Frederick Arm Integrated Visual Design

prepared for

International Forest Products Ltd.

by

RDI Resource Design Inc
Kenneth B. Fairhurst, R.P.F.

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Forest Investment Account
Project # 69072001

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Introduction

RDI Resource Design Inc was engaged by International Forest Products Ltd. (Interfor) to prepare an Integrated Visual Design (IVD) for the Frederick Arm area of TFL 45.

The intent of the IVD was to provide direction for the long-term development of the visually sensitive component of the timber resource in the operating areas in a manner consistent with higher-level planning direction and respectful of other resource values. Employing a process that considers all resource values simultaneously in an integrated fashion, the IVD is a strategic plan focussed on optimising harvest opportunities without compromising desired visual quality. The process follows the approach defined in the guiding document: Integrated Visual Design Procedures and Standards, Revised April 10, 2008[1].

The process may be thought of in terms of three major phases (as paraphrased from the procedures document):

1) Inventory

Inventory is concerned with gathering information about a site's abiotic, biotic, cultural, ecological and regulatory influences. The inventory first defined the visible area for the IVD, called the visual design unit (VDU) (Figure 1)[2]. A critical step in the VDU delineation task was the selection of the project viewpoints. Project viewpoints were to be representative of the means of travel or use of the average visitor or traveller in the area (i.e., boat travel), and account for Visual Landscape Inventory (VLI) viewpoints, main boating routes along Cordero Channel, and secondary travel routes along Frederick Arm. The existing 1995 Visual Landscape Inventory provided much of the needed visibility information, refined by GIS viewshed analysis (Figure 2).

2) Analysis

Analysis is focused on identifying the dominant patterns, structures, and functions of a landscape. The process combines and interprets resource information such that its significance is understood as to what the site can actually produce in terms of timber and other resources, and the limitations and opportunities for use and management.

3) Design

Design employs the understanding gained about structure, function, and limitations or opportunities, to development, to guide the physical design of the VDU. It fully incorporates visual considerations into the design, such as shape, scale, pattern, visual

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[1] The procedures document is available for downloading at http://www.for.gov.bc.ca/hfp/publications/00040/FIA-Standards-Final.pdf.
[2] All maps and images were also provided Interfor as individual pdf's for closer inspection. Each pdf is entitled with the figure number for easy cross-reference.

force analysis, verbal definitions of visual quality classes, and alteration limits assigned to those classes. Each of the criteria are assessed as would be experienced from the viewpoints, in the quest to assure that the established visual quality objectives can be achieved over the short and longer term.

The IVD approximates how long-term forest development could occur over time within the Frederick Arm VDU. It has been prepared on the basis of digital data, map projections, and with visual reconnaissance from the water-based viewpoints. As such, the plan should be considered conceptual only. To ensure the feasibility of plan implementation, further, more detailed, consideration and additional ground assessments are warranted.

This report offers a brief summary of the design objectives, assumptions, and criteria employed in the development of the plan, supported by graphic and numerical analyses.

The procedures were as follows:

1 Define Visual Design Units (VDUs)

The Frederick Arm VDU was defined by the visible south-east-facing portions of the TFL 45 landbase in Frederick Arm (Figure 1).

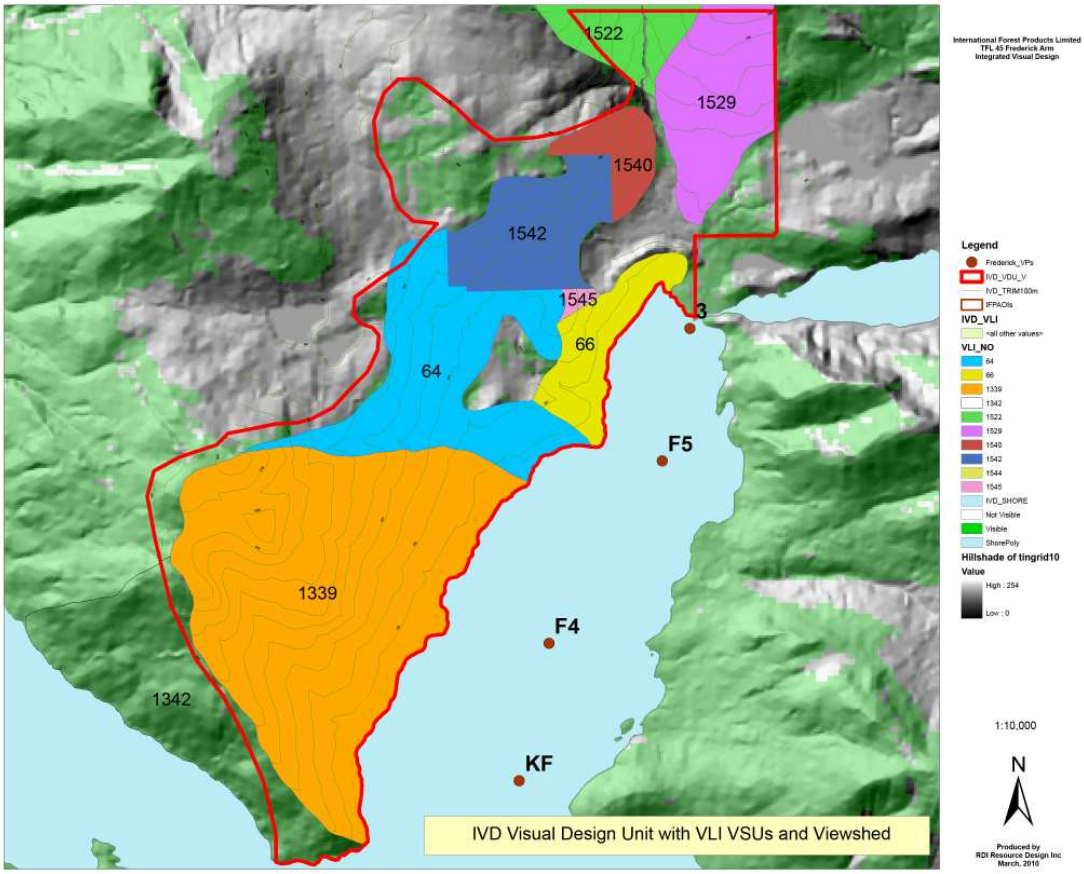

Figure 1 Frederick Arm Visual Design Unit with VLI Visual Sensitivity Units

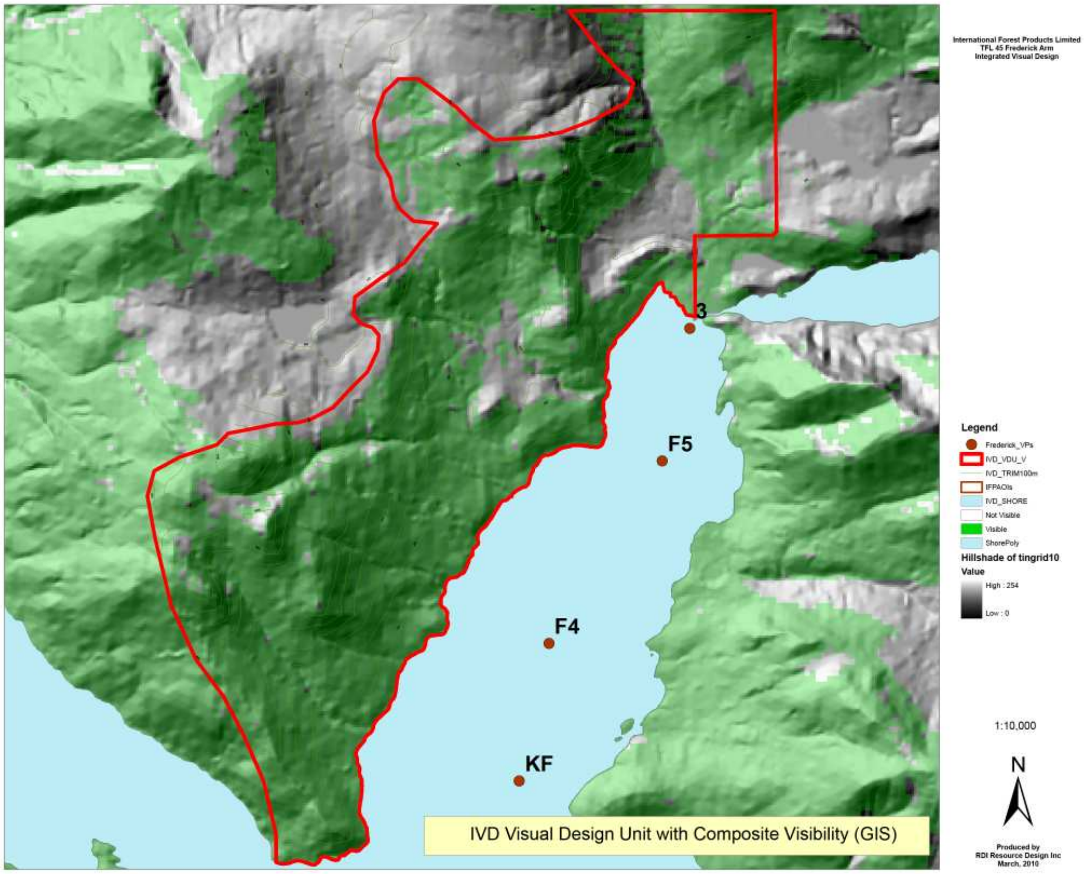

Figure 2 Frederick Arm Composite Viewshed (Visibility) Map

2 Phase 1 (Objectives)

2.1 Pre-work

Telephone and email communications were conducted with Dave Wolfe, Interfor Engineer.

2.2 Viewpoint Selection

Three key viewpoints spanning 3400 m of the 5800 m waterway were selected from the Visual Landscape Inventory (VLI). These were, F4, F5 and 3. An additional viewpoint was added to capture the southern portion of the VDU (viewpoint KF), providing a total span of 4700 m. More southerly viewpoints in Cordero Channel (F3, and HP1) were tested in the visual simulation model but presented similar, though more oblique views compared to the KF viewpoint (Figure 3). Viewpoint C1 offered obscured views of much of the VDU and was deleted from consideration.

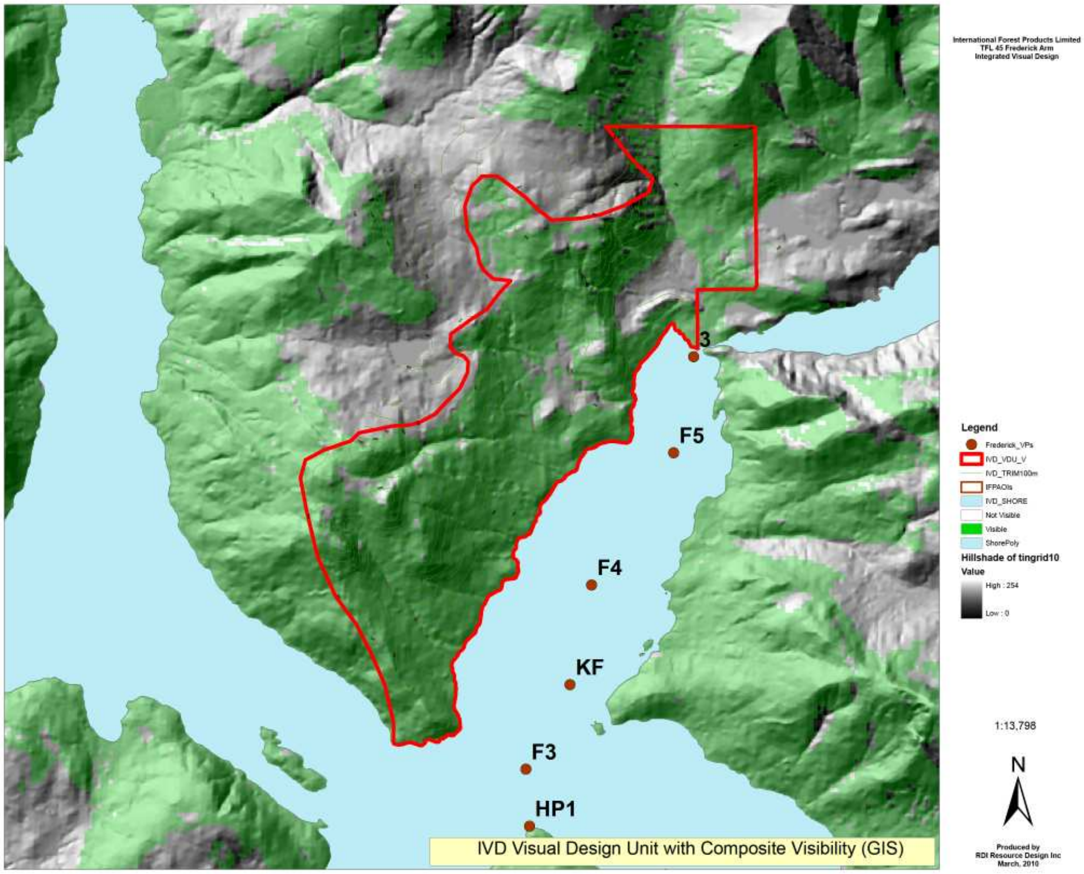

Figure 3 Map with all Viewpoint Coverage

2.3 Photo Coverage

Photo coverage of the entire expanse of the VDU was obtained from seven representative viewpoints by Interfor on July 15, 2009. These were HP1, F1, F3, Oleo, F4, 7, F5 and 3. Viewpoint F1, not shown on the map, is in Cordero Channel, east of HP1; Viewpoint Oleo is near the small island on the east shore between KF and F4, and Viewpoint 7 is along the east shore between F4 and F5. Lighting conditions were excellent. Viewpoints were registered by the chartered boat's GPS. Four final analysis viewpoints were selected. These were Viewpoints KF, F4, F5, and 3. Fig. 2 and 3. These viewpoints were selected as providing adequate coverage and were used for computer visualization purposes. The pictures were digitally placed into panoramas by RDI, using Panorama Maker 4 (Figure 4).

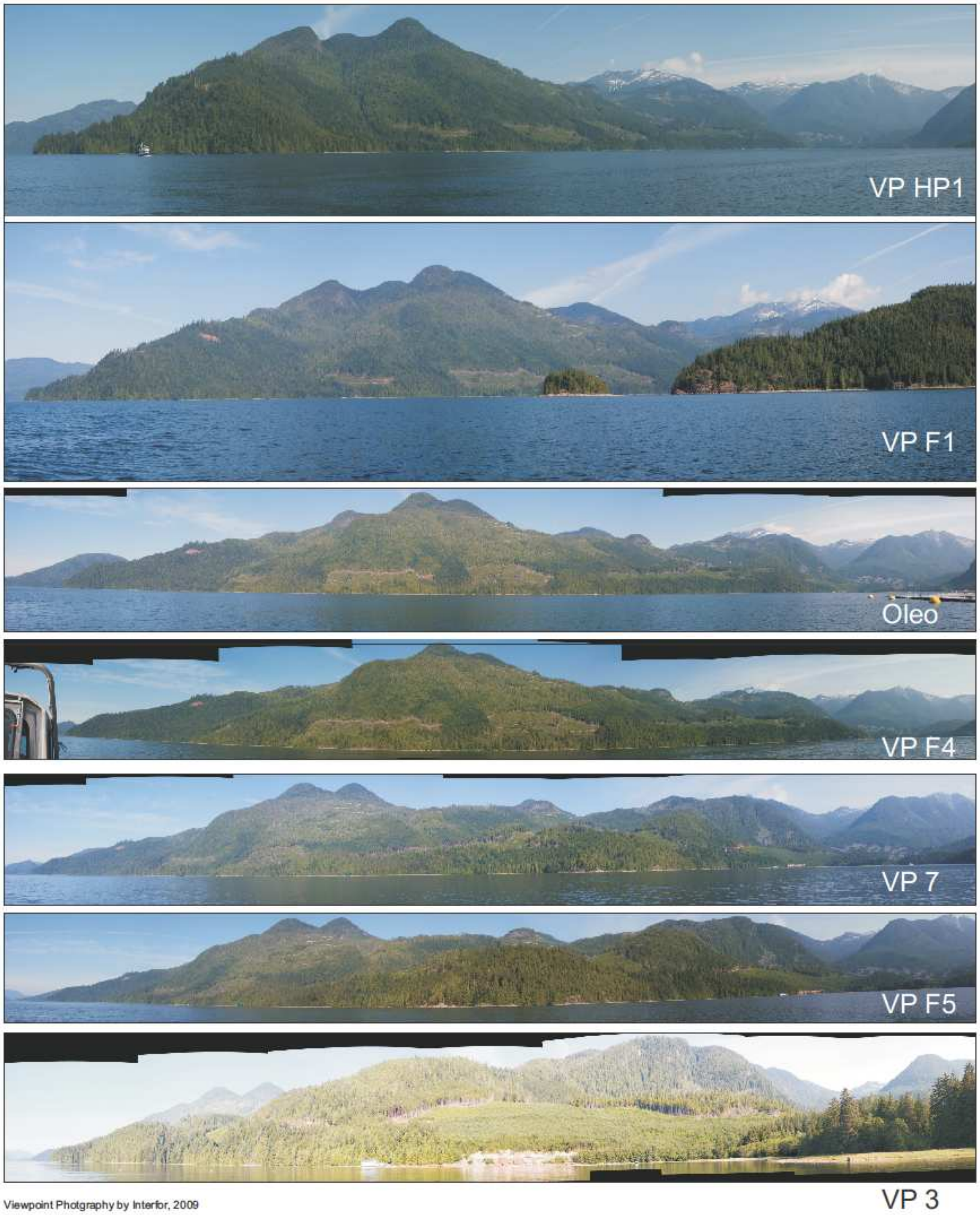

Figure 4 Photo-panoramas

2.4 Visual Design Unit Definition

The VLI map was assessed to identify the main coverage area for the VDU (Figure 1), and was refined by generating the composite visible area map (Figures 2 and 3). The VDU is part of a broader landscape and viewing experience from Frederick Arm and Cordero Channel. Activities within the VDU will have an influence on neigbouring landscape units and vice versa. A broader plan could consider the entire Frederick Arm landscape, but was outside of the terms of the IVD contract.

2.5 Resource Objectives

Design objectives identify the targets which the design plan aims to achieve. These were determined through 1) direct consultation, 2) reference to management goals and objectives, 3) reference to the specific resource management goals, and 4) reference to the relevant legislation and policy governing activities in the planning area.

Consultations were conducted primarily with Dave Wolfe, Interfor Engineer (Figure 4).

Reference was made to the specific resource management goals and objectives presented in the TFL 45 Forest Stewardship Plan. The Forest and Range Practices Act and its Regulations provided specific guidance in the IVD.

The following resource objectives and values were considered in the development of the plan:

Visual Quality Objectives

The plan was to meet the established VQOs of Partial Retention (PR) and Modification (M) as indicated in the provided Visual Landscape Inventory map (Figure 1) All Visual Sensitivity Units in the VLI map have a Partial Retention VQO except for VSU 1522 at the top end of the licence which has a Modification VQO.

Timber Flow (Annual AAC)

The objective was to maximize harvest opportunity while meeting VQOs. The plan was to incorporate all operable forest over one rotation in four phases of approximately 20 to 25 years per phase. The plan did not account for subsequent re-growth over the period nor did it include re-growth in recently harvest areas. The Interfor Forest Inventory provided the base information as to species, heights, volumes per hectare, with updates provided for recent harvesting (Figure 5).

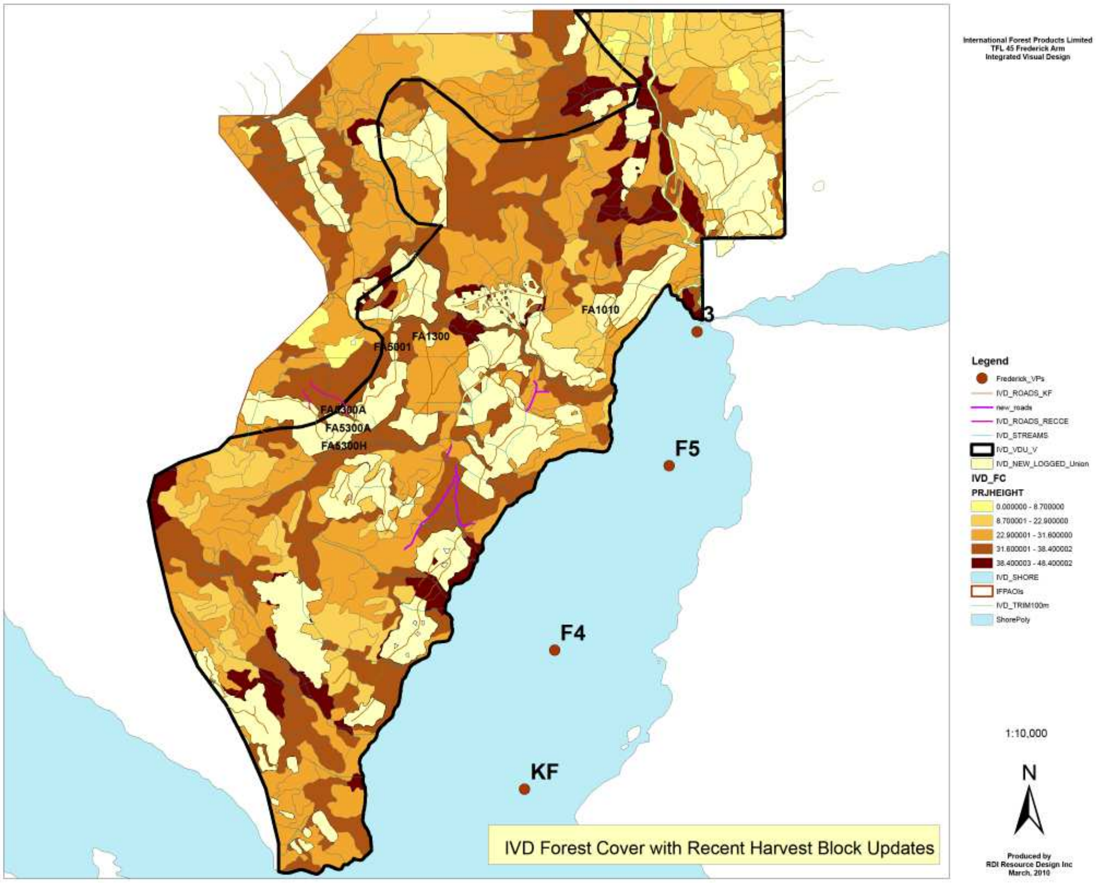

Figure 5 Forest Cover Projected Heights from Forest Inventory (updated)

Recreation/Tourism

Frederick Arm is connected to Cordero Channel, a primary recreational boating route. Though actual use of the arm is lower than the main channel, it is easily accessible over its 5800 m length, and provides anchorage and beach activities.

Water Quality (Riparian areas)

Riparian Management Zone, Classes 1-3, were identified in digital files provided by Interfor and included as reserve zones (Figure 6). The map also shows Riparian Management Areas in a lighter blue. Unlike RMZs, the RMAs represent stream considerations such as retention levels rather than avoidance.

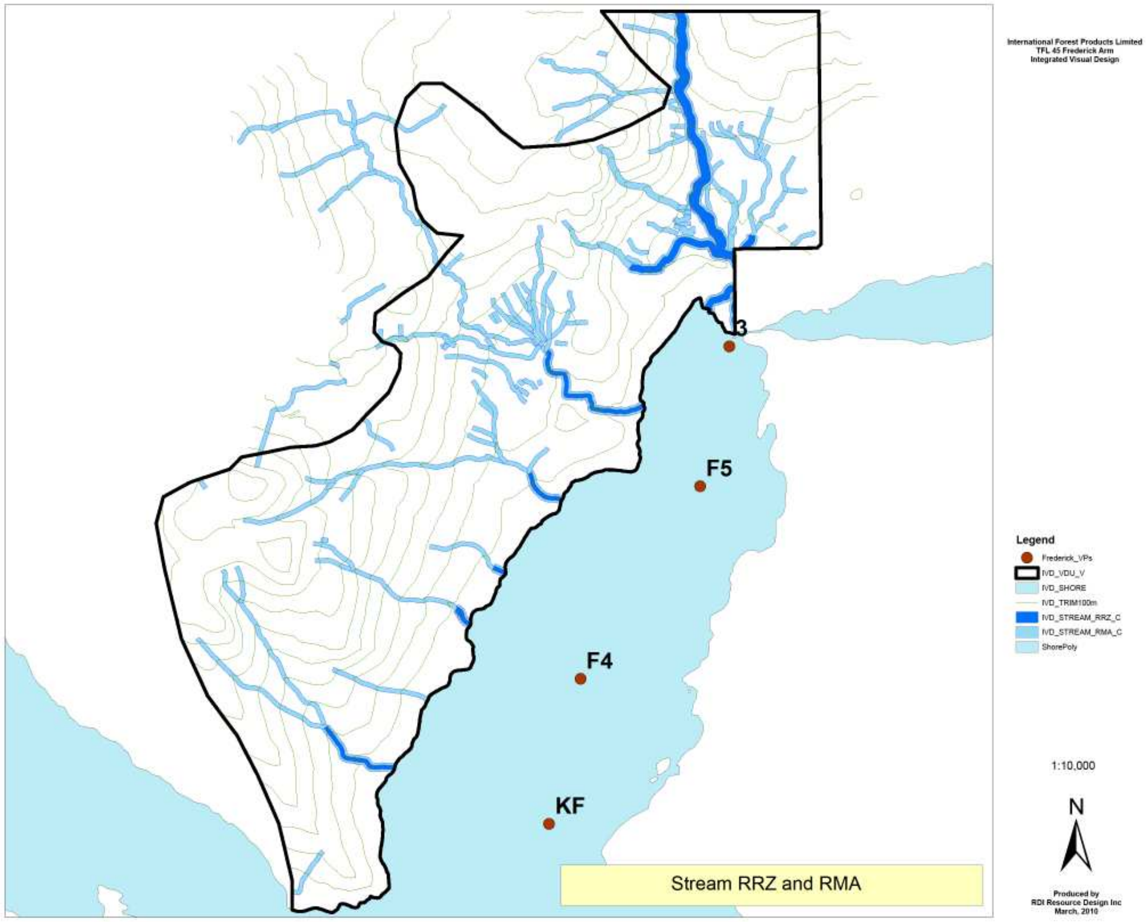

Figure 6 Riparian Management Zones

Fish / Wildlife Resources

Interfor provided digital map layers for Marbled Murrelet areas (MAMUs), Grizzly, and high value habitat (HVHA for fish). These were combined into a composite constraints map (Figure 7). No wildlife tree patches were identified, nor determined in the plan. The MAMUs were provided while recognizing that they are currently subject to review. The map also shows unstable terrain, the RMAs and RRZs, as well as non-productive forest types.

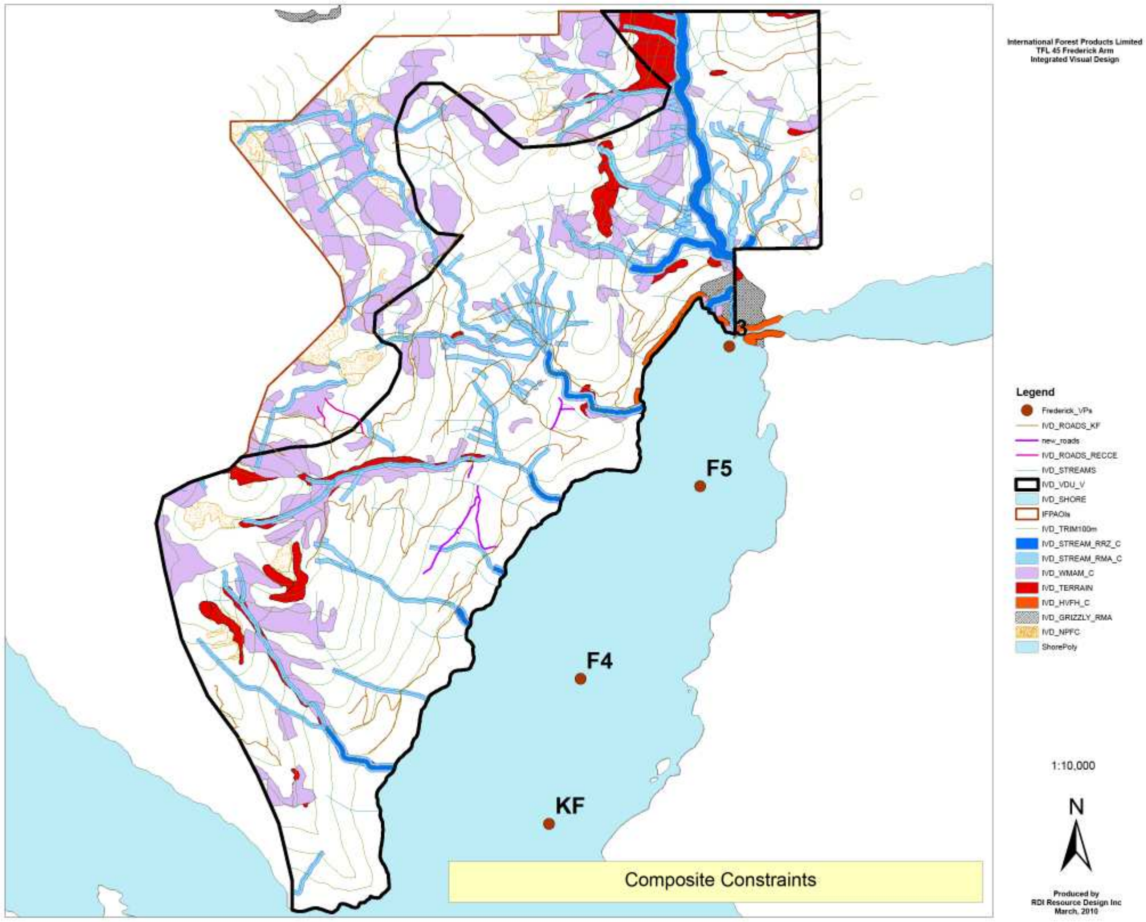

Figure 7 Composite Constraints Map

Cultural Heritage

No information provided by Interfor. No consultations with First Nations representatives was conducted by RDI.

Soils and Terrain Hazard

Terrain Classes IV and V were provided as digital mapping layers by BCTS. These areas were avoided in the plan (Figure 7)

Forest Health

No information was provided.

2.6 Resource Inventory

A resource inventory was completed for the VDU. The analyses are presented together in the maps and computer simulations as they can be viewed together and will influence each other. The information gathered for the analysis covered the following information in ArcMap feature classes or shapefiles. Each of the layers of information were added to the GIS project for analysis and output as map products. The inventory maps already presented and discussed in the previous section are referenced in the list below. Additional maps are referenced and presented following the list. The maps generally speak for themselves.

2.6.1 TRIM Contours (Figure 8)

2.6.2a Vegetation Resources Inventory (Figure 5)

2.6.2b Operability

2.6.3 Visual Landscape Inventory (VQOs, EVC, VAC, VSC) (Figure 1)

2.6.4 Recreation Features Inventory (no features mapping available)

2.6.5 Recreation Opportunity Spectrum (no mapping provided)

2.6.6 Riparian/Wetland (Stream Class S1-3) (Figures 6 and 7)

2.6.7 Wildlife Management Areas (grizzly, MAMU) (Figure 7)

2.6.8 Terrain Hazard (Class IV and V) (Figure 7)

2.6.9 Forest Health Factors (none made available)

2.6.10 Cutblocks (existing) (Figure 5)

2.6.11 IFP Roads (existing and proposed) (Figure 8)

2.6.12 Composite Visibility (Figure 2)

2.6.13 Old Growth Management Areas (not provided by Interfor)

The feature classes and shapefiles were entered into ArcGIS 9 for analysis, and maps output for use in the report (pdf).

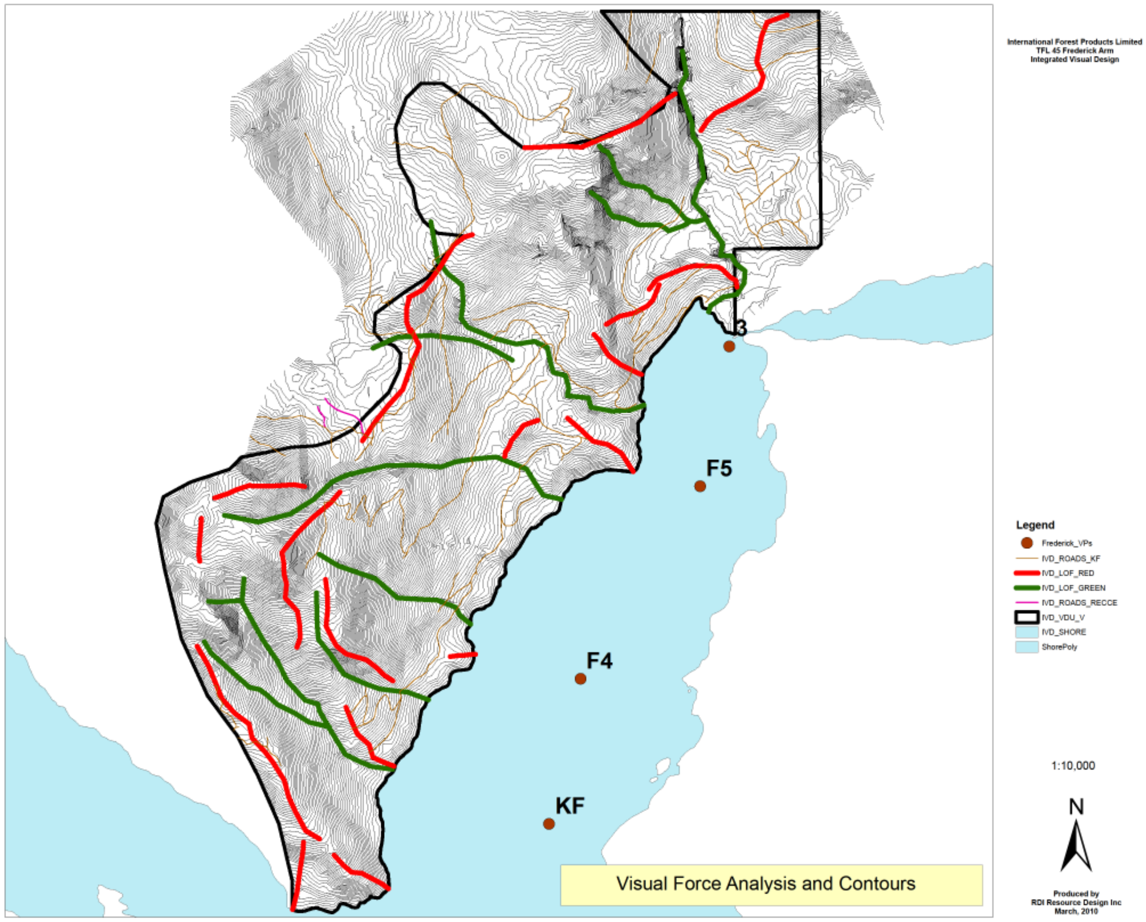

Figure 8 Contour Map (Interfor) with Roads and Visual Force Lines (RDI)

3 Phase 2

3.1 Resource Analysis

The following analyses were completed:

3.1.1 Operability Assessment

The net operable forest was determined to be all forest except young (recent harvesting, Riparian (S1-3), Grizzly, High Value Habitat, and non-productive brush (Figure 9):

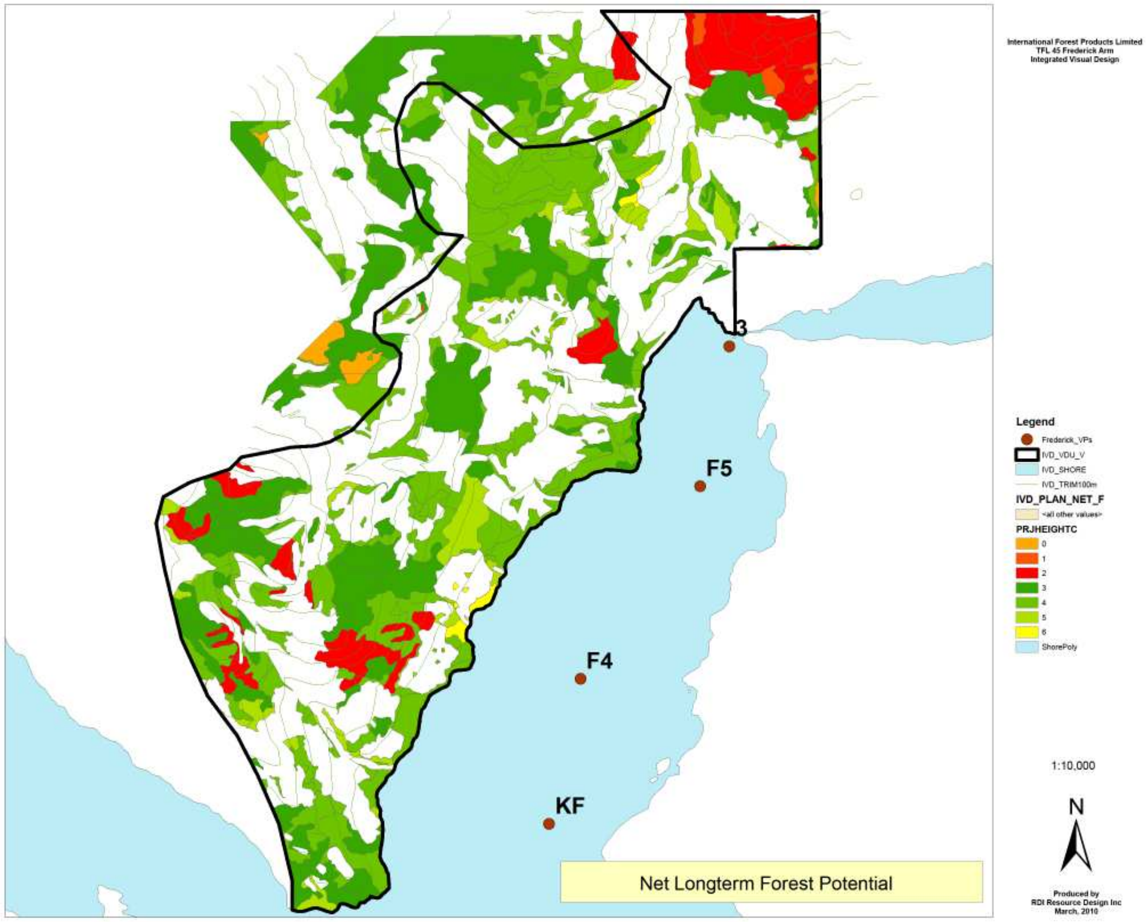

Figure 9 Net Operable Forest - Concept Design Priority Areas:

3.1.2 Visual Force Analysis

Visual force is a concept of how humans access and interpret the visual landscape. By convention, it is considered that the eye tracks up hollows (green) and down ridges (red) as presented earlier (Figure 8). Visual force lines are also used to guide design. Main force lines indicate the structure and flow in the landscape. The main force lines in the landscape were first used to identify and shape the Visual Design Units themselves. Forest components under the force lines are prominent and important for maintaining the structure and flow. While these components can be considered for harvesting over the long term within a comprehensive visual design, alterations should be avoided which truncate or otherwise conflict with significant force lines, and should merge upwards in the hollows and downwards on the ridges. Visual force lines were developed in ArcMap for consistent application and tracking in planimetric and perspective analyses. Lines are added to the perspective view using CorelDraw. They were given a common weight as they indicate major ridges (red/down) and creek draws (green/up) (Figure 10). The figure used the constraints image. showing riparian zones in the creeks (blue) and Terrain hazard (red) and MAMUs (orange) on the hills

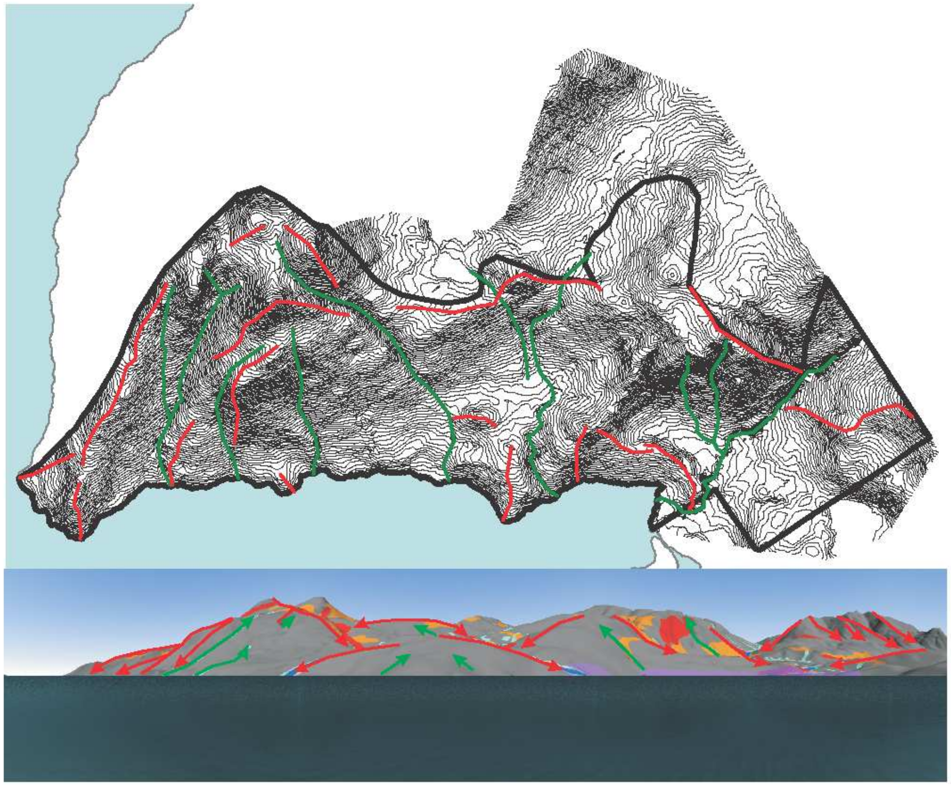

Figure 10 Visual Force Analysis in Plan and Perspective Views; with Constraints

The IVD procedure employed 3-dimensional simulation tools, using Visual Nature Studio software to examine the VDU analyses and plans in perspective view from the viewpoints.

3.1.3 Land Feature Analysis

The photo-panoramas were assembled for the analysis (Figure 4).

Using a single panorama (3-D) as an indicator, together with a key map, patterns and features were identified, including cut blocks, mountain features, creeks, shoreline (Figure 11).

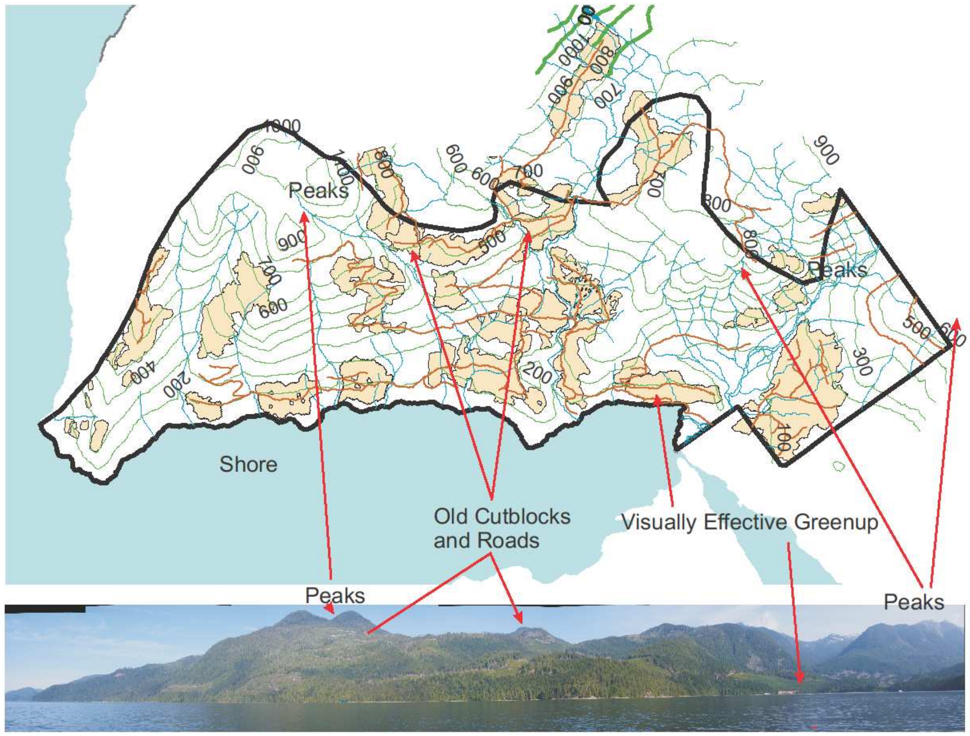

Figure 11 Land Feature Analysis in Plan View and Perspective View (VP F5)

3.1.4 Opportunities and Constraints Analysis

The collective constraints, in relation to the operable/available forest, were examined. Design issues were identified and considerations devised that could aid in the detailed design of harvest areas. A table of each resource/condition and the opportunities and limitations to development was created, as follows (Table 1):

Table 1 Design Issues and Opportunities

Design Issues and Opportunities

Visual Force	Guide patterns of development
Land Features	Reveal existing patterns/focal points (natural/human made)
VQO/EVC	Go/no go and intensity
Riparian	Reserves are shaping influences
HVFH	Reserves are shaping influences
MAMU	Murrelet Reserves are shaping influences (subject to review)
Steep Slopes	Reserves are shaping influences
Terrain Hazard	Reserves are shaping influences
Grizzly	Reserve
Cutovers	Guide patterns of development / scheduling consideration
Non-Productive	Guide patterns of development / scheduling consideration
Roads	Guide patterns of development / scheduling consideration
Forest Health	Guide patterns of development / scheduling consideration

The constraints identified in the resource inventories (Section 2.5.1 and 2.6) and the issues and opportunities described in the table above provide a significant and comprehensive influence on what might happen in the future in the Frederick Arm VDU. By no means is the Frederick a 'blank slate" for visual landscape design. When placed together, the Frederick is a complex composite of existing conditions (Figure 5) and constraints (Figure 7) and, in response to the constraints and opportunities, the forest available for integrated visual design (Figure 9).

The constraints were added to the VNS model in order to generate perspective 3-D views. A different, more distinctive colour coding approach was assigned to the constraints in the VNS model to provide greater distinction on the grey background of the terrain model. A planimetric image was generated and rotated to have the viewpoints at the bottom to relate more easily to the orientation of the views (Figure 12).

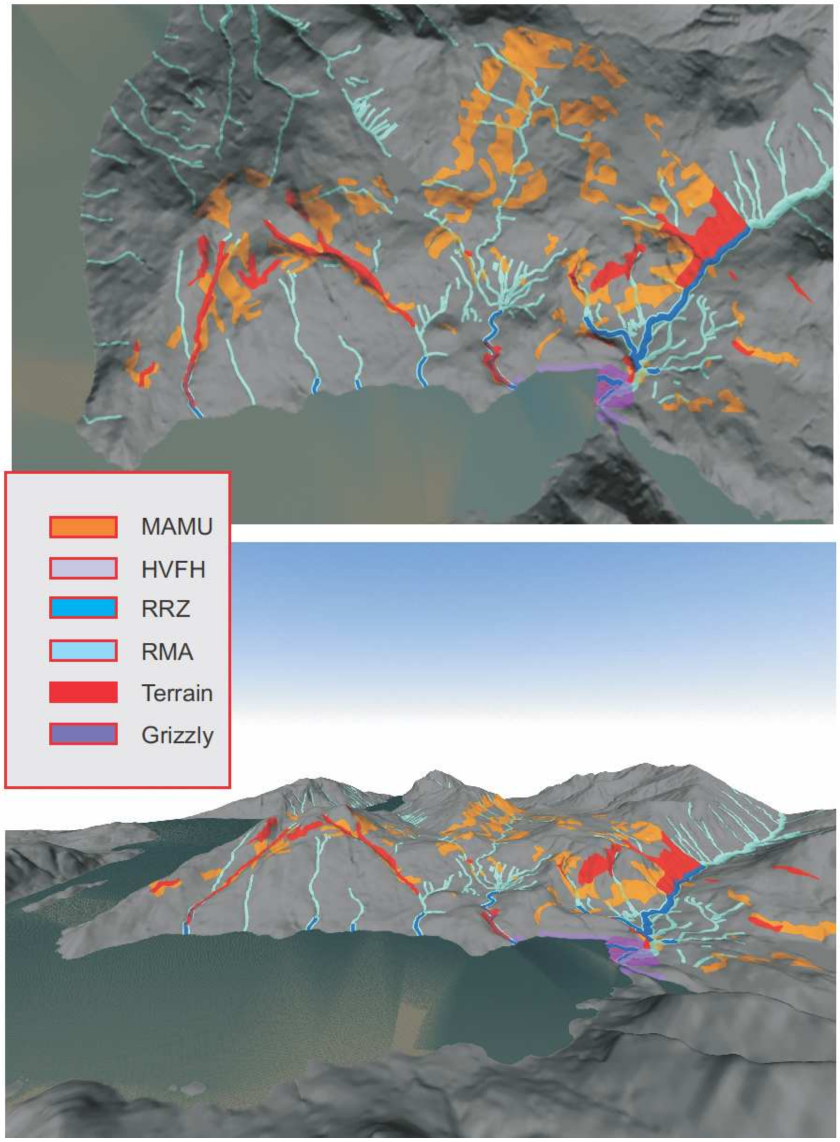

Figure 12 Constraints in Plan and Perspective Views

The aerial perspective provides a 3-dimensionsal overview of the constraints on the landform. The constraints are also shown in perspective view from each of the 5 design the viewpoints. These are shown in the collective image sheets for each viewpoint provided in Phase 3 which follows.

4 Phase 3 Design

The following procedures and products were completed for each VDU and collectively presented herein:

4.1 Concept Design Areas

The operable/available forest (Figure 9) was grouped into 13 Concept Design Areas (CDAs)[3] after netting out reserves, recent alteration, non-productive areas, low volume areas (<100m3 / ha). The design areas were determined by two principal influences - the available forest (location, patterns, and extent) in the VDUs, and major visual force lines (creeks and ridges) (Figure 13).

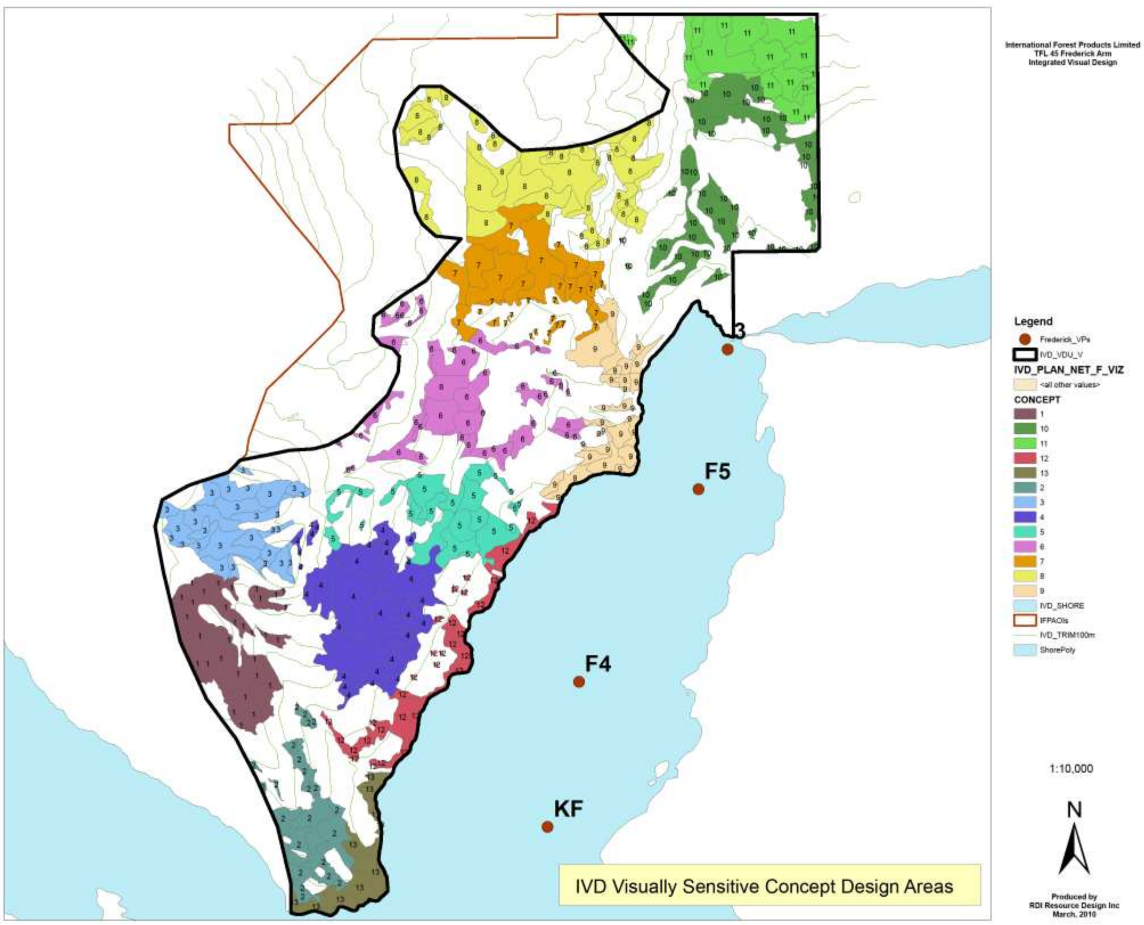

Figure 13 Concept Design Areas

[3] Concept Design Area (CDA) is a name derived by RDI.

Each CDA was comprised of many cells derived primarily from the forest cover polygons. The attributes of the forest cover polygons were maintained in each cell to support decision-making in the detailed design stage (Section 5.2).

The available forest was then classified as to priority using the following classification system developed by RDI together with Interfor (Dave Wolfe) (Figure 14).

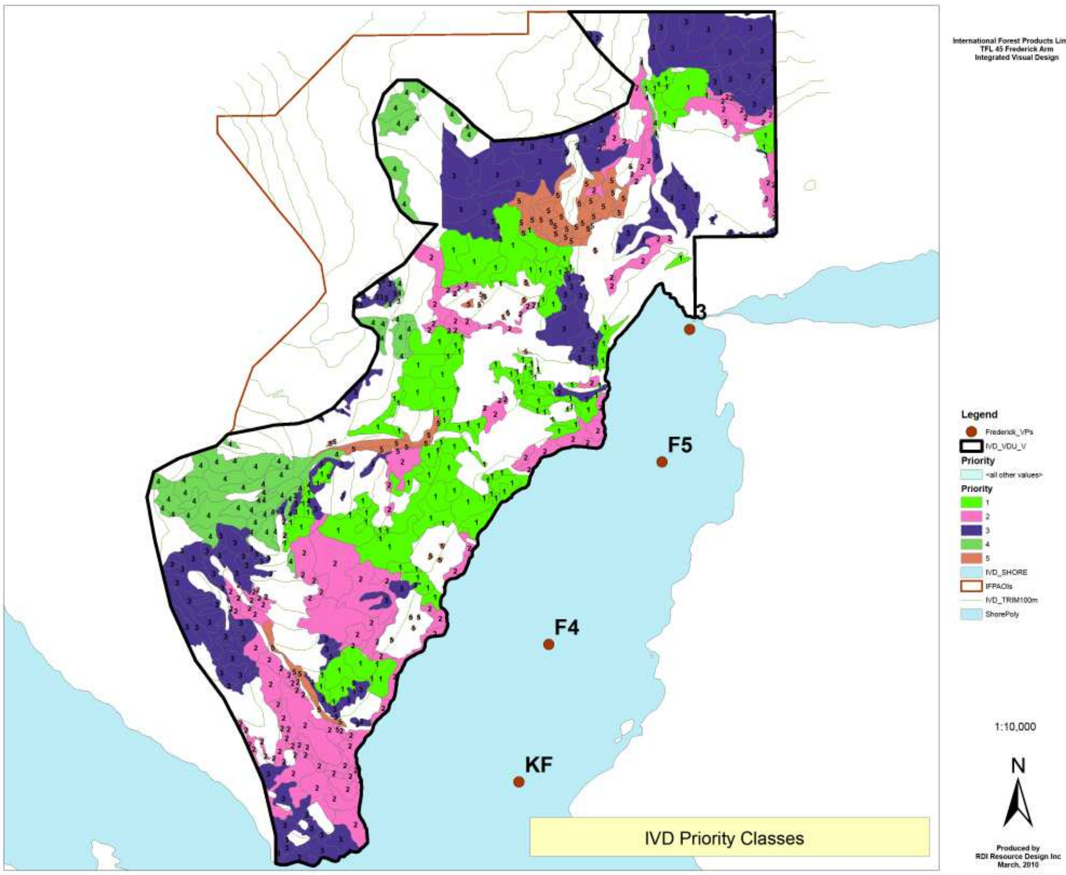

Figure 14 Priority Areas

The priority classes provided guidance as to the concept design and subsequent scheduling of the 1282 hectare forest area within the VDU:

Priority 1 - immediate availability (336 ha)
Priority 2 - moderate (interim) availability (322 ha)
Priority 3 - future (20 years plus) (418 ha)
Priority 4 - no potential (139 ha)
Priority 5 - special practices (variable retention limits) (67 ha)

With Priority 1 areas accounting for 26% of the total area, it was decided to make Priority 1 the focus the next phase of the integrated visual design (see Phase 3 Design). The colour-coding also provided the means to rapidly assess the extents, shape and prominence of each unit in plan and perspective views reveals the relationships of the design and as they relate to the Visual Design Unit overall. Composite sheet for both planimetric (Figure 16) and perspective aerial views (Figure 17) are provided. The Priority Areas were also rendered from each viewpoint in VNS (see image sheet composites for each viewpoint, Figures 18-21).

4.2 Detailed Design

4.2.1 Complete Pattern of Shapes (Design Blocks)

The Priority 1 component of the concept design was refined through iterations to develop a complete pattern of shapes (design blocks) depicting all possible harvest opportunities over 4 passes.

The design blocks were comprised of the individual cells identified in the concept design. and prioritization process. In some cases, individual cells were assigned as a harvest units, in other cases, groups of cells were assigned as a unit, in others again, larger cells were divided into workable design blocks (Figure 15).

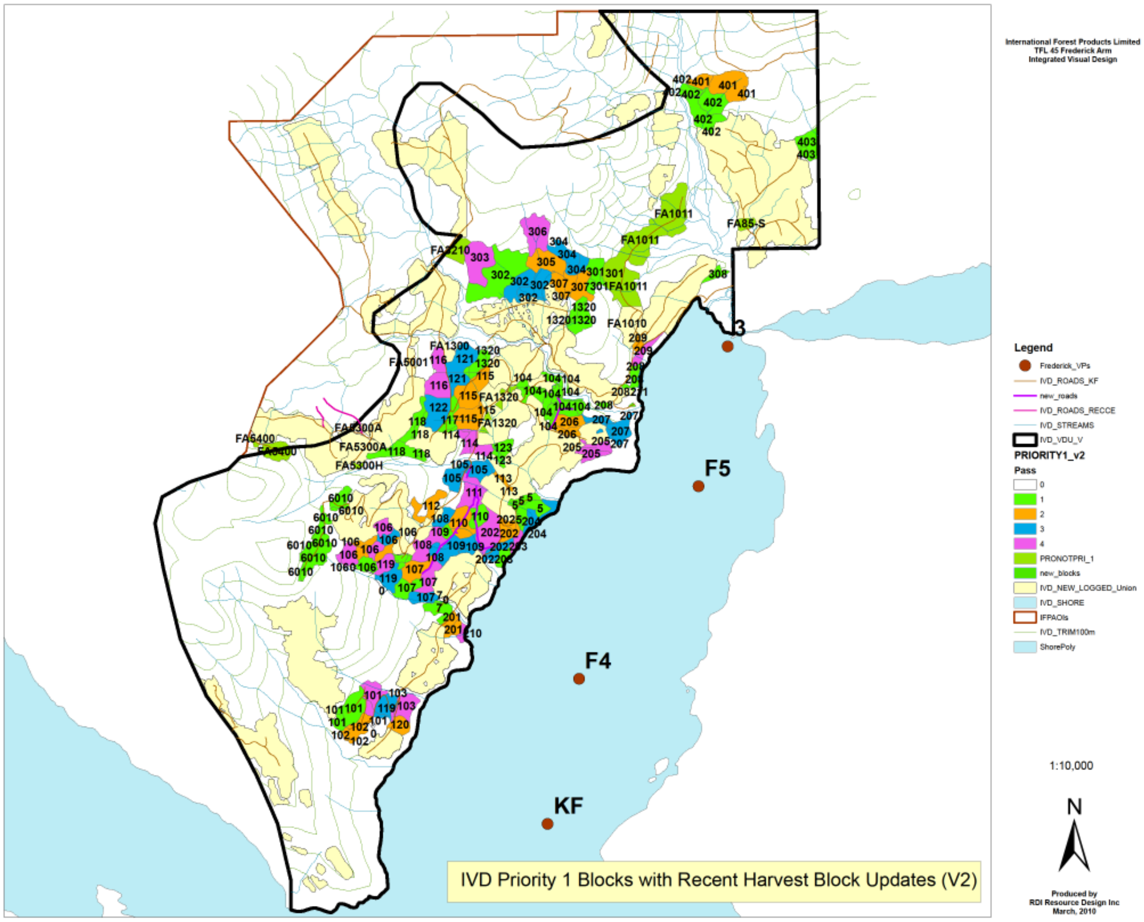

Figure 15 Detailed Design Blocks, Scheduled into 4 Passes

The blocking process regarded visual force lines, topography, prominence in the landscape, existing patterns and conditions such as recent timber harvest areas, retention areas such as riparian, steep slopes and unstable terrain, and the shapes and patterns that would be created in each phase. Visual force lines were regarded in two major ways: 1) to influence the shape, and 2) to set the schedule for a particular unit. Fortunately, the major upward force lines (green) such as those dividing the VSUs (Figure 1) and the other major creeks were largely off-limits due to other resource constraints, thereby providing strong visual cohesion of unaltered forest ranging from bottom to the top of the VDU. Units following major downward force line (red) were considered for retention over the shorter term to maintain the structure of the landscape, but added into the schedule in later phases, mainly in Pass 4. Inevitably, when planning the entire visible, operable forest, conflicts arose with shapes and patterns. The existing harvested areas played a strong role in the design, frequently imposing geometric patterns which were sometimes difficult to mitigate. Where particular units exhibit too much angularity, detailed interventions will be required, such as disbursed or grouped variable retention, or corners left un-harvested. Existing road access was utilized to maximum extent.

In all,185 individual design cells were scheduled within 49 design block groupings with a total area of 400 hectares. The first pass also incorporates 53 hectares of proposed cutblocks and "new" blocks outside of the Priority 1 areas for a total of 169 ha in Pass 1 and an overall total of 463 ha. The following table summarizes the scheduling (Table 2):

Table 2 Priority 1 Pass Areas

Pass	Area (ha)
1	169
2	91
3	86
4	106
0	1
Total	**463***

The block numbers on the map in Figure 15 show each component cell. Interfor's proposed blocks are numbered as they were provided to RDI for easy identification (although without the `FA` prefix). The proposed blocks were occasional modified for visual quality purposes (either larger or with minor deletions).The silvicultural systems are clear-cut and/or variable retention. Stand diversity, ecological functioning, visual apparency, and scale and pattern from the viewpoint(s) will direct the silvicultural system selection. Portrayal of the harvest units is non-retention (clear cut). As each pass is assumed to be 5+ years, early cuts in the plan will achieve a measure of visually effective green-up (VEG) as new openings evolve. For portrayal purposes only, each pass was assigned re-growth when portraying the subsequent phase (3m for a single pass of regrowth; 7m for two passes of re-growth, 10m for three passes of re-growth). The growth is considered somewhat optimistic in the single phase re-growth, but somewhat conservative over the three phase re-growth.

The design blocks with their scheduling are conceptual only and should not be interpreted to be an actual plan. The scheduling of the 185 block units is fully and easily adjustable in ArcMap. Each unit has all attributes from the forest cover file attached, such as projected height, volume per hectare, species, and licence ownership. Fuller discussion should take place with all involved parties.

4.2.2 Block / Pass Response to Landscape Structure

A visual force analysis was performed in plan view and in perspective view, as seen from the design viewpoints, to assess how well each block / pass responds to the underlying landscape structure. This analysis was ran together with the design tests in a combined, interactive operation (see 4.3). A full visual force analysis, together with perspective percent alteration analysis was prepared for VP F5.

4.3 Testing the Design

4.3.1 Perspective Modelling

Each harvest phase (pass) was modelled in perspective view, using Visual Nature Studio, from the key design viewpoints to determine how well design criteria have been addressed in terms of functional, visual, environmental and economic objectives. The display of block groupings in each phase was assigned a colour for ease of recognition and differentiation amongst the phases. The colour emphasized the block contrast to a greater extent than would a more natural colour, exaggerating perceived visual impacts (Figures 16-21). Figure 16 contains the planimetric views; Figure 17 provides aerial oblique views; Figure 18 is all Pass 1; Figure 19 - Pass 2; Figure 20 - Pass 3; and Figure 4 - Pass 4. Each image sheet provides bare land views of the Visual Sensitivity Units, constraints and the design, and treed images of the design as it is cut and regrows over the 4 passes. Corresponding maps and image sheets are provided separately in higher resolution quality.

Due to programming conflicts caused by roads in the model, roads were disabled during the visual simulation runs. No allowances (deductions) were made for existing and new road areas within the plan.

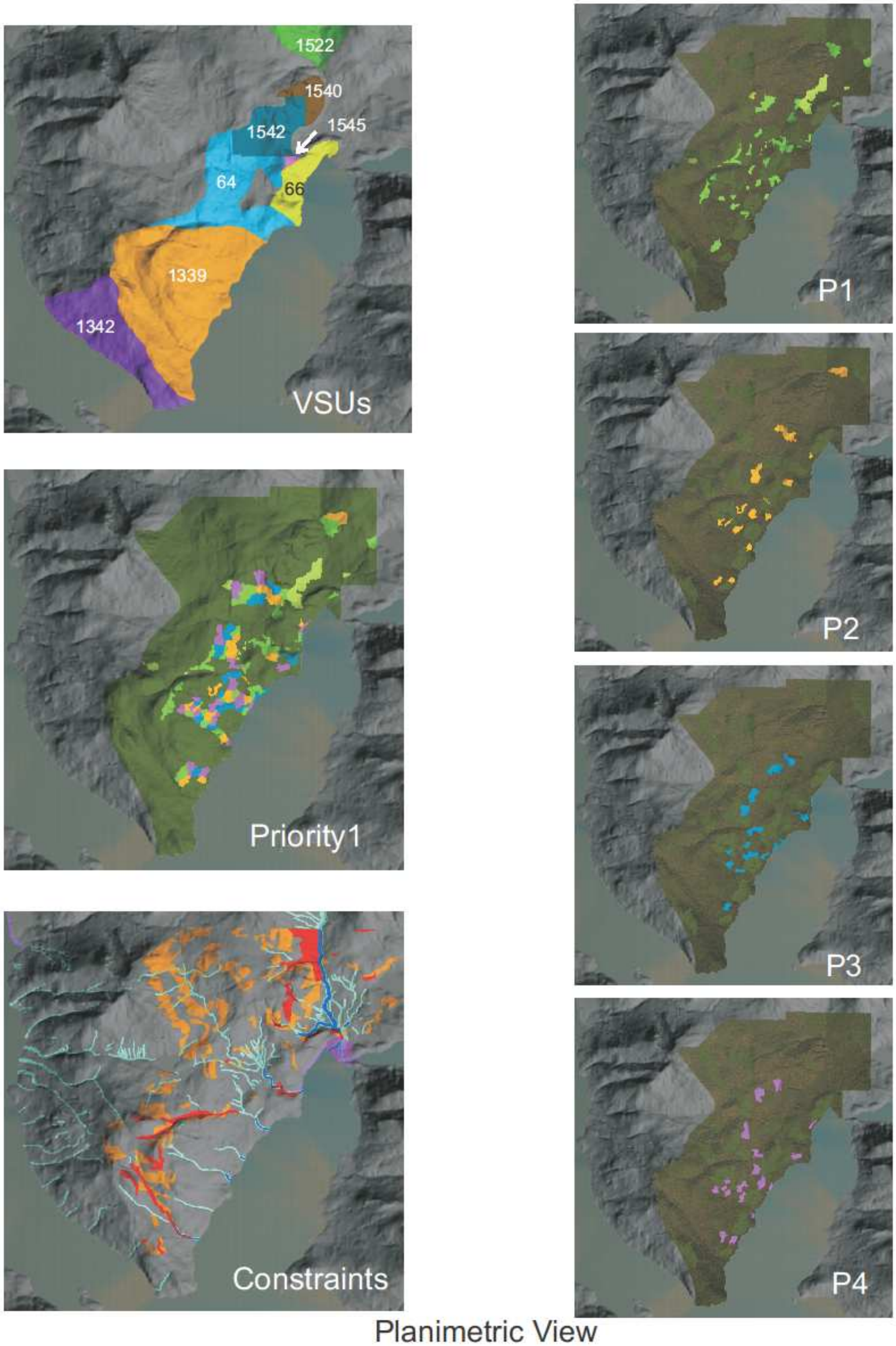

Figure 16 Priority 1 Plan - Planimetric Views

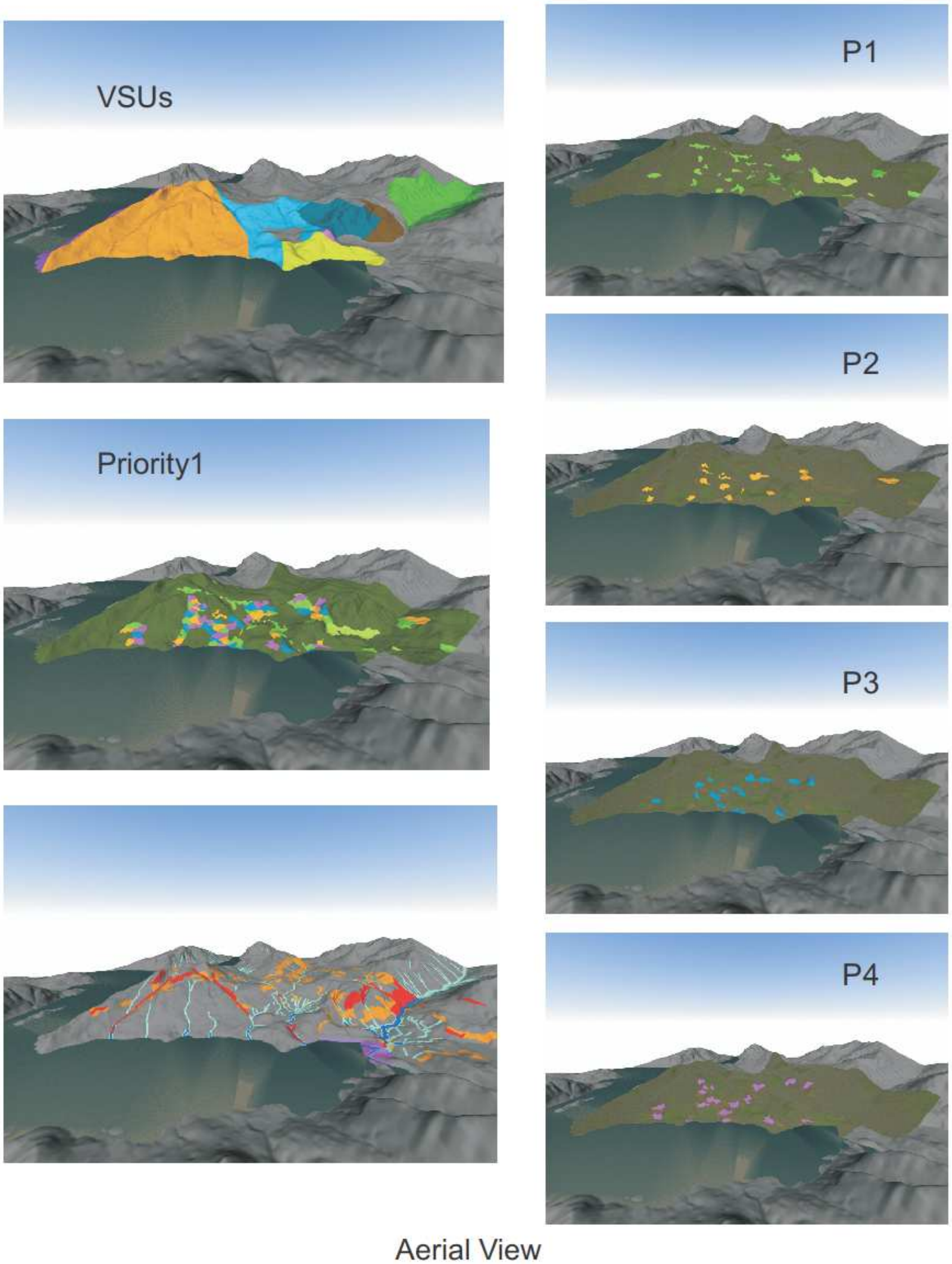

Figure 17 Perspective (Aerial) Views

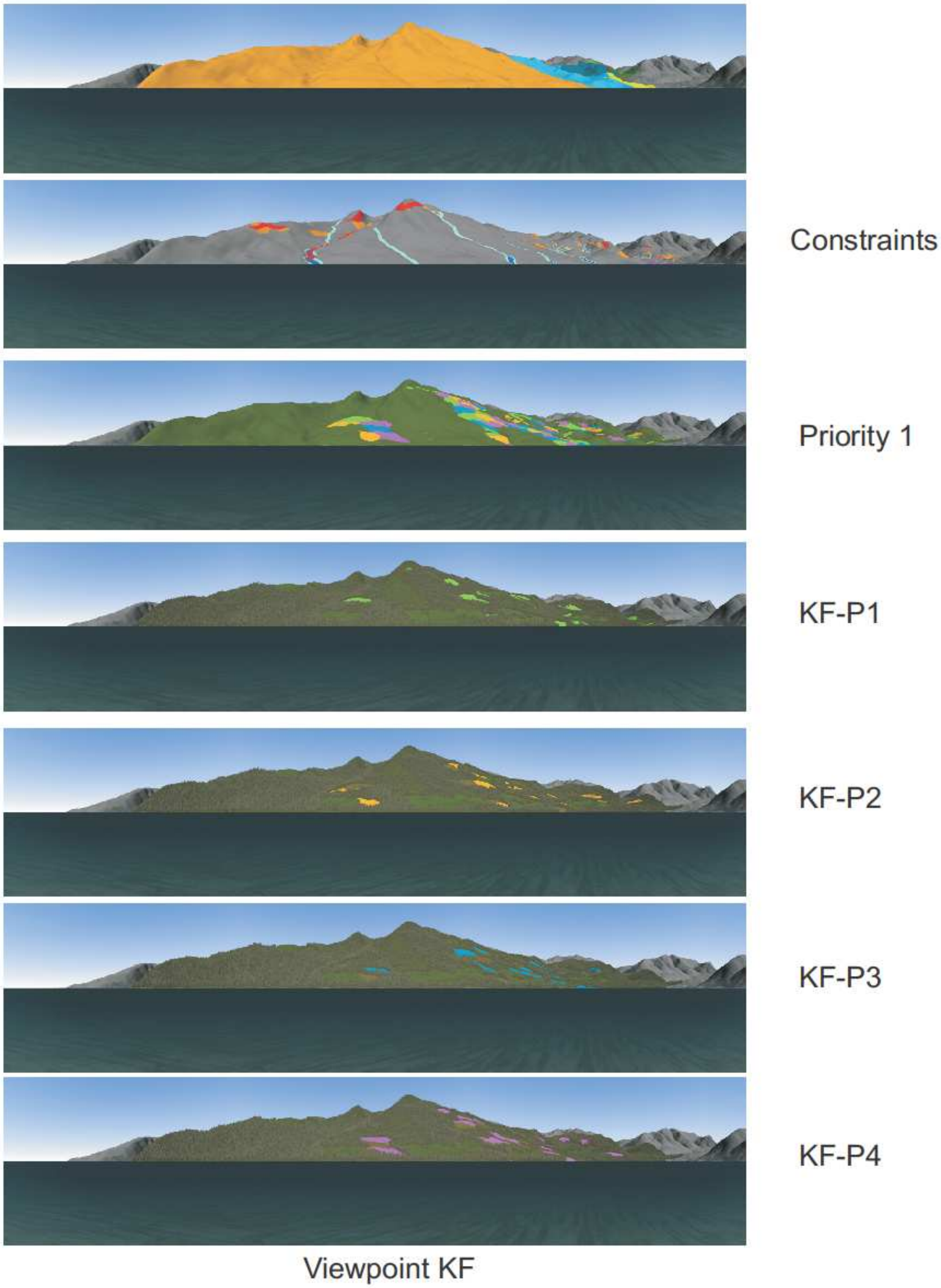

Figure 18 Viewpoint KF Design Blocks

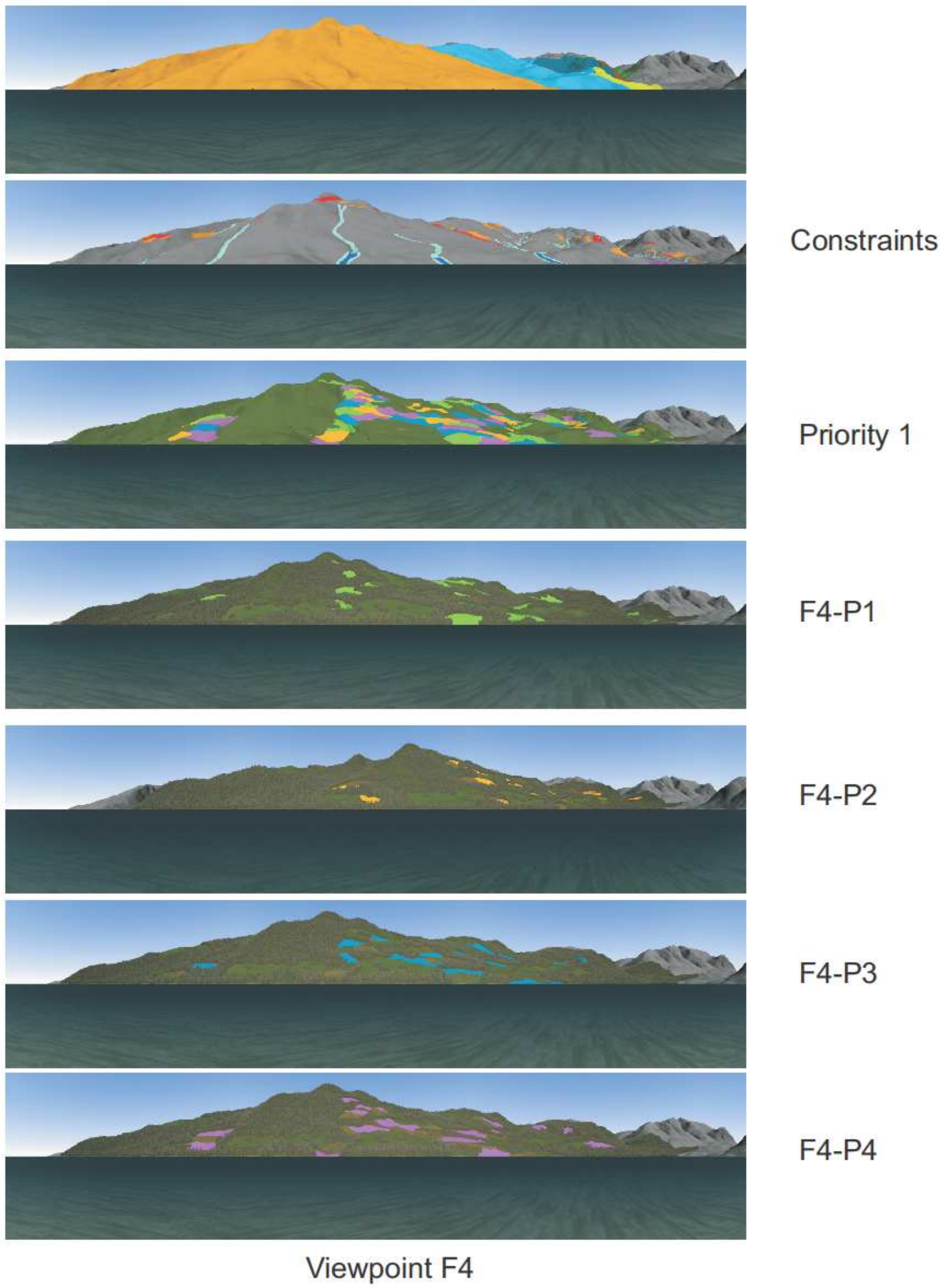

Figure 19 Viewpoint F4 Design Blocks

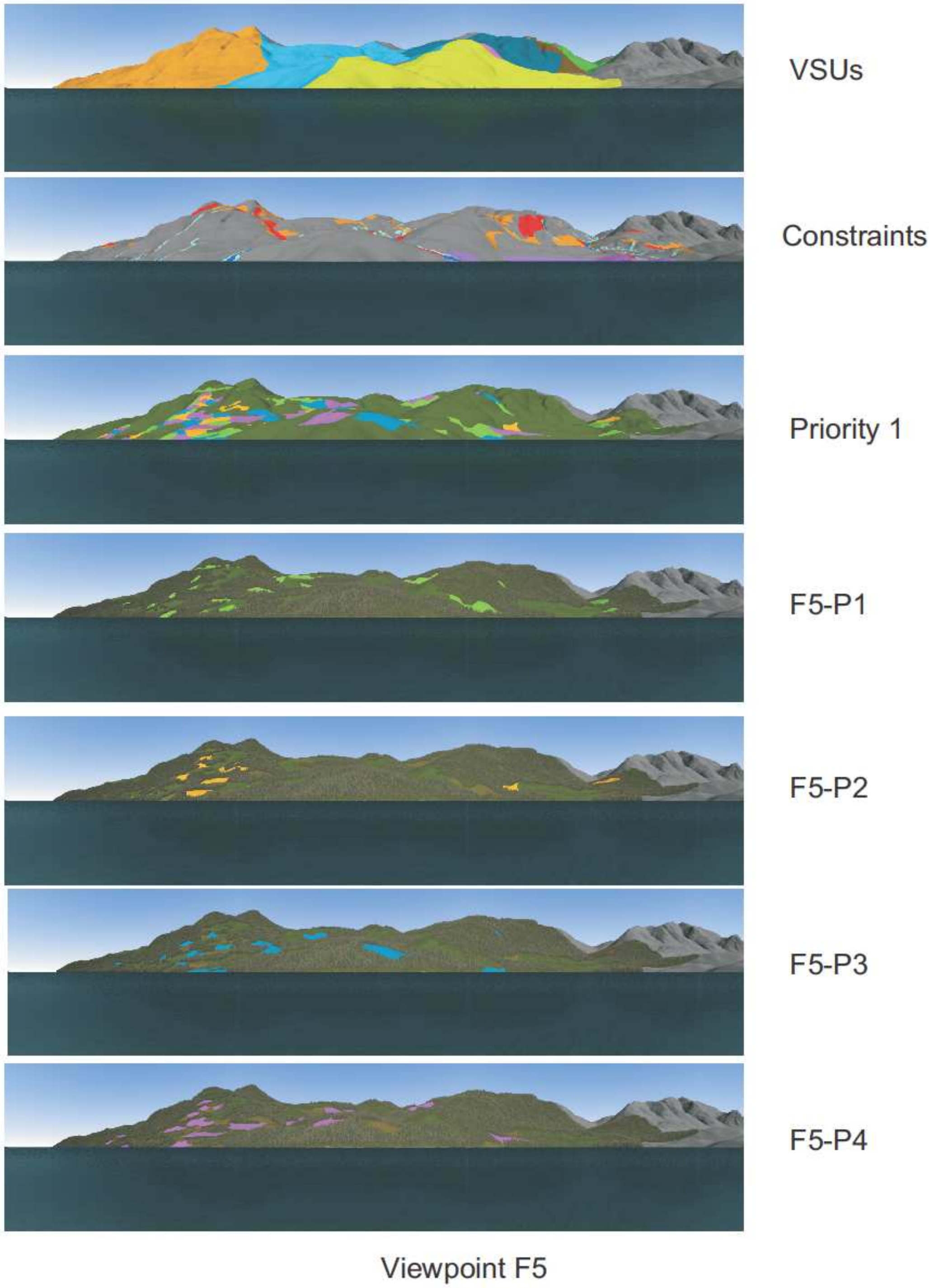

Figure 20 Viewpoint F5 Design Blocks

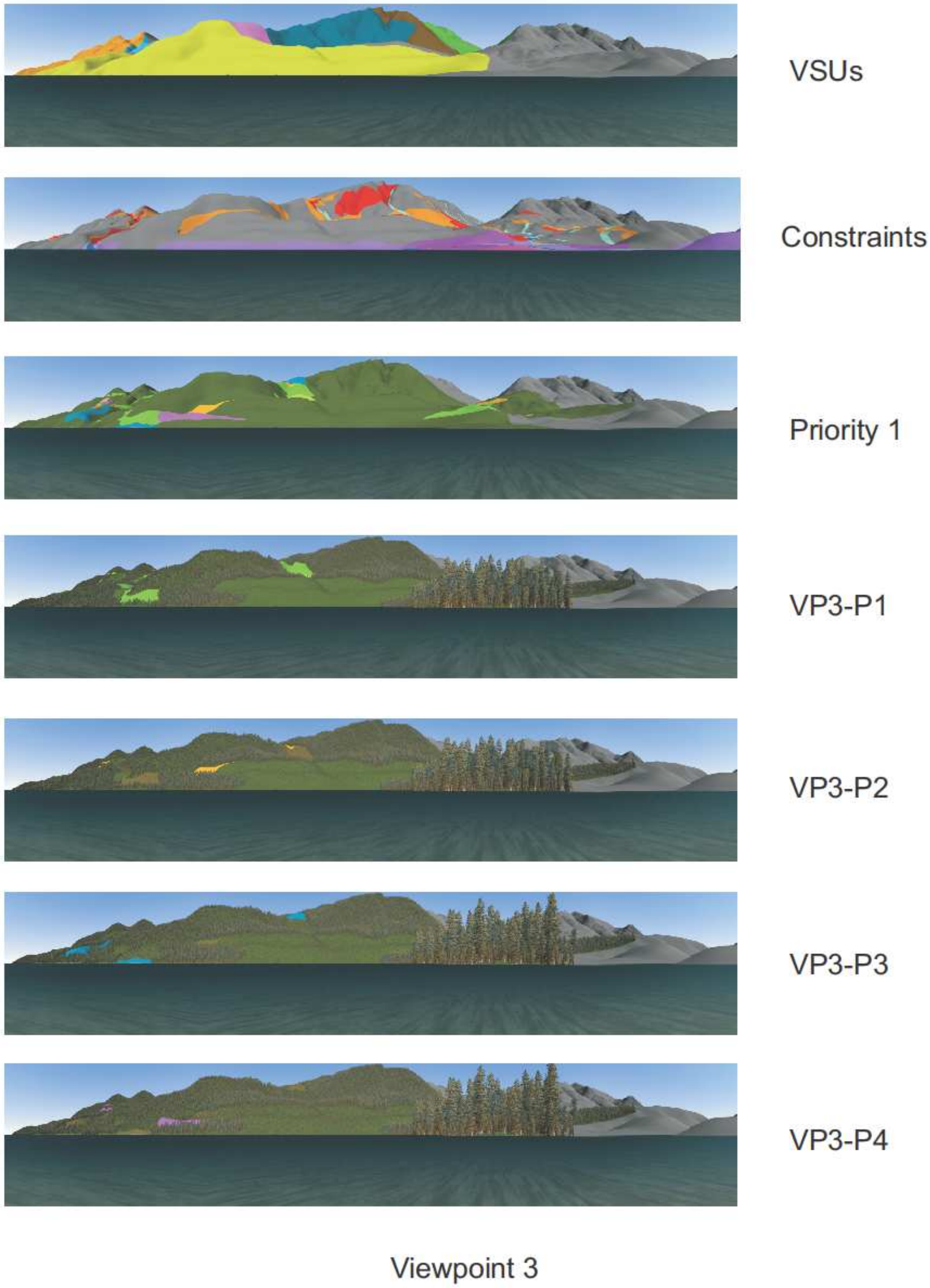

Figure 21 Viewpoint 3 Design Blocks

4.3.2 Design Evaluation

The design of each pass was evaluated to confirm if it meets visual and/or other resource objectives. The block groupings are not necessarily intended for single entry harvesting and could be spread across the 5+ year planning horizon of each pass as necessary to accomplish the VQO. The appearance will help guide decisions such as the application of variable retention, and detailed scheduling within each block. The plan assumes visually effective greenup will have occurred in existing harvested areas.

Percent Alteration Calculation

Percent alteration in perspective view was calculated for each pass from one design viewpoint. The results all fell within Partial Retention (1.6% - 7% alteration) except for. The results are shown in Table 4.

Table 3 Percent Alteration if VDU in Perspective View from Viewpoint F5, by Pass

Pass 1	4.35%
Pass 2	2.04%
Pass 3	4.67%
Pass 4	4.98%

Visually acceptable design relies on three factors - verbal definition of the visual quality class/objective, design criteria (e.g. meeting lines of force), and percent alteration in perspective view. With good design, the higher levels in the range of percent alteration can be appropriate. Under-achievement of the VQO can mean foregone harvesting opportunities. Adjustments can be made within and amongst the passes to maximize the harvesting opportunities while meeting the VQO.

Existing alteration, was considered to have visually effective greenup (VEG) and was not measured (actual conditions vary). There are non-VEG areas that will raise the percent alteration in Phase 1. Each phase was considered to achieve VEG at the start of the next phase (optimistic).

4.3.3 Design Revision

The design was revised as needed to meet visual and/or other resource objectives. The shape of some blocks remains too angular. They should be re-shaped during operational implementation using variable retention and / or appropriate scheduling of block units.

4.4 Final Design and Documentation

The draft summary report, mapping and simulations were submitted to Donna Wilson, Forsite (the Forest Investment Account Coordinator) on March 26, 2010.