



Visual Quality Analysis of Silviculture Treatment Options in the Capilano Watershed

**Analysis Report, Management Plan No. 5
Greater Vancouver Water District
Watershed Management Division**

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Contents

1.0 Introduction	3
2.0 Current Visual Landscape Condition	3
2.1 Viewpoints and Visual Sensitivity Identification	3
2.2 Landscape Inventory Classification	4
3.0 Silviculture Treatment Options	7
3.1 Option A.....	7
3.2 Option B.....	7
3.3 Option C.....	8
4.0 Computer Visualization Methodology and Procedures	8
4.1 Viewpoints.....	8
4.2 Simulation Procedures	8
4.3 Simulation Results	8
5.0 Findings.....	12
6.0 Conclusions	14

**Key Map of Capilano Watershed
with Visual Sensitivity Units and
Silviculture Treatment Options**

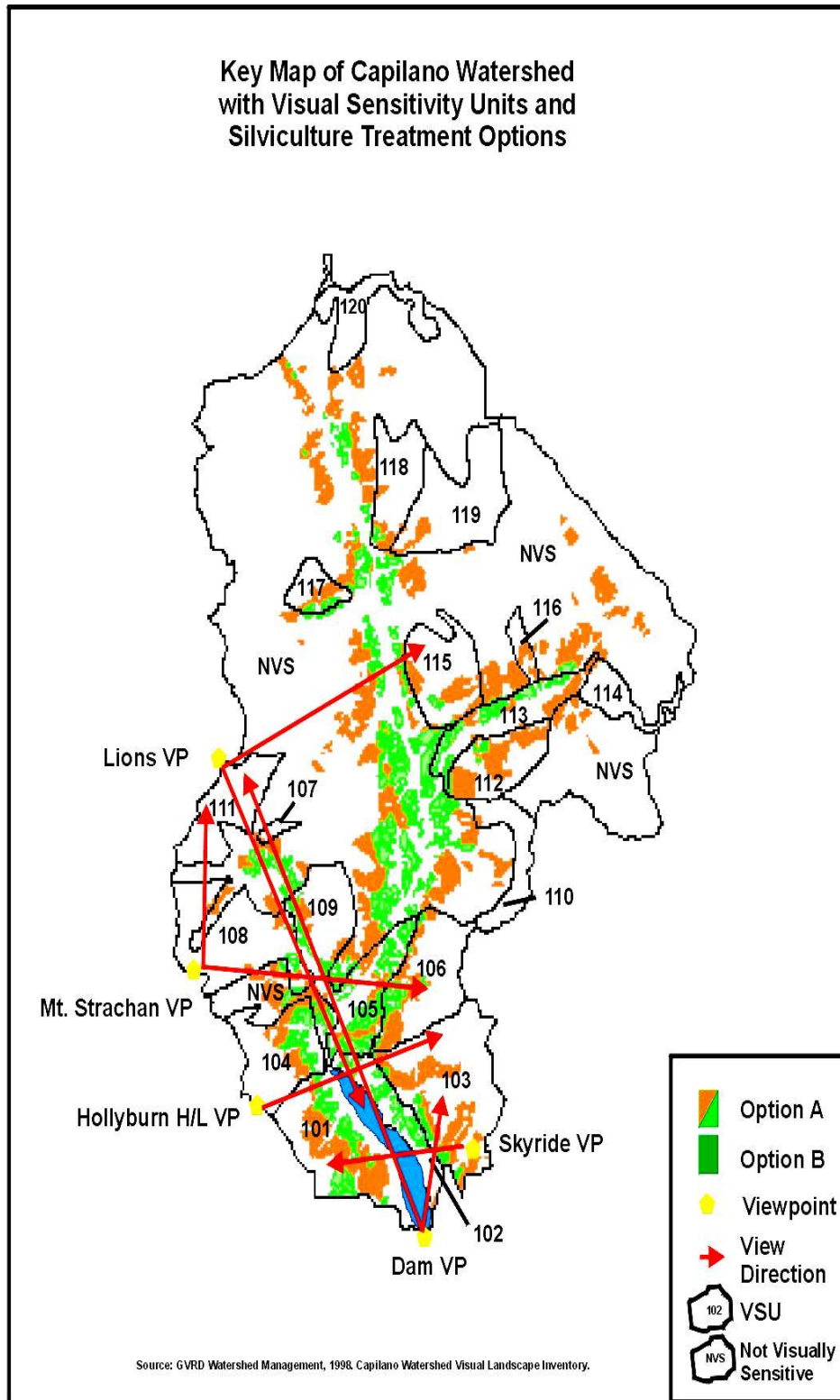


Figure 1. Key Map

1.0 Introduction

The Watershed Management Division of the Greater Vancouver Water District (GVWD) has conducted a study of silviculture treatment options in the Capilano Watershed that could benefit the quality of water delivered to the water supply system.¹ Resource Design Inc was requested to provide a visual quality analysis of the options. The objective of the visual quality analysis was to provide a process by which visual change in the landscape that would be potentially introduced by each of the three silviculture treatment options could be assessed, and compared with existing visual conditions as a baseline measure of quality.

The analysis applied visual impact assessment procedures according to guidance established under the Forest Practices Code of British Columbia.² The influence of visible change was determined for each silviculture treatment option using computer visualization to provide a future look at visual conditions resulting at year 20 of the treatment options.

An understanding of existing visual conditions (EVCs) was provided in the Visual Landscape Inventory that was conducted by the GVRD Watershed Management Division in 1998, using Ministry of Forests' standards.³ The viewpoints that were identified in the visual landscape inventory were used for computer visualization and subsequent visual quality predictions and analysis.

2.0 Current Visual Landscape Condition

The Ministry of Forests' Visual Landscape Inventory process provides information about the visual condition, characteristics and sensitivity to alteration of areas and travel corridors on provincial Crown land throughout British Columbia. Following the procedures manual, key viewpoints are selected based on use and viewing opportunity, the extent of visibility recorded from each viewpoint, and ratings assigned regarding existing visual conditions and visual sensitivity through completion of checklists.

The results for the Capilano Watershed are provided on the Visual Landscape Inventory map which is a component of the GVRD Capilano Watershed resource database. The visible landscape was delineated during the inventory process into Visual Sensitivity Units (VSUs), based on biophysical elements and viewing conditions. Figure 1 depicts the VSUs, non-visually sensitive area (NVS), viewpoints and view direction arrows. Silviculture treatment options A and B are also depicted on the map in relation to the VSUs.

2.1 Viewpoints and Visual Sensitivity Identification

The landforms within the southern half of the Capilano Watershed provide the centrepiece of the scenic mountain backdrop of greater Vancouver. The front-most Grouse Mountain portion of the watershed, above Cleveland Dam is approximately 12 km viewing distance from downtown Vancouver, while the Lions, which are focal at the back of the visible landscape from most viewpoints, are 20 km distant from downtown Vancouver. As the watershed is closed to general public access, close-in viewing is restricted to a limited number of panoramic viewpoints outside of, but at the edges of, the watershed. These viewpoints, which have been selected as the key viewpoints for inventory evaluation, are:

¹ Analysis Report, Management Plan No. 5. Greater Vancouver Water District. Watershed Management Division

² Ministry of Forests, 1995. Visual Impact Assessment Guidebook.

³ Ministry of Forests, 1997. Visual Landscape Inventory Procedures and Standards Manual. 69pp.

Grouse Mountain Skyride

The Grouse Mountain Skyride takes skiers and other visitors up to Grouse Mountain, a popular skiing and summer hiking area, located approximately 5 km from downtown Vancouver.

Cleveland Dam/Capilano Reservoir

The low elevation viewpoint at Cleveland Dam looks north along Capilano Reservoir to the outward extent of the watershed at the Lions.

Lions Viewpoint

The Lions viewpoint enjoys broad vistas of most of the watershed, including a number of units along the Capilano River seen only from that viewpoint. This viewpoint provides an important contextual view of the watershed, but viewing distances and oblique or parallel viewing conditions, for the most part, offer only minor viewing opportunity of the project's treatment units around the reservoir, up to those on the lower flanks of the Lions

Mount Strachan Viewpoint

Mount Strachan is one of the peaks developed for downhill skiing in Cypress Bowl. Visitors in both winter and summer can experience a breadth of views spanning from the Lions across to Crown Mountain.

Hollyburn Hydro-Line Viewpoint

The hydro-line viewpoint is at the slope break above the reservoir before the line descends steeply into the Capilano River Valley. While not receiving frequent viewers, except perhaps some cross-country skiers, the viewpoint presents elevated views towards the Capilano Reservoir, and further into the Capilano River Valley.

2.2 Landscape Inventory Classification

Applying a standard classification process defined in the inventory manual⁴, each VSU was evaluated from a rating viewpoint selected for its best viewing opportunity to that VSU. Six sets of factors were evaluated:

Existing Visual Condition (EVC)

- the degree of change currently in the landscape, representing the baseline visual quality measure present in each VSU, which is used to compare with the predicted results of the silviculture treatment options. EVCs consider the scale of existing alteration, the influences of site disturbance, vegetative colour and texture, and visual landscape design, and are defined by the same Visual Quality Class descriptions applied to predicted visual conditions (Table 1).

⁴ Ministry of Forests, 1997. Visual Landscape Inventory Procedures and Standards Manual.

Table 1. Visual Quality Class Descriptions for Existing Visual Conditions (EVCs) and Predicted Visual Conditions (PVCs)

Visual Quality Class (EVC/PVC)	Definition and Design Criteria	Scale of Alteration (non-VEG) % VSU
Preservation (P)	No visible human-caused alterations	0
Retention (R)	Alterations visible, but not evident	0 - 1.5
Partial Retention (PR)	Alterations are evident but subordinate and display good visual landscape design attributes	1.5 - 7
Modification (M)	Alteration dominant, meets line and form, good design	7 - 20
Maximum Modification (MM)	Alteration dominant, out of scale, poor design	20 - 30

Visual Absorption Capability (VAC)

— the ability of the landscape to accept (absorb) change. VAC considers slope, aspect surface variation, and rock/soil/vegetative variety.

Biophysical Rating (BR)

— the character and arrangement of natural elements in the landscape, including slope, aspect, edge effects, topographic variety, vertical relief, vegetative variety.

Viewing Condition (VC)

— how the landscape is seen, considering distance, frequency, duration, and angle of view.

Viewer Rating (VR)

— a measure of viewer numbers and expectations.

Visual Sensitivity Class (VSC)

— a measure of the sensitivity and importance of the unit to viewers, and their concern regarding visual alteration within a particular unit. VSC ratings are derived by combining the ratings of 4 elements (VSC=BR+VC=VR-VAC). Inventory ratings are presented in Table 2; descriptions of each VSC Class are presented in Table 3.

All ratings and their supporting derivation are reported in checklists prepared for each VSU, and appear as components of the inventory map label for each unit. The unit number and location of each VSU in the Capilano is presented in the key map (page 2) and referenced in Table 2, together with the existing visual condition rating and visual sensitivity class.

**Table 2. Capilano Watershed Visual Landscape Inventory Summary
Existing Visual Condition (EVC) and Visual Sensitivity Class (VSC)**

VSU#	Location	EVC	VSC
101	Hollyburn Ridge, West side of Reservoir	Retention	1
102	East side of Reservoir below Grouse Mountain	Retention	3
103	Grouse, Dam, Little Goat, Crown Mountains	Retention	1
104	Hollyburn Mountain	Preservation	1
105	Capilano River, at Head of Reservoir	Retention	2
106	Crown Mountain, northwest aspect	Preservation	2
107	Lions Shoulder	Preservation	3
108	Sisters Creek, Mt. Strachan	Preservation	1
109	Sisters Creek eastside	Preservation	3
110	Lower Capilano River	Preservation	3
111	Lions, Head of Sisters Creek	Preservation	1
112	Eastcap Creek	Retention	3
113	Eastcap Creek	Retention	3
114	Eastcap Creek, Cathedral Mountain	Retention	3
115	Eastcap Creek	Preservation	3
116	Eastcap Creek	Retention	3
117	Upper Capilano River	Retention	2
118	Upper Capilano River	Preservation	3
119	Upper Capilano River	Retention	3
120	Upper Capilano River	Preservation	3

Existing Visual conditions ranged from Preservation to Retention in the Capilano, indicating that a natural appearing landscape prevails in the watershed as seen from the main viewpoints. EVCs are determined by the degree of change from the natural appearing landscape. To achieve Retention and Preservation EVC, either no visible alteration may have occurred or existing visible alterations may not be evident to the average viewer. Three measures are applied in combination: the verbal definition as described in Table 1, design quality⁵, and scale of alteration (amount of area not yet visually effectively greened-up⁶ within the VSU, measured in perspective view). Site disturbances such as roads and hydro-lines must be either not visible or have very minor influence in the landscape.

As indicated in Table 2, Visual Sensitivity Classes in the Capilano ranged from Class 1 to Class 3. The Visual Sensitivity Class descriptions (Table 3) indicate generally a very high to moderate sensitivity to human-made alteration and importance to viewers for the portion of the watershed in the view. The highest ratings are in VSUs surrounding the Reservoir (see Key Map, page 2).

⁵ Such as illustrated in: Ministry of Forests, 1994. Visual Landscape Design Training Manual.

⁶ Visually-effective green-up (VEG) is achieved when regeneration is seen by the public as newly established forest, with forest cover generally blocking views of tree stumps, and bare ground; distinctions in height, colour, and texture may remain. See: Ministry of Forests, 1994. A First Look at Visually Effective Green-up in British Columbia.

Table 3. Visual Sensitivity Class Descriptions

VSC	Description
1	Very high sensitivity to human-made alteration. The area is extremely important to viewers. There is a very high probability that the public would be concerned if the Visual Sensitivity Unit was visually altered in any way or to any scale.
2	High sensitivity to human-made alteration. The area is very important to viewers. There is a high probability that the public would be concerned if the Visual Sensitivity Unit was visually altered.
3	Moderate sensitivity to human-made alteration. The area is important to viewers. There is a probability that the public would be concerned if the Visual Sensitivity Unit was visually altered.
4	Low sensitivity to human-made alteration. The area is moderately important to viewers. There is a risk that the public would be concerned if the Visual Sensitivity Unit was visually altered.
5	Very low sensitivity to human-made alteration. The area may be somewhat important to viewers. There is a small risk that the public would be concerned if the Visual Sensitivity Unit was visually altered.

3.0 Silviculture Treatment Options

The treatment options were directed at forest stands with very high, high, and moderate fire hazard classes on a range of structural stages and terrain types (class I-IV) as summarized from Section 13 of the Annex Report. Vegetation management treatment options would occur mainly within the southern portion of the watershed. The options were:

3.1 Option A

Considered the “most aggressive option,” Option A would reduce stand level fire hazard through a reduction of tree density, crown closure, ladder fuels (branching along the tree stem), and increasing height to live crown on 3931ha (approx. 20%) of the Capilano watershed over a 20-year timeframe. The option applies partial cutting for Terrain Classes III (40% stem density reduction) and IV (30% stem density reduction) in mature and old forests, patch cutting (40% stem density reduction with openings restricted to two tree lengths) in Terrain Classes I and II, and thinning from below (i.e., removal of intermediate and suppressed trees) within young forests. To provide a softened or indistinct visual transition between treatment units and untreated forest, a 30 m perimeter treatment zone around partial cutting treatment units was added with 10% less removal.

The patch cut silvicultural system (restricted to two tree lengths) would be considered in young forest sites with a forest health issue posing a significant threat to water quality or undesirable species and/or stand structure attributes. Areas excluded from treatment in Option A include those polygons classified as old or mature forest structural stages and designated as a red or blue-listed ecosystem. No treatment would occur in the riparian management area or in the area south of the Grouse Mountain Skyride. Terrain Class V polygons were excluded from treatment selection, given the significant risk of sediment production and related water quality impacts. In pole sapling stands, juvenile spacing combined with pruning would be prescribed.

3.2 Option B

Option B is considered a “less aggressive option” compared to Option A. Option B would reduce stand level fire hazard on approx. 1670 ha (8% of the Capilano) over a 20-year timeframe, restricted to younger successional forest on low risk terrain (Terrain Classes I-III). The option applies partial cutting (40% stem density reduction). To provide a softened or indistinct visual transition between treatment units and untreated forest, a 30m perimeter treatment zone with 10% less stem density removal was added around partial cutting treatment units. Excluded from

treatment are those polygons classified as mature and old forest structural stages or polygons in Terrain Classes IV and V. Treatments would be restricted to pole sapling and young forest structural stages with very high, high, and moderate hazard classes, implemented as in Option A.

3.3 Option C

In this “no treatment” option, forest succession would be allowed to progress without intervention, serving as a benchmark by which the other analysis options can be compared. Existing visual conditions would remain unchanged; natural disturbances such as fire will continue to be “aggressively suppressed” as in Options A and B.

4.0 Computer Visualization Methodology and Procedures

The G.V.R.D. Watershed Management Division provided the digital map files for the project. TRIM files were used to create a digital elevation model with World Construction Set (WCS) computer software. ArcInfo “shape files” containing Options A and B silviculture treatment options, visual landscape inventory, terrain classification, and forest cover polygons were imported into WCS. Each option, including the “no-treatment” Option C, was built into an “ecosystem” with its specific attributes of stems/hectare, tree heights, bare ground, regrowth, and intermixing. Roads and the Skyride right-of-way were simulated as lineal “terrefactors” with attributes of surface width, vegetation cover texture and colour. Hydro-lines were simulated as indicated by their height class in the forest cover file (height class 0).

4.1 Viewpoints

The treatment options were projected in 3-dimensional view from 5 viewpoints (the Grouse Mountain Skyride (looking west), Cleveland Dam (looking east and north) the Lions (looking south), and from the hydro line on Hollyburn Ridge (looking east). One 60-degree width of view image was processed from each viewpoint for each treatment in summer and winter (snow on ground) conditions. Additional simulations were prepared from Mount Strachan and the Lions looking east to provide a more comprehensive understanding of the visual landbase and of the treatment options which would mainly influence forest stands in the southern portion of the watershed (see Figure 1).

4.2 Simulation Procedures

The 3-D modelling procedure simulated forest cover by applying full tree images at an assigned stem density of 300 trees per hectare for all mature and old forest, and a stem density of 800 trees per hectare for young forest. Hydro-lines were simulated with 1-2 m vegetation at 2000 brush plants/ha. Tree heights were assigned by the height classes provided in the forest cover database. Partial cutting treatment options that would remove 40% of the stem density were simulated as 60% retention of the original forest density (180 trees/ha for old and mature forest, and 250 trees/ha for young forest).

Patch cuts, resembling irregular group selection cutting 1 tree length (50m) in width, were assigned to mature forest units with Terrain Class III or less, removing 40% of the forest area of each treatment polygon. In 2 instances, adjacent patches were grouped together to examine the response to a 2 tree-height patch size. For contrast differentiation from the surrounding forest, and to portray a sense of the visual condition in winter, treatment units were also simulated with snow on the ground (colour only, no depth).

4.3 Simulation Results

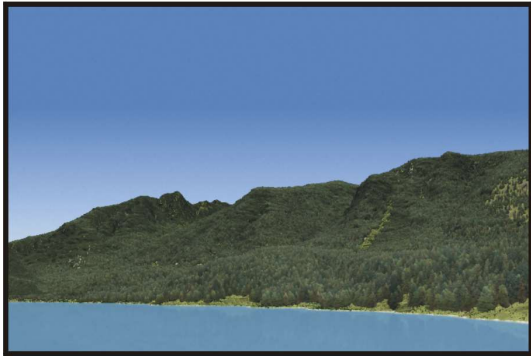
The following computer visualization images for each option depict the amount of visible change, if any, relative to the VSU in the view. Figure 10 presents Options A, B and C in winter, with 40% stem density reduction, while Figure 11 presents Option A in summer conditions.

**Option A
40% Stem Density Reduction**



Skyride Viewpoint

**Non-Option Trial
90% Reduction (Demonstration Only)**



Dam Viewpoint



Dam Viewpoint



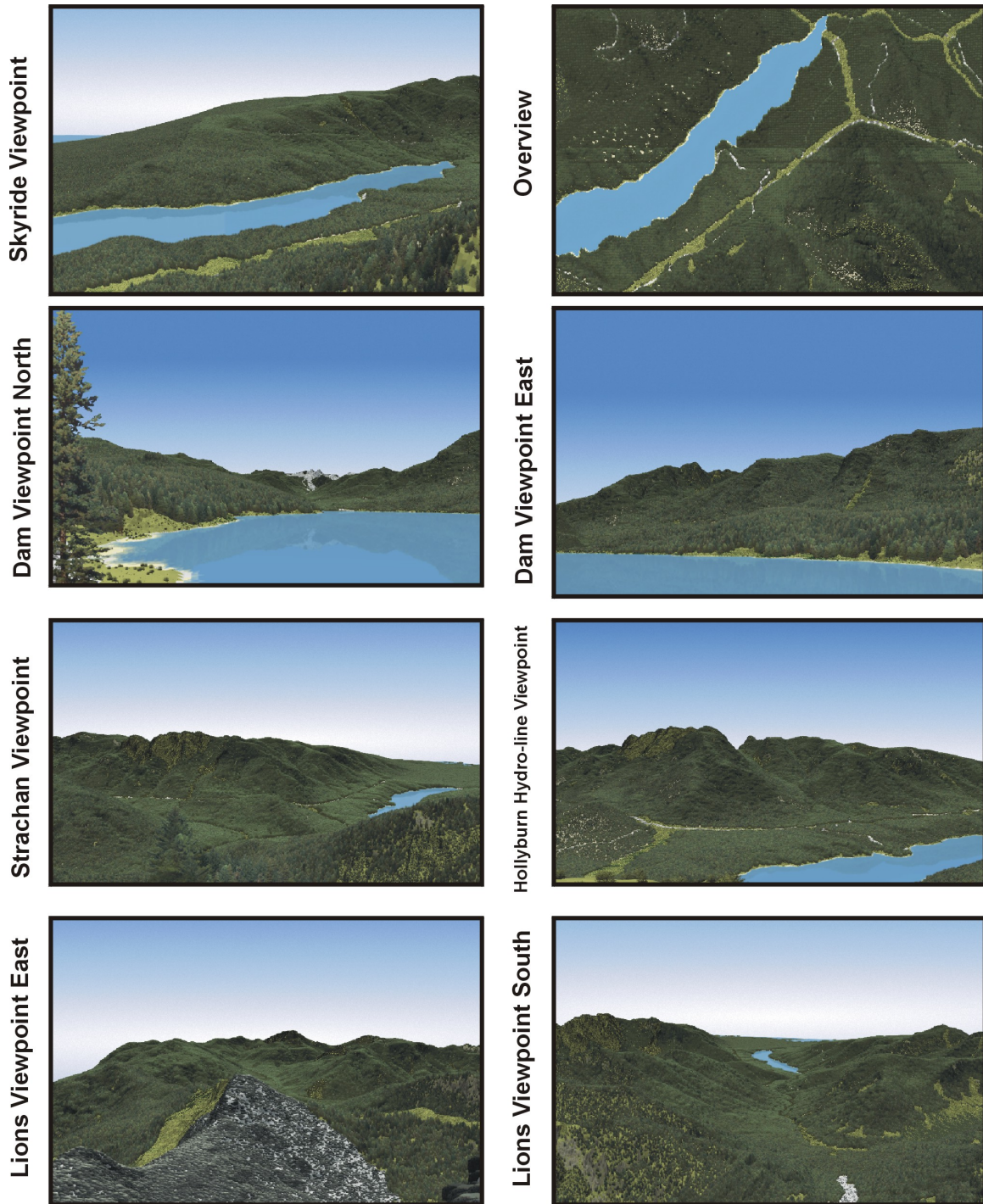
Lions Viewpoint



Capilano Watershed Silviculture Treatment Option A
 Summer Condition, with Demonstration of Effects of Greater Density Removal

Resource Design Inc
 Forest and Land Planning

Figure 10



Capilano Watershed Silviculture Treatment Option A (Summer Conditions)
Refer to Figures 1-9 for Orientation

Resource Design Inc
Forest and Land Planning

Figure 11

5.0 Findings

The visual quality analysis examined the potential change in visual conditions that would be introduced by three silvicultural treatment options at the end of a 20-year treatment period. Options A and B would introduce stem density reductions that could influence existing visual conditions, while Option C, the “no change” option, would allow current visual conditions to evolve towards the preservation visual condition over time without intervention. Over the 20 year treatment period, all units with past change would become increasingly natural-appearing as forest growth occurs. The analysis projected the visual influence of treatment options A and B through computer visualization to examine and compare the potential effects.

Options A and B treatment areas are concentrated in the southern portion of the watershed in visually sensitive units (VSUs) that have high visual sensitivity class ratings (VSCs 1-3) as identified in the visual landscape inventory. As provided by the Ministry of Forests’ definitions for each of these ratings, the area is important to viewers, and public concern is likely if the VSUs were visually altered. Landscape Inventory assessment of existing visual conditions in the visually sensitive landscape of the watershed indicated that the conditions are either Preservation (no change) or Retention (change may be visible but not evident to the average viewer).

Images prepared for each treatment option were assessed for the predicted visual condition (PVC) degree of visual change and compared with the benchmark of existing visual condition (EVC) using the “worst-case” winter condition set of simulations (Figure 10). Summer simulations were also presented for Options A with 40% stem density reduction (Figure 11).

The best viewpoint was selected for assessment of each VSU. VSUs 101-111 were addressed from the Skyride, Dam, Lions and Hollyburn hydro-line viewpoints. The simulation produced from Mt. Strachan addresses VSU 112 (Figure 11). The Lions view looking east (Figure 11) included VSUs 112-115. The PVCs in the remaining units (116-120) were estimated based on the results in other units, viewing distance and the intensity of treatment.

Visible change within a given VSU was influenced by the distance from the viewpoint to the VSU, viewpoint elevation relative to the VSU (angle of view), slope of the VSU, forest cover existing in the VSU and forest cover remaining following treatment.

The visualization procedure consistently indicated that the effect on visual quality from Options A and B would not exceed the limits of the Retention visual quality class. The comparison of the visual results of Options A and B to each other and to Option C, the “no change” option, were so similar that PVC differentiation between Preservation and Retention was difficult, except for likely changes in texture. Retention of at least 60% of the forest stem density in each treatment unit provided an overall continuity in the forest canopy. The comparison of predicted visual conditions and existing visual conditions are summarized in Table 4.

**Table 4. Capilano Visual Quality Results
Silviculture Treatment Options at Year 20**

VSU	Location	EVC	Option C PVC =EVC	Option A PVC		Option B PVC		Comments
				Presence in VSU	P V C	Presence in VSU	P V C	
101	Hollyburn Ridge West Reservoir	R	R	Y	R	Y	R	maintains limit for R both A and B
102	East Reservoir	R	R	Y	R	Y	R	maintains limit for R both A and B
103	Grouse, Dam, Goat, Crown Mts.	R	R	Y	R	Y	R	maintains limit for R both A and B
104	Hollyburn Mt.	P	P	Y	R	Y	R	potential change to R both A and B
105	Capilano River, Head of Reservoir	R	R	Y	R	Y	R	maintains limit for R both A and B
106	Crown Mountain Northwest aspect	P	P	Y	R	Y	P	potential change to R with A Minor B maintains P
107	Shoulder, near Lions	P	P	Y	P	N	P	very minor A, maintains P no treatment B
108	Mt. Strachan	P	P	Y	P	Y	P	minor A, B maintains P
109	Sisters Creek- Capilano River	P	P	Y	R	Y	R	potential change to R both A and B
110	Capilano River Helmond Creek	P	P	Y	P	N	P	very minor A, maintains P no treatment B
111	Lions	P	P	N	P	N	P	no treatment A or B
112*	Eastcap Creek	R	R	Y	R	Y	R	maintains limit for R
113*	Eastcap Creek	R	R	Y	R	Y	R	maintains limit for R
114*	Eastcap Creek	R	R	Y	R	N	R	very minor A, maintains R no treatment B
115*	Eastcap Creek	P	P	Y	R	Y	P	potential change to R with A very Minor B maintains P
116*	Eastcap Creek	R	R	Y	R	N	R	very minor A maintains R no treatment B
117*	Capilano River	R	R	Y	R	Y	R	maintains limit for R both A and B
118*	Capilano River	P	P	Y	P	Y	P	very minor A, B maintains P
119*	Capilano River	R	R	Y	R	N	R	very minor A, maintains P no treatment B
120*	Capilano River	P	P	Y	P	N	P	very minor A, maintains P no treatment B
Sum	VSUs with Treatment		0	19		13		6 more units treated in Option A
Sum	Preservation	10	10		6		8	4 P units may shift to R in Option A, 2 in B
Sum	Retention	10	10		14		12	

P= Preservation Visual Condition; R=Retention Visual Condition

* VSUs not assessed in detail. Units are distant (5-11km), Lions and Strachan viewpoints only).

6.0 Conclusions

Computer simulations of silvicultural treatments Options A and B indicate that the overall existing visual quality conditions of Preservation and Retention presently occurring within the Capilano watershed would prevail at the end of the 20 year treatment period. Option A would cause the visual condition in 4 of 10 visually sensitive units (VSUs) with an existing visual condition of Preservation to change to a predicted visual condition of Retention. By comparison, only 1 VSU is predicted to change from Preservation to Retention with Option B.

Both treatment options A and B would maintain a continuous forest canopy, though depending on viewing conditions, treatment areas might be discerned as having a courser texture than the surrounding forest in which individual trees and tree boles (trunks) may be visible. If bare ground were to appear it would be deeply shaded by the remaining forest, and therefore of low visual contrast. These textural distinctions are to remain "non-evident" to the average viewer, though the trained eye may be able to distinguish treated areas from non-treated areas.

Option A patch treatments were not visible as they were restricted to lower slopes. Patches were visible where units were grouped (greater than 2 tree-height in width).

The Option A requires greater caution in its deployment than Option B, as it is more extensive, and reaches higher on steep visible slopes than Option B.

Some Visual Sensitivity Units will require more attention than others:

- VSU 101, the broad slope of Hollyburn ridge along the west side of Capilano Reservoir, seen from a high viewing angle from the Grouse Mountain Skyride. The unit's shoreline portion is also seen from the dam.
- VSU 102, the flat eastside shoreline strip along the reservoir, seen nearly vertically from the Skyride. The unit is also seen from elevated viewpoints on the opposite side if the reservoir such as the Hollyburn hydro-line.
- VSU 103, the Grouse/Dam/Goat/Crown Mountain landform seen from Cleveland Dam, Hollyburn and Strachan and from points throughout Vancouver.
- VSU 104 (Hollyburn Mountain), seen from the Skyride.
- VSU 105, the south facing portion of the unit at the head of the reservoir next to Grouse Mountain, which, together with the Grouse Mountain landform, form the major central focus in the mountain skyline seen from Vancouver. North-west facing portions of the unit are seen from the Lions, Strachan and Hollyburn.
- VSU 106, the northwest aspect of Crown Mountain, seen prominently from the Lions, Strachan and Hollyburn.
- VSU 108, seen in near view from Strachan, mid-view from the Lions.
- VSU 109, the landform at the divide between Sisters Creek and the Capilano River, seen from the dam, Lions and Strachan.
- VSU 111, the scenic Lions, the focal point from the dam and points throughout Vancouver.

Site-specific adjustment to stem density reductions will be required where existing density is already thin, or where slopes are steep. Further computer simulation trials are recommended to test the limits of individual landscape units to support greater or lesser density reductions. Field trials are recommended in order to verify computer visualization, and to test required percentages relative to slope and viewing opportunities within the Capilano. For example treatment areas with steep and moderate slopes should be tested for visual influence by removing stem density in 10 % increments starting at 20% and ending at 50%. During the treatment period and in the years following, visual greenup and successional influences tending towards the natural-appearing (Preservation) visual quality condition should be tracked for each treatment option.

Permanent roads, transmission corridors, and the Skyride corridor can result in long-term altered (Modification) visual quality conditions, depending on the viewpoint. Greenup has allowed the Skyride and hydro-lines to subside such that they currently considered minor influences in the larger Retention visual quality condition landscape. As new clearing of the corridors can make them dominant, corridor treatment plans should be designed with consideration of their visual influence in advance of treatment and co-ordinated with the GVRD Watershed Management Division to ensure overall visual quality results in the Capilano Watershed.