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**Sea to Sky Power Corporation**

Skookum Power Project  
Visual Quality Assessment of 138 kV Transmission  
Line

Conducted by

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# 1 Introduction

The Sea to Sky Power Corporation (SSPC) has proposed a run-of-the-river power generation facility to be located on Skookum Creek (Figure 1). The water intake facility would be located approximately 6 km further up Skookum Creek, and transferred through a buried penstock connecting the intake and the generation station. The electrical power generated at the installation would be transferred along a 138 kV single-pole 3-strings transmission line to the Cheekye Substation in the north end of Squamish, a distance of approximately 20km.

The expected routing of the line is shown in Figure 1 below. The line starts at the Skookum Power Project generation station at 49°43'14"N, 122°59'45"W, and travels westward approximately 7km, where it reaches the north-south right-of-way for existing BC Hydro 500 kV line 5L045. The new line will cross under the 500 kV line at this point, and then turn north, running adjacent to the west side of the BC Hydro ROW for about 10km. Then it will turn, heading southwest for approximately 3km along the south side of existing ROWs for 5L045 and the BC Hydro 230 kV line 2L002. It will terminate at the existing 138 kV/230 kV BC Hydro Cheekye Substation (CKY), passing to the south of the substation, so as to enter from the west (where existing BC Hydro 138 kV equipment is located). As the line approaches CKY, it will cross underneath 230 kV lines. Just outside of the substation, the line will be elevated to pass over top of the BC Hydro 69 kV lines. Where required, the 138 kV line will be buried.

SSPC requested that RDI Resource Design Inc (RDI) conduct a Visual Quality Assessment (VQA) of the proposed transmission line. For purposes of the VQA, three distinct line segments were identified, as shown in the following map (Figure 1).

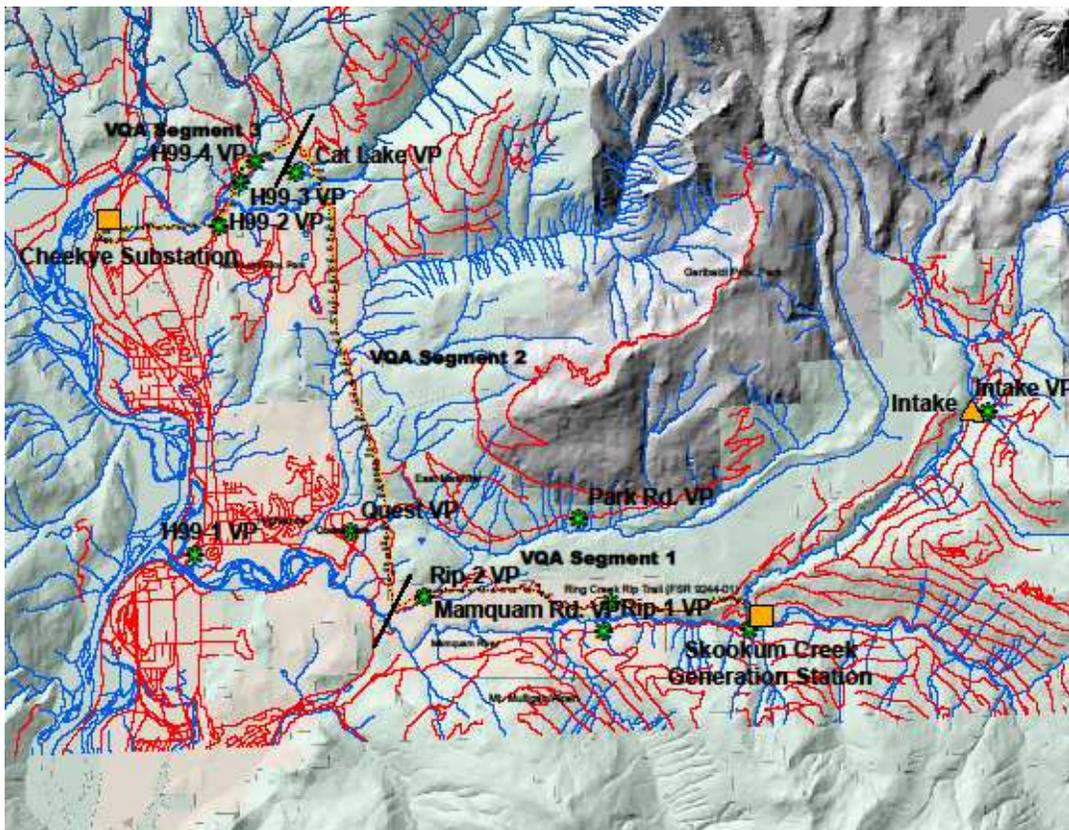


Figure 1. SSPC 138 kV transmission line location and the 3 VQA segments from Skookum Power Project generation station to Cheekye substation.

The VQA segments are further defined in the following table (Table 1).

Table 1. SSPC 138 kV Transmission line VQA Segments

<b>Line VQA Segment #</b>	<b>Transmission line VQA Segment Description</b>	<b>Transmission line VQA Segment Context</b>
<b>1</b>	<b>West from Skookum Creek to Mamquam River - Polepoints 1-70 (7 km approx.)</b>	<b>Remote/new; Garibaldi trail viewpoints; enters VSU 128 (Partial Retention VQO)</b>
<b>2</b>	<b>North from Mamquam River to Cat Lake - Polepoints 71-160 (9 km. approx.)</b>	<b>Parallel to/within existing BC Hydro T/L 5L045 - Highway 99 VP 1, Quest University / Cat Lake viewpoints - VSU 128 (Partial Retention VQO)</b>
<b>3</b>	<b>West from Cat Lake to Cheekye - Polepoints 161-207 (5 km approx.)</b>	<b>Parallel to existing BC Hydro T/Ls 5L045 and 2L002 - 3 Highway 99 crossings (VPs H99 2, 3, 4); VSUs 134, 131,140, 120 (Partial Retention VQO)</b>

The segments are shown separately in perspective views derived from the Google Earth KMZ model of the proposed transmission line produced by produced by Andritz Automation Ltd. using PLS-CAD (Figures 2-4).

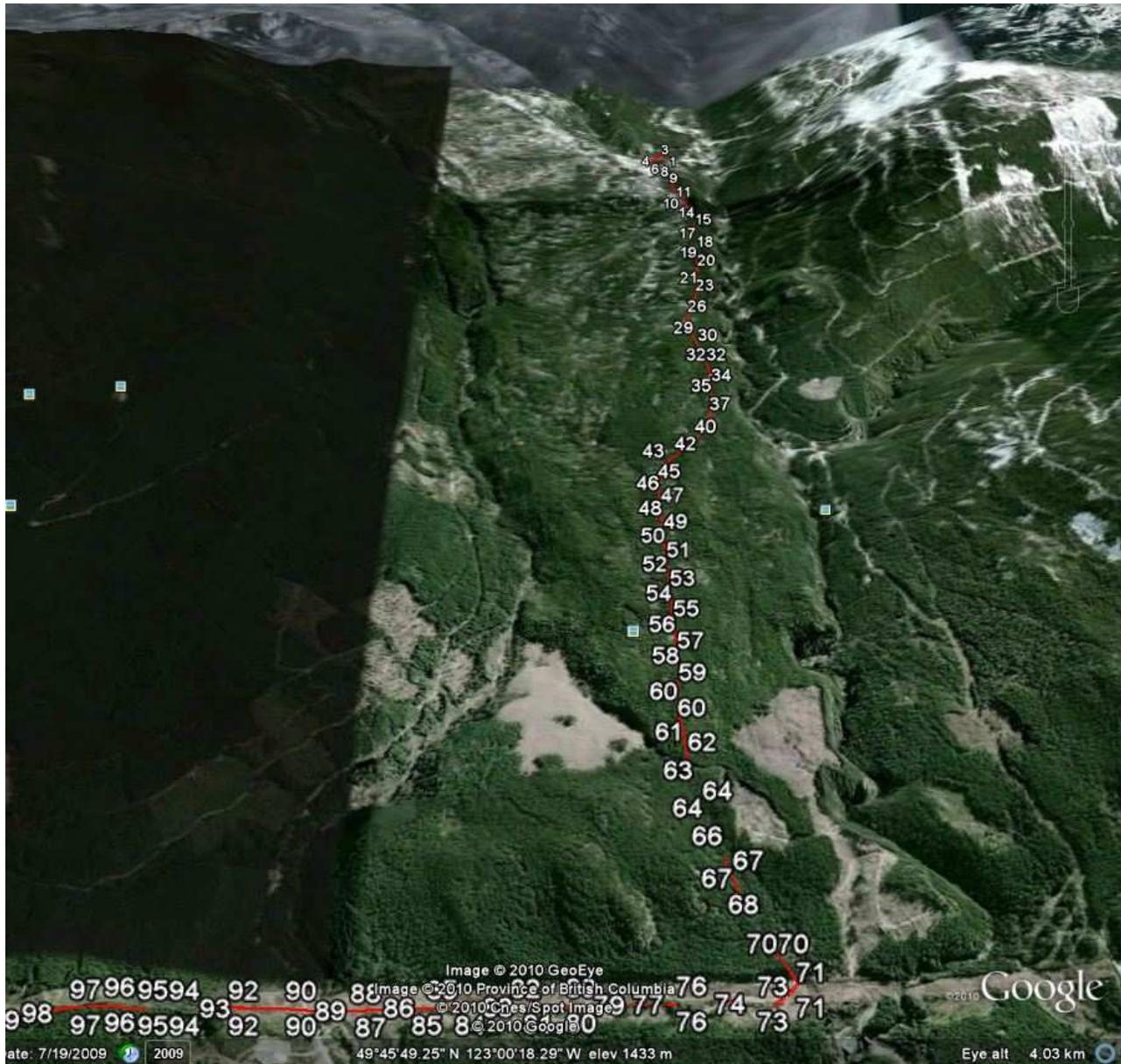


Figure 2. VQA Segment 1 looking east up the line near the Mamquam River to where it commences at the generation station (Polepoint 1) and traverses the lava flow to reach the bend at Polepoint 71 where the it turns north to run within the existing BC Hydro 5L045 ROW and then onto BC Hydro 2L002 ROW.

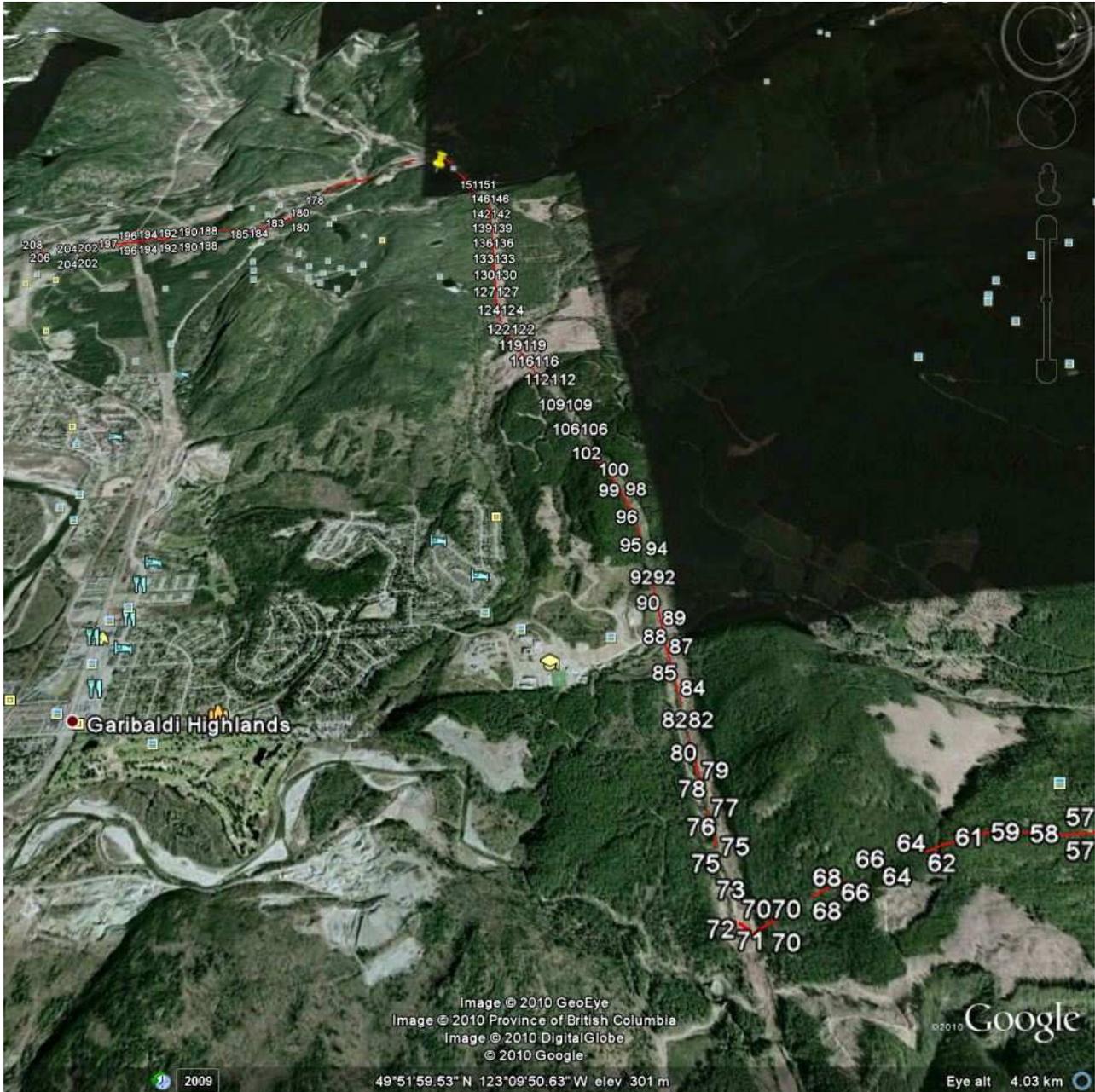


Figure 3. VQA Segment 2 looking north from Polepoint 71 where the proposed line travels parallel to the existing BC Hydro line 5L045 within the ROW east of Quest University (yellow mortarboard symbol) to the bend beyond Cat Lake (yellow push-pin).

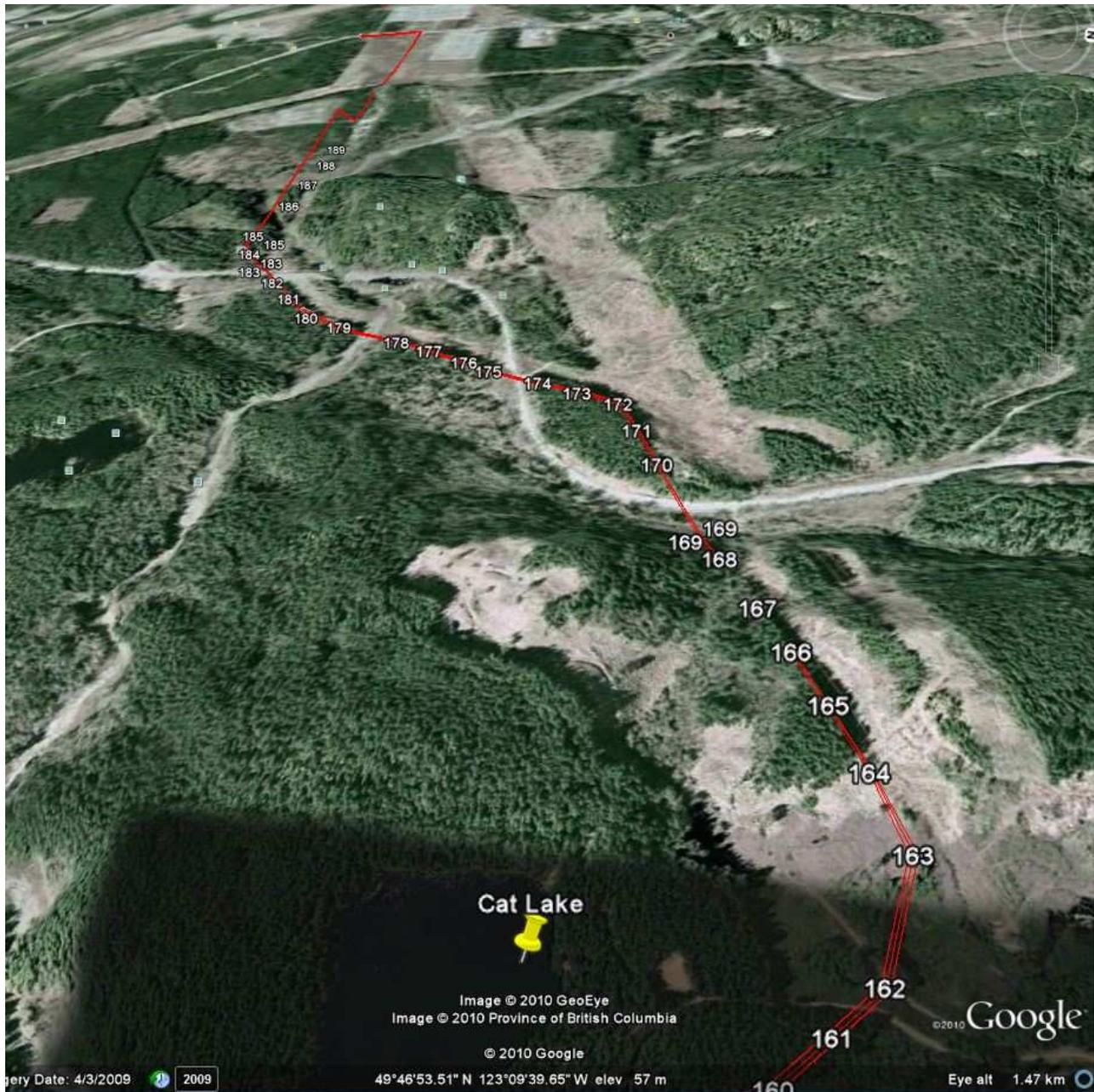


Figure 4. VQA Segment 3 looking west from Polepoint 160 where the proposed line travels parallel to the existing 500 kV BC Hydro line 5L045 and 230 kV BC Hydro line 2L002 past Cat Lake, crossing Highway 99, then parallels the existing small transmission line, crossing Highway 99 twice again before reaching the Cheekye substation (top of picture).

The intake, penstock and generation station are located outside of the municipal boundaries of the District Of Squamish boundary. Only the transmission line would enter the District boundary, in the "Limited Use" zone of the Official Community Plan (OCP), Schedule B - Land Use Map (Figure 5).

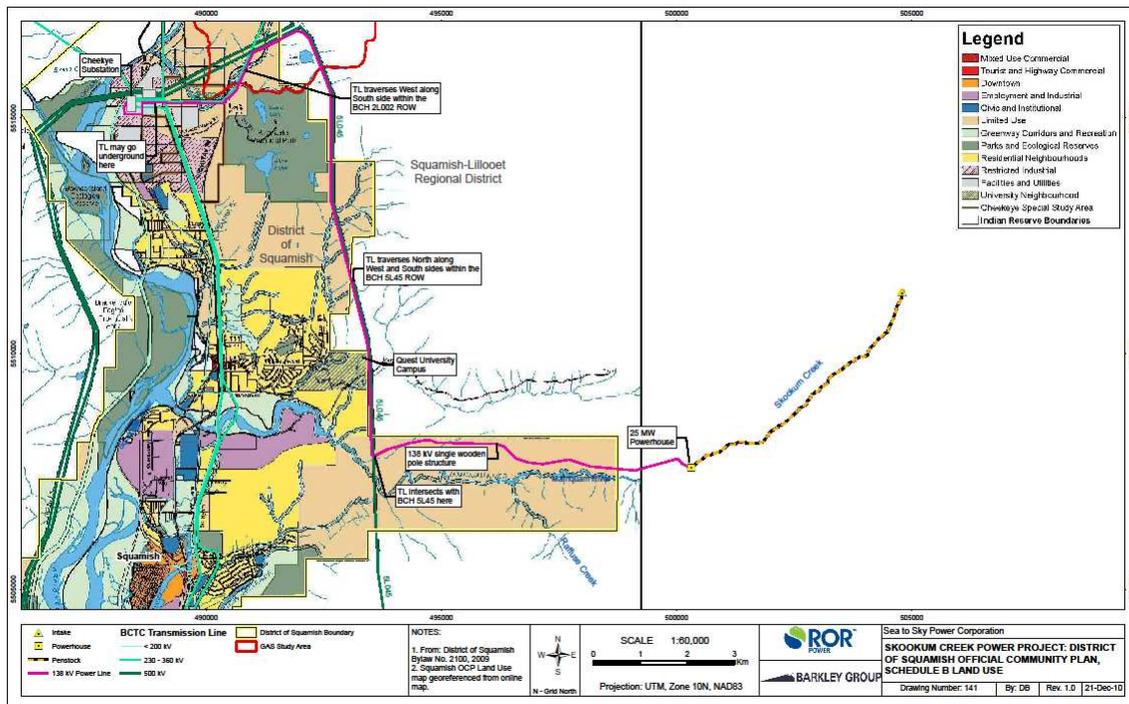


Figure 5. Squamish OCP Land Use Map showing 138 kV Skookum Power Project transmission line located partially within the "Limited Use" Zone (beige colour) within existing BC Hydro transmission lines 5L045 and 2L002 ROWs.

The District of Squamish OCP policy for Energy (Appendix 24-19) states:

*The District generally supports the development of low impact alternative and renewable energy sources, such as wind power, micro hydro, small-scale hydro, or run-of-the-river hydroelectric projects, subject to:*

- a. minimal impacts on recreational amenities
- b. limited visual impacts from all infrastructure and transmission lines
- c. minimal impacts on natural ecosystems, and,
- d. community consultation.

The OCP specifies trail networks which bring recreational intensity to the various transmission line segments (Figure 6).

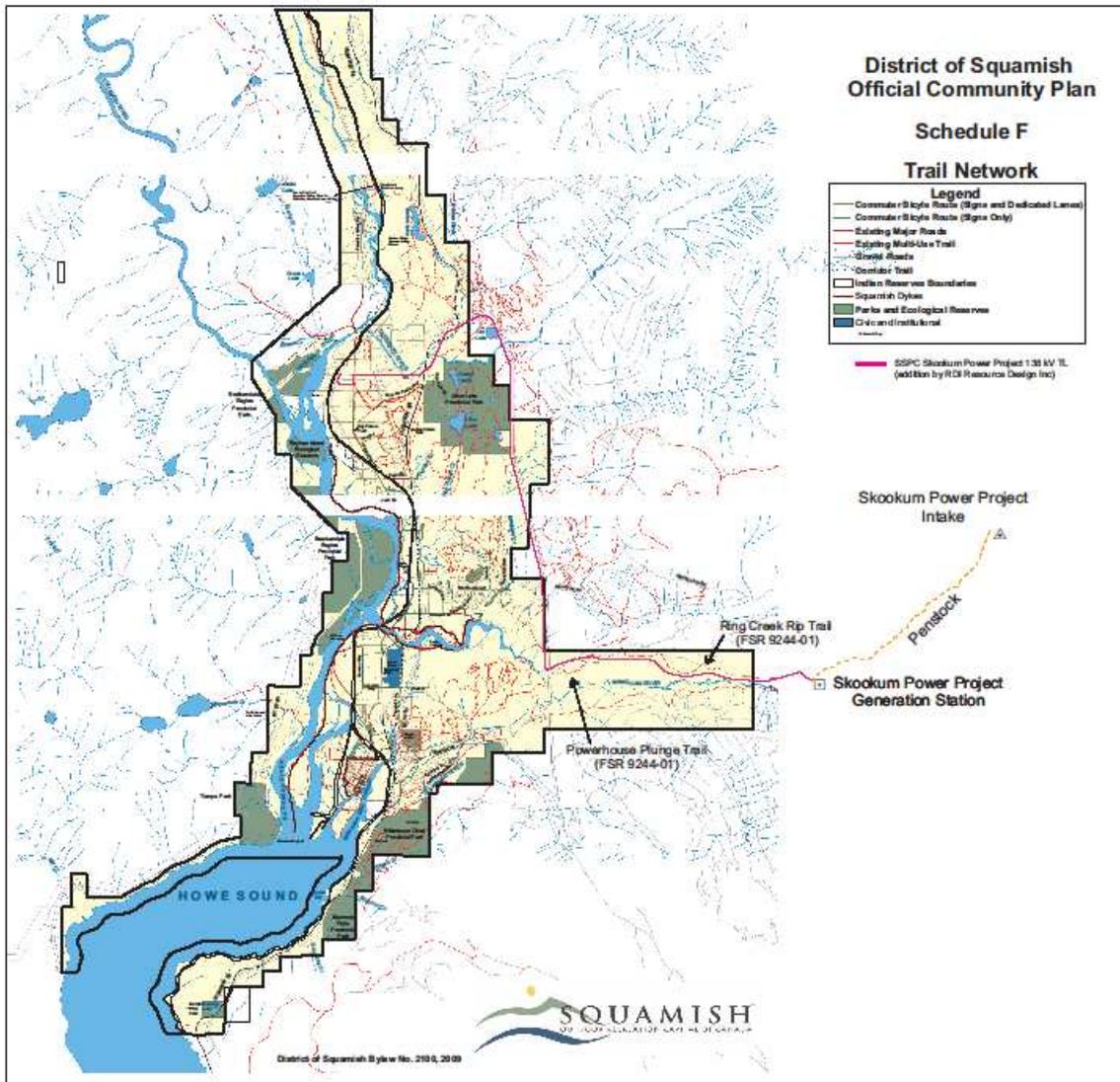


Figure 6. District of Squamish OCP Trails (Schedule F) with Ring Creek Rip and Powerhouse Plunge trails (FSR 9244-01) indicated relative to the 138 kV Skookum Power Project transmission line.

The Sea-to-Sky Land and Resource Management Plan (LRMP) High Summer Tourism Capability Maps and the Outdoor Recreation Council's proposed Tourism Zone maps also cover all of the proposed transmission line, including Segment 1. These maps are provided in the Squamish Mountain Bike Management Plan, produced for the Squamish Off Road Cycling Association (SORCA) by Cascade Environmental Resource Group, 2005. The report, obtained from the District of Squamish website, was a scanned document. Unfortunately, the file did not contain graphics of suitable quality for inclusion within this report.

In further consideration of visual quality, the Ministry of Forests, Mines, and Lands (MFML) provides specific guidelines and design suggestions for land-use alteration within what has been determined to be visually sensitive areas of Crown Land outside of parks (Bell, British Columbia. Recreation Branch. et al. 1994;

BCMoF 2001). The intended target of visual management guidelines is forest practices. Although transmission lines are outside of the jurisdiction of MFML, consideration of their guidelines has been endorsed by SSPC when planning the transmission line route.

The line would travel through a number of Visual Sensitivity Units as delineated in the Sea-to-Sky Frontcountry Visual Landscape Inventory (BCMoFR 2006):

VSU 128 -	4200 m
VSU 134 -	2200 m
VSU 140 -	340 m
<u>VSU 120 -</u>	<u>1780 m</u>
Total -	8520 m.

The map units are shown in Figure 7.

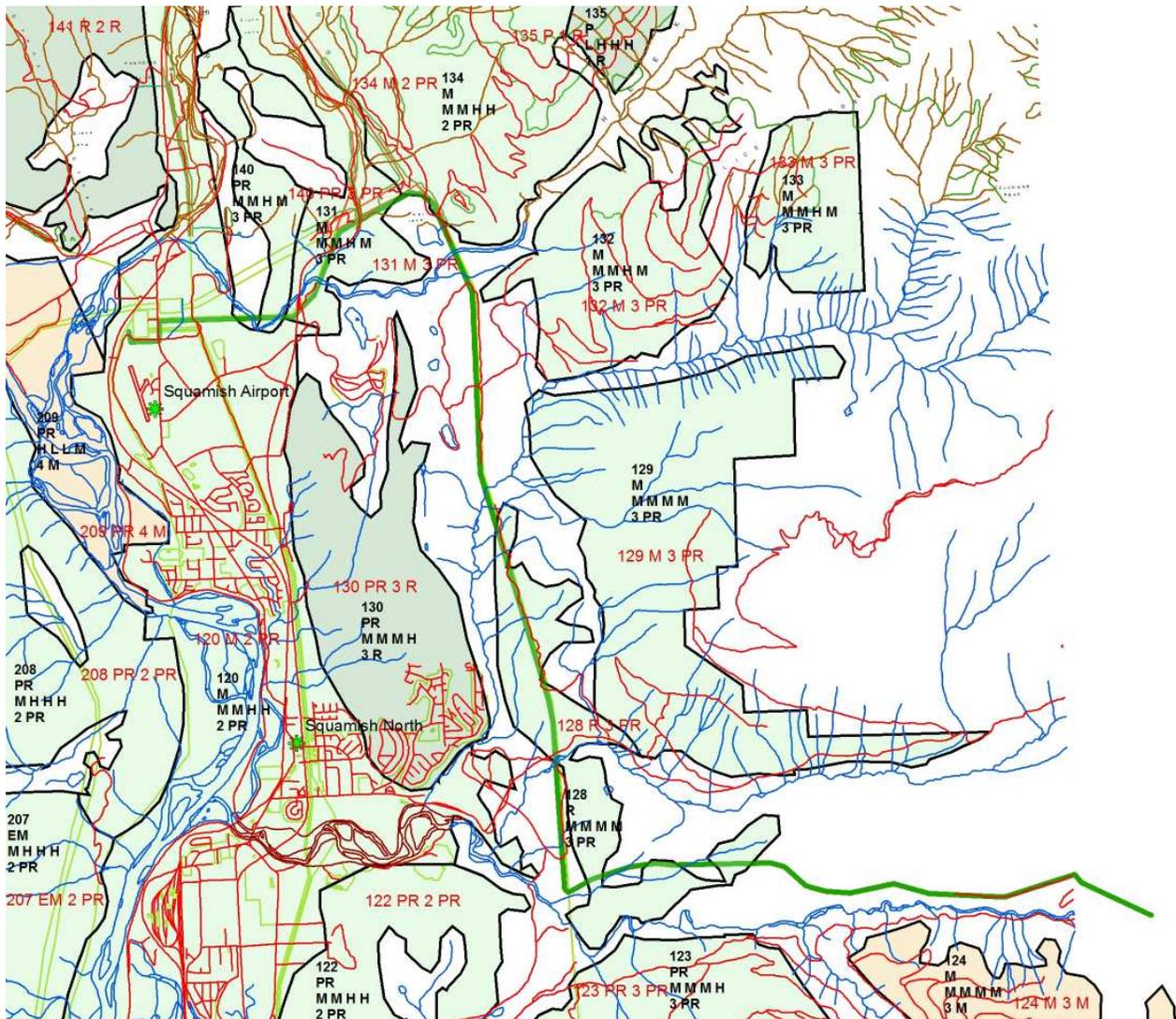


Figure 7. Visual Sensitivity Units related to the 138 kV Skookum Power Project transmission line, each with a Partial Retention VQO.

All of the VSUs were assigned the same Visual Quality Objective (VQO) of Partial Retention (PR). That VQO means "an alteration of a forest landscape (resulting from the presence of cutblocks or roads, etc) such that, when assessed from a viewpoint that is representative of significant public viewing opportunities, the alteration:

- (a) is easy to see,
- (b) is small to moderate in scale, and
- (c) has a design that appears natural and is not angular or geometric (BCMoFR 2008).

Electrical transmission lines require cleared rights-of-way (ROWs) for installation, maintenance and protection from surrounding tree hazards. Transmission lines are frequently seen along, or crossing, highways and near, or within, communities where they have become accepted or at least tolerated as a necessity of human dependence on electricity. The current presence of BC Hydro transmission lines within and around Squamish are likely an indication of that tolerance. Transmission lines in remote, natural areas are considered by some to be in conflict with recreational pursuits and park values. Transmission lines that are planned to meet Visual Resource Management<sup>1</sup> principles have a greater likelihood of acceptance than those that have not incorporated those principles.

Three-dimensional models of proposed electrical generation facilities (intake and generation station) were provided by SSPC for inclusion in the visualization. They will have a limited visual impact if they are able to be viewed (see Sec. 4; Figures 22 and 23).

The visual quality assessment of the transmission line required simulation of clearing corridors and pole and line structures along the route. A 3-dimensional model of the transmission pole and line structures was produced by Andritz Automation Ltd. using PLS-CAD, and converted to both a Google Earth KMZ (Figure 8)<sup>2</sup>.

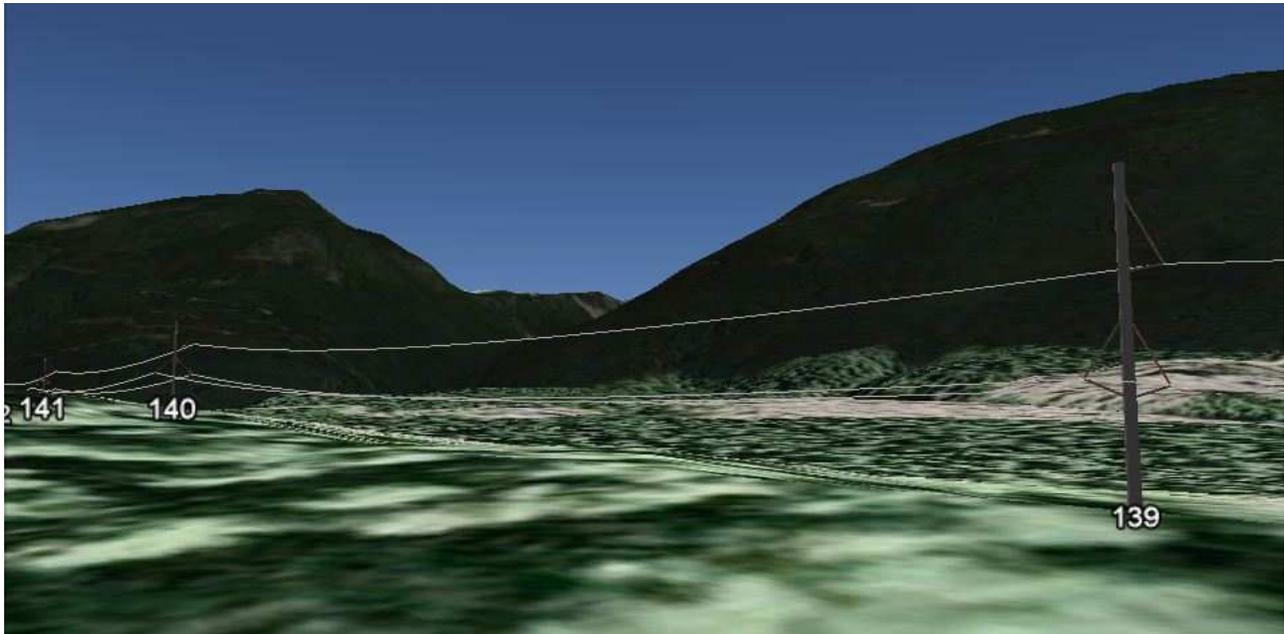


Figure 8. Google Earth KMZ image of 138 kV Skookum Power Project transmission line (PLS-CAD model by Andritz Automation Ltd.).

<sup>1</sup> Such as described in the 2004 BC Ministry of Forests' *Visual Landscape Design Training Manual*.

<sup>2</sup> The limitation of Google Earth is that it does not portray the effects of clearing rights-of-way through varying heights of existing land cover.

Portrayal of line clearings and pole placement and heights required the development of a 3-dimensional terrain model and an accurate portrayal of adjacent forest heights. Visualizations of the future visual quality of the proposed line were prepared using Visual Nature Studio 3 visualization software, with line and pole positioning provided by the SSPC 3-D transmission line file derived from the PLS-CAD model by Andritz for importation into the RDI visualization model (Figure 9).



Figure 9. Visual Nature Studio visualization of the SSPC 138 kV transmission line and 35m ROW clearing within existing BC Hydro 500 kV 5L045 ROW as would be seen from Quest University's main building area. Existing BC Hydro 500 kV transmission line pylon on hilltop in upper left of image to show comparative scale of the two transmission line structures. Tree heights derived from BC MFML VRI files.

The terrain was derived from BC TRIM. Vegetation Resources Inventory (VRI)<sup>3</sup> shapefiles provided the detailed land cover information. Terrain, vegetation, and transmission line files were imported into Visual Nature Studio to produce the surficial textures detailing existing land cover heights and approximate ROW clearing. The right-of-way was cleared to 35m width in the model, and poles and lines placed according to the DXF. Actual clearing widths will vary with adjacent vegetation heights and required span between poles. Retention of vegetation is anticipated along the ROW, thereby reducing visual contrasts. For comparison and demonstration, 45m structures were assigned to the existing BC Hydro 500 kV line which the proposed

<sup>3</sup> Ministry of Forest, Mines and Lands, Forest Analysis and Inventory Branch. Vegetation Resources Inventory.

line will parallel. Visualizations were produced from viewpoints along the routes. Google Earth and VNS aerial oblique views were prepared for orientation as they reveal the broader context of the lines including where they are obscured by intervening topography from the viewpoints. The SSPC 3-D transmission line file model exhibits some burying error (as shown in Figure 9 where the line travels up the hill on the left side of the image) due to differences between the terrain model used by Andritz to prepare PLS-CAD model and BC TRIM used to produce the VNS terrain model and simulations.

## 2 Analysis

Assessment of the three transmission line segments considered several visual influences:

1. Visual influence from primary / long duration / main highway viewpoints.
2. Visual influence from secondary / transitory viewpoints.
3. Population proximity (residential / institutional populations).
4. Visual influence in relation to existing transmission infrastructure.
5. Overall visual impact potential.

The assessment findings are presented in Section 3 and summarized in Table 2.

## 3 Findings

### 1. Visual influence from primary viewpoints.

The BC MFML Visual Landscape Inventory (VLI) (BCMoF 1997) records and rates visual sensitivity units as determined from main travel corridors (in this case, Highway 99) (Figure 10).

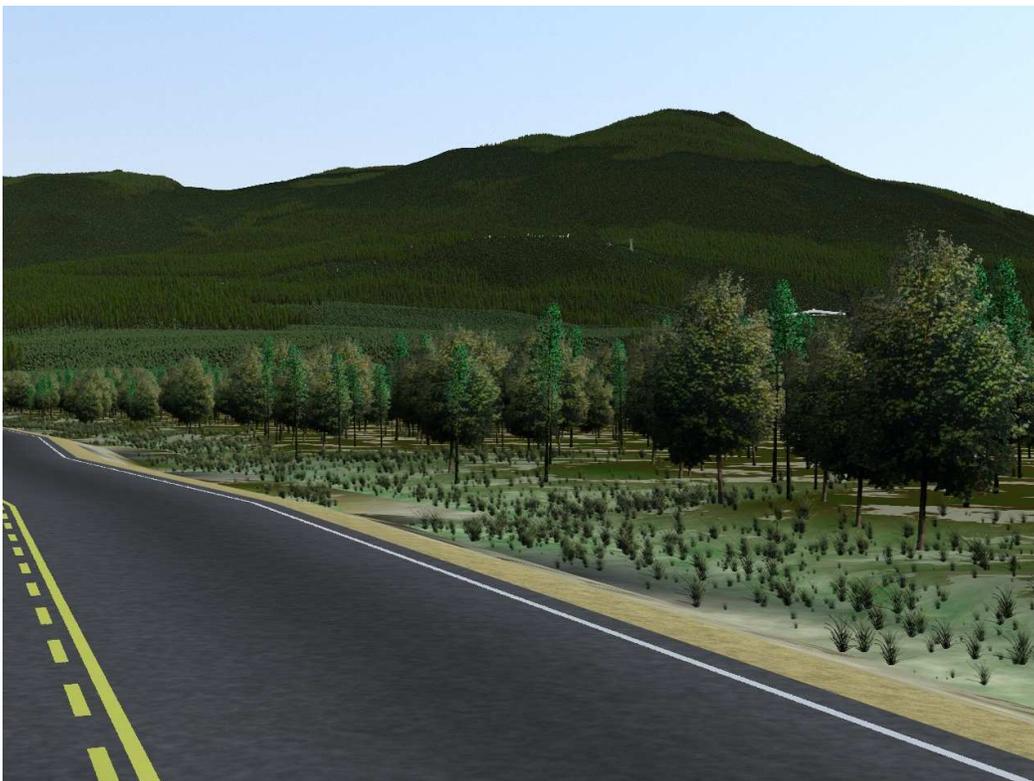


Figure 10. View towards location of the SSPC 138 kV transmission line next to the 500 kV BC Hydro transmission line 5L045 as potentially, but barely, seen from Highway 99 (viewpoint H99-1 VP) near Squamish Valley Golf and Country Club. BCH tower in view on hill near Quest University at centre of image.

The presence of the SSPC 138 kV transmission line in the VLI does not necessarily indicate it will be seen in distant views from Highway 99 such as from viewpoint H99-1 VP. The visibility of the line has been exaggerated in this view in Figure 10 for demonstration purposes, but will be barely seen, if at all. If so, it would be subordinate to the existing 500 kV BCH line.

The SSPC 138 kV transmission line will make three crossings of Highway 99 where there are already two BC Hydro transmission lines (5L042 and 5L045) crossing the highway immediately adjacent to each other, and one 230 kV line (2L002) crossing the highway nearby, seen from viewpoints H99-2, H99-3, and H99-4. Exposure would be very brief while travelling at highway speed over a 1500 m section of the highway (Figure 11). Right-of-way clearing is expected to be minimal alongside the highway.



Figure 11. Proposed SSPC 138 kV transmission line crossing of Highway 99, looking north.

Two 500 kV BC Hydro transmission lines also cross the highway in that area, as well as the BCH 230 kV line 2L002. The following photo shows the BCH 230 kV line 2L002 crossing the highway (Figure 12).



Figure 12. Existing BC Hydro 230 kV line 2L002 crossing Highway 99 (viewpoint H99 VP1) looking Southwest.

## 2. Population Proximity (residential / institutional populations).

Population proximity is primarily limited to existing/potential views from Quest University and the Highlands towards Segment 2 (shown previously in Figure 9). The SSPC 138 kV transmission line will be subordinate to the BC Hydro 500 kV line seen currently in east views from university buildings and grounds from viewpoint Quest VP (Figure 13). Additional visual impact is expected to be minor.



Figure 13. Photo of existing BC Hydro 500 kV 5L045 transmission line seen from Quest University near viewpoint Quest VP (RDI 2007 photo).

The Google Earth KMZ image from the University from near viewpoint Quest VP provides further evidence of the limited scale of visual impact anticipated from the proposed new transmission line (Figure 14).

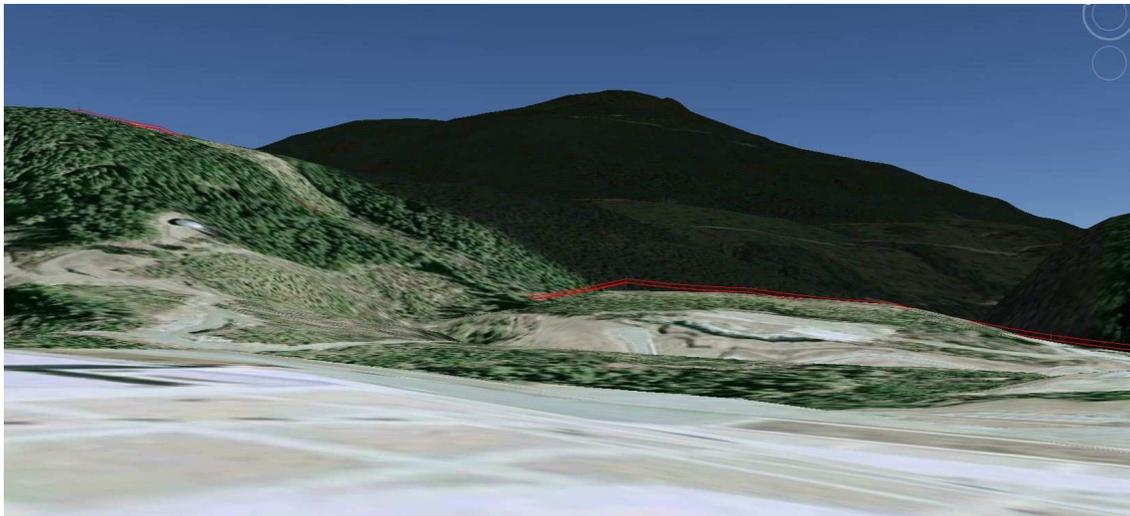


Figure 14. Google Earth KMZ of SSPC 138 kV transmission line as viewed from Quest University main building area (viewpoint Quest VP). The line (in red) will be visible as it climbs the hill within the existing BC Hydro 500 kV line 5L045 ROW, but the coarseness of the terrain used in the KMZ has obscured it.

As well, there is some residential development in the Cheekye area near the Squamish Valley Road, and the airport. This area is where many BC Hydro lines converge at the substation, therefore it is expected that additional impact from the proposed, smaller lines and poles will be very minor, if noticed at all.

### **3. Visual influence from secondary viewpoints.**

Secondary viewpoints include secondary roads and places where people spend time for recreation. A notable recreation feature is Cat Lake (Segment 2). A trail provides access around the lake, and, from there, to Brohm Ridge, crossing the existing and proposed transmission lines. From the west shore (viewpoint: Cat Lake), 2 metres above the lake, views are intermittent through the trees towards the proposed line (Figure 15, top view) along with the existing BC Hydro 500 kV line. The proposed line will be subordinate to the existing line, and will travel mainly behind the tree cover around the edge of the lake. The visibility of the line is reduced at the dock further north on the west side of the lake (Figure 15, bottom view).

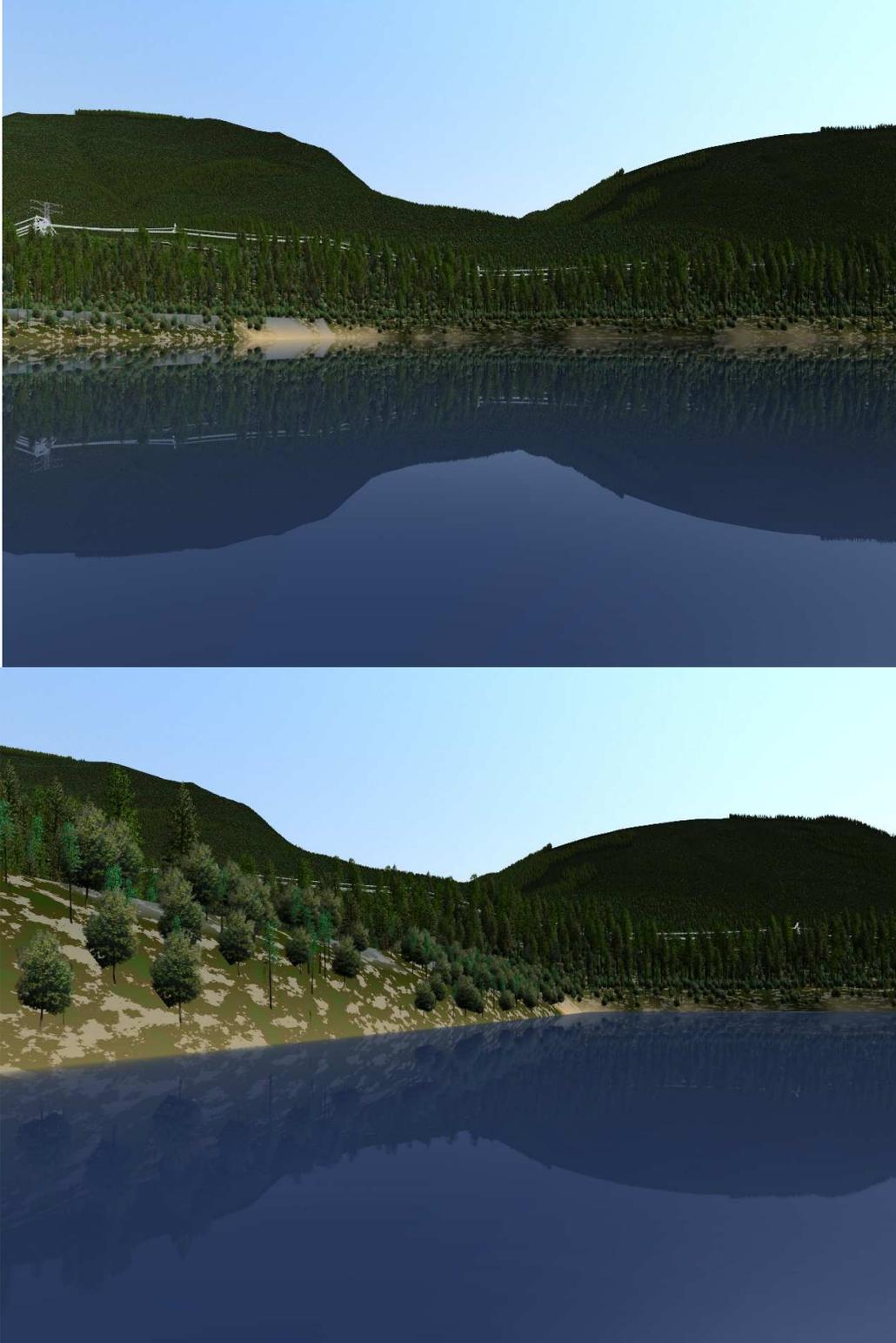


Figure 15. Simulated views of proposed transmission line from west side of Cat Lake (top), with darker, larger pylon of existing BC Hydro 500 kV 5L045 transmission line placed for scale comparison purposes, and from dock on northwest shore of lake (bottom view). Both views are at 314m elevation, 2m above lake level.

Secondary roads/trails will also come in close proximity to the line, namely the Garibaldi Park Road where it crosses Segment 2 of the proposed line along with the existing line, Segment 3 from the Squamish River Road near the Cheekye substation, and Segment 1 potentially from Garibaldi Park Road where it climbs the switchbacks (viewpoint: Park Road, Figure 16).



Figure 16. View towards SSPC 138 kV transmission line in Segment 1 from Garibaldi Park Road (viewpoint: Park Road). Visibility and contrast have been exaggerated for ease of interpretation.

Somewhat distant viewing opportunity will be possible along limited portions of the Mamquam FSR (viewpoint: Mamquam Road, Figure 17).



Figure 17. View potential towards SSPC 138 kV transmission line from limited parts of the Mamquam FSR (viewpoint: Mamquam Road).

Trails such as the Ring Creek Rip trail (viewpoint: Rip 1) and Powerhouse Plunge trail (viewpoint: Rip 2), both situated on FSR 9244-01, will bring recreationists such as mountain bikers close to and/or cross over the transmission line route in several places (see Key Map, Figure 1 of Squamish OCP Schedule F). To provide some understanding of the potential interaction of the trails with the line, the sequence of Segment 1 line sections is presented in Figures 18-21, showing the line in relation to the trails. Starting at the Skookum Power Project generation station at the end of the Ring Creek Rip trail (Figure 18; viewpoint: Generation Station), the line closely hugs the north side landforms of the Mamquam River (Figures 19, 20), avoiding the Old Growth Management Areas, until descending between two recent clear-cut above the existing transmission line (Figure 21). The KMZ model shows some burying of the lines due to terrain model/Google Earth differences. The visual influence of the line structures and right-of-way clearing will present a change in visual experience, with openness and more day-lighting where the transmission line crosses FSR 9244-01 (Ring Creek Rip trail), providing intermittent, varying awareness of the structures along the length of the trail.

The Ring Creek Rip and Powerhouse Plunge trails will cross the proposed transmission line route in 7 locations, at polepoints 3, 4 (Figure 18), 27, 33-35 (Figures 19, 20), and 60 (Figure 21). In several other locations, the trails will come close, but not cross, as at polepoints 10 and 13 (Figure 18), polepoints 18 and 22-23 (Figure 19) and at polepoint 61 (Figure 21).



Figure 18. Google Earth KMZ of SSPC 138 kV transmission line in VQA Segment 1, Polepoints 1-14, from the proposed Skookum Power Project generation station (Polepoint 1) showing location of Ring Creek Rip trail (FSR 9244-01) switchbacks (blue line).

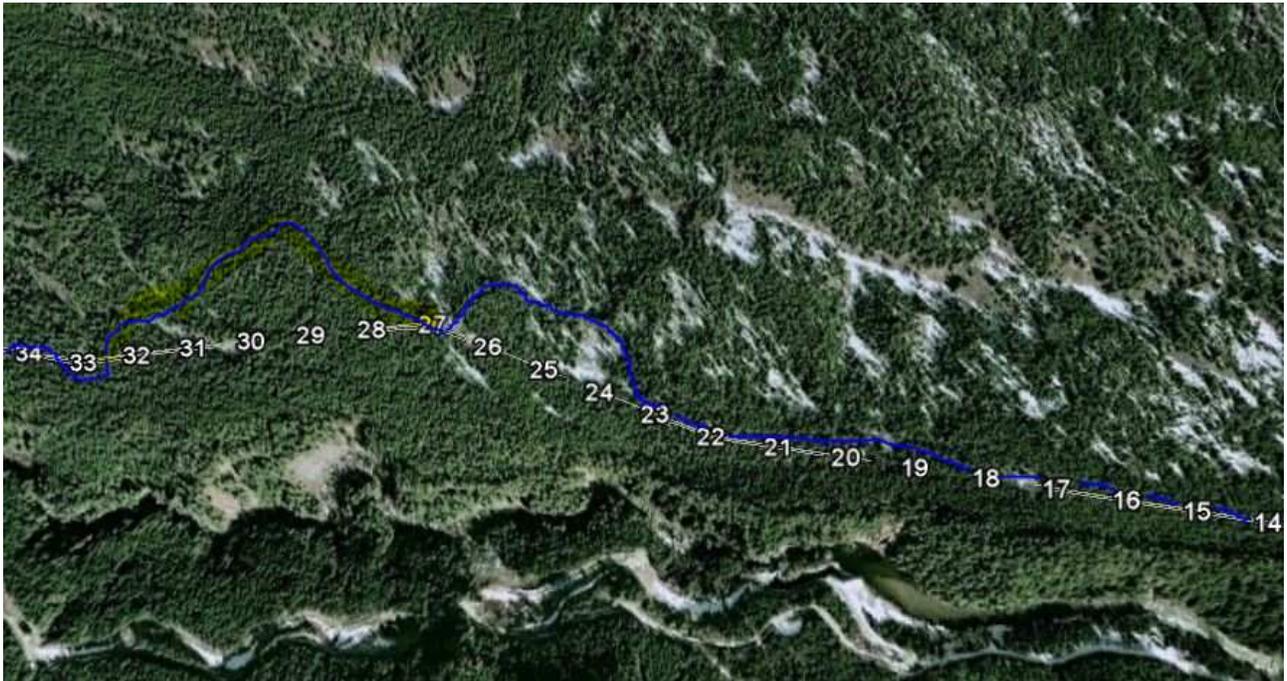


Figure 19. Google Earth KMZ of SSPC 138 kV transmission line in VQA Segment 1, Polepoints 14-34, intermittently overlapping Ring Creek Rip trail (FSR 9244-01) (blue line).

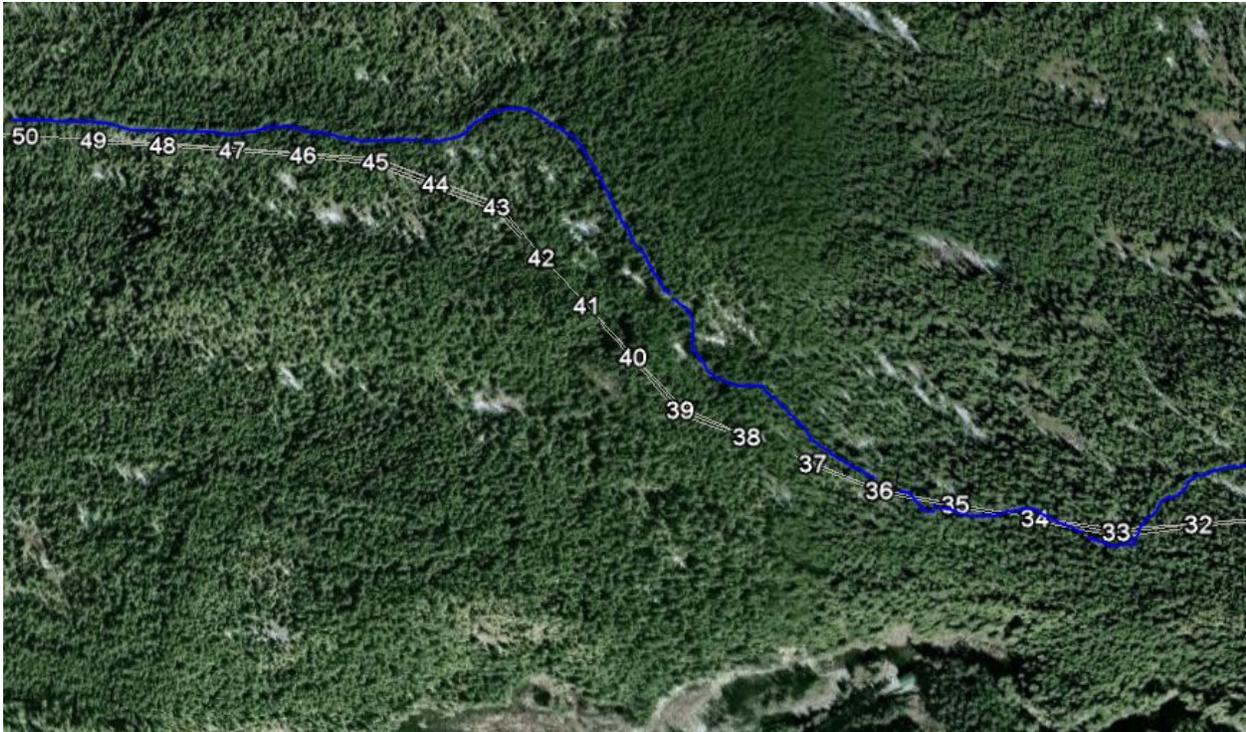


Figure 20. Google Earth KMZ of SSPC 138 kV transmission line in VQA Segment 1, Polepoints 32-50, intermittently overlapping Ring Creek Rip trail (FSR 9244-01) (blue line).

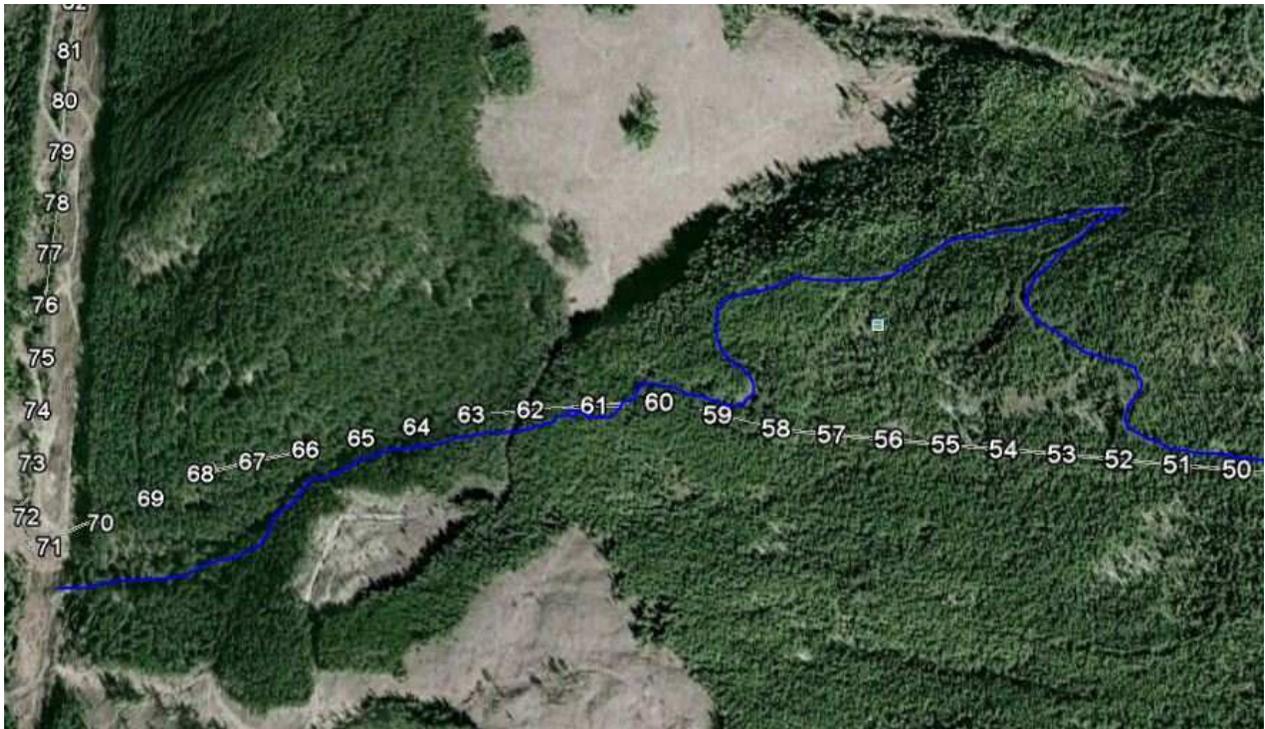


Figure 21. Google Earth KMZ of SSPC 138 kV transmission line in VQA Segment 1, Polepoints 50-71, with crossing of the Ring Creek Rip and Powerhouse Plunge trails (FSR 9244-01) (blue line), reaching Ring Creek Falls (Powerline) trail.

#### 4. Skookum Power Project Intake Facility and Generation Station Visual Simulations

For purposes of examining the visual effects of the intake facility and generation station, a high resolution Visual Nature Studio was prepared using the 1m terrain provided by Gygax Engineering Associates, along with the forest cover used in the transmission line model. Three-dimensional models of the intake and generating station, produced by Boullard Illustrations, were inserted into the high resolution Visual Nature Studio Model.

An aerial view of the intake structure provides a sense of the structure in the landscape (Figure 22). The intake facility will be inaccessible (restricted access only).

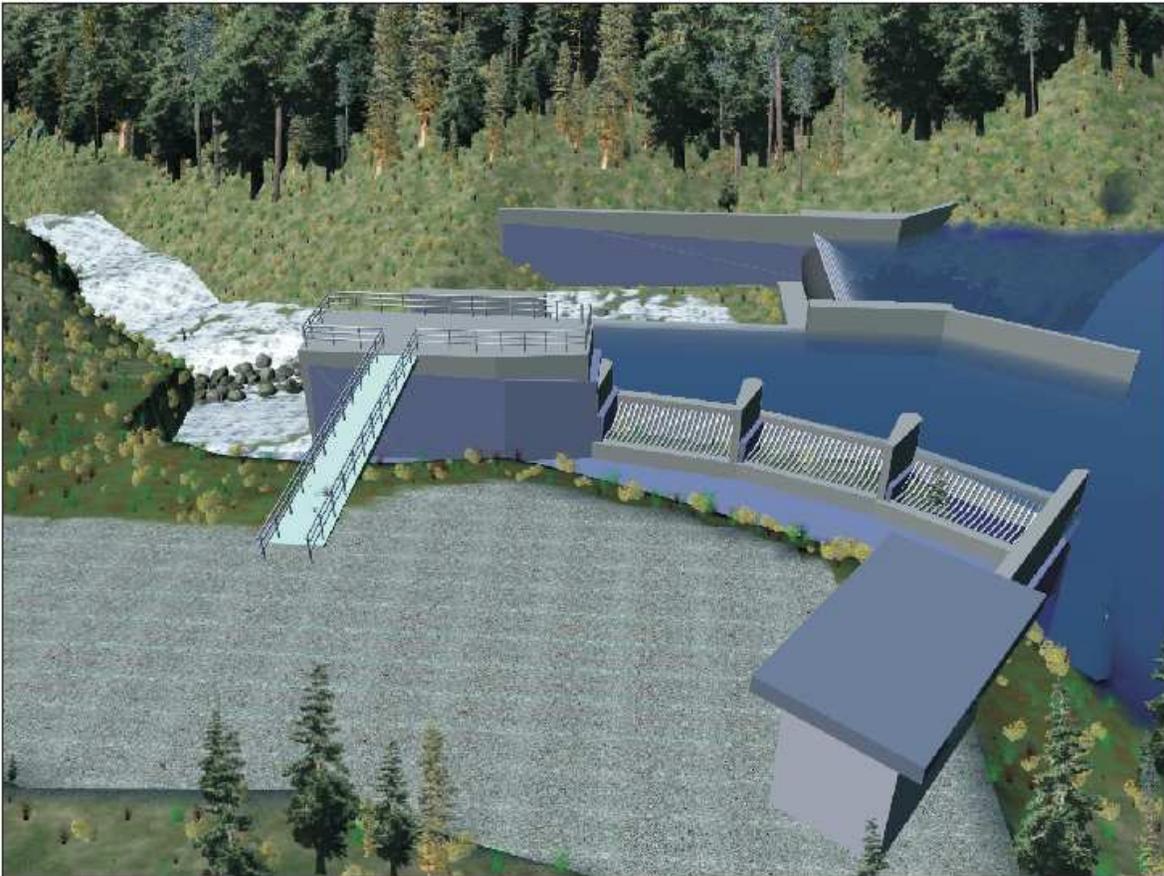


Figure 22. VNS aerial view simulation of the Skookum Power Project intake facility (no road access).

A view from the existing bridge just below the generation station was produced in VNS to provide a sense of the structure from that location (Figure 23).



Figure 23. VNS simulation of the Skookum Power Project generation station as seen from the bridge on Skookum Creek downstream.

## 5. Overall Visual Impact Potential

Segment 1 of the SSPC 138 kV transmission line will be directly evident from the Ring Creek Rip and Powerhouse Plunge trails (FSR 9244-01) where they intersect with, or provide close views of, the line. The SSPC generation station will be possible where the north end of the Ring Creek Rip trail (FSR 9244-01) connects to the road and bridge crossing Skookum Creek. As access will be restricted access at the intake facility, there will no likely visual impact of the facility to the the general public. The penstock linking the intake and the generation station will be buried (where possible) alongside the existing access road.

Segments 2 and 3, will be visible from points along Highway 99, other roads, and Quest University. By its specifications, the line will be visually subordinate where seen in conjunction with the existing BC Hydro infrastructure. The proposed line will meet the OCP policy 24-19 of limited visual impacts, and the MFML Visual Quality Objective of Partial Retention in each of the 5 VSUs in which the line would be located.

The assessment findings are summarized in Table 2.

Table 2. Summary of Visual Quality Assessment Findings.

	<b>Segment 1</b>	<b>Segment 2</b>	<b>Segment 3</b>
<b>1. Primary Viewpoints</b>	Distant - highway view potential - VSU 128. No anticipated visual change in VSU.	Distant - highway view potential - VSU 128. Very minor/no visual change in VSU.	Immediate views of Highway 99 crossings together with BC Hydro 500 kV T/L's 5L045 and 5L042 and BCH 230 kV TL 2L002 in VSU 131. Minor additional change in VSU.
<b>2. Population Proximity Viewing</b>	n/a	Highlands / Quest University concentrations. Minor additional visual change in VSU.	Small population at Cheekye / Squamish Airport near to substation; Existing BC Hydro T/L's 5L030, 5L032, 5L042, 5L045, 2L001, 60L070, 1L031, 2L009, 2L013, 2L0135, 2L002. Very minor additional visual change in VSUs 140 and 120.
<b>3. Secondary Viewpoints</b>	Ring Creek Rip and Powerhouse Plunge trails (FSR 9244-01) in close association. Apparent visual change at crossings (7) and where trails are close. Minor/no visual change anticipated in distant views from Garibaldi Park Road and Mamquam FSR Road. Close views of the generation station from Skookum Creek Bridge (apparent visual change).	Cat Lake (Recreation Site) provides close view of SSPC TL and BCH 500 kV 5L045 lines. SSPC lines subordinate to BCH in height and prominence. Minor additional visual change. Garibaldi Park Road near Quest University will provide views of both existing BCH 5L045 and SSPC TLs. Minor additional visual change in VSU.	Squamish Valley Road passing by BC Hydro substation; 3 main T/Ls. Existing BC Hydro T/L's 5L030, 5L032, 5L042, 5L045, 2L001, 60L070, 1L031, 2L009, 2L013, 2L0135, 2L002. Very minor additional visual change in VSUs 140 and 120.
<b>4. Overall visual impact potential</b>	Direct visual influence on trail experience. Project meets VQO of Partial Retention.	Minor visual influences - subordinate to existing BC Hydro line. Project meets VQO of Partial Retention.	Minor visual influences - subordinate to existing BC Hydro lines and infrastructure. Project meets VQO of Partial Retention.

## 4 Conclusions and Recommendations

Based on the 4 criteria used for Visual Quality Assessment, the SSPC Skookum Power Project transmission line is considered acceptable in consideration of District of Squamish's OCP Energy Policy which is supportive of projects with minimal visual quality issue/concerns, based on known viewing opportunities, trail use, and in relation to BC MFML's established Visual Quality Objectives, the Sea-to-Sky LRMP High Summer Tourism Capability Tourism Zone / ORC proposed maps, and inconsideration of the Squamish Mountain Bike Management Plan (Cascade Environmental Resource Group, 2005). SSPC is currently engaged in Agency and stakeholder consultation to address recreationist and trail user groups concerns.

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