Integrated Visual Design
for
Visual Sensitivity Unit #512

- a justification for relaxation of the VQO under GAR

produced for

Tamihi Logging Co. Ltd.

by

RDI Resource Design Inc
March 18, 2011

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1. Introduction

Visual Sensitivity Unit (VSU) 512 is 2367.4 hectares in extent, and has an established VQO of Retention (R). The VSU was delimited in the 1996 Chilliwack Forest District Visual Landscape Inventory (VLI) which was conducted by RDI Resource Design Inc., the author of this report. The VLI was coarse in scale, as it incorporated all of the visually sensitive areas within the Chilliwack Forest District, namely all areas visible from main highways and major lakes. The VLI rated three key aspects of the VSU: visual sensitivity rating (VSR) existing visual condition (EVC) and Visual absorption rating (VAC). A final rating, recommended Visual Quality Class (rVQC), was outside of the parameters of the VLI, being a planning decision left to the District and, ultimately, through a Land and Resource Management Plan (LRMP), prepared by the Integrated Land Management Bureau (ILMB). When established through that process, and made known, the VQC's become established Visual Quality Objectives (eVQOs).

The large VSU contains an operating area of Tamihi Logging Co. Ltd. The Company used viewpoints identified in the VLI when preparing Visual Impact Assessments within the VSU. These were along Highway 7 at Lake Errock, and Kilby Provincial Park on Harrison Bay. (Figure 1). Immediately to the east of VSU 512 are VSUs 527 and 554, both having a PR Retention VQO. VSU 527 is the prominent landform along the north side of Harrison Bay; VSU 554 is the landform along the south side of Harrison Bay. Both VSUs are seen closely from Kilby Provincial Park, with VSU 512 seen more distantly between the two.

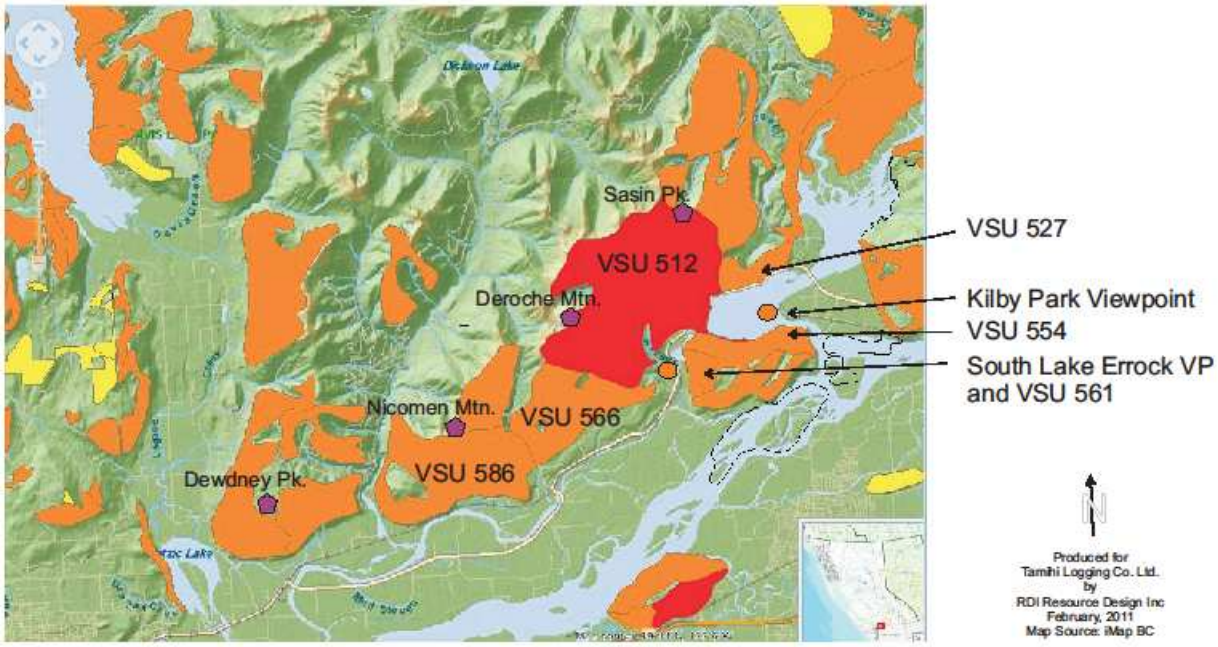

Figure 1. VSU 512 (VQO of Retention) and neighbouring VSUs (all Partial Retention).

As defined by the Forest and Range Evaluation Program (FREP), Retention means an alteration of a forest landscape setting[1] resulting from the presence of cutblocks or roads, such that when assessed from a viewpoint that is representative of significant viewing opportunities, the alteration (a) is difficult to see, (b) is small to moderate in scale, and (c) has a design that mimics natural occurrences. A somewhat more lenient VQO, Partial Retention (PR), has been assigned to all of the adjacent VSUs in the viewscape along Highway 7. PR is defined as (a) easy to see, (b) small to moderate in scale, and (c) has a design that appears natural and is not angular of geometric.

Earlier definitions (VIA Guidebook) defines three criteria for each VQO - verbal definition, design, and percent alteration in perspective view. The percent alteration limit for Retention is 0% to 1.5%, and for Partial Retention is 1.5% to 7% in perspective view, an approximate 5-times increase in the alteration limit over Retention at the upper end of each VQO. Research[2] has shown that public acceptance of forest operations, while preferring retained landscapes over modified, has, on average, a neutral Public Acceptance Rating for Partial Retention landscapes.

The alteration limits are useful when developing a long term plan such an IVD, as each phase requires visually effective green-up before proceeding (roughly 15 years) to the next phase. As such, Retention would require very roughly 67 phases (1000 years) to harvest the entire VSU, including green-up, while Partial Retention would require 14 phases (210 years). As said, the numbers are very rough, particularly as screening and regrowth over the duration of each plan will provide for additional area to be harvested without increasing apparency.

A recent audit by the Forest Practices Board concluded that operations within the VSU have exceeded the VQO of Retention, from a viewpoint that was not determined in the mainly highway and large lake oriented VLI[3]. The assessment viewpoint, shown in Figure 1, was at the beach park at South Lake Errock, a small residential community. The beach park is posted as private property, and public access to the lake is not provided, so it doesn't truly represent a "significant public viewpoint" for VLI purposes, but provides close, open viewing of the VSU, so is significant in its own right. The recent alteration, seen in Figure 2, represents 3.7% of the VSU in perspective view from the viewpoint, and therefore was capable of meeting Partial Retention. Although the Company accepted the ruling, it did question the need for such a restrictive VQO in the VSU of such great size and diversity amidst the surrounding Partial Retention landscape, and is seeking relaxation of the VQO under Government Action Regulation (GAR) order. In order to examine the potential of the VSU for supporting increased forest operations as justification for relation of the VQO, the Company invited RDI Resource Design Inc to prepare an Integrated Visual Design (IVD) plan for the VSU.

[1] Commonly the VSU itself, but also may mean a somewhat broader scene, such as an entire landform.
[2] Ministry of Forests and Range, 2006. The public response to harvest practices in British Columbia at the Landscape and Stand Level (citing earlier research).
[3] The FPB report # FPB/IRC/141 can be found on-line at:
http://www.for.gov.bc.ca/hfp/values/visual/Publications/compliance/IRC141_ml.pdf

2. Analysis

The VSU has sustained a long history of forest management, such as the harvesting in upper Sasin Creek, for more than 40 years ago. The harvesting and regrowth provide a great mix of forest patterns, increasing the Visual Absorption Capability (VAC), another element of Visual Sensitivity Rating (having the effect of lower the sensitivity). An array of forest access roads already reach many parts of the VSU.

VSU 512 is very diverse in terrain and forest cover, comprising two mountain landforms (Nicomen Mountain and Sasin Peak), deeply incised creeks and back valleys between the peaks, and hilly, bottom land. The VSU terrain varies in aspect (a visual sensitivity element), mostly ranging from east-, to south- and west-facing slopes. East- and west-facing slopes are in shade for longer periods of the day than the south-facing slopes and alterations on those slopes are often harder to see.

The VSU provides the backdrop to views from Lake Errock (Figure 2) as well as other viewpoints.

Figure 2. View from South Lake Errock private beach park (J. Jonker photo).

A broader wide-angled panorama winter shot was taken in January 2, 2011, shown in relation to a 3-D simulation prepared using Visual Nature Studio (Figure 3).

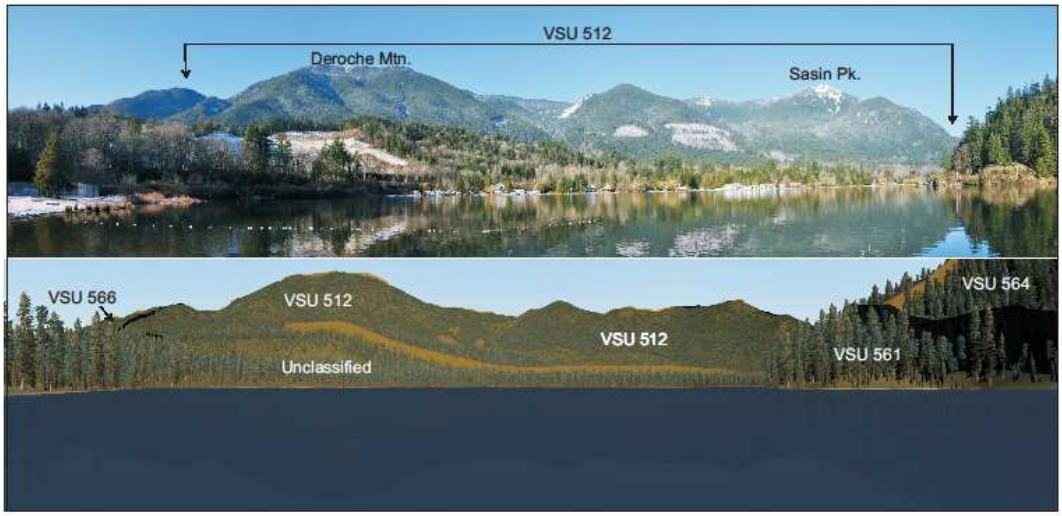

Figure 3. Wide-angle panorama from South Lake Errock private beach (top) and related simulation showing VSUs (K. Fairhurst, January, 2011).

As well, Highway 7 provides partially screened views and longer duration (1 minute) views of the eastern uplands of Sasin Peak when travelling east towards along the highway (Figure 4).

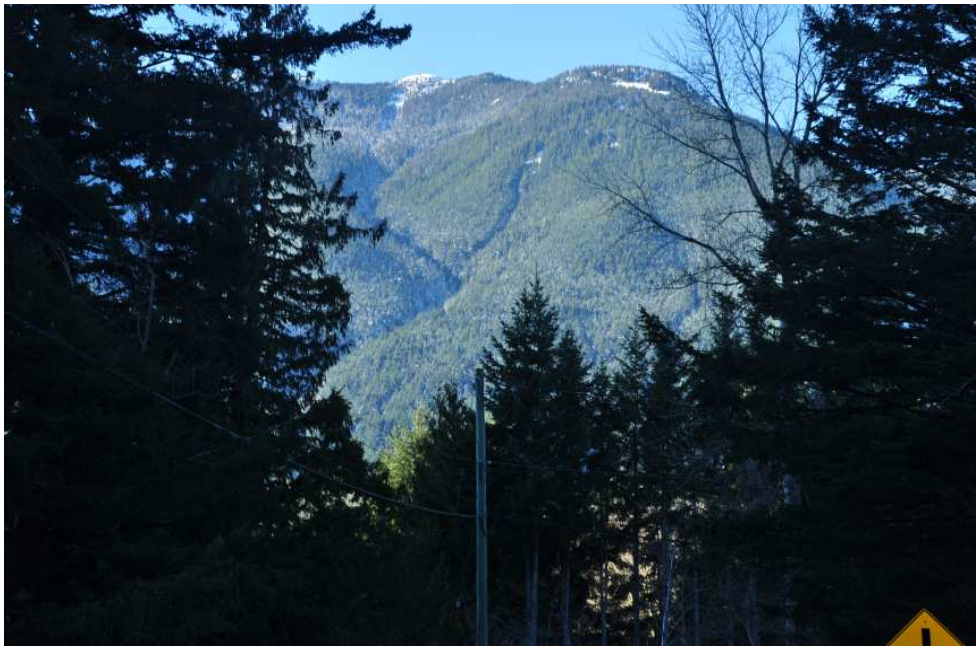

Figure 4. View from Highway 7 at Lake Errock towards Sasin Peak (K. Fairhurst photo Jan., 2011).

Kilby Provincial Park on Harrison Bay provides open, sustained-use viewing towards the VSU, seen situated between the visually prominent VSUs 527 and 561 along the north and south sides of Harrison Bay (Figure 5).

Figure 5. View from Kilby Provincial Park (close-up photo above; wide-angle photo mid-image; VNS model below) (K. Fairhurst photos, January, 2011).

VSU 512 is also part of a larger mountain backdrop seen from more distant viewpoints such as from Chilliwack and Highway 1 that includes Nicomen Mtn., Deroche Mtn. and Sasin Peak, the last two being within in the VSU. While much of the lower portion of the VSU is hidden by Harrison Hill, the more distant views add increased visibility of upper areas, such as upper Squakum Creek (Figure 6).

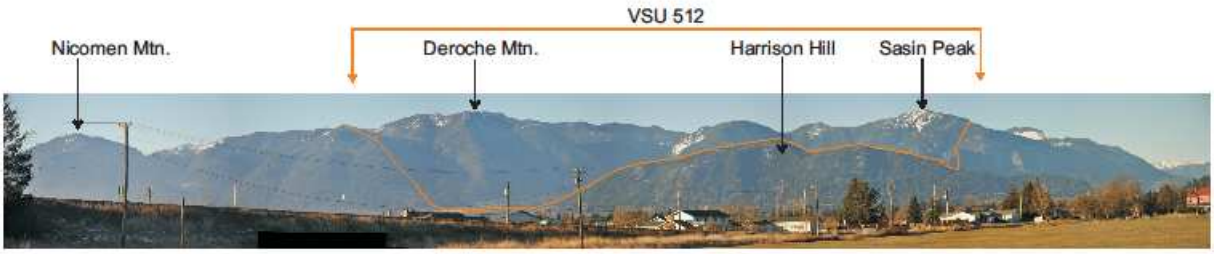

Figure 6. View of mountains with VSU 512 outlined, from Chilliwack (K. Fairhurst photo, Jan. 2011).

Two key viewpoints were selected for the exercise: Lake Errock South, and Kilby Provincial Park (Harrison Bay). A third viewpoint, Lake Errock North, close by Highway 7 but without roadside screening, was selected and used to prepare the viewshed map and also for GEOptics apparency determination, a process to account for viewpoint-viewed terrain interactions in the planning process as described later in the report (Sec. 3B(i)).

Using the BC TRIM DEM points and breaklines, a terrain surface was created in ArcGIS. Using that terrain, a viewshed map was prepared in ArcGIS to show the area visible from these viewpoints (Figure 7). To provide a more accurate viewshed determination, the terrain heights were raised by the height of the forest cover. Actual visibility and through-the-trees viewing/screening depends on detailed forest stand characteristics, including seasonal variation where deciduous trees are present. The viewshed was draped onto a hillshade produced from the terrain to further display the steep and varying character of the VSU.

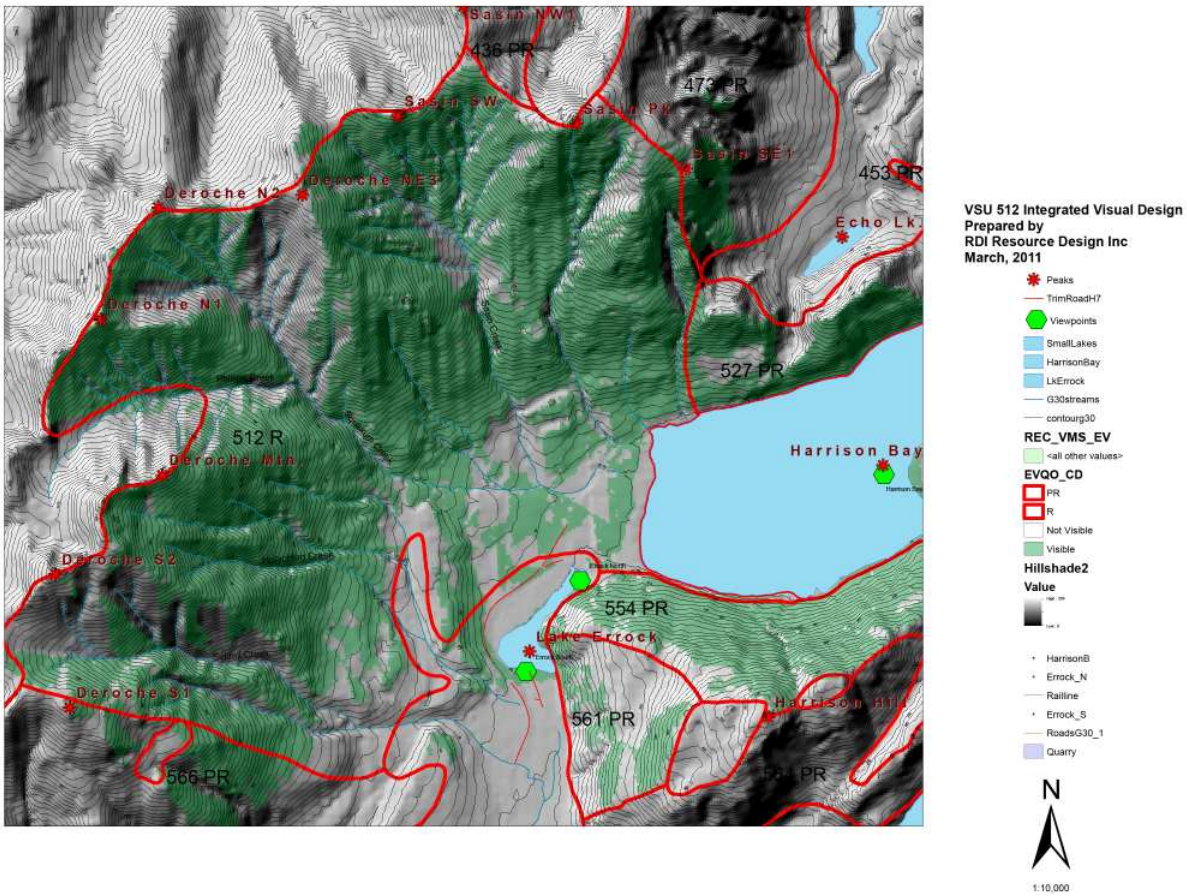

Figure 7. Cumulative viewshed from the three design viewpoints using 20 digital elevation model with surface raised by forest heights from VRI.

The viewshed map also reveals the topographic contours. The contours reveal the steepness and complexity of the VSU. A slope map derived from the terrain reveals the steepness (slope), by percentage class (Figure 8).

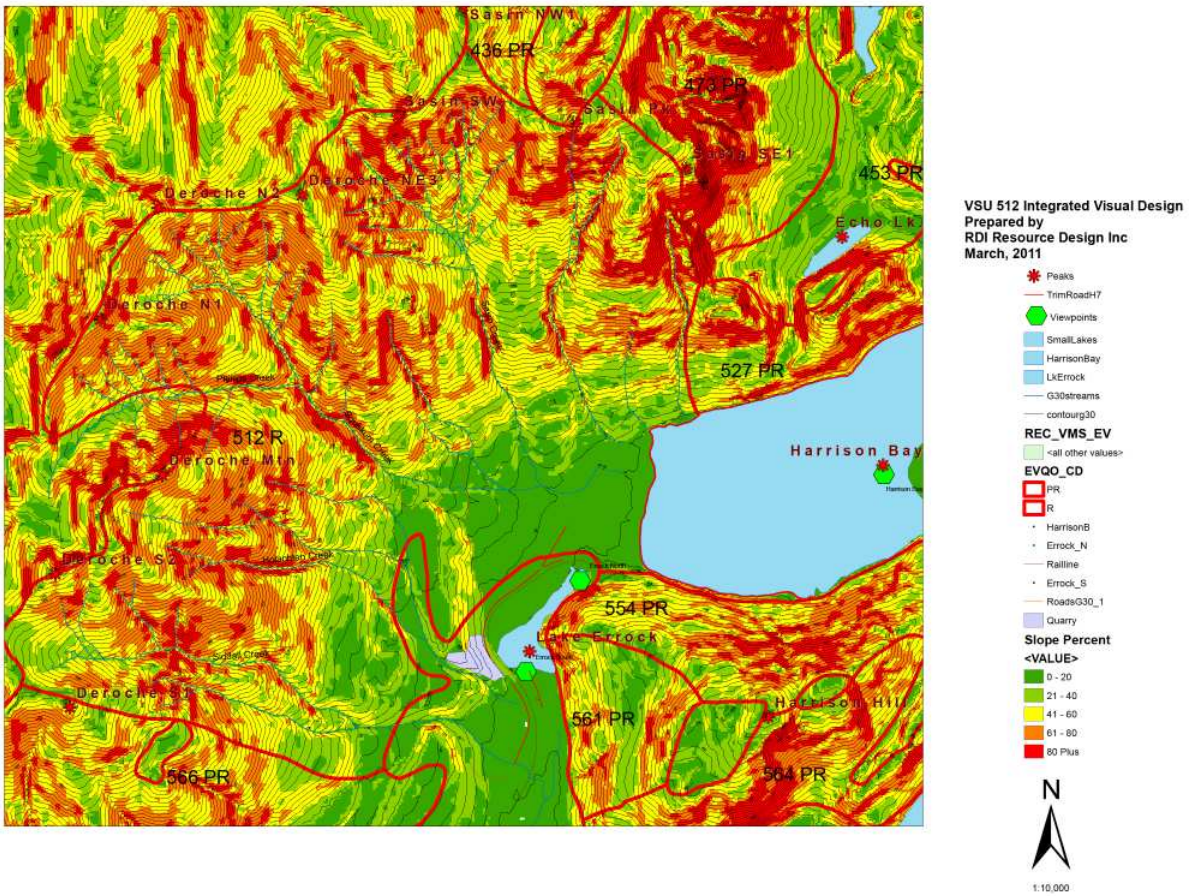

Figure 8. Terrain slope map coloured as to 20% slope classes, revealing steep and gentler terrain within VSU 512.

3. Integrated Visual Design Procedures

To produce an Integrated Visual Design for VSU 512, a series of steps or procedures were required. These were:

A) create distinctive units within the VSU called Visual Design Units (VDUs).
B) conduct further analyses within the VDUs to enhance the planning process.
C) create the visual design of potential harvest opportunities termed Resource Design Blocks (RDBs or just "design blocks") within VSU 512, and assign phases to the resulting blocks.

A) Visual Design Units

The IVD procedure first separated the VSU into 7 distinct terrain units called Visual Design Units (VDUs) based on topographic features and visual force lines as seen from the key viewpoints (Figure 9). The major force lines (shown in Figure 15) were used predominantly to define VDU boundaries. Having VSU 512 broken into the 7 design units greatly assisted the design phase of the project by providing the ability to concentrate on distinct portions of the VSU, each with its range of characteristics and controlling features, such as the variety of creeks and ridges, topography and aspects, mountain peaks, viewability from individual viewpoints, and existing forest conditions. Harvesting opportunity was examined within each VDU, and how that may influence neighbouring units, and the VSU overall.

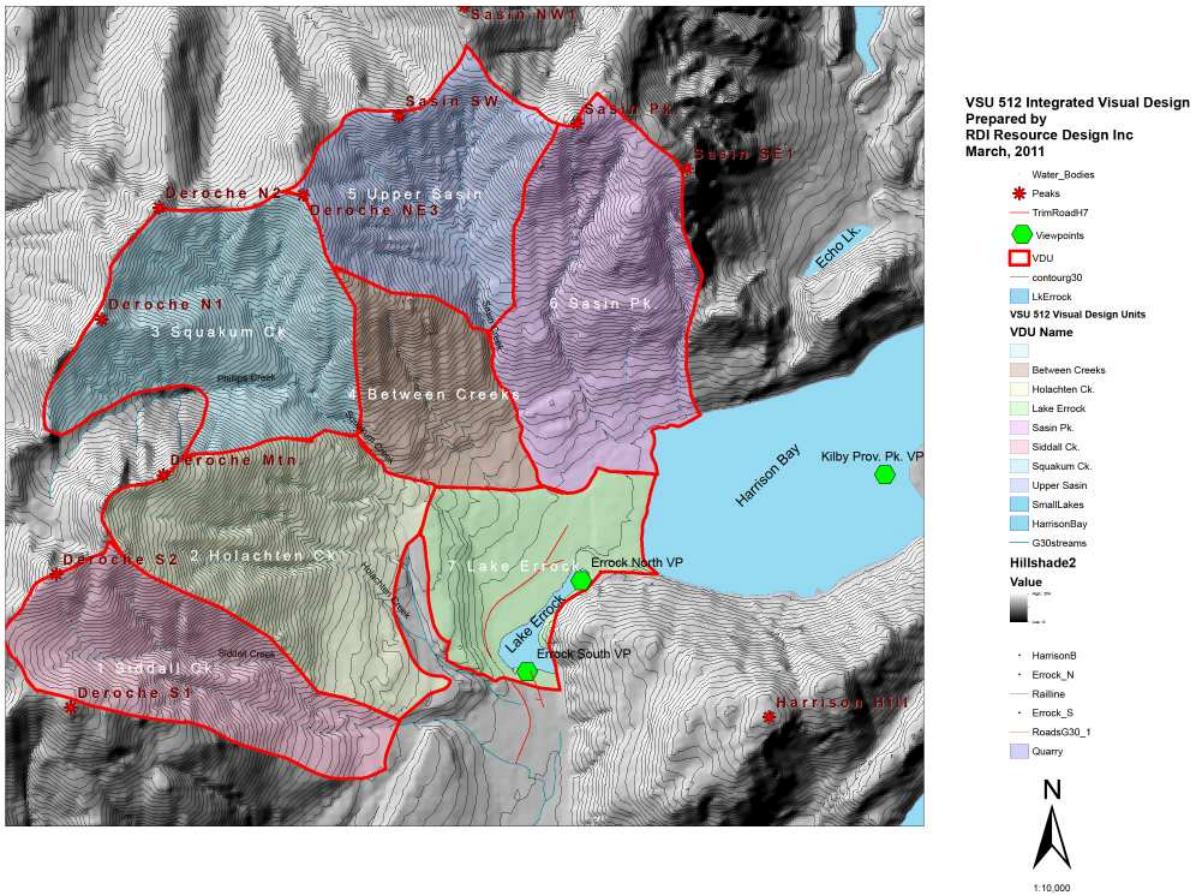

Figure 9. VSU 512 Visual Design Units (VDUs).

The name, area, aspect, and top elevation of each VDU are presented in the following table (Table 1):

Table 1. VSU 512 Visual Design Unit Descriptions

VSU 512 Visual Design Units				
VDU #	VDU Name	Area (ha)	Aspect	Top Elevation (m)
1	Siddall Creek	336	E, SE, S, NE, N	1201
2	Holachten Creek	434	E, SE, NE	1412
3	Squakum Creek	426	SE, S, SW, E, NE, N	1341
4	Between Creeks	214	SE, S, SW, E	1123
5	Upper Sasin Creek	325	E, SE, S, SW, W, NE	1292
6	Sasin Peak	457	S, SE, SW, E, W	1337
7	Lake Errock	254	E, SE	179

The VSUs as seen from South Lake Errock viewpoint, together with recent photography capturing the same view are presented in Figure 10. The two comparisons from Kilby Provincial Park viewpoint are presented in Figure 11.

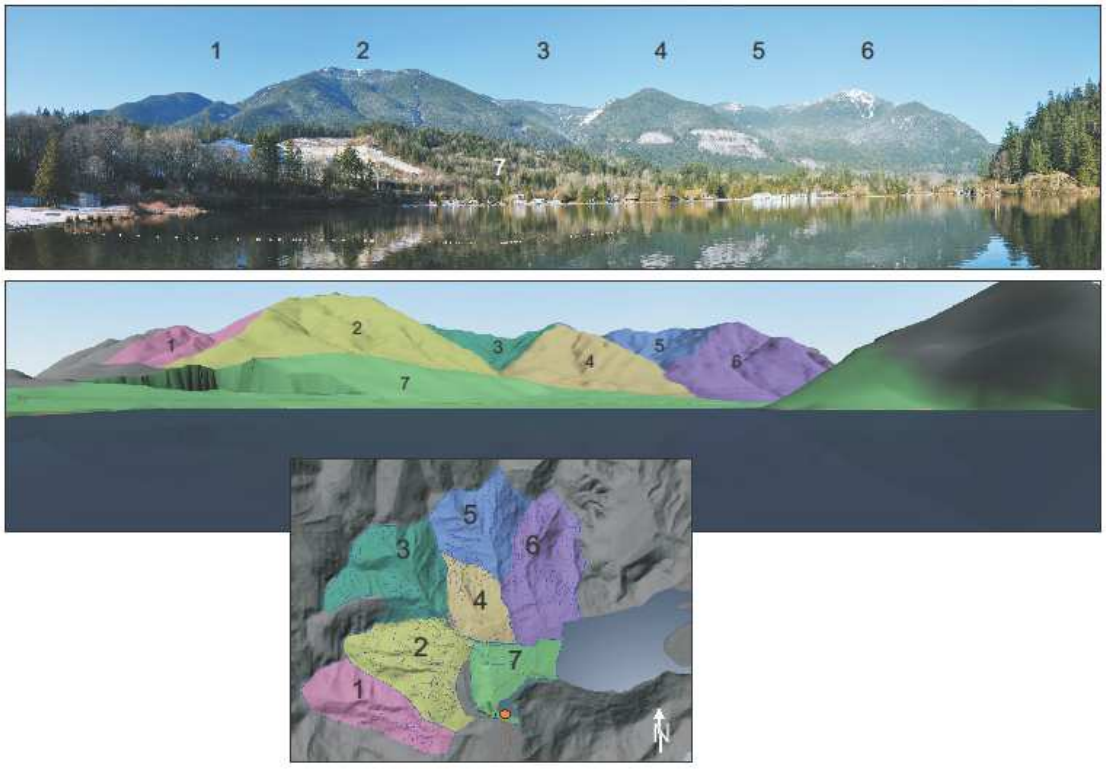

Figure 10. VSU 512 Visual Design Units as seen from South Lake Errock viewpoint.

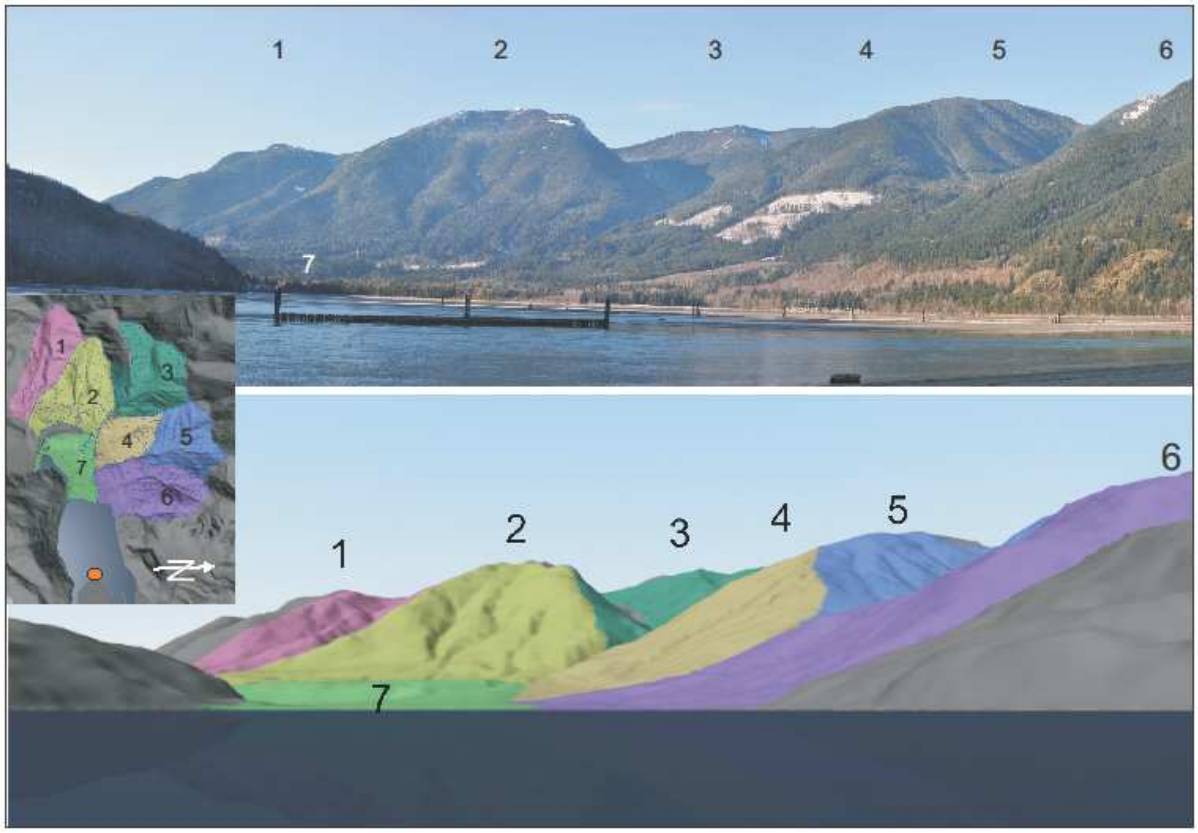

Figure 11. VSU 512 Visual Design Units as seen from Kilby Provincial Park viewpoint.

B) Further Analyses within the Visual Design Units

To obtain a better understanding of the controlling and guiding factors within and amongst the VDUs, five further analyses were prepared:

i. Aspect
ii. Landscape Apparency
iii. Forest Cover Assessment
iv. Constraints and Opportunities
v. Net Available Forest

i. Aspect

The variety of aspects encountered in each Visual Design Unit can be seen in the following map (Figure 12).

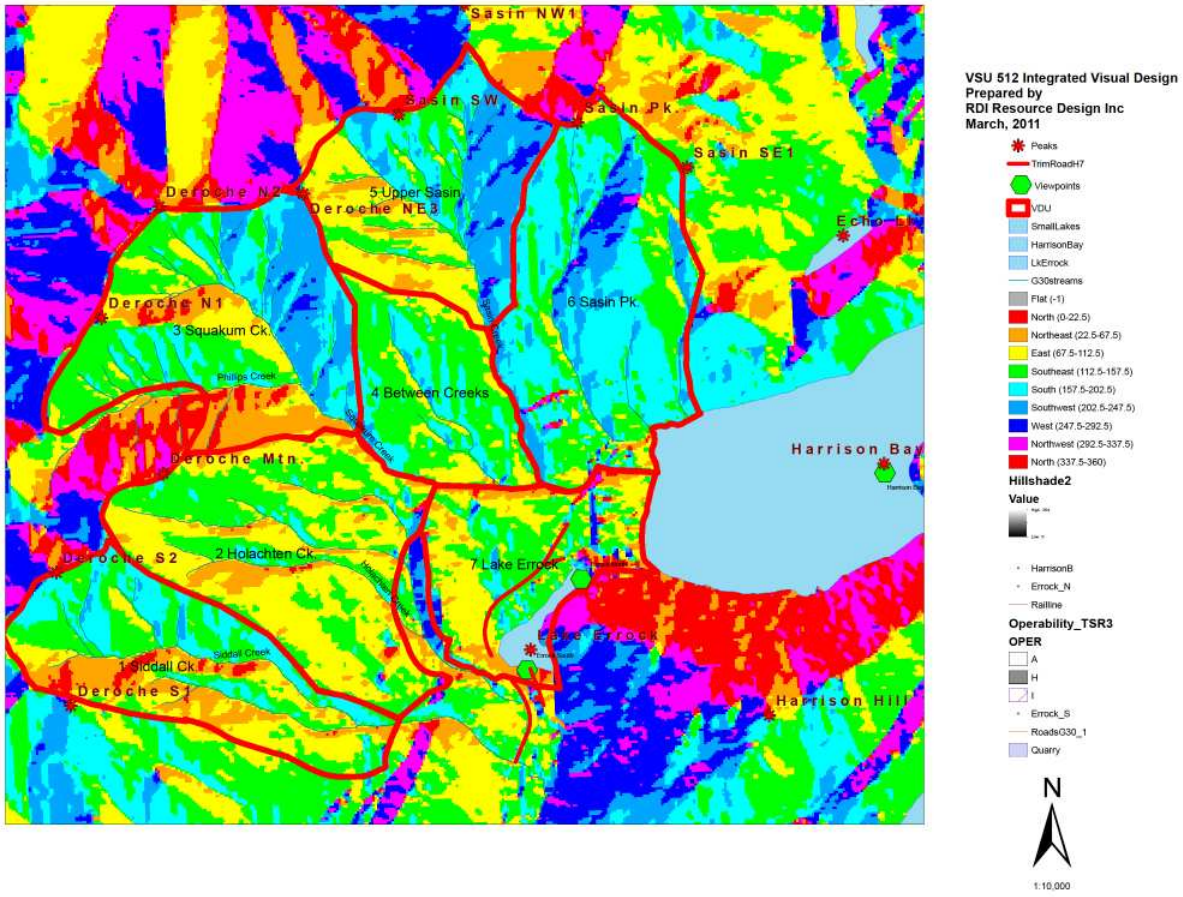

Figure 12. Aspect Map showing aspects variations within each of the VDUs.

Aspect influences visual sensitivity in that the more northerly (north-facing) the aspect, the greater the depth and duration of shading, and the less features, including logging, stand out in the view. As well, aspect affects forest productivity, most importantly the rate of re-growth. Very dry south facing slopes may be slow to achieve VEG while easterly and westerly may have more moisture and faster re-growth. Small amounts of North (red), northeast (orange) and northwest (pink) aspects, having the greatest shading and least sensitivity, occur in VDUs 1-4. Next, considerable amounts of east aspect (yellow) with moderate sensitivity, occur in VDUs 1, 2, 5 and 7. Greatest sensitivity (least shading) occurs in the southeast (bright green), south (bright blue) to southwest (blue) - all of which occur in great abundance throughout the VSU - the aspects requiring greater care in planning. The view from South Lake Errock spans all of the VDUs encompassing a full 110 degree width of view within a wider panorama. The view from Kilby Park is somewhat narrower (80 degree width of view), within a broader (210 degree panorama). Both views look directly upon E/SE-facing VDU 2, and SE/S-facing VDUs 4 and 6, though VDU 6 is seen more closely, but obliquely from Kilby Park. It is clear the orientation towards the viewpoints that adds increased visual sensitivity over aspect alone. This factor is discussed in the next subsection (Landscape Apparency).

ii. Landscape Apparency

As noted when discussing aspect in the previous section, aspect may not be the critical factor when determining visual sensitivity for design considerations, but orientation of the range of aspects (or slope) towards the viewpoints. A procedure called GEOptics Landscape apparency, developed by Ken Fairhurst as his 2010 Ph.D. thesis research[4], was applied to further differentiate the VSU based on the cumulative "lay of the land" from all of those viewpoints at once. Using lights set at the viewpoints in the 3-D model, and measuring illumination (reflectance RGB values) back from the terrain, it emulates how the eye intersects with the land from the combined viewpoints (Figure 13).

Apparency was used to differentiate the higher and lower visual risk areas in each design unit. For example, the dark green zones has the greatest flexibility and supported larger block sizes, while the yellow and orange zones indicated where the greatest care was required, and most often where the smallest blocks should be designed.

[4] Available from the UBC library with the following link: http://hdl.handle.net/2429/28006.

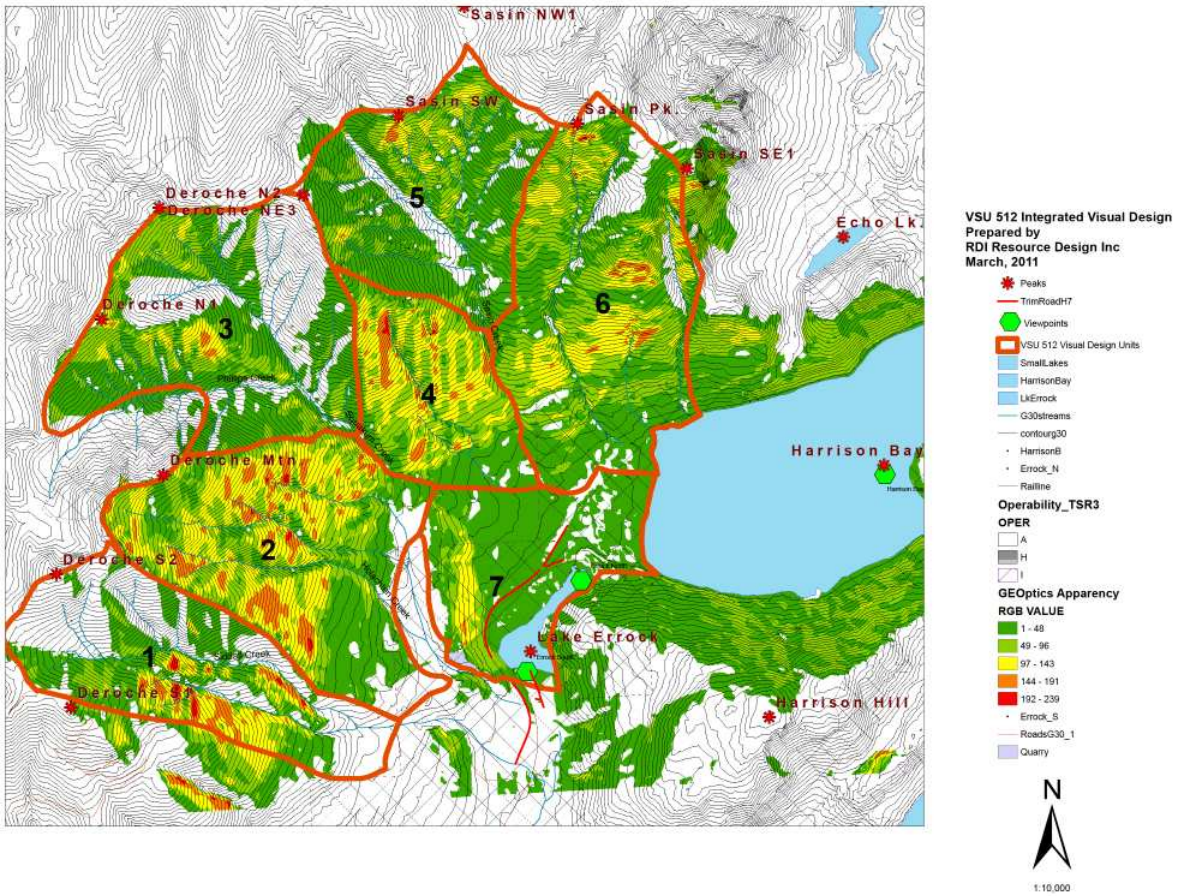

Figure 13. Apparency map showing cumulative visual risk from the selected 3 viewpoints.

While the viewshed (Figure 7) shows only what can be seen, apparency shows how that is seen - the angles of incidence from viewpoint to the land from all viewpoints in the set. Further, whereas slope provides a good indicator of general prominence of the terrain, GEOptics shows how that terrain is actually experienced, such as steep slopes bending away from view are less sensitive than those perpendicular (face-on) to the view. As well, screening effects are greater along more oblique sight lines than perpendicular one, allowing more tree screening to be accommodated in the design process.

Depending on viewpoint location, sightlines may be perpendicular to or cross obliquely across the terrain, or the terrain may angle away from the viewpoint. The line of sight greatly influences the degree of tree screening, and the ability of regrowth to be seen as covering over bare ground, even on steep slopes. Landscape apparency accounts for all of those interactions from all viewpoints at once, thereby making the job of the harvest planner a little easier, and increases the success of the final product in avoiding unexpected or unacceptable visual impacts.

iii Forest Cover Assessment

To continue the design process, the existing forest cover had to be differentiated within the VDUs. Forest stand height was selected as the marker feature (Figure 14). Only stands 25 m or greater (light brown, dark brown and dark green) would be considered in the final plan.

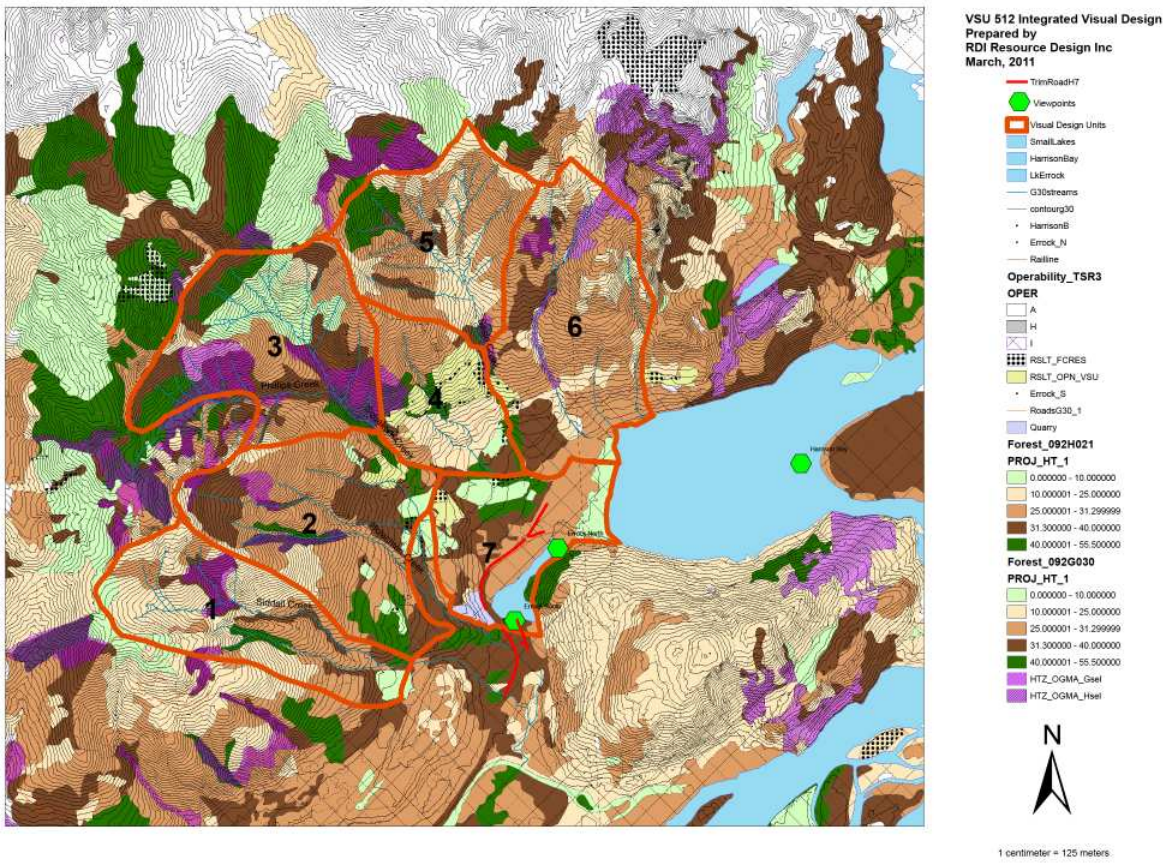

Figure 14. Map of VRI forest cover by height class showing VDU boundaries .

iv. Constraints and Opportunities

The IVD process examined all potentially harvestable timber of 25 m stand height or greater, eliminating reserves such as TSR 3 Operability, Old Growth Management Areas (OGMA's), riparian zones, steep slopes, visual force lines, and general access considerations (existing road network). A Constraints and Opportunities map was prepared detailing the exclusions and considerations (Figure 15).

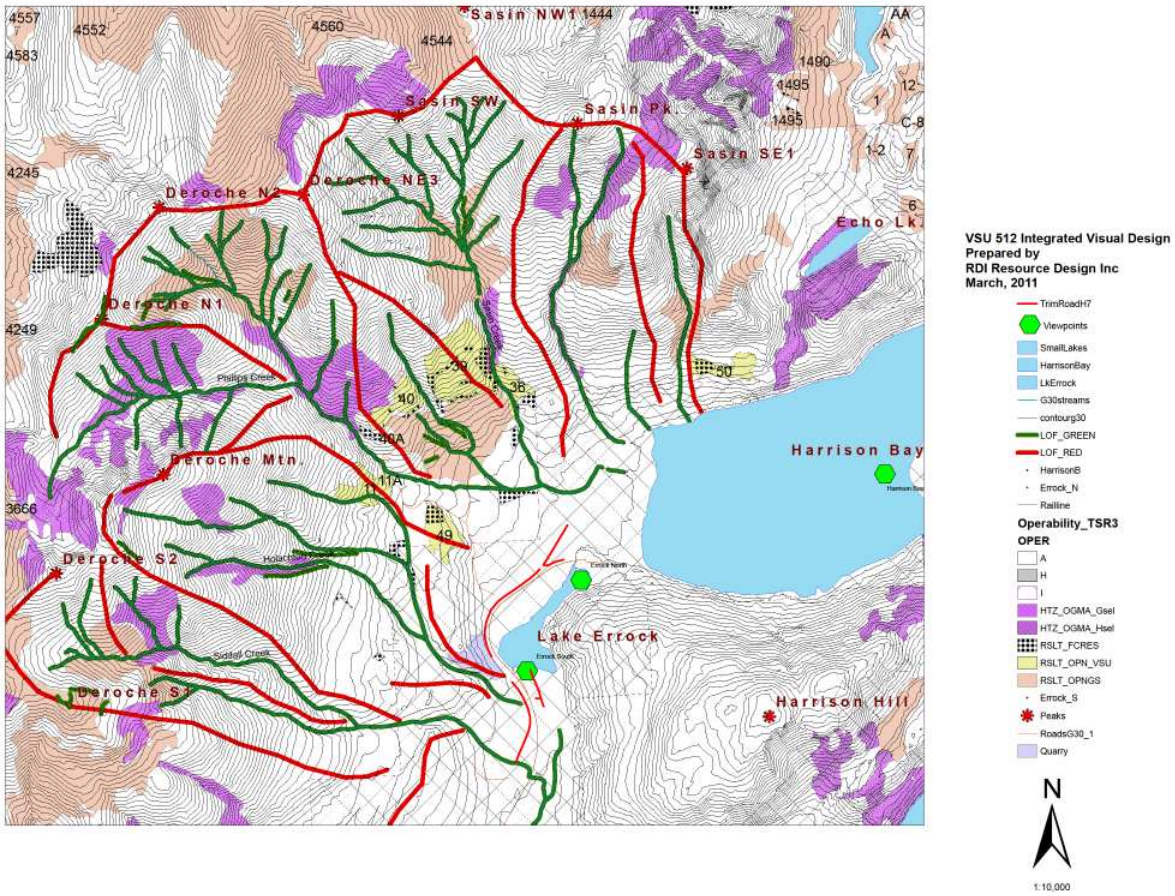

Figure 15. Constraints and Opportunities Map for VSU 512, showing VDUs.

v. Net Available Forest

The net available forest 25 m and greater after removal of constrained areas was then assembled for consideration in the design process (Figure 16). The source polygons from the VRI files were tracked by the Poly_ID that they were assigned in the file. This enabled their tracking as to forest species, volume, height, etc.

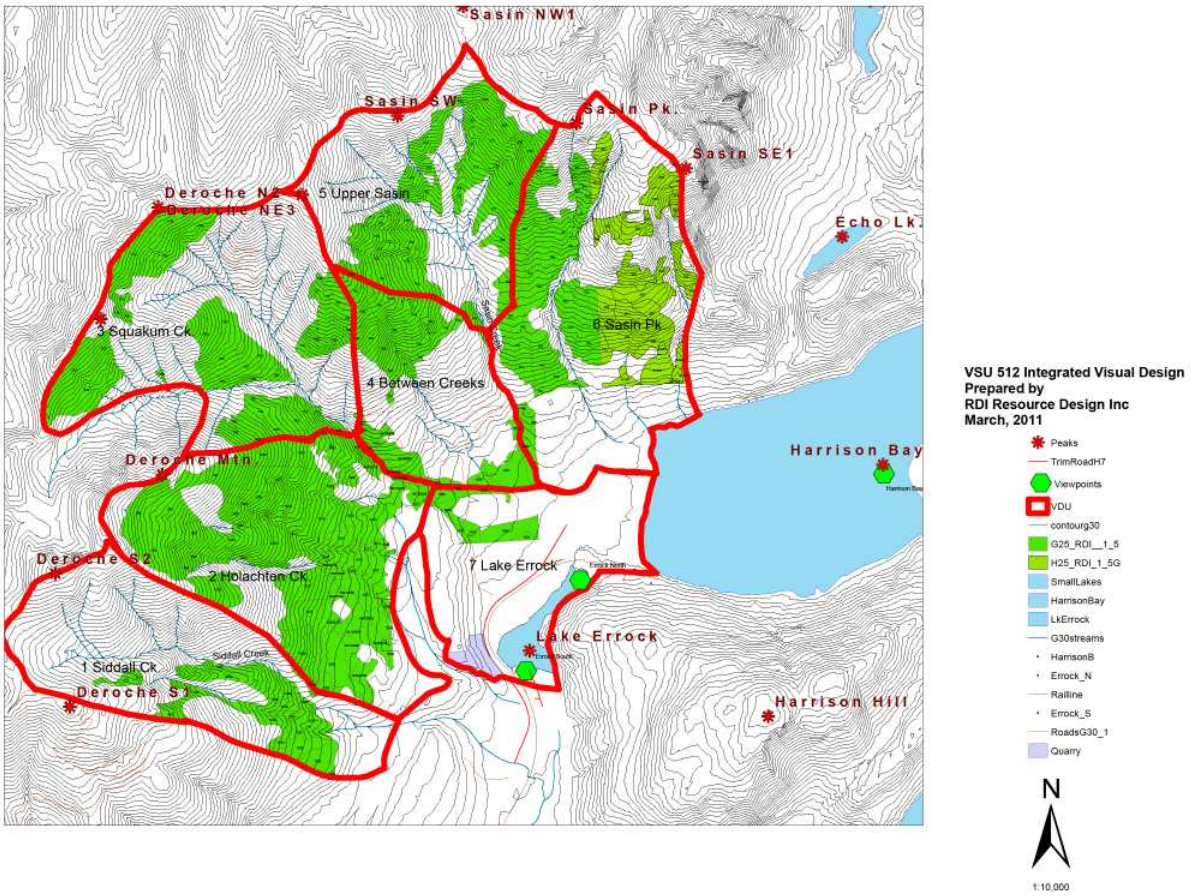

Figure 16. Map showing net available forest in VSU 512, with VDU boundaries.

C. Visual Design of Blocks and Phasing

In an iterative process, an entire array of potential harvest units (Resource Design Blocks) were delimited in ArcGIS to cover the entire available forest in each design unit. The design blocks were designed from forest polygons, in consideration of shape and scale relative to their landscape apparency, with less apparent blocks allowed to be larger, while more apparent blocks necessarily smaller. In addition, guidance was derived from terrain contours, and visual force lines. The purpose of designing the blocks was to be able to show what accessing the entire operable forest over time would look like, and, when completed, show the forest planner in charge of actual operations what an individually design block would look like from the viewpoints, and how it would fit into a large harvesting plan. The blocks were then assigned to one of five "harvest phases", the fifth phase (99) left unassigned as to schedule. These were mainly high on the terrain or patches along streams needing further information before inclusion (Figure 17).

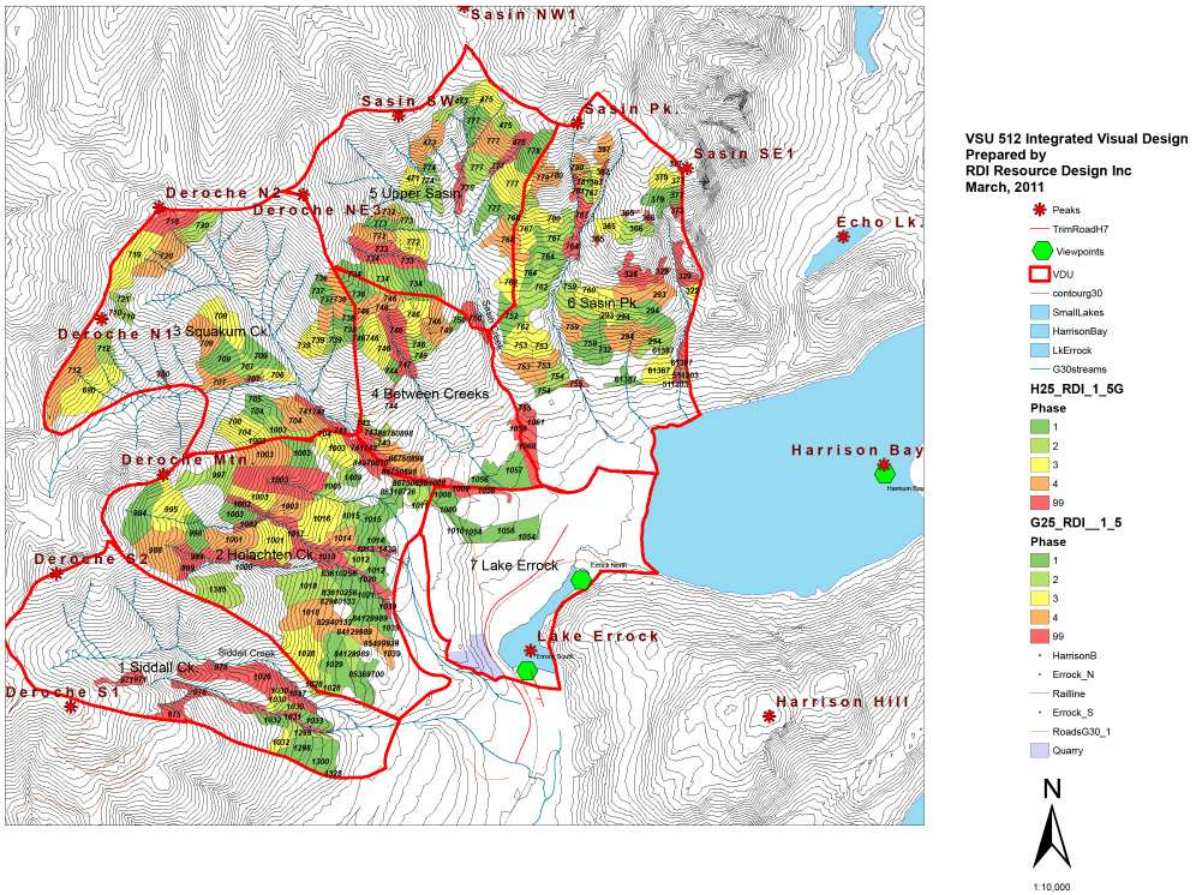

Figure 17. Integrated Visual Design Phase Map

The purpose of the phasing process was to separate the blocks temporally and spatially. Each phase was to be representative of a single period during with visually effective green-up (VEG)[5] could occur after harvesting about 5 m growth, in general), allowing that phase to re-grow and therefore subside, visually, into the landscape before the next phase could be harvested (approx. 15 - 25 years, depending on slope, and growing conditions, and apparency). The VRI polygon heights of the surrounding forest were held constant throughout the exercise, though the forest would acquire additional height through the phases which would contribute to further greening and screening. Forest polygons of young age (previously logged) which would eventually reach harvestable age in a long term plan were also held constant and not accounted for in the plan. More complex growth and yield and harvest planning programs would be required to accurately account for forest growth, such as UBC's Atlas-Simfor[6] modelling programs, as was used in one test in the recent GEOptics apparency research by Ken Fairhurst cited previously. A foreground gravel pit was left "as is" throughout the entire plan for reference.

Visual simulations were prepared for each phase using Visual Nature Studio from each of the two key viewpoints. With each successive phase, harvested blocks were assigned an initial 5 m green-up height, with successive additions in 5 m increments to age the alterations as time progressed. While green-up would be more advanced in the earliest harvested blocks in the phase, the portrayals were set as if each entire phase was harvested in one go. This all-at-once portrayal exaggerated the visual influence of each phase, having not benefitted from green-up of blocks harvested earlier in the phase. The results of the phases and their simulations from the viewpoints follow, first for Lake Errock South viewpoint (Figures 18-22), followed by Kilby Provincial Park viewpoint on Harrison Bay (Figures 23-28).

Using the images generated, percent alteration in perspective view from Lake Errock South viewpoint was determined for each Phase (Table 2)

Table 2. Percent Alteration in Perspective View - Lake Errock South.

Phase	% Alteration
1	7.15
2	6.07
3	10.89
4	8.55
5 (99)	8.83
Average 1-4	8.17
Average 1-5	8.30

[5] Visually effective green-up is re-growth sufficient to cover over bare ground and stumps, and seen as a regenerating forest to the average viewer.
[6] Available from the Faculty of Forestry, the University of British Columbia (http://www.forestry.ubc.ca/atlas-simfor/).

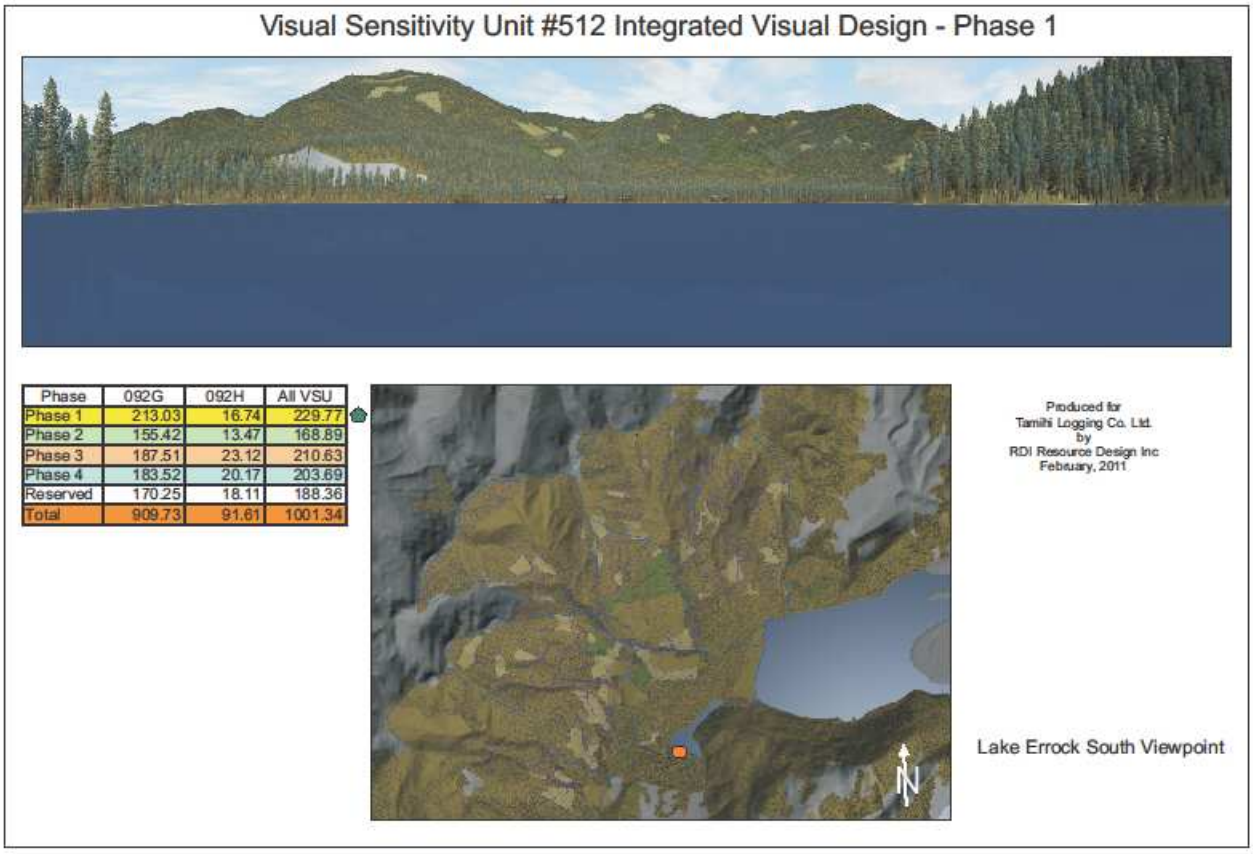

Figure 18. IVD Phase 1 - Errock South viewpoint revealing 7.15% alteration of the VSU in perspective view.

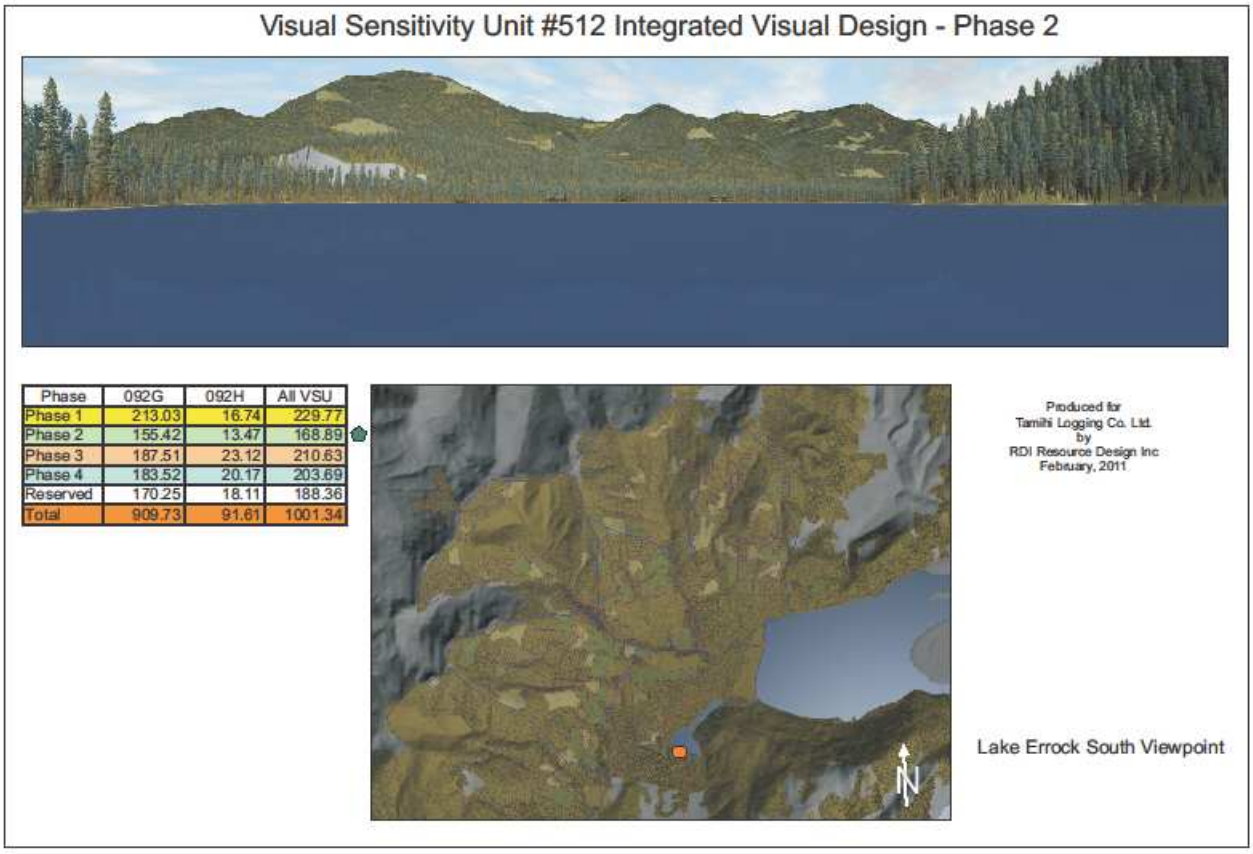

Figure 19. IVD Phase 2 - Errock South viewpoint revealing 6.07% alteration of the VSU in perspective view.

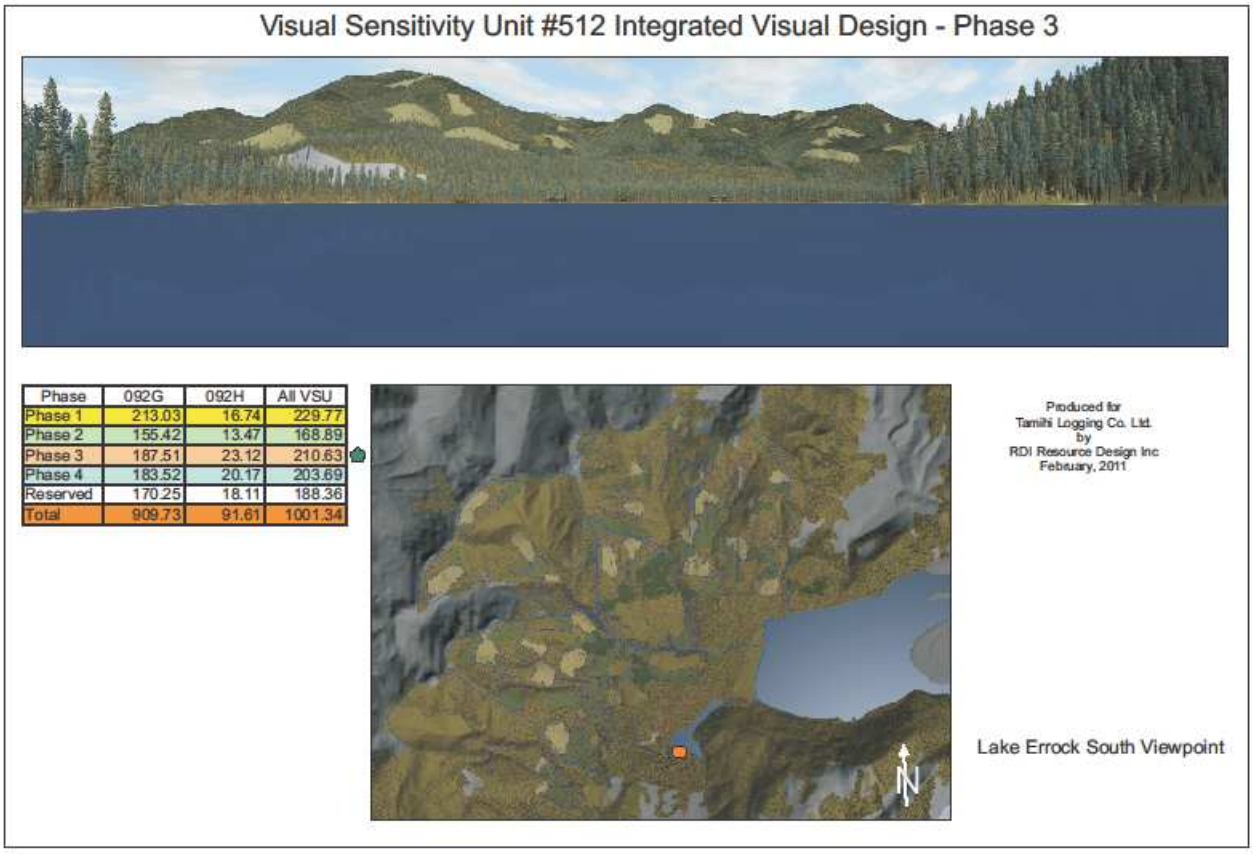

Figure 20. IVD Phase 3 - Errock South viewpoint 10.89% alteration of the VSU in perspective view.

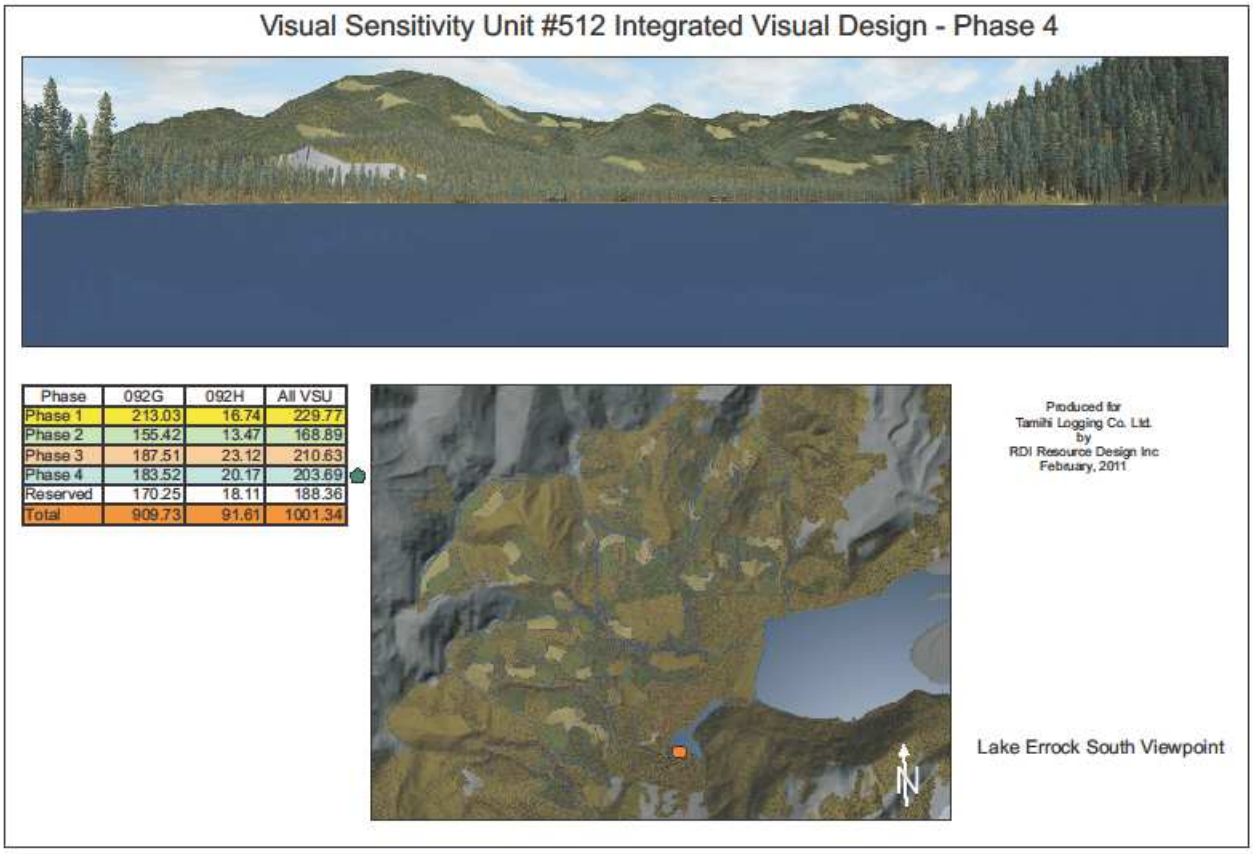

Figure 21. IVD Phase 4 - Errock South viewpoint revealing 8.55% alteration of the VSU in perspective view.

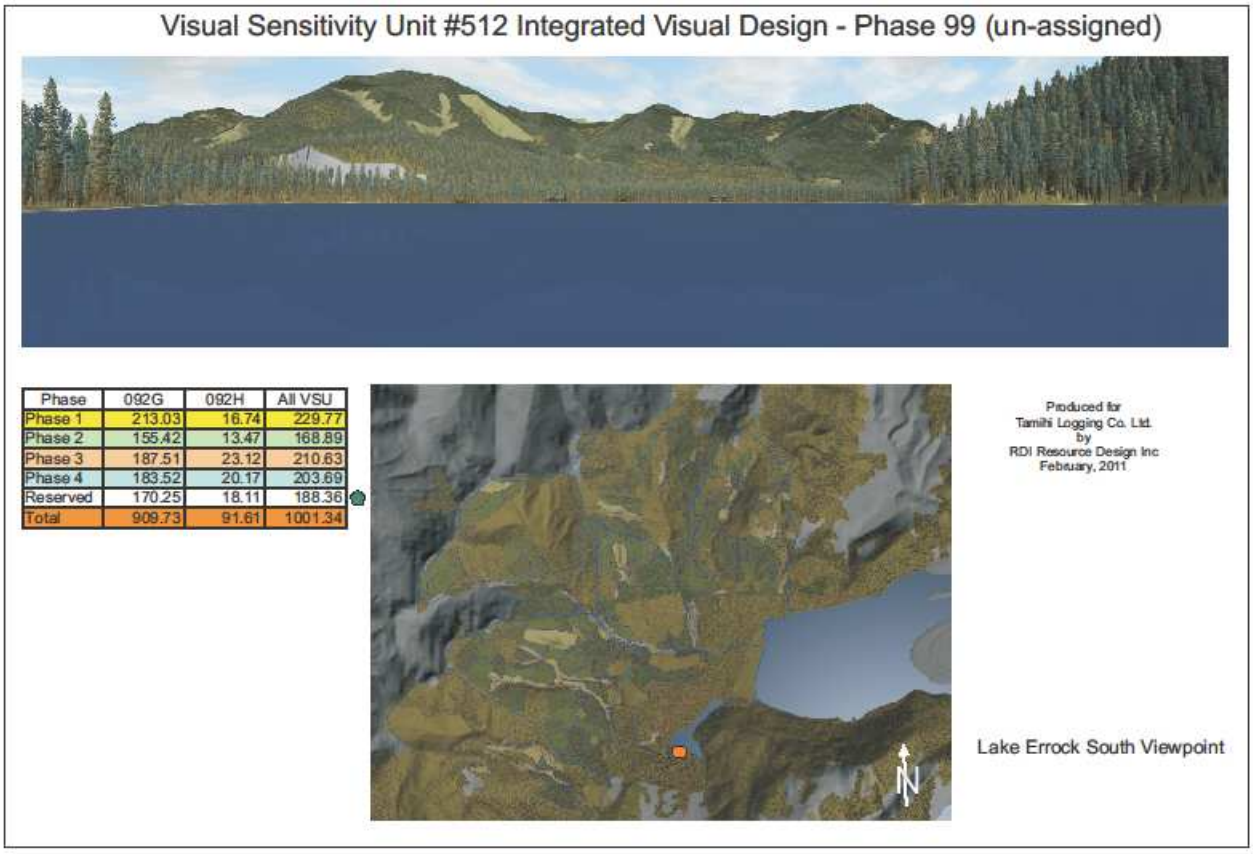

Figure 22. IVD Phase 99 (un-assigned) - Errock South viewpoint revealing 8.83% alteration of the VSU in perspective view.

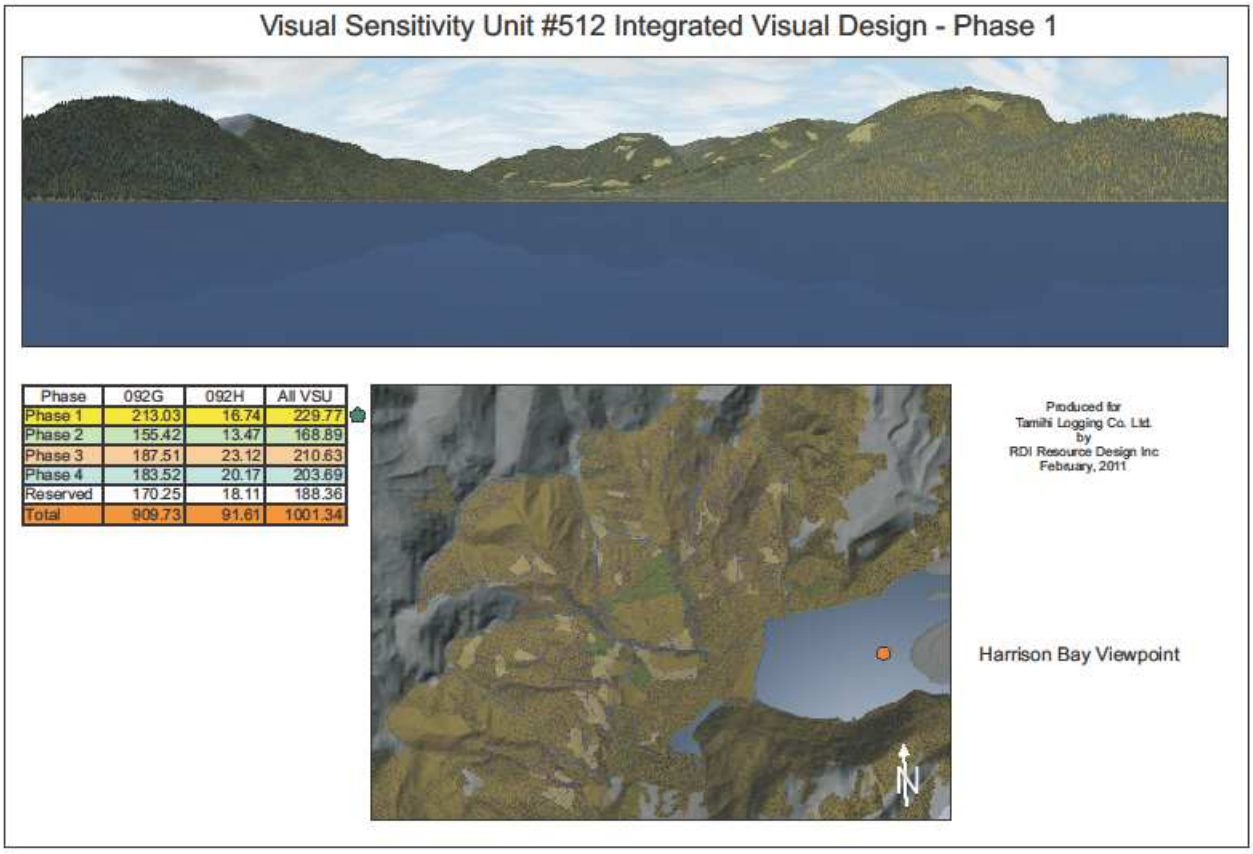

Figure 23. IVD Phase 1 - Kilby Provincial Park (Harrison Bay) viewpoint.

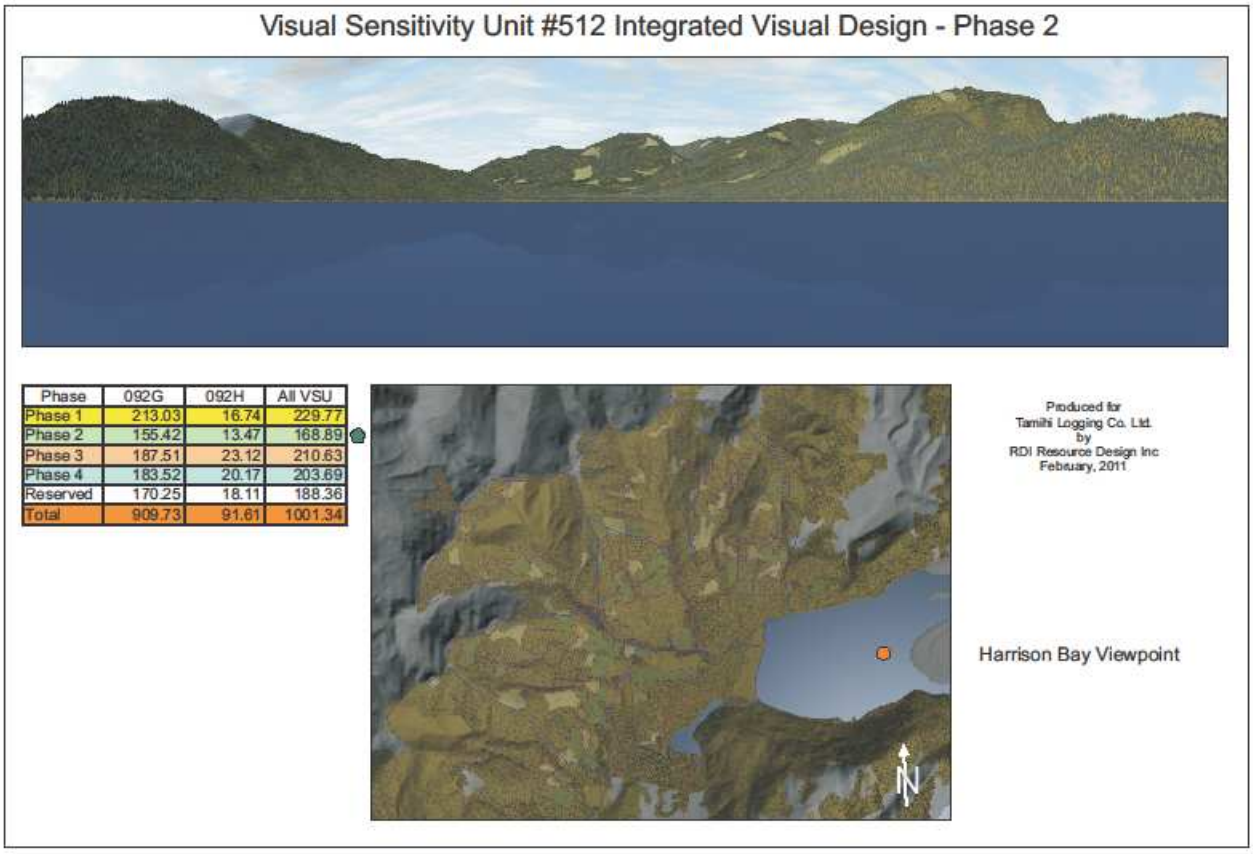

Figure 24. IVD Phase 2 - Kilby Provincial Park (Harrison Bay) viewpoint.

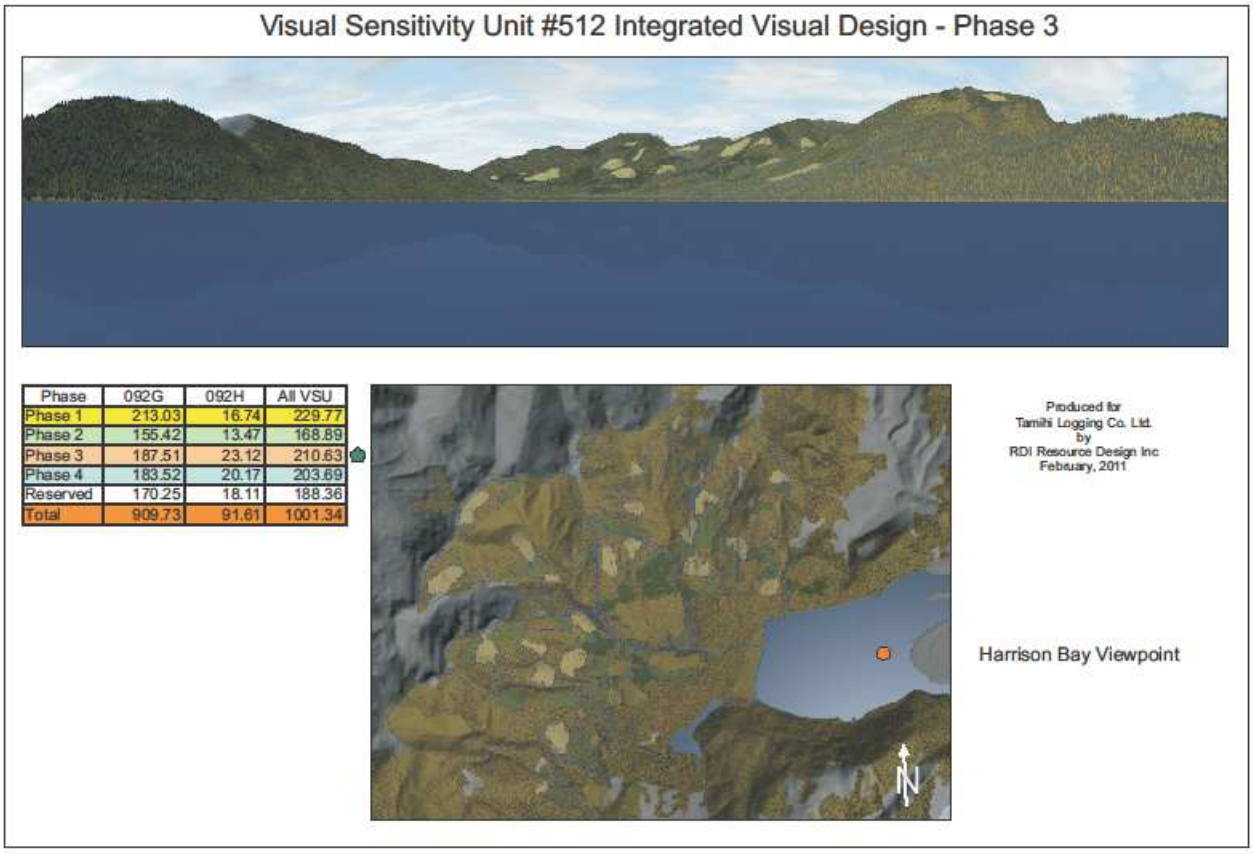

Figure 25. IVD Phase 3 - Kilby Provincial Park (Harrison Bay) viewpoint.

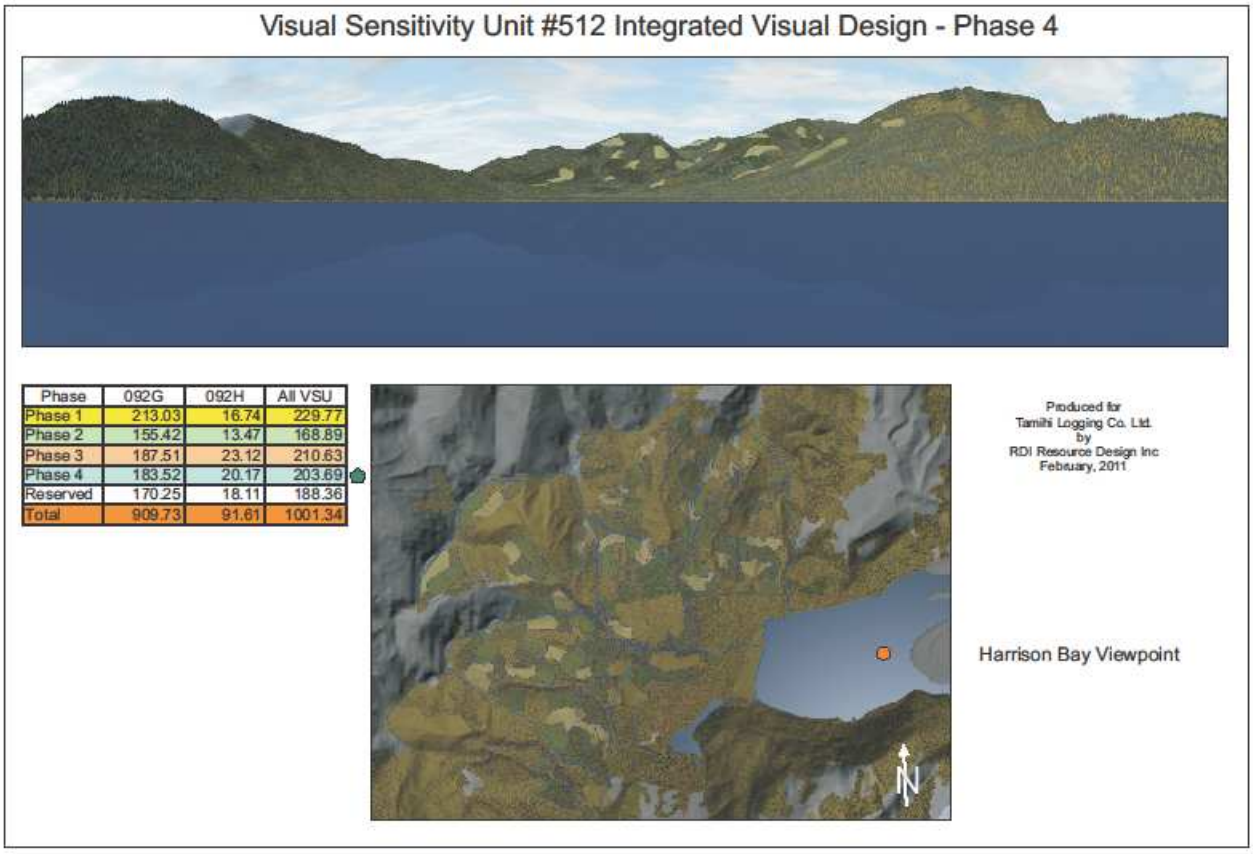

Figure 26. IVD Phase 4 - Kilby Provincial Park (Harrison Bay) viewpoint.

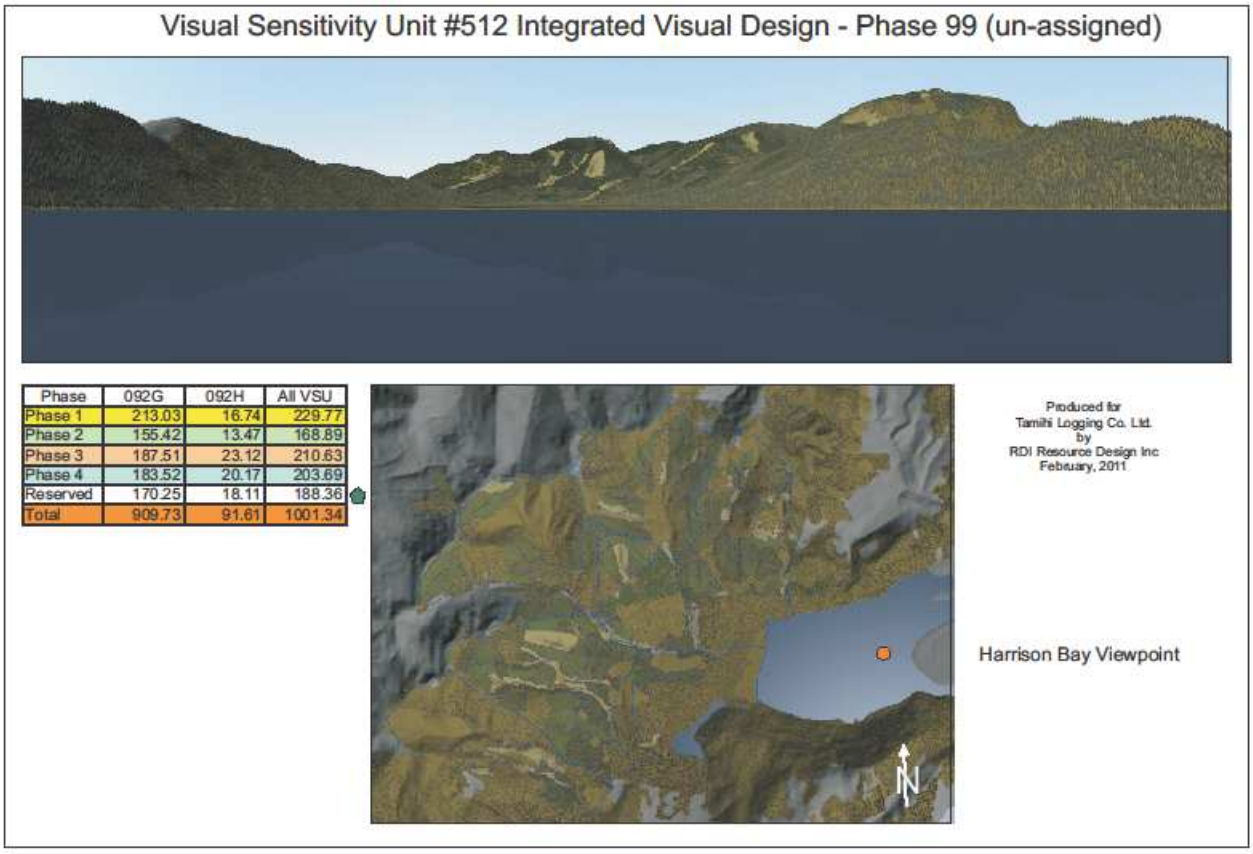

Figure 27. IVD Phase 99 (un-assigned) - Kilby Provincial Park (Harrison Bay) viewpoint.

4. Results, Conclusions, and Recommendations

Of the 2367.4 hectares in the VSU, 1001 ha were determined to be available for timber harvesting. Of that, 813 hectares were placed into the design blocks, and assigned to 1 of 4 phases. The additional 188 ha left unassigned (Phase 99) for future consideration could constitute a 5th final phase or blocks in it could possibly be interspersed within the first 4 phases. A phase period of 15 years would permit an average of 200 ha per phase or just over 13 ha per year for the 5 phases (75 years). The 3-dimensional visualizations allow easy tracking of blocks within each of the five phases, and provide an understanding of the visual impression contributed by each block and the overall patterns created by each phase.

The results are summarized in the following table (Table 3). The perspective alteration visual results of each Phase as seen from South Lake Errock, are shown in Column 7. Similar calculations from Kilby Park were foregone, as the viewpoint is more distant, and South Lake Errock was the key viewpoint used in the Forest Practices Board audit.

Table 3. Summary of VSU 512 Integrated Visual Design results.

VSU 512 IVD Phase	Phase RDB Area (Ha) Map 092G	Phase RDB Area (Ha) Map 092H	Phase RDB Area Total (Ha)	Phase RDB % of Total RDB Area in Plan View	Phase RDB % of VSU Area (2367.4 ha) in Plan View	Phase RDB % of VSU in Perspective View	Plan to Perspective Relation Plan/Pers (P2P)
Phase 1	213.03	16.74	229.77	22.95%	9.71%	7.15%	1.36
Phase 2	155.42	13.47	168.89	16.87%	7.13%	6.07%	1.18
Phase 3	187.51	23.12	210.63	21.03%	8.90%	10.89%	0.82
Phase 4	183.52	20.17	203.69	20.34%	8.60%	8.55%	1.01
Phase 99	170.25	18.11	188.36	18.81%	7.96%	8.83%	0.90
Totals	909.73	91.61	1001.34	100.00%	42.30%	41.49%	1.02
VSU 512			2367.4				
Averages			200.27	20.00%	8.46%	8.30%	1.05

As shown in Column 7, some phases exceed the PR limit of 7%, and the average by 1.3%. The timing within the phase would influence the amount of exposure at any point in time during each phase. The block design and scheduling are conceptual and will require fine-tuning initially and over time. Re-shaping, addition of leave-patches, or re-scheduling, in part or whole, of particular blocks may be necessary where some individual blocks may appear too angular or large, or block pattern is too concentrated in a particular area. Operability, accessibility, and economic issues will dictate final layout and scheduling.

As well, with all the unknowns of the future, including public expectations, the plan should be allowed to evolve, so that the further out phases will be capable of producing desirable outcomes. As the plan was developed as shapefiles with attributes, referenced to VRI polygons, sequencing can be easily changed, and revisions to polygon boundaries can be made.

The plan-to-perspective (P2P) values entered in the final column on the right express the ratio of how much planimetric alteration (map view) there will be in each phase compared to perspective alteration in each phase. The value would read as a ratio, e.g. 1.36:1 for the first phase, meaning that 36% more plan area can be altered in Phase 1 than shows up as altered in perspective view for the VSU, or 36% less visual impact potential per hectare of alteration. The result for Phase 1 is not surprising, as much of the non-visible or low landscape apparency blocks were assigned to Phase 1. The lowest P2P, 0.82:1 in Phase 3, is also not surprising, as that phase accessed more of the high visual risk areas of VSU 512 as determined in the landscape apparency analysis. This result means that the phase will show 10% more in perspective view than its proportion in plan view, or higher visual impact potential per hectare altered.

The plan revealed a high capacity to accept slow, well-designed harvest opportunities over the long term in VSU 512 at the rate directed by the Partial Retention VQO, or slightly above[7], and commensurate with operational realities of the "working forest". The VQO is consistent with all neighbouring VSUs along the Highway 7 corridor. There is no evidence of unacceptable harm of a relaxed Visual Quality Objective of Partial Retention for this landscape as experienced from the viewpoints, and particularly in relation to the neighbouring VSUs having that same VQO. It is therefore recommended that relaxation be sought under GAR. Should the plan be implemented, in concept, at least, the VSU will likely benefit from the mix of forest patterns and age classes, keeping the forest healthy and visually attractive over the long term.

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7 The next higher VQO is Modification, described as (a) large in scale with a design that is natural in its appearance, or (b) small to moderate in scale but with a design that has some angular characteristics.