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# **SMALL STORAGE HYDROELECTRIC RESOURCE OPTIONS STUDY REPORT**

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## EXECUTIVE SUMMARY

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Knight Piésold Ltd. (KP) was retained by BC Hydro to complete an assessment of storage hydro potential in three regions of BC: the North Coast, Vancouver Island, and the Lower Mainland. The study areas were further limited within these regions by a maximum of 50 km from BC Hydro transmission lines and a variety of exclusion zones. Given these parameters KP established a four-step screening process that applied increasing constraints to narrow down the areas of interest to projects that may be technically and commercially viable:

- Screen 1: Drainage Area Mapping, to eliminate rivers with drainage areas that would be too small (thereby requiring unachievable amounts of head) or too large (thereby resulting in an under-sized facility that would require excessive diversion structures and spillways).
- Screen 2: Dam Site Identification, a review of mapping and Google Earth to identify potentially viable dam sites.
- Screen 3: Minimum Capacity Screening, to determine the combination of head and flow required to achieve a minimum power output of 20 MW, as required to meet the BC Hydro definition for Dependable Capacity.
- Screen 4: Dam Geometry and Capital Cost Screening, an iterative process of adjusting facility configuration to provide minimum and maximum reservoir operating range, design flows, penstock, transmission line, and access road lengths, and to determine high-level capital cost estimates for each site passing Screen 3.

In total, KP identified 6 sites on the North Coast, 2 sites on Vancouver Island, and 8 sites in the Lower Mainland region which have estimated overnight capital costs of less than \$8M/MW for the 16-hour per day generation period. Study results for all generation periods assessed are summarized below.



### Study Results – 16-Hour Generation

Region	SITE NAME	Dam Height for Dependable Capacity (m)	Total Head (m)	Design Flow (m³/s)	Installed Capacity (MW)	Total Capital (Overnight)	Capacity Cost (/MW)	Annual Energy Production (GWh)
North Coast	Ball Creek	23	123	21.1	21.6	\$ 168,580,000	\$ 7,800,000	46.2
North Coast	Nass River	39	39	192.1	61.8	\$ 457,917,000	\$ 7,408,000	290.4
North Coast	Kinskuch River	10	705	5.4	31.8	\$ 207,309,000	\$ 6,519,000	129.6
North Coast	Zymoetz River	45	45	136.4	51.2	\$ 330,990,000	\$ 6,459,000	276.8
North Coast	Anudol Creek (a)	15	507	6.6	28.1	\$ 213,927,000	\$ 7,611,000	134.1
North Coast	More Creek	34	34	135.6.6	38.3	\$ 261,833,000	\$ 6,833,000	148.8
Van Island	Nimpkish River (b)	12	54	171.2	77.6	\$ 518,430,000	\$ 6,683,000	463.7
Van Island	Chemainus River	47	161	19.0	25.5	\$ 181,117,000	\$ 7,100,000	137.6
Lower Mainland	Freda Creek	21	348	10.5	30.6	\$ 193,069,000	\$ 6,319,000	202.5
Lower Mainland	Squamish River (b)	22	43	189.7	67.7	\$ 506,534,000	\$ 7,481,000	375.1
Lower Mainland	Elaho River	42	55	139.0	63.9	\$ 427,915,000	\$ 6,696,000	354.7
Lower Mainland	South Creek	27	625	8.7	45.1	\$ 242,970,000	\$ 5,382,000	251.4
Lower Mainland	Siwash Creek	41	437	5.7	20.7	\$ 132,452,000	\$ 6,388,000	77.3
Lower Mainland	Silverhope Creek	34	299	20.5	51.1	\$ 373,088,000	\$ 7,301,000	313.8
Lower Mainland	Nahatlatch River	20	166	60.7	83.9	\$ 416,465,000	\$ 4,963,000	442.6
Lower Mainland	Spuzzum Creek	18	419	8.6	30.2	\$ 184,602,000	\$ 6,116,000	156.3

### Study Results – 12-Hour Generation

Region	SITE NAME	Dam Height for Dependable Capacity (m)	Total Head (m)	Design Flow (m³/s)	Installed Capacity (MW)	Total Capital (Overnight)	Capacity Cost (/MW)	Annual Energy Production (GWh)
North Coast	Ball Creek	23	123	28.1	28.8	\$ 191,428,000	\$ 6,643,000	46.2
North Coast	Nass River	39	39	192.1	61.8	\$ 457,917,000	\$ 7,408,000	290.4
North Coast	Kinskuch River	10	705	5.4	31.8	\$ 207,309,000	\$ 6,519,000	129.6
North Coast	Zymoetz River	45	45	136.4	51.2	\$ 330,990,000	\$ 6,459,000	276.8
North Coast	Anudol Creek (a)	15	507	6.6	28.1	\$ 213,927,000	\$ 7,611,000	134.1
North Coast	More Creek	34	34	180.8	51.1	\$ 302,548,000	\$ 5,922,000	166.3
Van Island	Nimpkish River (b)	12	54	171.2	77.6	\$ 518,430,000	\$ 6,683,000	463.7
Van Island	Chemainus River	47	161	19.9	26.7	\$ 184,852,000	\$ 6,914,000	141.6
Lower Mainland	Freda Creek	21	348	10.5	30.6	\$ 193,069,000	\$ 6,319,000	202.5
Lower Mainland	Squamish River (b)	22	43	189.7	67.7	\$ 506,534,000	\$ 7,481,000	375.1
Lower Mainland	Elaho River	42	55	139.0	63.9	\$ 427,915,000	\$ 6,696,000	354.7
Lower Mainland	South Creek	27	625	8.7	45.1	\$ 242,970,000	\$ 5,382,000	251.4
Lower Mainland	Siwash Creek	41	437	7.6	27.6	\$ 150,290,000	\$ 5,436,000	86.9
Lower Mainland	Silverhope Creek	34	299	20.5	51.1	\$ 373,088,000	\$ 7,301,000	313.8
Lower Mainland	Nahatlatch River	20	166	60.7	83.9	\$ 416,465,000	\$ 4,963,000	442.6
Lower Mainland	Spuzzum Creek	18	419	8.6	30.2	\$ 184,602,000	\$ 6,116,000	156.3

### Study Results – 8-Hour Generation

Region	SITE NAME	Dam Height for Dependable Capacity (m)	Total Head (m)	Design Flow (m³/s)	Installed Capacity (MW)	Total Capital (Overnight)	Capacity Cost (/MW)	Annual Energy Production (GWh)
North Coast	Ball Creek	23	123	42.2	43.2	\$ 235,463,000	\$ 5,448,000	46.2
North Coast	Nass River	39	39	240.0	77.2	\$ 504,527,000	\$ 6,531,000	324.5
North Coast	Kinskuch River	10	705	6.8	40.1	\$ 227,504,000	\$ 5,671,000	151.8
North Coast	Zymoetz River	45	45	136.4	51.2	\$ 330,990,000	\$ 6,459,000	276.8
North Coast	Anudol Creek (a)	15	507	9.5	40.3	\$ 251,969,000	\$ 6,257,000	168.2
North Coast	More Creek	34	34	271.2	76.6	\$ 383,985,000	\$ 5,011,000	169.3
Van Island	Nimpkish River (b)	12	54	171.2	77.6	\$ 518,430,000	\$ 6,683,000	463.7
Van Island	Chemainus River	47	161	29.9	40.1	\$ 224,580,000	\$ 5,600,000	168.5
Lower Mainland	Freda Creek	21	348	13.8	40.1	\$ 224,330,000	\$ 5,601,000	210.7
Lower Mainland	Squamish River (b)	22	43	189.7	67.7	\$ 506,534,000	\$ 7,481,000	375.1
Lower Mainland	Elaho River	42	55	139.0	63.9	\$ 427,915,000	\$ 6,696,000	354.7
Lower Mainland	South Creek	27	625	8.7	45.1	\$ 242,970,000	\$ 5,382,000	251.4
Lower Mainland	Siwash Creek	41	437	11.4	41.5	\$ 184,726,000	\$ 4,454,000	87.6
Lower Mainland	Silverhope Creek	34	299	20.5	51.1	\$ 373,088,000	\$ 7,301,000	313.8
Lower Mainland	Nahatlatch River	20	166	60.7	83.9	\$ 416,465,000	\$ 4,963,000	442.6
Lower Mainland	Spuzzum Creek	18	419	11.6	40.4	\$ 218,104,000	\$ 5,397,000	171.2

### Study Results – 4-Hour Generation

Region	SITE NAME	Dam Height for Dependable Capacity (m)	Total Head (m)	Design Flow (m³/s)	Installed Capacity (MW)	Total Capital (Overnight)	Capacity Cost (/MW)	Annual Energy Production (GWh)
North Coast	Ball Creek	23	123	84.4	86.4	\$ 361,131,000	\$ 4,178,000	46.2
North Coast	Nass River	39	39	480.1	154.5	\$ 737,814,000	\$ 4,776,000	423.4
North Coast	Kinskuch River	10	705	13.6	80.2	\$ 320,555,000	\$ 3,995,000	200.7
North Coast	Zymoetz River	45	45	215.0	80.8	\$ 415,039,000	\$ 5,139,000	336.8
North Coast	Anudol Creek (a)	15	507	19.0	80.5	\$ 368,153,000	\$ 4,571,000	200.8
North Coast	More Creek	34	34	542.4	153.3	\$ 628,287,000	\$ 4,099,000	169.3
Van Island	Nimpkish River (b)	12	54	181.5	82.2	\$ 536,411,000	\$ 6,524,000	472.6
Van Island	Chemainus River	47	161	59.7	80.2	\$ 337,434,000	\$ 4,207,000	171.9
Lower Mainland	Freda Creek	21	348	27.6	80.1	\$ 346,536,000	\$ 4,326,000	211.4
Lower Mainland	Squamish River (b)	22	43	229.2	81.8	\$ 568,058,000	\$ 6,943,000	412.0
Lower Mainland	Elaho River	42	55	176.9	81.3	\$ 481,159,000	\$ 5,919,000	398.5
Lower Mainland	South Creek	27	625	15.5	80.9	\$ 327,681,000	\$ 4,050,000	317.0
Lower Mainland	Siwash Creek	41	437	22.8	82.9	\$ 283,244,000	\$ 3,415,000	87.6
Lower Mainland	Silverhope Creek	34	299	32.2	80.3	\$ 466,130,000	\$ 5,807,000	352.5
Lower Mainland	Nahatlatch River	20	166	60.7	83.9	\$ 416,465,000	\$ 4,963,000	442.6
Lower Mainland	Spuzzum Creek	18	419	23.1	80.8	\$ 340,367,000	\$ 4,211,000	213.7

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## ABBREVIATIONS

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AACE.....	American Association of Civil Engineers
BC .....	British Columbia
BC FLNRO .....	British Columbia Forests, Lands, and Natural Resource Operations
BC MOTI .....	British Columbia Ministry of Transportation and Infrastructure
BQN.....	Bob Quinn Substation
CFB .....	Canadian Forces Base
CFRD .....	concrete faced rockfill dam
CWB .....	Canadian Water Branch
EPA .....	Energy Purchase Agreement
EPCM .....	engineering, procurement and construction management
GEOBC .....	Geography British Columbia
ILMB .....	Integrated Land Management Bureau
IPPBC.....	Independent Power Producers of British Columbia
km.....	kilometre
KP .....	Knight Piésold Ltd.
kV .....	kilovolt
kWh .....	kilowatt hour
LRDW .....	Land and Resource Data Warehouse
m .....	metres
MAD .....	mean annual discharge
MW .....	megawatt
M .....	millions
N.....	north
NTS .....	National Topographic System
POD.....	point of diversion
Qd.....	design flow
RC .....	reinforced concrete
RCC.....	roller compacted concrete
RFP .....	request for proposal
TSF.....	tailings storage facility
W .....	west
WSC.....	Water Survey of Canada

# 1.0 INTRODUCTION

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## 1.1 BACKGROUND

BC Hydro's Energy Planning Department has commissioned Knight Piésold Ltd. (KP) to complete a study that identifies small hydroelectric potential across three regions of BC: the North Coast, the Lower Mainland and Vancouver Island. The results of this study will be used as inputs to BC Hydro's long-term portfolio analysis that evaluates the relative merits of different resources under a variety of design scenarios.

## 1.2 SCOPE OF STUDY

The scope of the Small Storage Hydro Study was defined in the BC Hydro Request for Proposals (RFP) entitled Assessment of Small Storage Hydroelectric Potential and modified as necessary in consultation with BC Hydro. The study was focused on the North Coast, Lower Mainland and Vancouver Island regions of BC. Several exclusion areas within each study region were identified by BC Hydro. Further information on these exclusion zones and how they were utilized in the study is provided in Section 2.1.

The overall intention of the study was to identify potential small storage hydroelectric sites having an installed capacity of between 20 MW and 100 MW capable of providing dependable capacity of greater or equal to 20 MW. Dependable capacity was defined as the maximum sustained capacity that a plant can deliver, with 85% exceedance probability for a certain number of hours per day, 6 days a week for 2 weeks between December 1 and January 31. Generation durations for dependable capacity calculations considered 4, 8, 12, and 16 hours/day.

The study was aimed at short-listing no more than 20 sites per region that have the potential for future development, are cost effective, and meet the technical requirements noted above. A threshold of \$8 Million per Megawatt installed capacity (\$8M/MW) was chosen as the upper bound limit for final project screening. No environmental or fisheries considerations were applied to the screening process.

In order to estimate costs and determine the sites that met the maximum threshold of \$8M/MW various technical and economic attributes were determined, including estimated dam type and height, reservoir size, penstock, transmission line, and access road lengths.

## 2.0 SITE IDENTIFICATION

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### 2.1 REGIONAL DELINEATION AND EXCLUSION ZONES

As defined by BC Hydro the small storage hydro study was conducted within three specific regions within BC subject to zones that would be excluded from site identification. The definition of the regional boundaries and the specific study areas are described below.

#### 2.1.1 STUDY REGIONS

##### 2.1.1.1 NORTH COAST

The study area for the North Coast region of British Columbia was limited to a 50 km boundary on either side of the 2L99, 2L101, and 2L102 transmission lines of BC Hydro's grid, with the most north substation being Bob Quinn (BQN). Only 138 kV and 230 kV lines were considered. GIS data of the BC Hydro transmission system within the North Coast region was provided by BC Hydro.

##### 2.1.1.2 LOWER MAINLAND

Lower Mainland is defined as the area within mainland BC that is southwest of latitude N 51 and longitude W 121. The study area was limited to a 50 km boundary on either side of existing 138 kV and 230 kV transmission lines in this area, excluding privately owned and operated transmission lines. No islands off the coast of the Lower Mainland region were included in this study.

##### 2.1.1.3 VANCOUVER ISLAND

The Vancouver Island study area was limited to a 50 km boundary on either side of existing 138 kV and 230 kV transmission lines on the island. No islands surrounding Vancouver Island were included in this study.

#### 2.1.2 EXCLUSION ZONES

Exclusion zones were identified by BC Hydro as provided in Appendix B of the RFP documents. Table 2.1 below summarizes these zones.

**Table 2.1 Study Area Exclusion Zones**

<b>Exclusion Zone</b>	<b>Source</b>	<b>Screening Buffer</b>
<b>Biodiversity Areas</b>	Province of British Columbia, GeoBC, ILMB	No projects within 100 m of exclusion area
<b>Wildlife Management Areas</b> Areas for which administration and control was transferred to the Ministry of Environment via the <i>Land Act</i> due to the significance of their wildlife/fish values and designated as Wildlife Management Areas under the <i>Wildlife Act</i>	Province of British Columbia, GeoBC, LRDW	No projects within 100 m of exclusion area
<b>Conservancy Areas</b> Conservancy areas designated under the <i>Park Act</i> or by the <i>Protected Areas of British Columbia Act</i> , whose management and development is constrained by the <i>Park Act</i>	Province of British Columbia, GeoBC, LRDW	No projects within 100 m of exclusion area
<b>National Parks</b>	Province of British Columbia, GeoBC, LRDW	No projects within 100 m of exclusion area
<b>Legally Protected Areas</b> Ecological Reserves, Protected Areas, Provincial Parks, Recreation Areas	Province of British Columbia, GeoBC, LRDW	No projects within 100 m of exclusion area
<b>Canadian Forces Bases</b>	CFB Esquimalt (Navy) CFB Comox (Air Force)	No projects within 100 m of exclusion area
<b>Migratory Bird Sanctuaries</b>	Environment Canada	No projects within 100 m of exclusion area
<b>Glaciers</b>	Province of British Columbia, GeoBC, CWB	No projects, roads or power lines within 100 m of exclusion area
<b>Existing and Approved Projects</b>	Water Licenses, IPPBC	No projects within a 10 km buffer of all existing, approved, and under construction power generation projects. For the purposes of this study, “approved” refers to projects with EPAs with BC Hydro.

All exclusion zones were mapped as defined in Table 2.1 with the exception of existing and approved projects. The 10 km screening buffer around all existing, approved and under construction power generation projects was not defined as to the specific entity or entities in which the buffer was to be applied. In consultation with BC Hydro it was agreed that KP would apply the 10 km buffer to the approved Point of Diversion (POD) that were sourced from the BC Water Licences Query website ([http://a100.gov.bc.ca/pub/wtrwhse/water\\_licences.input](http://a100.gov.bc.ca/pub/wtrwhse/water_licences.input)). In addition, the screening buffer definition for this study was also not limited to projects with EPAs with BC Hydro since independent power projects that do not sell power to BC Hydro were seen as equally important with respect to impacts from other developments.



Maps showing the study areas and exclusion zones are provided in Appendix A.

## 2.2 REGIONAL HYDROLOGY ESTIMATES

An estimate of the anticipated hydrologic conditions across each region was required for the initial stages of screening such that design flows could be determined. In order to do this for such a large study area, KP utilized published regional estimates of mean annual unit area runoff from the following reports as follows:

- North Coast – Inventory of Streamflow in the Skeena Region (A. Ahmed and S. Jackson 2013), and
- Vancouver Island and Lower Mainland – Streamflow in the Lower Mainland and Vancouver Island (W. Obedkoff 2003).

Obedkoff (2003) and Ahmed and Jackson (2013) present hydrologic zones, which are regions of relatively homogeneous hydrologic characteristics. For each zone, plots of mean annual runoff versus median watershed elevation are presented. Because median watershed elevation was not known at this stage, an upper bound mean annual runoff was selected for each hydrologic zone. The upper bound was selected as this was considered a conservative assumption (i.e. unlikely to exclude sites that have higher runoff than estimated from this screening method). Each hydrologic zone was delineated in ArcGIS and the mean annual runoff estimates were used to determine the estimated Mean Annual Discharge (MAD) for each catchment area.

## 2.3 SITE SCREENING

The screening assessment included four levels of screening in order to first identify all potential dam sites across each region and then systematically screen candidate sites to identify a short-list of sites that have the greatest potential for future development. It should be noted that each screening level was limited to the data sources available and the number of specific attributes that could be realistically assessed at each stage. A summary of the assumptions made and the data sources available is provided with a description of each Screen in the sections to follow.

### 2.3.1 SCREEN 1 – DRAINAGE AREA MAPPING

A series of maps were prepared for each study region using ArcGIS software to aid in identifying candidate sites. The maps were prepared by first delineating study regions, then amending study regions to include all exclusion zones described in Section 2.1.2 above.

Drainage areas were then mapped for each stream confluence that met the minimum and maximum catchment area requirements as follows:

- A minimum drainage area was defined for each hydrologic zone such that in order for a project to meet the minimum 20 MW installed capacity threshold a maximum design gross head of 1,000 m could not be exceeded. 1,000 m gross head was seen as the anticipated upper limit for a feasible 20 MW facility, and if a drainage area was small enough that more than 1,000 m of head would be required, the drainage area was too small for further consideration.

- A maximum drainage area was defined for each hydrologic zone such that the design flow would be reasonably limited to 0.5 times the Mean Annual Discharge and the project would not exceed the maximum 100 MW installed capacity criteria. In this case, if a project was to have diversion facilities that divert a greater proportion of the annual flows for a particular site than would be used for power generation, the cost for developing the diversion facilities (i.e. Spillway) would be an overwhelming cost to the project.

### 2.3.1.1 DATA SOURCES AND ASSUMPTIONS

#### Drainage Area Mapping

All drainage areas and contour data were developed using NTS mapping data. NTS mapping was used since these data were freely obtained and provided coverage across all project regions. The limitation of these data was that they are based on historic mapping techniques that are inferior to more modern techniques. The resulting data set provided contour data with intervals of between 30 and 33 m.

#### Mean Annual Discharge

MAD estimates were determined for this stage as described in Section 2.2. The defined hydrologic zones were found to cross drainage areas. In these instances, MAD was based on the hydrologic zone that the intake was located in. For larger watersheds this assumption may not be very representative; however it was assumed that these estimates are sufficient for initial screening.

#### Design Flow

For the initial screening it was assumed that a design flow equal to MAD was a reasonable estimate for identifying storage hydro sites.

## 2.3.2 SCREEN 2 – DAM SITE IDENTIFICATION

Google Earth was used to conduct a visual assessment for each region to identify suitable dam sites that had the following characteristics:

- Cross sections that were along reasonably confined reaches of subject rivers/creeks, resulting in efficient and cost effective dam construction.
- Upstream reaches that would allow a large volume of water to be held upstream of the dam, helping to minimize dam heights and construction costs. Long, wide, flat reaches tend to be more efficient than short, narrow, steep reaches.

The terrain data provided by Google Earth was used to identify potential dam sites. It was assumed that these data were fit for the purpose of this assessment and were either comparable to or better than the NTS mapping data. It should be noted that no assessment of data accuracy was completed as part of this study.

The total number of potential dam sites identified in this Screen is as follows:

- North Coast – 50 sites
- Vancouver Island – 95 sites, and
- Lower Mainland – 96 sites.

These sites are shown on Figures A-1 (North Coast) and A-2 (Vancouver Island and Lower Mainland) in Appendix A. A list of these sites is provided on Table B-1 in Appendix B for reference.

### 2.3.3 SCREEN 3 – GROSS GENERATION HEAD REQUIREMENT

In order to refine the number of candidate sites to those that meet the minimum installed capacity requirements, as set out in Section 1.2 – Scope of Study, all sites identified during Screen 2 were assessed for minimum head requirements. Gross generation head was determined as a sum of the head available from the dam as well as head available from a penstock.

Drainage areas and MAD estimates were refined based on the dam site locations identified in Screen 2. Following from assumptions noted above for initial design flow estimates the minimum head required for each site to achieve the minimum capacity of 20 MW was calculated, assuming an overall system efficiency of 85 percent. Dam storage volumes to satisfy the dependable capacity definition were minimized, as it was assumed that minimizing dam construction costs would yield the best project economics. This is to say that the development of a penstock, where the gradient downstream of a dam permits, would be more economic than constructing a higher dam.

Google Earth was used to delineate stream reaches downstream of each dam site. These delineations were used to determine the available generation head downstream of each dam site. Distances were initially limited to 10 km where estimated gradients were too flat. Penstocks at less than approximately 5 percent grade are marginal in value, as the penstock costs counteract the added benefit of developing the additional head downstream of a dam rather than constructing a larger dam. However, final screening of sites considered a maximum capacity cost metric of \$8M/MW of installed capacity, therefore in cases where a reduced capacity cost can be achieved utilizing less efficient penstocks (i.e. Less than 5% grade) to increase the installed capacity such arrangements were considered. This is described further in the following section.

Each site was evaluated based on the minimum dam height required to achieve 20 MW dependable capacity storage volumes and available penstock head. Sites not capable of achieving minimum gross head requirements were eliminated from further assessment.

The total number of potential dam sites passing this Screen were as follows:

- North Coast – 19 sites
- Vancouver Island – 4 sites, and
- Lower Mainland – 13 sites.

A list of these sites including map coordinates is provided on Table B-2 in Appendix B for reference.

### 2.3.4 SCREEN 4 – DAM GEOMETRY AND CAPITAL COSTS

Conceptual facility geometry was developed for those sites passing Screen 3 in order to provide further definition to each potential project. A spreadsheet based model that allowed user input of various calculated project data was used to estimate facility geometry, provide dependable capacity, installed capacity, monthly energy estimates for average and firm flow conditions, capital cost estimates and other related

project outputs that would be required for assessing the sites. The process for developing facility geometry using this spreadsheet model is described in further detail below.

#### **2.3.4.1 DAM GEOMETRY FOR DEPENDABLE CAPACITY**

Site-specific monthly average hydrology estimates and reservoir depth-area-curve data was compiled for each dam site to allow for an assessment of dam storage potential and height requirements. The storage volume to provide the minimum dependable capacity of 20 MW for the two week period between December 1 and January 31 was calculated, and storage volume estimates were adjusted (reduced) to account for winter inflows during the dependable capacity generation period. Initial dam heights were then adjusted upwards to account for a 50 percent dead storage capacity, to reduce reservoir operating level variability and to ensure capacity for the 85<sup>th</sup> percentile flow case. All dams were sized to accommodate the 16-hour generation case as this would require the greatest storage volumes to meet the 20 MW dependable capacity definition.

#### **2.3.4.2 DAM TYPE SELECTION**

A preliminary assessment of dam type that would be utilized at each project site was completed. Dam types were limited to the following:

- Concrete Faced Rockfill Dam (CFRD)
- Roller Compacted Concrete (RCC), and
- Reinforced Concrete (RC).

Dam type was selected based initially on dam height and crest length. RC dams were specified for dam heights of 15 m or less considering concrete volumes could be optimized with the integration of intake facilities. In most cases, the remaining sites were specified as CFRD as they would be more cost effective than RCC or RC. In some instances RCC dams were specified where diversion flows were likely to be significantly larger than design flows. Such sites would require costly gated spillway facilities if a CFRD was specified. RCC dams in these cases would be designed with an integral ungated overflow section to help reduce gated spillway costs. No attempt at optimizing dam type and or geometry has been completed at this stage. It is anticipated that a more detailed options study should be undertaken at each site in order to determine the optimum dam/spillway/intake arrangement.

#### **2.3.4.3 TURBINE SELECTION**

For the purposes of this study only two types of turbines were assumed; Francis for low head facilities and Pelton for high head facilities. A gross head of 250 m was selected as the limit for Francis turbines. It should be noted that no attempt to optimize the turbine type or number of turbines has been made and that final selection will take into account other facility parameters including design flow, ramping requirements, etc. The energy modelling completed for this study was based on overall assumed system efficiencies and did not draw specifically on unique turbine parameters.

#### **2.3.4.4 PENSTOCK LENGTH REFINEMENT**

As noted in Section 2.3.3 penstock lengths required some amount of optimization to assess whether or not the project would benefit from the additional capacity and energy gained by developing head below the dam site. Penstock lengths that were determined in Screen 3 were initially eliminated if the overall penstock grade was less than 5%. In several cases, the penstock contributes to a significant portion of the overall facility head and elimination of the penstock resulted in some facilities having higher capacity costs. For these sites, a high level assessment using Google Earth was completed to determine the optimum penstock length that would retain as much head as possible.

#### **2.3.4.5 TRANSMISSION AND ROAD ACCESS**

An estimation of transmission line length and main access road requirements was made using Google Earth. Transmission lines were assumed to interconnect with BC Hydro's transmission system at the nearest substation to the dam site. Access roads were assumed to be required only to the nearest existing road, presumed to be actively maintained either by BC MOTI or BC FLNRO.

#### **2.3.4.6 ASSUMPTIONS**

In order to complete Screen 4 and establish a final set of potential small storage hydroelectric projects several assumptions were made. These are listed below.

1. Depth-Area-Curve data based on NTS contour data were sufficient for estimating storage volume requirements. Due to the contour interval being 30-33 m, only 2 contours were available for most sites to delineate reservoir areas. Therefore, linear interpolation and extrapolation were performed in the spreadsheet model to estimate dam heights and reservoir volumes.
2. Penstock, transmission line and access road alignments were only estimated in Google Earth and were simply considered on linear length. No actual designs for these components were completed. Penstocks and roads were assumed to follow stream gradients. Transmission line routes were assumed to follow as direct a path as possible to the BC Hydro grid, while considering constructability (e.g. follow valleys where suitable, avoid high elevation passes where snow and ice loading would be high etc.).
3. Dam height and dam construction costs and technical challenges were a major consideration, and for a relatively small hydropower output (20 MW to 100 MW), it was subjectively decided that dam heights exceeding 90 metres would be too expensive or technically challenging to construct.
4. No consideration of variable geotechnical or terrain conditions was made for any of the sites.
5. Installed capacity was based on the total system head (dam height + penstock head).
6. Reservoirs were sized such that dependable capacity of 20 MW of power output was achieved, assuming at the minimum reservoir operating level.
7. No freeboard on dam crests was included in the model due to the extremely coarse nature of the mapping data.

#### **2.3.4.7 CAPITAL COST ESTIMATES**

Capital cost estimates were completed to an AACE Class 5 estimate (-50% to +100%) for the remaining projects (those satisfying the dependable capacity definition and dam height limitation) using a combination of site-specific technical considerations (estimated dam height, crest length, and volume, reservoir area,

transmission line, access road, and penstock length), and scaled input parameters (design flow and installed capacity). The unit rates were derived from actual hydropower construction costs for comparable projects and although very high level, are considered to be a reasonable basis for cost-based screening. Capital costs are described in more detail in Section 3 – Project Definition.

#### **2.3.4.8 CAPACITY COST SCREENING**

Capacity cost (\$/MW) was calculated for each site using the capital cost estimate and the installed capacity calculated for each site. Sites that fell above \$8M/MW were assumed too costly to develop as capacity projects at this time. The total number of projects from each region passing the cost screening were as follows:

- North Coast: 6
- Vancouver Island: 2, and
- Lower Mainland: 8.

The full list of sites passing the cost-screening assessment are provided on Table B-3 in Appendix B for reference. Site-specific data sheets for each site, including hydrology data, technical design parameters, cost estimates, energy models, and unit capacity and energy cost metrics are included in Appendix C.

Further details with respect to site definition for the final list of projects is provided in Section 3.

## 3.0 SITE DEFINITION

---

### 3.1 SITE CHARACTERISTICS

Following from specification of dam and facility geometry completed in Screen 4 each site was characterized based on the following attributes:

- Site Hydrology (see Section 3.2 below)
- Plant design flow
- Dam height, crest length and type
- Reservoir area and volume
- Total gross generation head
- Penstock, transmission line and access road lengths, and
- Project footprint.

These site characteristics are provided on the site summary sheets provided in Appendix C.

### 3.2 SITE HYDROLOGY

For the short-listed sites, passing Screen 4, site specific daily flow series were developed by drainage area proration of a representative Water Survey of Canada (WSC) gauging station. Key criteria in selecting a suitable WSC station include:

- Proximity
- Watershed area and elevation
- Glaciation
- Lake content
- Existing regulation
- Aspect, and
- Period of record.

The key factors governing the differences in timing and magnitude of unit discharge (discharge per unit area) are elevation, glacier cover, distance from the coast, and location relative to the Coast Mountain drainage divide, which dictates maritime/continental and windward/leeward effects. The hydrologic zones on the west coast of British Columbia are generally oriented on a northwest-southeast alignment parallel to the Coast Mountain ranges. The relatively narrow width of the zones is indicative of strong climatic gradients perpendicular to the mountain range and coastline. In general, precipitation decreases, and temperature extremes increase at a given elevation in a landward direction from the coast. Strong orographic enhancement of precipitation occurs on the windward side of the mountains. For these reasons, the closest station may not be the most representative of conditions at the proposed intake locations.

This spatial variability, when combined with the temporal and spatial scarcity of data coverage, presents a significant challenge for estimating the hydrology for an ungauged location. Despite these limitations, a

WSC station was selected for each potential site to estimate inflow conditions. In many cases, WSC has collected data on the rivers in question and the scaled flow series likely provides a good estimate of inflows to the dam. In other cases, KP had completed hydrology studies previously for the rivers in question. The flow series developed for these studies cannot be provided to BC Hydro, but regional analysis and WSC surrogate stations used in these studies was reviewed. However, in many cases, paucity of WSC stations and large variability in hydrologic conditions mean that there may be significant uncertainty in the hydrologic estimates.

Stations with less than 10 complete years of record were excluded as the RFP notes that “inflow conditions from a minimum of 10 years of record should be considered, with a broad variability of water conditions covered”. Additionally, stations with very old records (before approximately 1950) have been excluded as the records are often seasonal, based on infrequent manual observation and/or incomplete. For energy modelling, approximately 20 years of streamflow data have been used to estimate average and firm conditions and where possible the period 1995-2015 was selected as the standard period. In some cases alternative periods were used to accommodate as much as practical a continuous 20 year data set. Not all stations had complete records for this period (i.e. Nahatlatch) or a full 20 year data set. In these cases gaps were left in the data or shorter timeframes were used in order to develop the appropriate flow data. Dam sites and surrogate WSC stations are summarized in Table 3.1.



**Table 3.1 Surrogate WSC Stations**

Region	Dam Site		WSC Station		
	River	Drainage Area (km <sup>2</sup> )	River	ID	Drainage Area (km <sup>2</sup> )
North Coast	Ball	336	Iskut at Kinaslan Lk.	08CG003	1,250
	Iskut River	3,789			
	Nass River	5,333	Skeena ab. Babine	08EB005	12,400
	Kinskuch River	57	Surprise nr. Mouth	08DA005	218
	Zymoetz River	2,963	Zymoetz ab. OK Ck.	08EF005	2,850
	Anudol Creek (b)	99	Surprise nr. Mouth	08DA005	218
	Anudol Creek (a)	70			
	More Creek	889	Zymoetz ab. OK Ck.	08EF005	2,850
	Clore River	772			
Vancouver Island	Nimpkish River	1,751	Nimpkish ab. Woss	08HF005	783
	Nimpkish River	1,163			
	Nanaimo River	658	Nanaimo nr. Cassidy	08HB034	676
	Chemainus River	293	Chemanis nr. Westholme	08HA001	355
Lower Mainland	Bear River	286	Elaho nr mouth	08GA071	1,200
	Orford River	282			
	Tahumming	233			
	Brem River	144			
	Freda Creek	70	Capilano above intake	08GA001	173
	Squamish River	1,722	Elaho nr. mouth	08GA071	1,200
	Elaho River	1,263			
	Squamish River	325	Fitzsimmons bl. Blackcomb	08MG026	90
	Soo River	174			
	South Creek	79	Elaho nr. mouth	08GA071	1,200
	Siwash Creek	61	Coquihalla bl. Needle	08MF062	86
	Sowaqua Creek	140			
	Silverhope Creek	235	Slesse nr. Vedder Crossing	08MH056	160
	Cogburn Creek	78	Coquihalla bl. Needle	08MF062	86
	Pitt River	437	Pitt nr. Alvin	08MH017	515
	Nahatlatch River	930	Nahatlach bl. Tachewana	08MF065	712
	Spuzzum Creek	160	Coquihalla bl. Needle	08MF062	86

### 3.3 CAPACITY AND ENERGY ESTIMATES

BC Hydro requested that the facilities be assessed for dependable capacity. BC Hydro defined dependable capacity in this study as “the maximum sustained capacity (MW) that a plant can deliver, with 85% exceedance probability, for a certain number of hours per day, 6 days a week (Monday – Saturday) for 2-weeks between December 1 and January 31. The dependable capacity for 4, 8, 12, and 16 hours per day should be considered, thereby determining four different optimal designs per site. Each facility has been sized with sufficient storage to meet this requirement, assuming mean monthly inflow. Our assessment was based on mean monthly discharge, as this metric could be readily estimated for many sites. In order to design the facility for dependable capacity, the 85<sup>th</sup> percentile inflow would be calculated, and the required reservoir storage capacity assessed. This resizing was not considered explicitly, as it was considered beyond the resolution of the screening level assessment, given the precision of the hydrology and reservoir storage-elevation data.

In order to estimate annual energy generation, a simple energy model was developed. The basis of the energy model is a run-of-river concept, which assumes that the facility operates at full-pool and energy generating flow equals inflow up to the design flow. The exception to this is during January when the reservoir dewateres to meet the dependable capacity requirement (see point 1. below) and in the subsequent period until the reservoir returns to full-pool, and one additional reservoir drawdown at the onset of spring freshet (in order to capture more of the freshet). Key assumptions in the energy model are as follows:

1. The facility operates in run-of-river mode for the first 17 days of January. The reservoir is then dewatered during the last 14 days of January to meet the dependable capacity requirement.
2. The facility does not operate again until the reservoir is refilled. Several of the facilities fill rapidly and operate again in February, others are not full until March or April. During facility optimization, plants that take a long time to refill the reservoir would likely be designed to operate with a dewatered reservoir through winter and refill the reservoir during freshet.
3. The facility operates in run-of-river mode at full pool for the remainder of the year. No allowance has been included for utilizing storage to increase capacity except for one draw-down at the onset of freshet (after winter refilling). This assumption leads to underestimation of annual energy generation potential, and it is conceivable that most sites may achieve higher performance than is presented in this study.
4. The model is based on monthly flows. If monthly inflow is less than the design flow ( $Q_d$ ), the facility is assumed to operate all month at the average inflow rate. If monthly inflow exceeds  $Q_d$ , the facility is assumed to operate all month at  $Q_d$  (design flow). This assumption has the potential to overestimate annual energy generation because in months with average inflow less than  $Q_d$  there may be periods of flow exceeding  $Q_d$  that have to be spilled. In months with average inflow greater than  $Q_d$  there may be periods of flow less than  $Q_d$ , leading to an average generation flow less than  $Q_d$ . Optimized storage operation may be able to minimize “lost” generation.

The energy model was used to assess average annual and monthly energy estimates for each facility. This model is based on average monthly inflow at each facility (i.e. the model does not use a hydrology timeseries, it simply calculates energy in each month based on the average monthly inflows).

A “firm energy” model was also developed. BC Hydro defined firm energy as “total energy generated in lowest flow water year in period of record”. The energy model was run using monthly average inflow for the year with the lowest annual mean discharge. No consideration was given to which months had low flow and

how this influenced annual total energy generation. In a time-series based energy model, the year with the lowest energy generation could be determined. This may not coincide with the lowest flow year.

### 3.4 CAPITAL COST ESTIMATES

Capital cost estimates have been developed for each project site initially for a dependable generation period of 16-hours per day. Once the initial estimates were refined capital cost estimates were developed for dependable generation periods of 4, 8, and 12-hour per day generation periods. KP has developed a capital cost estimating model that takes into account the various components of a particular hydroelectric facility.

Where quantity estimates could easily be measured appropriate industry unit rates were applied. Measured quantities for this study included:

- Dam volumes
- Reservoir clearing area
- Transmission line length
- Penstock length, and
- Access road length.

In other cases where quantities are not as easily determined KP utilizes proprietary cost curves that aid in estimating costs based on specific design criteria such as design flow, gross penstock head, installed capacity, etc. Capital cost estimates include the following major cost categories:

1. Mobilization, Demobilization, Insurance, Bonds, Overhead, Contractor's Profits (25% of subtotal of items 2-7)
2. Access and Site Preparation
3. Cofferdams and Construction Water Management
4. Intake, Headrace, and Forebay
5. Dam Construction
6. Water Conveyance System
7. Powerhouse Construction
8. Switchyard and Transmission
9. Engineering, Procurement and Construction Management (EPCM) Costs (8% of subtotal of items 1-7), and
10. Contingency (30% of subtotal of items 1-7).

In order to develop capital cost estimates for generation periods of 4, 8, and 12-hours per day it was assumed that only the design flow (and installed capacity) would change such that all measured quantities relating to the dam would not need to be re-calculated and only cost curves that use design flow, such as for intakes, penstocks, and powerhouses would be used to develop the adjusted capital cost estimates. It should be noted that if the screening assessment was completed for each generation period it is possible that more cost effective project arrangements could be realized. Cost estimates for each dam site across the range of generation periods is provided in the site summary tables provided in Appendix C.

### 3.5 OPERATING COSTS

A high level estimation of operation costs has been made for each facility arrangement. For planning purposes these costs have been estimated as follows:

- Fixed Operating Costs – 2% of initial capital cost per year of operation, and
- Variable Operating Costs - \$0.005/kWh of energy generation.

Fixed Operating Costs are assumed to include but not be limited to the following:

- Permanent Staff
- Fixed overheads including corporate costs, long-term leases, etc.
- Regular scheduled maintenance
- Major equipment replacement, refurbishment (future costs assumed to be averaged over life of facility), and
- Etc.

Operating cost estimates are provided on the site summary sheets provided in Appendix C. Operating costs do not include Water Rentals payable to the BC Provincial Government.

### 3.6 ECONOMIC ASSESSMENT

Outputs from the capital cost estimates and energy estimates described above were used to complete an economic assessment for each facility. As noted above the capacity cost calculation was used as the basis for selecting preferred project sites. However, other economic metrics were calculated to provide a broader understanding of the economics of each site. The economic assessment metrics calculated include:

- Installed Capacity Cost
- Dependable Capacity Cost
- Energy Cost (Average Hydrology), and
- Energy Cost (Firm Hydrology).

A summary of these economic measures is provided for each site on the site summary tables provided in Appendix C.

A detailed assessment of project economics has not been included in this study. However, an assumed generic payment schedule is provided for information. This generic payment schedule based on KP's experience developing similar hydroelectric facilities, assuming a development duration of 6 years. The development period assumes the first 2 years are required for permitting and initial studies with the last 4 years for construction.

#### Construction Payment Schedule

Year 1 – 0%  
Year 2 – 0%  
Year 3 – 15%  
Year 4 – 35%  
Year 5 – 35%  
Year 6 – 15%

## 4.0 REFERENCES

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- Ahmed, A. and Jackson, S. 2013. Inventory of Streamflow in the Skeena Region Knowledge Management Branch, British Columbia Ministry of Environment, Victoria, B.C.
- Obedkoff, W. 2003. Streamflow in the Lower Mainland and Vancouver Island. BC Ministry of Sustainable Resource Management.

## 5.0 CERTIFICATION

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This report was prepared and reviewed by the undersigned.

Prepared:



Scott Rees, P.Eng.  
Senior Engineer

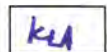


Reviewed:

Keith Ainsley, P.Eng.  
Senior Civil Engineer | Associate

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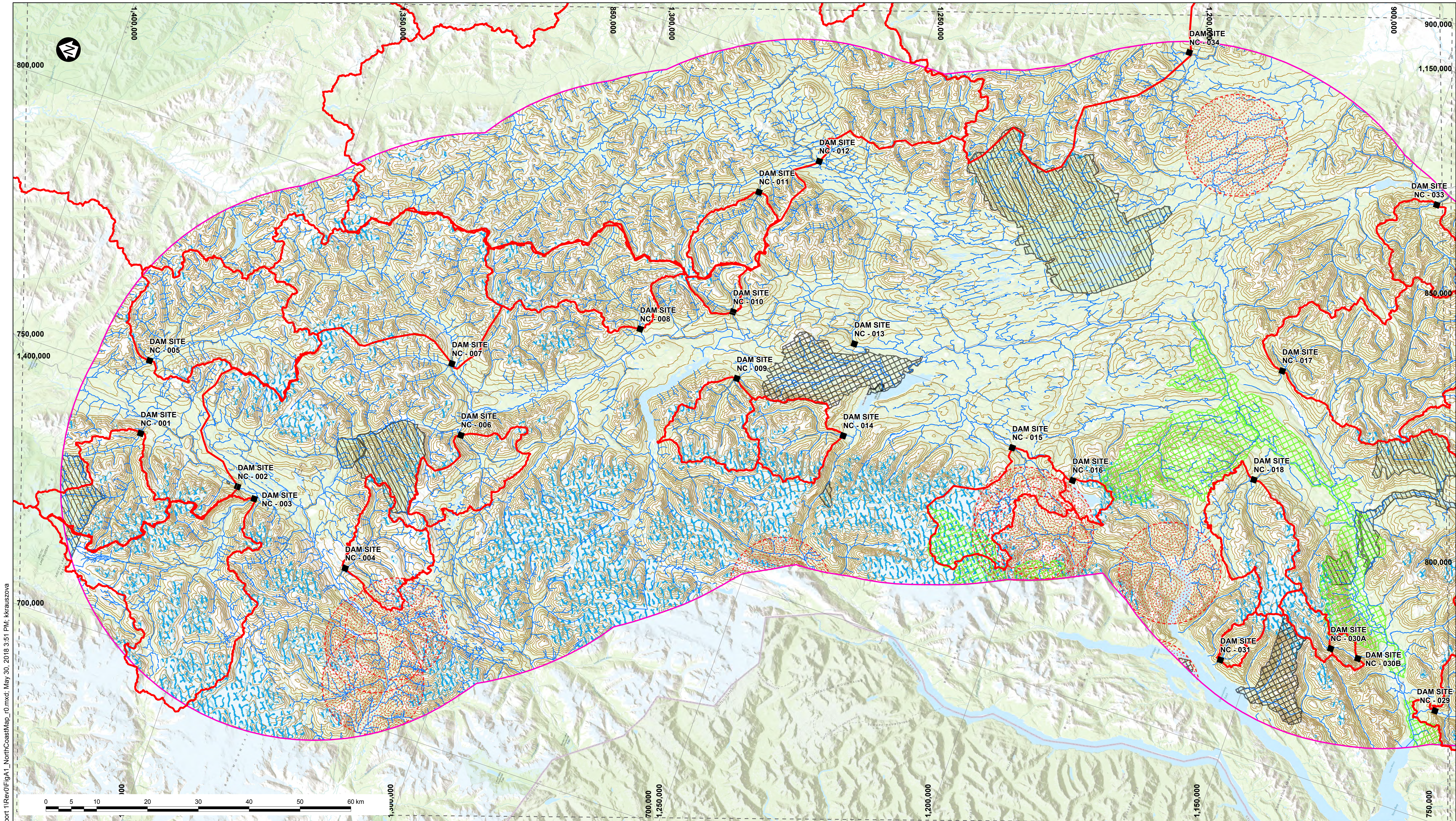
## APPENDIX A

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### Study Area Maps

(Figures A1 and A2)





LEGEND:					
■	DAM	■	BIODIVERSITYAREAS	■	LEGALLYPROTECTEDAREAS
—	RIVER/STREAM	■	EXISTINGANDAPPROVEDPROJECTS_10KMBUFFER	■	MIGRATORYBIRDSANCTUARIES
—	200 M CONTOUR	■	CANADIANFORCESBASES	■	NATIONALPARKS
—	1000 M CONTOUR	■	CONSERVACYAREA	■	WILDLIFEMANAGEMENTAREA
■	CATCHMENT	■	GLACIER		
■	MAP INDEX				
■	STUDY AREA				

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REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED

NOTES:

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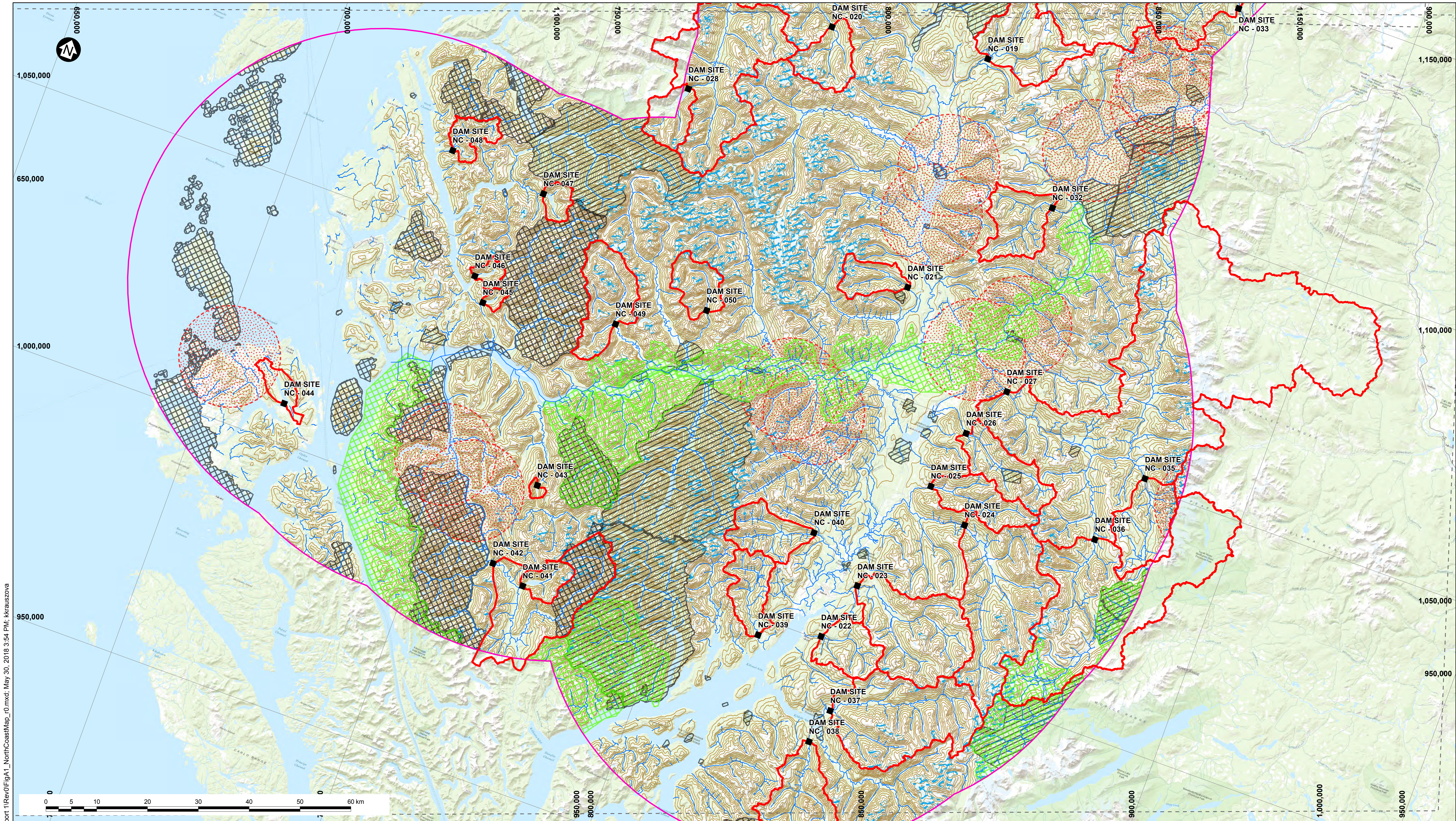
2. COORDINATE GRID IS IN METRES.  
COORDINATE SYSTEM: NAD 1983 BC ENVIRONMENT ALBERS.

3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:350,000 FOR 24x36 (11"X14") PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

4. ALL EXCLUSION ZONES ARE BUFFERED BY 100M. EXISTING AND APPROVED PROJECTS ARE SHOWN AS 10 KM RADIUS AROUND POINTS OF DIVERSION.

BC HYDRO		
SMALL STORAGE SCREENING ASSESSMENT		
NORTH COAST SELECTED PROJECTS AND CATCHMENTS SHEET 1 OF 2		
Knight Piesold CONSULTING		PIA NO. VA103-647/1
FIGURE A1		REF NO. 1
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LEGEND:					
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— RIVER/STREAM	— EXISTING AND APPROVED PROJECTS 10 KM BUFFER	— MIGRATORY BIRD SANCTUARIES			
— 200 M CONTOUR	— CANADIAN FORCES BASES	— NATIONAL PARKS			
— 1000 M CONTOUR	— CONSERVANCY AREA	— WILDLIFE MANAGEMENT AREA			
— CATCHMENT	— GLACIER				
— MAP INDEX					
— STUDY AREA					

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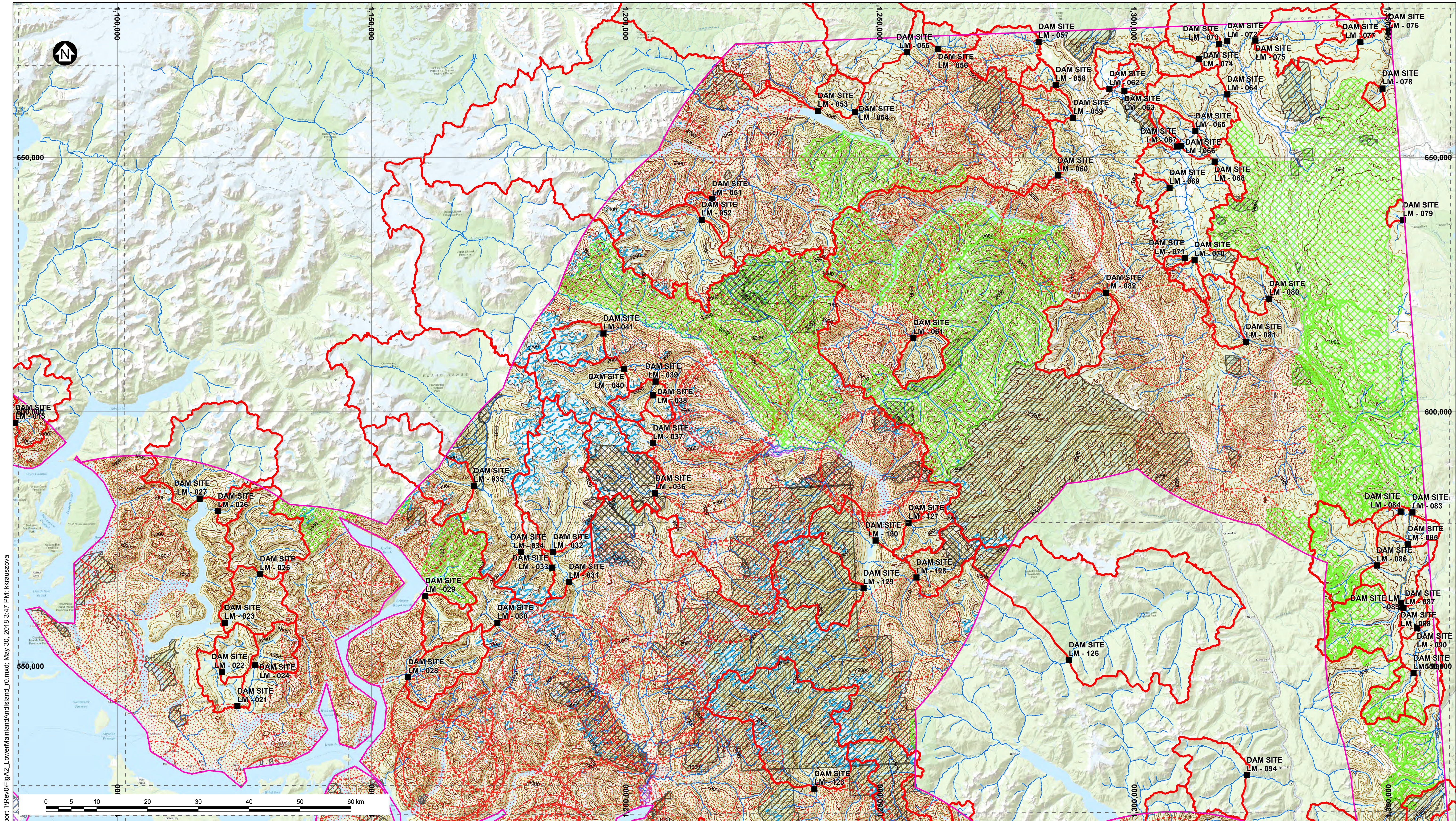
2. COORDINATE GRID IS IN METRES.  
COORDINATE SYSTEM: NAD 1983 BC ENVIRONMENT ALBERS.

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4. ALL EXCLUSION ZONES ARE BUFFERED BY 100M. EXISTING AND APPROVED PROJECTS ARE SHOWN AS 10 KM RADIUS AROUND POINTS OF DIVERSION.

BC HYDRO		
SMALL STORAGE SCREENING ASSESSMENT		
NORTH COAST SELECTED PROJECTS AND CATCHMENTS SHEET 2 OF 2		
Knight Piésold CONSULTING	P/A NO. VA103-647/1	REF NO. 1
	FIGURE A1	
		REV 0





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**LEGEND:**

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- 1000 M CONTOUR
- MAP INDEX
- STUDY AREA
- CATCHMENT LOWER MAINLAND
- CATCHMENT VANCOUVER ISLAND
- BIODIVERSITY AREAS
- EXISTING AND APPROVED PROJECTS\_10KM BUFFER
- CANADIAN FORCES BASES
- CONSERVATION AREA
- GLACIER
- LEGALLY PROTECTED AREAS
- MIGRATORY BIRDS SANCTUARIES
- NATIONAL PARKS
- WILDLIFE MANAGEMENT AREA

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- NOTES:
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  - COORDINATE GRID IS IN METRES.  
COORDINATE SYSTEM: NAD 1983 BC ENVIRONMENT ALBERS.
  - THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:350,000 FOR 24x36 (11" X 15") PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.
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BC HYDRO

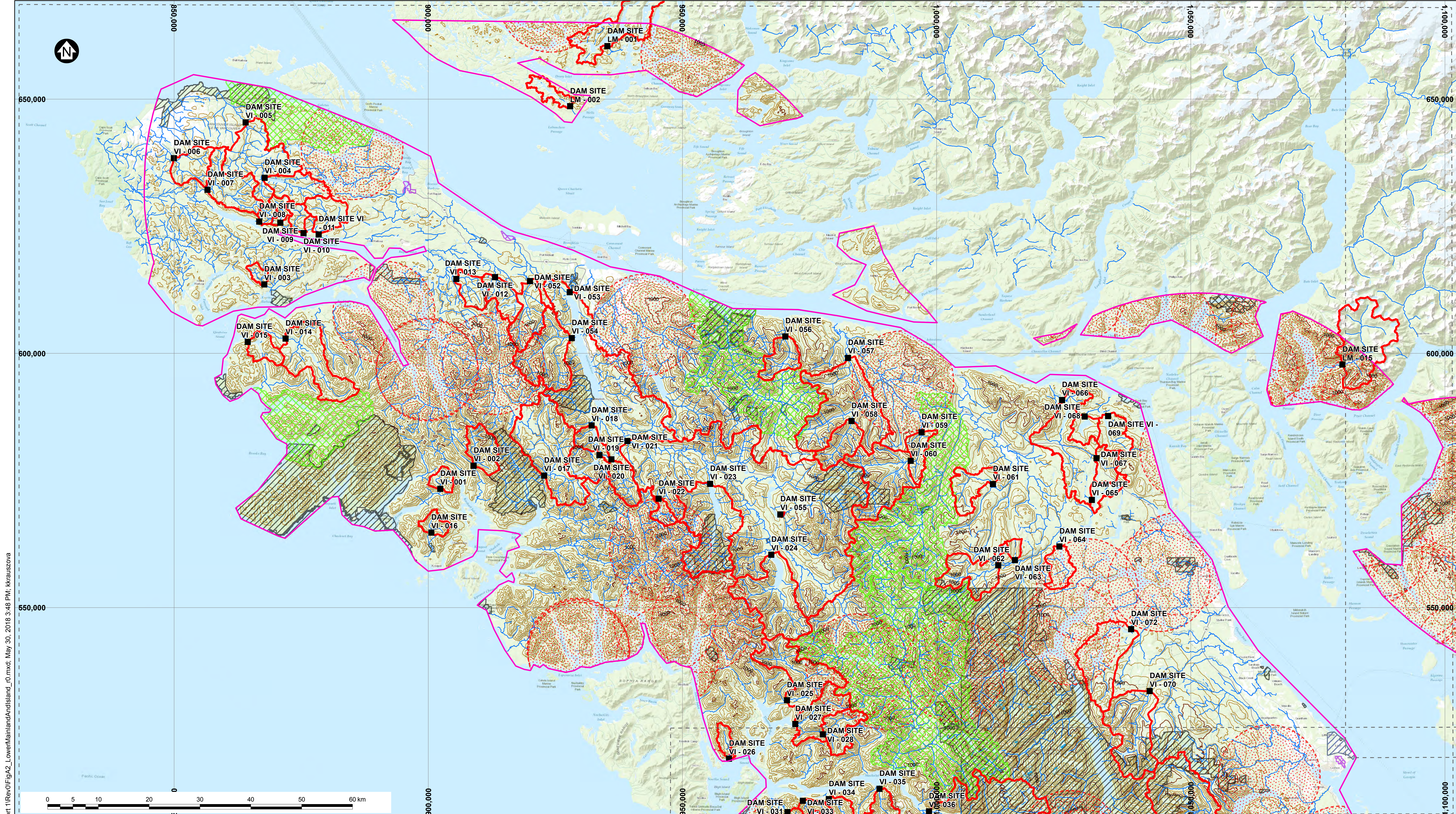
SMALL STORAGE SCREENING ASSESSMENT

LOWER MAINLAND AND VANCOUVER ISLAND  
SELECTED PROJECTS AND CATCHMENTS  
SHEET 1 OF 4

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FIGURE A2	
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- MAP INDEX
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- CANADIAN FORCES BASES
- CONSERVACY AREA
- GLACIER
- LEGALLY PROTECTED AREAS
- MIGRATORY BIRDS SANCTUARIES
- NATIONAL PARKS
- WILDLIFE MANAGEMENT AREA

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- NOTES:
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BC HYDRO

SMALL STORAGE SCREENING ASSESSMENT

LOWER MAINLAND AND VANCOUVER ISLAND  
SELECTED PROJECTS AND CATCHMENTS  
SHEET 2 OF 4

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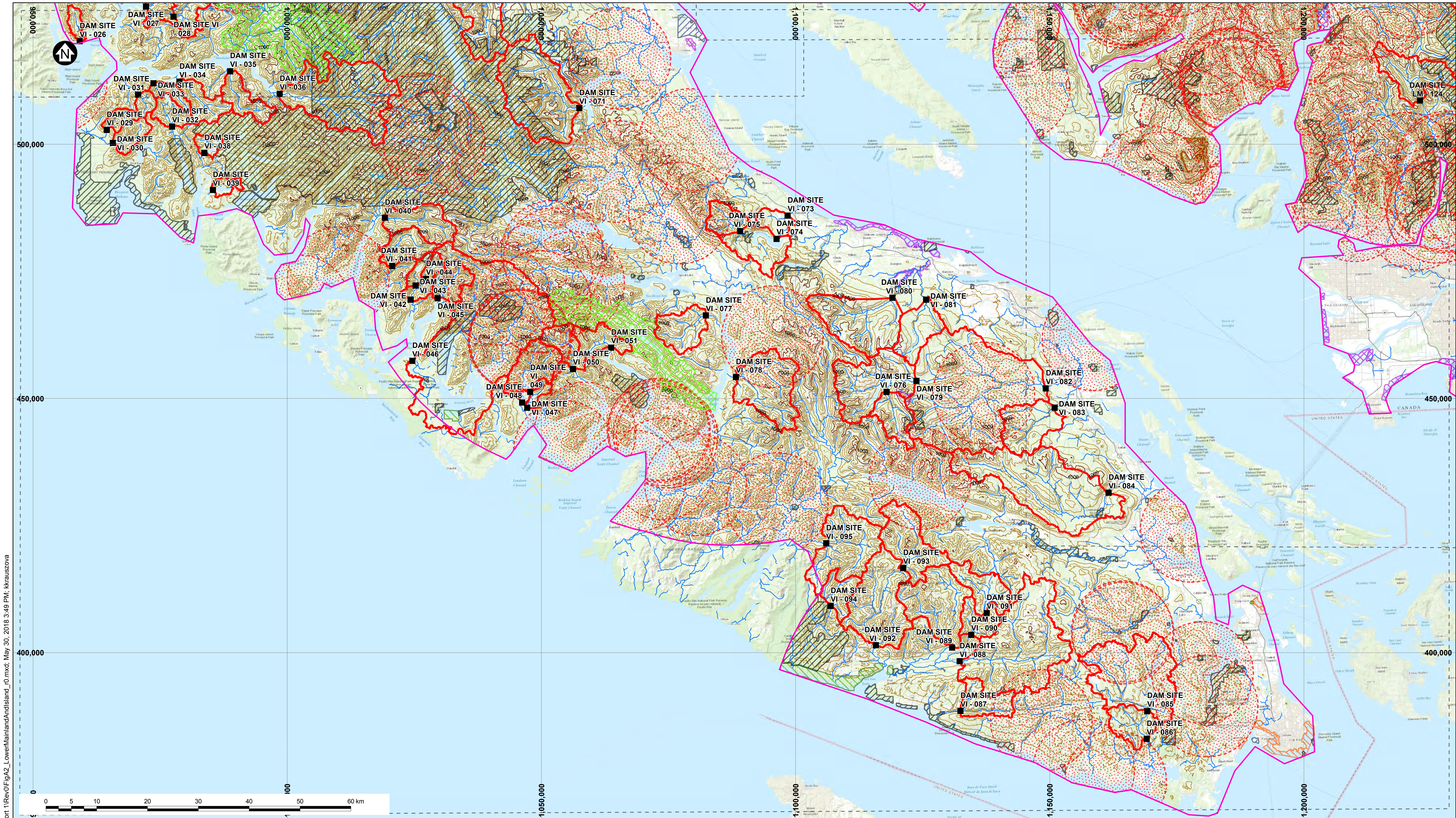
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FIGURE A2

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- MAP INDEX
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- BIODIVERSITY AREAS
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- CONSERVATION AREA
- GLACIER
- LEGALLY PROTECTED AREAS
- MIGRATORY BIRDS SANCTUARIES
- NATIONAL PARKS
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- NOTES:
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  - ALL EXCLUSION ZONES ARE BUFFERED BY 100M. EXISTING AND APPROVED PROJECTS ARE SHOWN AS 10 KM RADIUS AROUND POINTS OF DIVERSION.

**BC HYDRO**

**SMALL STORAGE SCREENING ASSESSMENT**

**LOWER MAINLAND AND VANCOUVER ISLAND  
SELECTED PROJECTS AND CATCHMENTS  
SHEET 3 OF 4**

**Knight Piesold**  
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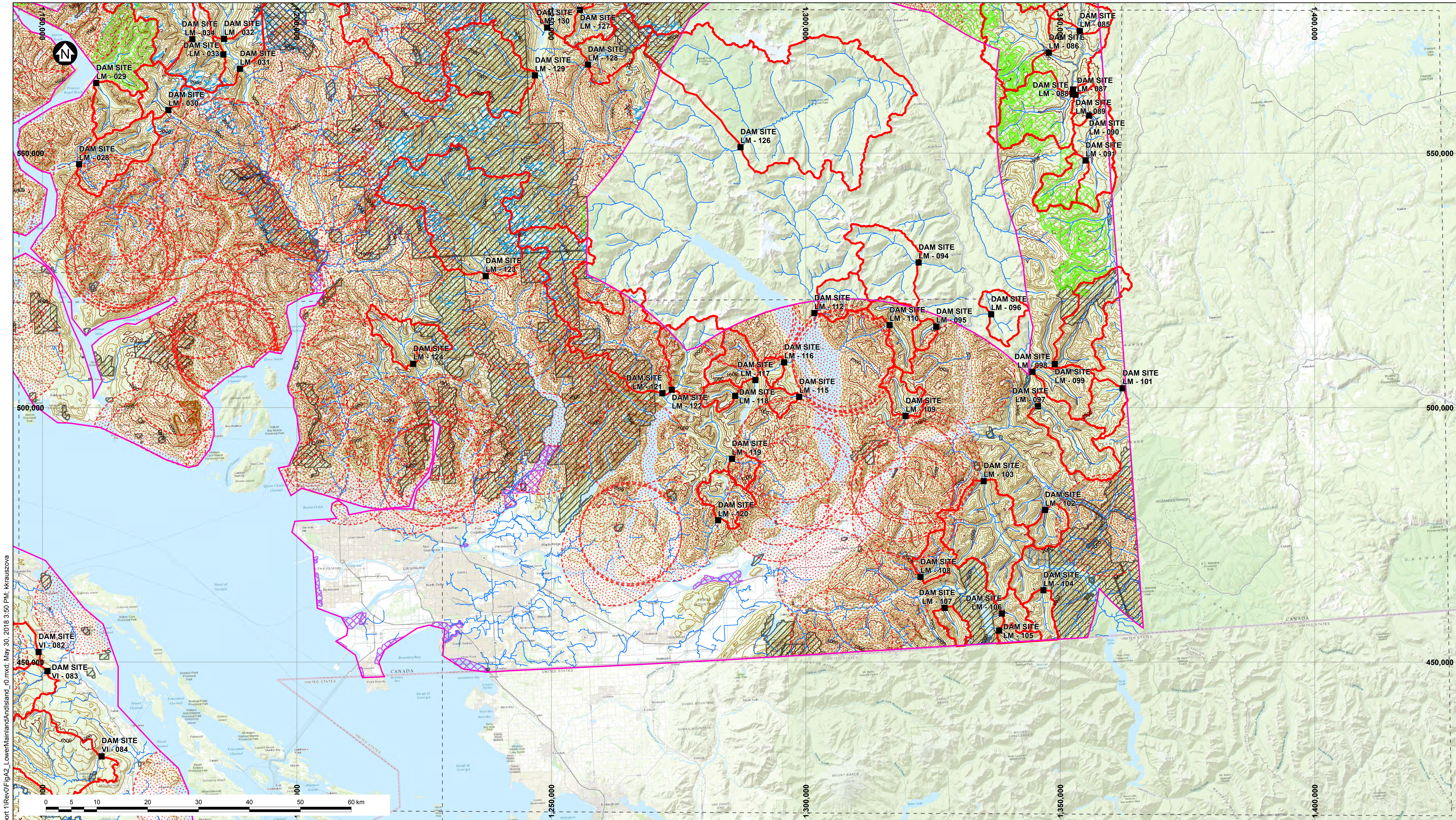
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**FIGURE A2**

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- LEGEND:**
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  - CATCHMENT VANCOUVER ISLAND
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0	30 MAY 18	ISSUED FOR INFORMATION	KK	KK	KLA
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED

- NOTES:**
- BASE MAP: ESRI ONLINE TOPO MAP.
  - COORDINATE GRID IS IN METRES.  
COORDINATE SYSTEM: NAD 1983 BC ENVIRONMENT ALBERS.
  - THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:350,000 FOR 24x36 (11" X 15") PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.
  - ALL EXCLUSION ZONES ARE BUFFERED BY 100M. EXISTING AND APPROVED PROJECTS ARE SHOWN AS 10 KM RADIUS AROUND POINTS OF DIVERSION.

BC HYDRO		
SMALL STORAGE SCREENING ASSESSMENT		
LOWER MAINLAND AND VANCOUVER ISLAND SELECTED PROJECTS AND CATCHMENTS SHEET 4 OF 4		
<b>Knight Piesold</b> CONSULTING	P/A NO. VA103-647/1	REF NO. 1
	FIGURE A2	
		REV 0



## APPENDIX B

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### Dam Site Screening Summaries

(Tables B-1 to B-3)

TABLE B-1

BC HYDRO

SMALL STORAGE HYDRO ASSESSMENT

SCREEN 2 - DAM SITE IDENTIFICATION

SELECTED DAM SITES

Print May/30/18 15:54:16

NORTH COAST		VANCOUVER ISLAND		LOWER MAINLAND	
Site #	Watershed Name	Site #	Watershed Name	Site #	Watershed Name
NC - 001	Ball Creek	VI - 001	Malksope River	LM - 001	Embley Creek
NC - 002	Iskut River	VI - 002	Kauwinch River	LM - 002	Kenneth River
NC - 003	More Creek	VI - 003	Koprino River	LM - 015	Quatam River
NC - 004	Estshi Creek	VI - 004	Nahwitti River	LM - 021	Horseshoe River
NC - 005	Burrage Creek	VI - 005	Nahwitti River	LM - 022	Horseshoe River
NC - 006	Teigen Creek	VI - 006	Strandby River	LM - 023	Eldred River
NC - 007	Bell-Irving River	VI - 007	Goodspeed River	LM - 024	Freda Creek
NC - 008	Taft Creek	VI - 008	Clesklagh Creek	LM - 025	Eldred River
NC - 009	Surveyors Creek	VI - 009	Hushamu Creek	LM - 026	Jim Brown Creek
NC - 010	Bell Creek	VI - 010	Youghpan Creek	LM - 027	Powell River
NC - 011	West Taylor River	VI - 011	Wanokana Creek	LM - 028	Vancouver River
NC - 012	Nass River	VI - 012	Keogh River	LM - 029	Stakawus Creek
NC - 014	Surprise Creek	VI - 013	Waukwaas Creek	LM - 030	Ashlu Creek
NC - 015	White River	VI - 014	Mahatta Creek	LM - 031	Squamish River
NC - 016	Kinskuch River	VI - 015	Culleet Creek	LM - 033	Elaho River
NC - 017	Kiteen River	VI - 016	Clanninick Creek	LM - 034	Elaho River
NC - 018	Ksi Gwinha'tal	VI - 017	Tahsish River	LM - 035	Squamish River
NC - 019	Cedar River	VI - 018	Atluck Creek	LM - 036	Sims Creek
NC - 020	Ksi Mat'in	VI - 019	Atluck Creek	LM - 037	Soo River
NC - 021	Erlandsen Creek	VI - 020	Atluck Creek	LM - 038	Rutherford Creek
NC - 022	Wathl Creek	VI - 021	Nimpkish River	LM - 039	Petersen Creek
NC - 023	Hirsch Creek	VI - 022	Kaipit Creek	LM - 040	Petersen Creek
NC - 024	Kitimat River	VI - 023	Woss River	LM - 041	Ryan River
NC - 025	Chist Creek	VI - 024	Sebahall Creek	LM - 051	South Creek
NC - 026	Williams Creek	VI - 025	Conuma River	LM - 052	Hurley River
NC - 027	Zymoetz River	VI - 026	Hoiss Creek	LM - 053	Hurley River
NC - 028	Amoth Creek	VI - 027	Tlupana River	LM - 054	Tyaughton Creek
NC - 029	Ksi Hlginx	VI - 028	Nesook River	LM - 055	Marshall Creek
NC - 030a	Anudol Creek	VI - 029	Escalante River	LM - 056	Yalakom River
NC - 030b	Anudol Creek	VI - 030	Escalante River	LM - 057	Junction Creek
NC - 031	Kelskiist Creek	VI - 031	Mooyah River	LM - 058	Leon Creek
NC - 032	Fiddler Creek	VI - 032	Sydney River	LM - 059	McKay Creek
NC - 033	Kitwancool Creek	VI - 033	Silverado Creek	LM - 060	Slok Creek
NC - 034	Skeena River	VI - 034	Houston River	LM - 061	Bridge River
NC - 035	Kitnayakwa River	VI - 035	Jacklah River	LM - 062	Haylmore Creek
NC - 036	Clore River	VI - 036	Burman River	LM - 063	Gillon Creek
NC - 037	Dala River	VI - 038	Ice River	LM - 064	Pavilion Creek
NC - 038	Falls River	VI - 039	Cecilia Creek	LM - 065	Hat Creek
NC - 039	Bish Creek	VI - 040	Ursus Creek	LM - 066	Hat Creek
NC - 040	Little Wedeene River	VI - 041	Bulson Creek	LM - 067	Hat Creek
NC - 041	Johnston Creek	VI - 042	Tranquil Creek	LM - 068	Hat Creek
NC - 042	Ecstall River	VI - 043	Tranquil Creek	LM - 069	Medicine Creek
NC - 043	Scotia River	VI - 044	Tranquil Creek	LM - 070	Anderson Creek
NC - 044	Route Creek/ Salt Lagoon	VI - 045	Tofino Creek	LM - 071	Hat Creek
NC - 045	Lachmach River	VI - 046	Kennedy River	LM - 072	Colley Creek
NC - 046	Leverson Creek	VI - 047	Toquart River	LM - 073	Maiden Creek
NC - 047	Toon River	VI - 048	Little Toquart Creek	LM - 074	Maiden Creek
NC - 048	Ensheshese River	VI - 049	Toquart River	LM - 075	Scottie Creek
NC - 049	Kasiks River	VI - 050	Effingham River	LM - 076	Gorge Creek
NC - 050	Exchamsiks River	VI - 051	Clemens Creek	LM - 077	Barricade Creek
		VI - 052	Cluxewe River	LM - 078	Charette Creek
		VI - 053	Nimpkish River	LM - 079	Guichon Creek
		VI - 054	Kilpala River	LM - 080	Twaal Creek
		VI - 055	Davie River	LM - 081	Murray Creek
		VI - 056	Naka Creek	LM - 082	Texas Creek
		VI - 057	Eve River	LM - 083	Spius Creek
		VI - 058	Kunnum Creek	LM - 084	Roberts Creek
		VI - 059	Adam River	LM - 085	Spius Creek
		VI - 060	Adam River	LM - 086	Prospect Creek
		VI - 061	North Memekay River	LM - 087	Spius Creek
		VI - 062	Grilse Creek	LM - 088	Spius Creek
		VI - 063	Grilse Creek	LM - 089	Maka Creek
		VI - 064	Salmon River	LM - 090	Maka Creek
		VI - 065	Amor De Cosmos Creek	LM - 091	Maka Creek
		VI - 066	Amor De Cosmos Creek	LM - 094	Spuzzum Creek
		VI - 067	Roberts Creek	LM - 095	Yale Creek
		VI - 068	Pye Creek	LM - 096	Siwash Creek
		VI - 069	Pye Creek	LM - 097	Sowaqua Creek
		VI - 070	Oyster River	LM - 098	Dewdney Creek
		VI - 071	Cruickshank River	LM - 099	Coquihalla River
		VI - 072	Quinsam River	LM - 101	Vuich Creek
		VI - 073	Qualicum River	LM - 102	Sumallo River
		VI - 074	Qualicum River	LM - 103	Silverhope Creek
		VI - 075	Qualicum River	LM - 104	Maselpanik Creek
		VI - 076	Green Creek	LM - 105	Depot Creek
		VI - 077	Cous Creek	LM - 106	Paleface Creek
		VI - 078	Franklin River	LM - 107	Centre Creek
		VI - 079	Nanaimo River	LM - 108	Foley Creek
		VI - 080	Englishman River	LM - 109	Garnet Creek
		VI - 081	South Englishman River	LM - 110	Cogburn Creek
		VI - 082	Nanaimo River	LM - 112	Hornet Creek
		VI - 083	Haslam Creek	LM - 115	Walian Creek
		VI - 084	Chemainus River	LM - 116	Mystery Creek
		VI - 085	Sooke River	LM - 117	Chehalis River
		VI - 086	Sooke River	LM - 118	Skwellepil Creek
		VI - 087	Loss Creek	LM - 119	Statlu Creek
		VI - 088	San Juan River	LM - 120	Norrish Creek
		VI - 089	Harris Creek	LM - 121	Stave River
		VI - 090	Lens Creek	LM - 122	Winslow Creek
		VI - 091	Lens Creek	LM - 123	Pitt River
		VI - 092	Gordon River	LM - 124	Indian River
		VI - 093	Gordon River	LM - 126	Nahatlatch River
		VI - 094	Walbran Creek	LM - 127	Lizzie Creek
		VI - 095	Caycuse River	LM - 128	Rogers Creek
		VI - 096	Klanawa River	LM - 129	Billygoat Creek
				LM - 130	Lillooet River

M:\1\03\00647\01\A\Report\Rev 0\Appendices\B\Appendix B - Tables B-1 to B-3.xlsxTable B-1

NOTES:

1. GAPS IN SITE NUMBERING EXIST AS A RESULT OF SITE ELIMINATION DURING SCREEN 2.
2. SITES LISTED MAY NOT BE AN EXHAUSTIVE LIST. OTHER SITES MAY EXIST WITHIN THE SAME CATCHMENTS.

0	30MAY'18	ISSUED WITH REPORT VA103-647/1-1	KLA	TJP
REV	DATE	DESCRIPTION	PREPD	RVWD

**TABLE B-2**

**BC HYDRO  
SMALL STORAGE HYDRO ASSESSMENT**

**SCREEN 3 - GROSS GENERATION HEAD REQUIREMENT  
SELECTED DAM SITES**

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Site #	Watershed Name	Longitude	Latitude
<b>NORTH COAST</b>			
NC - 001	Ball Creek	-130.32	57.26
NC - 002	Iskut River	-130.36	57.06
NC - 005	Burrage Creek	-130.09	57.29
NC - 012	Nass River	-128.69	56.33
NC - 016	Kinskuch River	-129.34	55.71
NC - 017	Kiteen River	-128.78	55.43
NC - 018	Ksi Gwinhat'al	-129.13	55.41
NC - 023	Hirsch Creek	-128.55	54.09
NC - 024	Kitimat River	-128.32	54.26
NC - 026	Williams Creek	-128.42	54.41
NC - 027	Zymoetz River	-128.35	54.50
NC - 029	Ksi Hlginx	-129.59	54.96
NC - 030B	Anudol Creek (b)	-129.53	55.17
NC - 030A	Anudol Creek (a)	-129.53	55.12
NC - 034	Skeena River	-127.96	55.79
NC - 036	Clore River	-127.94	54.32
NC - 003	More Creek	-130.38	57.03
NC - 007	Bell-Irving River	-129.73	56.80
NC - 008	Taft Creek	-129.40	56.51
<b>VANCOUVER ISLAND</b>			
VI - 053	Nimpkish River (b)	-127.02	50.52
VI - 021	Nimpkish River (a)	-126.85	50.26
VI - 082	Nanaimo River	-123.96	49.06
VI - 084	Chemainus River	-123.80	48.88
<b>LOWER MAINLAND</b>			
LM - 024	Freda Creek	-124.23	49.95
LM - 031	Squamish River (b)	-123.36	50.08
LM - 033	Elaho River	-123.40	50.11
LM - 034	Squamish River (a)	-123.49	50.14
LM - 036	Soo River	-123.11	50.23
LM - 041	South Creek	-123.24	50.52
LM - 096	Siwash Creek	-121.35	49.58
LM - 097	Sowaqua Creek	-121.24	49.41
LM - 103	Silverhope Creek	-121.40	49.29
LM - 110	Cogburn Creek	-121.62	49.57
LM - 123	Pitt River	-122.71	49.70
LM - 126	Nahatlatch River	-122.00	49.90
LM - 094	Spuzzum Creek	-121.53	49.68

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**NOTES:**

1. SITE COORDINATES ARE APPROXIMATE.
2. DAM SITE OPTIMIZATION HAS NOT BEEN UNDERTAKEN AS PART OF THIS STUDY.

0	30MAY'18	ISSUED WITH REPORT VA103-647/1-1	KLA	TJP
REV	DATE	DESCRIPTION	PREP'D	RVW'D



**TABLE B-3**

**BC HYDRO  
SMALL STORAGE HYDRO ASSESSMENT**

**SCREEN 4 - DAM GEOMETRY  
SELECTED DAM SITES**

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Site #	Watershed Name	Longitude	Latitude	Capacity Cost (\$M/MW)
<b>NORTH COAST</b>				
NC - 001	Ball Creek	-130.32	57.26	7,800,000
NC - 012	Nass River	-128.69	56.33	7,408,000
NC - 016	Kinskuch River	-129.34	55.71	6,519,000
NC - 027	Zymoetz River	-128.35	54.50	6,459,000
NC - 030A	Anudol Creek (a)	-129.53	55.12	7,611,000
NC - 003	More Creek	-130.38	57.03	6,833,000
<b>VANCOUVER ISLAND</b>				
VI - 053	Nimpkish River (b)	-127.02	50.52	6,683,000
VI - 084	Chemainus River	-123.80	48.88	7,100,000
<b>LOWER MAINLAND</b>				
LM - 024	Freda Creek	-124.23	49.95	6,319,000
LM - 031	Squamish River (b)	-123.36	50.08	7,481,000
LM - 033	Elaho River	-123.40	50.11	6,696,000
LM - 041	South Creek	-123.24	50.52	5,382,000
LM - 096	Siwash Creek	-121.35	49.58	6,388,000
LM - 103	Silverhope Creek	-121.40	49.29	7,301,000
LM - 126	Nahatlatch River	-122.00	49.90	4,963,000
LM - 094	Spuzzum Creek	-121.53	49.68	6,116,000

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**NOTES:**

1. SITE COORDINATES ARE APPROXIMATE.
2. DAM SITE OPTIMIZATION HAS NOT BEEN UNDERTAKEN AS PART OF THIS STUDY.
3. CAPACITY COST CALCULATED AS \$CAD MILLIONS PER MW OF INSTALLED CAPACITY.

0	30MAY18	ISSUED WITH REPORT VA103-647/1-1	KLA	TJP
REV	DATE	DESCRIPTION	PREP'D	RW'D

## APPENDIX C

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### Site Summary Sheets

(Pages C-1 to C-34)

TABLE C1

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

BALL CREEK

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-130.32	Catchment Area at Intake						km <sup>2</sup>	336		
Easting	E	57.26	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	14		
Region		North Coast	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	2.8		
Estimated Footprint	ha	410										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	1.3	1.1	1.0	1.2	3.7	12.0	13.3	8.3	5.6	4.7	2.8	1.7
Firm (Low Flow)	0.6	0.5	0.7	1.1	1.3	6.5	6.7	5.4	3.8	3.0	2.8	1.6
DESIGN PARAMETERS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Dependable Capacity				MW	20	27		40		80		
Installed Capacity				MW	22	29		43		86		
Gross Head				m	123	123		123		123		
Design Flow, Qd				m <sup>3</sup> /s	21	28		42		84		
MAD Multiplier at Qd					7.4	9.9		14.8		29.6		
Reservoir Storage Volume				m <sup>3</sup>	19,478,500	19,478,500		19,478,500		19,478,500		
Live Storage Volume				m <sup>3</sup>	12,797,000	12,797,000		12,797,000		12,797,000		
Dam Height at Minimum Operating Level				m	14	14		14		14		
Dam Height at Full Supply Level				m	23	23		23		23		
Dam Type					CFRD	CFRD		CFRD		CFRD		
Dam Crest Length				m	124	124		124		124		
Reservoir Surface Area				m <sup>2</sup>	1,393,000	1,393,000		1,393,000		1,393,000		
Penstock Length				km	3	3		3		3		
Transmission Line Length				km	42	42		42		42		
Access Road Length				km	6	6		6		6		
ESTIMATED CAPITAL COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits				\$	24,432,000	\$ 27,743,000		\$ 34,125,000		\$ 52,338,000		
Access and Site Preparation				\$	18,322,000	\$ 18,322,000		\$ 18,322,000		\$ 18,322,000		
Cofferdams and Construction Water Management				\$	521,000	\$ 521,000		\$ 521,000		\$ 521,000		
Intake, Headrace, and Forebay				\$	3,492,000	\$ 4,656,000		\$ 6,984,000		\$ 13,969,000		
Dam Construction				\$	7,871,000	\$ 7,871,000		\$ 7,871,000		\$ 7,871,000		
Water Conveyance System				\$	22,873,000	\$ 27,040,000		\$ 34,408,000		\$ 52,780,000		
Powerhouse Construction				\$	22,667,000	\$ 30,222,000		\$ 45,333,000		\$ 90,666,000		
Switchyard and Transmission				\$	21,981,000	\$ 22,341,000		\$ 23,061,000		\$ 25,222,000		
SUB-TOTAL				\$	122,159,000	\$ 138,716,000		\$ 170,625,000		\$ 261,689,000		
EPCM Costs (8% of Subtotal)				\$	9,773,000	\$ 11,097,000		\$ 13,650,000		\$ 20,935,000		
Contingency (30% of Subtotal)				\$	36,648,000	\$ 41,615,000		\$ 51,188,000		\$ 78,507,000		
TOTAL ESTIMATED OVERNIGHT CAPITAL COST				\$	168,580,000	\$ 191,428,000		\$ 235,463,000		\$ 361,131,000		
ESTIMATED ANNUAL OPERATING COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)				\$	3,372,000	\$ 3,829,000		\$ 4,709,000		\$ 7,223,000		
Variable Operating Costs (\$0.005/kWh)				\$	231,000	\$ 231,000		\$ 231,000		\$ 231,000		
TOTAL ESTIMATED OPERATING COST				\$	3,603,000	\$ 4,060,000		\$ 4,940,000		\$ 7,454,000		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDITIONS												
Month	Units			16-Hour	12-Hour		8-Hour		4-Hour			
Jan	MWh			4,410	4,410		4,410		4,410			
Feb	MWh			0	0		0		0			
Mar	MWh			0	0		0		0			
Apr	MWh			0	0		0		0			
May	MWh			5,356	5,356		5,356		5,356			
Jun	MWh			8,840	8,840		8,840		8,840			
Jul	MWh			10,152	10,152		10,152		10,152			
Aug	MWh			6,316	6,316		6,316		6,316			
Sep	MWh			4,155	4,155		4,155		4,155			
Oct	MWh			3,577	3,577		3,577		3,577			
Nov	MWh			2,060	2,060		2,060		2,060			
Dec	MWh			1,317	1,317		1,317		1,317			
ENERGY OUTPUT (AVERAGE)	GWh/yr			46.2	46.2		46.2		46.2			
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDITIONS												
Month	Units			16-Hour	12-Hour		8-Hour		4-Hour			
Jan	MWh			4,088	4,088		4,088		4,088			
Feb	MWh			0	0		0		0			
Mar	MWh			0	0		0		0			
Apr	MWh			0	0		0		0			
May	MWh			3,840	3,840		3,840		3,840			
Jun	MWh			3,841	3,841		3,841		3,841			
Jul	MWh			5,116	5,116		5,116		5,116			
Aug	MWh			4,112	4,112		4,112		4,112			
Sep	MWh			2,815	2,815		2,815		2,815			
Oct	MWh			2,285	2,285		2,285		2,285			
Nov	MWh			2,069	2,069		2,069		2,069			
Dec	MWh			1,250	1,250		1,250		1,250			
ENERGY OUTPUT (FIRM)	GWh/yr			29.4	29.4		29.4		29.4			
CAPACITY AND ENERGY COST METRICS												
Metric	Units			16-Hour	12-Hour		8-Hour		4-Hour			
Capacity Cost, Dependable Capacity	\$/MW			\$ 8,429,000	\$ 7,179,000		\$ 5,887,000		\$ 4,514,000			
Capacity Cost, Installed Capacity	\$/MW			\$ 7,800,000	\$ 6,643,000		\$ 5,448,000		\$ 4,178,000			
Energy Cost (Average)	\$/GWh			\$ 3,650,000	\$ 4,145,000		\$ 5,098,000		\$ 7,820,000			
Energy Cost (Firm)	\$/GWh			\$ 5,731,000	\$ 6,507,000		\$ 8,004,000		\$ 12,276,000			

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TABLE C2

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

ISKUT RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-130.36	Catchment Area at Intake						km <sup>2</sup>	3,789		
Easting	E	57.06	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	14		
Region		North Coast	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	32.1		
Estimated Footprint	ha	290										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	14.5	12.3	11.3	13.0	41.4	135.2	150.2	93.5	63.5	52.9	31.5	19.5
Firm (Low Flow)	6.3	6.0	7.4	12.2	15.0	73.4	75.7	60.9	43.0	33.8	31.6	18.5
DESIGN PARAMETERS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Dependable Capacity			MW	20		27		40		80		
Installed Capacity			MW	32		41		62		124		
Gross Head			m	58		58		58		58		
Design Flow, Qd			m <sup>3</sup> /s	67		86		130		259		
MAD Multiplier at Qd				2.1		2.7		4.0		8.1		
Reservoir Storage Volume			m <sup>3</sup>	36,445,500		36,445,500		36,445,500		36,445,500		
Live Storage Volume			m <sup>3</sup>	20,923,000		20,923,000		20,923,000		20,923,000		
Dam Height at Minimum Operating Level			m	25		25		25		25		
Dam Height at Full Supply Level			m	46		46		46		46		
Dam Type				CFRD		CFRD		CFRD		CFRD		
Dam Crest Length			m	376		376		376		376		
Reservoir Surface Area			m <sup>2</sup>	1,693,000		1,693,000		1,693,000		1,693,000		
Penstock Length			km	2		2		2		2		
Transmission Line Length			km	19		19		19		19		
Access Road Length			km	1		1		1		1		
ESTIMATED CAPITAL COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$	46,043,000		\$ 50,926,000		\$ 61,403,000		\$ 91,743,000		
Access and Site Preparation			\$	13,247,000		\$ 13,247,000		\$ 13,247,000		\$ 13,247,000		
Cofferdams and Construction Water Management			\$	5,880,000		\$ 5,880,000		\$ 5,880,000		\$ 5,880,000		
Intake, Headrace, and Forebay			\$	11,059,000		\$ 14,311,000		\$ 21,467,000		\$ 42,933,000		
Dam Construction			\$	75,835,000		\$ 75,835,000		\$ 75,835,000		\$ 75,835,000		
Water Conveyance System			\$	30,612,000		\$ 36,019,000		\$ 46,838,000		\$ 74,935,000		
Powerhouse Construction			\$	35,386,000		\$ 45,790,000		\$ 68,685,000		\$ 137,370,000		
Switchyard and Transmission			\$	12,152,000		\$ 12,623,000		\$ 13,660,000		\$ 16,770,000		
SUB-TOTAL			\$	230,214,000		\$ 254,631,000		\$ 307,015,000		\$ 458,713,000		
EPCM Costs (8% of Subtotal)			\$	18,417,000		\$ 20,370,000		\$ 24,561,000		\$ 36,697,000		
Contingency (30% of Subtotal)			\$	69,064,000		\$ 76,389,000		\$ 92,105,000		\$ 137,614,000		
TOTAL ESTIMATED OVERNIGHT CAPITAL COST			\$	317,695,000		\$ 351,390,000		\$ 423,681,000		\$ 633,024,000		
ESTIMATED ANNUAL OPERATING COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)			\$	6,354,000		\$ 7,028,000		\$ 8,474,000		\$ 12,660,000		
Variable Operating Costs (\$0.005/kWh)			\$	823,000		\$ 927,000		\$ 1,091,000		\$ 1,137,000		
TOTAL ESTIMATED OPERATING COST			\$	7,177,000		\$ 7,955,000		\$ 9,565,000		\$ 13,797,000		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDITIONS												
Month	Units			16-Hour		12-Hour		8-Hour		4-Hour		
Jan		MWh		6,849		6,849		6,849		6,849		
Feb		MWh		1,167		1,167		1,167		1,167		
Mar		MWh		4,029		4,029		4,029		4,029		
Apr		MWh		4,479		4,479		4,479		4,479		
May		MWh		18,604		18,604		18,604		18,604		
Jun		MWh		23,072		29,856		44,784		46,674		
Jul		MWh		23,841		30,851		46,277		53,601		
Aug		MWh		23,841		30,851		33,348		33,348		
Sep		MWh		21,938		21,938		21,938		21,938		
Oct		MWh		18,885		18,885		18,885		18,885		
Nov		MWh		10,878		10,878		10,878		10,878		
Dec		MWh		6,954		6,954		6,954		6,954		
ENERGY OUTPUT (AVERAGE)		GWh/yr		164.5		185.3		218.2		227.4		
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDITIONS												
Month	Units			16-Hour		12-Hour		8-Hour		4-Hour		
Jan		MWh		5,150		5,150		5,150		5,150		
Feb		MWh		0		0		0		0		
Mar		MWh		1,786		1,786		1,786		1,786		
Apr		MWh		4,217		4,217		4,217		4,217		
May		MWh		9,204		9,204		9,204		9,204		
Jun		MWh		23,072		25,350		25,350		25,350		
Jul		MWh		23,841		27,012		27,012		27,012		
Aug		MWh		21,713		21,713		21,713		21,713		
Sep		MWh		14,861		14,861		14,861		14,861		
Oct		MWh		12,064		12,064		12,064		12,064		
Nov		MWh		10,926		10,926		10,926		10,926		
Dec		MWh		6,599		6,599		6,599		6,599		
ENERGY OUTPUT (FIRM)		GWh/yr		133.4		138.9		138.9		138.9		
CAPACITY AND ENERGY COST METRICS												
Metric	Units			16-Hour		12-Hour		8-Hour		4-Hour		
Capacity Cost, Dependable Capacity		\$/MW	\$	15,885,000		\$ 13,177,000		\$ 10,592,000		\$ 7,913,000		
Capacity Cost, Installed Capacity		\$/MW	\$	9,914,000		\$ 8,474,000		\$ 6,812,000		\$ 5,089,000		
Energy Cost (Average)		\$/GWh	\$	1,931,000		\$ 1,896,000		\$ 1,942,000		\$ 2,784,000		
Energy Cost (Firm)		\$/GWh	\$	2,381,000		\$ 2,530,000		\$ 3,051,000		\$ 4,558,000		

M:\1103100647\01\A\Data\Dam and Reservoir Data\SCREEN-3+4\_20180531.xls\ISKUT RIVER

NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

TABLE C3

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

BURRAGE CREEK

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-130.09						Catchment Area at Intake	km <sup>2</sup>	659		
Easting	E	57.29						Estimated Mean Annual Unit Runoff	L/s/km <sup>2</sup>	43		
Region		North Coast						Mean Annual Discharge (MAD)	m <sup>3</sup> /s	28.3		
Estimated Footprint	ha	680										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m³/s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	3.8	2.2	2.2	4.5	45.3	89.9	73.4	52.0	33.4	18.8	8.5	4.7
Firm (Low Flow)	3.8	2.2	2.2	4.5	45.3	89.9	73.4	52.0	33.4	18.8	8.5	4.7
DESIGN PARAMETERS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Dependable Capacity	MW			20		27		40		80		
Installed Capacity	MW			42		56		84		168		
Gross Head	m			70		70		70		70		
Design Flow, Qd	m³/s			72		96		143		287		
MAD Multiplier at Qd				2.5		3.4		5.1		10.1		
Reservoir Storage Volume	m³			55,279,500		55,279,500		55,279,500		55,279,500		
Live Storage Volume	m³			31,744,000		31,744,000		31,744,000		31,744,000		
Dam Height at Minimum Operating Level	m			34		34		34		34		
Dam Height at Full Supply Level	m			70		70		70		70		
Dam Type				RCC		RCC		RCC		RCC		
Dam Crest Length	m			391		391		391		391		
Reservoir Surface Area	m²			3,254,000		3,254,000		3,254,000		3,254,000		
Penstock Length	km			0		0		0		0		
Transmission Line Length	km			55		55		55		55		
Access Road Length	km			10		10		10		10		
ESTIMATED CAPITAL COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits	\$			72,146,000		\$ 77,160,000		\$ 87,186,000		\$ 117,268,000		
Access and Site Preparation	\$			30,312,000		\$ 30,312,000		\$ 30,312,000		\$ 30,312,000		
Cofferdams and Construction Water Management	\$			3,116,000		\$ 3,116,000		\$ 3,116,000		\$ 3,116,000		
Intake, Headrace, and Forebay	\$			11,862,000		\$ 15,816,000		\$ 23,724,000		\$ 47,449,000		
Dam Construction	\$			168,245,000		\$ 168,245,000		\$ 168,245,000		\$ 168,245,000		
Water Conveyance System	\$			717,000		\$ 956,000		\$ 1,433,000		\$ 2,867,000		
Powerhouse Construction	\$			45,488,000		\$ 60,650,000		\$ 90,975,000		\$ 181,951,000		
Switchyard and Transmission	\$			28,845,000		\$ 29,544,000		\$ 30,940,000		\$ 35,131,000		
SUB-TOTAL	\$			360,731,000		\$ 385,799,000		\$ 435,931,000		\$ 586,339,000		
EPCM Costs (8% of Subtotal)	\$			28,858,000		\$ 30,864,000		\$ 34,874,000		\$ 46,907,000		
Contingency (30% of Subtotal)	\$			108,219,000		\$ 115,740,000		\$ 130,779,000		\$ 175,902,000		
TOTAL ESTIMATED OVERNIGHT CAPITAL COST	\$			497,808,000		\$ 532,403,000		\$ 601,584,000		\$ 809,148,000		
ESTIMATED ANNUAL OPERATING COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)	\$			9,956,000		\$ 10,648,000		\$ 12,032,000		\$ 16,183,000		
Variable Operating Costs (\$0.005/kWh)	\$			694,000		\$ 736,000		\$ 736,000		\$ 736,000		
TOTAL ESTIMATED OPERATING COST	\$			10,650,000		\$ 11,384,000		\$ 12,768,000		\$ 16,919,000		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDITIONS												
Month	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Jan	MWh		4,800		4,800		4,800		4,800			
Feb	MWh		0		0		0		0			
Mar	MWh		0		0		0		0			
Apr	MWh		0		0		0		0			
May	MWh		22,104		22,104		22,104		22,104			
Jun	MWh		30,171		37,843		37,843		37,843			
Jul	MWh		31,177		31,927		31,927		31,927			
Aug	MWh		22,619		22,619		22,619		22,619			
Sep	MWh		14,059		14,059		14,059		14,059			
Oct	MWh		8,177		8,177		8,177		8,177			
Nov	MWh		3,578		3,578		3,578		3,578			
Dec	MWh		2,044		2,044		2,044		2,044			
ENERGY OUTPUT (AVERAGE)	GWh/yr		138.7		147.2		147.2		147.2			
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDITIONS												
Month	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Jan	MWh		4,800		4,800		4,800		4,800			
Feb	MWh		0		0		0		0			
Mar	MWh		0		0		0		0			
Apr	MWh		0		0		0		0			
May	MWh		22,104		22,104		22,104		22,104			
Jun	MWh		30,171		37,843		37,843		37,843			
Jul	MWh		31,177		31,927		31,927		31,927			
Aug	MWh		22,619		22,619		22,619		22,619			
Sep	MWh		14,059		14,059		14,059		14,059			
Oct	MWh		8,177		8,177		8,177		8,177			
Nov	MWh		3,578		3,578		3,578		3,578			
Dec	MWh		2,044		2,044		2,044		2,044			
ENERGY OUTPUT (FIRM)	GWh/yr		138.7		147.2		147.2		147.2			
CAPACITY AND ENERGY COST METRICS												
Metric	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Capacity Cost, Dependable Capacity	\$/MW		\$ 24,837,000		\$ 19,923,000		\$ 15,008,000		\$ 10,093,000			
Capacity Cost, Installed Capacity	\$/MW		\$ 11,880,000		\$ 9,529,000		\$ 7,178,000		\$ 4,827,000			
Energy Cost (Average)	\$/GWh		\$ 3,588,000		\$ 3,618,000		\$ 4,088,000		\$ 5,499,000			
Energy Cost (Firm)	\$/GWh		\$ 3,588,000		\$ 3,618,000		\$ 4,088,000		\$ 5,499,000			

TABLE C4

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

NASS RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-128.69						Catchment Area at Intake	km <sup>2</sup>	5,333		
Easting	E	56.33						Estimated Mean Annual Unit Runoff	L/s/km <sup>2</sup>	29		
Region		North Coast						Mean Annual Discharge (MAD)	m <sup>3</sup> /s	129.9		
Estimated Footprint	ha	720										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	21.4	19.5	20.4	56.9	336.8	533.5	324.2	150.9	131.8	145.3	68.7	28.4
Firm (Low Flow)	17.6	14.7	17.2	74.8	453.6	376.6	188.5	157.7	97.2	87.9	44.9	19.0
DESIGN PARAMETERS												
						16-Hour		12-Hour		8-Hour		4-Hour
Dependable Capacity				MW		20		27		40		80
Installed Capacity				MW		62		62		77		154
Gross Head				m		39		39		39		39
Design Flow, Qd				m <sup>3</sup> /s		192		192		240		480
MAD Multiplier at Qd						1.5		1.5		1.8		3.7
Reservoir Storage Volume				m <sup>3</sup>		66,034,500		66,034,500		66,034,500		66,034,500
Live Storage Volume				m <sup>3</sup>		35,513,000		35,513,000		35,513,000		35,513,000
Dam Height at Minimum Operating Level				m		20		20		20		20
Dam Height at Full Supply Level				m		39		39		39		39
Dam Type						RCC		RCC		RCC		RCC
Dam Crest Length				m		206		206		206		206
Reservoir Surface Area				m <sup>2</sup>		3,478,000		3,478,000		3,478,000		3,478,000
Penstock Length				km		0		0		0		0
Transmission Line Length				km		46		46		46		46
Access Road Length				km		46		46		46		46
ESTIMATED CAPITAL COSTS												
						16-Hour		12-Hour		8-Hour		4-Hour
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits	\$					66,365,000	\$	66,365,000	\$	73,120,000	\$	106,930,000
Access and Site Preparation	\$					47,199,000	\$	47,199,000	\$	47,199,000	\$	47,199,000
Cofferdams and Construction Water Management	\$					16,904,000	\$	16,904,000	\$	16,904,000	\$	16,904,000
Intake, Headrace, and Forebay	\$					31,790,000	\$	31,790,000	\$	39,728,000	\$	79,455,000
Dam Construction	\$					70,437,000	\$	70,437,000	\$	70,437,000	\$	70,437,000
Water Conveyance System	\$					1,921,000	\$	1,921,000	\$	2,400,000	\$	4,801,000
Powerhouse Construction	\$					71,417,000	\$	71,417,000	\$	89,249,000	\$	178,497,000
Switchyard and Transmission	\$					25,791,000	\$	25,791,000	\$	26,562,000	\$	30,425,000
SUB-TOTAL	\$					331,824,000	\$	331,824,000	\$	365,599,000	\$	534,648,000
EPCM Costs (8% of Subtotal)	\$					26,546,000	\$	26,546,000	\$	29,248,000	\$	42,772,000
Contingency (30% of Subtotal)	\$					99,547,000	\$	99,547,000	\$	109,680,000	\$	160,394,000
TOTAL ESTIMATED OVERNIGHT CAPITAL COST	\$					457,917,000	\$	457,917,000	\$	504,527,000	\$	737,814,000
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour		12-Hour		8-Hour		4-Hour
Fixed Operating Costs (2% of Capital)	\$					9,158,000	\$	9,158,000	\$	10,091,000	\$	14,756,000
Variable Operating Costs (\$0.005/kWh)	\$					1,452,000	\$	1,452,000	\$	1,623,000	\$	2,117,000
TOTAL ESTIMATED OPERATING COST	\$					10,610,000	\$	10,610,000	\$	11,714,000	\$	16,873,000
ENERGY OUTPUT UNDER AVERAGE FLOW CONDITIONS												
Month		Units		16-Hour		12-Hour		8-Hour		4-Hour		
Jan		MWh		6,808		6,808		6,808		6,808		6,808
Feb		MWh		1,045		1,045		1,045		1,045		1,045
Mar		MWh		4,893		4,893		4,893		4,893		4,893
Apr		MWh		13,194		13,194		13,194		13,194		13,194
May		MWh		49,829		49,829		61,311				84,482
Jun		MWh		44,505		44,505		55,617				111,234
Jul		MWh		45,989		45,989		57,471				77,618
Aug		MWh		36,137		36,137		36,137				36,137
Sep		MWh		30,527		30,527		30,527				30,527
Oct		MWh		34,792		34,792		34,792				34,792
Nov		MWh		15,919		15,919		15,919				15,919
Dec		MWh		6,798		6,798		6,798				6,798
ENERGY OUTPUT (AVERAGE)		GWh/yr		290.4		290.4		324.5				423.4
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDITIONS												
Month		Units		16-Hour		12-Hour		8-Hour		4-Hour		
Jan		MWh		6,292		6,292		6,292				6,292
Feb		MWh		15		15		15				15
Mar		MWh		4,119		4,119		4,119				4,119
Apr		MWh		17,327		17,327		17,327				17,327
May		MWh		49,829		49,829		61,311				112,435
Jun		MWh		44,505		44,505		55,617				87,247
Jul		MWh		45,120		45,120		45,120				45,120
Aug		MWh		37,766		37,766		37,766				37,766
Sep		MWh		22,514		22,514		22,514				22,514
Oct		MWh		21,052		21,052		21,052				21,052
Nov		MWh		10,412		10,412		10,412				10,412
Dec		MWh		4,542		4,542		4,542				4,542
ENERGY OUTPUT (FIRM)		GWh/yr		263.5		263.5		286.1				368.8
CAPACITY AND ENERGY COST METRICS												
Metric		Units		16-Hour		12-Hour		8-Hour		4-Hour		
Capacity Cost, Dependable Capacity		\$/MW		22,897,000		17,173,000		12,614,000		9,223,000		
Capacity Cost, Installed Capacity		\$/MW		7,408,000		7,408,000		6,531,000		4,776,000		
Energy Cost (Average)		\$/GWh		1,577,000		1,577,000		1,555,000		1,742,000		
Energy Cost (Firm)		\$/GWh		1,738,000		1,738,000		1,764,000		2,000,000		

M:\1\03\00647\01\A\Data\Dam and Reservoir Data\SCREEN-3+4\_20180531.xls\NASS RIVER

NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103.647/1.1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RVWD

TABLE C5

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

KINSKUCH RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-129.34	Catchment Area at Intake						km <sup>2</sup>	57		
Easting	E	55.71	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	76		
Region		North Coast	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	3.9		
Estimated Footprint	ha	1,460										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	0.4	0.3	0.3	1.3	6.8	12.6	11.2	8.1	5.9	3.3	1.0	0.5
Firm (Low Flow)	0.3	0.1	0.3	1.3	4.8	11.5	11.2	8.3	4.1	3.2	0.8	0.4
DESIGN PARAMETERS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Dependable Capacity	MW			20		27		40		80		
Installed Capacity	MW			32		32		40		80		
Gross Head	m			705		705		705		705		
Design Flow, Qd	m <sup>3</sup> /s			5		5		7		14		
MAD Multiplier at Qd				1.4		1.4		1.8		3.5		
Reservoir Storage Volume	m <sup>3</sup>			18,947,500		18,947,500		18,947,500		18,947,500		
Live Storage Volume	m <sup>3</sup>			17,931,000		17,931,000		17,931,000		17,931,000		
Dam Height at Minimum Operating Level	m			8		8		8		8		
Dam Height at Full Supply Level	m			10		10		10		10		
Dam Type	RC			RC		RC		RC		RC		
Dam Crest Length	m			82		82		82		82		
Reservoir Surface Area	m <sup>2</sup>			9,888,000		9,888,000		9,888,000		9,888,000		
Penstock Length	km			6		6		6		6		
Transmission Line Length	km			60		60		60		60		
Access Road Length	km			50		50		50		50		
ESTIMATED CAPITAL COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits	\$			30,045,000		\$ 30,045,000		\$ 32,972,000		\$ 46,457,000		
Access and Site Preparation	\$			22,159,000		\$ 22,159,000		\$ 22,159,000		\$ 22,159,000		
Cofferdams and Construction Water Management	\$			476,000		\$ 476,000		\$ 476,000		\$ 476,000		
Intake, Headrace, and Forebay	\$			6,124,000		\$ 6,124,000		\$ 6,157,000		\$ 6,314,000		
Dam Construction	\$			7,410,000		\$ 7,410,000		\$ 7,410,000		\$ 7,410,000		
Water Conveyance System	\$			21,350,000		\$ 21,350,000		\$ 24,222,000		\$ 35,547,000		
Powerhouse Construction	\$			32,070,000		\$ 32,070,000		\$ 40,456,000		\$ 80,912,000		
Switchyard and Transmission	\$			30,590,000		\$ 30,590,000		\$ 31,006,000		\$ 33,011,000		
SUB-TOTAL	\$			150,224,000		\$ 150,224,000		\$ 164,858,000		\$ 232,286,000		
EPCM Costs (8% of Subtotal)	\$			12,018,000		\$ 12,018,000		\$ 13,189,000		\$ 18,583,000		
Contingency (30% of Subtotal)	\$			45,067,000		\$ 45,067,000		\$ 49,457,000		\$ 69,686,000		
TOTAL ESTIMATED OVERNIGHT CAPITAL COST	\$			207,309,000		\$ 207,309,000		\$ 227,504,000		\$ 320,555,000		
ESTIMATED ANNUAL OPERATING COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)	\$			4,146,000		\$ 4,146,000		\$ 4,550,000		\$ 6,411,000		
Variable Operating Costs (\$0.005/kWh)	\$			648,000		\$ 648,000		\$ 759,000		\$ 1,004,000		
TOTAL ESTIMATED OPERATING COST	\$			4,794,000		\$ 4,794,000		\$ 5,309,000		\$ 7,415,000		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDITIONS												
Month	Units		16-Hour	12-Hour	8-Hour	4-Hour						
Jan	MWh		4,758	4,758	4,758	4,758						
Feb	MWh		0	0	0	0						
Mar	MWh		0	0	0	0						
Apr	MWh		0	0	0	0						
May	MWh		10,523	10,523	12,214	12,214						
Jun	MWh		22,896	22,896	28,883	53,155						
Jul	MWh		23,659	23,659	29,845	49,024						
Aug	MWh		23,659	23,659	29,845	35,333						
Sep	MWh		22,896	22,896	25,066	25,066						
Oct	MWh		14,404	14,404	14,404	14,404						
Nov	MWh		4,439	4,439	4,439	4,439						
Dec	MWh		2,333	2,333	2,333	2,333						
ENERGY OUTPUT (AVERAGE)	GWh/yr		129.6	129.6	151.8	200.7						
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDITIONS												
Month	Units		16-Hour	12-Hour	8-Hour	4-Hour						
Jan	MWh		4,602	4,602	4,602	4,602						
Feb	MWh		0	0	0	0						
Mar	MWh		0	0	0	0						
Apr	MWh		0	0	0	0						
May	MWh		3,840	3,840	3,840	3,840						
Jun	MWh		22,523	22,523	28,413	47,999						
Jul	MWh		23,659	23,659	29,845	49,187						
Aug	MWh		23,659	23,659	29,845	36,206						
Sep	MWh		17,502	17,502	17,502	17,502						
Oct	MWh		13,994	13,994	13,994	13,994						
Nov	MWh		3,209	3,209	3,209	3,209						
Dec	MWh		1,578	1,578	1,578	1,578						
ENERGY OUTPUT (FIRM)	GWh/yr		114.6	114.6	132.8	178.1						
CAPACITY AND ENERGY COST METRICS												
Metric	Units		16-Hour	12-Hour	8-Hour	4-Hour						
Capacity Cost, Dependable Capacity	\$/MW		\$ 10,365,000	\$ 7,774,000	\$ 5,688,000	\$ 4,007,000						
Capacity Cost, Installed Capacity	\$/MW		\$ 6,519,000	\$ 6,519,000	\$ 5,671,000	\$ 3,995,000						
Energy Cost (Average)	\$/GWh		\$ 1,600,000	\$ 1,600,000	\$ 1,499,000	\$ 1,597,000						
Energy Cost (Firm)	\$/GWh		\$ 1,810,000	\$ 1,810,000	\$ 1,713,000	\$ 1,800,000						

M:\1103100647\01\VA\Data\Dam and Reservoir Data\SCREEN-3+4\_20180531.xls\KINSKUCH RIVER

NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103.647/1.1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RVWD

TABLE C6

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

KITEEN RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-128.78	Catchment Area at Intake						km <sup>2</sup>	834		
Easting	E	55.43	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	52		
Region		North Coast	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	42.9		
Estimated Footprint	ha	270										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	5.5	7.9	8.4	20.5	84.1	116.2	89.4	59.6	46.9	43.5	20.4	10.8
Firm (Low Flow)	5.5	7.9	8.4	20.5	84.1	116.2	89.4	59.6	46.9	43.5	20.4	10.8
DESIGN PARAMETERS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Dependable Capacity	MW			20		27		40		80		
Installed Capacity	MW			37		37		55		110		
Gross Head	m			82		82		82		82		
Design Flow, Qd	m <sup>3</sup> /s			54		54		80		161		
MAD Multiplier at Qd				1.3		1.3		1.9		3.7		
Reservoir Storage Volume	m <sup>3</sup>			23,815,500		23,815,500		23,815,500		23,815,500		
Live Storage Volume	m <sup>3</sup>			14,349,000		14,349,000		14,349,000		14,349,000		
Dam Height at Minimum Operating Level	m			22		22		22		22		
Dam Height at Full Supply Level	m			44		44		44		44		
Dam Type				CFRD		CFRD		CFRD		CFRD		
Dam Crest Length	m			278		278		278		278		
Reservoir Surface Area	m <sup>2</sup>			1,092,000		1,092,000		1,092,000		1,092,000		
Penstock Length	km			5		5		5		5		
Transmission Line Length	km			23		23		23		23		
Access Road Length	km			4		4		4		4		
ESTIMATED CAPITAL COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits	\$			50,311,000		\$ 50,311,000		\$ 61,253,000		\$ 91,978,000		
Access and Site Preparation	\$			13,790,000		\$ 13,790,000		\$ 13,790,000		\$ 13,790,000		
Cofferdams and Construction Water Management	\$			4,723,000		\$ 4,723,000		\$ 4,723,000		\$ 4,723,000		
Intake, Headrace, and Forebay	\$			8,883,000		\$ 8,883,000		\$ 13,316,000		\$ 26,631,000		
Dam Construction	\$			54,342,000		\$ 54,342,000		\$ 54,342,000		\$ 54,342,000		
Water Conveyance System	\$			66,005,000		\$ 66,005,000		\$ 84,808,000		\$ 132,714,000		
Powerhouse Construction	\$			39,317,000		\$ 39,317,000		\$ 58,935,000		\$ 117,869,000		
Switchyard and Transmission	\$			14,182,000		\$ 14,182,000		\$ 15,096,000		\$ 17,841,000		
SUB-TOTAL	\$			251,553,000		\$ 251,553,000		\$ 306,263,000		\$ 459,888,000		
EPCM Costs (8% of Subtotal)	\$			20,124,000		\$ 20,124,000		\$ 24,501,000		\$ 36,791,000		
Contingency (30% of Subtotal)	\$			75,466,000		\$ 75,466,000		\$ 91,879,000		\$ 137,966,000		
TOTAL ESTIMATED OVERNIGHT CAPITAL COST	\$			347,143,000		\$ 347,143,000		\$ 422,643,000		\$ 634,645,000		
ESTIMATED ANNUAL OPERATING COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)	\$			6,943,000		\$ 6,943,000		\$ 8,453,000		\$ 12,693,000		
Variable Operating Costs (\$0.005/kWh)	\$			967,000		\$ 967,000		\$ 1,183,000		\$ 1,303,000		
TOTAL ESTIMATED OPERATING COST	\$			7,910,000		\$ 7,910,000		\$ 9,636,000		\$ 13,996,000		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDITIONS												
Month	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Jan	MWh		5,462		5,462		5,462		5,462			
Feb	MWh		903		903		903		903			
Mar	MWh		4,265		4,265		4,265		4,265			
Apr	MWh		10,074		10,074		10,074		10,074			
May	MWh		31,095		31,095		44,694		46,544			
Jun	MWh		26,376		26,376		39,536		57,100			
Jul	MWh		27,255		27,255		40,854		45,395			
Aug	MWh		27,255		27,255		30,263		30,263			
Sep	MWh		23,046		23,046		23,046		23,046			
Oct	MWh		22,088		22,088		22,088		22,088			
Nov	MWh		10,024		10,024		10,024		10,024			
Dec	MWh		5,484		5,484		5,484		5,484			
ENERGY OUTPUT (AVERAGE)	GWh/yr		193.3		193.3		236.7		260.6			
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDITIONS												
Month	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Jan	MWh		5,462		5,462		5,462		5,462			
Feb	MWh		903		903		903		903			
Mar	MWh		4,265		4,265		4,265		4,265			
Apr	MWh		10,074		10,074		10,074		10,074			
May	MWh		31,095		31,095		44,694		46,544			
Jun	MWh		26,376		26,376		39,536		57,100			
Jul	MWh		27,255		27,255		40,854		45,395			
Aug	MWh		27,255		27,255		30,263		30,263			
Sep	MWh		23,046		23,046		23,046		23,046			
Oct	MWh		22,088		22,088		22,088		22,088			
Nov	MWh		10,024		10,024		10,024		10,024			
Dec	MWh		5,484		5,484		5,484		5,484			
ENERGY OUTPUT (FIRM)	GWh/yr		193.3		193.3		236.7		260.6			
CAPACITY AND ENERGY COST METRICS												
Metric	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Capacity Cost, Dependable Capacity	\$/MW		\$ 17,357,000		\$ 13,018,000		\$ 10,566,000		\$ 7,933,000			
Capacity Cost, Installed Capacity	\$/MW		\$ 9,476,000		\$ 9,476,000		\$ 7,697,000		\$ 5,779,000			
Energy Cost (Average)	\$/GWh		\$ 1,796,000		\$ 1,796,000		\$ 1,786,000		\$ 2,435,000			
Energy Cost (Firm)	\$/GWh		\$ 1,796,000		\$ 1,796,000		\$ 1,786,000		\$ 2,435,000			

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NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS



TABLE C7

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

KSI GWINHAT'AL

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-129.13						Catchment Area at Intake		km <sup>2</sup>		314
Easting	E	55.41						Estimated Mean Annual Unit Runoff		L/s/km <sup>2</sup>		75
Region		North Coast						Mean Annual Discharge (MAD)		m <sup>3</sup> /s		23.6
Estimated Footprint	ha	250										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	3.6	3.5	3.9	10.2	42.7	60.5	51.0	38.3	28.9	23.0	11.2	5.6
Firm (Low Flow)	3.6	3.5	3.9	10.2	42.7	60.5	51.0	38.3	28.9	23.0	11.2	5.6
DESIGN PARAMETERS												
						16-Hour		12-Hour		8-Hour		4-Hour
Dependable Capacity				MW		20		27		40		80
Installed Capacity				MW		32		32		47		93
Gross Head				m		131		131		131		131
Design Flow, Qd				m <sup>3</sup> /s		30		30		43		85
MAD Multiplier at Qd						1.3		1.3		1.8		3.6
Reservoir Storage Volume				m <sup>3</sup>		15,012,000		15,012,000		15,012,000		15,012,000
Live Storage Volume				m <sup>3</sup>		9,626,000		9,626,000		9,626,000		9,626,000
Dam Height at Minimum Operating Level				m		17		17		17		17
Dam Height at Full Supply Level				m		35		35		35		35
Dam Type						CFRD		CFRD		CFRD		CFRD
Dam Crest Length				m		381		381		381		381
Reservoir Surface Area				m <sup>2</sup>		939,000		939,000		939,000		939,000
Penstock Length				km		5		5		5		5
Transmission Line Length				km		20		20		20		20
Access Road Length				km		15		15		15		15
ESTIMATED CAPITAL COSTS												
						16-Hour		12-Hour		8-Hour		4-Hour
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits				\$		41,047,000		41,047,000		48,272,000		70,426,000
Access and Site Preparation				\$		17,790,000		17,790,000		17,790,000		17,790,000
Cofferdams and Construction Water Management				\$		2,600,000		2,600,000		2,600,000		2,600,000
Intake, Headrace, and Forebay				\$		4,891,000		4,891,000		7,041,000		14,082,000
Dam Construction				\$		46,252,000		46,252,000		46,252,000		46,252,000
Water Conveyance System				\$		46,188,000		46,188,000		57,342,000		87,850,000
Powerhouse Construction				\$		33,849,000		33,849,000		48,733,000		97,467,000
Switchyard and Transmission				\$		12,619,000		12,619,000		13,330,000		15,661,000
SUB-TOTAL				\$		205,236,000		205,236,000		241,360,000		352,128,000
EPCM Costs (8% of Subtotal)				\$		16,419,000		16,419,000		19,309,000		28,170,000
Contingency (30% of Subtotal)				\$		61,571,000		61,571,000		72,408,000		105,638,000
TOTAL ESTIMATED OVERNIGHT CAPITAL COST				\$		283,226,000		283,226,000		333,077,000		485,936,000
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour		12-Hour		8-Hour		4-Hour
Fixed Operating Costs (2% of Capital)				\$		5,665,000		5,665,000		6,662,000		9,719,000
Variable Operating Costs (\$0.005/kWh)				\$		854,000		854,000		1,047,000		1,153,000
TOTAL ESTIMATED OPERATING COST				\$		6,519,000		6,519,000		7,709,000		10,872,000
ENERGY OUTPUT UNDER AVERAGE FLOW CONDITONS												
Month				Units		16-Hour		12-Hour		8-Hour		4-Hour
Jan				MWh		5,544		5,544		5,544		5,544
Feb				MWh		0		0		0		0
Mar				MWh		2,826		2,826		2,826		2,826
Apr				MWh		8,045		8,045		8,045		8,045
May				MWh		27,925		27,925		38,515		38,643
Jun				MWh		23,308		23,308		33,556		47,720
Jul				MWh		24,085		24,085		34,675		41,567
Aug				MWh		24,085		24,085		31,216		31,216
Sep				MWh		22,795		22,795		22,795		22,795
Oct				MWh		18,746		18,746		18,746		18,746
Nov				MWh		8,834		8,834		8,834		8,834
Dec				MWh		4,564		4,564		4,564		4,564
ENERGY OUTPUT (AVERAGE)				GWh/yr		170.8		170.8		209.3		230.5
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDITONS												
Month				Units		16-Hour		12-Hour		8-Hour		4-Hour
Jan				MWh		5,544		5,544		5,544		5,544
Feb				MWh		0		0		0		0
Mar				MWh		2,826		2,826		2,826		2,826
Apr				MWh		8,045		8,045		8,045		8,045
May				MWh		27,925		27,925		38,515		38,643
Jun				MWh		23,308		23,308		33,556		47,720
Jul				MWh		24,085		24,085		34,675		41,567
Aug				MWh		24,085		24,085		31,216		31,216
Sep				MWh		22,795		22,795		22,795		22,795
Oct				MWh		18,746		18,746		18,746		18,746
Nov				MWh		8,834		8,834		8,834		8,834
Dec				MWh		4,564		4,564		4,564		4,564
ENERGY OUTPUT (FIRM)				GWh/yr		170.8		170.8		209.3		230.5
CAPACITY AND ENERGY COST METRICS												
Metric				Units		16-Hour		12-Hour		8-Hour		4-Hour
Capacity Cost, Dependable Capacity				\$/MW		14,161,000		10,621,000		8,327,000		6,074,000
Capacity Cost, Installed Capacity				\$/MW		8,749,000		8,749,000		7,147,000		5,213,000
Energy Cost (Average)				\$/GWh		1,659,000		1,659,000		1,591,000		2,108,000
Energy Cost (Firm)				\$/GWh		1,659,000		1,659,000		1,591,000		2,108,000

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NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103.647/1.1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RVWD

TABLE C8

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

HIRSCH CREEK

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-128.55	Catchment Area at Intake						km <sup>2</sup>	332		
Easting	E	54.09	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	62		
Region		North Coast	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	20.8		
Estimated Footprint	ha	130										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	9.4	8.0	5.6	12.0	28.2	45.8	34.1	25.2	22.2	25.4	20.8	11.8
Firm (Low Flow)	9.4	8.0	5.6	12.0	28.2	45.8	34.1	25.2	22.2	25.4	20.8	11.8
DESIGN PARAMETERS												
						16-Hour		12-Hour		8-Hour		4-Hour
Dependable Capacity				MW		20		27		40		80
Installed Capacity				MW		24		27		41		82
Gross Head				m		109		109		109		109
Design Flow, Qd				m <sup>3</sup> /s		26		30		45		90
MAD Multiplier at Qd						1.3		1.4		2.2		4.3
Reservoir Storage Volume				m <sup>3</sup>		13,871,613		13,871,613		13,871,613		13,871,613
Live Storage Volume				m <sup>3</sup>		6,116,000		6,116,000		6,116,000		6,116,000
Dam Height at Minimum Operating Level				m		19		19		19		19
Dam Height at Full Supply Level				m		21		21		21		21
Dam Type						CFRD		CFRD		CFRD		CFRD
Dam Crest Length				m		799		799		799		799
Reservoir Surface Area				m <sup>2</sup>		948,000		948,000		948,000		948,000
Penstock Length				km		3		3		3		3
Transmission Line Length				km		4		4		4		4
Access Road Length				km		5		5		5		5
ESTIMATED CAPITAL COSTS												
						16-Hour		12-Hour		8-Hour		4-Hour
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits	\$					28,243,000	\$	29,968,000	\$	36,269,000	\$	54,211,000
Access and Site Preparation	\$					9,418,000	\$	9,418,000	\$	9,418,000	\$	9,418,000
Cofferdams and Construction Water Management	\$					2,284,000	\$	2,284,000	\$	2,284,000	\$	2,284,000
Intake, Headrace, and Forebay	\$					4,295,000	\$	4,952,000	\$	7,428,000	\$	14,856,000
Dam Construction	\$					41,266,000	\$	41,266,000	\$	41,266,000	\$	41,266,000
Water Conveyance System	\$					25,791,000	\$	28,037,000	\$	35,710,000	\$	54,884,000
Powerhouse Construction	\$					24,934,000	\$	28,750,000	\$	43,124,000	\$	86,249,000
Switchyard and Transmission	\$					4,982,000	\$	5,163,000	\$	5,844,000	\$	7,888,000
SUB-TOTAL	\$					141,213,000	\$	149,838,000	\$	181,343,000	\$	271,056,000
EPCM Costs (8% of Subtotal)	\$					11,297,000	\$	11,987,000	\$	14,507,000	\$	21,684,000
Contingency (30% of Subtotal)	\$					42,364,000	\$	44,951,000	\$	54,403,000	\$	81,317,000
TOTAL ESTIMATED OVERNIGHT CAPITAL COST	\$					194,874,000	\$	206,776,000	\$	250,253,000	\$	374,057,000
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour		12-Hour		8-Hour		4-Hour
Fixed Operating Costs (2% of Capital)	\$					3,897,000	\$	4,136,000	\$	5,005,000	\$	7,481,000
Variable Operating Costs (\$0.005/kWh)	\$					745,000	\$	779,000	\$	843,000	\$	846,000
TOTAL ESTIMATED OPERATING COST	\$					4,642,000	\$	4,915,000	\$	5,848,000	\$	8,327,000
ENERGY OUTPUT UNDER AVERAGE FLOW CONDITIONS												
Month		Units				16-Hour		12-Hour		8-Hour		4-Hour
Jan		MWh				7,539		7,539		7,539		7,539
Feb		MWh				3,349		3,349		3,349		3,349
Mar		MWh				3,795		3,795		3,795		3,795
Apr		MWh				7,870		7,870		7,870		7,870
May		MWh				21,425		22,950		22,950		22,950
Jun		MWh				17,018		19,622		29,434		30,036
Jul		MWh				17,585		20,277		23,108		23,108
Aug		MWh				17,077		17,077		17,077		17,077
Sep		MWh				14,559		14,559		14,559		14,559
Oct		MWh				17,213		17,213		17,213		17,213
Nov		MWh				13,641		13,641		13,641		13,641
Dec		MWh				7,996		7,996		7,996		7,996
ENERGY OUTPUT (AVERAGE)		GWh/yr				149.1		155.9		168.5		169.1
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDITIONS												
Month		Units				16-Hour		12-Hour		8-Hour		4-Hour
Jan		MWh				7,539		7,539		7,539		7,539
Feb		MWh				3,349		3,349		3,349		3,349
Mar		MWh				3,795		3,795		3,795		3,795
Apr		MWh				7,870		7,870		7,870		7,870
May		MWh				21,425		22,950		22,950		22,950
Jun		MWh				17,018		19,622		29,434		30,036
Jul		MWh				17,585		20,277		23,108		23,108
Aug		MWh				17,077		17,077		17,077		17,077
Sep		MWh				14,559		14,559		14,559		14,559
Oct		MWh				17,213		17,213		17,213		17,213
Nov		MWh				13,641		13,641		13,641		13,641
Dec		MWh				7,996		7,996		7,996		7,996
ENERGY OUTPUT (FIRM)		GWh/yr				149.1		155.9		168.5		169.1
CAPACITY AND ENERGY COST METRICS												
Metric		Units				16-Hour		12-Hour		8-Hour		4-Hour
Capacity Cost, Dependable Capacity		\$/MW				9,744,000		7,754,000		6,256,000		4,676,000
Capacity Cost, Installed Capacity		\$/MW				8,245,000		7,587,000		6,122,000		4,575,000
Energy Cost (Average)		\$/GWh				1,307,000		1,326,000		1,485,000		2,212,000
Energy Cost (Firm)		\$/GWh				1,307,000		1,326,000		1,485,000		2,212,000

M:\1103100647\01\VA\Data\Dam and Reservoir Data\SCREEN-3+4\_20180531.xls]HIRSCH CREEK

NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103.647/1.1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RVWD

TABLE C9

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

KITIMAT RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-128.32	Catchment Area at Intake						km <sup>2</sup>	457		
Easting	E	54.26	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	70		
Region		North Coast	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	32.2		
Estimated Footprint	ha	750										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	11.6	10.4	7.2	15.5	43.4	80.8	62.7	44.6	32.3	34.9	25.6	15.7
Firm (Low Flow)	11.6	10.4	7.2	15.5	43.4	80.8	62.7	44.6	32.3	34.9	25.6	15.7
DESIGN PARAMETERS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Dependable Capacity	MW			20		27		40		80		
Installed Capacity	MW			37		49		73		146		
Gross Head	m			37		37		37		37		
Design Flow, Qd	m <sup>3</sup> /s			119		158		238		475		
MAD Multiplier at Qd				3.7		4.9		7.4		14.8		
Reservoir Storage Volume	m <sup>3</sup>			83,088,000		83,088,000		83,088,000		83,088,000		
Live Storage Volume	m <sup>3</sup>			47,859,000		47,859,000		47,859,000		47,859,000		
Dam Height at Minimum Operating Level	m			20		20		20		20		
Dam Height at Full Supply Level	m			37		37		37		37		
Dam Type				CFRD		CFRD		CFRD		CFRD		
Dam Crest Length	m			307		307		307		307		
Reservoir Surface Area	m <sup>2</sup>			4,759,000		4,759,000		4,759,000		4,759,000		
Penstock Length	km			0		0		0		0		
Transmission Line Length	km			40		40		40		40		
Access Road Length	km			18		18		18		18		
ESTIMATED CAPITAL COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits	\$			42,629,000		\$ 48,067,000		\$ 58,942,000		\$ 91,567,000		
Access and Site Preparation	\$			39,007,000		\$ 39,007,000		\$ 39,007,000		\$ 39,007,000		
Cofferdams and Construction Water Management	\$			3,537,000		\$ 3,537,000		\$ 3,537,000		\$ 3,537,000		
Intake, Headrace, and Forebay	\$			19,667,000		\$ 26,223,000		\$ 39,335,000		\$ 78,669,000		
Dam Construction	\$			42,720,000		\$ 42,720,000		\$ 42,720,000		\$ 42,720,000		
Water Conveyance System	\$			1,188,000		\$ 1,584,000		\$ 2,377,000		\$ 4,753,000		
Powerhouse Construction	\$			42,565,000		\$ 56,753,000		\$ 85,129,000		\$ 170,258,000		
Switchyard and Transmission	\$			21,831,000		\$ 22,442,000		\$ 23,662,000		\$ 27,325,000		
SUB-TOTAL	\$			213,144,000		\$ 240,333,000		\$ 294,709,000		\$ 457,836,000		
EPCM Costs (8% of Subtotal)	\$			17,052,000		\$ 19,227,000		\$ 23,577,000		\$ 36,627,000		
Contingency (30% of Subtotal)	\$			63,943,000		\$ 72,100,000		\$ 88,413,000		\$ 137,351,000		
TOTAL ESTIMATED OVERNIGHT CAPITAL COST	\$			294,139,000		\$ 331,660,000		\$ 406,699,000		\$ 631,814,000		
ESTIMATED ANNUAL OPERATING COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)	\$			5,883,000		\$ 6,633,000		\$ 8,134,000		\$ 12,636,000		
Variable Operating Costs (\$0.005/kWh)	\$			447,000		\$ 447,000		\$ 447,000		\$ 447,000		
TOTAL ESTIMATED OPERATING COST	\$			6,330,000		\$ 7,080,000		\$ 8,581,000		\$ 13,083,000		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDITIONS												
Month	Units	16-Hour	12-Hour	8-Hour	4-Hour							
Jan	MWh	5,384	5,384	5,384	5,384							
Feb	MWh	0	0	0	0							
Mar	MWh	0	0	0	0							
Apr	MWh	3,147	3,147	3,147	3,147							
May	MWh	13,791	13,791	13,791	13,791							
Jun	MWh	17,929	17,929	17,929	17,929							
Jul	MWh	14,376	14,376	14,376	14,376							
Aug	MWh	10,226	10,226	10,226	10,226							
Sep	MWh	7,167	7,167	7,167	7,167							
Oct	MWh	8,002	8,002	8,002	8,002							
Nov	MWh	5,680	5,680	5,680	5,680							
Dec	MWh	3,600	3,600	3,600	3,600							
ENERGY OUTPUT (AVERAGE)	GWh/yr	89.3	89.3	89.3	89.3							
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDITIONS												
Month	Units	16-Hour	12-Hour	8-Hour	4-Hour							
Jan	MWh	5,384	5,384	5,384	5,384							
Feb	MWh	0	0	0	0							
Mar	MWh	0	0	0	0							
Apr	MWh	3,147	3,147	3,147	3,147							
May	MWh	13,791	13,791	13,791	13,791							
Jun	MWh	17,929	17,929	17,929	17,929							
Jul	MWh	14,376	14,376	14,376	14,376							
Aug	MWh	10,226	10,226	10,226	10,226							
Sep	MWh	7,167	7,167	7,167	7,167							
Oct	MWh	8,002	8,002	8,002	8,002							
Nov	MWh	5,680	5,680	5,680	5,680							
Dec	MWh	3,600	3,600	3,600	3,600							
ENERGY OUTPUT (FIRM)	GWh/yr	89.3	89.3	89.3	89.3							
CAPACITY AND ENERGY COST METRICS												
Metric	Units	16-Hour	12-Hour	8-Hour	4-Hour							
Capacity Cost, Dependable Capacity	\$/MW	\$ 14,707,000	\$ 12,437,000	\$ 10,168,000	\$ 7,898,000							
Capacity Cost, Installed Capacity	\$/MW	\$ 8,032,000	\$ 6,792,000	\$ 5,553,000	\$ 4,313,000							
Energy Cost (Average)	\$/GWh	\$ 3,294,000	\$ 3,714,000	\$ 4,554,000	\$ 7,075,000							
Energy Cost (Firm)	\$/GWh	\$ 3,294,000	\$ 3,714,000	\$ 4,554,000	\$ 7,075,000							

TABLE C10

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

ZYMOETZ RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-128.35	Catchment Area at Intake						km <sup>2</sup>	2,963		
Easting	E	54.50	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	37		
Region		North Coast	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	73.9		
Estimated Footprint	ha	290										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	32.3	23.7	24.1	60.7	230.7	296.3	196.5	122.9	105.8	111.6	65.1	35.5
Firm (Low Flow)	27.6	19.1	14.2	35.6	181.6	234.8	126.1	78.9	61.0	43.5	28.5	33.1
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Dependable Capacity			MW			20	27	40	80			
Installed Capacity			MW			51	51	51	81			
Gross Head			m			45	45	45	45			
Design Flow, Qd			m <sup>3</sup> /s			136	136	136	215			
MAD Multiplier at Qd						1.8	1.8	1.8	2.9			
Reservoir Storage Volume			m <sup>3</sup>			18,767,669	18,767,669	18,767,669	18,767,669			
Live Storage Volume			m <sup>3</sup>			188,000	188,000	188,000	188,000			
Dam Height at Minimum Operating Level			m			45	45	45	45			
Dam Height at Full Supply Level			m			45	45	45	45			
Dam Type						RCC	RCC	RCC	RCC			
Dam Crest Length			m			201	201	201	201			
Reservoir Surface Area			m <sup>2</sup>			1,242,000	1,242,000	1,242,000	1,242,000			
Penstock Length			km			0	0	0	0			
Transmission Line Length			km			27	27	27	27			
Access Road Length			km			1	1	1	1			
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits	\$					47,970,000	47,970,000	47,970,000	\$	60,151,000		
Access and Site Preparation	\$					11,280,000	11,280,000	11,280,000	\$	11,280,000		
Cofferdams and Construction Water Management	\$					12,007,000	12,007,000	12,007,000	\$	12,007,000		
Intake, Headrace, and Forebay	\$					22,581,000	22,581,000	22,581,000	\$	35,590,000		
Dam Construction	\$					69,867,000	69,867,000	69,867,000	\$	69,867,000		
Water Conveyance System	\$					1,364,000	1,364,000	1,364,000	\$	2,150,000		
Powerhouse Construction	\$					58,067,000	58,067,000	58,067,000	\$	91,520,000		
Switchyard and Transmission	\$					16,712,000	16,712,000	16,712,000	\$	18,188,000		
SUB-TOTAL	\$					239,848,000	239,848,000	239,848,000	\$	300,753,000		
EPCM Costs (8% of Subtotal)	\$					19,188,000	19,188,000	19,188,000	\$	24,060,000		
Contingency (30% of Subtotal)	\$					71,954,000	71,954,000	71,954,000	\$	90,226,000		
TOTAL ESTIMATED OVERNIGHT CAPITAL COST	\$					330,990,000	330,990,000	330,990,000	\$	415,039,000		
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Fixed Operating Costs (2% of Capital)	\$					6,620,000	6,620,000	6,620,000	\$	8,301,000		
Variable Operating Costs (\$0.005/kWh)	\$					1,384,000	1,384,000	1,384,000	\$	1,684,000		
TOTAL ESTIMATED OPERATING COST	\$					8,004,000	8,004,000	8,004,000	\$	9,985,000		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month	Units					16-Hour	12-Hour	8-Hour	4-Hour			
Jan	MWh					9,074	9,074	9,074	9,074			
Feb	MWh					5,971	5,971	5,971	5,971			
Mar	MWh					6,725	6,725	6,725	6,725			
Apr	MWh					16,416	16,416	16,416	16,416			
May	MWh					41,966	41,966	41,966	63,931			
Jun	MWh					36,896	36,896	36,896	58,153			
Jul	MWh					38,126	38,126	38,126	54,910			
Aug	MWh					34,353	34,353	34,353	34,353			
Sep	MWh					28,612	28,612	28,612	28,612			
Oct	MWh					31,180	31,180	31,180	31,180			
Nov	MWh					17,591	17,591	17,591	17,591			
Dec	MWh					9,910	9,910	9,910	9,910			
ENERGY OUTPUT (AVERAGE)	GWh/yr					276.8	276.8	276.8	336.8			
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month	Units					16-Hour	12-Hour	8-Hour	4-Hour			
Jan	MWh					8,325	8,325	8,325	8,325			
Feb	MWh					4,793	4,793	4,793	4,793			
Mar	MWh					3,957	3,957	3,957	3,957			
Apr	MWh					9,635	9,635	9,635	9,635			
May	MWh					41,966	41,966	41,966	54,586			
Jun	MWh					36,896	36,896	36,896	58,153			
Jul	MWh					35,241	35,241	35,241	35,241			
Aug	MWh					22,038	22,038	22,038	22,038			
Sep	MWh					16,502	16,502	16,502	16,502			
Oct	MWh					12,148	12,148	12,148	12,148			
Nov	MWh					7,700	7,700	7,700	7,700			
Dec	MWh					9,238	9,238	9,238	9,238			
ENERGY OUTPUT (FIRM)	GWh/yr					208.4	208.4	208.4	242.3			
CAPACITY AND ENERGY COST METRICS												
Metric	Units					16-Hour	12-Hour	8-Hour	4-Hour			
Capacity Cost, Dependable Capacity	\$/MW	\$				16,550,000	12,412,000	8,275,000	\$	5,188,000		
Capacity Cost, Installed Capacity	\$/MW	\$				6,459,000	6,459,000	6,459,000	\$	5,139,000		
Energy Cost (Average)	\$/GWh	\$				1,196,000	1,196,000	1,196,000	\$	1,232,000		
Energy Cost (Firm)	\$/GWh	\$				1,588,000	1,588,000	1,588,000	\$	1,713,000		

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NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREPD	RVWD

TABLE C11

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

KSI HLGINX

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-129.59						Catchment Area at Intake	km <sup>2</sup>		579	
Easting	E	54.96						Estimated Mean Annual Unit Runoff	L/s/km <sup>2</sup>		124	
Region		North Coast						Mean Annual Discharge (MAD)	m <sup>3</sup> /s		71.8	
Estimated Footprint	ha	740										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	22.3	20.8	15.8	28.2	74.2	152.6	128.8	116.3	103.5	91.9	72.1	33.3
Firm (Low Flow)	22.3	20.8	15.8	28.2	74.2	152.6	128.8	116.3	103.5	91.9	72.1	33.3
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Dependable Capacity				MW		20	27	40	80			
Installed Capacity				MW		34	45	67	135			
Gross Head				m		33	33	33	33			
Design Flow, Qd				m <sup>3</sup> /s		124	165	247	494			
MAD Multiplier at Qd						1.7	2.3	3.4	6.9			
Reservoir Storage Volume				m <sup>3</sup>		71,141,000	71,141,000	71,141,000	71,141,000			
Live Storage Volume				m <sup>3</sup>		40,130,000	40,130,000	40,130,000	40,130,000			
Dam Height at Minimum Operating Level				m		19	19	19	19			
Dam Height at Full Supply Level				m		33	33	33	33			
Dam Type						CFRD	CFRD	CFRD	CFRD			
Dam Crest Length				m		755	755	755	755			
Reservoir Surface Area				m <sup>2</sup>		3,915,000	3,915,000	3,915,000	3,915,000			
Penstock Length				km		0	0	0	0			
Transmission Line Length				km		58	58	58	58			
Access Road Length				km		1	1	1	1			
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits	\$					53,353,000	58,618,000	69,147,000	100,735,000			
Access and Site Preparation	\$					29,796,000	29,796,000	29,796,000	29,796,000			
Cofferdams and Construction Water Management	\$					7,900,000	7,900,000	7,900,000	7,900,000			
Intake, Headrace, and Forebay	\$					20,444,000	27,259,000	40,889,000	81,777,000			
Dam Construction	\$					84,440,000	84,440,000	84,440,000	84,440,000			
Water Conveyance System	\$					1,235,000	1,647,000	2,471,000	4,941,000			
Powerhouse Construction	\$					39,815,000	53,086,000	79,629,000	159,258,000			
Switchyard and Transmission	\$					29,782,000	30,343,000	31,464,000	34,828,000			
<b>SUB-TOTAL</b>	<b>\$</b>					<b>266,765,000</b>	<b>293,089,000</b>	<b>345,736,000</b>	<b>503,675,000</b>			
EPCM Costs (8% of Subtotal)	\$					21,341,000	23,447,000	27,659,000	40,294,000			
Contingency (30% of Subtotal)	\$					80,030,000	87,927,000	103,721,000	151,103,000			
<b>TOTAL ESTIMATED OVERNIGHT CAPITAL COST</b>	<b>\$</b>					<b>368,136,000</b>	<b>404,463,000</b>	<b>477,116,000</b>	<b>695,072,000</b>			
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Fixed Operating Costs (2% of Capital)	\$					7,363,000	8,089,000	9,542,000	13,901,000			
Variable Operating Costs (\$0.005/kWh)	\$					837,000	871,000	871,000	871,000			
<b>TOTAL ESTIMATED OPERATING COST</b>	<b>\$</b>					<b>8,200,000</b>	<b>8,960,000</b>	<b>10,413,000</b>	<b>14,772,000</b>			
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month	Units					16-Hour	12-Hour	8-Hour	4-Hour			
Jan	MWh					6,463	6,463	6,463	6,463			6,463
Feb	MWh					771	771	771	771			771
Mar	MWh					3,201	3,201	3,201	3,201			3,201
Apr	MWh					5,529	5,529	5,529	5,529			5,529
May	MWh					18,873	18,873	18,873	18,873			18,873
Jun	MWh					24,219	29,919	29,919	29,919			29,919
Jul	MWh					25,027	26,094	26,094	26,094			26,094
Aug	MWh					23,562	23,562	23,562	23,562			23,562
Sep	MWh					20,292	20,292	20,292	20,292			20,292
Oct	MWh					18,618	18,618	18,618	18,618			18,618
Nov	MWh					14,136	14,136	14,136	14,136			14,136
Dec	MWh					6,746	6,746	6,746	6,746			6,746
<b>ENERGY OUTPUT (AVERAGE)</b>	<b>GWh/yr</b>					<b>167.4</b>	<b>174.2</b>	<b>174.2</b>	<b>174.2</b>			<b>174.2</b>
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month	Units					16-Hour	12-Hour	8-Hour	4-Hour			
Jan	MWh					6,463	6,463	6,463	6,463			6,463
Feb	MWh					771	771	771	771			771
Mar	MWh					3,201	3,201	3,201	3,201			3,201
Apr	MWh					5,529	5,529	5,529	5,529			5,529
May	MWh					18,873	18,873	18,873	18,873			18,873
Jun	MWh					24,219	29,919	29,919	29,919			29,919
Jul	MWh					25,027	26,094	26,094	26,094			26,094
Aug	MWh					23,562	23,562	23,562	23,562			23,562
Sep	MWh					20,292	20,292	20,292	20,292			20,292
Oct	MWh					18,618	18,618	18,618	18,618			18,618
Nov	MWh					14,136	14,136	14,136	14,136			14,136
Dec	MWh					6,746	6,746	6,746	6,746			6,746
<b>ENERGY OUTPUT (FIRM)</b>	<b>GWh/yr</b>					<b>167.4</b>	<b>174.2</b>	<b>174.2</b>	<b>174.2</b>			<b>174.2</b>
CAPACITY AND ENERGY COST METRICS												
Metric	Units					16-Hour	12-Hour	8-Hour	4-Hour			
Capacity Cost, Dependable Capacity	\$/MW	\$				18,362,000	15,130,000	11,899,000	8,667,000			
Capacity Cost, Installed Capacity	\$/MW	\$				10,944,000	9,018,000	7,092,000	5,166,000			
Energy Cost (Average)	\$/GWh	\$				2,199,000	2,322,000	2,739,000	3,990,000			
Energy Cost (Firm)	\$/GWh	\$				2,199,000	2,322,000	2,739,000	3,990,000			

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NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREPD	RVWD

TABLE C12

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

ANUDOL CREEK (A)

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-129.53	Catchment Area at Intake						km <sup>2</sup>	70		
Easting	E	55.12	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	76		
Region		North Coast	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	4.8		
Estimated Footprint	ha	410										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	0.4	0.4	0.4	1.6	8.3	15.4	13.8	9.9	7.3	4.0	1.3	0.7
Firm (Low Flow)	0.4	0.1	0.4	1.6	5.9	14.2	13.8	10.2	5.1	3.9	0.9	0.4
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour		4-Hour		
Dependable Capacity				MW		20	27	40		80		
Installed Capacity				MW		28	28	40		81		
Gross Head				m		507	507	507		507		
Design Flow, Qd				m <sup>3</sup> /s		7	7	10		19		
MAD Multiplier at Qd						1.4	1.4	2.0		4.0		
Reservoir Storage Volume				m <sup>3</sup>		4,322,500	4,322,500	4,322,500		4,322,500		
Live Storage Volume				m <sup>3</sup>		2,878,000	2,878,000	2,878,000		2,878,000		
Dam Height at Minimum Operating Level				m		12	12	12		12		
Dam Height at Full Supply Level				m		15	15	15		15		
Dam Type						CFRD	CFRD	CFRD		CFRD		
Dam Crest Length				m		123	123	123		123		
Reservoir Surface Area				m <sup>2</sup>		569,000	569,000	569,000		569,000		
Penstock Length				km		10	10	10		10		
Transmission Line Length				km		51	51	51		51		
Access Road Length				km		14	14	14		14		
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits	\$					31,004,000	31,004,000	36,517,000	\$	53,356,000		
Access and Site Preparation	\$					22,895,000	22,895,000	22,895,000	\$	22,895,000		
Cofferdams and Construction Water Management	\$					585,000	585,000	585,000	\$	585,000		
Intake, Headrace, and Forebay	\$					1,099,000	1,099,000	1,575,000	\$	3,151,000		
Dam Construction	\$					4,901,000	4,901,000	4,901,000	\$	4,901,000		
Water Conveyance System	\$					39,739,000	39,739,000	48,400,000	\$	71,415,000		
Powerhouse Construction	\$					28,441,000	28,441,000	40,749,000	\$	81,498,000		
Switchyard and Transmission	\$					26,355,000	26,355,000	26,964,000	\$	28,977,000		
<b>SUB-TOTAL</b>	<b>\$</b>					<b>155,019,000</b>	<b>155,019,000</b>	<b>182,586,000</b>	<b>\$</b>	<b>266,778,000</b>		
EPCM Costs (8% of Subtotal)	\$					12,402,000	12,402,000	14,607,000	\$	21,342,000		
Contingency (30% of Subtotal)	\$					46,506,000	46,506,000	54,776,000	\$	80,033,000		
<b>TOTAL ESTIMATED OVERNIGHT CAPITAL COST</b>	<b>\$</b>					<b>213,927,000</b>	<b>213,927,000</b>	<b>251,969,000</b>	<b>\$</b>	<b>368,153,000</b>		
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)	\$					4,279,000	4,279,000	5,039,000	\$	7,363,000		
Variable Operating Costs (\$0.005/kWh)	\$					671,000	671,000	841,000	\$	1,004,000		
<b>TOTAL ESTIMATED OPERATING COST</b>	<b>\$</b>					<b>4,950,000</b>	<b>4,950,000</b>	<b>5,880,000</b>	<b>\$</b>	<b>8,367,000</b>		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month	Units					16-Hour	12-Hour	8-Hour		4-Hour		
Jan	MWh					4,651	4,651	4,651		4,651		
Feb	MWh					0	0	0		0		
Mar	MWh					0	0	0		0		
Apr	MWh					3,697	3,697	3,697		3,697		
May	MWh					24,753	24,753	30,043		30,043		
Jun	MWh					20,238	20,238	28,997		46,986		
Jul	MWh					20,913	20,913	29,963		43,335		
Aug	MWh					20,913	20,913	29,963		31,233		
Sep	MWh					20,238	20,238	22,157		22,157		
Oct	MWh					12,732	12,732	12,732		12,732		
Nov	MWh					3,923	3,923	3,923		3,923		
Dec	MWh					2,063	2,063	2,063		2,063		
<b>ENERGY OUTPUT (AVERAGE)</b>	<b>GWh/yr</b>					<b>134.1</b>	<b>134.1</b>	<b>168.2</b>		<b>200.8</b>		
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month	Units					16-Hour	12-Hour	8-Hour		4-Hour		
Jan	MWh					4,513	4,513	4,513		4,513		
Feb	MWh					0	0	0		0		
Mar	MWh					0	0	0		0		
Apr	MWh					3,190	3,190	3,190		3,190		
May	MWh					22,447	22,447	22,447		22,447		
Jun	MWh					20,238	20,238	28,997		43,129		
Jul	MWh					20,913	20,913	29,963		43,478		
Aug	MWh					20,913	20,913	29,963		32,004		
Sep	MWh					15,470	15,470	15,470		15,470		
Oct	MWh					12,369	12,369	12,369		12,369		
Nov	MWh					2,836	2,836	2,836		2,836		
Dec	MWh					1,395	1,395	1,395		1,395		
<b>ENERGY OUTPUT (FIRM)</b>	<b>GWh/yr</b>					<b>124.3</b>	<b>124.3</b>	<b>151.1</b>		<b>180.8</b>		
CAPACITY AND ENERGY COST METRICS												
Metric	Units					16-Hour	12-Hour	8-Hour		4-Hour		
Capacity Cost, Dependable Capacity	\$/MW	\$				10,696,000	8,022,000	6,299,000	\$	4,602,000		
Capacity Cost, Installed Capacity	\$/MW	\$				7,611,000	7,611,000	6,257,000	\$	4,571,000		
Energy Cost (Average)	\$/GWh	\$				1,595,000	1,595,000	1,498,000	\$	1,833,000		
Energy Cost (Firm)	\$/GWh	\$				1,721,000	1,721,000	1,667,000	\$	2,036,000		

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NOTES:

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- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREPD	RVWD

TABLE C13

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

ANUDOL CREEK (B)

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-129.53	Catchment Area at Intake						km <sup>2</sup>	99		
Easting	E	55.17	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	76		
Region		North Coast	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	6.7		
Estimated Footprint	ha	380										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	0.6	0.5	0.6	2.2	11.8	21.8	19.5	14.0	10.3	5.7	1.8	0.9
Firm (Low Flow)	0.5	0.2	0.5	2.3	8.4	20.0	19.5	14.4	7.2	5.6	1.3	0.6
DESIGN PARAMETERS												
						16-Hour		12-Hour		8-Hour		4-Hour
Dependable Capacity			MW			20		27		40		80
Installed Capacity			MW			21		28		41		83
Gross Head			m			245		245		245		245
Design Flow, Qd			m <sup>3</sup> /s			10		13		20		40
MAD Multiplier at Qd						1.5		2.0		3.0		6.0
Reservoir Storage Volume			m <sup>3</sup>			9,510,500		9,510,500		9,510,500		9,510,500
Live Storage Volume			m <sup>3</sup>			6,301,000		6,301,000		6,301,000		6,301,000
Dam Height at Minimum Operating Level			m			13		13		13		13
Dam Height at Full Supply Level			m			21		21		21		21
Dam Type						CFRD		CFRD		CFRD		CFRD
Dam Crest Length			m			96		96		96		96
Reservoir Surface Area			m <sup>2</sup>			791,000		791,000		791,000		791,000
Penstock Length			km			5		5		5		5
Transmission Line Length			km			45		45		45		45
Access Road Length			km			8		8		8		8
ESTIMATED CAPITAL COSTS												
						16-Hour		12-Hour		8-Hour		4-Hour
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$			24,048,000		\$ 27,132,000		\$ 33,020,000		\$ 49,608,000
Access and Site Preparation			\$			17,768,000		\$ 17,768,000		\$ 17,768,000		\$ 17,768,000
Cofferdams and Construction Water Management			\$			827,000		\$ 827,000		\$ 827,000		\$ 827,000
Intake, Headrace, and Forebay			\$			1,672,000		\$ 2,230,000		\$ 3,345,000		\$ 6,690,000
Dam Construction			\$			6,386,000		\$ 6,386,000		\$ 6,386,000		\$ 6,386,000
Water Conveyance System			\$			25,065,000		\$ 29,432,000		\$ 37,053,000		\$ 55,610,000
Powerhouse Construction			\$			21,191,000		\$ 28,255,000		\$ 42,382,000		\$ 84,765,000
Switchyard and Transmission			\$			23,284,000		\$ 23,629,000		\$ 24,319,000		\$ 26,387,000
SUB-TOTAL			\$			120,241,000		\$ 135,659,000		\$ 165,100,000		\$ 248,041,000
EPCM Costs (8% of Subtotal)			\$			9,619,000		\$ 10,853,000		\$ 13,208,000		\$ 19,843,000
Contingency (30% of Subtotal)			\$			36,072,000		\$ 40,698,000		\$ 49,530,000		\$ 74,412,000
TOTAL ESTIMATED OVERNIGHT CAPITAL COST			\$			165,932,000		\$ 187,210,000		\$ 227,838,000		\$ 342,296,000
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour		12-Hour		8-Hour		4-Hour
Fixed Operating Costs (2% of Capital)			\$			3,319,000		\$ 3,744,000		\$ 4,557,000		\$ 6,846,000
Variable Operating Costs (\$0.005/kWh)			\$			491,000		\$ 581,000		\$ 681,000		\$ 693,000
TOTAL ESTIMATED OPERATING COST			\$			3,810,000		\$ 4,325,000		\$ 5,238,000		\$ 7,539,000
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month			Units			16-Hour		12-Hour		8-Hour		4-Hour
Jan			MWh			4,395		4,395		4,395		4,395
Feb			MWh			0		0		0		0
Mar			MWh			0		0		0		0
Apr			MWh			1,261		1,261		1,261		1,261
May			MWh			19,230		21,769		21,769		21,769
Jun			MWh			14,894		19,858		29,788		32,148
Jul			MWh			15,390		20,520		29,650		29,650
Aug			MWh			15,390		20,520		21,370		21,370
Sep			MWh			14,894		15,160		15,160		15,160
Oct			MWh			8,712		8,712		8,712		8,712
Nov			MWh			2,684		2,684		2,684		2,684
Dec			MWh			1,411		1,411		1,411		1,411
ENERGY OUTPUT (AVERAGE)			GWh/yr			98.3		116.3		136.2		138.6
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month			Units			16-Hour		12-Hour		8-Hour		4-Hour
Jan			MWh			4,301		4,301		4,301		4,301
Feb			MWh			0		0		0		0
Mar			MWh			0		0		0		0
Apr			MWh			914		914		914		914
May			MWh			16,571		16,571		16,571		16,571
Jun			MWh			14,894		19,858		29,510		29,510
Jul			MWh			15,390		20,520		29,748		29,748
Aug			MWh			15,390		20,520		21,897		21,897
Sep			MWh			10,585		10,585		10,585		10,585
Oct			MWh			8,463		8,463		8,463		8,463
Nov			MWh			1,941		1,941		1,941		1,941
Dec			MWh			954		954		954		954
ENERGY OUTPUT (FIRM)			GWh/yr			89.4		104.6		124.9		124.9
CAPACITY AND ENERGY COST METRICS												
Metric			Units			16-Hour		12-Hour		8-Hour		4-Hour
Capacity Cost, Dependable Capacity			\$/MW			8,297,000		7,020,000		5,696,000		4,279,000
Capacity Cost, Installed Capacity			\$/MW			8,022,000		6,788,000		5,507,000		4,137,000
Energy Cost (Average)			\$/GWh			1,689,000		1,610,000		1,673,000		2,470,000
Energy Cost (Firm)			\$/GWh			1,856,000		1,789,000		1,824,000		2,741,000

TABLE C14

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

SKEENA RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-127.96	Catchment Area at Intake						km <sup>2</sup>	12,304		
Easting	E	55.79	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	29		
Region		North Coast	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	353.3		
Estimated Footprint	ha	1,190										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	59.5	41.7	43.8	91.3	787.0	1150.5	795.6	471.4	305.9	277.8	128.1	67.4
Firm (Low Flow)	59.5	41.7	43.8	91.3	787.0	1150.5	795.6	471.4	305.9	277.8	128.1	67.4
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Dependable Capacity				MW		20	27	40	80			
Installed Capacity				MW		79	79	79	133			
Gross Head				m		21	21	21	21			
Design Flow, Qd				m <sup>3</sup> /s		442	442	442	748			
MAD Multiplier at Qd						1.3	1.3	1.3	2.1			
Reservoir Storage Volume				m <sup>3</sup>		89,174,000	89,174,000	89,174,000	89,174,000			
Live Storage Volume				m <sup>3</sup>		47,939,000	47,939,000	47,939,000	47,939,000			
Dam Height at Minimum Operating Level				m		13	13	13	13			
Dam Height at Full Supply Level				m		21	21	21	21			
Dam Type						RCC	RCC	RCC	RCC			
Dam Crest Length				m		110	110	110	110			
Reservoir Surface Area				m <sup>2</sup>		6,067,000	6,067,000	6,067,000	6,067,000			
Penstock Length				km		0	0	0	0			
Transmission Line Length				km		90	90	90	90			
Access Road Length				km		23	23	23	23			
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits	\$					95,319,000	95,319,000	95,319,000	126,957,000			
Access and Site Preparation	\$					56,163,000	56,163,000	56,163,000	56,163,000			
Cofferdams and Construction Water Management	\$					38,858,000	38,858,000	38,858,000	38,858,000			
Intake, Headrace, and Forebay	\$					73,079,000	73,079,000	73,079,000	123,845,000			
Dam Construction	\$					61,586,000	61,586,000	61,586,000	61,586,000			
Water Conveyance System	\$					4,416,000	4,416,000	4,416,000	7,483,000			
Powerhouse Construction	\$					100,742,000	100,742,000	100,742,000	170,726,000			
Switchyard and Transmission	\$					46,433,000	46,433,000	46,433,000	49,166,000			
SUB-TOTAL	\$					476,596,000	476,596,000	476,596,000	634,784,000			
EPCM Costs (8% of Subtotal)	\$					38,128,000	38,128,000	38,128,000	50,783,000			
Contingency (30% of Subtotal)	\$					142,979,000	142,979,000	142,979,000	190,435,000			
TOTAL ESTIMATED OVERNIGHT CAPITAL COST	\$					657,703,000	657,703,000	657,703,000	876,002,000			
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Fixed Operating Costs (2% of Capital)	\$					13,154,000	13,154,000	13,154,000	17,520,000			
Variable Operating Costs (\$0.005/kWh)	\$					1,830,000	1,830,000	1,830,000	2,453,000			
TOTAL ESTIMATED OPERATING COST	\$					14,984,000	14,984,000	14,984,000	19,973,000			
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month	Units	16-Hour	12-Hour	8-Hour	4-Hour							
Jan	MWh	8,419	8,419	8,419	8,419							
Feb	MWh	2,620	2,620	2,620	2,620							
Mar	MWh	5,805	5,805	5,805	5,805							
Apr	MWh	11,711	11,711	11,711	11,711							
May	MWh	62,366	62,366	62,366	103,023							
Jun	MWh	56,638	56,638	56,638	95,983							
Jul	MWh	58,526	58,526	58,526	99,183							
Aug	MWh	58,526	58,526	58,526	62,481							
Sep	MWh	39,237	39,237	39,237	39,237							
Oct	MWh	36,820	36,820	36,820	36,820							
Nov	MWh	16,431	16,431	16,431	16,431							
Dec	MWh	8,933	8,933	8,933	8,933							
ENERGY OUTPUT (AVERAGE)	GWh/yr	366.0	366.0	366.0	490.6							
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month	Units	16-Hour	12-Hour	8-Hour	4-Hour							
Jan	MWh	8,419	8,419	8,419	8,419							
Feb	MWh	2,620	2,620	2,620	2,620							
Mar	MWh	5,805	5,805	5,805	5,805							
Apr	MWh	11,711	11,711	11,711	11,711							
May	MWh	62,366	62,366	62,366	103,023							
Jun	MWh	56,638	56,638	56,638	95,983							
Jul	MWh	58,526	58,526	58,526	99,183							
Aug	MWh	58,526	58,526	58,526	62,481							
Sep	MWh	39,237	39,237	39,237	39,237							
Oct	MWh	36,820	36,820	36,820	36,820							
Nov	MWh	16,431	16,431	16,431	16,431							
Dec	MWh	8,933	8,933	8,933	8,933							
ENERGY OUTPUT (FIRM)	GWh/yr	366.0	366.0	366.0	490.6							
CAPACITY AND ENERGY COST METRICS												
Metric	Units	16-Hour	12-Hour	8-Hour	4-Hour							
Capacity Cost, Dependable Capacity	\$/MW	\$ 32,885,000	\$ 24,664,000	\$ 16,443,000	\$ 10,950,000							
Capacity Cost, Installed Capacity	\$/MW	\$ 8,361,000	\$ 8,361,000	\$ 8,361,000	\$ 6,571,000							
Energy Cost (Average)	\$/GWh	\$ 1,797,000	\$ 1,797,000	\$ 1,797,000	\$ 1,785,000							
Energy Cost (Firm)	\$/GWh	\$ 1,797,000	\$ 1,797,000	\$ 1,797,000	\$ 1,785,000							

M:\1\03100647\01\A\Data\Dam and Reservoir Data\SCREEN-3+4\_20180531.xls\SKEENA RIVER

NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREPD	RVWD



TABLE C15

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

CLORE RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-127.94						Catchment Area at Intake		km <sup>2</sup>		772
Easting	E	54.32						Estimated Mean Annual Unit Runoff		L/s/km <sup>2</sup>		37
Region		North Coast						Mean Annual Discharge (MAD)		m <sup>3</sup> /s		19.3
Estimated Footprint	ha	500										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	8.4	6.2	6.3	15.8	60.1	77.2	51.2	32.0	27.6	29.1	16.9	9.2
Firm (Low Flow)	7.2	5.0	3.7	9.3	47.3	61.2	32.9	20.5	15.9	11.3	7.4	8.6
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour			4-Hour	
Dependable Capacity			MW			20	27	40			80	
Installed Capacity			MW			35	35	52			103	
Gross Head			m			117	117	117			117	
Design Flow, Qd			m <sup>3</sup> /s			36	36	53			106	
MAD Multiplier at Qd						1.8	1.8	2.8			5.5	
Reservoir Storage Volume			m <sup>3</sup>			14,545,500	14,545,500	14,545,500			14,545,500	
Live Storage Volume			m <sup>3</sup>			8,863,000	8,863,000	8,863,000			8,863,000	
Dam Height at Minimum Operating Level			m			22	22	22			22	
Dam Height at Full Supply Level			m			48	48	48			48	
Dam Type						CFRD	CFRD	CFRD			CFRD	
Dam Crest Length			m			219	219	219			219	
Reservoir Surface Area			m <sup>2</sup>			980,000	980,000	980,000			980,000	
Penstock Length			km			4	4	4			4	
Transmission Line Length			km			66	66	66			66	
Access Road Length			km			1	1	1			1	
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour			4-Hour	
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$			45,846,000	45,846,000	53,849,000			76,891,000	
Access and Site Preparation			\$			18,053,000	18,053,000	18,053,000			18,053,000	
Cofferdams and Construction Water Management			\$			3,128,000	3,128,000	3,128,000			3,128,000	
Intake, Headrace, and Forebay			\$			5,883,000	5,883,000	8,768,000			17,536,000	
Dam Construction			\$			48,185,000	48,185,000	48,185,000			48,185,000	
Water Conveyance System			\$			38,210,000	38,210,000	48,594,000			75,030,000	
Powerhouse Construction			\$			36,488,000	36,488,000	54,380,000			108,759,000	
Switchyard and Transmission			\$			33,436,000	33,436,000	34,287,000			36,873,000	
SUB-TOTAL			\$			229,229,000	229,229,000	269,244,000			384,455,000	
EPCM Costs (8% of Subtotal)			\$			18,338,000	18,338,000	21,540,000			30,756,000	
Contingency (30% of Subtotal)			\$			68,769,000	68,769,000	80,773,000			115,337,000	
TOTAL ESTIMATED OVERNIGHT CAPITAL COST			\$			316,336,000	316,336,000	371,557,000			530,548,000	
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour			4-Hour	
Fixed Operating Costs (2% of Capital)			\$			6,327,000	6,327,000	7,431,000			10,611,000	
Variable Operating Costs (\$0.005/kWh)			\$			938,000	938,000	1,119,000			1,230,000	
TOTAL ESTIMATED OPERATING COST			\$			7,265,000	7,265,000	8,550,000			11,841,000	
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month		Units				16-Hour	12-Hour	8-Hour			4-Hour	
Jan		MWh				7,385	7,385	7,385			7,385	
Feb		MWh				1,654	1,654	1,654			1,654	
Mar		MWh				4,555	4,555	4,555			4,555	
Apr		MWh				11,119	11,119	11,119			11,119	
May		MWh				29,665	29,665	42,328			47,498	
Jun		MWh				24,991	24,991	37,246			54,276	
Jul		MWh				25,825	25,825	37,193			37,193	
Aug		MWh				23,268	23,268	23,268			23,268	
Sep		MWh				19,380	19,380	19,380			19,380	
Oct		MWh				21,120	21,120	21,120			21,120	
Nov		MWh				11,915	11,915	11,915			11,915	
Dec		MWh				6,712	6,712	6,712			6,712	
ENERGY OUTPUT (AVERAGE)		GWh/yr				187.6	187.6	223.9			246.1	
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month		Units				16-Hour	12-Hour	8-Hour			4-Hour	
Jan		MWh				6,878	6,878	6,878			6,878	
Feb		MWh				856	856	856			856	
Mar		MWh				2,680	2,680	2,680			2,680	
Apr		MWh				6,526	6,526	6,526			6,526	
May		MWh				29,665	29,665	38,212			38,212	
Jun		MWh				24,991	24,991	37,246			43,012	
Jul		MWh				23,870	23,870	23,870			23,870	
Aug		MWh				14,927	14,927	14,927			14,927	
Sep		MWh				11,177	11,177	11,177			11,177	
Oct		MWh				8,229	8,229	8,229			8,229	
Nov		MWh				5,215	5,215	5,215			5,215	
Dec		MWh				6,257	6,257	6,257			6,257	
ENERGY OUTPUT (FIRM)		GWh/yr				141.3	141.3	162.1			167.8	
CAPACITY AND ENERGY COST METRICS												
Metric		Units				16-Hour	12-Hour	8-Hour			4-Hour	
Capacity Cost, Dependable Capacity		\$/MW	\$			15,817,000	11,862,000	9,289,000			6,632,000	
Capacity Cost, Installed Capacity		\$/MW	\$			9,114,000	9,114,000	7,183,000			5,128,000	
Energy Cost (Average)		\$/GWh	\$			1,686,000	1,686,000	1,660,000			2,156,000	
Energy Cost (Firm)		\$/GWh	\$			2,239,000	2,239,000	2,293,000			3,161,000	

TABLE C16

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

MORE CREEK

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-130.38	Catchment Area at Intake						km <sup>2</sup>	889		
Easting	E	57.03	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	76		
Region		North Coast	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	60.5		
Estimated Footprint	ha	740										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	5.6	4.5	5.1	20.0	105.7	195.9	174.8	126.0	92.4	51.4	16.4	8.3
Firm (Low Flow)	4.7	1.7	4.9	20.7	75.1	179.8	175.4	129.1	64.5	49.9	11.8	5.6
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour		4-Hour		
Dependable Capacity			MW			29	38	57		115		
Installed Capacity			MW			38	51	77		153		
Gross Head			m			34	34	34		34		
Design Flow, Qd			m <sup>3</sup> /s			136	181	271		542		
MAD Multiplier at Qd						2.2	3.0	4.5		9.0		
Reservoir Storage Volume			m <sup>3</sup>			108,429,500	108,429,500	108,429,500		108,429,500		
Live Storage Volume			m <sup>3</sup>			64,106,000	64,106,000	64,106,000		64,106,000		
Dam Height at Minimum Operating Level			m			25	25	25		25		
Dam Height at Full Supply Level			m			34	34	34		34		
Dam Type						CFRD	CFRD	CFRD		CFRD		
Dam Crest Length			m			151	151	151		151		
Reservoir Surface Area			m <sup>2</sup>			6,601,000	6,601,000	6,601,000		6,601,000		
Penstock Length			km			0	0	0		0		
Transmission Line Length			km			13	13	13		13		
Access Road Length			km			1	1	1		1		
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits	\$					37,947,000	43,848,000	55,650,000	\$	91,056,000		
Access and Site Preparation	\$					35,461,000	35,461,000	35,461,000	\$	35,461,000		
Cofferdams and Construction Water Management	\$					7,425,000	7,425,000	7,425,000	\$	7,425,000		
Intake, Headrace, and Forebay	\$					22,444,000	29,925,000	44,888,000	\$	89,775,000		
Dam Construction	\$					30,237,000	30,237,000	30,237,000	\$	30,237,000		
Water Conveyance System	\$					1,356,000	1,808,000	2,712,000	\$	5,424,000		
Powerhouse Construction	\$					45,098,000	60,130,000	90,195,000	\$	180,390,000		
Switchyard and Transmission	\$					9,766,000	10,404,000	11,682,000	\$	15,513,000		
<b>SUB-TOTAL</b>	<b>\$</b>					<b>189,734,000</b>	<b>219,238,000</b>	<b>278,250,000</b>	<b>\$</b>	<b>455,281,000</b>		
EPCM Costs (8% of Subtotal)	\$					15,179,000	17,539,000	22,260,000	\$	36,422,000		
Contingency (30% of Subtotal)	\$					56,920,000	65,771,000	83,475,000	\$	136,584,000		
<b>TOTAL ESTIMATED OVERNIGHT CAPITAL COST</b>	<b>\$</b>					<b>261,833,000</b>	<b>302,548,000</b>	<b>383,985,000</b>	<b>\$</b>	<b>628,287,000</b>		
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)	\$					5,237,000	6,051,000	7,680,000	\$	12,566,000		
Variable Operating Costs (\$0.005/kWh)	\$					744,000	831,000	847,000	\$	847,000		
<b>TOTAL ESTIMATED OPERATING COST</b>	<b>\$</b>					<b>5,981,000</b>	<b>6,882,000</b>	<b>8,527,000</b>	<b>\$</b>	<b>13,413,000</b>		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month	Units					16-Hour	12-Hour	8-Hour		4-Hour		
Jan	MWh					4,528	4,528	4,528		4,528		
Feb	MWh					0	0	0		0		
Mar	MWh					0	0	0		0		
Apr	MWh					973	973	973		973		
May	MWh					26,062	26,062	26,062		26,062		
Jun	MWh					27,588	36,784	39,848		39,848		
Jul	MWh					28,508	36,751	36,751		36,751		
Aug	MWh					26,488	26,488	26,488		26,488		
Sep	MWh					18,791	18,791	18,791		18,791		
Oct	MWh					10,798	10,798	10,798		10,798		
Nov	MWh					3,327	3,327	3,327		3,327		
Dec	MWh					1,749	1,749	1,749		1,749		
<b>ENERGY OUTPUT (AVERAGE)</b>	<b>GWh/yr</b>					<b>148.8</b>	<b>166.3</b>	<b>169.3</b>		<b>169.3</b>		
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month	Units					16-Hour	12-Hour	8-Hour		4-Hour		
Jan	MWh					4,411	4,411	4,411		4,411		
Feb	MWh					0	0	0		0		
Mar	MWh					0	0	0		0		
Apr	MWh					543	543	543		543		
May	MWh					19,620	19,620	19,620		19,620		
Jun	MWh					27,588	36,577	36,577		36,577		
Jul	MWh					28,508	36,873	36,873		36,873		
Aug	MWh					27,142	27,142	27,142		27,142		
Sep	MWh					13,120	13,120	13,120		13,120		
Oct	MWh					10,490	10,490	10,490		10,490		
Nov	MWh					2,406	2,406	2,406		2,406		
Dec	MWh					1,183	1,183	1,183		1,183		
<b>ENERGY OUTPUT (FIRM)</b>	<b>GWh/yr</b>					<b>135.0</b>	<b>152.4</b>	<b>152.4</b>		<b>152.4</b>		
CAPACITY AND ENERGY COST METRICS												
Metric	Units					16-Hour	12-Hour	8-Hour		4-Hour		
Capacity Cost, Dependable Capacity	\$/MW	\$				9,111,000	7,896,000	6,681,000	\$	5,465,000		
Capacity Cost, Installed Capacity	\$/MW	\$				6,833,000	5,922,000	5,011,000	\$	4,099,000		
Energy Cost (Average)	\$/GWh	\$				1,759,000	1,820,000	2,268,000	\$	3,711,000		
Energy Cost (Firm)	\$/GWh	\$				1,939,000	1,986,000	2,520,000	\$	4,124,000		

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NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RW'D

TABLE C17

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

BELL-IRVING RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-129.73	Catchment Area at Intake						km <sup>2</sup>	939		
Easting	E	56.80	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	41		
Region		North Coast	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	38.9		
Estimated Footprint	ha	650										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	6.2	3.9	3.8	7.7	66.1	121.1	96.7	67.1	44.1	27.7	13.3	7.4
Firm (Low Flow)	6.2	3.9	3.8	7.7	66.1	121.1	96.7	67.1	44.1	27.7	13.3	7.4
DESIGN PARAMETERS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Dependable Capacity			MW	20		27		40		80		
Installed Capacity			MW	27		37		55		110		
Gross Head			m	43		43		43		43		
Design Flow, Qd			m <sup>3</sup> /s	76		101		152		304		
MAD Multiplier at Qd				2.0		2.6		3.9		7.8		
Reservoir Storage Volume			m <sup>3</sup>	64,015,500		64,015,500		64,015,500		64,015,500		
Live Storage Volume			m <sup>3</sup>	39,974,000		39,974,000		39,974,000		39,974,000		
Dam Height at Minimum Operating Level			m	32		32		32		32		
Dam Height at Full Supply Level			m	43		43		43		43		
Dam Type				CFRD		CFRD		CFRD		CFRD		
Dam Crest Length			m	435		435		435		435		
Reservoir Surface Area			m <sup>2</sup>	3,358,000		3,358,000		3,358,000		3,358,000		
Penstock Length			km	0		0		0		0		
Transmission Line Length			km	50		50		50		50		
Access Road Length			km	8		8		8		8		
ESTIMATED CAPITAL COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$	44,893,000		\$ 48,720,000		\$ 56,374,000		\$ 79,338,000		
Access and Site Preparation			\$	28,947,000		\$ 28,947,000		\$ 28,947,000		\$ 28,947,000		
Cofferdams and Construction Water Management			\$	4,281,000		\$ 4,281,000		\$ 4,281,000		\$ 4,281,000		
Intake, Headrace, and Forebay			\$	12,562,000		\$ 16,749,000		\$ 25,123,000		\$ 50,246,000		
Dam Construction			\$	75,914,000		\$ 75,914,000		\$ 75,914,000		\$ 75,914,000		
Water Conveyance System			\$	759,000		\$ 1,012,000		\$ 1,518,000		\$ 3,036,000		
Powerhouse Construction			\$	31,235,000		\$ 41,646,000		\$ 62,469,000		\$ 124,938,000		
Switchyard and Transmission			\$	25,872,000		\$ 26,329,000		\$ 27,244,000		\$ 29,988,000		
SUB-TOTAL			\$	224,463,000		\$ 243,598,000		\$ 281,870,000		\$ 396,688,000		
EPCM Costs (8% of Subtotal)			\$	17,957,000		\$ 19,488,000		\$ 22,550,000		\$ 31,735,000		
Contingency (30% of Subtotal)			\$	67,339,000		\$ 73,079,000		\$ 84,561,000		\$ 119,006,000		
TOTAL ESTIMATED OVERNIGHT CAPITAL COST			\$	309,759,000		\$ 336,165,000		\$ 388,981,000		\$ 547,429,000		
ESTIMATED ANNUAL OPERATING COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)			\$	6,195,000		\$ 6,723,000		\$ 7,780,000		\$ 10,949,000		
Variable Operating Costs (\$0.005/kWh)			\$	545,000		\$ 606,000		\$ 632,000		\$ 632,000		
TOTAL ESTIMATED OPERATING COST			\$	6,740,000		\$ 7,329,000		\$ 8,412,000		\$ 11,581,000		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Jan	MWh		4,808		4,808		4,808		4,808			
Feb	MWh		0		0		0		0			
Mar	MWh		0		0		0		0			
Apr	MWh		0		0		0		0			
May	MWh		21,578		21,578		21,578		21,578			
Jun	MWh		19,756		26,342		31,521		31,521			
Jul	MWh		20,415		26,009		26,009		26,009			
Aug	MWh		18,048		18,048		18,048		18,048			
Sep	MWh		11,479		11,479		11,479		11,479			
Oct	MWh		7,450		7,450		7,450		7,450			
Nov	MWh		3,462		3,462		3,462		3,462			
Dec	MWh		1,990		1,990		1,990		1,990			
ENERGY OUTPUT (AVERAGE)	GWh/yr		109.0		121.2		126.3		126.3			
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Jan	MWh		4,808		4,808		4,808		4,808			
Feb	MWh		0		0		0		0			
Mar	MWh		0		0		0		0			
Apr	MWh		0		0		0		0			
May	MWh		21,578		21,578		21,578		21,578			
Jun	MWh		19,756		26,342		31,521		31,521			
Jul	MWh		20,415		26,009		26,009		26,009			
Aug	MWh		18,048		18,048		18,048		18,048			
Sep	MWh		11,479		11,479		11,479		11,479			
Oct	MWh		7,450		7,450		7,450		7,450			
Nov	MWh		3,462		3,462		3,462		3,462			
Dec	MWh		1,990		1,990		1,990		1,990			
ENERGY OUTPUT (FIRM)	GWh/yr		109.0		121.2		126.3		126.3			
CAPACITY AND ENERGY COST METRICS												
Metric	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Capacity Cost, Dependable Capacity	\$/MW		\$ 15,488,000		\$ 12,606,000		\$ 9,725,000		\$ 6,843,000			
Capacity Cost, Installed Capacity	\$/MW		\$ 11,289,000		\$ 9,188,000		\$ 7,088,000		\$ 4,988,000			
Energy Cost (Average)	\$/GWh		\$ 2,842,000		\$ 2,774,000		\$ 3,079,000		\$ 4,333,000			
Energy Cost (Firm)	\$/GWh		\$ 2,842,000		\$ 2,774,000		\$ 3,079,000		\$ 4,333,000			

TABLE C18

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

NIMPKISH RIVER (A)

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-126.85	Catchment Area at Intake						km <sup>2</sup>	1,163		
Easting	E	50.26	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	78		
Region		Van Island	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	66.0		
Estimated Footprint	ha	380										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	136.8	88.8	91.6	93.5	91.1	74.0	42.5	22.8	34.5	105.0	176.6	134.2
Firm (Low Flow)	43.1	86.8	98.0	96.8	119.3	67.8	28.3	11.2	57.4	66.9	54.4	64.5
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Dependable Capacity			MW			20	27	40	80			
Installed Capacity			MW			31	31	40	81			
Gross Head			m			32	32	32	32			
Design Flow, Qd			m <sup>3</sup> /s			114	114	150	300			
MAD Multiplier at Qd						1.7	1.7	2.3	4.5			
Reservoir Storage Volume			m <sup>3</sup>			26,371,980	26,371,980	26,371,980	26,371,980			
Live Storage Volume			m <sup>3</sup>			482,000	482,000	482,000	482,000			
Dam Height at Minimum Operating Level			m			22	22	22	22			
Dam Height at Full Supply Level			m			22	22	22	22			
Dam Type						CFRD	CFRD	CFRD	CFRD			
Dam Crest Length			m			232	232	232	232			
Reservoir Surface Area			m <sup>2</sup>			2,480,000	2,480,000	2,480,000	2,480,000			
Penstock Length			km			3	3	3	3			
Transmission Line Length			km			20	20	20	20			
Access Road Length			km			1	1	1	1			
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$			47,868,000	\$ 47,868,000	\$ 55,845,000	\$ 87,198,000			
Access and Site Preparation			\$			17,694,000	\$ 17,694,000	\$ 17,694,000	\$ 17,694,000			
Cofferdams and Construction Water Management			\$			10,003,000	\$ 10,003,000	\$ 10,003,000	\$ 10,003,000			
Intake, Headrace, and Forebay			\$			18,813,000	\$ 18,813,000	\$ 24,796,000	\$ 49,592,000			
Dam Construction			\$			26,036,000	\$ 26,036,000	\$ 26,036,000	\$ 26,036,000			
Water Conveyance System			\$			70,146,000	\$ 70,146,000	\$ 84,055,000	\$ 134,874,000			
Powerhouse Construction			\$			36,252,000	\$ 36,252,000	\$ 47,782,000	\$ 95,563,000			
Switchyard and Transmission			\$			12,528,000	\$ 12,528,000	\$ 13,015,000	\$ 15,029,000			
<b>SUB-TOTAL</b>			<b>\$</b>			<b>239,340,000</b>	<b>\$ 239,340,000</b>	<b>\$ 279,226,000</b>	<b>\$ 435,989,000</b>			
EPCM Costs (8% of Subtotal)			\$			19,147,000	\$ 19,147,000	\$ 22,338,000	\$ 34,879,000			
Contingency (30% of Subtotal)			\$			71,802,000	\$ 71,802,000	\$ 83,768,000	\$ 130,797,000			
<b>TOTAL ESTIMATED OVERNIGHT CAPITAL COST</b>			<b>\$</b>			<b>330,289,000</b>	<b>\$ 330,289,000</b>	<b>\$ 385,332,000</b>	<b>\$ 601,665,000</b>			
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Fixed Operating Costs (2% of Capital)			\$			6,606,000	\$ 6,606,000	\$ 7,707,000	\$ 12,033,000			
Variable Operating Costs (\$0.005/kWh)			\$			957,000	\$ 957,000	\$ 1,026,000	\$ 1,052,000			
<b>TOTAL ESTIMATED OPERATING COST</b>			<b>\$</b>			<b>7,563,000</b>	<b>\$ 7,563,000</b>	<b>\$ 8,733,000</b>	<b>\$ 13,085,000</b>			
ENERGY OUTPUT UNDER AVERAGE FLOW CONDNTIONS												
Month	Units	16-Hour	12-Hour	8-Hour	4-Hour							
Jan	MWh	17,046	17,046	19,736	19,736							
Feb	MWh	16,019	16,019	16,019	16,019							
Mar	MWh	18,321	18,321	18,321	18,321							
Apr	MWh	18,109	18,109	18,109	18,109							
May	MWh	22,074	22,074	22,074	22,074							
Jun	MWh	14,329	14,329	14,329	14,329							
Jul	MWh	8,506	8,506	8,506	8,506							
Aug	MWh	4,561	4,561	4,561	4,561							
Sep	MWh	6,688	6,688	6,688	6,688							
Oct	MWh	21,002	21,002	21,002	21,002							
Nov	MWh	22,009	22,009	29,009	34,187							
Dec	MWh	22,743	22,743	26,859	26,859							
<b>ENERGY OUTPUT (AVERAGE)</b>	<b>GWh/yr</b>	<b>191.4</b>	<b>191.4</b>	<b>205.2</b>	<b>210.4</b>							
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDNTIONS												
Month	Units	16-Hour	12-Hour	8-Hour	4-Hour							
Jan	MWh	8,842	8,842	8,842	8,842							
Feb	MWh	15,652	15,652	15,652	15,652							
Mar	MWh	19,602	19,602	19,602	19,602							
Apr	MWh	18,740	18,740	18,740	18,740							
May	MWh	26,583	26,583	27,710	27,710							
Jun	MWh	13,135	13,135	13,135	13,135							
Jul	MWh	5,660	5,660	5,660	5,660							
Aug	MWh	2,250	2,250	2,250	2,250							
Sep	MWh	11,122	11,122	11,122	11,122							
Oct	MWh	13,376	13,376	13,376	13,376							
Nov	MWh	10,526	10,526	10,526	10,526							
Dec	MWh	12,909	12,909	12,909	12,909							
<b>ENERGY OUTPUT (FIRM)</b>	<b>GWh/yr</b>	<b>158.4</b>	<b>158.4</b>	<b>159.5</b>	<b>159.5</b>							
CAPACITY AND ENERGY COST METRICS												
Metric	Units	16-Hour	12-Hour	8-Hour	4-Hour							
Capacity Cost, Dependable Capacity	\$/MW	\$ 16,514,000	\$ 12,386,000	\$ 9,633,000	\$ 7,521,000							
Capacity Cost, Installed Capacity	\$/MW	\$ 10,805,000	\$ 10,805,000	\$ 9,564,000	\$ 7,467,000							
Energy Cost (Average)	\$/GWh	\$ 1,726,000	\$ 1,726,000	\$ 1,878,000	\$ 2,860,000							
Energy Cost (Firm)	\$/GWh	\$ 2,085,000	\$ 2,085,000	\$ 2,416,000	\$ 3,772,000							

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NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RW'D

TABLE C19

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

NIMPKISH RIVER (B)

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-127.02	Catchment Area at Intake						km <sup>2</sup>	1,751		
Easting	E	50.52	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	78		
Region		Van Island	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	99.4		
Estimated Footprint	ha	4,850										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	206.1	133.8	137.9	140.9	137.3	111.5	64.0	34.3	52.0	158.1	265.9	202.2
Firm (Low Flow)	64.8	130.8	147.6	145.8	179.7	102.2	42.6	16.9	86.5	100.7	81.9	97.2
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Dependable Capacity			MW			20	27	40	80			
Installed Capacity			MW			78	78	78	82			
Gross Head			m			54	54	54	54			
Design Flow, Qd			m <sup>3</sup> /s			171	171	171	181			
MAD Multiplier at Qd						1.7	1.7	1.7	1.8			
Reservoir Storage Volume			m <sup>3</sup>			97,610,015	97,610,015	97,610,015	97,610,015			
Live Storage Volume			m <sup>3</sup>			81,931,000	81,931,000	81,931,000	81,931,000			
Dam Height at Minimum Operating Level			m			11	11	11	11			
Dam Height at Full Supply Level			m			12	12	12	12			
Dam Type						RC	RC	RC	RC			
Dam Crest Length			m			307	307	307	307			
Reservoir Surface Area			m <sup>2</sup>			47,975,000	47,975,000	47,975,000	47,975,000			
Penstock Length			km			3	3	3	3			
Transmission Line Length			km			8	8	8	8			
Access Road Length			km			1	1	1	1			
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$			75,135,000	\$ 75,135,000	\$ 75,135,000	\$	77,741,000		
Access and Site Preparation			\$			29,691,000	\$ 29,691,000	\$ 29,691,000	\$	29,691,000		
Cofferdams and Construction Water Management			\$			15,067,000	\$ 15,067,000	\$ 15,067,000	\$	15,067,000		
Intake, Headrace, and Forebay			\$			28,336,000	\$ 28,336,000	\$ 28,336,000	\$	30,033,000		
Dam Construction			\$			48,152,000	\$ 48,152,000	\$ 48,152,000	\$	48,152,000		
Water Conveyance System			\$			83,673,000	\$ 83,673,000	\$ 83,673,000	\$	87,009,000		
Powerhouse Construction			\$			86,141,000	\$ 86,141,000	\$ 86,141,000	\$	91,300,000		
Switchyard and Transmission			\$			9,479,000	\$ 9,479,000	\$ 9,479,000	\$	9,711,000		
SUB-TOTAL			\$			375,674,000	\$ 375,674,000	\$ 375,674,000	\$	388,704,000		
EPCM Costs (8% of Subtotal)			\$			30,054,000	\$ 30,054,000	\$ 30,054,000	\$	31,096,000		
Contingency (30% of Subtotal)			\$			112,702,000	\$ 112,702,000	\$ 112,702,000	\$	116,611,000		
TOTAL ESTIMATED OVERNIGHT CAPITAL COST			\$			518,430,000	\$ 518,430,000	\$ 518,430,000	\$	536,411,000		
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Fixed Operating Costs (2% of Capital)			\$			10,369,000	\$ 10,369,000	\$ 10,369,000	\$	10,728,000		
Variable Operating Costs (\$0.005/kWh)			\$			2,319,000	\$ 2,319,000	\$ 2,319,000	\$	2,363,000		
TOTAL ESTIMATED OPERATING COST			\$			12,688,000	\$ 12,688,000	\$ 12,688,000	\$	13,091,000		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDITONS												
Month		Units				16-Hour	12-Hour	8-Hour	4-Hour			
Jan		MWh				37,355	37,355	37,355		39,362		
Feb		MWh				30,435	30,435	30,435		30,435		
Mar		MWh				46,497	46,497	46,497		46,497		
Apr		MWh				45,959	45,959	45,959		45,959		
May		MWh				50,117	50,117	50,117		50,117		
Jun		MWh				36,365	36,365	36,365		36,365		
Jul		MWh				21,587	21,587	21,587		21,587		
Aug		MWh				11,576	11,576	11,576		11,576		
Sep		MWh				16,973	16,973	16,973		16,973		
Oct		MWh				53,302	53,302	53,302		53,302		
Nov		MWh				55,858	55,858	55,858		59,203		
Dec		MWh				57,720	57,720	57,720		61,176		
ENERGY OUTPUT (AVERAGE)		GWh/yr				463.7	463.7	463.7		472.6		
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDITONS												
Month		Units				16-Hour	12-Hour	8-Hour	4-Hour			
Jan		MWh				16,534	16,534	16,534		16,534		
Feb		MWh				29,502	29,502	29,502		29,502		
Mar		MWh				49,749	49,749	49,749		49,749		
Apr		MWh				47,560	47,560	47,560		47,560		
May		MWh				61,560	61,560	61,560		64,421		
Jun		MWh				33,335	33,335	33,335		33,335		
Jul		MWh				14,365	14,365	14,365		14,365		
Aug		MWh				5,710	5,710	5,710		5,710		
Sep		MWh				28,227	28,227	28,227		28,227		
Oct		MWh				33,946	33,946	33,946		33,946		
Nov		MWh				26,713	26,713	26,713		26,713		
Dec		MWh				32,761	32,761	32,761		32,761		
ENERGY OUTPUT (FIRM)		GWh/yr				380.0	380.0	380.0		382.8		
CAPACITY AND ENERGY COST METRICS												
Metric		Units				16-Hour	12-Hour	8-Hour	4-Hour			
Capacity Cost, Dependable Capacity		\$/MW				25,921,000	19,441,000	12,961,000	\$	6,705,000		
Capacity Cost, Installed Capacity		\$/MW				6,683,000	6,683,000	6,683,000	\$	6,524,000		
Energy Cost (Average)		\$/GWh				1,118,000	1,118,000	1,118,000	\$	1,135,000		
Energy Cost (Firm)		\$/GWh				1,364,000	1,364,000	1,364,000	\$	1,401,000		

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NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RW'D

TABLE C20

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

NANAIMO RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-123.96	Catchment Area at Intake						km <sup>2</sup>	658		
Easting	E	49.06	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	61		
Region		Van Island	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	26.2		
Estimated Footprint	ha	180										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	83.1	51.0	56.3	42.8	32.7	8.1	17.8	5.3	8.1	30.1	73.5	74.1
Firm (Low Flow)	46.2	22.5	35.0	21.8	58.1	8.3	23.6	7.0	6.7	17.1	52.9	14.7
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Dependable Capacity			MW			20	27	40	80			
Installed Capacity			MW			25	27	40	81			
Gross Head			m			59	59	59	59			
Design Flow, Qd			m <sup>3</sup> /s			50	55	82	165			
MAD Multiplier at Qd						1.9	2.1	3.1	6.3			
Reservoir Storage Volume			m <sup>3</sup>			15,415,688	15,415,688	15,415,688	15,415,688			
Live Storage Volume			m <sup>3</sup>			1,193,000	1,193,000	1,193,000	1,193,000			
Dam Height at Minimum Operating Level			m			15	15	15	15			
Dam Height at Full Supply Level			m			16	16	16	16			
Dam Type						CFRD	CFRD	CFRD	CFRD			
Dam Crest Length			m			192	192	192	192			
Reservoir Surface Area			m <sup>2</sup>			1,231,000	1,231,000	1,231,000	1,231,000			
Penstock Length			km			4	4	4	4			
Transmission Line Length			km			7	7	7	7			
Access Road Length			km			1	1	1	1			
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$			30,289,000	\$ 31,865,000	\$ 40,903,000	\$ 66,195,000			
Access and Site Preparation			\$			9,881,000	\$ 9,881,000	\$ 9,881,000	\$ 9,881,000			
Cofferdams and Construction Water Management			\$			4,423,000	\$ 4,423,000	\$ 4,423,000	\$ 4,423,000			
Intake, Headrace, and Forebay			\$			8,318,000	\$ 9,081,000	\$ 13,622,000	\$ 27,244,000			
Dam Construction			\$			11,639,000	\$ 11,639,000	\$ 11,639,000	\$ 11,639,000			
Water Conveyance System			\$			53,349,000	\$ 56,283,000	\$ 72,396,000	\$ 113,441,000			
Powerhouse Construction			\$			27,162,000	\$ 29,655,000	\$ 44,482,000	\$ 88,964,000			
Switchyard and Transmission			\$			6,382,000	\$ 6,496,000	\$ 7,168,000	\$ 9,187,000			
<b>SUB-TOTAL</b>			<b>\$</b>			<b>151,443,000</b>	<b>\$ 159,323,000</b>	<b>\$ 204,514,000</b>	<b>\$ 330,974,000</b>			
EPCM Costs (8% of Subtotal)			\$			12,115,000	\$ 12,746,000	\$ 16,361,000	\$ 26,478,000			
Contingency (30% of Subtotal)			\$			45,433,000	\$ 47,797,000	\$ 61,354,000	\$ 99,292,000			
<b>TOTAL ESTIMATED OVERNIGHT CAPITAL COST</b>			<b>\$</b>			<b>208,991,000</b>	<b>\$ 219,866,000</b>	<b>\$ 282,229,000</b>	<b>\$ 456,744,000</b>			
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Fixed Operating Costs (2% of Capital)			\$			4,180,000	\$ 4,397,000	\$ 5,645,000	\$ 9,135,000			
Variable Operating Costs (\$0.005/kWh)			\$			706,000	\$ 738,000	\$ 837,000	\$ 838,000			
<b>TOTAL ESTIMATED OPERATING COST</b>			<b>\$</b>			<b>4,886,000</b>	<b>\$ 5,135,000</b>	<b>\$ 6,482,000</b>	<b>\$ 9,973,000</b>			
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month		Units				16-Hour	12-Hour	8-Hour	4-Hour			
Jan		MWh				14,489	15,466	21,278	21,449			
Feb		MWh				16,404	16,657	16,657	16,657			
Mar		MWh				18,339	20,022	20,536	20,536			
Apr		MWh				15,100	15,100	15,100	15,100			
May		MWh				15,770	15,770	15,770	15,770			
Jun		MWh				2,860	2,860	2,860	2,860			
Jul		MWh				6,479	6,479	6,479	6,479			
Aug		MWh				1,929	1,929	1,929	1,929			
Sep		MWh				2,846	2,846	2,846	2,846			
Oct		MWh				10,996	10,996	10,996	10,996			
Nov		MWh				17,748	19,376	25,961	25,961			
Dec		MWh				18,339	20,022	27,031	27,031			
<b>ENERGY OUTPUT (AVERAGE)</b>		<b>GWh/yr</b>				<b>141.3</b>	<b>147.5</b>	<b>167.4</b>	<b>167.6</b>			
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month		Units				16-Hour	12-Hour	8-Hour	4-Hour			
Jan		MWh				13,636	13,636	13,636	13,636			
Feb		MWh				7,261	7,261	7,261	7,261			
Mar		MWh				12,789	12,789	12,789	12,789			
Apr		MWh				7,712	7,712	7,712	7,712			
May		MWh				22,179	23,862	25,023	25,023			
Jun		MWh				2,939	2,939	2,939	2,939			
Jul		MWh				8,625	8,625	8,625	8,625			
Aug		MWh				2,566	2,566	2,566	2,566			
Sep		MWh				2,382	2,382	2,382	2,382			
Oct		MWh				6,249	6,249	6,249	6,249			
Nov		MWh				17,748	18,681	18,681	18,681			
Dec		MWh				5,363	5,363	5,363	5,363			
<b>ENERGY OUTPUT (FIRM)</b>		<b>GWh/yr</b>				<b>109.4</b>	<b>112.1</b>	<b>113.2</b>	<b>113.2</b>			
CAPACITY AND ENERGY COST METRICS												
Metric		Units				16-Hour	12-Hour	8-Hour	4-Hour			
Capacity Cost, Dependable Capacity		\$/MW	\$			10,449,000	\$ 8,245,000	\$ 7,056,000	\$ 5,709,000			
Capacity Cost, Installed Capacity		\$/MW	\$			8,479,000	\$ 8,170,000	\$ 6,992,000	\$ 5,657,000			
Energy Cost (Average)		\$/GWh	\$			1,479,000	\$ 1,490,000	\$ 1,686,000	\$ 2,725,000			
Energy Cost (Firm)		\$/GWh	\$			1,909,000	\$ 1,962,000	\$ 2,493,000	\$ 4,034,000			

M:\1\03100647\01\A\Data\Dam and Reservoir Data\SCREEN-3+4\_20180531.xls\NANAIMO RIVER

NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RW'D

TABLE C21

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

CHEMAINUS RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-123.80	Catchment Area at Intake						km <sup>2</sup>	293		
Easting	E	48.88	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	52		
Region		Van Island	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	9.4		
Estimated Footprint	ha	110										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	34.6	20.5	22.4	16.5	11.2	5.3	1.7	0.6	1.4	9.6	28.4	30.4
Firm (Low Flow)	11.5	16.7	17.3	13.7	11.7	8.8	1.5	0.6	0.5	5.6	7.3	18.5
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour		4-Hour		
Dependable Capacity			MW			20	27	40		80		
Installed Capacity			MW			26	27	40		80		
Gross Head			m			161	161	161		161		
Design Flow, Qd			m <sup>3</sup> /s			19	20	30		60		
MAD Multiplier at Qd						2.0	2.1	3.2		6.3		
Reservoir Storage Volume			m <sup>3</sup>			5,253,689	5,253,689	5,253,689		5,253,689		
Live Storage Volume			m <sup>3</sup>			94,000	94,000	94,000		94,000		
Dam Height at Minimum Operating Level			m			46	46	46		46		
Dam Height at Full Supply Level			m			47	47	47		47		
Dam Type						CFRD	CFRD	CFRD		CFRD		
Dam Crest Length			m			172	172	172		172		
Reservoir Surface Area			m <sup>2</sup>			394,000	394,000	394,000		394,000		
Penstock Length			km			4	4	4		4		
Transmission Line Length			km			10	10	10		10		
Access Road Length			km			1	1	1		1		
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$			26,249,000	26,790,000	32,548,000		48,904,000		
Access and Site Preparation			\$			5,818,000	5,818,000	5,818,000		5,818,000		
Cofferdams and Construction Water Management			\$			1,672,000	1,672,000	1,672,000		1,672,000		
Intake, Headrace, and Forebay			\$			3,144,000	3,294,000	4,942,000		9,883,000		
Dam Construction			\$			35,039,000	35,039,000	35,039,000		35,039,000		
Water Conveyance System			\$			25,087,000	25,771,000	32,620,000		49,503,000		
Powerhouse Construction			\$			26,460,000	27,730,000	41,595,000		83,189,000		
Switchyard and Transmission			\$			7,775,000	7,837,000	8,505,000		10,510,000		
SUB-TOTAL			\$			131,244,000	133,951,000	162,739,000		244,518,000		
EPCM Costs (8% of Subtotal)			\$			10,500,000	10,716,000	13,019,000		19,561,000		
Contingency (30% of Subtotal)			\$			39,373,000	40,185,000	48,822,000		73,355,000		
TOTAL ESTIMATED OVERNIGHT CAPITAL COST			\$			181,117,000	184,852,000	224,580,000		337,434,000		
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)			\$			3,622,000	3,697,000	4,492,000		6,749,000		
Variable Operating Costs (\$0.005/kWh)			\$			688,000	708,000	843,000		859,000		
TOTAL ESTIMATED OPERATING COST			\$			4,310,000	4,405,000	5,335,000		7,608,000		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month		Units				16-Hour	12-Hour	8-Hour		4-Hour		
Jan		MWh				14,860	15,389	21,164		23,915		
Feb		MWh				17,110	17,931	18,447		18,447		
Mar		MWh				18,979	19,890	22,350		22,350		
Apr		MWh				15,937	15,937	15,937		15,937		
May		MWh				15,068	15,068	15,068		15,068		
Jun		MWh				5,113	5,113	5,113		5,113		
Jul		MWh				1,709	1,709	1,709		1,709		
Aug		MWh				596	596	596		596		
Sep		MWh				1,323	1,323	1,323		1,323		
Oct		MWh				9,545	9,545	9,545		9,545		
Nov		MWh				18,367	19,249	27,447		27,447		
Dec		MWh				18,979	19,890	29,836		30,415		
ENERGY OUTPUT (AVERAGE)		GWh/yr				137.6	141.6	168.5		171.9		
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month		Units				16-Hour	12-Hour	8-Hour		4-Hour		
Jan		MWh				10,525	10,525	10,525		10,525		
Feb		MWh				14,996	14,996	14,996		14,996		
Mar		MWh				17,303	17,303	17,303		17,303		
Apr		MWh				13,208	13,208	13,208		13,208		
May		MWh				15,507	15,507	15,507		15,507		
Jun		MWh				8,495	8,495	8,495		8,495		
Jul		MWh				1,473	1,473	1,473		1,473		
Aug		MWh				601	601	601		601		
Sep		MWh				466	466	466		466		
Oct		MWh				5,615	5,615	5,615		5,615		
Nov		MWh				7,025	7,025	7,025		7,025		
Dec		MWh				18,514	18,514	18,514		18,514		
ENERGY OUTPUT (FIRM)		GWh/yr				113.7	113.7	113.7		113.7		
CAPACITY AND ENERGY COST METRICS												
Metric		Units				16-Hour	12-Hour	8-Hour		4-Hour		
Capacity Cost, Dependable Capacity		\$/MW				9,072,000	6,944,000	5,624,000		4,225,000		
Capacity Cost, Installed Capacity		\$/MW				7,100,000	6,914,000	5,600,000		4,207,000		
Energy Cost (Average)		\$/GWh				1,316,000	1,305,000	1,333,000		1,963,000		
Energy Cost (Firm)		\$/GWh				1,593,000	1,625,000	1,975,000		2,967,000		

M:\1\03100647\01\A\Data\Dam and Reservoir Data\SCREEN-3+4\_20180531.xls\CHEMAINUS RIVER

NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RW'D

TABLE C22

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

FREDA CREEK

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-124.23	Catchment Area at Intake						km <sup>2</sup>	70		
Easting	E	49.95	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	121		
Region		Lower Mainland	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	6.7		
Estimated Footprint	ha	220										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	11.0	6.8	9.3	9.1	10.9	8.7	4.7	2.5	3.5	10.0	14.2	10.5
Firm (Low Flow)	3.8	5.8	6.1	8.6	12.8	14.1	6.1	1.5	2.4	9.0	4.3	5.4
DESIGN PARAMETERS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Dependable Capacity			MW	20		27		40		80		
Installed Capacity			MW	31		31		40		80		
Gross Head			m	348		348		348		348		
Design Flow, Qd			m <sup>3</sup> /s	11		11		14		28		
MAD Multiplier at Qd				1.6		1.6		2.1		4.2		
Reservoir Storage Volume			m <sup>3</sup>	2,945,945		2,945,945		2,945,945		2,945,945		
Live Storage Volume			m <sup>3</sup>	558,000		558,000		558,000		558,000		
Dam Height at Minimum Operating Level			m	20		20		20		20		
Dam Height at Full Supply Level			m	21		21		21		21		
Dam Type				CFRD		CFRD		CFRD		CFRD		
Dam Crest Length			m	86		86		86		86		
Reservoir Surface Area			m <sup>2</sup>	365,000		365,000		365,000		365,000		
Penstock Length			km	9		9		9		9		
Transmission Line Length			km	27		27		27		27		
Access Road Length			km	1		1		1		1		
ESTIMATED CAPITAL COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$	27,981,000		\$ 27,981,000		\$ 32,512,000		\$ 50,223,000		
Access and Site Preparation			\$	11,095,000		\$ 11,095,000		\$ 11,095,000		\$ 11,095,000		
Cofferdams and Construction Water Management			\$	928,000		\$ 928,000		\$ 928,000		\$ 928,000		
Intake, Headrace, and Forebay			\$	1,745,000		\$ 1,745,000		\$ 2,287,000		\$ 4,574,000		
Dam Construction			\$	5,806,000		\$ 5,806,000		\$ 5,806,000		\$ 5,806,000		
Water Conveyance System			\$	45,592,000		\$ 45,592,000		\$ 53,032,000		\$ 78,842,000		
Powerhouse Construction			\$	31,080,000		\$ 31,080,000		\$ 40,745,000		\$ 81,490,000		
Switchyard and Transmission			\$	15,678,000		\$ 15,678,000		\$ 16,153,000		\$ 18,155,000		
SUB-TOTAL			\$	139,905,000		\$ 139,905,000		\$ 162,558,000		\$ 251,113,000		
EPCM Costs (8% of Subtotal)			\$	11,192,000		\$ 11,192,000		\$ 13,005,000		\$ 20,089,000		
Contingency (30% of Subtotal)			\$	41,972,000		\$ 41,972,000		\$ 48,767,000		\$ 75,334,000		
TOTAL ESTIMATED OVERNIGHT CAPITAL COST			\$	193,069,000		\$ 193,069,000		\$ 224,330,000		\$ 346,536,000		
ESTIMATED ANNUAL OPERATING COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)			\$	3,861,000		\$ 3,861,000		\$ 4,487,000		\$ 6,931,000		
Variable Operating Costs (\$0.005/kWh)			\$	1,012,000		\$ 1,012,000		\$ 1,053,000		\$ 1,057,000		
TOTAL ESTIMATED OPERATING COST			\$	4,873,000		\$ 4,873,000		\$ 5,540,000		\$ 7,988,000		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month	Units			16-Hour		12-Hour		8-Hour		4-Hour		
Jan	MWh			17,039		17,039		17,608		17,608		
Feb	MWh			12,879		12,879		12,879		12,879		
Mar	MWh			19,950		19,950		19,950		19,950		
Apr	MWh			18,980		18,980		18,980		18,980		
May	MWh			26,572		26,572		27,322		27,322		
Jun	MWh			18,109		18,109		18,109		18,109		
Jul	MWh			10,169		10,169		10,169		10,169		
Aug	MWh			5,486		5,486		5,486		5,486		
Sep	MWh			7,209		7,209		7,209		7,209		
Oct	MWh			21,481		21,481		21,481		21,481		
Nov	MWh			21,998		21,998		28,839		29,604		
Dec	MWh			22,627		22,627		22,627		22,627		
ENERGY OUTPUT (AVERAGE)	GWh/yr			202.5		202.5		210.7		211.4		
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month	Units			16-Hour		12-Hour		8-Hour		4-Hour		
Jan	MWh			8,571		8,571		8,571		8,571		
Feb	MWh			10,822		10,822		10,822		10,822		
Mar	MWh			13,175		13,175		13,175		13,175		
Apr	MWh			17,997		17,997		17,997		17,997		
May	MWh			26,572		26,572		31,500		31,500		
Jun	MWh			21,998		21,998		28,839		29,416		
Jul	MWh			13,134		13,134		13,134		13,134		
Aug	MWh			3,210		3,210		3,210		3,210		
Sep	MWh			4,963		4,963		4,963		4,963		
Oct	MWh			19,439		19,439		19,439		19,439		
Nov	MWh			8,970		8,970		8,970		8,970		
Dec	MWh			11,594		11,594		11,594		11,594		
ENERGY OUTPUT (FIRM)	GWh/yr			160.4		160.4		172.2		172.8		
CAPACITY AND ENERGY COST METRICS												
Metric	Units			16-Hour		12-Hour		8-Hour		4-Hour		
Capacity Cost, Dependable Capacity	\$/MW		\$	9,653,000		\$ 7,240,000		\$ 5,608,000		\$ 4,332,000		
Capacity Cost, Installed Capacity	\$/MW		\$	6,319,000		\$ 6,319,000		\$ 5,601,000		\$ 4,326,000		
Energy Cost (Average)	\$/GWh		\$	953,000		\$ 953,000		\$ 1,065,000		\$ 1,639,000		
Energy Cost (Firm)	\$/GWh		\$	1,203,000		\$ 1,203,000		\$ 1,303,000		\$ 2,006,000		



TABLE C23

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

SQUAMISH RIVER (A)

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-123.49	Catchment Area at Intake						km <sup>2</sup>	325		
Easting	E	50.14	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	88		
Region		Lower Mainland	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	24.7		
Estimated Footprint	ha	360										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	8.7	5.8	8.2	16.3	39.8	58.5	66.5	51.1	33.5	24.9	19.2	9.1
Firm (Low Flow)	4.8	3.3	5.7	12.3	30.6	42.7	55.5	58.4	33.5	15.0	27.0	5.8
DESIGN PARAMETERS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Dependable Capacity			MW	20		27		40		80		
Installed Capacity			MW	30		30		40		81		
Gross Head			m	100		100		100		100		
Design Flow, Qd			m <sup>3</sup> /s	36		36		48		97		
MAD Multiplier at Qd				1.4		1.4		2.0		3.9		
Reservoir Storage Volume			m <sup>3</sup>	15,141,000		15,141,000		15,141,000		15,141,000		
Live Storage Volume			m <sup>3</sup>	10,062,000		10,062,000		10,062,000		10,062,000		
Dam Height at Minimum Operating Level			m	29		29		29		29		
Dam Height at Full Supply Level			m	30		30		30		30		
Dam Type				CFRD		CFRD		CFRD		CFRD		
Dam Crest Length			m	127		127		127		127		
Reservoir Surface Area			m <sup>2</sup>	1,338,000		1,338,000		1,338,000		1,338,000		
Penstock Length			km	5		5		5		5		
Transmission Line Length			km	27		27		27		27		
Access Road Length			km	27		27		27		27		
ESTIMATED CAPITAL COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$	36,565,000		\$ 36,565,000		\$ 42,307,000		\$ 63,037,000		
Access and Site Preparation			\$	26,445,000		\$ 26,445,000		\$ 26,445,000		\$ 26,445,000		
Cofferdams and Construction Water Management			\$	3,146,000		\$ 3,146,000		\$ 3,146,000		\$ 3,146,000		
Intake, Headrace, and Forebay			\$	5,916,000		\$ 5,916,000		\$ 7,995,000		\$ 15,989,000		
Dam Construction			\$	16,829,000		\$ 16,829,000		\$ 16,829,000		\$ 16,829,000		
Water Conveyance System			\$	46,549,000		\$ 46,549,000		\$ 55,765,000		\$ 85,796,000		
Powerhouse Construction			\$	31,728,000		\$ 31,728,000		\$ 42,874,000		\$ 85,748,000		
Switchyard and Transmission			\$	15,647,000		\$ 15,647,000		\$ 16,173,000		\$ 18,196,000		
<b>SUB-TOTAL</b>			<b>\$</b>	<b>182,825,000</b>		<b>\$ 182,825,000</b>		<b>\$ 211,534,000</b>		<b>\$ 315,186,000</b>		
EPCM Costs (8% of Subtotal)			\$	14,626,000		\$ 14,626,000		\$ 16,923,000		\$ 25,215,000		
Contingency (30% of Subtotal)			\$	54,848,000		\$ 54,848,000		\$ 63,460,000		\$ 94,556,000		
<b>TOTAL ESTIMATED OVERNIGHT CAPITAL COST</b>			<b>\$</b>	<b>252,299,000</b>		<b>\$ 252,299,000</b>		<b>\$ 291,917,000</b>		<b>\$ 434,957,000</b>		
ESTIMATED ANNUAL OPERATING COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)			\$	5,046,000		\$ 5,046,000		\$ 5,838,000		\$ 8,699,000		
Variable Operating Costs (\$0.005/kWh)			\$	840,000		\$ 840,000		\$ 969,000		\$ 1,065,000		
<b>TOTAL ESTIMATED OPERATING COST</b>			<b>\$</b>	<b>5,886,000</b>		<b>\$ 5,886,000</b>		<b>\$ 6,807,000</b>		<b>\$ 9,764,000</b>		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month	Units			16-Hour		12-Hour		8-Hour		4-Hour		
Jan	MWh			6,970		6,970		6,970		6,970		
Feb	MWh			935		935		935		935		
Mar	MWh			5,088		5,088		5,088		5,088		
Apr	MWh			9,843		9,843		9,843		9,843		
May	MWh			26,116		26,116		28,651		28,651		
Jun	MWh			21,558		21,558		29,130		35,291		
Jul	MWh			22,276		22,276		30,101		41,443		
Aug	MWh			22,276		22,276		30,101		31,867		
Sep	MWh			20,176		20,176		20,176		20,176		
Oct	MWh			15,497		15,497		15,497		15,497		
Nov	MWh			11,559		11,559		11,559		11,559		
Dec	MWh			5,693		5,693		5,693		5,693		
<b>ENERGY OUTPUT (AVERAGE)</b>	<b>GWh/yr</b>			<b>168.0</b>		<b>168.0</b>		<b>193.7</b>		<b>213.0</b>		
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month	Units			16-Hour		12-Hour		8-Hour		4-Hour		
Jan	MWh			5,585		5,585		5,585		5,585		
Feb	MWh			0		0		0		0		
Mar	MWh			3,053		3,053		3,053		3,053		
Apr	MWh			7,393		7,393		7,393		7,393		
May	MWh			22,889		22,889		22,889		22,889		
Jun	MWh			21,558		21,558		25,779		25,779		
Jul	MWh			22,276		22,276		30,101		34,604		
Aug	MWh			22,276		22,276		30,101		36,371		
Sep	MWh			20,179		20,179		20,179		20,179		
Oct	MWh			9,353		9,353		9,353		9,353		
Nov	MWh			16,277		16,277		16,277		16,277		
Dec	MWh			3,621		3,621		3,621		3,621		
<b>ENERGY OUTPUT (FIRM)</b>	<b>GWh/yr</b>			<b>154.5</b>		<b>154.5</b>		<b>174.3</b>		<b>185.1</b>		
CAPACITY AND ENERGY COST METRICS												
Metric	Units			16-Hour		12-Hour		8-Hour		4-Hour		
Capacity Cost, Dependable Capacity	\$/MW		\$	12,615,000		\$ 9,461,000		\$ 7,298,000		\$ 5,437,000		
Capacity Cost, Installed Capacity	\$/MW		\$	8,427,000		\$ 8,427,000		\$ 7,215,000		\$ 5,375,000		
Energy Cost (Average)	\$/GWh		\$	1,502,000		\$ 1,502,000		\$ 1,507,000		\$ 2,042,000		
Energy Cost (Firm)	\$/GWh		\$	1,633,000		\$ 1,633,000		\$ 1,674,000		\$ 2,350,000		

TABLE C24

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

SQUAMISH RIVER (B)

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-123.36	Catchment Area at Intake						km <sup>2</sup>	1,722		
Easting	E	50.08	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	88		
Region		Lower Mainland	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	130.9		
Estimated Footprint	ha	430										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	45.9	30.9	43.3	86.6	211.3	310.5	352.9	271.4	177.5	132.0	101.7	48.5
Firm (Low Flow)	25.6	17.4	30.2	65.0	162.2	226.8	294.7	309.7	177.6	79.6	143.2	30.8
DESIGN PARAMETERS												
			16-Hour		12-Hour		8-Hour		4-Hour			
Dependable Capacity		MW	20		27		40		80			
Installed Capacity		MW	68		68		68		82			
Gross Head		m	43		43		43		43			
Design Flow, Qd		m <sup>3</sup> /s	190		190		190		229			
MAD Multiplier at Qd			1.4		1.4		1.4		1.8			
Reservoir Storage Volume		m <sup>3</sup>	23,840,552		23,840,552		23,840,552		23,840,552			
Live Storage Volume		m <sup>3</sup>	4,038,000		4,038,000		4,038,000		4,038,000			
Dam Height at Minimum Operating Level		m	21		21		21		21			
Dam Height at Full Supply Level		m	22		22		22		22			
Dam Type			CFRD		CFRD		CFRD		CFRD			
Dam Crest Length		m	274		274		274		274			
Reservoir Surface Area		m <sup>2</sup>	2,602,000		2,602,000		2,602,000		2,602,000			
Penstock Length		km	3		3		3		3			
Transmission Line Length		km	20		20		20		20			
Access Road Length		km	20		20		20		20			
ESTIMATED CAPITAL COSTS												
			16-Hour		12-Hour		8-Hour		4-Hour			
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits		\$	73,411,000		\$ 73,411,000		\$ 73,411,000		\$ 82,327,000			
Access and Site Preparation		\$	27,500,000		\$ 27,500,000		\$ 27,500,000		\$ 27,500,000			
Cofferdams and Construction Water Management		\$	16,692,000		\$ 16,692,000		\$ 16,692,000		\$ 16,692,000			
Intake, Headrace, and Forebay		\$	31,393,000		\$ 31,393,000		\$ 31,393,000		\$ 37,932,000			
Dam Construction		\$	36,826,000		\$ 36,826,000		\$ 36,826,000		\$ 36,826,000			
Water Conveyance System		\$	89,650,000		\$ 89,650,000		\$ 89,650,000		\$ 101,993,000			
Powerhouse Construction		\$	77,196,000		\$ 77,196,000		\$ 77,196,000		\$ 93,275,000			
Switchyard and Transmission		\$	14,386,000		\$ 14,386,000		\$ 14,386,000		\$ 15,091,000			
SUB-TOTAL		\$	367,054,000		\$ 367,054,000		\$ 367,054,000		\$ 411,636,000			
EPCM Costs (8% of Subtotal)		\$	29,364,000		\$ 29,364,000		\$ 29,364,000		\$ 32,931,000			
Contingency (30% of Subtotal)		\$	110,116,000		\$ 110,116,000		\$ 110,116,000		\$ 123,491,000			
TOTAL ESTIMATED OVERNIGHT CAPITAL COST		\$	506,534,000		\$ 506,534,000		\$ 506,534,000		\$ 568,058,000			
ESTIMATED ANNUAL OPERATING COSTS												
			16-Hour		12-Hour		8-Hour		4-Hour			
Fixed Operating Costs (2% of Capital)		\$	10,131,000		\$ 10,131,000		\$ 10,131,000		\$ 11,361,000			
Variable Operating Costs (\$0.005/kWh)		\$	1,876,000		\$ 1,876,000		\$ 1,876,000		\$ 2,060,000			
TOTAL ESTIMATED OPERATING COST		\$	12,007,000		\$ 12,007,000		\$ 12,007,000		\$ 13,421,000			
ENERGY OUTPUT UNDER AVERAGE FLOW CONDITONS												
Month	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Jan	MWh		10,919		10,919		10,919		10,919			
Feb	MWh		7,008		7,008		7,008		7,008			
Mar	MWh		11,507		11,507		11,507		11,507			
Apr	MWh		22,259		22,259		22,259		22,259			
May	MWh		54,218		54,218		54,218		59,950			
Jun	MWh		48,753		48,753		48,753		58,907			
Jul	MWh		50,378		50,378		50,378		60,871			
Aug	MWh		50,378		50,378		50,378		60,871			
Sep	MWh		45,627		45,627		45,627		45,627			
Oct	MWh		35,048		35,048		35,048		35,048			
Nov	MWh		26,142		26,142		26,142		26,142			
Dec	MWh		12,875		12,875		12,875		12,875			
ENERGY OUTPUT (AVERAGE)	GWh/yr		375.1		375.1		375.1		412.0			
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDITONS												
Month	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Jan	MWh		7,787		7,787		7,787		7,787			
Feb	MWh		3,768		3,768		3,768		3,768			
Mar	MWh		8,031		8,031		8,031		8,031			
Apr	MWh		16,719		16,719		16,719		16,719			
May	MWh		46,921		46,921		46,921		46,921			
Jun	MWh		48,753		48,753		48,753		58,299			
Jul	MWh		50,378		50,378		50,378		60,871			
Aug	MWh		50,378		50,378		50,378		60,871			
Sep	MWh		45,635		45,635		45,635		45,635			
Oct	MWh		21,152		21,152		21,152		21,152			
Nov	MWh		36,810		36,810		36,810		36,810			
Dec	MWh		8,188		8,188		8,188		8,188			
ENERGY OUTPUT (FIRM)	GWh/yr		344.5		344.5		344.5		375.1			
CAPACITY AND ENERGY COST METRICS												
Metric	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Capacity Cost, Dependable Capacity	\$/MW	\$	25,327,000		\$ 18,995,000		\$ 12,663,000		\$ 7,101,000			
Capacity Cost, Installed Capacity	\$/MW	\$	7,481,000		\$ 7,481,000		\$ 7,481,000		\$ 6,943,000			
Energy Cost (Average)	\$/GWh	\$	1,350,000		\$ 1,350,000		\$ 1,350,000		\$ 1,379,000			
Energy Cost (Firm)	\$/GWh	\$	1,470,000		\$ 1,470,000		\$ 1,470,000		\$ 1,515,000			

TABLE C25

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

ELAHO RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-123.40	Catchment Area at Intake						km <sup>2</sup>	1,262		
Easting	E	50.11	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	88		
Region		Lower Mainland	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	96.0		
Estimated Footprint	ha	290										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	33.6	22.6	31.8	63.5	154.9	227.6	258.7	198.9	130.1	96.7	74.6	35.5
Firm (Low Flow)	18.8	12.7	22.2	47.7	118.9	166.3	216.0	227.0	130.1	58.4	105.0	22.6
DESIGN PARAMETERS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Dependable Capacity			MW	20		27		40		80		
Installed Capacity			MW	64		64		64		81		
Gross Head			m	55		55		55		55		
Design Flow, Qd			m <sup>3</sup> /s	139		139		139		177		
MAD Multiplier at Qd				1.4		1.4		1.4		1.8		
Reservoir Storage Volume			m <sup>3</sup>	16,089,933		16,089,933		16,089,933		16,089,933		
Live Storage Volume			m <sup>3</sup>	810,000		810,000		810,000		810,000		
Dam Height at Minimum Operating Level			m	41		41		41		41		
Dam Height at Full Supply Level			m	42		42		42		42		
Dam Type				CFRD		CFRD		CFRD		CFRD		
Dam Crest Length			m	343		343		343		343		
Reservoir Surface Area			m <sup>2</sup>	779,000		779,000		779,000		779,000		
Penstock Length			km	1		1		1		1		
Transmission Line Length			km	26		26		26		26		
Access Road Length			km	26		26		26		26		
ESTIMATED CAPITAL COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$	62,017,000		\$ 62,017,000		\$ 62,017,000		\$ 69,733,000		
Access and Site Preparation			\$	21,492,000		\$ 21,492,000		\$ 21,492,000		\$ 21,492,000		
Cofferdams and Construction Water Management			\$	12,235,000		\$ 12,235,000		\$ 12,235,000		\$ 12,235,000		
Intake, Headrace, and Forebay			\$	23,011,000		\$ 23,011,000		\$ 23,011,000		\$ 29,269,000		
Dam Construction			\$	78,359,000		\$ 78,359,000		\$ 78,359,000		\$ 78,359,000		
Water Conveyance System			\$	25,214,000		\$ 25,214,000		\$ 25,214,000		\$ 29,683,000		
Powerhouse Construction			\$	70,860,000		\$ 70,860,000		\$ 70,860,000		\$ 90,131,000		
Switchyard and Transmission			\$	16,895,000		\$ 16,895,000		\$ 16,895,000		\$ 17,764,000		
<b>SUB-TOTAL</b>			<b>\$</b>	<b>310,083,000</b>		<b>\$ 310,083,000</b>		<b>\$ 310,083,000</b>		<b>\$ 348,666,000</b>		
EPCM Costs (8% of Subtotal)			\$	24,807,000		\$ 24,807,000		\$ 24,807,000		\$ 27,893,000		
Contingency (30% of Subtotal)			\$	93,025,000		\$ 93,025,000		\$ 93,025,000		\$ 104,600,000		
<b>TOTAL ESTIMATED OVERNIGHT CAPITAL COST</b>			<b>\$</b>	<b>427,915,000</b>		<b>\$ 427,915,000</b>		<b>\$ 427,915,000</b>		<b>\$ 481,159,000</b>		
ESTIMATED ANNUAL OPERATING COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)			\$	8,558,000		\$ 8,558,000		\$ 8,558,000		\$ 9,623,000		
Variable Operating Costs (\$0.005/kWh)			\$	1,774,000		\$ 1,774,000		\$ 1,774,000		\$ 1,993,000		
<b>TOTAL ESTIMATED OPERATING COST</b>			<b>\$</b>	<b>10,332,000</b>		<b>\$ 10,332,000</b>		<b>\$ 10,332,000</b>		<b>\$ 11,616,000</b>		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month	Units			16-Hour		12-Hour		8-Hour		4-Hour		
Jan	MWh			10,521		10,521		10,521		10,521		
Feb	MWh			6,888		6,888		6,888		6,888		
Mar	MWh			10,861		10,861		10,861		10,861		
Apr	MWh			21,009		21,009		21,009		21,009		
May	MWh			51,388		51,388		51,388		56,798		
Jun	MWh			46,014		46,014		46,014		58,528		
Jul	MWh			47,548		47,548		47,548		60,479		
Aug	MWh			47,548		47,548		47,548		60,479		
Sep	MWh			43,064		43,064		43,064		43,064		
Oct	MWh			33,079		33,079		33,079		33,079		
Nov	MWh			24,673		24,673		24,673		24,673		
Dec	MWh			12,152		12,152		12,152		12,152		
<b>ENERGY OUTPUT (AVERAGE)</b>	<b>GWh/yr</b>			<b>354.7</b>		<b>354.7</b>		<b>354.7</b>		<b>398.5</b>		
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month	Units			16-Hour		12-Hour		8-Hour		4-Hour		
Jan	MWh			7,565		7,565		7,565		7,565		
Feb	MWh			3,831		3,831		3,831		3,831		
Mar	MWh			7,580		7,580		7,580		7,580		
Apr	MWh			15,780		15,780		15,780		15,780		
May	MWh			44,501		44,501		44,501		44,501		
Jun	MWh			46,014		46,014		46,014		55,024		
Jul	MWh			47,548		47,548		47,548		60,479		
Aug	MWh			47,548		47,548		47,548		60,479		
Sep	MWh			43,071		43,071		43,071		43,071		
Oct	MWh			19,964		19,964		19,964		19,964		
Nov	MWh			34,743		34,743		34,743		34,743		
Dec	MWh			7,728		7,728		7,728		7,728		
<b>ENERGY OUTPUT (FIRM)</b>	<b>GWh/yr</b>			<b>325.9</b>		<b>325.9</b>		<b>325.9</b>		<b>360.7</b>		
CAPACITY AND ENERGY COST METRICS												
Metric	Units			16-Hour		12-Hour		8-Hour		4-Hour		
Capacity Cost, Dependable Capacity	\$/MW		\$	21,396,000		\$ 16,047,000		\$ 10,698,000		\$ 6,014,000		
Capacity Cost, Installed Capacity	\$/MW		\$	6,696,000		\$ 6,696,000		\$ 6,696,000		\$ 5,919,000		
Energy Cost (Average)	\$/GWh		\$	1,206,000		\$ 1,206,000		\$ 1,206,000		\$ 1,207,000		
Energy Cost (Firm)	\$/GWh		\$	1,313,000		\$ 1,313,000		\$ 1,313,000		\$ 1,334,000		

TABLE C26

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

SOO RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-123.11	Catchment Area at Intake						km <sup>2</sup>	174		
Easting	E	50.23	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	42		
Region		Lower Mainland	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	6.7		
Estimated Footprint	ha	320										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	3.2	2.3	2.5	3.6	8.8	16.5	17.5	12.1	7.2	5.8	5.3	3.2
Firm (Low Flow)	2.6	2.1	2.3	2.2	10.9	13.8	12.9	11.3	6.3	5.5	7.2	3.1
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour			4-Hour	
Dependable Capacity			MW			20	27	40			80	
Installed Capacity			MW			20	27	40			81	
Gross Head			m			164	164	164			164	
Design Flow, Qd			m <sup>3</sup> /s			15	20	29			59	
MAD Multiplier at Qd						2.2	2.9	4.4			8.8	
Reservoir Storage Volume			m <sup>3</sup>			11,369,000	11,369,000	11,369,000			11,369,000	
Live Storage Volume			m <sup>3</sup>			7,563,000	7,563,000	7,563,000			7,563,000	
Dam Height at Minimum Operating Level			m			35	35	35			35	
Dam Height at Full Supply Level			m			37	37	37			37	
Dam Type						CFRD	CFRD	CFRD			CFRD	
Dam Crest Length			m			417	417	417			417	
Reservoir Surface Area			m <sup>2</sup>			1,315,000	1,315,000	1,315,000			1,315,000	
Penstock Length			km			4	4	4			4	
Transmission Line Length			km			22	22	22			22	
Access Road Length			km			22	22	22			22	
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour			4-Hour	
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits	\$					33,881,000	37,016,000	43,017,000	\$		59,980,000	
Access and Site Preparation	\$					22,913,000	22,913,000	22,913,000	\$		22,913,000	
Cofferdams and Construction Water Management	\$					811,000	811,000	811,000	\$		811,000	
Intake, Headrace, and Forebay	\$					2,440,000	3,253,000	4,880,000	\$		9,760,000	
Dam Construction	\$					50,720,000	50,720,000	50,720,000	\$		50,720,000	
Water Conveyance System	\$					24,800,000	29,213,000	36,963,000	\$		56,054,000	
Powerhouse Construction	\$					20,931,000	27,908,000	41,861,000	\$		83,723,000	
Switchyard and Transmission	\$					12,910,000	13,246,000	13,919,000	\$		15,939,000	
SUB-TOTAL	\$					169,406,000	185,080,000	215,084,000	\$		299,900,000	
EPCM Costs (8% of Subtotal)	\$					13,552,000	14,806,000	17,207,000	\$		23,992,000	
Contingency (30% of Subtotal)	\$					50,822,000	55,524,000	64,525,000	\$		89,970,000	
TOTAL ESTIMATED OVERNIGHT CAPITAL COST	\$					233,780,000	255,410,000	296,816,000	\$		413,862,000	
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour			4-Hour	
Fixed Operating Costs (2% of Capital)	\$					4,676,000	5,108,000	5,936,000	\$		8,277,000	
Variable Operating Costs (\$0.005/kWh)	\$					437,000	460,000	460,000	\$		460,000	
TOTAL ESTIMATED OPERATING COST	\$					5,113,000	5,568,000	6,396,000	\$		8,737,000	
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month		Units				16-Hour	12-Hour	8-Hour			4-Hour	
Jan		MWh				5,723	5,723	5,723			5,723	
Feb		MWh				0	0	0			0	
Mar		MWh				1,772	1,772	1,772			1,772	
Apr		MWh				3,591	3,591	3,591			3,591	
May		MWh				12,839	12,839	12,839			12,839	
Jun		MWh				14,539	16,316	16,316			16,316	
Jul		MWh				15,024	17,853	17,853			17,853	
Aug		MWh				12,345	12,345	12,345			12,345	
Sep		MWh				7,079	7,079	7,079			7,079	
Oct		MWh				5,945	5,945	5,945			5,945	
Nov		MWh				5,219	5,219	5,219			5,219	
Dec		MWh				3,261	3,261	3,261			3,261	
ENERGY OUTPUT (AVERAGE)		GWh/yr				87.3	91.9	91.9			91.9	
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month		Units				16-Hour	12-Hour	8-Hour			4-Hour	
Jan		MWh				5,371	5,371	5,371			5,371	
Feb		MWh				0	0	0			0	
Mar		MWh				1,340	1,340	1,340			1,340	
Apr		MWh				2,169	2,169	2,169			2,169	
May		MWh				14,956	14,956	14,956			14,956	
Jun		MWh				13,634	13,634	13,634			13,634	
Jul		MWh				13,125	13,125	13,125			13,125	
Aug		MWh				11,553	11,553	11,553			11,553	
Sep		MWh				6,199	6,199	6,199			6,199	
Oct		MWh				5,624	5,624	5,624			5,624	
Nov		MWh				7,074	7,074	7,074			7,074	
Dec		MWh				3,170	3,170	3,170			3,170	
ENERGY OUTPUT (FIRM)		GWh/yr				84.2	84.2	84.2			84.2	
CAPACITY AND ENERGY COST METRICS												
Metric		Units				16-Hour	12-Hour	8-Hour			4-Hour	
Capacity Cost, Dependable Capacity		\$/MW	\$			11,712,000	9,597,000	7,435,000	\$		5,183,000	
Capacity Cost, Installed Capacity		\$/MW	\$			11,577,000	9,486,000	7,349,000	\$		5,124,000	
Energy Cost (Average)		\$/GWh	\$			2,677,000	2,778,000	3,228,000	\$		4,501,000	
Energy Cost (Firm)		\$/GWh	\$			2,776,000	3,033,000	3,524,000	\$		4,914,000	

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NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RW'D

TABLE C27

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

SOUTH CREEK

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-123.24	Catchment Area at Intake						km <sup>2</sup>	79		
Easting	E	50.52	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	88		
Region		Lower Mainland	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	6.0		
Estimated Footprint	ha	380										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	2.1	1.4	2.0	4.0	9.6	14.2	16.1	12.4	8.1	6.0	4.6	2.2
Firm (Low Flow)	1.2	0.8	1.4	3.0	7.4	10.4	13.4	14.1	8.1	3.6	6.5	1.4
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Dependable Capacity			MW			20	27	40	80			
Installed Capacity			MW			45	45	45	81			
Gross Head			m			625	625	625	625			
Design Flow, Qd			m <sup>3</sup> /s			9	9	9	16			
MAD Multiplier at Qd						1.4	1.4	1.4	2.6			
Reservoir Storage Volume			m <sup>3</sup>			2,398,224	2,398,224	2,398,224	2,398,224			
Live Storage Volume			m <sup>3</sup>			1,058,000	1,058,000	1,058,000	1,058,000			
Dam Height at Minimum Operating Level			m			20	20	20	20			
Dam Height at Full Supply Level			m			27	27	27	27			
Dam Type						CFRD	CFRD	CFRD	CFRD			
Dam Crest Length			m			219	219	219	219			
Reservoir Surface Area			m <sup>2</sup>			148,000	148,000	148,000	148,000			
Penstock Length			km			6	6	6	6			
Transmission Line Length			km			52	52	52	52			
Access Road Length			km			20	20	20	20			
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits	\$					35,213,000	35,213,000	35,213,000	\$	47,490,000		
Access and Site Preparation	\$					21,869,000	21,869,000	21,869,000	\$	21,869,000		
Cofferdams and Construction Water Management	\$					762,000	762,000	762,000	\$	762,000		
Intake, Headrace, and Forebay	\$					1,433,000	1,433,000	1,433,000	\$	2,567,000		
Dam Construction	\$					17,331,000	17,331,000	17,331,000	\$	17,331,000		
Water Conveyance System	\$					26,219,000	26,219,000	26,219,000	\$	36,305,000		
Powerhouse Construction	\$					45,581,000	45,581,000	45,581,000	\$	81,681,000		
Switchyard and Transmission	\$					27,657,000	27,657,000	27,657,000	\$	29,445,000		
SUB-TOTAL	\$					176,065,000	176,065,000	176,065,000	\$	237,450,000		
EPCM Costs (8% of Subtotal)	\$					14,085,000	14,085,000	14,085,000	\$	18,996,000		
Contingency (30% of Subtotal)	\$					52,820,000	52,820,000	52,820,000	\$	71,235,000		
TOTAL ESTIMATED OVERNIGHT CAPITAL COST	\$					242,970,000	242,970,000	242,970,000	\$	327,681,000		
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Fixed Operating Costs (2% of Capital)	\$					4,859,000	4,859,000	4,859,000	\$	6,554,000		
Variable Operating Costs (\$0.005/kWh)	\$					1,257,000	1,257,000	1,257,000	\$	1,585,000		
TOTAL ESTIMATED OPERATING COST	\$					6,116,000	6,116,000	6,116,000	\$	8,139,000		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month	Units					16-Hour	12-Hour	8-Hour	4-Hour			
Jan	MWh					8,560	8,560	8,560	8,560			
Feb	MWh					3,407	3,407	3,407	3,407			
Mar	MWh					7,673	7,673	7,673	7,673			
Apr	MWh					14,842	14,842	14,842	14,842			
May	MWh					37,430	37,430	37,430	41,253			
Jun	MWh					32,507	32,507	32,507	53,216			
Jul	MWh					33,590	33,590	33,590	60,194			
Aug	MWh					33,590	33,590	33,590	48,052			
Sep	MWh					30,423	30,423	30,423	30,423			
Oct	MWh					23,369	23,369	23,369	23,369			
Nov	MWh					17,431	17,431	17,431	17,431			
Dec	MWh					8,585	8,585	8,585	8,585			
ENERGY OUTPUT (AVERAGE)	GWh/yr					251.4	251.4	251.4	317.0			
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month	Units					16-Hour	12-Hour	8-Hour	4-Hour			
Jan	MWh					6,472	6,472	6,472	6,472			
Feb	MWh					1,247	1,247	1,247	1,247			
Mar	MWh					5,355	5,355	5,355	5,355			
Apr	MWh					11,148	11,148	11,148	11,148			
May	MWh					32,565	32,565	32,565	32,565			
Jun	MWh					32,507	32,507	32,507	38,872			
Jul	MWh					33,590	33,590	33,590	52,179			
Aug	MWh					33,590	33,590	33,590	54,844			
Sep	MWh					30,428	30,428	30,428	30,428			
Oct	MWh					14,103	14,103	14,103	14,103			
Nov	MWh					24,544	24,544	24,544	24,544			
Dec	MWh					5,460	5,460	5,460	5,460			
ENERGY OUTPUT (FIRM)	GWh/yr					231.0	231.0	231.0	277.2			
CAPACITY AND ENERGY COST METRICS												
Metric	Units					16-Hour	12-Hour	8-Hour	4-Hour			
Capacity Cost, Dependable Capacity	\$/MW	\$				12,166,000	9,124,000	6,083,000	\$	4,102,000		
Capacity Cost, Installed Capacity	\$/MW	\$				5,382,000	5,382,000	5,382,000	\$	4,050,000		
Energy Cost (Average)	\$/GWh	\$				966,000	966,000	966,000	\$	1,034,000		
Energy Cost (Firm)	\$/GWh	\$				1,052,000	1,052,000	1,052,000	\$	1,182,000		

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NOTES:

- 1. VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- 2. ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- 3. NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RW'G'D

**TABLE C28**

**BC HYDRO**  
**SMALL STORAGE HYDRO REGIONAL ASSESSMENT**

## SHORTLISTED SITE DATA SHEET

### SIWASH CREEK

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Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-121.35	Catchment Area at Intake						km <sup>2</sup>	61		
Easting	E	49.58	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	43		
Region		Lower Mainland	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	1.8		
Estimated Footprint	ha	110										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	1.6	1.0	1.4	3.0	7.9	7.4	2.8	0.8	1.3	0.6	2.4	1.6
Firm (Low Flow)	0.6	0.5	0.5	2.3	6.5	4.4	1.6	0.6	0.6	0.4	2.5	1.1
DESIGN PARAMETERS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Dependable Capacity			MW	20		27		40		80		
Installed Capacity			MW	21		28		41		83		
Gross Head			m	437		437		437		437		
Design Flow, Qd			m <sup>3</sup> /s	6		8		11		23		
MAD Multiplier at Qd				3.2		4.2		6.3		12.6		
Reservoir Storage Volume			m <sup>3</sup>	4,150,000		4,150,000		4,150,000		4,150,000		
Live Storage Volume			m <sup>3</sup>	2,743,000		2,743,000		2,743,000		2,743,000		
Dam Height at Minimum Operating Level			m	25		25		25		25		
Dam Height at Full Supply Level			m	41		41		41		41		
Dam Type				CFRD		CFRD		CFRD		CFRD		
Dam Crest Length			m	158		158		158		158		
Reservoir Surface Area			m <sup>2</sup>	190,000		190,000		190,000		190,000		
Penstock Length			km	4		4		4		4		
Transmission Line Length			km	12		12		12		12		
Access Road Length			km	5		5		5		5		
ESTIMATED CAPITAL COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$	19,196,000		\$ 21,781,000		\$ 26,772,000		\$ 41,050,000		
Access and Site Preparation			\$	7,574,000		\$ 7,574,000		\$ 7,574,000		\$ 7,574,000		
Cofferdams and Construction Water Management			\$	291,000		\$ 291,000		\$ 291,000		\$ 291,000		
Intake, Headrace, and Forebay			\$	942,000		\$ 1,257,000		\$ 1,885,000		\$ 3,770,000		
Dam Construction			\$	22,772,000		\$ 22,772,000		\$ 22,772,000		\$ 22,772,000		
Water Conveyance System			\$	15,748,000		\$ 18,423,000		\$ 23,053,000		\$ 34,167,000		
Powerhouse Construction			\$	21,020,000		\$ 28,026,000		\$ 42,039,000		\$ 84,078,000		
Switchyard and Transmission			\$	8,437,000		\$ 8,782,000		\$ 9,473,000		\$ 11,547,000		
SUB-TOTAL			\$	95,980,000		\$ 108,906,000		\$ 133,859,000		\$ 205,249,000		
EPCM Costs (8% of Subtotal)			\$	7,678,000		\$ 8,712,000		\$ 10,709,000		\$ 16,420,000		
Contingency (30% of Subtotal)			\$	28,794,000		\$ 32,672,000		\$ 40,158,000		\$ 61,575,000		
TOTAL ESTIMATED OVERNIGHT CAPITAL COST			\$	132,452,000		\$ 150,290,000		\$ 184,726,000		\$ 283,244,000		
ESTIMATED ANNUAL OPERATING COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)			\$	2,649,000		\$ 3,006,000		\$ 3,695,000		\$ 5,665,000		
Variable Operating Costs (\$0.005/kWh)			\$	387,000		\$ 434,000		\$ 438,000		\$ 438,000		
TOTAL ESTIMATED OPERATING COST			\$	3,036,000		\$ 3,440,000		\$ 4,133,000		\$ 6,103,000		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDITONS												
Month		Units		16-Hour		12-Hour		8-Hour		4-Hour		
Jan		MWh		6,288		6,288		6,288		6,288		
Feb		MWh		0		0		0		0		
Mar		MWh		3,343		3,343		3,343		3,343		
Apr		MWh		7,807		7,807		7,807		7,807		
May		MWh		19,267		24,409		25,127		25,127		
Jun		MWh		14,929		19,321		19,321		19,321		
Jul		MWh		7,721		7,721		7,721		7,721		
Aug		MWh		2,301		2,301		2,301		2,301		
Sep		MWh		3,509		3,509		3,509		3,509		
Oct		MWh		1,700		1,700		1,700		1,700		
Nov		MWh		6,223		6,223		6,223		6,223		
Dec		MWh		4,255		4,255		4,255		4,255		
ENERGY OUTPUT (AVERAGE)		GWh/yr		77.3		86.9		87.6		87.6		
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDITONS												
Month		Units		16-Hour		12-Hour		8-Hour		4-Hour		
Jan		MWh		4,719		4,719		4,719		4,719		
Feb		MWh		0		0		0		0		
Mar		MWh		0		0		0		0		
Apr		MWh		5,746		5,746		5,746		5,746		
May		MWh		19,267		21,479		21,479		21,479		
Jun		MWh		11,490		11,490		11,490		11,490		
Jul		MWh		4,269		4,269		4,269		4,269		
Aug		MWh		1,736		1,736		1,736		1,736		
Sep		MWh		1,552		1,552		1,552		1,552		
Oct		MWh		1,147		1,147		1,147		1,147		
Nov		MWh		6,575		6,575		6,575		6,575		
Dec		MWh		2,996		2,996		2,996		2,996		
ENERGY OUTPUT (FIRM)		GWh/yr		59.5		61.7		61.7		61.7		
CAPACITY AND ENERGY COST METRICS												
Metric		Units		16-Hour		12-Hour		8-Hour		4-Hour		
Capacity Cost, Dependable Capacity		\$/MW	\$	6,626,000		\$ 5,638,000		\$ 4,620,000		\$ 3,542,000		
Capacity Cost, Installed Capacity		\$/MW	\$	6,388,000		\$ 5,436,000		\$ 4,454,000		\$ 3,415,000		
Energy Cost (Average)		\$/GWh	\$	1,713,000		\$ 1,730,000		\$ 2,109,000		\$ 3,234,000		
Energy Cost (Firm)		\$/GWh	\$	2,226,000		\$ 2,435,000		\$ 2,993,000		\$ 4,590,000		

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**NOTES:**

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3. NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RWV'D

TABLE C29

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

SOWAQUA CREEK

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-121.24							Catchment Area at Intake	km <sup>2</sup>		140
Easting	E	49.41							Estimated Mean Annual Unit Runoff	L/s/km <sup>2</sup>		43
Region		Lower Mainland							Mean Annual Discharge (MAD)	m <sup>3</sup> /s		4.1
Estimated Footprint	ha	180										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	3.6	2.3	3.1	6.8	18.0	16.9	6.5	1.9	3.1	1.4	5.4	3.6
Firm (Low Flow)	1.3	1.0	1.2	5.2	14.9	10.0	3.6	1.5	1.4	1.0	5.7	2.5
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Dependable Capacity			MW			20	27	40	80			
Installed Capacity			MW			24	32	48	96			
Gross Head			m			242	242	242	242			
Design Flow, Qd			m <sup>3</sup> /s			12	16	24	48			
MAD Multiplier at Qd						2.9	3.8	5.8	11.5			
Reservoir Storage Volume			m <sup>3</sup>			7,693,000	7,693,000	7,693,000	7,693,000			
Live Storage Volume			m <sup>3</sup>			4,870,000	4,870,000	4,870,000	4,870,000			
Dam Height at Minimum Operating Level			m			33	33	33	33			
Dam Height at Full Supply Level			m			73	73	73	73			
Dam Type						CFRD	CFRD	CFRD	CFRD			
Dam Crest Length			m			261	261	261	261			
Reservoir Surface Area			m <sup>2</sup>			427,000	427,000	427,000	427,000			
Penstock Length			km			5	5	5	5			
Transmission Line Length			km			19	19	19	19			
Access Road Length			km			5	5	5	5			
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$			44,306,000	47,707,000	54,237,000	72,776,000			
Access and Site Preparation			\$			10,101,000	10,101,000	10,101,000	10,101,000			
Cofferdams and Construction Water Management			\$			667,000	667,000	667,000	667,000			
Intake, Headrace, and Forebay			\$			1,967,000	2,623,000	3,934,000	7,868,000			
Dam Construction			\$			103,420,000	103,420,000	103,420,000	103,420,000			
Water Conveyance System			\$			24,703,000	29,045,000	36,641,000	55,230,000			
Powerhouse Construction			\$			24,616,000	32,822,000	49,233,000	98,465,000			
Switchyard and Transmission			\$			11,751,000	12,151,000	12,952,000	15,354,000			
SUB-TOTAL			\$			221,531,000	238,536,000	271,185,000	363,881,000			
EPCM Costs (8% of Subtotal)			\$			17,722,000	19,083,000	21,695,000	29,110,000			
Contingency (30% of Subtotal)			\$			66,459,000	71,561,000	81,356,000	109,164,000			
TOTAL ESTIMATED OVERNIGHT CAPITAL COST			\$			305,712,000	329,180,000	374,236,000	502,155,000			
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Fixed Operating Costs (2% of Capital)			\$			6,114,000	6,584,000	7,485,000	10,043,000			
Variable Operating Costs (\$0.005/kWh)			\$			468,000	527,000	550,000	550,000			
TOTAL ESTIMATED OPERATING COST			\$			6,582,000	7,111,000	8,035,000	10,593,000			
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month		Units				16-Hour	12-Hour	8-Hour	4-Hour			
Jan		MWh				6,951	6,951	6,951	6,951			6,951
Feb		MWh				373	373	373	373			373
Mar		MWh				4,667	4,667	4,667	4,667			4,667
Apr		MWh				9,922	9,922	9,922	9,922			9,922
May		MWh				21,712	27,670	30,892	30,892			30,892
Jun		MWh				17,296	23,061	24,554	24,554			24,554
Jul		MWh				9,812	9,812	9,812	9,812			9,812
Aug		MWh				2,924	2,924	2,924	2,924			2,924
Sep		MWh				4,459	4,459	4,459	4,459			4,459
Oct		MWh				2,160	2,160	2,160	2,160			2,160
Nov		MWh				7,909	7,909	7,909	7,909			7,909
Dec		MWh				5,408	5,408	5,408	5,408			5,408
ENERGY OUTPUT (AVERAGE)		GWh/yr				93.6	105.3	110.0	110.0			
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month		Units				16-Hour	12-Hour	8-Hour	4-Hour			
Jan		MWh				4,957	4,957	4,957	4,957			4,957
Feb		MWh				0	0	0	0			0
Mar		MWh				524	524	524	524			524
Apr		MWh				7,570	7,570	7,570	7,570			7,570
May		MWh				21,712	26,257	26,257	26,257			26,257
Jun		MWh				14,602	14,602	14,602	14,602			14,602
Jul		MWh				5,425	5,425	5,425	5,425			5,425
Aug		MWh				2,206	2,206	2,206	2,206			2,206
Sep		MWh				1,973	1,973	1,973	1,973			1,973
Oct		MWh				1,457	1,457	1,457	1,457			1,457
Nov		MWh				8,356	8,356	8,356	8,356			8,356
Dec		MWh				3,808	3,808	3,808	3,808			3,808
ENERGY OUTPUT (FIRM)		GWh/yr				72.6	77.1	77.1	77.1			
CAPACITY AND ENERGY COST METRICS												
Metric		Units				16-Hour	12-Hour	8-Hour	4-Hour			
Capacity Cost, Dependable Capacity		\$/MW	\$			15,273,000	12,334,000	9,348,000	6,272,000			
Capacity Cost, Installed Capacity		\$/MW	\$			12,726,000	10,277,000	7,789,000	5,226,000			
Energy Cost (Average)		\$/GWh	\$			3,266,000	3,126,000	3,401,000	4,564,000			
Energy Cost (Firm)		\$/GWh	\$			4,211,000	4,268,000	4,852,000	6,510,000			

TABLE C30

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

SILVERHOPE CREEK

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-121.40	Catchment Area at Intake						km <sup>2</sup>	235		
Easting	E	49.29	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	70		
Region		Lower Mainland	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	12.3		
Estimated Footprint	ha	280										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	15.2	9.6	10.5	13.6	27.4	31.6	21.4	9.7	7.4	12.9	22.9	14.4
Firm (Low Flow)	8.0	3.3	6.2	9.6	22.8	22.6	13.5	8.4	4.5	9.5	25.4	13.2
DESIGN PARAMETERS												
						16-Hour	12-Hour		8-Hour		4-Hour	
Dependable Capacity			MW			20	27		40		80	
Installed Capacity			MW			51	51		51		80	
Gross Head			m			299	299		299		299	
Design Flow, Qd			m <sup>3</sup> /s			20	20		20		32	
MAD Multiplier at Qd						1.7	1.7		1.7		2.6	
Reservoir Storage Volume			m <sup>3</sup>			5,080,336	5,080,336		5,080,336		5,080,336	
Live Storage Volume			m <sup>3</sup>			2,299,000	2,299,000		2,299,000		2,299,000	
Dam Height at Minimum Operating Level			m			33	33		33		33	
Dam Height at Full Supply Level			m			34	34		34		34	
Dam Type						CFRD	CFRD		CFRD		CFRD	
Dam Crest Length			m			552	552		552		552	
Reservoir Surface Area			m <sup>2</sup>			1,104,000	1,104,000		1,104,000		1,104,000	
Penstock Length			km			9	9		9		9	
Transmission Line Length			km			25	25		25		25	
Access Road Length			km			1	1		1		1	
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour		8-Hour		4-Hour	
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$			54,071,000	54,071,000		54,071,000		67,555,000	
Access and Site Preparation			\$			14,758,000	14,758,000		14,758,000		14,758,000	
Cofferdams and Construction Water Management			\$			1,803,000	1,803,000		1,803,000		1,803,000	
Intake, Headrace, and Forebay			\$			3,391,000	3,391,000		3,391,000		5,328,000	
Dam Construction			\$			59,111,000	59,111,000		59,111,000		59,111,000	
Water Conveyance System			\$			69,290,000	69,290,000		69,290,000		90,071,000	
Powerhouse Construction			\$			52,125,000	52,125,000		52,125,000		81,885,000	
Switchyard and Transmission			\$			15,805,000	15,805,000		15,805,000		17,264,000	
<b>SUB-TOTAL</b>			<b>\$</b>			<b>270,354,000</b>	<b>270,354,000</b>		<b>270,354,000</b>		<b>337,775,000</b>	
EPCM Costs (8% of Subtotal)			\$			21,628,000	21,628,000		21,628,000		27,022,000	
Contingency (30% of Subtotal)			\$			81,106,000	81,106,000		81,106,000		101,333,000	
<b>TOTAL ESTIMATED OVERNIGHT CAPITAL COST</b>			<b>\$</b>			<b>373,088,000</b>	<b>373,088,000</b>		<b>373,088,000</b>		<b>466,130,000</b>	
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour		8-Hour		4-Hour	
Fixed Operating Costs (2% of Capital)			\$			7,462,000	7,462,000		7,462,000		9,323,000	
Variable Operating Costs (\$0.005/kWh)			\$			1,569,000	1,569,000		1,569,000		1,762,000	
<b>TOTAL ESTIMATED OPERATING COST</b>			<b>\$</b>			<b>9,031,000</b>	<b>9,031,000</b>		<b>9,031,000</b>		<b>11,085,000</b>	
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month		Units				16-Hour	12-Hour		8-Hour		4-Hour	
Jan		MWh				20,215	20,215		20,215		20,215	
Feb		MWh				14,511	14,511		14,511		14,511	
Mar		MWh				19,473	19,473		19,473		19,473	
Apr		MWh				24,368	24,368		24,368		24,368	
May		MWh				41,859	41,859		41,859		54,767	
Jun		MWh				36,793	36,793		36,793		56,665	
Jul		MWh				38,019	38,019		38,019		39,623	
Aug		MWh				17,971	17,971		17,971		17,971	
Sep		MWh				13,267	13,267		13,267		13,267	
Oct		MWh				23,926	23,926		23,926		23,926	
Nov		MWh				36,793	36,793		36,793		41,042	
Dec		MWh				26,641	26,641		26,641		26,641	
<b>ENERGY OUTPUT (AVERAGE)</b>		<b>GWh/yr</b>				<b>313.8</b>	<b>313.8</b>		<b>313.8</b>		<b>352.5</b>	
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month		Units				16-Hour	12-Hour		8-Hour		4-Hour	
Jan		MWh				12,423	12,423		12,423		12,423	
Feb		MWh				3,924	3,924		3,924		3,924	
Mar		MWh				11,458	11,458		11,458		11,458	
Apr		MWh				17,267	17,267		17,267		17,267	
May		MWh				41,859	41,859		41,859		46,124	
Jun		MWh				36,793	36,793		36,793		40,601	
Jul		MWh				25,048	25,048		25,048		25,048	
Aug		MWh				15,618	15,618		15,618		15,618	
Sep		MWh				8,089	8,089		8,089		8,089	
Oct		MWh				17,570	17,570		17,570		17,570	
Nov		MWh				36,793	36,793		36,793		45,689	
Dec		MWh				24,469	24,469		24,469		24,469	
<b>ENERGY OUTPUT (FIRM)</b>		<b>GWh/yr</b>				<b>251.3</b>	<b>251.3</b>		<b>251.3</b>		<b>268.3</b>	
CAPACITY AND ENERGY COST METRICS												
Metric		Units				16-Hour	12-Hour		8-Hour		4-Hour	
Capacity Cost, Dependable Capacity		\$/MW				18,654,000	13,991,000		9,327,000		5,827,000	
Capacity Cost, Installed Capacity		\$/MW				7,301,000	7,301,000		7,301,000		5,807,000	
Energy Cost (Average)		\$/GWh				1,189,000	1,189,000		1,189,000		1,322,000	
Energy Cost (Firm)		\$/GWh				1,485,000	1,485,000		1,485,000		1,737,000	

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NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RW'D



TABLE C31

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

COGBURN CREEK

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-121.62	Catchment Area at Intake						km <sup>2</sup>		78	
Easting	E	49.57	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>		43	
Region		Lower Mainland	Mean Annual Discharge (MAD)						m <sup>3</sup> /s		2.3	
Estimated Footprint	ha	200										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	2.0	1.3	1.7	3.8	10.1	9.5	3.7	1.1	1.7	0.8	3.0	2.0
Firm (Low Flow)	0.7	0.6	0.7	2.9	8.4	5.6	2.0	0.8	0.8	0.5	3.2	1.4
DESIGN PARAMETERS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Dependable Capacity				MW	20	27		40		80		
Installed Capacity				MW	21	29		43		86		
Gross Head				m	474	474		474		474		
Design Flow, Qd				m <sup>3</sup> /s	5	7		11		22		
MAD Multiplier at Qd					2.4	3.1		4.7		9.4		
Reservoir Storage Volume				m <sup>3</sup>	3,340,500	3,340,500		3,340,500		3,340,500		
Live Storage Volume				m <sup>3</sup>	2,181,000	2,181,000		2,181,000		2,181,000		
Dam Height at Minimum Operating Level				m	22	22		22		22		
Dam Height at Full Supply Level				m	54	54		54		54		
Dam Type					CFRD	CFRD		CFRD		CFRD		
Dam Crest Length				m	378	378		378		378		
Reservoir Surface Area				m <sup>2</sup>	202,000	202,000		202,000		202,000		
Penstock Length				km	10	10		10		10		
Transmission Line Length				km	21	21		21		21		
Access Road Length				km	15	15		15		15		
ESTIMATED CAPITAL COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits				\$	43,107,000	\$ 46,578,000		\$ 53,116,000		\$ 71,167,000		
Access and Site Preparation				\$	16,662,000	\$ 16,662,000		\$ 16,662,000		\$ 16,662,000		
Cofferdams and Construction Water Management				\$	374,000	\$ 374,000		\$ 374,000		\$ 374,000		
Intake, Headrace, and Forebay				\$	900,000	\$ 1,200,000		\$ 1,800,000		\$ 3,600,000		
Dam Construction				\$	84,913,000	\$ 84,913,000		\$ 84,913,000		\$ 84,913,000		
Water Conveyance System				\$	35,291,000	\$ 41,262,000		\$ 51,587,000		\$ 76,312,000		
Powerhouse Construction				\$	21,764,000	\$ 29,019,000		\$ 43,528,000		\$ 87,057,000		
Switchyard and Transmission				\$	12,525,000	\$ 12,883,000		\$ 13,599,000		\$ 15,748,000		
<b>SUB-TOTAL</b>				<b>\$</b>	<b>215,536,000</b>	<b>\$ 232,891,000</b>		<b>\$ 265,579,000</b>		<b>\$ 355,833,000</b>		
EPCM Costs (8% of Subtotal)				\$	17,243,000	\$ 18,631,000		\$ 21,246,000		\$ 28,467,000		
Contingency (30% of Subtotal)				\$	64,661,000	\$ 69,867,000		\$ 79,674,000		\$ 106,750,000		
<b>TOTAL ESTIMATED OVERNIGHT CAPITAL COST</b>				<b>\$</b>	<b>297,440,000</b>	<b>\$ 321,389,000</b>		<b>\$ 366,499,000</b>		<b>\$ 491,050,000</b>		
ESTIMATED ANNUAL OPERATING COSTS												
				16-Hour		12-Hour		8-Hour		4-Hour		
Fixed Operating Costs (2% of Capital)				\$	5,949,000	\$ 6,428,000		\$ 7,330,000		\$ 9,821,000		
Variable Operating Costs (\$0.005/kWh)				\$	477,000	\$ 529,000		\$ 602,000		\$ 602,000		
<b>TOTAL ESTIMATED OPERATING COST</b>				<b>\$</b>	<b>6,426,000</b>	<b>\$ 6,957,000</b>		<b>\$ 7,932,000</b>		<b>\$ 10,423,000</b>		
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month				Units	16-Hour	12-Hour		8-Hour		4-Hour		
Jan				MWh	7,250	7,250		7,250		7,250		
Feb				MWh	1,011	1,011		1,011		1,011		
Mar				MWh	5,115	5,115		5,115		5,115		
Apr				MWh	10,874	10,874		10,874		10,874		
May				MWh	19,830	25,160		33,489		33,489		
Jun				MWh	15,474	20,633		26,911		26,911		
Jul				MWh	10,754	10,754		10,754		10,754		
Aug				MWh	3,205	3,205		3,205		3,205		
Sep				MWh	4,887	4,887		4,887		4,887		
Oct				MWh	2,367	2,367		2,367		2,367		
Nov				MWh	8,668	8,668		8,668		8,668		
Dec				MWh	5,927	5,927		5,927		5,927		
<b>ENERGY OUTPUT (AVERAGE)</b>				<b>GWh/yr</b>	<b>95.4</b>	<b>105.9</b>		<b>120.5</b>		<b>120.5</b>		
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month				Units	16-Hour	12-Hour		8-Hour		4-Hour		
Jan				MWh	5,065	5,065		5,065		5,065		
Feb				MWh	0	0		0		0		
Mar				MWh	1,176	1,176		1,176		1,176		
Apr				MWh	8,296	8,296		8,296		8,296		
May				MWh	19,830	25,160		28,408		28,408		
Jun				MWh	15,474	16,004		16,004		16,004		
Jul				MWh	5,946	5,946		5,946		5,946		
Aug				MWh	2,418	2,418		2,418		2,418		
Sep				MWh	2,162	2,162		2,162		2,162		
Oct				MWh	1,597	1,597		1,597		1,597		
Nov				MWh	9,158	9,158		9,158		9,158		
Dec				MWh	4,174	4,174		4,174		4,174		
<b>ENERGY OUTPUT (FIRM)</b>				<b>GWh/yr</b>	<b>75.3</b>	<b>81.2</b>		<b>84.4</b>		<b>84.4</b>		
CAPACITY AND ENERGY COST METRICS												
Metric				Units	16-Hour	12-Hour		8-Hour		4-Hour		
Capacity Cost, Dependable Capacity				\$/MW	\$ 14,845,000	\$ 12,030,000		\$ 9,146,000		\$ 6,127,000		
Capacity Cost, Installed Capacity				\$/MW	\$ 13,839,000	\$ 11,215,000		\$ 8,526,000		\$ 5,712,000		
Energy Cost (Average)				\$/GWh	\$ 3,119,000	\$ 3,036,000		\$ 3,043,000		\$ 4,077,000		
Energy Cost (Firm)				\$/GWh	\$ 3,950,000	\$ 3,960,000		\$ 4,342,000		\$ 5,818,000		

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NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RW'D

TABLE C32

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

PITT RIVER

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-122.71	Catchment Area at Intake						km <sup>2</sup>	437		
Easting	E	49.70	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	104		
Region		Lower Mainland	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	31.2		
Estimated Footprint	ha	410										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	19.1	19.3	11.9	23.2	51.5	88.0	100.1	73.0	55.9	45.5	36.0	21.6
Firm (Low Flow)	32.9	22.5	12.5	11.4	39.6	86.3	69.0	43.8	24.5	14.0	9.6	7.4
DESIGN PARAMETERS												
			16-Hour		12-Hour		8-Hour		4-Hour			
Dependable Capacity		MW	20		27		40		80			
Installed Capacity		MW	24		32		48		96			
Gross Head		m	38		38		38		38			
Design Flow, Qd		m <sup>3</sup> /s	76		102		152		305			
MAD Multiplier at Qd			2.4		3.3		4.9		9.8			
Reservoir Storage Volume		m <sup>3</sup>	41,344,500		41,344,500		41,344,500		41,344,500			
Live Storage Volume		m <sup>3</sup>	25,857,000		25,857,000		25,857,000		25,857,000			
Dam Height at Minimum Operating Level		m	31		31		31		31			
Dam Height at Full Supply Level		m	38		38		38		38			
Dam Type			CFRD		CFRD		CFRD		CFRD			
Dam Crest Length		m	353		353		353		353			
Reservoir Surface Area		m <sup>2</sup>	2,787,000		2,787,000		2,787,000		2,787,000			
Penstock Length		km	0		0		0		0			
Transmission Line Length		km	22		22		22		22			
Access Road Length		km	1		1		1		1			
ESTIMATED CAPITAL COSTS												
			16-Hour		12-Hour		8-Hour		4-Hour			
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits		\$	31,194,000		\$ 34,728,000		\$ 41,796,000		\$ 63,001,000			
Access and Site Preparation		\$	12,018,000		\$ 12,018,000		\$ 12,018,000		\$ 12,018,000			
Cofferdams and Construction Water Management		\$	4,996,000		\$ 4,996,000		\$ 4,996,000		\$ 4,996,000			
Intake, Headrace, and Forebay		\$	12,608,000		\$ 16,810,000		\$ 25,215,000		\$ 50,431,000			
Dam Construction		\$	53,455,000		\$ 53,455,000		\$ 53,455,000		\$ 53,455,000			
Water Conveyance System		\$	762,000		\$ 1,016,000		\$ 1,524,000		\$ 3,047,000			
Powerhouse Construction		\$	27,837,000		\$ 37,116,000		\$ 55,674,000		\$ 111,349,000			
Switchyard and Transmission		\$	13,101,000		\$ 13,502,000		\$ 14,303,000		\$ 16,706,000			
<b>SUB-TOTAL</b>		<b>\$</b>	<b>155,971,000</b>		<b>\$ 173,641,000</b>		<b>\$ 208,981,000</b>		<b>\$ 315,003,000</b>			
EPCM Costs (8% of Subtotal)		\$	12,478,000		\$ 13,891,000		\$ 16,718,000		\$ 25,200,000			
Contingency (30% of Subtotal)		\$	46,791,000		\$ 52,092,000		\$ 62,694,000		\$ 94,501,000			
<b>TOTAL ESTIMATED OVERNIGHT CAPITAL COST</b>		<b>\$</b>	<b>215,240,000</b>		<b>\$ 239,624,000</b>		<b>\$ 288,393,000</b>		<b>\$ 434,704,000</b>			
ESTIMATED ANNUAL OPERATING COSTS												
			16-Hour		12-Hour		8-Hour		4-Hour			
Fixed Operating Costs (2% of Capital)		\$	4,305,000		\$ 4,792,000		\$ 5,768,000		\$ 8,694,000			
Variable Operating Costs (\$0.005/kWh)		\$	606,000		\$ 647,000		\$ 647,000		\$ 647,000			
<b>TOTAL ESTIMATED OPERATING COST</b>		<b>\$</b>	<b>4,911,000</b>		<b>\$ 5,439,000</b>		<b>\$ 6,415,000</b>		<b>\$ 9,341,000</b>			
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Jan	MWh		6,438		6,438		6,438		6,438			
Feb	MWh		1,826		1,826		1,826		1,826			
Mar	MWh		2,791		2,791		2,791		2,791			
Apr	MWh		5,272		5,272		5,272		5,272			
May	MWh		15,925		15,925		15,925		15,925			
Jun	MWh		17,300		19,976		19,976		19,976			
Jul	MWh		17,877		23,484		23,484		23,484			
Aug	MWh		17,131		17,131		17,131		17,131			
Sep	MWh		12,697		12,697		12,697		12,697			
Oct	MWh		10,686		10,686		10,686		10,686			
Nov	MWh		8,173		8,173		8,173		8,173			
Dec	MWh		5,067		5,067		5,067		5,067			
<b>ENERGY OUTPUT (AVERAGE)</b>	<b>GWh/yr</b>		<b>121.2</b>		<b>129.5</b>		<b>129.5</b>		<b>129.5</b>			
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Jan	MWh		8,316		8,316		8,316		8,316			
Feb	MWh		2,499		2,499		2,499		2,499			
Mar	MWh		2,931		2,931		2,931		2,931			
Apr	MWh		2,593		2,593		2,593		2,593			
May	MWh		13,133		13,133		13,133		13,133			
Jun	MWh		17,300		19,600		19,600		19,600			
Jul	MWh		16,199		16,199		16,199		16,199			
Aug	MWh		10,276		10,276		10,276		10,276			
Sep	MWh		5,558		5,558		5,558		5,558			
Oct	MWh		3,291		3,291		3,291		3,291			
Nov	MWh		2,179		2,179		2,179		2,179			
Dec	MWh		1,739		1,739		1,739		1,739			
<b>ENERGY OUTPUT (FIRM)</b>	<b>GWh/yr</b>		<b>86.0</b>		<b>88.3</b>		<b>88.3</b>		<b>88.3</b>			
CAPACITY AND ENERGY COST METRICS												
Metric	Units		16-Hour		12-Hour		8-Hour		4-Hour			
Capacity Cost, Dependable Capacity	\$/MW	\$	10,762,000		\$ 8,986,000		\$ 7,210,000		\$ 5,434,000			
Capacity Cost, Installed Capacity	\$/MW	\$	8,958,000		\$ 7,479,000		\$ 6,001,000		\$ 4,523,000			
Energy Cost (Average)	\$/GWh	\$	1,776,000		\$ 1,851,000		\$ 2,228,000		\$ 3,358,000			
Energy Cost (Firm)	\$/GWh	\$	2,502,000		\$ 2,713,000		\$ 3,265,000		\$ 4,922,000			

TABLE C33

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

NAHATLATCH RIVER

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BASIC SITE PARAMETERS												
Northing	N	-122.00	Catchment Area at Intake						km <sup>2</sup>	930		
Easting	E	49.90	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	52		
Region		Lower Mainland	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	34.6		
Estimated Footprint	ha	490										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	19.7	14.2	19.3	36.6	96.0	129.7	98.9	44.6	27.4	34.8	36.8	22.9
Firm (Low Flow)	9.7	7.0	9.1	20.4	68.2	103.6	48.4	29.0	24.5	26.9	46.2	21.7
DESIGN PARAMETERS												
			16-Hour		12-Hour		8-Hour		4-Hour			
Dependable Capacity		MW	20		27		40		80			
Installed Capacity		MW	84		84		84		84			
Gross Head		m	166		166		166		166			
Design Flow, Qd		m <sup>3</sup> /s	61		61		61		61			
MAD Multiplier at Qd			1.8		1.8		1.8		1.8			
Reservoir Storage Volume		m <sup>3</sup>	6,809,505		6,809,505		6,809,505		6,809,505			
Live Storage Volume		m <sup>3</sup>	1,776,000		1,776,000		1,776,000		1,776,000			
Dam Height at Minimum Operating Level		m	19		19		19		19			
Dam Height at Full Supply Level		m	20		20		20		20			
Dam Type			CFRD		CFRD		CFRD		CFRD			
Dam Crest Length		m	332		332		332		332			
Reservoir Surface Area		m <sup>2</sup>	1,059,000		1,059,000		1,059,000		1,059,000			
Penstock Length		km	5		5		5		5			
Transmission Line Length		km	63		63		63		63			
Access Road Length		km	1		1		1		1			
ESTIMATED CAPITAL COSTS												
			16-Hour		12-Hour		8-Hour		4-Hour			
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits		\$	60,357,000		\$ 60,357,000		\$ 60,357,000		\$ 60,357,000			
Access and Site Preparation		\$	18,427,000		\$ 18,427,000		\$ 18,427,000		\$ 18,427,000			
Cofferdams and Construction Water Management		\$	5,340,000		\$ 5,340,000		\$ 5,340,000		\$ 5,340,000			
Intake, Headrace, and Forebay		\$	10,043,000		\$ 10,043,000		\$ 10,043,000		\$ 10,043,000			
Dam Construction		\$	22,015,000		\$ 22,015,000		\$ 22,015,000		\$ 22,015,000			
Water Conveyance System		\$	64,107,000		\$ 64,107,000		\$ 64,107,000		\$ 64,107,000			
Powerhouse Construction		\$	86,951,000		\$ 86,951,000		\$ 86,951,000		\$ 86,951,000			
Switchyard and Transmission		\$	34,546,000		\$ 34,546,000		\$ 34,546,000		\$ 34,546,000			
SUB-TOTAL		\$	301,786,000		\$ 301,786,000		\$ 301,786,000		\$ 301,786,000			
EPCM Costs (8% of Subtotal)		\$	24,143,000		\$ 24,143,000		\$ 24,143,000		\$ 24,143,000			
Contingency (30% of Subtotal)		\$	90,536,000		\$ 90,536,000		\$ 90,536,000		\$ 90,536,000			
TOTAL ESTIMATED OVERNIGHT CAPITAL COST		\$	416,465,000		\$ 416,465,000		\$ 416,465,000		\$ 416,465,000			
ESTIMATED ANNUAL OPERATING COSTS												
			16-Hour		12-Hour		8-Hour		4-Hour			
Fixed Operating Costs (2% of Capital)		\$	8,329,000		\$ 8,329,000		\$ 8,329,000		\$ 8,329,000			
Variable Operating Costs (\$0.005/kWh)		\$	2,213,000		\$ 2,213,000		\$ 2,213,000		\$ 2,213,000			
TOTAL ESTIMATED OPERATING COST		\$	10,542,000		\$ 10,542,000		\$ 10,542,000		\$ 10,542,000			
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month	Units	16-Hour	12-Hour	8-Hour	4-Hour							
Jan	MWh	15,597	15,597	15,597	15,597							
Feb	MWh	12,476	12,476	12,476	12,476							
Mar	MWh	19,849	19,849	19,849	19,849							
Apr	MWh	36,433	36,433	36,433	36,433							
May	MWh	66,274	66,274	66,274	66,274							
Jun	MWh	60,420	60,420	60,420	60,420							
Jul	MWh	62,434	62,434	62,434	62,434							
Aug	MWh	45,863	45,863	45,863	45,863							
Sep	MWh	27,259	27,259	27,259	27,259							
Oct	MWh	35,850	35,850	35,850	35,850							
Nov	MWh	36,635	36,635	36,635	36,635							
Dec	MWh	23,510	23,510	23,510	23,510							
ENERGY OUTPUT (AVERAGE)	GWh/yr	442.6	442.6	442.6	442.6							
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month	Units	16-Hour	12-Hour	8-Hour	4-Hour							
Jan	MWh	9,629	9,629	9,629	9,629							
Feb	MWh	5,854	5,854	5,854	5,854							
Mar	MWh	9,330	9,330	9,330	9,330							
Apr	MWh	20,358	20,358	20,358	20,358							
May	MWh	66,274	66,274	66,274	66,274							
Jun	MWh	60,420	60,420	60,420	60,420							
Jul	MWh	49,751	49,751	49,751	49,751							
Aug	MWh	29,847	29,847	29,847	29,847							
Sep	MWh	24,364	24,364	24,364	24,364							
Oct	MWh	27,715	27,715	27,715	27,715							
Nov	MWh	45,954	45,954	45,954	45,954							
Dec	MWh	22,344	22,344	22,344	22,344							
ENERGY OUTPUT (FIRM)	GWh/yr	371.8	371.8	371.8	371.8							
CAPACITY AND ENERGY COST METRICS												
Metric	Units	16-Hour	12-Hour	8-Hour	4-Hour							
Capacity Cost, Dependable Capacity	\$/MW	\$ 20,805,000	\$ 15,604,000	\$ 10,402,000	\$ 5,201,000							
Capacity Cost, Installed Capacity	\$/MW	\$ 4,963,000	\$ 4,963,000	\$ 4,963,000	\$ 4,963,000							
Energy Cost (Average)	\$/GWh	\$ 941,000	\$ 941,000	\$ 941,000	\$ 941,000							
Energy Cost (Firm)	\$/GWh	\$ 1,120,000	\$ 1,120,000	\$ 1,120,000	\$ 1,120,000							

TABLE C34

BC HYDRO

SMALL STORAGE HYDRO REGIONAL ASSESSMENT

SHORTLISTED SITE DATA SHEET

SPUZZUM CREEK

Print: May/31/18 14:04:59

BASIC SITE PARAMETERS												
Northing	N	-121.53	Catchment Area at Intake						km <sup>2</sup>	159		
Easting	E	49.68	Estimated Mean Annual Unit Runoff						L/s/km <sup>2</sup>	43		
Region		Lower Mainland	Mean Annual Discharge (MAD)						m <sup>3</sup> /s	4.7		
Estimated Footprint	ha	120										
ESTIMATED MONTHLY FLOWS TO RESERVOIR/INTAKE (m <sup>3</sup> /s)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	4.1	2.6	3.5	7.8	20.5	19.2	7.4	2.2	3.5	1.6	6.2	4.1
Firm (Low Flow)	1.5	1.2	1.4	5.9	17.0	11.4	4.1	1.7	1.5	1.1	6.5	2.9
DESIGN PARAMETERS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Dependable Capacity			MW			20	27	40	80			
Installed Capacity			MW			30	30	40	81			
Gross Head			m			419	419	419	419			
Design Flow, Qd			m <sup>3</sup> /s			9	9	12	23			
MAD Multiplier at Qd						1.8	1.8	2.5	4.9			
Reservoir Storage Volume			m <sup>3</sup>			2,989,569	2,989,569	2,989,569	2,989,569			
Live Storage Volume			m <sup>3</sup>			990,000	990,000	990,000	990,000			
Dam Height at Minimum Operating Level			m			14	14	14	14			
Dam Height at Full Supply Level			m			18	18	18	18			
Dam Type						CFRD	CFRD	CFRD	CFRD			
Dam Crest Length			m			178	178	178	178			
Reservoir Surface Area			m <sup>2</sup>			199,000	199,000	199,000	199,000			
Penstock Length			km			10	10	10	10			
Transmission Line Length			km			10	10	10	10			
Access Road Length			km			10	10	10	10			
ESTIMATED CAPITAL COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Mob, Demob, Insurance, Bonds, Overhead, Contractor's Profits			\$			26,754,000	26,754,000	31,609,000	\$ 49,329,000			
Access and Site Preparation			\$			12,369,000	12,369,000	12,369,000	\$ 12,369,000			
Cofferdams and Construction Water Management			\$			761,000	761,000	761,000	\$ 761,000			
Intake, Headrace, and Forebay			\$			1,430,000	1,430,000	1,915,000	\$ 3,830,000			
Dam Construction			\$			7,940,000	7,940,000	7,940,000	\$ 7,940,000			
Water Conveyance System			\$			45,891,000	45,891,000	53,939,000	\$ 79,889,000			
Powerhouse Construction			\$			30,615,000	30,615,000	40,992,000	\$ 81,984,000			
Switchyard and Transmission			\$			8,009,000	8,009,000	8,521,000	\$ 10,541,000			
SUB-TOTAL			\$			133,769,000	133,769,000	158,046,000	\$ 246,643,000			
EPCM Costs (8% of Subtotal)			\$			10,702,000	10,702,000	12,644,000	\$ 19,731,000			
Contingency (30% of Subtotal)			\$			40,131,000	40,131,000	47,414,000	\$ 73,993,000			
TOTAL ESTIMATED OVERNIGHT CAPITAL COST			\$			184,602,000	184,602,000	218,104,000	\$ 340,367,000			
ESTIMATED ANNUAL OPERATING COSTS												
						16-Hour	12-Hour	8-Hour	4-Hour			
Fixed Operating Costs (2% of Capital)			\$			3,692,000	3,692,000	4,362,000	\$ 6,807,000			
Variable Operating Costs (\$0.005/kWh)			\$			781,000	781,000	856,000	\$ 1,069,000			
TOTAL ESTIMATED OPERATING COST			\$			4,473,000	4,473,000	5,218,000	\$ 7,876,000			
ENERGY OUTPUT UNDER AVERAGE FLOW CONDIONS												
Month		Units				16-Hour	12-Hour	8-Hour	4-Hour			
Jan		MWh				9,969	9,969	9,969	9,969			
Feb		MWh				5,161	5,161	5,161	5,161			
Mar		MWh				9,195	9,195	9,195	9,195			
Apr		MWh				19,548	19,548	19,548	19,548			
May		MWh				26,296	26,296	33,907	57,136			
Jun		MWh				21,731	21,731	29,098	48,374			
Jul		MWh				19,331	19,331	19,331	19,331			
Aug		MWh				5,761	5,761	5,761	5,761			
Sep		MWh				8,785	8,785	8,785	8,785			
Oct		MWh				4,256	4,256	4,256	4,256			
Nov		MWh				15,581	15,581	15,581	15,581			
Dec		MWh				10,654	10,654	10,654	10,654			
ENERGY OUTPUT (AVERAGE)		GWh/yr				156.3	156.3	171.2	213.7			
ENERGY OUTPUT UNDER MINIMUM (FIRM) FLOW CONDIONS												
Month		Units				16-Hour	12-Hour	8-Hour	4-Hour			
Jan		MWh				6,041	6,041	6,041	6,041			
Feb		MWh				1,817	1,817	1,817	1,817			
Mar		MWh				3,642	3,642	3,642	3,642			
Apr		MWh				14,913	14,913	14,913	14,913			
May		MWh				26,296	26,296	33,907	48,003			
Jun		MWh				21,731	21,731	28,769	28,769			
Jul		MWh				10,688	10,688	10,688	10,688			
Aug		MWh				4,347	4,347	4,347	4,347			
Sep		MWh				3,886	3,886	3,886	3,886			
Oct		MWh				2,871	2,871	2,871	2,871			
Nov		MWh				16,463	16,463	16,463	16,463			
Dec		MWh				7,502	7,502	7,502	7,502			
ENERGY OUTPUT (FIRM)		GWh/yr				120.2	120.2	134.8	148.9			
CAPACITY AND ENERGY COST METRICS												
Metric		Units				16-Hour	12-Hour	8-Hour	4-Hour			
Capacity Cost, Dependable Capacity		\$/MW		\$		9,230,000	6,923,000	5,453,000	\$ 4,255,000			
Capacity Cost, Installed Capacity		\$/MW		\$		6,116,000	6,116,000	5,397,000	\$ 4,211,000			
Energy Cost (Average)		\$/GWh		\$		1,181,000	1,181,000	1,274,000	\$ 1,592,000			
Energy Cost (Firm)		\$/GWh		\$		1,536,000	1,536,000	1,617,000	\$ 2,285,000			

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NOTES:

- VALUES PRESENTED ARE BASED ON CONCEPTUAL LEVEL DESIGN. ASSUMPTIONS MADE DURING THIS ASSESSMENT ARE NOTED IN THE ACCOMPANYING REPORT.
- ALL COST ESTIMATES FOLLOW AACE CLASS 5 ESTIMATE (-50% TO +100%)
- NO OPTIMIZATION HAS BEEN COMPLETED DURING THIS STUDY.

0	31MAY'18	ISSUED WITH REPORT VA103-647/1-1	SDR	KLA
REV	DATE	DESCRIPTION	PREP'D	RW'D