection of th
		interests. (http://www.tahltan.org/administration/threat)
		<ul> <li>2005 community action stopped Shell Canada test well activities.</li> </ul>
		Tahltan activists block Red Chris Mine site in 2014
	Surface Rights	First Nation consultative areas include Tahltan Indian Band, Iskut Band.
		• Tahltan Nation Development Council is business council owned by the people of Tahltan Iskut bands and ensures First N
		within Tahltan territory. (http://www.tahltan.org/nation/economy/economic-development)
	Tourism	Bob Quinn Lake Airport is near proposed project location. Schoquette Hot Springs is near Stikine, BC. Proposed project

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

tion output of less than 15 MW.

he market will be necessary.

and environmental studies, public consultation, transmission even years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while struct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

ted terrain. Routing along existing unpaved roads where

infrastructure (particularly Bob Quinn and Dease Lake),

the environmental, social, cultural, heritage and economic

Nation consultation, involvement in economic ventures

ect location is remote; no significant infrastructure in within

Near Stikine, British Columbia, Canada Topographical Map Sheet: Figure 34 Geological Map Sheet: Figure 35

	Category	Comments
Ι.	Water Rights	
	Availability (for example "air-cooled required")	Plant water requirement estimated approx. 13 L/s for binary plant. Approx. 10,000 L/s MAD in Sphaler Creek. Very few exi approx. 16 km from point location for Power General on Sphaler Creek for 26,000 L/s.
	Availability for Drilling	Drilling requirement of 20 L/s. Approx. 10,000 L/s MAD in Sphaler Creek. Very few existing water licences in area. Closes Power General on Sphaler Creek for 26,000 L/s.
	Engineering	
	Plant Location and Design	Remote plant location with little available access.
	Construction Issues	No existing road access. Possible permanent snow and/or muskeg conditions. Forested, steep terrain.
	Transportation Issues	No existing road access, approx. 30 km to nearest road.
	Architectural Issues (Blend/hide into environment? Local styles? etc.)	None found
	Special Construction Issues (zero emissions)	None found
K.	Non-Electrical Infrastructure (Roads and Habitation)	
	Nearest Large Community > 50,000	Prince George, BC
	Nearest Community	Stikine, BC
	Nearest Road and Condition	No existing roads in vicinity of point location. Closest road is unpaved approx. 30 km from plan location. Requirement to bunpaved road.
	Current Access Conditions (restrictions)	No existing road access to point location. Mountainous terrain, possible permanent snow conditions.
	Terrain and Distance Factor for Road Building	New road is required; approx. 31 km of new road through steep, forested terrain.

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

existing water licences in area. Closest water licence is sest water licence is approx. 16 km from point location for to build new road approx. 31 km from plant to existing

Near Stikine, British Columbia, Canada **Topographical Map Sheet: Figure 34** Geological Map Sheet: Figure 35

	Category					(	Comments	
<u>L.</u>						gram targets proje ments (EPAs) und e made up of a pre dex annually up to the Lower Mainlan -side managemen I energy and capade.		
			Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)	
			Biomass – Wood Based	9,772	1,226	122 – 276	132 – 306	
			Biomass – Biogas	134	16	59 – 154	56 – 156	
			Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204	
			Wind – Onshore	46,165	4,271	90 – 309	115 – 365	
			Wind – Offshore	56,700	3,819	166 - 605	182 – 681	
			Geothermal	5,992	780	91 – 573	90 - 593	
			Run-of-River	24,543	1,149	97 – 493	143 – 1,170	
			Site C <sup>3</sup>	4,700	1,100	83	88	
			Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	6,103	774	58 – 92	57 – 86	
			Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103	
			Wave	2,506	259	440 - 772	453 - 820	
			Tidal	1,426	247	253 – 556	264 - 581	
			Solar	57	12	266 - 746	341 – 954	
			<ol> <li>Notes:</li> <li>The resources and UEC values si and may not include all possible r</li> <li>The details of how the cost adjust</li> <li>The Site C values presented in th Impact Statement (EIS) submission real discount rate.</li> <li>Representative projects were use the resource potential is generally</li> </ol>	esources that may ters were developed is table are based of on filed in January 2 ed to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC ine natural gas-fired a	xpected higher cos ovided in Appendix ded in the Site C Er is calculated assum	t. 12. nvironmental ning 5 per cent	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

cluding the mini-SOP under development), and (3) upgrades jects less than 100 kW and is therefore not relevant to

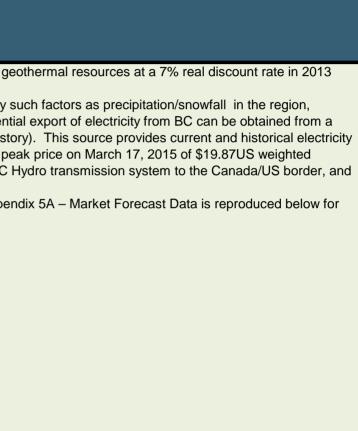
nder Calls for Tender are proprietary and confidential. redetermined base price in 2010 dollars as determined by to the year in which an EPA is signed, and further adjusted and region in 2010 dollars is \$103.69/MWh.

ent options and supply-side resource options to consider in pacity and unit energy costs, are listed in Table 2-2 of the

nal Potential by Transmission Region.

Near Stikine, British Columbia, Canada **Topographical Map Sheet: Figure 34** Geological Map Sheet: Figure 35

Category							Comments
Market Price (\$/MWhr)	dollars rang • Wholesale unforeseen variety of so market data average cos on the appro- • BC Hydro ready reference	es from \$91/M electricity prio generation ou urces. One su . Of particula to from 72 trad ppriate transm forecasts of m nce. ctricity Prio	Wh to 573/M ces for trading tages and an uch source is r relevance is les). Access ission system harket prices	Wh at the po g purposes can bient temper the US Energy the mid-C tra to that marke n (e.g. Bonne under various	int of intercor an vary greatly atures. A ger y Information ading hub in th t for geothern ville Power Au scenarios wa	nection to the y. In the Pacif neral flavour of Administration he Northwest nal projects in uthority) in the	Report Update, the Unit Energy Cost for ge e BC Hydro system. ic Northwest, these prices are affected by so of the wholesale electricity prices for potent on (www.eia.gov/electricity/wholesale/#histo Region (one example would be a Mid-C per a BC would require access on both the BC e US. a the November 2013 IRP. Table 5 in Appen
		Table		y Price Forecasts I (Real 2012 US\$/M)			
	Market Scenari		2 Low Electricity Low GHG (Regional) Low Gas	3 High Electricity High GHG (Regional) High Gas	4 Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	5 High Electricity High GHG (Regional/Nat'l) High Gas	
	2014	25.0	21.9	31.1	25.0	31.1	
	2015	25.5	21.7	31.9	25.5	31.9	
	2016	25.8 27.1	21.2 22.0	32.0 33.4	25.8 27.1	32.0 33.4	
	2018	27.1	21.7	33.9	27.1	33.9	
	2019	28.0	22.1	35.5	28.0	35.5	
	2020	28.0	21.9	36.0	28.0	36.0	
	2021	29.3	22.5	37.3	29.3	37.3	
	2022 2023	30.1 31.8	22.7 23.2	38.8 41.7	30.9 35.5	41.3 52.1	
	2023	33.0	23.7	43.4	41.8	68.6	
	2025	34.2	24.0	45.4	50.3	91.2	
	2026	34.9	24.1	46.7	52.2	95.1	
	2027	36.0	24.3	48.6	54.7	98.9	
	2028	36.3 37.2	24.0 23.9	50.2 51.1	56.8 58.8	101.8 106.1	
	2029	37.6	23.8	52.7	60.1	109.3	
	2031	38.6	24.0	54.7	62.6	112.0	
	2032	39.9	24.0	57.0	65.6	116.0	
	2033	41.5	24.4	60.1	69.3	122.0	
	2034	42.8	25.1	61.9	71.5	125.7	
	2035	44.6	26.2 26.9	64.5 66.2	74.5	131.0 134.3	
	2037	47.8	28.1	69.1	79.8	140.3	
	2038	48.4	28.4	70.0	80.8	142.1	
	2039	48.9	28.7	70.7	81.6	143.5	
	2040	49.3	29.0	71.4	82.4	144.9	



Near Stikine, British Columbia, Canada **Topographical Map Sheet: Figure 34** Geological Map Sheet: Figure 35

Category					Comments			
Green Power Premium (\$/MWhr) Capacity Price (\$/KW)	<ul> <li>BC Hydro's past procurement processes for the acquisition for power from independent power producers has offered a performance of "Within British Columbia, there is little demand for the purchase of "green power certificates" (instruments that a custome environmentally friendly) from BC Hydro. BC Hydro's generation mix is already approximately 93% clean.</li> <li>California has a goal of 33% of retail sales by 2020 to be sourced from eligible renewable energy sources. However, the particularly "bundled" green energy with Renewable Energy Certificates (RECs), to compete in that market is low, for a nu 1. The price of electricity is driven by the low cost of natural gas;</li> <li>There are large amounts of renewables, such as wind and solar, in California; and</li> <li>Firm transmission access to the California market through the BPA transmission system is generally not available.</li> </ul>							
Capacity Price (\$/KW)	There is no pric     Table 3-27 entit	e in \$/kW for ca led "UCCs of Ca iped storage, sir	pacity resour apacity Resou nple cycle ga	ce options in t urce Supply Op s turbines and	ne market at present. ptions" in BC Hydro's Integrated Resource Plan dated Noveml resource smart projects such as Revelstoke Unit 6). The unit			
		<ul> <li>"1. Definitions: In this Appendix 4, the following words and expressions have the following meanings:</li> <li>(a) "Off-Peak Hours" means all hours other than Super-Peak Hours and Peak Hours.</li> <li>(b) "Peak Hours" means the hours commencing at 06:00 PPT and ending at 16:00 PPT, and commencing at inclusive, but excluding British Columbia statutory holidays.</li> <li>(c) "Super-Peak Hours" means the hours commencing at 16:00 PPT and ending at 20:00 PPT Monday thro holidays."</li> </ul>						
	inclusive, but exc (c) "Super-Peak	means the hour luding British Co Hours" means th	e hours com	ng at 06:00 PP tory holidays. mencing at 16	T and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	inclusive, but exc (c) "Super-Peak	means the hour luding British Co Hours" means th Time of	olumbia statu ne hours com Delivery Facto	ng at 06:00 PP tory holidays. mencing at 16	T and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	inclusive, but exc (c) "Super-Peak holidays." Month	means the hour luding British Co Hours" means th Time of Super-Peak	olumbia statu e hours com Delivery Facto Peak	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak	T and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	inclusive, but exc (c) "Super-Peak holidays." Month January	means the hour luding British Co Hours" means the Time of Super-Peak 141%	Delivery Factor Pelak 122%	ng at 06:00 PP tory holidays. mencing at 16	T and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	inclusive, but exc (c) "Super-Peak holidays." Month	means the hour luding British Co Hours" means th Time of Super-Peak	olumbia statu e hours com Delivery Facto Peak	ng at 06:00 PP tory holidays. mencing at 16 pr (TDF) Off-Peak 105%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	inclusive, but exe (c) "Super-Peak holidays." Month January February	means the hour luding British Co Hours" means the Time of Super-Peak 141% 124%	Delivery Factor Peak 122% 113%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	inclusive, but exc (c) "Super-Peak holidays." Month January February March	Time of Super-Peak 141% 124%	Delivery Factor Pelvery Factor 122% 113% 112%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	inclusive, but exc (c) "Super-Peak holidays." Month January February March April	Time of Super-Peak 124% 124% 104%	Delivery Factor Peak 122% 113% 95%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	inclusive, but exc (c) "Super-Peak holidays." Month January February March April May	means the hour luding British Co Hours" means the Super-Peak 141% 124% 104% 90%	Delivery Factor Peak 122% 113% 112% 95% 82%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	inclusive, but exc (c) "Super-Peak holidays." Month January February March April May June	means the hour luding British Co Hours" means the Super-Peak 141% 124% 124% 104% 90% 87%	Delivery Factor Peak 122% 113% 112% 95% 82% 81%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	inclusive, but exc (c) "Super-Peak holidays." Month January February March April May June July	means the hour luding British Co Hours" means the Super-Peak 141% 124% 124% 104% 90% 87% 105%	Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	inclusive, but exc (c) "Super-Peak holidays." Month January February March April May June July August	means the hour luding British Co Hours" means the Super-Peak 141% 124% 124% 104% 90% 87% 105% 110%	Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96% 101%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a			
	inclusive, but exc (c) "Super-Peak holidays." Month January February March April May June July August September	means the hour luding British Co Hours" means the Super-Peak 141% 124% 124% 104% 90% 87% 105% 110% 116%	Delivery Factor Peak 122% 113% 112% 95% 82% 81% 96% 101% 107%	ng at 06:00 PP tory holidays. mencing at 16 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86% 91%	T and ending at 16:00 PPT, and commencing at 20:00 PPT a			

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

premium for green power. er can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

mber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

v inclusive, but excluding British Columbia statutory

Near Stikine, British Columbia, Canada **Topographical Map Sheet: Figure 34** Geological Map Sheet: Figure 35

Category	Comments
Estimated Size of Resource	See Section A.
Is there any green power incentives?	<ul> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercia expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program of Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p o Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project development o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of the calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include:</li> <li>Natural Resources Canada ecoEnergy for Renewable Power program;</li> <li>Sustainable Development Technology Canada funds;</li> <li>Clean Energy Fund;</li> <li>Industrial Research Assistance Program; and</li> <li>Green Infrastructure Fund</li> </ul>
Grants	See above under green power incentives
Tax Holidays	None listed on federal and provincial websites.
Tax Relief	<ul> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 4 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred dur and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the ye deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now entitled Scientific Research and Experimental ty and relevance. participation in the clean energy sector. It provides: ent; and these programs may be active but not currently issuing al technologies/resources, while others may be fully

itv and relevance.

ce energy by using renewable energy sources or fuels from 43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 ets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy vear they are incurred, carried forward indefinitely and

Near Stikine, British Columbia, Canada **Topographical Map Sheet: Figure 34** Geological Map Sheet: Figure 35

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/ "The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly, The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities t The advantages of joining the FNFA as a Borrowing Member are: 1. Access to low rate, below bank prime, loans with repayment terms up to 30 years; 2. First Nations choose the repayment terms that work best for their budget; 3. FNFA loans do not require collateral; 4. FNFA loans can be used to refinance existing debt; and 5. FNFA's interest rates and terms parallel those available to provincial and local governments. Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infras purchases, independent power projects, community housing and rolling stock/heavy equipment. FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Borr and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015 Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribed Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section, (b) an amount agreed under this section to be paid instead of royalty, or (c) if no royalty or amount has been agreed under this section, the prescribed royalty.

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. s that join as Borrowing Members.

astructure, social and economic development, land

orrowing Members, represented by the First Nation's Chief

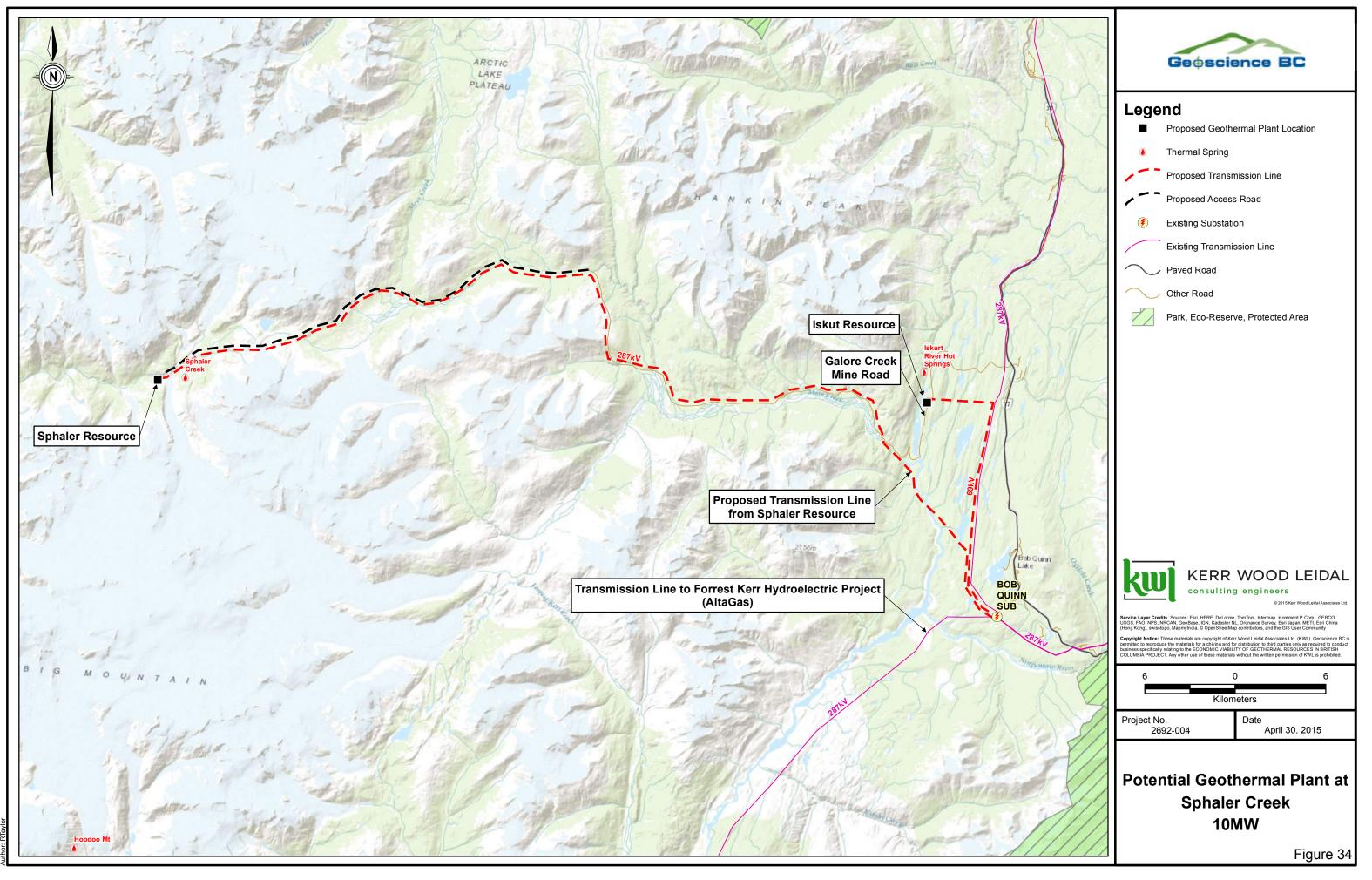
ed rent for the permit (Section 5).

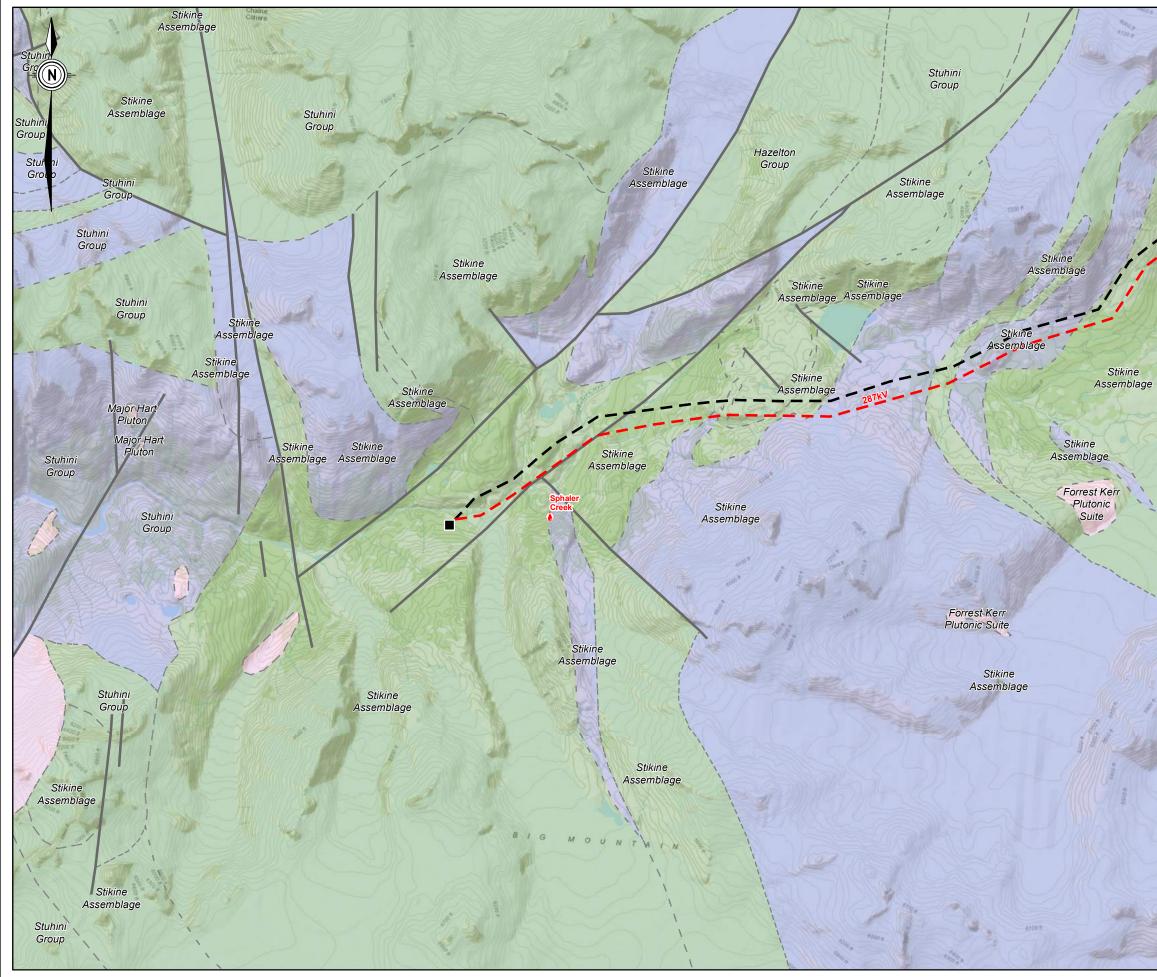
pay to the government

Near Stikine, British Columbia, Canada Topographical Map Sheet: Figure 34 Geological Map Sheet: Figure 35

	Category	Comments
	General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "This in section 1 (1) [definitions] of the Geothermal Resources Act."
	Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners for Proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg Statu
	Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincial</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
	Transmission Tariffs	<ul> <li>Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Albert generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission acc Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the</li> <li>Tariff Supplement 37, approved by the BC Utilities commission on April 10, 2013, sets out the contributions from future c and mine developments that will connect to the Northwest Transmission Line (NTL). This contribution, in general terms, ec intended to offset the ratepayer contributions for the cost of building NTL.</li> </ul>
N		
	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)	
	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 34
	Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 35
	Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 35
Ν	. Other Issues and Considerations	

his Act does not apply to geothermal resources as defined
s for the geothermal land tract. atutory Right of Way, Licence of Occupation).
ial (British Columbia): 13.5%. %
erta, the US, or other wholesale customers in BC, the hission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power he economic viability of the potential wholesale opportunity. e clean, renewable energy projects (such as geothermal) equates to about \$10/MWh. These contributions are





Stikine	Ge¢science BC
Stikine Assemblage	<ul> <li>Proposed Geothermal Plant Location</li> <li>Thermal Spring</li> <li>Proposed Transmission Line</li> <li>Proposed Access Road</li> </ul> Bedrock Type <ul> <li>Intrusive Rocks</li> <li>Sedimentary Rocks</li> <li>Volcanic Rocks</li> <li>Rock Type Boundary</li> <li>Fault</li> </ul>
	
Forrest Kerr Plutonic Suite	Kilometers         Project No.       Date         2692-004       April 30, 2015         Geological Strata Map for       Sphaler Creek         10MW       Figure 35



Appendix S

# Upper Arrow Lake Geothermal Development Decision Matrix and Figures 36 & 37

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Near Revelstoke, British Columbia, Canada Topographical Map Sheet: Figure 36 Geological Map Sheet: Figure 37

	Category	Comments
Α.	Reservoir Potential	
	Size/Potential/Type	<ul> <li>Reservoir size: No clearly defined area or thickness in literature, but description of multiple springs warrants an area est estimated at: 5.5 km<sup>3</sup> (most-likely area: 5 km<sup>2</sup>; most-likely thickness*: 1.1 km) (*Reservoir thickness assumption based on</li> <li>Potential: 20 MW (Lovekin and Pletka, 2009)</li> <li>Type: low-temperature resource, suitable for binary plant.</li> </ul>
	Temperature/Water and Gas Chemistry/Mineral Indicators	<ul> <li>Surface features:</li> <li>Frosthall: No information</li> <li>Halcyon spring: 48°C (Fairbank &amp; Faulkner, 1992); 46.5°C, 50.5°C (Souther, 1975); 50.1°C (Grasby &amp; Hutcheon, 2001)</li> <li>Halfway river: 55°C (Fairbank &amp; Faulkner, 1992); 54.9°C (Grasby &amp; Hutcheon, 2001)</li> <li>Nakusp spring: 54°C (Fairbank &amp; Faulkner, 1992); 50.0°C, 49.0°C (Souther, 1975); 55.8°C (Grasby &amp; Hutcheon, 2001)</li> <li>St. Leon hot spring: 49°C (Fairbank &amp; Faulkner, 1992); 50.0°C, 49.0°C (Souther, 1975); 46.5°C (Grasby &amp; Hutcheon, 2001)</li> <li>Whiskey Point: None reported.</li> <li>Wilson Lake: 30°C (Fairbank &amp; Faulkner, 1992) (Grasby &amp; Hutcheon, 2001)</li> <li>Geothermometry:</li> <li>"SiO<sub>2</sub> and Na-K-Ca geothermometry give regional source temperatures of 46.3°C to 73.9°C and 128.3°C to 67.4°C, resp temps) (Fairbank &amp; Faulkner, 1992).</li> <li>Halcyon spring: 72-74°C (Souther, 1975); 69°C (Grasby &amp; Hutcheon, 2001)</li> <li>Halfway river: 27°C (Grasby &amp; Hutcheon, 2001)</li> <li>Nakusp spring: 49-52°C (Souther, 1975); 69°C (Grasby &amp; Hutcheon, 2001)</li> <li>St. Leon hot spring: 44-46°C (Souther, 1975); 44°C (Grasby &amp; Hutcheon, 2001)</li> <li>Exploration drilling:</li> <li>None reported</li> <li>Water chemistry:</li> <li>Halcyon spring: water type is (Ca&gt;Na)-SQ<sub>4</sub> with SQ<sub>4</sub> at ~400 mg/L and low Mg (0.6 mg/L) and Cl 6 mg/L: pH 7.1-7.7 (Souther, Halfway hot spring: water type is (Ca&gt;Na)-SQ<sub>4</sub> with SQ<sub>4</sub> at ~300 mg/L and Mg &lt;1 mg/L; pH 8.2; Cl 5 mg/L (Grasby &amp; Hut Nakusp spring: water type is (Ca&gt;Na)-SQ<sub>4</sub> with SQ<sub>4</sub> at ~300 mg/L and Mg about 0.1 mg/L; pH 8.3-8.4 (Souther, 1975)</li> <li>St. Leon hot spring: water type is (Ca&gt;Na)-SQ<sub>4</sub> with SQ<sub>4</sub> at 560 mg/L and Mg about 0.1 mg/L; pH 8.3-8.4 (Souther, 1975)</li> <li>St. Leon hot spring: water type is (Ca&gt;Na)-SQ<sub>4</sub> with SQ<sub>4</sub> at 560 mg/L and Mg about 0.1 mg/L; pH 8.3-8.4 (Souther, 1975)</li> <li>St. Leon hot spring: water type is (Ca&gt;Na)-SQ<sub>4</sub> with SQ<sub>4</sub> at 560 mg/L and Mg about 0.1 mg/L; pH 8.3-8.4 (Souther, 1975)</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

estimate of about 5 km<sup>2</sup>) - therefore, reservoir volume on most-likely value from Appendix III in GeothermEx, 2004)

001)

pectively" (not clear which 4 springs gave these specific

r, 1975) (Grasby & Hutcheon, 2001) utcheon, 2001) y & Hutcheon, 2001); CI 1-2 mg/L (Souther, 1975) 75) (Grasby & Hutcheon, 2001); Cl 2 mg/L (Souther, 1975);

Near Revelstoke, British Columbia, Canada Topographical Map Sheet: Figure 36 Geological Map Sheet: Figure 37

Category	Comments
Surface Flow Rates and Reservoir Recharge	<ul> <li>Halcyon spring: 5 L/s (Fairbank &amp; Faulkner, 1992)</li> <li>Halfway river: 3 L/s (Fairbank &amp; Faulkner, 1992)</li> <li>Nakusp spring: 1 L/s (Fairbank &amp; Faulkner, 1992)</li> <li>St. Leon hot spring: 2 L/s (Fairbank &amp; Faulkner, 1992)</li> <li>Wilson Lake: 1 L/s (Fairbank &amp; Faulkner, 1992)</li> </ul>
3D Permeability (heat exchange potential)	No information
Recent Magmatism	None. Radiogenic heat source. (Fairbank & Faulkner, 1992)
Structural Setting	<ul> <li>Columbia River Fault along eastern margin of regional extension complex; characterized by mylonite zone up to 1 km with 2001)</li> <li>Stratified rocks are more complexly deformed and metamorphosed adjacent to the Kuskanax batholith on the eastern site Complex on the western side of Upper Arrow Lake. The Columbia River fault is a complex fault system composed of number truncated regional folds and metamorphic isograds during the Middle Jurassic to Cretaceous. (Mountjoy et al., 1997)</li> </ul>
Geophysics	No information
Reservoir Host Rock	<ul> <li>Silicate hosted (Grasby et al., 2000); crystalline schist (Souther &amp; Halstead, 1973)</li> <li>Halfway, Nakusp, St. Leon and Wilson all lie within the Kuskanax Batholith; Mount Maldur and Halcyon lie within sedime</li> </ul>
Drilling Issues	None reported.
Brief Description of Geological Setting of Thermal Features (i.e., springs emanate from fluvial gravels; beside a river, etc.)	<ul> <li>The area east of Upper Arrow Lake is dominated by strata of the Quesnel Terrane, which includes the Triassic Slocan G gneiss dome complex is exposed west of Upper Arrow Lake. This structure includes metamorphic rocks of the Proterozoi Proterozoic core (basement) gneiss. The northwest structural trend of these strata have been disrupted by two Middle Jur portion of the map area and the Nelson batholith along the southern margin. (Mountjoy et al., 1997)</li> <li>Circulation depth of ~4 km calculated based on local geothermal gradients (32°C/km for Columbia River Fault (Grasby et Many have small natural pools used recreationally (Halfway) (Google earth observations)</li> <li>St Leon has natural pools with installed pipes (Google earth observations)</li> <li>Nakusp has a commercial spa (Google earth observations)</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

wide, intense folding and fracturing. (Grasby & Hutcheon,

side of Upper Arrow Lake, and within the Monashee imerous cataclastite, mylonite and fault zones which have

nentary rocks (Slocan Group and Milford Formation)

Group and Lower Jurassic Rossland Group. The Valhalla coic to (?)lower Paleozoic Monashee Complex and Lower urassic plutons - the Kuskanax batholith in the northwestern

v et al., 2000)

Near Revelstoke, British Columbia, Canada Topographical Map Sheet: Figure 36 Geological Map Sheet: Figure 37

	Category	Comments
В.	Exploration Uncertainty (Risk)	
	Degree of Identification of Resources/Reserves	Low
	Likelihood of Covering Reservoir with Concession	Unknown - looks possible (springs not within national park/restricted area); Halcyon and Whiskey Point springs are near m
	Expected Authorization Date	Unknown
	Specific Timing of Exploration (2 + 2 years, BC 8 years, etc.)	5 years (1 year permitting and surface exploration, possibly drilling shallow temperature gradient holes + 1 year deep gradient-well testing + 1 year further development drilling and start plant construction + 1 year drilling wrap-up and finish plant construct
	Degree of Previous Exploration (can be good or bad)	Low
	Surface Operational Capacity (enough stable area for drilling and a plant?)	Likely Halfway, Nakusp, St. Leon and Wilson are all located up river valleys, away from Upper Arrow Lake.
	Exploration to Exploitation: A summary rating of Exploration	Moderate
	Uncertainty (risk) on a scale of difficult (high risk) through medium (moderate risk) to easy (low risk)	A lot of unknowns, but no items have been identified as high risk.
C.	Environmental Issues	
	Protected Areas	<ul> <li>Proposed transmission line crosses through an Ungulate Winter Range No Harvest Zone.</li> </ul>
		Goat Range Provincial Park approx. 37 km from proposed plant location.
	Endangered Species	<ul> <li>Proposed transmission line runs through Southern Mountain Caribou (Endangered (SARA Schedule 1); red-listed) habita occurrence polygon.</li> </ul>
	Geothermal Surface Features	<ul> <li>Nearest hotsprings approx 11 km from proposed infrastructure.</li> </ul>
		<ul> <li>Three hotsprings located approx. 16 km from proposed infrastructure.</li> </ul>
	Other	<ul> <li>Proposed powerline crosses approximately 10 streams, including Turner Creek which contains Rainbow Trout, and Mccl observed fish.</li> </ul>
		• The nearest Wildlife Habitat Area allotment for Grizzly Bears is approx. 45 km west of proposed infrastructure.
_		
D.	Geothermal Area - Bidding and/or Type of Land Holding (private/government/lease/etc.)	
	Bidding Area	No existing geothermal title tracts.
	Other Claim Rights (mining and/or oil)	Plant location is within mineral / coal title. Several mineral/coal titles in area. Proposed location is not within known oil and location.

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

mining titles

vell drilling + 1 year successful development drilling and ction)

bitat polygon and Snow Ramble (blue-listed plant)

ccleod Creek and Kuskanax Creek which contain unnnamed

nd gas management area; no known tenures at proposed

Near Revelstoke, British Columbia, Canada **Topographical Map Sheet: Figure 36** Geological Map Sheet: Figure 37

Category	Comments
E. Market	
Main Electricity Consumers (direct sales and/or government)	<ul> <li>General Overview</li> <li>1. BC Hydro acquires power from Independent Power Producers (which would include geothermal proponents) through th • Competitive calls: when BC Hydro issues a Call for Tenders for the supply of electricity to BC Hydro, geothermal propor • Standing Offer Program (SOP): This program is presently available for clean generation projects greater than 0.1 MW b against each other but are paid a predetermined price by BC Hydro. Depending on the specifics of each project, proponer threshold for the SOP (BC Hydro is developing a 'mini-SOP' component within the overall SOP. This mini-SOP will apply realistically apply to potential geothermal generation projects).</li> <li>• In addition, BC Hydro's net metering program is designed for residential and commercial customers who wish to connec distribution system. Generating units up to 0.1 MW in capacity that utilize a clean or renewable resource are eligible to pa program has no applicability to potential geothermal generation projects. The acquisition of geothermal power would contribute to BC Hydro's current target for clean energy and to the diversificati snow melt and stream flow.</li> <li>2. Although FortisBC is a potential customer for electricity from geothermal sources, the opportunities may be limited give under Rate Schedule 3808. However there is a wheeling agreement in place which would facilitate a geothermal project I BC Hydro through BC Hydro's competitive calls and/or the SOP, or to other potential customers as noted below.</li> <li>3. Wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta, th generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmis Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission ac Authority for wheeling to a US customer). This 'pancaking' of rates, along with congestion issues, affects the economic vic 4. Retail ac</li></ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

two main processes:

onents can bid into those competitive calls.

but not more than 15 MW. Proponents do not compete ents may wish to size their projects to be under the 15 MW y to projects in the 0.1 MW to 1 MW range, but would not

ct a small electricity generating unit to the BC Hydro participate in the program. Given the small size, this

ation of BC Hydro's resource mix, making it less reliant on

ren FortisBC's ability to receive electricity from BC Hydro located in FortisBC's service territory to sell electricity to

the US, or other wholesale customer in BC is allowed. The nission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power iability of the potential wholesale opportunity.

lly not permitted in BC. However there may be rs (e.g. pulp mills, large sawmills, mines) as follows: ctric Tariff. Such replacement would be challenging given

ant located in close proximity to the facility, thereby

Near Revelstoke, British Columbia, Canada Topographical Map Sheet: Figure 36 Geological Map Sheet: Figure 37

Category	Comments
Time Limits? (business agreements, ope deadlines?)	<ul> <li>BC Hydro has issued competitive Calls for Tender for the supply of electricity in the past.</li> <li>BC Hydro's SOP is presently directly available for clean energy projects which meet certain criteria, including a generation.</li> <li>Typical BC Hydro Energy Purchase Agreements from Independent Power Producers are 20-40 years in duration.</li> <li>Business agreements with the owners of private transmission lines (e.g. independent power producers) for access to the</li> <li>The lead times to develop geothermal resources will include appropriate allowances for investigative drilling, technical an considerations, marketing, licencing, design, construction and commissioning. These lead times will vary from four to sever Projects with a history of exploration and analysis (e.g. Meager Creek/Pebble Creek, Lakelse, and Canoe Creek) will gene other projects with less investigative work will take longer. Although the time required to drill a geothermal well and construction were produced to drill a geothermal well and construction and regulatory processes will realistically result in a further two years at a minimum for these activities.</li> </ul>
F. Transmission Line Infrastructure	
State of the Infrastructure	69 kV transmission line to Nakusp substation.
Transmission Route (distance, terrain an	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ion output of less than 15 MW.

e market will be necessary.

and environmental studies, public consultation, transmission even years depending on the specifics of each project. nerally be on the shorter end of this time continuum, while truct a power plant could conceivably be less than two with BC Hydro or a private transmission owner), and the

ions close to lake; steep, treed mountainous terrain in St.

Near Revelstoke, British Columbia, Canada Topographical Map Sheet: Figure 36 Geological Map Sheet: Figure 37

	Category	Comments
Н.	Community Issues	
	Indigenous Law and Indigenous Development Areas	<ul> <li>First Nation consultative areas include Secwepemc Nation, Okanagan Indian Band, Splats'in First Nation, Neskonlith Indian Band, Penticton Indian Band, Little Shuswap Indian Band, Adams Lake Indian Band.</li> <li>Many of the consultative areas have community or land use plans however none are found to be near the proposed plant</li> <li>Sinixt Nation (Arrow Lakes) is most relevant to plant location (http://sinixtnation.org/content/sinixt-territory). Requirement their agents and employees consult with the Sinixt Nation is regards to development and business operations and land use</li> <li>Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Communi</li></ul>
	Community Action	<ul> <li>Perry Ridge Wilderness Initiative - united campaign with Perry Ridge Water Users Association to protect Perry Ridge in the ridge/overview/)</li> <li>2010 - Injunction against Sinixt protest for Perry Ridge overturned by Vancouver court</li> <li>2013 Sinixt Nation receives notice of trespass at Perry Ridge</li> <li>Challenge to Pass Creek logging</li> </ul>
	Surface Rights	<ul> <li>First Nation consultative areas include Secwepemc Nation, Okanagan Indian Band, Splats'in First Nation, Neskonlith Indi Indian Band, Penticton Indian Band, Little Shuswap Indian Band, Adams Lake Indian Band.</li> <li>Many of the consultative areas have community or land use plans however none are found to be near the proposed plant</li> <li>Sinixt Nation (Arrow Lakes) is most relevant to plant location (http://sinixtnation.org/content/sinixt-territory). Requirement is their agents and employees consult with the Sinixt Nation is regards to development and business operations and land use</li> </ul>
	Tourism	<ul> <li>Halcyon hot springs in Nakusp is tourist destination. Large tourist industry due to proximity to Revelstoke and variety of of Nakusp Tourism (http://nakusparrowlakes.com/)</li> <li>Nakusp regional interests include ecosystem integrity and water and shoreline access for recreation.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

dian Band, Lower Similkameen Indian Band, Upper Nicola

nt location.

nt for "corporations, provincial and federal governments and se and resource extraction with the territory." ommunity Plan)

the Slocan Valley (http://www.perryridge.org/about-perry-

dian Band, Lower Similkameen Indian Band, Upper Nicola

nt location.

nt for "corporations, provincial and federal governments and se and resource extraction with the territory."

outdoor recreational activities available.

Near Revelstoke, British Columbia, Canada Topographical Map Sheet: Figure 36 Geological Map Sheet: Figure 37

	Category	Comments
Ι.	Water Rights	
	Availability (for example "air-cooled required")	Plant water requirement estimated approx. 25 L/s for binary plant. MAD of 3000 L/s on St. Leon Creek. No existing water I concentrated on Arrow Lake and along Highway 1 corridor.
	Availability for Drilling	Drilling requirement of 20 L/s. MAD of 3000 L/s on St. Leon Creek. No existing water licence 9 km of proposed location. E along Highway 1 corridor.
J.	Engineering	
	Plant Location and Design	Remote plant location in valley of St. Leon Creek.
	Construction Issues	Remote plant location, mountainous terrain, limited existing access via logging roads.
	Transportation Issues	Limited access via existing unpaved roads in St. Leon Creek Valley and paved road to Nakusp substation.
	Architectural Issues (Blend/hide into environment? Local styles? etc.)	None found.
	Special Construction Issues (zero emissions)	None found.
K.	Non-Electrical Infrastructure (Roads and Habitation)	
	Nearest Large Community > 50,000	Kelowna, BC
	Nearest Community	Revelstoke, BC by distance, Nakusp by access (roads)
	Nearest Road and Condition	Unpaved access road within 1 km of plant location; steep mountainous terrain.
	Current Access Conditions (restrictions)	Provincial park at south west of location. Access via Nakusp along Arrow Lake.
	Terrain and Distance Factor for Road Building	No new road requirement expected. Paved road access from Nakusp to St. Leon Creek. Unpaved access road through s

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

r licence 9 km of proposed location. Existing water licence
Existing water licence concentrated on Arrow Lake and
steep, treed terrain from lake to plant location.

Near Revelstoke, British Columbia, Canada Topographical Map Sheet: Figure 36 Geological Map Sheet: Figure 37

	Category						Comments		
<u>L.</u>	Finance General Power Prices	to ge th ba N	BC Hydro acquires power through (1) competitive processes (Calls for Tender), (2) the Standing Offer Progo o its existing facilities or the development of new generation facilities. (Note that the net metering program geothermal generation projects). Comments on the general price of power under each one are: The power price paid by BC Hydro to independent power producers through Energy Purchase Agreement The power price paid by BC Hydro to independent power producers through EPAs under the SOP are ma he region of the point of interconnection to the BC Hydro system, escalated at the Consumer Price Index a based upon the time of day and month when the energy is delivered. For reference, the base price for the L BC Hydro's current Integrated Resource Plan dated November 2013 includes details of both demand-side neeting the future demand for electricity. These resource options, together with their attributes of total ene November 2013 Resource Options Report Update. That table is reproduced below for ready reference. Table 5-7 of the above-noted November 2013 Resource Options Report Update provides a summary of the						
			Energy Resource	Total FELCC Energy (GWh/year)	Total DGC or ELCC Capacity (MW)	UEC at POI @ 7% Real (\$2013/MWh)	Adjusted Firm UEC <sup>2</sup> @ 7% Real (\$2013/MWh)		
			Biomass – Wood Based	9,772	1,226	122 – 276	132 – 306		
			Biomass – Biogas	134	16	59 – 154	56 – 156		
			Biomass – Municipal Solid Waste	425	50	85 – 184	83 - 204		
			Wind – Onshore	46,165	4,271	90 - 309	115 – 365		
			Wind – Offshore	56,700	3,819	166 - 605	182 - 681		
			Geothermal	5,992	780	91 – 573	90 - 593		
			Run-of-River	24,543	1,149	97 – 493	143 – 1,170		
			Site C <sup>3</sup> Combined Cycle Gas Turbine and Cogeneration <sup>4</sup>	4,700 6,103	1,100 774	83 58 – 92	88 57 – 86		
			Coal-fired Generation with Carbon Capture and Sequestration	3,896	556	88	103		
			Wave	2,506	259	440 - 772	453 - 820		
			Tidal	1,426	247	253 - 556	264 - 581		
			Solar	57	12	266 - 746	341 – 954		
			<ol> <li>Notes:</li> <li>The resources and UEC values si and may not include all possible m</li> <li>The details of how the cost adjust</li> <li>The Site C values presented in th Impact Statement (EIS) submission real discount rate.</li> <li>Representative projects were use the resource potential is generally</li> </ol>	esources that may ers were developed is table are based o on filed in January 2 d to characterize th	be available at an e d and applied are pr on information provi 2013, and the UEC e natural gas-fired a	xpected higher cos ovided in Appendix ded in the Site C Er is calculated assum	t. 12. nvironmental ning 5 per cent		

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

cluding the mini-SOP under development), and (3) upgrades jects less than 100 kW and is therefore not relevant to

nder Calls for Tender are proprietary and confidential. predetermined base price in 2010 dollars as determined by to the year in which an EPA is signed, and further adjusted and region in 2010 dollars is \$103.69/MWh.

ent options and supply-side resource options to consider in pacity and unit energy costs, are listed in Table 2-2 of the

nal Potential by Transmission Region.

Near Revelstoke, British Columbia, Canada Topographical Map Sheet: Figure 36 Geological Map Sheet: Figure 37

Category							Comments
Market Price (\$/MWhr)	dollars ra • Wholes unforese variety o market o average on the ap • BC Hyo ready re	ale electricity en generation sources. On ata. Of partic cost from 72 propriate trai tro forecasts of erence.	1/MWh to 573 prices for trac outages and e such source cular relevance trades). Acce hsmission syster of market price	3/MWh at the ding purposes ambient tem is the US Er is the mid-C ss to that ma tem (e.g. Bor es under vario	e point of inte s can vary gro peratures. A nergy Informa C trading hub arket for geoth neville Powe ous scenario	rconnection to eatly. In the Para general flavou ation Administra in the Northwe hermal projects or Authority) in t	as Report Update, the Unit Energy Cost for get the BC Hydro system. cific Northwest, these prices are affected by s in of the wholesale electricity prices for potent ation (www.eia.gov/electricity/wholesale/#histo est Region (one example would be a Mid-C per is in BC would require access on both the BC I the US. I in the November 2013 IRP. Table 5 in Apper
		Tab		(Real 2012 US\$/M			
	Mar Scen		2 y Low Electricity Low GHG (Regional) Low Gas	3 High Electricity High GHG (Regional) High Gas	4 Mid Electricity Mid GHG (Regional/Nat'l) Mid Gas	5 High Electricity High GHG (Regional/Nat'l) High Gas	
	20		21.9	31.1	25.0	31.1	
	20		21.7	31.9	25.5	31.9	
	20		21.2 22.0	32.0 33.4	25.8 27.1	32.0 33.4	
	20		21.7	33.9	27.1	33.9	
	20		22.1	35.5	28.0	35.5	
	20		21.9	36.0	28.0	36.0	
	20		22.5	37.3	29.3	37.3	
	202		22.7 23.2	38.8 41.7	30.9 35.5	41.3 52.1	
	20		23.7	43.4	41.8	68.6	
	20		24.0	45.4	50.3	91.2	
	20		24.1	46.7	52.2	95.1	
	202		24.3 24.0	48.6 50.2	54.7 56.8	98.9 101.8	
	20		23.9	51.1	58.8	106.1	
	20		23.8	52.7	60.1	109.3	
	20	1 38.6	24.0	54.7	62.6	112.0	
	203		24.0	57.0	65.6	116.0	
	20		24.4 25.1	60.1 61.9	69.3 71.5	122.0 125.7	
	20		26.2	64.5	74.5	131.0	
	203		26.9	66.2	76.4	134.3	
	20		28.1	69.1	79.8	140.3	
	203		28.4	70.0	80.8	142.1	
	20		28.7 29.0	70.7	81.6 82.4	143.5 144.9	
			20.0	1	02.1		

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

geothermal resources at a 7% real discount rate in 2013 y such factors as precipitation/snowfall in the region, ntial export of electricity from BC can be obtained from a story). This source provides current and historical electricity peak price on March 17, 2015 of \$19.87US weighted C Hydro transmission system to the Canada/US border, and

endix 5A – Market Forecast Data is reproduced below for

Near Revelstoke, British Columbia, Canada Topographical Map Sheet: Figure 36 Geological Map Sheet: Figure 37

Category					Comments
Green Power Premium (\$/MWhr)	<ul> <li>Within British Co environmentally fr</li> <li>California has a particularly "bundle 1. The price of ele 2. There are large</li> </ul>	lumbia, there is li endly) from BC H goal of 33% of ret ed" green energy ctricity is driven b amounts of rene	ttle demand lydro. BC Hy ail sales by with Renew y the low co wables, sucl	for the purcha ydro's generati 2020 to be so able Energy C st of natural ga h as wind and	solar, in California; and
Capacity Price (\$/KW)	There is no price     Table 3-27 entitle	in \$/kW for capa ed "UCCs of Capa ed storage, simp	city resource acity Resour le cycle gas	e options in the ce Supply Opt	the BPA transmission system is generally not available. e market at present. ions" in BC Hydro's Integrated Resource Plan dated Noveml resource smart projects such as Revelstoke Unit 6). The unit
					pressions have the following meanings:
	(b) "Peak Hours" r inclusive, but excl	neans the hours o iding British Colu ours" means the	commencing mbia statuto hours comm	g at 06:00 PPT bry holidays. hencing at 16:0	
	(b) "Peak Hours" r inclusive, but excl (c) "Super-Peak H	neans the hours of uding British Colu ours" means the Time of I	commencing mbia statuto hours comm Delivery Facto	g at 06:00 PPT bry holidays. hencing at 16:0	Hours and Peak Hours. and ending at 16:00 PPT, and commencing at 20:00 PPT at 00 PPT and ending at 20:00 PPT Monday through Saturday i
	(b) "Peak Hours" r inclusive, but excl (c) "Super-Peak H holidays."	neans the hours o iding British Colu ours" means the	commencing mbia statuto hours comm	g at 06:00 PPT bry holidays. hencing at 16:0	and ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" r inclusive, but exclu (c) "Super-Peak H holidays."	neans the hours of Iding British Colu ours" means the Time of I Super-Peak	commencing mbia statuto hours comm Delivery Facto Peak	g at 06:00 PPT pry holidays. hencing at 16:0 or (TDF) Off-Peak	and ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" r inclusive, but exclu (c) "Super-Peak H holidays." Month January	Time of I Super-Peak	commencing mbia statuto hours comm Delivery Facto Peak 122%	g at 06:00 PPT ory holidays. hencing at 16:0 or (TDF) Off-Peak 105%	and ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" r inclusive, but exclu (c) "Super-Peak H holidays." Month January February	Time of I Super-Peak	commencing mbia statuto hours comm Delivery Facto Peak 122% 113%	at 06:00 PPT bry holidays. hencing at 16:0 or (TDF) Off-Peak 105% 101%	and ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" r inclusive, but exclu (c) "Super-Peak H holidays." Month January February March	Time of I Super-Peak 124%	Commencing mbia statuto hours comm Delivery Facto Peak 122% 113% 112%	at 06:00 PPT bry holidays. hencing at 16:0 or (TDF) Off-Peak 105% 101% 99%	and ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" r inclusive, but exclu (c) "Super-Peak H holidays." Month January February March April May June	Time of I Super-Peak 141% 124% 104% 90% 87%	Commencing mbia statuto hours comm Delivery Facto Peak 122% 113% 112% 95% 82% 81%	at 06:00 PPT bry holidays. hencing at 16:0 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69%	and ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" r inclusive, but exclu (c) "Super-Peak H holidays." Month January February March April May	Time of I Super-Peak 141% 124% 124% 104% 90% 87% 105%	Commencing mbia statuto hours comm Delivery Facto Peak 122% 113% 112% 95% 82% 81% 96%	at 06:00 PPT by holidays. hencing at 16:0 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79%	and ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" r inclusive, but exclu (c) "Super-Peak H holidays." Month January February March April May June July August	Time of I Super-Peak 141% 124% 124% 104% 90% 87% 105% 110%	commencing mbia statuto hours comm Delivery Facto Peak 122% 113% 112% 95% 82% 81% 96% 101%	g at 06:00 PPT bry holidays. hencing at 16:0 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86%	and ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" r inclusive, but exclu (c) "Super-Peak H holidays." Month January February March April May June July August September	Time of I       Super-Peak       141%       124%       124%       104%       90%       87%       105%       110%       116%	commencing mbia statuto hours comm Delivery Facto Peak 122% 113% 112% 95% 82% 81% 96% 101% 107%	at 06:00 PPT bry holidays. hencing at 16:0 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86% 91%	and ending at 16:00 PPT, and commencing at 20:00 PPT a
	(b) "Peak Hours" r inclusive, but exclu (c) "Super-Peak H holidays." Month January February March April May June July August	Time of I Super-Peak 141% 124% 124% 104% 90% 87% 105% 110%	commencing mbia statuto hours comm Delivery Facto Peak 122% 113% 112% 95% 82% 81% 96% 101%	g at 06:00 PPT bry holidays. hencing at 16:0 or (TDF) Off-Peak 105% 101% 99% 85% 70% 69% 79% 86%	and ending at 16:00 PPT, and commencing at 20:00 PPT a

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

premium for green power. er can purchase to be assured that the electricity used is

e opportunity for geothermal power from British Columbia, umber of reasons

mber 2013 provided a summary of capacity resource nit capacity costs (UCCs) at the point of interconnection to

wer varies by month throughout the year. As an example,

and ending at 22:00 PPT, Monday through Saturday

v inclusive, but excluding British Columbia statutory

Near Revelstoke, British Columbia, Canada **Topographical Map Sheet: Figure 36** Geological Map Sheet: Figure 37

Category	Comments
Estimated Size of Resource Is there any green power incentives?	<ul> <li>See Section A.</li> <li>The BC government created the Innovative Clean Energy (ICE) fund with an initial mandate to accelerate the commercial expanded to include a broad range of energy efficiency and conservation projects). British Columbia also has a program e Development Tax credit (SR&amp;ED). Geothermal proponents could keep a watching brief on these programs for applicability</li> <li>The BC government's First Nations Clean Energy Business Fund. This fund promotes increased Aboriginal community p o Capacity funding of up to \$50,000 per applicant to cover the early stages (e.g. feasibility studies) of project development o Equity funding of up to \$500,000 per applicant to support a financially viable and resourced clean energy project.</li> <li>There are a number of government of Canada programs to encourage the development of renewable power. Some of th calls for proposals. Others may be focussed on research and innovation and may not be directly applicable to geothermal subscribed and even inactive but are noted in terms of completeness. Some of these programs include: o Natural Resources Canada ecoEnergy for Renewable Power program; o Sustainable Development Technology Canada funds; o Clean Energy Fund; o Industrial Research Assistance Program; and o Green Infrastructure Fund</li> <li>Geothermal proponents could keep a watching brief on these and other federal government programs for their applicability</li> </ul>
Grants Tax Holidays Tax Relief	<ul> <li>See above under green power incentives</li> <li>None listed on federal and provincial websites.</li> <li>Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, certain capital costs of systems that produce waste, or conserve energy by using fuel more efficiently are eligible for accelerated capital cost allowance. Under Class 43 per year on a declining balance basis. In general, equipment that is eligible for Class 43.1 but is acquired after February 2 percent per year on a declining balance basis under Class 43.2. Without these accelerated write-offs, many of these asset annual rates between 4 and 30 percent.</li> <li>In addition to Class 43.1 or 43.2 capital cost allowance, the Income Tax Regulations allow certain expenses incurred duri and energy conservation projects [Canadian renewable and conservation expenses (CRCE)] to be fully deducted in the ye deducted in future years, or transferred to investors through a flow-through share agreement.</li> </ul>

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

ialization of emerging clean energy technologies (now entitled Scientific Research and Experimental ty and relevance.

participation in the clean energy sector. It provides: ent; and

these programs may be active but not currently issuing al technologies/resources, while others may be fully

ity and relevance.

ce energy by using renewable energy sources or fuels from 43.1, eligible equipment may be written-off at 30 percent 22, 2005 and before year 2020 may be written-off at 50 ets would be depreciated for income tax purposes at

uring the development and start-up of renewable energy vear they are incurred, carried forward indefinitely and

Near Revelstoke, British Columbia, Canada Topographical Map Sheet: Figure 36 Geological Map Sheet: Figure 37

Category	Comments
Loan Guarantees	The following is an excerpt from http://www.fnfa.ca/en/fnfa/
	"The First Nations Finance Authority (FNFA) is a statutory not-for-profit organization without share capital, operating under 2005. The FNFA's purposes are to provide investment options and capital planning advice and—perhaps most importantly The FNFA is not an agent of Her Majesty or a Crown corporation and is governed solely by the First Nations communities
	The advantages of joining the FNFA as a Borrowing Member are:
	<ol> <li>Access to low rate, below bank prime, loans with repayment terms up to 30 years;</li> <li>First Nations choose the repayment terms that work best for their budget;</li> <li>FNFA loans do not require collateral;</li> </ol>
	<ul><li>4. FNFA loans can be used to refinance existing debt; and</li><li>5. FNFA's interest rates and terms parallel those available to provincial and local governments.</li></ul>
	Most revenue streams are eligible to support FNFA loan requests. Eligible capital projects FNFA can finance include infras purchases, independent power projects, community housing and rolling stock/heavy equipment.
	FNFA is a stand-alone organization separate from the Government of Canada, and its operating policies are set by its Bor and Council appointee. The FNFA is for First Nations, by First Nations."
Royalties/Fees	Geothermal Resources Act, [RSBC 1996] CHAPTER 171, as of March 11, 2015
	Permits for well authorizations for wells to be drilled within the boundaries of the permittee's location must pay a prescribed
	Based on Section 17 of the Act, (1) A lessee who produces a geothermal resource for purposes other than testing must pa (a) a royalty established by agreement under this section,
	(b) an amount agreed under this section to be paid instead of royalty, or
	(c) if no royalty or amount has been agreed under this section, the prescribed royalty.
General Idea of Royalties	With regard to use of the water resources within the geothermal tract, Section 4 of the Water Sustainability Act states "Thi in section 1 (1) [definitions] of the Geothermal Resources Act."
Private Land Owner or Government Land	Geothermal proponents will need to arrange financial agreements (eg leases or purchases) with private property owners for proponents for geothermal facilities on Crown Land must apply for the appropriate tenure under the BC Land Act (eg Statu
Tax Rate in the Country	<ul> <li>Income eligible for small-business deduction (up to \$500,000 income): 11% Federal tax, combined federal and provincial</li> <li>Income not eligible for small-business deduction: 15% Federal, combined federal and provincial (British Columbia): 26%</li> </ul>
Transmission Tariffs	Under wholesale wheeling (whereby electricity is transmitted from electricity generators to utilities) to customers in Alberta generation supplier must request service on the appropriate BC Hydro transmission line under the Open Access Transmiss Depending on the end customer, the generation supplier will have to make similar arrangements to cover transmission access Authority for wheeling to a US customer). This 'pancaking' of rates, along with transmission congestion issues, affects the

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015

er the authority of the First Nations Fiscal Management Act, tly, access to long-term loans with preferable interest rates. s that join as Borrowing Members.

astructure, social and economic development, land

prrowing Members, represented by the First Nation's Chief

ed rent for the permit (Section 5).

pay to the government

his Act does not apply to geothermal resources as defined

for the geothermal land tract.

atutory Right of Way, Licence of Occupation).

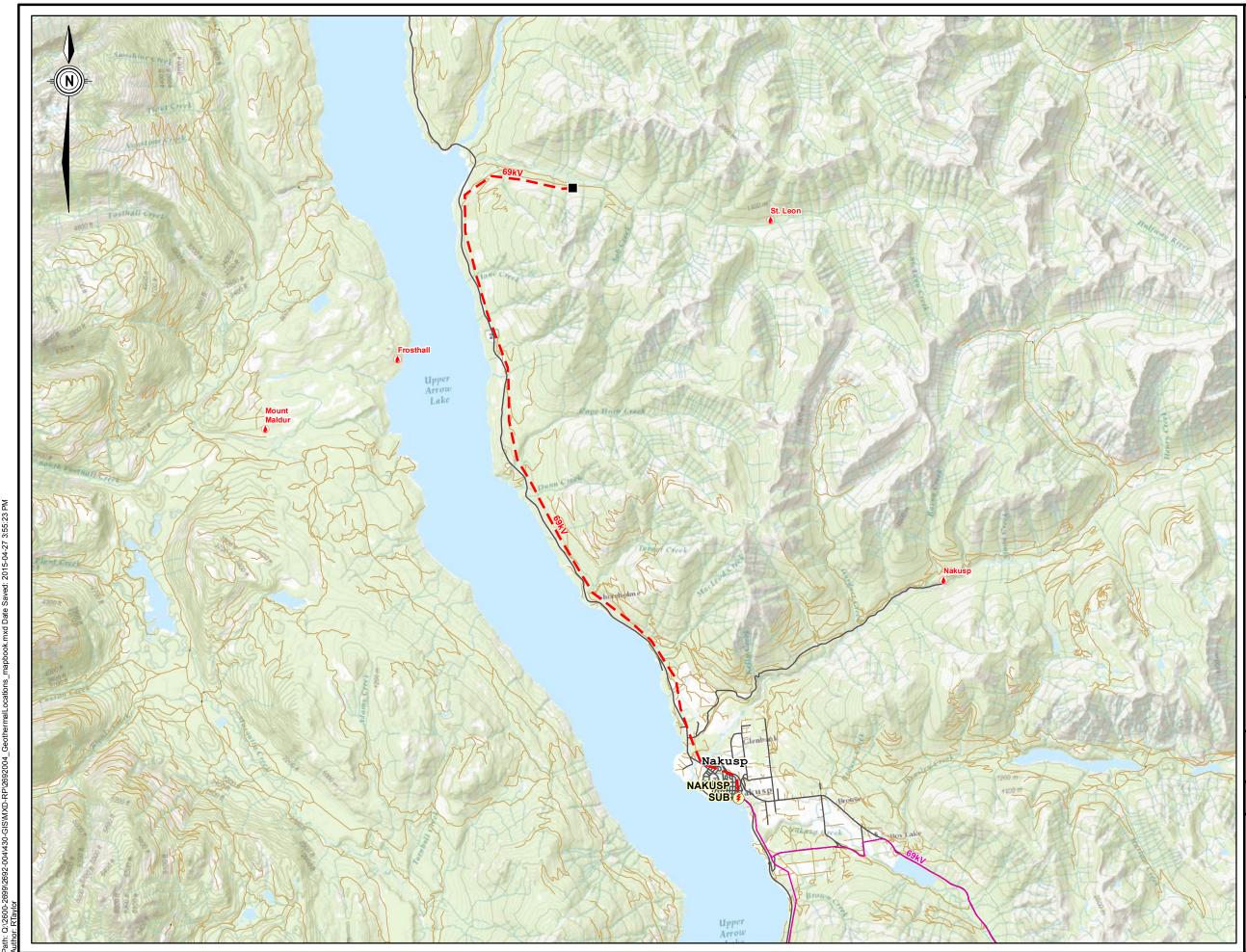
al (British Columbia): 13.5%.

a, the US, or other wholesale customers in BC, the ission Tariff (OATT) at a regulated cost for that service. access in other jurisdictions (e.g. the Bonneville Power e economic viability of the potential wholesale opportunity.

Near Revelstoke, British Columbia, Canada Topographical Map Sheet: Figure 36 Geological Map Sheet: Figure 37

	Category	Comments
Ν	. Maps	
	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)	
	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks). (1:500,000?)	Topographical Map Sheet: Figure 36
	Regional geological map. (1:250 or 500,000?)	Geological Map Sheet: Figure 37
	Detailed geological map of the immediate area of the concessions. (1:50,000 or 100,000)	Geological Map Sheet: Figure 37
N	Other Issues and Considerations	

#### An Assessment of the Economic Viability of Selected Geothermal Resources in British Columbia June 29, 2015





# Legend

Proposed Geothermal Plant Location

- Thermal Spring
- Proposed Transmission Line
- Existing Substation
- Existing Transmission Line
- Paved Road
- Other Road



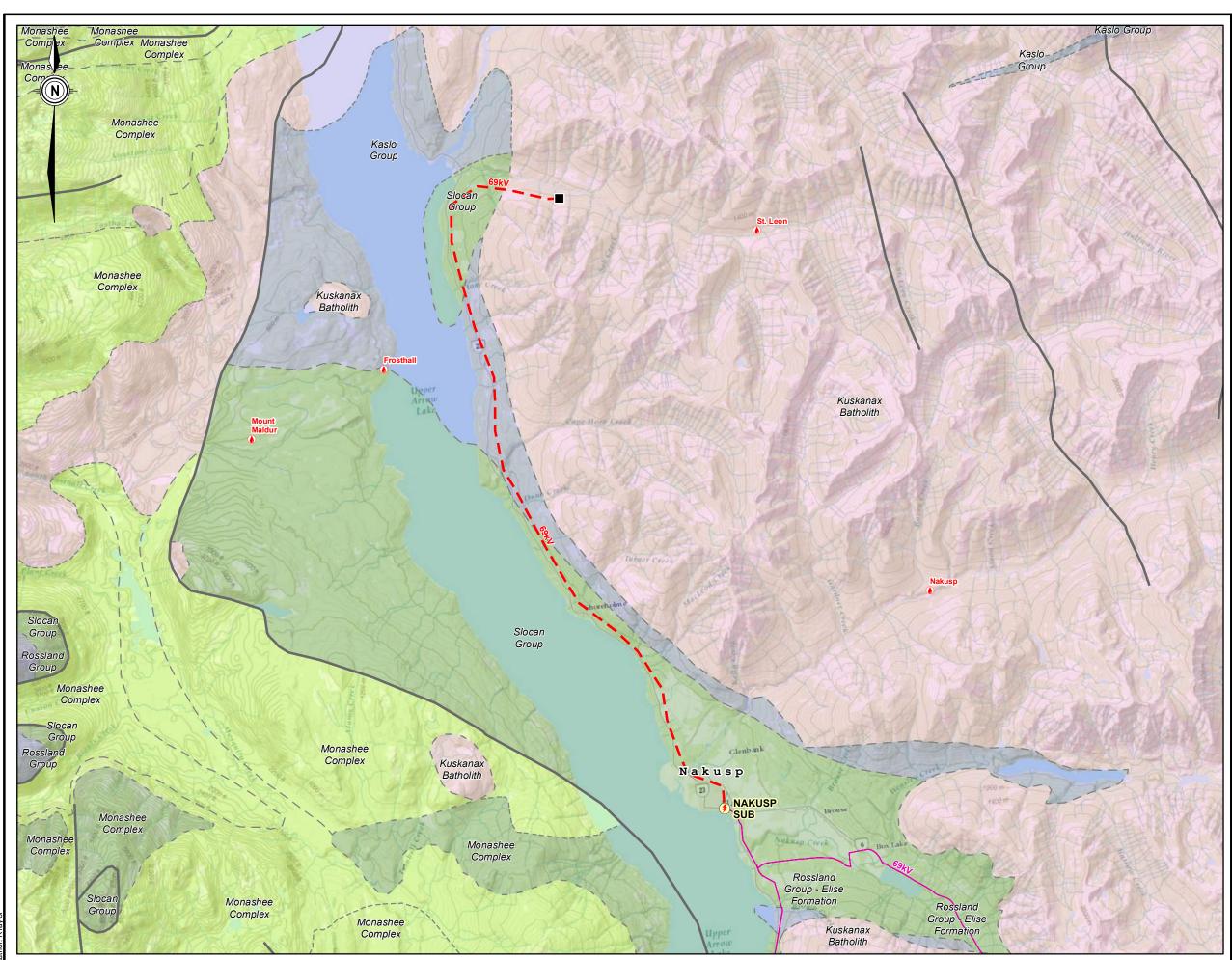
rvice Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, Increment P Corp., GEBCO, GS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China og Kong), «visistop, Manpy India, © DensFtreeMap contributors, and the GIS User Community

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3	(	)	3
	Kilom	eters	
Project No. 2692-004		Date April 30, 2	2015

# Potential Geothermal Plant at Upper Arrow 20MW

Figure 36



	Geéscience BC
Legend	
-	Proposed Geothermal Plant Location
<b>()</b>	Thermal Spring
	Proposed Transmission Line
۶	Existing Substation
	Existing Transmission Line
Bedrock	r <b>Type</b> Intrusive Rocks
	Metamorphic Rocks
	Sedimentary Rocks
	Volcanic Rocks
1	Rock Type Boundary
	Fault
KERR WOOD LEIDAL	
consulting engineers	
Service Layer Cree	© 2015 Kerr Wood Leidal Associates Ltd.
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4	0 4
Kilometers	
Project No 26	D. Date 192-004 April 30, 2015
Geological Strata Map for	
Upper Arrow	
20MW	
	Figure 37