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FOREST AND RANGE EVALUATION PROGRAM

ASSISTANT DEPUTY MINISTER RESOURCE STEWARDSHIP REPORT: RESULTS AND RECOMMENDATIONS FROM THE FOREST AND RANGE EVALUATION PROGRAM

May 2015

North Island District, photo by Christina Mardell

MINISTRY OF FORESTS, LANDS AND
NATURAL RESOURCE OPERATIONS

ASSISTANT DEPUTY MINISTER RESOURCE STEWARDSHIP REPORT: RESULTS AND RECOMMENDATIONS FROM THE FOREST AND RANGE EVALUATION PROGRAM

May 2015

FREP
Forest and Range Evaluation Program

BRITISH COLUMBIA

Management of forest and range resources is a complex process that often involves the balancing of ecological, social, and economic considerations. This evaluation report represents one facet of this process.

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MESSAGE FROM THE ASSISTANT DEPUTY MINISTER OF RESOURCE STEWARDSHIP

I am pleased to present the fifth annual Provincial summary report on the results of the Forest and Range Evaluation Program (FREP).

FREP is a cornerstone in the governance of the *Forests and Range Practices Act*. Under the results-based approach, FREP is the program responsible to monitor and evaluate the eleven *FRPA* values. This valuable data informs resource managers and provides a foundation of evidence to enable continuous improvement in resource stewardship practices. The processes used in FREP are science-based, resulting in trusted and high quality data. Since 2005, over 8000 samples have been collected.

FREP monitoring evaluates the effects of resource development at a stand or site level. This information is important in helping local resource managers and decision-makers evaluate the ongoing balance between ecological, social and economic factors. The FREP results also identify when stand-level values are not being managed sustainably, identifying areas that warrant improvement of on-the-ground management practices.

With a target audience of natural resource professionals and decision-makers, this report aims to encourage dialogue and inform decision-making among those who manage British Columbia's natural resource values on behalf of the public.

This report summarizes field-based assessments that determine the ecological condition of 11 *FRPA* resource values on, or near, recently harvested cutblocks. The intention of this monitoring is to evaluate the effects of resource development at a stand or site-level rather than the overall condition of the resource value. Thus, these assessments are confined to the working land base, and do not include the ecological contributions of parks, protected areas, and other conservancy areas.

This year, the FREP team will be exploring ways to further improve both the monitoring sample design for the respective values, and the way information can be reported. The team continues to be committed to continuous improvement and collaboration, and welcomes ideas and suggestions.

Tom Ethier
Assistant Deputy Minister
Resource Stewardship Division
Forest, Lands and Natural Resource Operations

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1.0 INTRODUCTION

This fifth annual overview of the Forest and Range Evaluation Program (FREP) summarizes regional-level program findings and makes recommendations for continued improvement of on-the-ground resource management practices. With a target audience of natural resource professionals and decision makers, this report aims to encourage dialogue and inform decision making among those who manage British Columbia's natural resource values on behalf of the public.

The development of the *Forest and Range Practices Act (FRPA)* had several key goals, including:

- simplifying the forest management legal framework;
- creating a "freedom to manage" approach for defined results; and
- maintaining the high environmental standards laid out in the *Forest Practices Code of British Columbia Act (FPC)*.

FREP began resource value monitoring in 2005. Table 1 lists the current monitoring status of the 11 *FRPA* resource values and shows the number of assessments completed to 2013. By providing science-based monitoring and evaluation information to resource managers, FREP supports professional reliance and the continuous improvement of land and resource stewardship. Ultimately, this information should be used to make necessary adjustments to practices, policies, and legislation. For more information on FREP, and to see how FREP is influencing change, please go to: http://www.for.gov.bc.ca/hfp/frep/index.htm

Table 1. The current status of Forest and Range Practices Act resource value monitoring under FREP

FRPA resource value and team lead(s)	*Monitoring status*
Biodiversity Nancy Densmore Nancy.Densmore@gov.bc.ca Richard Thompson Richard.Thompson@gov.bc.ca Barry Elliott (Landscape) Barry.Elliott@gov.bc.ca	• 2194 harvest openings sampled from 2006 to 2013 • Province wide implementation of stand-level biodiversity (all regions) • In collaboration with Forest Practices Board, indicators and provincial data are available for landscape-level biodiversity. Ranking of landscape units uses a subset of indicators, seral stage, and biogeoclimatic protected status
Cultural Heritage Kathleen Hebb Kathleen.Hebb@gov.bc.ca Nicole Pressey Nicole.Pressey@gov.bc.ca Peter Bradford Peter.Bradford@gov.bc.ca	• 198 harvest opening samples from 2009 to 2013 • Implementation in Omineca, Skeena, Thompson-Okanagan and West Coast Regions
Fish/Riparian Peter Tschaplinski Peter.Tschaplinski@gov.bc.ca Fish Sensitive Watersheds Lars Reese-Hansen Lars.ReeseHansen@gov.bc.ca Richard Thompson Richard.Thompson@gov.bc.ca	• 1925 stream reaches sampled from 2006 to 2013 • Province wide implementation (all regions) • 72 watersheds assessed with GIS techniques; two interior watersheds and three coastal watersheds assessed with field-based monitoring • Outcomes for Fish Sensitive Watersheds to be reported in 2015

FRPA resource value and team lead(s)	*Monitoring status*
Forage (Range) Doug Fraser Doug.Fraser@gov.bc.ca	• 865 streams, uplands, and wetlands assessed before 2008 • 2078 streams, uplands, and wetlands assessed from 2009 to 2013 • Provincial summary provided in Section 4
Recreation John Crooks John.Crooks@gov.bc.ca	• 120 recreation sites evaluated, and reported in 2006 (see FREP Report No. 5: Recreation Site Effectiveness Evaluation Project – October 2006) • Inactive for last several years
Resource Features Christina Mardell Christina.A.Mardell@gov.bc.ca	• Karst monitoring protocol at final development stage (in co-operation with Vancouver Island University); plan to implement in the 2015 field season. Pilot testing has taken place on Vancouver Island, North Island/Central Coast Natural Resource District • Results not yet reported
Soils Chuck Bulmer Chuck.Bulmer@gov.bc.ca Bill Chapman Bill.Chapman@gov.bc.ca Shannon Berch Shannon.Berch@gov.bc.ca	• 171 cutblocks sampled from 2008 to 2012 • Two special investigations conducted in 2013/2014; outcomes reported in 2013 FREP extension note with another to be released in 2015. • Implemented in all regions
Timber (Stand Development) Stefan Zeglen (Stand Development Monitoring) Stefan.Zeglen@gov.bc.ca Frank Barber (Timber Resource Value) Frank.Barber@gov.bc.ca	• 716 inventory polygons sampled from 2009 to 2013 • Stand development monitoring protocol piloted during 2009–2010 field season • Province-wide implementation (all regions)
Visual Quality Jacques Marc Jacques.Marc@gov.bc.ca	• 710 landforms assessed from 2007 to 2013 • Province-wide implementation (currently 17 districts for *FPC* and 21 for *FRPA* covering all regions)
Water Quality (Sediment) Dave Maloney David.Maloney@gov.bc.ca	• 4767 stream crossings assessed for fine sediment generation potential and 199 streams assessed for range impacts from 2008 to 2013 • Provincial summary for the range outcomes provided in Section 4 • Province-wide implementation (all regions)
Wildlife Kathy Paige Kathy.Paige@gov.bc.ca Melissa Todd Melissa.Todd@gov.bc.ca	• Implementation of coastal tailed frog Wildlife Habitat Area (WHA) monitoring; outcomes summarized in the December 2013 Assistant Deputy Minister Stewardship Report • Research and monitoring relevant to tailed frog WHA effectiveness monitoring in the Skeena Natural Resource Region • Development and testing of wildlife indicators and protocols for evaluating the effectiveness of ungulate winter ranges with a focus on mountain goat and caribou

This report focusses on stewardship at the regional level based on *FRPA* resource value monitoring data collected by natural resource district field staff. Monitoring results are summarized using four impact ratings.

1. very low
2. low
3. medium
4. high

"Very low" and "low" impact ratings are considered consistent with the government's goal of sustainable management of the resource values within the *Forest and Range Practices Act*. The "medium" impact rating is considered borderline and the "high" rating is generally considered unsustainable.

Section 2 provides a description of how 8 of the 11 *FRPA* resource values are currently monitored and reported out on a regional basis. Section 3 presents summaries of monitoring results for these values in each of the province's eight natural resource regions. Section 4 outlines provincial information and context for those resource values that could not be summarized at the regional level. For district-level results, please refer to the multiple resource value assessment (MRVA) reports found on the FREP website (http://www.for.gov.bc.ca/hfp/frep/publications/mrva.htm)

Important Context for Understanding this Report

All natural resource development will have an impact on ecosystem condition. The role of effectiveness evaluations is to assess the status and trends of British Columbia's natural resource values, and to identify related causal factors and opportunities for improvement. The site-level "impact ratings" presented here are based on assessments conducted within the working land base (e.g., areas where resource extraction takes place). The ecological contributions of parks, protected areas, and other conservancy areas (approximately 21% of the provincial land base) are not covered in this report. Where possible, impact ratings reflect both resource development and the effects of natural impacts, such as those related to the mountain pine beetle infestation, and fire or wind disturbances.

Effectiveness evaluations do not assess compliance with legal requirements. Instead, these evaluations assess the effects of development activities and natural influences on the condition of FRPA values, regardless of whether practices are in compliance with legislation. These evaluations are meant to help resource managers:

- *assess whether resource development is done sustainably;*
- *provide transparency and accountability for the management of public resources;*
- *support balanced decision making in consideration of environmental, social, and economic factors; and*
- *guide ongoing improvement of resource management practices, policies, and legislation.*

NOTE TO READERS: This report covers monitoring results for all eight Ministry of Forests, Lands and Natural Resource Operations regions. Readers should focus on the content that covers the region in which they work, as well as the summary section at the end of the document.

2.0 DESCRIPTION OF *FOREST AND RANGE PRACTICES ACT* RESOURCE VALUES

This section describes how 8 of the 11 *FRPA* resource values are currently monitored and reported out on a regional basis.

2.1 *Fish/Riparian*

The key FREP evaluation question for the fish/riparian resource value is: *Are riparian forestry and range practices effective in maintaining the structural integrity and functions of stream ecosystems and other aquatic resource features over both the short term and long term?* To answer this question, the impact of resource development and natural impacts is assessed for sampled stream reaches.

The riparian protocol assesses the functioning condition of stream reaches by determining the state of 15 aspects of riparian function and comparing these aspects to the range of natural variation from pre-harvest or pre-disturbance baseline conditions. Baseline was determined from multi-decade research projects on more than 100 streams where pre-harvest reference conditions were identified and compared to post-harvest changes. Table 2 outlines the legislated description of stream classes, defined by stream size and fish status. Reference conditions are built into the assessment system so that alterations attributed to either forestry practices or other causes, including natural disturbances, could be identified.

The four functioning conditions and their equivalent resource development impact ratings are:

1. "Properly Functioning Condition" – equivalent to "Very low" impact
2. "Properly Functioning Limited Impact" – equivalent to "Low" impact
3. "Properly Functioning With Impacts" – equivalent to "Medium" impact
4. "Not Properly Functioning" – equivalent to "High" impact

Trends for the fish/riparian resource value are assessed by timber harvest year.

- Harvested before 2004
- Harvested 2004–2006
- Harvested after 2006

*Table 2. **Stream class description and associated Forest and Range Practices Act riparian management default requirements***

Riparian class		Average channel width (m)	Reserve (no harvest) zone width (m)	Management zone width (m)	Total width of riparian management area (m)
Fish-bearing	S1- large	> 100 m (for 1 km stream length)	0	100	100
	S1	> 20	50	20	70
	S2	> 5 to ≤ 20	30	20	50
	S3	1.5 to ≤ 5	20	20	40
	S4	< 1.5	0	30	30
Without fish	S5	> 3	0	30	30
	S6	≤ 3	0	20	20

2.2 *Water Quality (Fine Sediment)*

The key FREP evaluation question for the water quality resource value is: *Are forest practices effective in protecting water quality (fine sediments)?* To answer this question, the impact of roads and natural events on water quality is assessed.

The water quality monitoring protocol for fine sediment assesses the "sediment generation potential" for road segments near streams or stream crossings. The five sediment generation potential categories and their four equivalent resource development impact ratings are:

1. "Very Low" sediment generation potential – equivalent to "Very Low" impact
2. "Low" sediment generation potential – equivalent to "Low" impact
3. "Moderate" sediment generation potential – equivalent to "Medium" impact
4. "High" and "Very High" sediment generation potential (two categories merged) – equivalent to "High" impact

To capture the yearly variations in traffic patterns and road maintenance, water quality trends were analyzed by the year samples were collected. The age of the road (how well it was planned and built) also affects this outcome however, information about the age of the road is not always readily accessible. District staff familiar with road systems in their areas would be able to provide more precise data. Some of the suggested improvements for road segments with "High" or "Medium" resource development impact ratings are related to maintenance, whereas others refer to future road construction.

2.3 *Stand-level Biodiversity*

The FREP evaluation question for the stand-level biodiversity resource value is: *Is stand-level retention providing the range of habitat and the structural attributes understood to be necessary for maintaining species dependent on wildlife trees and coarse woody debris?* To answer this question, the impact of harvesting on stand-level biodiversity attributes is assessed.

The stand-level biodiversity protocol utilizes standard timber cruising and line-transect plot methodologies to assess the quality and quantity of standing and downed wood on a recently harvested cutblock. Some of the indicators used include:

- density of large diameter trees and big snags;
- tree species diversity;
- coarse woody debris volume; and
- coarse woody debris quality (i.e., volume from large diameter pieces and density of log size pieces 10 m or longer and 20 cm or larger in diameter at point of transect crossing).

The tree indicator data for a cutblock is compared against a baseline of timber cruise data from major licensees and British Columbia Timber Sales cutblocks of the same biogeoclimatic subzone and variant. The coarse woody debris data within cutblock harvest areas is compared against a baseline of coarse woody debris data collected from retention patches of the same biogeoclimatic subzone.

Stand-level biodiversity trends are assessed by comparing the outcomes of cutblocks by timber harvest year (i.e., the same as the timber harvest year groupings used for the fish/riparian resource value). This comparison investigates differences in biodiversity planning, harvest layout and the resulting impact on biodiversity over time. The resource development impact rating for biodiversity has the following four components.

1. Percentage of treed retention
2. Retention quality
3. Coarse woody debris volume
4. Coarse woody debris quality

2.4 *Visual Quality*

The FREP evaluation question for the visual quality resource value is: *How are we managing views in scenic areas and achieving visual quality objectives (VQOs)?* To answer this question, the impact of resource development is assessed to determine the achievement of visual quality objectives on specific landforms.

The visual quality protocol evaluates the achievement of VQOs by assessing block design, percentage of landform altered, roads, tree retention, and viewpoint importance. The five VQO achievement categories and their equivalent resource development impact ratings are:

1. "Well Met" – equivalent to "Very Low" impact
2. "Met" – equivalent to "Low" impact

3. "Borderline" – equivalent to "Medium" impact
4. "Not Met" – equivalent to "High" impact
5. "Clearly Not Met" – equivalent to "High" impact

The achievement of visual quality objectives is compared between cutblocks harvested under the *FPC* (with forest development plans) and cutblocks harvested under the *FRPA* (with forest stewardship plans).

2.5 *Cultural Heritage*

The FREP evaluation question for the cultural heritage resource value is: *Are cultural heritage resources being conserved and, where necessary, protected for First Nations cultural and traditional activities?* To answer this question, the resource development impact of forest harvesting on known cultural heritage resources is assessed.

Cultural heritage resource value assessments are primarily focussed on the evaluation of resource development impacts on cultural features, such as culturally modified trees, cultural trails, traditional use sites, and other areas of specific interest and ongoing importance to First Nations. Sites assessed by FREP include those managed under the *FRPA* and the *Heritage Conservation Act* (i.e., archaeological sites). The resource development impact ratings for cultural heritage are based on evaluations of individual cultural features and an overall assessment of cutblock management, including any evidence (and extent) of damage to features, operational limitations, and strategies used to conserve values.

2.6 *Timber*

The FREP evaluation question for the timber resource value is: *What is the overall health and productivity of managed 20-year-old to 40-year-old stands?* To answer this question, the impact of forest practices and forest health factors on stand stocking is assessed.

The stand development monitoring protocol is designed to assess the health and productivity of young stands between the ages of 20 and 40 years. This assessment determines how stand attributes change in managed forests and provides input for silviculture policy decision making. The protocol looks at inventory polygons (which designate areas of consistent forest cover) for older regenerated stands. These polygons are assessed for the level of damaging agents (abiotic and biotic) and tree stocking. Using the protocol, evaluators collect data and provide an introductory analysis in five specific areas.

1. Stand density (total, well-spaced and free-growing stems per hectare)
2. Stand species composition
3. Stand health
4. Stand basal area
5. Site index

2.7 *Soils*

The FREP evaluation question for the soils resource value is: *Are forest practices successful in preventing site disturbances that are detrimental to soil productivity and hydrologic function?* To answer this question, the impact of forest harvesting on the soil resource is assessed by considering factors such as access structure construction, alteration to natural drainage patterns, and soil disturbance from harvest-related activities, as well as the presence of refugia (e.g., remnants of mature forests) for soil organisms, and the maintenance of sustaining levels of organic inputs (e.g., coarse woody debris) into the soil.

To assess the soils resource value, a structured process called "expert elicitation" is used whereby cutblock images are examined by a minimum of three soils experts. Each expert responds to soil conservation questions for each image and assesses the overall extent to which the observed results are consistent with soil conservation objectives. These questions include:

- Does the total amount of permanent access seem excessive given the site conditions?
- Is there evidence that harvesting, access construction, or maintenance have led to (or increased the potential for) mass movement or erosion?
- Are there areas where measures should have been taken to restore natural drainage patterns, but they were not carried out?
- Does there appear to be excessive soil disturbance associated with roadside work areas?
- Does there appear to be excessive dispersed soil disturbance in the net area to be reforested outside the roadside work area?
- Does it appear that there are insufficient mature forests to provide inoculum for slowly dispersed soil organisms to rapidly recolonize the cutblock?

- Does it appear that measures to conserve coarse dead wood should have been carried out but were neglected or ineffective?
- Are there issues of concern for other *FRPA* resource values?
- To what extent did the practices on this block maintain soil productivity and hydrologic function?

2.8 *Forage and Associated Plant Communities*

Range program staff monitor and report on the health of rangelands using the *Rangeland Health Field Guide* (2007).[1] Monitoring is done on land under Crown grazing tenures that is considered of primary use for grazing to determine the impact of livestock grazing on uplands, wetlands, and streams. Specific sampling sites are often linked to licence changes or renewals and land-based investment fund allocations.

Sites are rated in one of five categories of functioning condition.

- "Properly functioning condition" and "slightly at risk" sites are in a healthy condition and provide the goods and services expected from healthy ecosystems.
- "Moderately at risk" sites have several attributes that make them at risk to soil loss, erosion, and damage from high runoff events or prolonged drought.
- "Non-functional" to "highly at risk" sites are lacking key attributes associated with normal riparian or upland function. Streams function as a drainage ditch. Wetlands lack sufficient vegetation bands and riparian soil conditions to filter nutrients, contaminants, and microorganisms, and to provide forage for herbivores and habitat for wildlife. Uplands have low vigour, low live ground cover, low litter, shallow rooting, disrupted carbon and nitrogen cycles, soil compaction (and possibly soil loss), and invasive plant species.

A remedial measures model[2] is used to determine the likely cause(s) of poor function and to design remediation for sites in either a moderately at risk or non-functional to highly at risk category.

3.0 RESULTS BY NATURAL RESOURCE REGION

This section presents regional summaries of resource value monitoring results. The presentation style is similar to that used in FREP's Multiple Resource Value Assessments.[3] The "Impact Ratings" diagram indicates the effect of resource development on the resource value, from "very low" to "high" impact. The "Summary" presents a descriptive outline of the monitoring results. The "Causal Factors" for the impact ratings are derived from the field-based data. The "Opportunities for Improvement" are based on practices that resulted in the best outcomes and (or) expert knowledge.

Where sufficient data is available, the "Overall Stewardship Trend" shows trends between time periods. A chi-squared test, which determines a probability value, is used to determine trends between sampling eras for riparian, water quality, stand-level biodiversity, and visual quality results. P-values are used to help assess the likely significant difference between two populations (e.g., 2005–2012 and 1997–2004 eras). Because many of the evaluations conducted by FREP are exploratory, a critical p-value of 0.1 is used; this is higher than the standard for significance in more powerful studies. Setting the critical value at this level balances the likelihood of committing a Type 1 versus a Type 2 error (i.e., accepting something as significant when it isn't, as opposed to missing a significant effect because the trial was not powerful enough to detect it).

Figure 1 shows the resource stewardship monitoring sample locations in each of the province's eight natural resource regions.

1 Fraser, D.A. 2007. Rangeland health field guide. B.C. Ministry of Forests and Range, Range Branch, Kamloops, B.C. http://www.for.gov.bc.ca/hfd/pubs/docs/mr/Mr117.htm

2 B.C. Ministry of Forests. 2002. Considering tools for remediation. Forest Practices Branch, Victoria, B.C. Rangeland Health Brochure No. 4. https://www.for.gov.bc.ca/hra/Publications/brochures/Rangeland_Health_Brochure4.pdf

3 See http://www.for.gov.bc.ca/hfp/frep/publications/mrva.htm. The methodology is described in FREP Technical Note No. 6 (http://www.for.gov.bc.ca/ftp/HFP/external/!publish/frep/technical/FREP_Technical_Note_06.pdf).

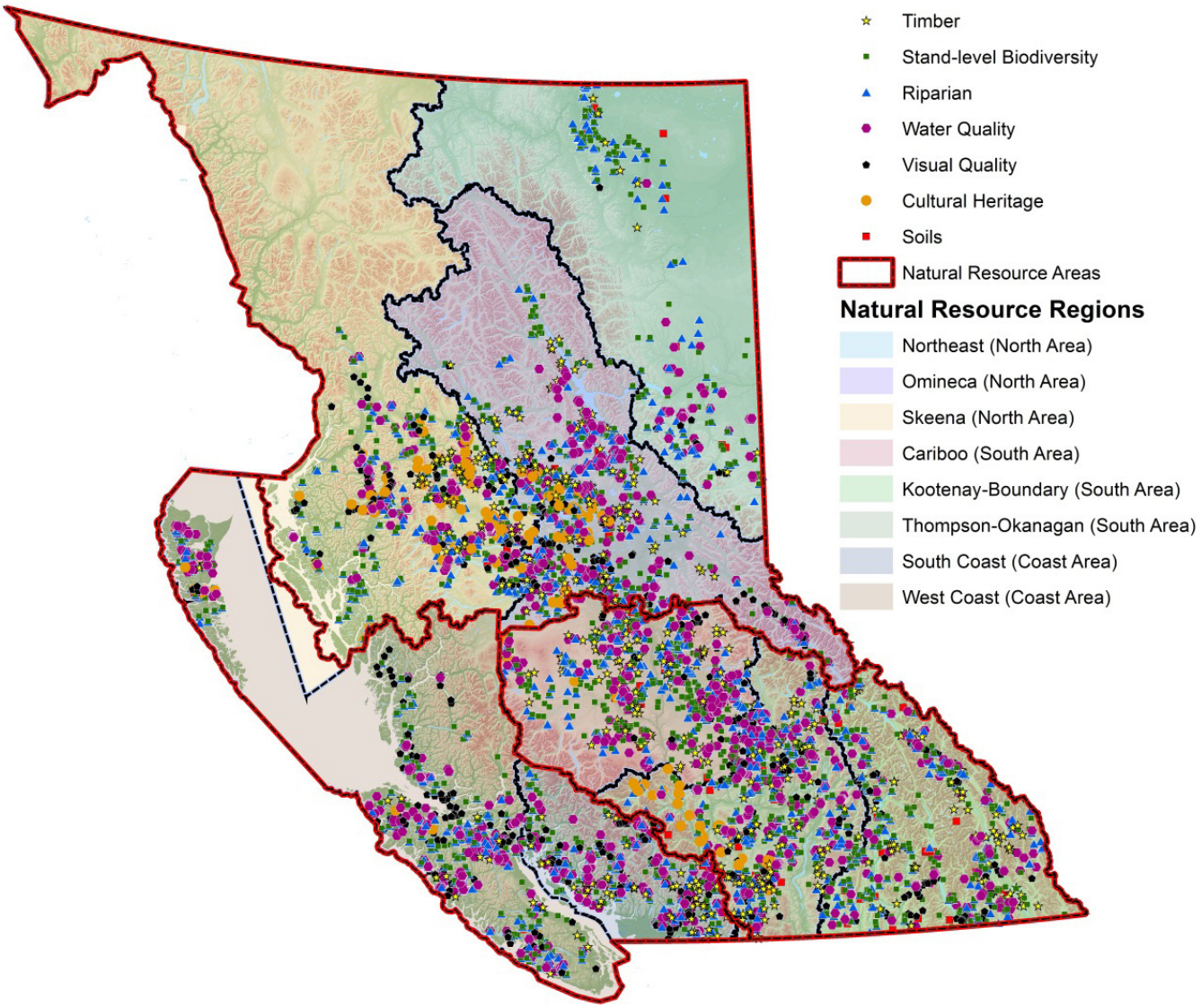
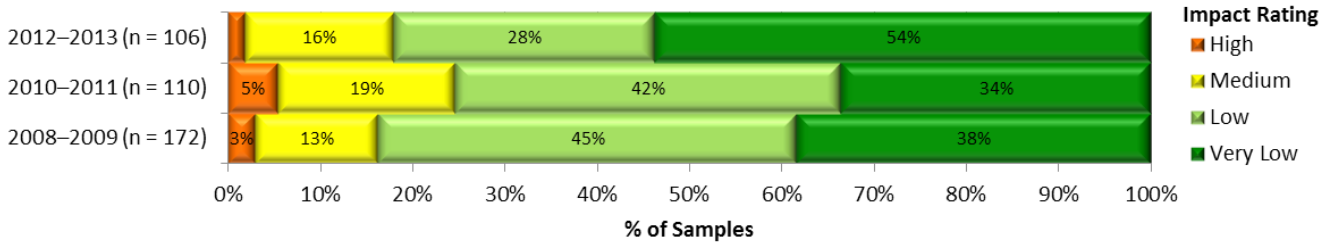


Figure 1. Sample locations of FREP Resource Stewardship Monitoring for seven resource values.

3.1 *Cariboo Natural Resource Region*

The intention of FREP monitoring is to evaluate the effects of resource development at a stand or site level, rather than the overall condition of the resource value. This information is an important element in helping resource managers determine the appropriate balance between ecological, social and economic factors. The FREP results also identify when stand-level values are not being managed sustainably, identifying areas that warrant improvement of on-the-ground resource management practices. The following section presents the outcomes of site-level FREP monitoring in the Cariboo Natural Resource Region.

Cariboo Water Quality: Resource Development Impacts



Data Source: Water quality data (potential for fine sediment generation) was collected by Ministry staff using the FREP water quality monitoring protocol. Sampling sites consist of roads (and [or] areas of mass wasting) connected to fish habitat and (or) drinking water sources that originate at randomly selected, recently harvested cutblocks. Stewardship trends are based on survey years to capture the effects of road traffic and maintenance.

Summary: Of 388 road segments, 81% were rated as "very low" or "low" road-related impact.

Causal Factors:

See opportunities for improvement on road segments with "high" or "medium" impact ratings. Some opportunities will apply to ongoing maintenance issues, whereas others mainly apply to new road construction.

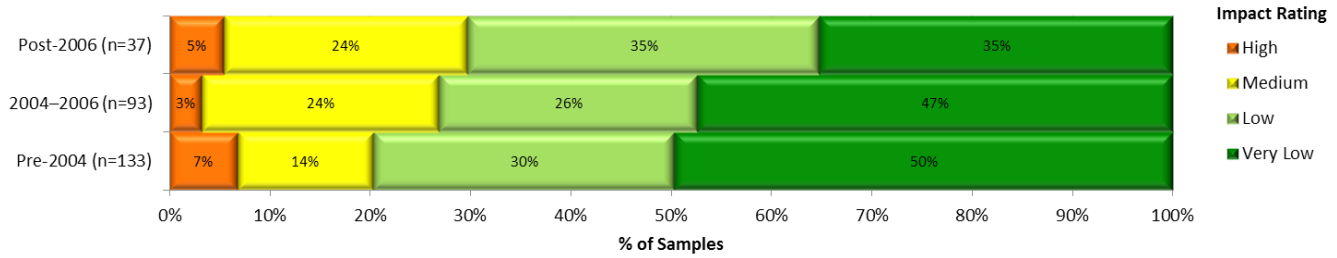
Overall Stewardship Trend: A statistical difference (p = 0.02) was evident between sampling eras with minor fluctuations in outcomes, showing lowest sediment generation in the 2008–2009 and the 2012–013 sample years.

Opportunities for Improvement and (or) Continuation of Practices that Help Minimize Sediment:

The most frequent suggested solutions to improve road segments with "high" or "medium" impact ratings are:

- Use of cross-ditches or kickouts to move sediment off the road
- Avoid long gradients approaching streams
- Armour, seed, and protect bare soil as soon as possible after disturbance

Cariboo Riparian: Resource Development and Natural Impacts on Stream Function



Data Source: Stream riparian data was collected by Ministry staff using the FREP riparian monitoring protocol. Sampling sites consist of randomly selected cutblocks with streams in or adjacent to cutblock boundaries. The largest stream of sufficient length is sampled. Stewardship trends are determined by harvest era.

Summary: Of 263 streams, 76% were rated as "very low" or "low" harvest-related impact.

Samples by Stream Class and Impact Rating

Class	High	Medium	Low	Very low	Total
S1			1		1
S2		2	6	10	18
S3	2	14	30	40	86
S4	4	14	20	25	63
S5				3	3
S6	8	19	20	45	92
Total	14	49	77	123	263

Causal Factors:

% of total	Most common specific impact in order of frequency
Natural events 36% *Beetle kill* *High natural sediment* *Wind*	• In-stream sediments increased • Moss levels decreased • Stream or riparian blockages increased • Bare erodible ground increased
Logging 33% *Windthrow* *Low retention*	• In-stream sediments increased • Bare erodible ground increased • Stream or riparian blockages increased • Moss levels decreased
Upstream factors 11% *Natural events* *Logging* *Roads*	• In-stream sediments increased • Moss levels decreased • Stream or riparian blockages increased
Cattle 10% Trampling by livestock	• In-stream sediments increased • Bare erodible ground increased
Roads 10% *Erosion, sediment, and channel infill* *Closed-bottom culverts*	• In-stream sediments increased • Moss levels decreased • Stream or riparian blockages increased

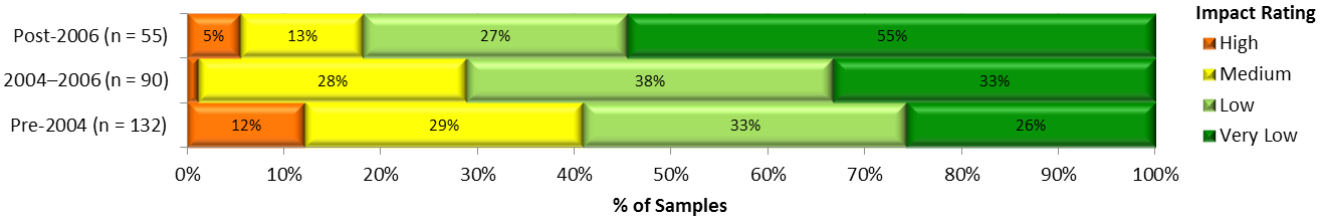
Natural events caused 36% of the stream impacts, with beetle kill the main natural event. Near-stream human actions (logging, cattle, roads) caused 52% of the impacts on streams. Windthrow, low retention, channel blockages and eroding roads, and trampling by cattle were main human-caused impacts.

Overall Stewardship Trend: No statistical difference (p = 0.30) was evident between the three harvest eras.

Opportunities for Improvement and (or) Continuation of Practices that Protect Stream and Riparian Conditions:

- Minimize introduction of fine and coarse sediment from roads
- Generally discourage cattle use of riparian areas
- Reduce windthrow by increasing buffer widths if narrow buffer strips are a problem, or use more selective harvest practices if windthrow-prone timber is an issue
- Increase retention generally on small streams, especially those wider perennial streams that make significant contributions of water, sediment, debris, and nutrients to downstream fish habitats and watershed function

Cariboo Stand-level Biodiversity: Resource Development Impacts



Data Source: Stand-level biodiversity data was collected by Ministry field staff using the FREP stand-level biodiversity monitoring protocol. Sampling sites consist of randomly selected, recently harvested cutblocks. Impact rating considers total treed retention, retention quality, and coarse woody debris quantity and quality. Stewardship trends are based on differences in outcomes between harvest years.

Summary: Of 277[4] cutblocks, 68% of sites were rated as "very low" or "low" harvest-related impact. The table below shows the percentage of sampled cutblocks by impact category. It also gives the average size of cutblock by category, with smaller cutblocks more likely to be in "high" impact category.

	High	Medium	Low	Very low
% of blocks	7	25	34	34
Average gross (ha)	19	35	41	47

Causal Factors:

86% of all cutblocks had more than 3.5% tree retention, with very little difference between the eras. The density of large snags (≥ 30 cm dbh and ≥ 10 m high) has increased. The number of live tree species and density of big trees (generally > 40 cm dbh) has stayed roughly the same and is representing baseline conditions (cruise data in same ecosystem). The range of coarse woody debris volume over many cutblocks has improved, and is similar or slightly higher than expected from baseline (as in retention patches). Coarse woody debris quality (i.e., volume from ≥ 20 cm pieces and density of big pieces per hectare of ≥ 20 cm diameter and ≥ 10 m long) has slightly increased, although is still skewed towards lower amounts compared to the baseline.

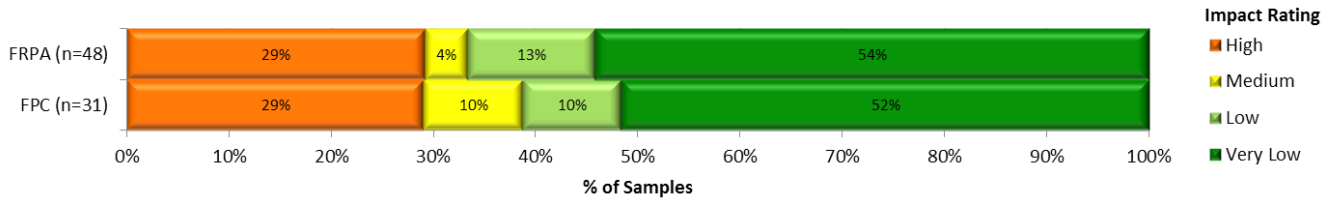
Overall Stewardship Trend: A statistical difference (p = 0.00) was evident between harvest eras with an improving trend over time. Retention increased from an average 19.3% for cutblocks harvested before 2004 to 26.1% for blocks harvested after 2006. Average retention quality increased slightly between eras. Coarse woody debris volume increased.

Opportunities for Improvement and (or) Continuation of Practices that Effectively Manage Stand-level Biodiversity:

- Continue leaving large snags, big trees, and numbers of tree species in the full range compared to pre-harvest conditions
- Leave at least some retention on every cutblock
- Have a range of retention (e.g., 3–30%) over many cutblocks
- Leave higher densities of big coarse woody debris pieces on-site

4 One cutblock could not be ranked since it had patch retention but no plots were established (likely safety issue). An additional eight cutblocks were sampled and assessed for individual indicators but could not be ranked because of a lack of baseline data (all for blocks harvested before 2005).

Cariboo Visual Quality: Resource Development Impacts on Achievement of Visual Quality Objectives



Data Source: Visual quality assessment data was collected by Ministry field staff using the FREP visual quality monitoring protocol. Sampling sites consist of landforms with visual quality objectives located in randomly selected, recently harvested cutblocks. Stewardship trends are based on comparisons of samples collected under *FPC* forest development plans versus *FRPA* forest stewardship plans.

For this natural resource region, *FRPA* data came from the Williams Lake and Quesnel timber supply areas. The *FPC* data came from the 100 Mile and Quesnel timber supply areas.

Summary: Of 79 landforms, 64% were rated as "very low" or "low" harvest-related impact. Existing data suggest that the visual value is at risk in this region.

Causal Factors:

The likely reasons for 29% of landforms receiving a "high" impact rating are:

- Large opening size
- Lack of visual landscape design (block shaping)
- Lack of retention within openings

Number of Samples by Visual Quality Objective (VQO) and Impact Rating

VQO[a]	High	Medium	Low	Very low	Total
M	7	2	1	22	32
PR	14	2	8	19	43
R	2	1		1	4
Total	23	5	9	42	79

[a] M = Modification, PR = Partial Retention, R = Retention

Overall Stewardship Trend: No direct comparison is possible since the *FPC* and *FRPA* sampling took place on different timber supply areas; however, practices in general seem not to have changed from the *FPC* to the *FRPA* eras.

Opportunities for Improvement Based on Viewscapes that Meet Visual Quality Objectives:

Districts are encouraged to continue FREP visual quality sampling to monitor trends.

- Reduce opening size in retention and partial retention VQO areas
- Use visual design techniques to create more natural-looking openings
- Use partial cutting to retain higher levels of volume per stems.

Cariboo Timber: Resource Development Impacts on Stand Health and Productivity

Data Source: Timber resource data for stand health and productivity was collected by Ministry field staff and contractors using the FREP stand development monitoring (SDM) protocol. Sampling sites consist of randomly selected harvested areas greater than 5 hectares, 20–40 years old, and declared "free-growing."

Summary: This assessment is based on 151 polygons from three natural resource districts in the Cariboo Region: Quesnel, Cariboo Chilcotin, and 100 Mile. Table A summarizes the relative stocking at time of sampling by comparing current well-spaced stems to the original target stocking standard (TSS) by biogeoclimatic zone.[5] This demonstrates that, other than in the IDF, the relative stocking was over 80% of the TSS value.

Table A. Average Percent of Target Stocking Standard by Biogeoclimatic Zone (sample size in brackets)

District	ICH	IDF	ESSF	SBS	SBPS	MS
Cariboo-Chilcotin	91 (15)	73 (17)	80 (7)	73 (9)	82 (28)	89 (9)
100 Mile	97 (2)	83 (11)	86 (2)	90 (4)	84 (7)	100 (1)
Quesnel	92 (3)		87 (1)	85 (13)	85 (17)	98 (5)
Average %	**92 (20)**	**77 (28)**	**82 (10)**	**82 (26)**	**83 (52)**	**93 (15)**

The total stems per hectare at time of SDM sampling averaged 3079 over all biogeoclimatic zones, with 1030 well-spaced stems per hectare. Further work will likely confirm that a significant component of these values came from layer 3 trees (i.e., < 1.3 m high and < 7.49 cm dbh). This metric could have a significant impact on potential timber supply over the medium to long term. Table B summarizes the percentage of stand-damaging agents by natural resource district.

Table B. Percentage of Stand-damaging Agents by Natural Resource District (component of total polygons with agent present in brackets)

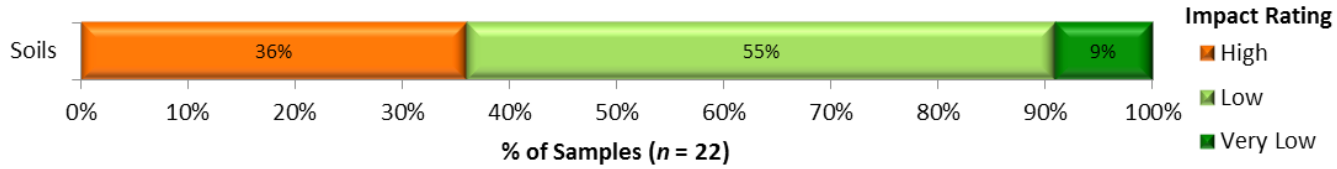
Stand-damaging agent	Cariboo-Chilcotin	100 Mile	Quesnel
Mammal	4.2 (14/87)	3.5 (3/28)	8.3 (10/37)
Mechanical damage, tree competition	5.3 (42/87)	7.2 (9/28)	16.3 (28/37)
Disease	6 (60/87)	6 (21/28)	9.8 (19/37)
Insects	7.3 (9/87)	14.5 (10/28)	14.9 (7/37)

Opportunities for Improvement: Lodgepole pine is a predominant species in the Cariboo Region and is being impacted the most by forest health factors. The productivity of spruce is significantly higher than lodgepole pine and could play an increasing role in mixed species planting prescriptions.

- Promote species that are less impacted by forest health factors and have higher productivity to benefit future timber supply.

5 Biogeoclimatic zones referred to in this section are: Interior Cedar–Hemlock (ICH), Interior Douglas-fir (IDF), Engelmann Spruce–Subalpine Fir (ESSF), Sub-Boreal Spruce (SBS), and Montane Spruce (MS).

Cariboo Soils: Resource Development Impacts on Soil Productivity and Hydrologic Function



Data Source: Soils data for assessments of soil productivity and hydrologic function was collected by provincial and regional soils experts using a FREP expert elicitation methodology. Sampling sites consist of randomly selected, recently harvested cutblocks. Assessments are based on high-resolution air photo analysis.

Summary: Of 22 cutblocks, 64% were rated as "very low" or "low" harvest-related impact, and 36% were rated as "high" harvest-related impact.

Causal Factors:

Excessive soil disturbance, both in roadside work areas and outside work areas, is a major factor that contributes to "highly" affected soil productivity. Several sites also show a lack of mature forest, which is required to allow recolonization of the cutblock with slowly dispersing soil organisms. In addition, a lack of effort was evident in maintaining sufficient coarse woody debris. Access design was a significant issue over much of the province; more recent work identifies the lack of reclaimed temporary access structures (e.g., short-term roads) and the deteriorating condition of abandoned short-term roads as issues.

Overall Stewardship Trend: Not enough historical monitoring has taken place to establish a trend.

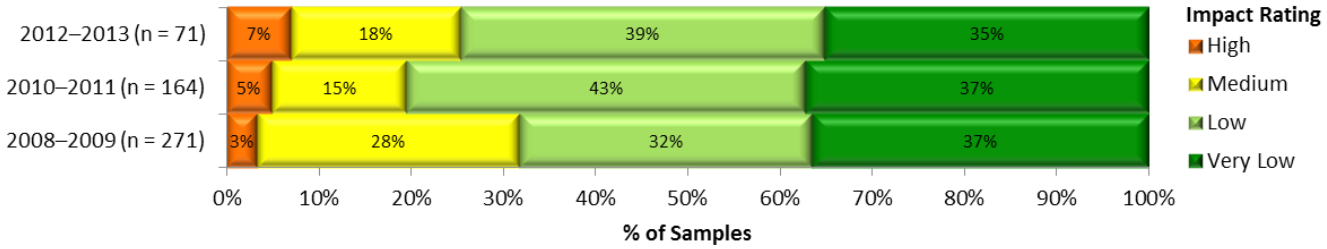
Opportunities for Improvement:

- Plan operations in and outside roadside work areas to minimize soil disturbance, including excessive construction of temporary roads
- Implement measures to conserve coarse woody debris and well-dispersed remnants of mature forest
- Introduce simple low-cost rehabilitation of roads as an alternative to deactivation

3.2 *Kootenay–Boundary Natural Resource Region*

The intention of FREP monitoring is to evaluate the effects of resource development at a stand or site level, rather than the overall condition of the resource value. This information is an important element in helping resource managers determine the appropriate balance between ecological, social and economic factors. The FREP results also identify when stand-level values are not being managed sustainably, identifying areas that warrant improvement of on-the-ground resource management practices. The following section presents the outcomes of site-level FREP monitoring in the Kootenay-Boundary Natural Resource Region.

Kootenay–Boundary Water Quality: Resource Development Impacts



Data Source: Water quality data (potential for fine sediment generation) was collected by Ministry staff using the FREP water quality monitoring protocol. Sampling sites consist of roads (and [or] areas of mass wasting) connected to fish habitat and (or) drinking water sources that originate at randomly selected, recently harvested cutblocks. Stewardship trends are based on survey years to capture the effects of road traffic and maintenance.

Summary: Of 506 road segments, 73% were rated as "very low" or "low" road-related impact.

Causal Factors:

See opportunities for improvement on road segments with "high" or "medium" impact ratings. Some opportunities will apply to ongoing maintenance issues, whereas others mainly apply to new road construction.

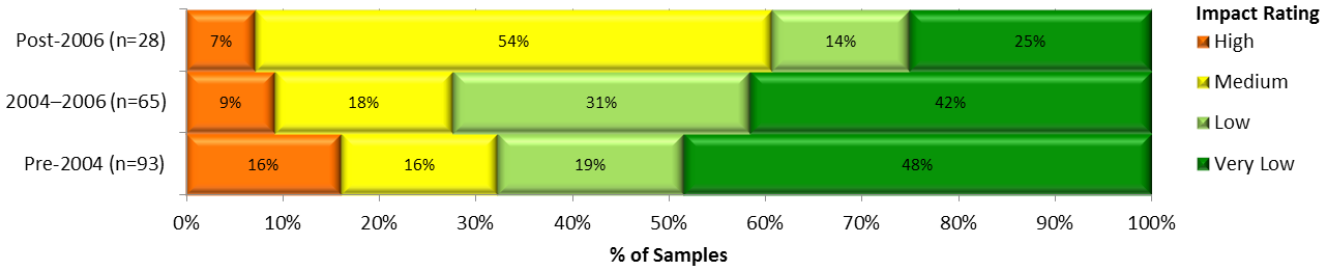
Overall Stewardship Trend: Overall Stewardship Trend: A statistical difference (p = 0.02) was evident between sampling eras with potentially better outcomes in the 2010–11 era.

Opportunities for Improvement and (or) Continuation of Practices that Help Minimize Sediment:

The most frequent suggested solutions to improve road segments with "high" or "medium" impact ratings are:

- Increase the number of strategically located culverts
- Armour, seed, and protect bare soil as soon as possible after disturbance
- Use more cross-ditches and kickouts

Kootenay–Boundary Riparian: Resource Development and Natural Impacts on Stream Function



Data Source: Stream riparian data was collected by Ministry staff using the FREP riparian monitoring protocol. Sampling sites consist of randomly selected cutblocks with streams in or adjacent to cutblock boundaries. The largest stream of sufficient length is sampled. Stewardship trends are determined by harvest era.

Summary: Of 186 streams, 65% were rated as "very low" or "low" harvest-related impact.

Samples by Stream Class and Impact Rating

Class	High	Medium	Low	Very low	Total
S1		1			**1**
S2		2	6	10	**18**
S3	1	1	4	19	**25**
S4	2	3	5	5	**15**
S5	1	4	3	12	**20**
S6	19	31	24	33	**107**
Total	**23**	**42**	**42**	**79**	**186**

Causal Factors:

% of total	Most common specific impact in order of frequency
Logging 44% *Low retention* *Windthrow* *Falling and yarding*	• Riparian vegetation decreased • Large woody debris processes altered • Stream or riparian blockages increased • In-stream sediments increased
Natural events 33% *High natural sediment* *Wind* *Floods*	• Moss levels decreased • In-stream sediments increased • Stream or riparian blockages increased
Roads 11% *Erosion causing sedimentation and channel infilling*	• In-stream sediments increased • Moss levels decreased • Stream or riparian blockages increased
Upstream factors 8% *Natural events* *Logging* *Roads*	• In-stream sediments increased • Moss levels decreased • Stream or riparian blockages increased
Cattle 2% *Trampling by livestock*	• In-stream sediments increased

Near-stream human actions (logging, cattle, roads) caused (on average) 44% of the impacts. Low retention, windthrow, and eroding roads were the main human-caused impacts. High natural background sediment was a main source of natural event impacts.

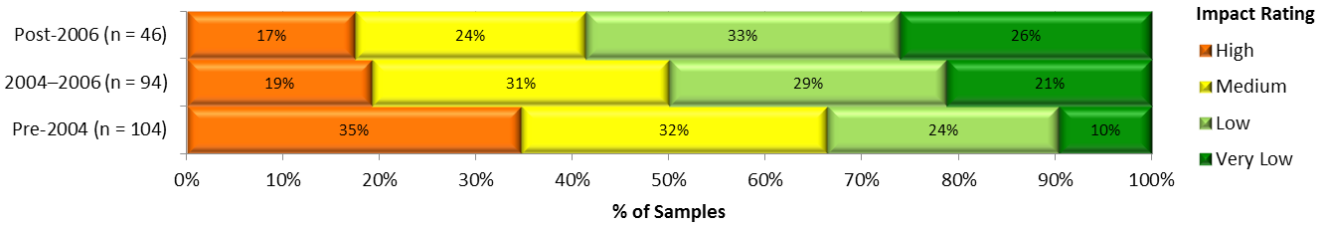
Overall Stewardship Trend: A statistical difference (p = 0.00) was evident between the three harvest eras. Of the streams on or near blocks harvested before 2004, 29% were S2 or S3 streams (mandatory reserve zones). This decreased to 23% for the 2004–2006 era and 7% for the post-2006 era.

Opportunities for Improvement and (or) Continuation of Practices that Protect Stream and Riparian Conditions:

An increase in sample size is required for streams associated with recently harvested cutblocks.

- Minimize introduction of fine and coarse sediment from roads
- Reduce windthrow by increasing buffer widths if narrow buffer strips are a problem, or use more selective harvest practices if windthrow-prone timber is an issue
- Increase retention on small streams, especially those wider perennial streams that make significant contributions of water, sediment, debris, and nutrients to downstream fish habitats, drinking water, and watershed function

Kootenay–Boundary Stand-level Biodiversity: Resource Development Impacts



Data Source: Stand-level biodiversity data was collected by Ministry field staff using the FREP stand-level biodiversity monitoring protocol. Sampling sites consist of randomly selected, recently harvested cutblocks. Impact rating considers total treed retention, retention quality, and coarse woody debris quantity and quality. Stewardship trends are based on differences in outcomes between harvest years.

Summary: Of 244[6] cutblocks, 45% of sites were rated as "very low" or "low" harvest-related impact. The table below shows the percentage of sampled cutblocks by impact category. It also gives the average size of cutblock by category.

	High	Medium	Low	Very low
% of blocks	25	30	27	17
Average gross (ha)	17	23	28	30

Causal Factors:

71% of all cutblocks had more than 3.5% tree retention, with little difference between the eras. The number of live tree species retained in the IDF zone[7] represents (or is better than expected) the baseline (cruise data in same ecosystems). The ESSF zone live tree species have improved from the pre-2004 harvest, although was still less than baseline. The ICH and MS live tree species are consistently less than the baseline. Density of big trees (> 40, 50, or 70 cm dbh, depending on zone, and compared to baseline) has improved for MS and ICH cutblocks but stayed roughly the same for blocks in other zones. The density of large snags is consistently equal or higher than baseline for the IDF zone but lower for the other zones. The range of coarse woody debris volume over many cutblocks has improved to be similar or slightly higher than expected from baseline (as in retention patches). Coarse woody debris quality (i.e., volume from ≥ 20 cm pieces and density of big pieces per hectare of ≥ 20 cm diameter and ≥ 10 m long) has slightly increased.

Overall Stewardship Trend: A statistical difference (p = 0.03) was evident between harvest eras, with an improving trend in later harvest years. Retention increased from an average 12.9% for blocks harvested before 2004 to 17.0% for blocks harvested after 2006. Average retention quality increased slightly between harvest eras. Coarse woody debris volume increased.

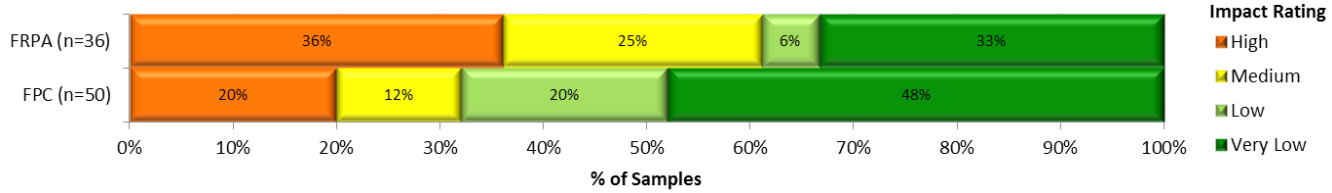
Opportunities for Improvement and (or) Continuation of Practices that Effectively Manage Stand-level Biodiversity:

- Leave at least low levels of retention on every cutblock, taking care in particular for ICH and MS zone cutblocks
- Have a range of retention (e.g., 3–30%) over many cutblocks
- Where possible, retain the full range of tree species
- Where possible, leave large trees for the site

6 Three cutblocks could not be ranked since they had patch retention but no plots were established (likely safety issue). An additional seven cutblocks were sampled and assessed for individual indicators but could not be ranked because of a lack of baseline data.

7 Biogeoclimatic zones mentioned in this section are: Interior Douglas-fir (IDF), Engelmann Spruce–Subalpine Fir (ESSF), Montane Spruce (MS), and Interior Cedar–Hemlock (ICH).

Kootenay–Boundary Visual Quality: Resource Development Impacts on Achievement of Visual Quality Objectives



Data Source: Visual quality assessment data was collected by Ministry field staff using the FREP visual quality monitoring protocol. Sampling sites consist of landforms with visual quality objectives located in randomly selected, recently harvested cutblocks. Stewardship trends are based on comparisons of samples collected under *FPC* forest development plans versus *FRPA* forest stewardship plans.

Summary: Of 86 landforms, 56% were rated as "very low" or "low" harvest-related impact. Under *FRPA*, this number is 39% for "very low" or "low" impacts. Existing data suggest that the visual value is at significant risk in this region.

Causal Factors:

Extensive use of operational exceptions (i.e., self-exemptions) without providing alternative results has given rise to large, poorly designed openings that contain inadequate in-block retention amounts.

Number of Samples by Visual Quality Objective (VQO) and Impact Rating

VQO[a]	High	Medium	Low	Very low	Total
MM		2		1	**3**
M	4	3	4	11	**22**
PR	13	8	6	20	**47**
R	6	2	2	4	**14**
Total	**23**	**15**	**12**	**36**	**86**

[a] M = Modification, PR = Partial Retention, R = Retention

Overall Stewardship Trend: A statistical difference (p = 0.04) was evident between the two eras, with a decreasing trend in *FRPA* assessments.

Opportunities for Improvement Based on Viewscapes that Meet Visual Quality Objectives:

Districts are encouraged to increase FREP visual quality sampling to determine whether change is occurring. Now that the mountain pine beetle is no longer at an emergency response level, more management options are available.

- Eliminate self-exemption language from forest stewardship plans at time of renewal; where exemptions are necessary, use the appropriate tools within *FRPA* (i.e., *Forest Planning and Practices Regulation* sections 12(7) or 25.1(1).[8] In addition, *FRPA* Bulletin 25 provides advice on how to write defensible practicable statements[9]
- Reduce opening size in retention and partial retention VQO areas
- Use visual design techniques to create more natural-looking openings and better achieve VQOs
- Use partial cutting to retain higher levels of volume per stems

8 See: http://www.bclaws.ca/civix/document/id/complete/statreg/14_2004.

9 See: https://www.for.gov.bc.ca/ftp/HTH/external/!publish/web/frpa-admin/frpa-implementation/bulletins/frpa-general-no-25-comparison-of-fsp-results-or-strategies-flexibility-options-jul-21-2011.pdf.

Kootenay–Boundary Timber: Resource Development Impacts on Stand Health and Productivity

Data Source: Timber resource data for stand health and productivity was collected by Ministry field staff and contractors using the FREP stand development monitoring protocol. Sampling sites consist of randomly selected harvested areas greater than 5 hectares, 20–40 years old, and declared "free-growing."

Summary: The 112 polygons sampled represent 12% of the sampling population area. Average polygon age is 26 years (range: 16–50 years). Table A summarizes stand information by leading species for all biogeoclimatic zones combined.

Table A. Stand Metrics for Five Leading Species

Species	Total tree sample (%)	Total basal area (%)	Average site index[10]
Lodgepole pine	39	39	20[11]
Spruce	13	18	22
Subalpine fir	10	5%	17
Western redcedar	8	7	20
Douglas-fir	8	12	22

Table B. Total and Well-spaced Stems per Hectare by Layer

Layer[12]	Total live stems per ha	Total live stems per ha (%)	Well-spaced live stems per ha (%)
L1	362	9	23
L2	714	18	37
L3	2995	73	40
Total	**4071**	**100**	**100**

Table B shows that 73% of the total trees and 40% of the well-spaced trees are in layer 3. A large component of potential crops harvested in the mid to long term will consist of natural ingress of these layer 3 trees. The three leading forest health factors were:

- Western gall rust
- Armillaria root disease
- Commandra blister rust

Table C shows the species most affected by these forest health factors: lodgepole pine with 19% of trees affected (i.e., non-acceptable) (total 9562 trees), and western redcedar with 16% of trees affected (total 1794 trees).

Table C. Total, Acceptable, Non-acceptable, and Dead Trees by Species

Species	Total stems per ha	Acceptable live trees (%)	Non-acceptable live trees (%)	Dead trees (%)
Lodgepole pine	9562	74	19	7
Spruce	3067	94	4	2
Subalpine fir	2405	95	3	3
Western redcedar	1794	82	16	2
Douglas-fir	1837	89	5	6
Average	**4318**	**82**	**12**	**6**

Opportunities for Improvement:

Lodgepole pine is by far the leading species in the Kootenay–Boundary Region. Lodgepole pine contributes most to the basal area on average and has been impacted the most by forest health factors.

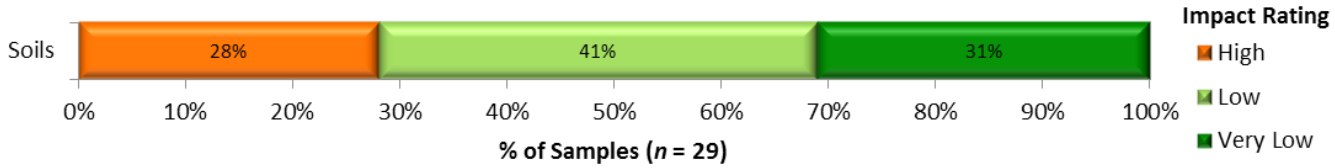
- Consider including species with higher potential productivity than pine (e.g., cedar, spruce, and interior Douglas-fir) in the species planting mix

10 Site index indicates productivity, as seen by the tree height at age 50 (based on biogeoclimatic zones with ≥ 30 polygons).

11 Site index for lodgepole pine is the only species with more than 30 polygons by biogeoclimatic zone; the remaining species site indices are based on the total sample of polygons.

12 Layer 1: > 12.5 cm dbh; layer 2: 7.5–12.49 cm dbh; layer 3: < 1.3 m high and < 7.49 cm dbh.

Kootenay–Boundary Soils: Resource Development Impacts on Soil Productivity and Hydrologic Function



Data Source: Soils data for assessments of soil productivity and hydrologic function was collected by provincial and regional soils experts using a FREP expert elicitation methodology. Sampling sites consist of randomly selected, recently harvested cutblocks. Assessments are based on high-resolution air photo analysis.

Summary: Of 29 cutblocks, 72% were rated as "very low" or "low" harvest-related impact, indicating that soil management objectives were achieved; 28% were rated as "high" harvest-related impact.

Causal Factors:

Excessive soil disturbance, both in roadside work areas and outside work areas, is a major factor that contributes to "highly" affected soil productivity. On many sites, measures were not taken to restore natural drainage patterns and (or) harvesting, access construction, and maintenance practices have led to (or increased the potential for) mass movement or erosion.

Overall Stewardship Trend: Not enough historical monitoring has taken place to establish a trend.

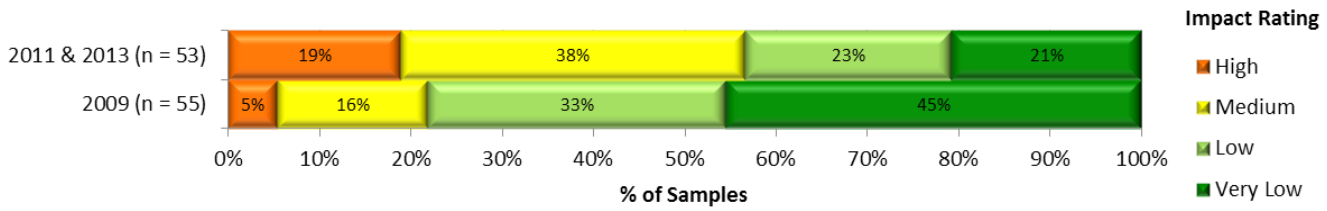
Opportunities for Improvement:

- Plan operations in and outside roadside work areas to minimize soil disturbance
- Ensure sufficient drainage control is in place to prevent erosion and restore natural drainage when site work is complete
- Introduce simple low-cost rehabilitation of roads as an alternative to deactivation

3.3 *Northeast Natural Resource Region*

The intention of FREP monitoring is to evaluate the effects of resource development at a stand or site level, rather than the overall condition of the resource value. This information is an important element in helping resource managers determine the appropriate balance between ecological, social and economic factors. The FREP results also identify when stand-level values are not being managed sustainably, identifying areas that warrant improvement of on-the-ground resource management practices. The following section presents the outcomes of site-level FREP monitoring in the Northeast Natural Resource Region.

Northeast Water Quality: Resource Development Impacts



Data Source: Water quality data (potential for fine sediment generation) was collected by Ministry staff using the FREP water quality monitoring protocol. Sampling sites consist of roads (and [or] areas of mass wasting) connected to fish habitat and (or) drinking water sources that originate at randomly selected, recently harvested cutblocks. Stewardship trends are based on survey years to capture the effects of road traffic and maintenance.

The water quality data for the Northeast Natural Resource Region is from the Peace Natural Resource District. In the Fort Nelson Natural Resource District, resource roads for movement of heavy equipment, such as logging trucks, are for winter use only. These winter-use roads are functional only when the subgrade and grade are completely frozen. Since the water quality protocol addresses gravel roads that are used in all seasons, it is not applicable to the Fort Nelson situation.

Summary: Of 108 road segments, 61% were rated as "very low" or "low" road-related impact.

Causal Factors:

See opportunities for improvement on road segments with "high" or "medium" impact ratings. Some opportunities will apply to ongoing maintenance issues, whereas others mainly apply to new road construction.

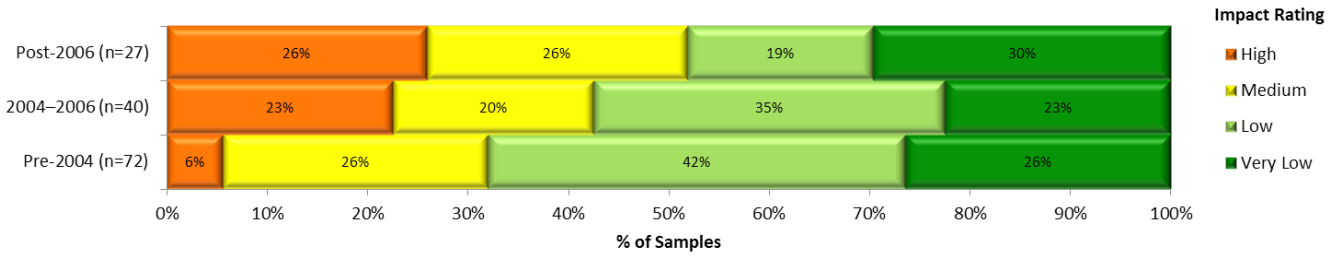
Overall Stewardship Trend: A statistical difference (p = 0.00) was evident between the two sampling eras, with an increase in potential for sediment generation from earlier to later sample years.

Opportunities for Improvement and (or) Continuation of Practices that Help Minimize Sediment:

The most frequent suggested solutions to improve road segments with "high" or "medium" impact ratings are:

- Armour, seed, and protect bare soil as soon as possible after disturbance
- Avoid long gradients approaching streams
- Use good-quality materials for road building

Northeast Riparian: Resource Development and Natural Impacts on Stream Function



Data Source: Stream riparian data was collected by Ministry staff using the FREP riparian monitoring protocol. Sampling sites consist of randomly selected cutblocks with streams in or adjacent to cutblock boundaries. The largest stream of sufficient length is sampled. Stewardship trends are determined by harvest era.

Summary: Of 139 streams, 61% were rated as "very low" or "low" harvest-related impact.

Samples by Stream Class and Impact Rating

Class	High	Medium	Low	Very low	Total
S1				1	**1**
S2	1		3	2	**6**
S3	2	6	5	7	**20**
S4	7	11	8	5	**31**
S5	1	1	2	4	**8**
S6	9	16	31	17	**73**
Total	**20**	**34**	**49**	**36**	**139**

Causal Factors:

% of total	Most common specific impact in order of frequency
Natural events 54% *High natural sediment* *Wind*	• In-stream sediments increased • Moss levels decreased • Invertebrates decreased • Stream or riparian blockages increased
Logging 32% *Low retention* *Windthrow*	• Riparian vegetation decreased • In-stream sediments increased • Stream or riparian blockages increased
Roads 10% *Erosion causing sedimentation and channel infilling*	• In-stream sediments increased • Stream or riparian blockages increased
Upstream factors 3% *Natural events* *Logging* *Roads*	• In-stream sediments increased • Moss levels decreased • Stream or riparian blockages increased • Invertebrates decreased

Near-stream human actions (logging, roads) caused 42% of the impacts on streams. Natural events, mainly high natural background sediment, are a key Northeast attribute causing 54% of the impact.

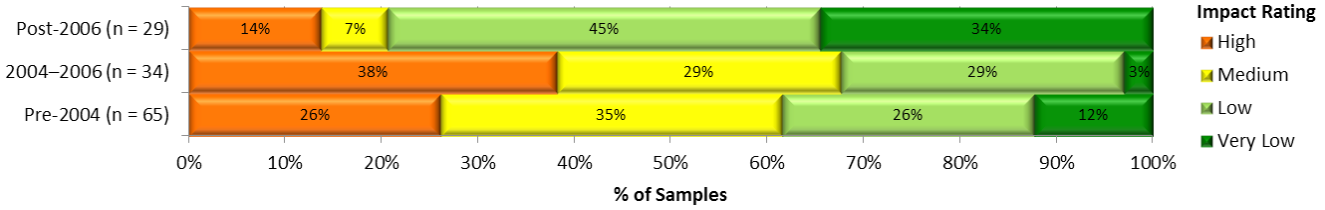
Overall Stewardship Trend: A statistical difference (p = 0.06) was evident between the three harvest eras, with decreasing stream condition.

Opportunities for Improvement and (or) Continuation of Practices that Protect Stream and Riparian Conditions:

This region's geology gives the highest natural background sediment levels in the province and proportionately fewer "very low" impact streams can be expected. Further sampling is necessary for recently harvested cutblocks.

- Minimize introduction of fine and coarse sediment from roads
- Reduce windthrow by increasing buffer widths if narrow buffer strips are a problem, or use more selective harvest practices if windthrow-prone timber is an issue
- Increase retention generally on small streams, especially those wider perennial streams that make significant contributions of water, sediment, debris, and nutrients to downstream fish habitats and watershed function

Northeast Stand-level Biodiversity: Resource Development Impacts



Data Source: Stand-level biodiversity data was collected by Ministry field staff using the FREP stand-level biodiversity monitoring protocol. Sampling sites consist of randomly selected, recently harvested cutblocks. Impact rating considers total treed retention, retention quality, and coarse woody debris quantity and quality. Stewardship trends are based on differences in outcomes between harvest years.

Summary: Of 128 cutblocks, 46% of sites were rated as "very low" or "low" harvest-related impact. The table below shows the percentage of sampled cutblocks by impact category. It also gives the average cutblock size by category, with smaller cutblocks potentially more likely to be in the "high" impact category.

	High	Medium	Low	Very low
% of blocks	27	27	31	15
Average gross (ha)	36	55	83	79

Causal Factors:

80% of all cutblocks had 3.5% or more tree retention. The post-2006 harvest era showed the highest results with 97% of cutblocks with 3.5% or more retention, and the 2004–2006 harvest era with the lowest at 68%. The majority of the data (106 samples) is from the Boreal White and Black Spruce (BWBS) biogeoclimatic zone, representing where the harvest has occurred in this region. The BWBS zone live tree species diversity is consistently less than expected from baseline, although with potential improvement and more variety of tree species retained in the post-2006 era. Density of big trees (> 40 cm dbh, and compared to baseline) is similar to baseline for the BWBS cutblocks. The density of large snags has increased in the BWBS blocks. The range of coarse woody debris volume over many cutblocks is consistently similar or slightly higher than expected from the baseline (compared to retention patches), with the exception of the five Sub-Boreal Spruce cutblocks sampled from the 2004–2006 harvest era, which had very little coarse woody debris. Coarse woody debris quality (i.e., volume from ≥ 20 cm pieces and density of big pieces per hectare of ≥ 20 cm diameter and ≥ 10 m long) is low compared to the baseline but with improvement in the BWBS in the post-2006 harvest era.

Overall Stewardship Trend: A statistical difference (p = 0.00) was evident between harvest eras, with an improving trend in later harvest years. Retention increased from an average 10.2% for cutblocks harvested before 2004, to 10.6% for blocks harvested during 2004–2006, and 21.4% for blocks harvested after 2006. Average retention quality was highest for the post-2006 era.

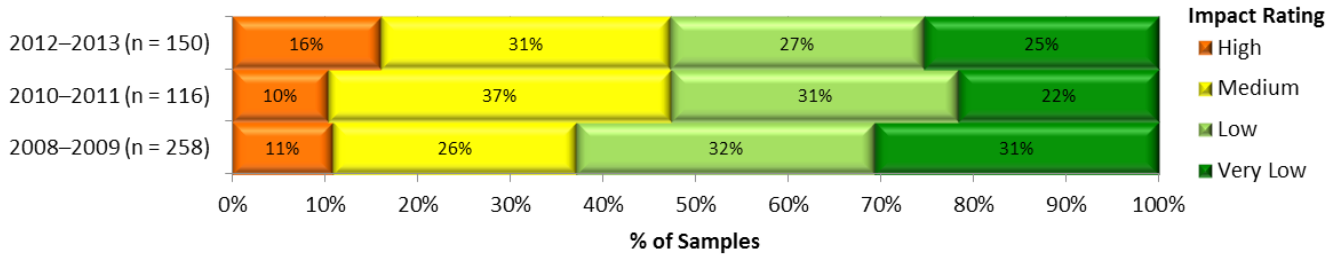
Opportunities for Improvement and (or) Continuation of Practices that Effectively Manage Stand-level Biodiversity:

- Continue trend to leave at least low levels of retention on every cutblock
- Have a range of retention (e.g., 3–30%) over many cutblocks
- Where possible, retain the full range of tree species and continue leaving large trees and large snags for the site

3.4 *Omineca Natural Resource Region*

The intention of FREP monitoring is to evaluate the effects of resource development at a stand or site level, rather than the overall condition of the resource value. This information is an important element in helping resource managers determine the appropriate balance between ecological, social and economic factors. The FREP results also identify when stand-level values are not being managed sustainably, identifying areas that warrant improvement of on-the-ground resource management practices. The following section presents the outcomes of site-level FREP monitoring in the Omineca Natural Resource Region.

Omineca Water Quality: Resource Development Impacts



Data Source: Water quality data (potential for fine sediment generation) was collected by Ministry staff using the FREP water quality monitoring protocol. Sampling sites consist of roads (and [or] areas of mass wasting) connected to fish habitat and (or) drinking water sources that originate at randomly selected, recently harvested cutblocks. Stewardship trends are based on survey years to capture the effects of road traffic and maintenance.

Summary: Of 524 road segments, 58% were rated as "very low" or "low" road-related impact.

Causal Factors:

See opportunities for improvement on road segments with "high" or "medium" impact ratings. Some opportunities will apply to ongoing maintenance issues, whereas others mainly apply to new road construction.

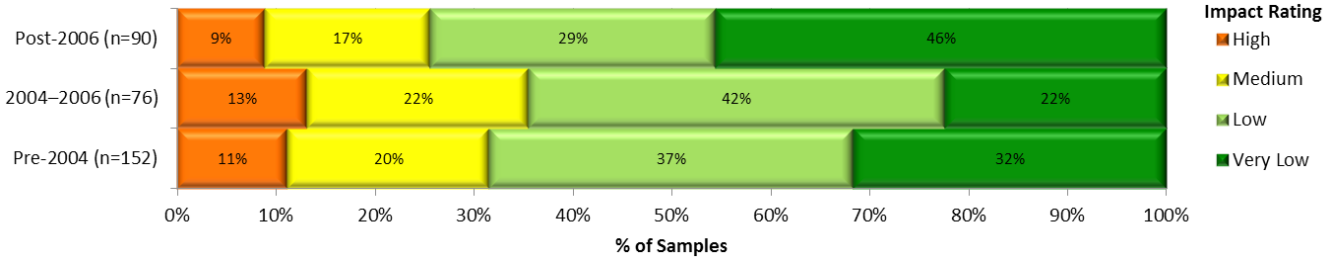
Overall Stewardship Trend: No statistical difference (p = 0.17) was evident between the three sampling eras.

Opportunities for Improvement and (or) Continuation of Practices that Help Minimize Sediment:

The most frequent suggested solutions to improve road segments with "high" or "medium" impact ratings are:

- Increase the number of strategically located culverts
- Remove berms that channel water towards streams
- Armour, seed, and protect bare soil as soon as possible after disturbance
- Use good-quality materials for road building

Omineca Riparian: Resource Development and Natural Impacts on Stream Function



Data Source: Stream riparian data was collected by Ministry staff using the FREP riparian monitoring protocol. Sampling sites consist of randomly selected cutblocks with streams in or adjacent to cutblock boundaries. The largest stream of sufficient length is sampled. Stewardship trends are determined by harvest era.

Summary: Of 318 streams, 69% were rated as "very low" or "low" harvest-related impact.

Samples by Stream Class and Impact Rating

Class	High	Medium	Low	Very low	Total
S1			1		**1**
S2	1	4	12	10	**27**
S3	7	14	34	51	**106**
S4	13	24	39	29	**105**
S5		2	1		**3**
S6	14	19	27	17	**77**
Total	**35**	**63**	**114**	**107**	**319**[13]

Causal Factors:

% of total	Most common specific impact in order of frequency
Logging 36% *Low retention* *Windthrow*	• Windthrow increased • Riparian vegetation decreased • In-stream sediments increased • Stream or riparian blockages increased
Natural events 35% *High natural sediment* *Wind, Beetle kill* *Organic streams, Floods*	• In-stream sediments increased • Moss levels decreased • Invertebrates decreased
Roads 16% *Erosion causing sedimentation and channel infilling*	• In-stream sediments increased • Moss levels decreased • Stream or riparian blockages increased • Invertebrates decreased
Upstream factors 12% *Natural events* *Logging* *Roads*	• In-stream sediments increased • Moss levels decreased • Invertebrates decreased • Stream or riparian blockages increased

Near-stream human actions (logging, roads) caused 52% of the impacts on streams. Naturally high background sediment related to natural events was a main source of impact (35% of impact).

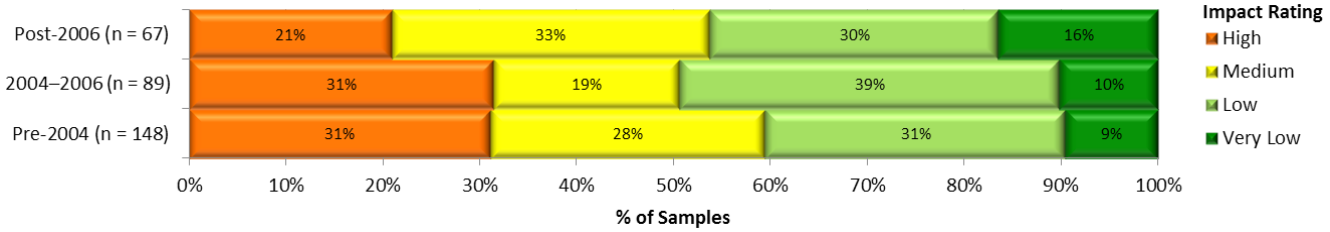
Overall Stewardship Trend: No statistical difference (p = 0.11) was evident between the three harvest eras.

Opportunities for Improvement and (or) Continuation of Practices that Protect Stream and Riparian Conditions:

- Minimize introduction of fine and coarse sediment from roads
- Reduce windthrow by increasing buffer widths if narrow buffer strips are a problem, or use more selective harvest practices if windthrow-prone timber is an issue
- Increase retention generally on small streams, especially those wider perennial streams that make significant contributions of water, sediment, debris, and nutrients to downstream fish habitats and watershed function

13 One stream had an unknown harvest year and was not included in the stewardship trend analysis.

Omineca Stand-level Biodiversity: Resource Development Impacts



Data Source: Stand-level biodiversity data was collected by Ministry field staff using the FREP stand-level biodiversity monitoring protocol. Sampling sites consist of randomly selected, recently harvested cutblocks. Impact rating considers total treed retention, retention quality, and coarse woody debris quantity and quality. Stewardship trends are based on differences in outcomes between harvest years.

Summary: Of 304[14] cutblocks, 44% of sites were rated as "very low" or "low" harvest-related impact. The table below shows the percentage of sampled cutblocks by impact category. It also gives the average size of cutblock by category, with smaller cutblocks potentially more likely to be in the "high" impact category.

	High	Medium	Low	Very low
% of blocks	29	27	33	11
Average gross (ha)	22	64	69	67

Causal Factors:

74% of all cutblocks had 3.5% or more tree retention. The post-2006 harvest era showed the best results with 85% of cutblocks with 3.5% or more retention. The ESSF[15] zone cutblocks generally have low live tree species diversity. The SBS zone is similar to baseline amounts for live tree species and ICH has higher amounts. Density of big trees (generally > 40 cm dbh) is similar or higher than baseline for SBS and ESSF cutblocks but lower for ICH blocks. Large snag density is higher than baseline for ESSF cutblocks but lower for SBS and ICH blocks. The range of coarse woody debris volume over many cutblocks is consistently lower than expected from baseline (compared to retention patches) with the exception of the ESSF blocks, which have similar to baseline amounts. Coarse woody debris quality (i.e., volume from ≥ 20 cm dbh pieces and density of big pieces per hectare of ≥ 20 cm diameter and ≥ 10 m long) is low compared to the baseline, although better in the ESSF zone.

Overall Stewardship Trend: No statistical difference (p = 0.20) was evident between harvest eras. Retention increased from an average 12.0% for cutblocks harvested before 2004, to 15.4% for blocks harvested during 2004–2006, and 15.2% for blocks harvested after 2006. Retention quality increased from the pre-2004 through post-2006 harvest eras. Gross cutblock size has increased from 40–53 ha to an average of 74 ha in the post-2006 harvest era.

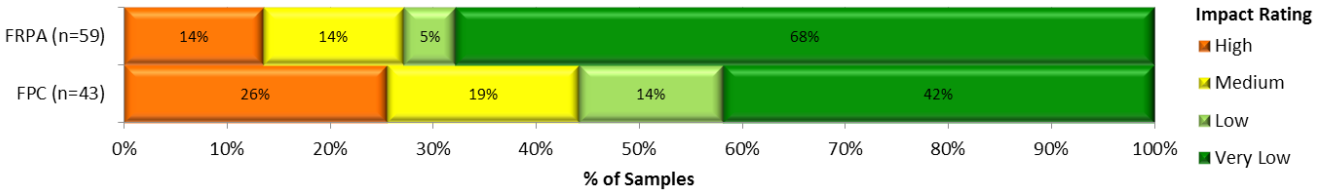
Opportunities for Improvement and (or) Continuation of Practices that Effectively Manage Stand-level Biodiversity:

- Continue leaving large diameter trees in densities similar to pre-harvest conditions, with particular emphasis on large tree retention in the ICH zone
- Leave at least low levels of retention on every cutblock
- Have a range of retention (e.g., 3–30%) over many cutblocks
- Improve coarse woody debris quality in the SBS zone by leaving more large diameter and (or) long pieces in the harvest area

14 An additional 41 cutblocks were assessed for individual indicators but could not be ranked because of a lack of baseline data.

15 Biogeoclimatic zones mentioned in this section are: Engelmann Spruce–Subalpine-Fir (ESSF), Sub-Boreal Spruce (SBS), and Interior Cedar–Hemlock (ICH).

Omineca Visual Quality: Resource Development Impacts on Achievement of Visual Quality Objectives



Data Source: Visual quality assessment data was collected by Ministry field staff using the FREP visual quality monitoring protocol. Sampling sites consist of landforms with visual quality objectives located in randomly selected, recently harvested cutblocks. Stewardship trends are based on comparisons of samples collected under *FPC* forest development plans versus *FRPA* forest stewardship plans.

Summary: Of 102 landforms, 66% were rated as "very low" or "low" harvest-related impact. Existing data suggest that the visual value is not at risk in this region.

Causal Factors:

The proportion of landforms with a high impact rating decreased from 26% under the *FPC* to 14% under the *FRPA*. This is most likely explained by smaller opening sizes as design and in-block retention have not changed appreciably.

Number of Samples by Visual Quality Objective (VQO) and Impact Rating

VQO[a]	High	Medium	Low	Very low	Total
MM			1	2	**3**
M	4	5		25	**34**
PR	10	8	8	24	**50**
R	5	3		7	**15**
Total	**19**	**16**	**9**	**58**	**102**

[a] MM = Maximum Modification, M = Modification, PR = Partial Retention, R = Retention

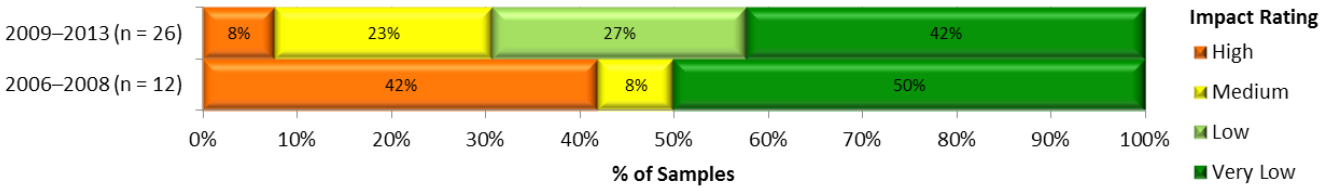
Overall Stewardship Trend: A statistical difference (p = 0.06) was evident between the two eras, indicating an improving trend for the *FRPA* assessments.

Opportunities for Improvement Based on Viewscapes that Meet Visual Quality Objectives:

Districts are encouraged to continue FREP visual quality sampling to monitor trends.

- Continue to reduce opening size in retention and partial retention VQO areas
- Use visual design techniques to create more natural-looking openings
- Use partial cutting to retain higher levels of volume per stems

Omineca Cultural Heritage: Resource Development Impacts



Data Source: Cultural heritage assessment data was collected by Ministry field staff, often with the assistance of local First Nations. Sampling sites consist of a minimum of 50% randomly selected sites and up to 50% targeted sites (First Nations and [or] licensees requests) based on recently harvested cutblocks with known cultural heritage resource values.

The Omineca data is from Fort St. James and Vanderhoof natural resource districts.

Summary: The impact rating accounts for both overall block management of cultural heritage resources and protection of individual cultural features. Of 38 cutblocks, 45% were rated as "very low" impact, 18% as "low," 18% as "medium," and 18% as "high."

Considering the two components of the impact rating score, 53% of cutblocks were considered "well" to "very well" managed, 29% were "moderately" managed, and 18% were "poorly" managed. At the cultural feature level, 52% of cutblocks showed no evidence of harvest-related damage, whereas 48% showed evidence of damage; 29% of the damaged features were rendered unsuitable for continued use.

Causal Factors:

Best outcomes were associated with stubbing of culturally modified trees, avoidance of cultural features, and machine-free zones. On sites with impacts, the primary causes of damage were covering or damaging trails, road building, and windthrow.

Opportunities for Improvement:

Opportunities for improvement are associated with the following practices that resulted in the best cultural heritage resource outcomes:

- Knowing, understanding and documenting local First Nations preferred management practices and outcomes through direct contact with local First Nations
- Review of cultural heritage resource documentation during planning and operations
- Avoid cultural features through the use of windfirm reserves, such as wildlife tree patches, machine-free zones, and block boundary changes
- Stub dead pine culturally modified trees above cultural marks to avoid future windfall or breakage
- Avoid skidding across cultural trails (in some cases, use of designated crossings)

Omineca Timber: Resource Development Impacts on Stand Health and Productivity

Data Source: Timber resource data for stand health and productivity was collected by Ministry field staff and contractors using the FREP stand development monitoring protocol. Sampling sites consist of randomly selected harvested areas greater than 5 hectares, 20–40 years old, and declared "free-growing."

Summary: The 89 polygons sampled represent 2% of the sampling population area. Average polygon age is 25 years (range: 15–47 years). Table A summarizes stand information by leading species for all biogeoclimatic zones combined.

Table A. Stand Metrics for Three Leading Species

Species	Total tree sample (%)	Total basal area (%)	Average site index[16]
Lodgepole pine	44	67	20
Spruce	25	21	21
Subalpine fir	9	5	19[17]

Table B. Total and Well-spaced Stems per Hectare by Layer

Layer[18]	Total live stems per ha	Total live stems per ha (%)	Well-spaced live stems per ha (%)
L1	313	9	20
L2	784	21	43
L3	2560	70	37
Total	**3657**	**100**	**100**

Table B shows that 70% of the total trees and 37% of the well-spaced trees are in layer 3. A large component of potential crops harvested in the mid to long term will consist of natural ingress of these layer 3 trees. The three leading forest health factors were:

- Western gall rust
- Commandra blister rust
- Mountain pine beetle

Table C shows the species most affected by these forest health factors: lodgepole pine with 29% of trees affected (i.e., non-acceptable) (total 8016 trees), and spruce with 13% of trees affected (total 4101 trees).

Table C. Total, Acceptable, Non-acceptable, and Dead Trees by Species

Species	Total stems per ha	Acceptable live trees (%)	Non-acceptable live trees (%)	Dead trees (%)
Lodgepole pine	8016	63	29	29
Spruce	4101	85	13	2
Subalpine fir	1486	89	9	1
Average	**3987**	**72**	**20**	**8**

Opportunities for Improvement:

Lodgepole pine is a predominant species in the Omineca Region and has been impacted most by forest health factors. The productivity of spruce is significantly higher than lodgepole pine and could play an increasing role in mixed species planting prescriptions.

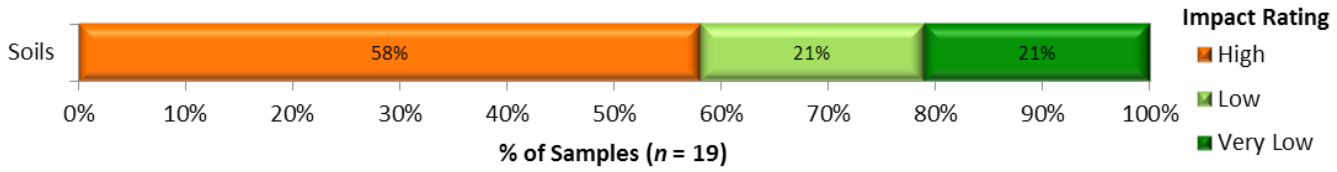
- Promote species that are less impacted by forest health factors and have higher productivity to benefit future timber supply

16 Site index indicates productivity, as seen by the tree height at age 50 (based on biogeoclimatic zones with ≥ 30 polygons).

17 Because there was insufficient data to base site index on only those biogeoclimatic zones with ≥ 30 polygons, site index for subalpine fir is from the total sample of polygons.

18 Layer 1: > 12.5 cm dbh; layer 2: 7.5–12.49 cm dbh; layer 3: < 1.3 m high and < 7.49 cm dbh.

Omineca Soils: Resource Development Impacts on Soil Productivity and Hydrologic Function



Data Source: Soils data for assessments of soil productivity and hydrologic function was collected by provincial and regional soils experts using a FREP expert elicitation methodology. Sampling sites consist of randomly selected, recently harvested cutblocks. Assessments are based on high-resolution air photo analysis.

Summary: Of 19 cutblocks, 42% were rated as "very low" or "low" harvest-related impact, indicating that soil management objectives were achieved; 58% were rated as "high" harvest-related impact.

Causal Factors:

Excessive soil disturbance, both in roadside work areas and outside work areas, is a major factor that contributes to "highly" affected soil productivity. Several sites also show a lack of mature forest, which is required to allow recolonization of the cutblock with slowly dispersing soil organisms.

Overall Stewardship Trend: Not enough historical monitoring has taken place to establish a trend.

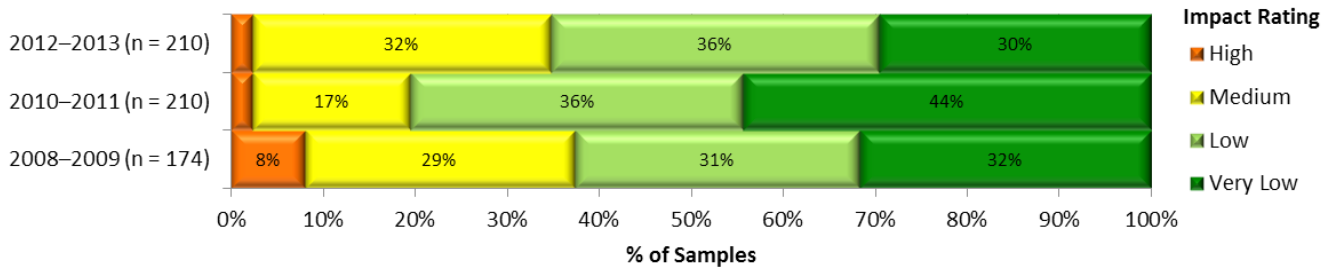
Opportunities for Improvement:

- Plan operations in and outside roadside work areas to minimize soil disturbance
- Ensure that measures to conserve well-distributed remnants of mature forest are implemented

3.5 *Skeena Natural Resource Region*

The intention of FREP monitoring is to evaluate the effects of resource development at a stand or site level, rather than the overall condition of the resource value. This information is an important element in helping resource managers determine the appropriate balance between ecological, social and economic factors. The FREP results also identify when stand-level values are not being managed sustainably, identifying areas that warrant improvement of on-the-ground resource management practices. The following section presents the outcomes of site-level FREP monitoring in the Skeena Natural Resource Region.

Skeena Water Quality: Resource Development Impacts



Data Source: Water quality data (potential for fine sediment generation) was collected by Ministry staff using the FREP water quality monitoring protocol. Sampling sites consist of roads (and [or] areas of mass wasting) connected to fish habitat and (or) drinking water sources that originate at randomly selected, recently harvested cutblocks. Stewardship trends are based on survey years to capture the effects of road traffic and maintenance.

Summary: Of 594 road segments, 70% were rated as "very low" or "low" road-related impact. Site assessments show the range for potential sediment generation as 35% "very low" ("very low" impact), 35% "low" ("low" impact), 26% "moderate" ("medium" impact), 4% "high" and 0% "very high" ("high" impact).

Causal Factors:

See opportunities for improvement on road segments with "high" or "medium" impact ratings. Some opportunities will apply to ongoing maintenance issues, whereas others mainly apply to new road construction.

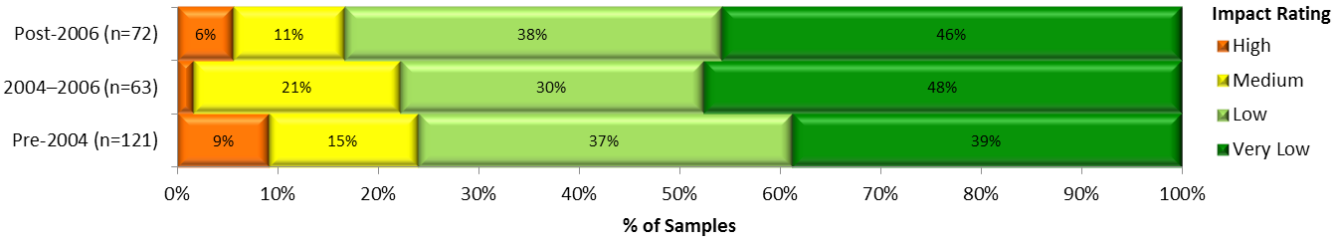
Overall Stewardship Trend: A statistical difference (p = 0.00) was evident between the three sampling eras, indicating a fluctuation in potential for sediment generation from roads and with less potential sediment during the 2010–2011 sample era.

Opportunities for Improvement and (or) Continuation of Practices that Help Minimize Sediment:

The most frequent suggested solutions to improve road segments with "high" or "medium" impact ratings are:

- Use cross-ditches and kickouts
- Armour, seed, and protect bare soil as soon as possible after disturbance
- Increase the number of strategically located culverts

Skeena Riparian: Resource Development Impacts on Stream Function



Data Source: Stream riparian data was collected by Ministry staff using the FREP riparian monitoring protocol. Sampling sites consist of randomly selected cutblocks with streams in or adjacent to cutblock boundaries. The largest stream of sufficient length is sampled. Stewardship trends are determined by harvest era.

Summary: Of 256 streams, 78% were rated as "very low" or "low" harvest-related impact.

Samples by Stream Class and Impact Rating

Class	High	Medium	Low	Very low	Total
S1				2	**2**
S2		1	1	2	**4**
S3	2	8	21	33	**64**
S4	1	7	16	7	**31**
S5		2	4	12	**18**
S6	15	21	49	54	**139**
Total	**18**	**39**	**91**	**110**	**258**[19]

Causal Factors:

% of total	Most common specific impact in order of frequency
Logging 46% *Low retention* *Falling and yarding* *Windthrow*	• Riparian vegetation decreased • In-stream sediment increased • Stream or riparian blockages increased
Natural events 38% *High natural sediment* *Wind*	• In-stream sediments increased • Moss levels decreased • Invertebrates decreased • Stream or riparian blockages increased
Roads 9% *Erosion causing sedimentation*	• In-stream sediments increased
Upstream factors 6% *Natural impacts* *Logging* *Roads*	• In-stream sediments increased

Near-stream human actions (logging, roads) caused 55% of the impacts to streams. Naturally high background sediment levels were a main natural event affecting streams.

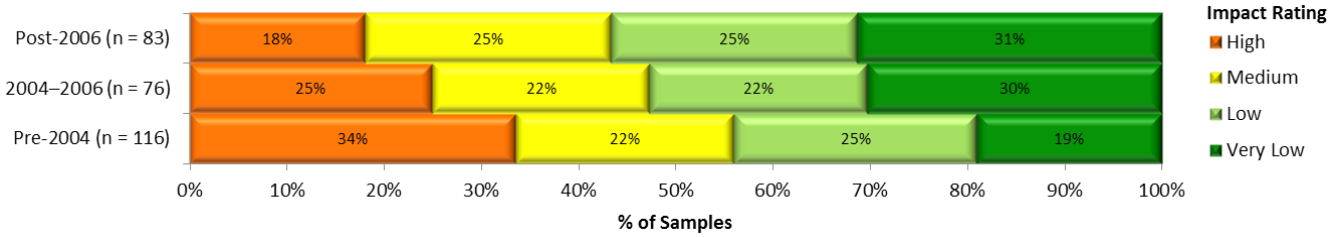
Overall Stewardship Trend: No statistical difference (p = 0.72) was evident between the three harvest eras.

Opportunities for Improvement and (or) Continuation of Practices that Protect Stream and Riparian Conditions:

- Minimize introduction of fine and coarse sediment from roads
- Reduce windthrow by increasing buffer widths if narrow buffer strips are a problem, or use more selective harvest practices if windthrow-prone timber is an issue
- Increase retention generally on small streams, especially those wider perennial streams that make significant contributions of water, sediment, debris, and nutrients to downstream fish habitats and watershed function

19 Two streams (both "high" impact) had an unknown pre-2006 harvest year and were not included in the stewardship trend analysis.

Skeena Stand-level Biodiversity: Resource Development Impacts



Data Source: Stand-level biodiversity data was collected by Ministry field staff using the FREP stand-level biodiversity monitoring protocol. Sampling sites consist of randomly selected, recently harvested cutblocks. Impact rating considers total treed retention, retention quality, and coarse woody debris quantity and quality. Stewardship trends are based on differences in outcomes between harvest years.

Summary: Of 275[20] cutblocks, 50% of sites were rated as "very low" or "low" harvest-related impact. The table below shows the percentage of cutblocks by impact category. It also gives the average size of cutblock by category, with smaller cutblocks potentially more likely to be in the "high" impact category.

	High	Medium	Low	Very low
% of blocks	27	23	24	26
Average gross (ha)	14	35	47	40

Causal Factors:

72% of all cutblocks had 3.5% or more tree retention. This value increased to 77% for the 2004–2006 harvest era cutblocks and 82.5% for the post-2006 harvest era cutblocks. The density of large snags retained is lower than baseline data (timber cruise) for the ESSF,[21] ICH, and SBS biogeoclimatic zones. Dispersed retention was used more as a retention technique in the later harvest years.

Overall Stewardship Trend: No statistical difference (p = 0.20) was evident between harvest eras. Retention averaged 16.0% for cutblocks harvested before 2004, 21.5% for blocks harvested during 2004–2006, and 19.2% for blocks harvested after 2006. Retention quality increased slightly in the later harvest years. Coarse woody debris quantity or quality remained fairly constant between the harvest eras.

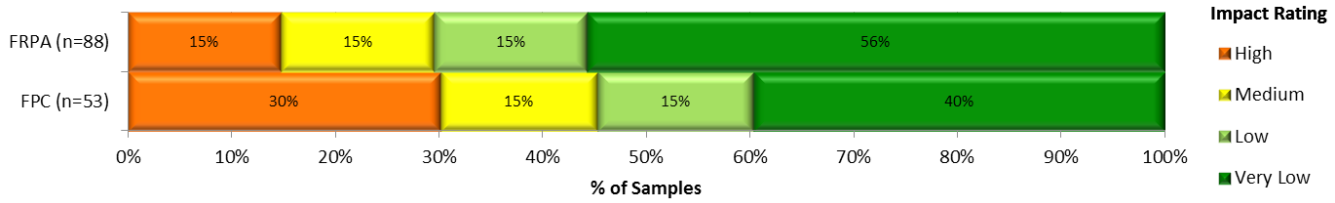
Opportunities for Improvement and (or) Continuation of Practices that Effectively Manage Stand-level Biodiversity:

- Leave at least low levels of retention on every cutblock with a diversity of tree species
- Look for opportunities to leave large snags safely as ecological anchors within retention patches

20 An additional nine cutblocks were assessed for individual indicators but could not be ranked because of a lack of baseline data, or the cutblocks had retention patches but no sample data from the patch (likely related to safety issues).

21 Biogeoclimatic zones mentioned in this section are: Engelmann Spruce–Subalpine Fir (ESSF), Interior Cedar–Hemlock (ICH), and Sub-Boreal Spruce (SBS).

Skeena Visual Quality: Resource Development Impacts on Achievement of Visual Quality Objectives



Data Source: Visual quality assessment data was collected by Ministry field staff using the FREP visual quality monitoring protocol. Sampling sites consist of landforms with visual quality objectives located in randomly selected, recently harvested cutblocks. Stewardship trends are based on comparisons of samples collected under *FPC* forest development plans versus *FRPA* forest stewardship plans.

Summary: Of 141 landforms, 65% were rated as "very low" or "low" harvest-related impact. Existing data suggest that the visual value is not at risk in this region.

Causal Factors:

Visual design and the degree of tree retention within openings did not change appreciably between the *FPC* and *FRPA* samples. The improvements observed are likely the result of smaller openings.

Number of Samples by Visual Quality Objective (VQO) and Impact Rating

VQO[a]	High	Medium	Low	Very low	Total
M	4	7	7	23	**41**
PR	20	10	8	40	**78**
R	5	2	6	7	**20**
P		2			**2**
Total	**29**	**21**	**21**	**70**	**141**

[a] M = Modification, PR = Partial Retention, R = Retention, P = Preservation

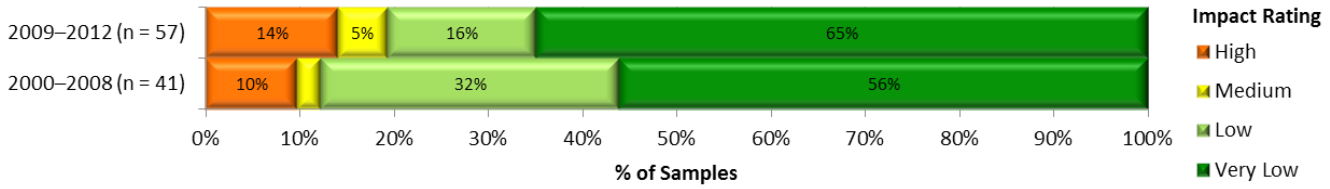
Overall Stewardship Trend: No statistical difference (p = 0.14) was evident between the two eras; however, a trend to improvement in the *FRPA* cutblocks was apparent.

Opportunities for Improvement Based on Viewscapes that Meet Visual Quality Objectives:

Districts are encouraged to continue FREP visual quality sampling to monitor trends.

- Reduce opening size in retention and partial retention VQO areas
- Use visual design techniques to create more natural-looking openings and better achieve visual quality objectives
- Use partial cutting to retain higher levels of volume per stems

Skeena Cultural Heritage: Resource Development Impacts



Data Source: Cultural heritage assessment data was collected by Ministry field staff, often with the assistance of local First Nations. Sampling sites consist of a minimum of 50% randomly selected sites and up to 50% targeted sites (First Nations and [or] licensees requests) based on recently harvested cutblocks with known cultural heritage resource values.

Skeena Region samples are predominantly from the Nadina (42%) and Skeena–Stikine (39%) natural resource districts, with a lower amount of sampling from the Coast Mountain (19%) district.

Summary: The impact ratings accounts for both overall block management of cultural heritage resources and protection of individual cultural features. Of 98 cutblocks, 61% were rated as "very low" impact, 22% as "low," 4% as "medium," and 12% as "high."

Considering the two components of the impact rating score, 56% of cutblocks were considered "well" to "very well" managed, 22% were "moderately" managed, and 12% were "poorly" to "very poorly" managed. At the cultural feature level, 57% of cutblocks showed no evidence of harvest-related damage, whereas 43% showed evidence of damage; 19% of the damaged features were rendered unsuitable for continued use.

Causal Factors:

Best outcomes were associated with stubbing of culturally modified trees, avoidance of cultural features, and reserves and buffers. On sites with impacts, the primary causes of damage were windthrow, harvesting activity causing damage to trails, and removal of cultural features.

Opportunities for Improvement:

Opportunities for improvement are associated with the following practices that resulted in the best cultural heritage resource outcomes:

- Knowing, understanding and documenting local First Nations preferred management practices and outcomes through direct contact with local First Nations
- Review of cultural heritage resource documentation during planning and operations
- During the pre-harvest site inspection, identify cultural features with flagging tape for easy recognition during operations
- Avoid cultural features through the use of windfirm reserves, such as wildlife tree patches, machine-free zones, and block boundary modification; combine reserves with visual quality objectives, retention, or other reserve needs
- Stub dead pine culturally modified trees above cultural marks to avoid future windfall or breakage
- Avoid skidding across cultural trails (in some cases, use of designated crossings)
- Consider harvesting during winter (e.g., frozen ground) to protect cultural plants

Skeena Timber: Resource Development Impacts on Stand Health and Productivity

Data Source: Timber resource data for stand health and productivity was collected by Ministry field staff and contractors using the FREP stand development monitoring protocol. Sampling sites consist of randomly selected harvested areas greater than 5 hectares, 20–40 years old, and declared "free-growing."

Summary: The 52 polygons sampled represent 4.2% of the sampling population area. Average polygon age is 24 years (range: 16–36 years). Table A summarizes stand information by leading species for all biogeoclimatic zones combined.

Table A. Stand Metrics for Three Leading Species

Species	Total tree sample (%)	Total basal area (%)	Average site index[22]
Lodgepole pine	46	72%	20
Spruce	23	16	21
Subalpine fir	17	7	16[23]

Table B. Total and Well-spaced Stems per Hectare by Layer

Layer[24]	Total live stems per ha	Total live stems per ha (%)	Well-spaced live stems per ha (%)
L1	411	14	29
L2	707	24	40
L3	1854	62	31
Total	**2972**	**100%**	**100**

Table B shows that 62% of the total trees and 31% of the well-spaced trees are in layer 3. A large component of potential crops harvested in the mid to long term will consist of natural ingress of these layer 3 trees. The three leading forest health factors were:

- Western gall rust
- Commandra blister rust
- Warrens root collar weevil

Table C shows the species most affected by these forest health factors: lodgepole pine with 27% of trees affected (i.e., non-acceptable) (total 3789 trees).

Table C. Total, Acceptable, Non-acceptable, and Dead Trees by Species

Species	Total stems per ha	Acceptable live trees (%)	Non-acceptable live trees (%)	Dead trees (%)
Lodgepole pine	3789	66	27	7
Spruce	1850	89	7	4
Subalpine fir	1348	90	8	2
Average	**3162**	**78**	**16**	**6**

Opportunities for Improvement:

Lodgepole pine is a predominant species in the Skeena Region and has been impacted most by forest health factors. The productivity of spruce is significantly higher than lodgepole pine and could play an increasing role in mixed species planting prescriptions.

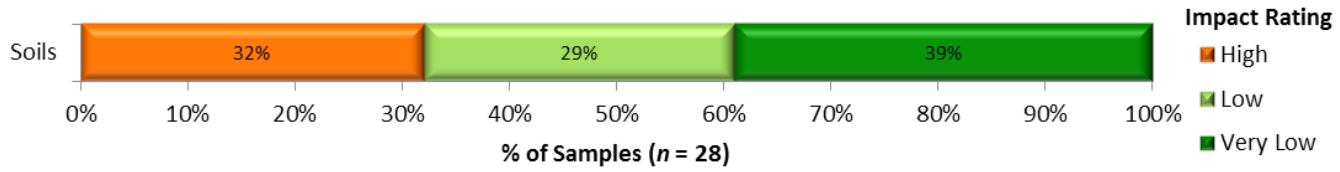
- Promote species that are less impacted by forest health factors and have higher productivity to benefit future timber supply

22 Site index indicates productivity, as seen by the tree height at age 50 (based on biogeoclimatic zones with ≥ 30 polygons)

23 Because there was insufficient data to base site index on only those biogeoclimatic zones with ≥ 30 polygons, site index for subalpine fir is from the total sample of polygons.

24 Layer 1: > 12.5 cm dbh; layer 2: 7.5–12.49 cm dbh; layer 3: < 1.3 m high and < 7.49 cm dbh.

Skeena Soils: Resource Development Impacts on Soil Productivity and Hydrologic Function



Data Source: Soils data for assessments of soil productivity and hydrologic function was collected by provincial and regional soils experts using a FREP expert elicitation methodology. Sampling sites consist of randomly selected, recently harvested cutblocks. Assessments are based on high-resolution air photo analysis.

Summary: Of 28 cutblocks, 68% were rated as "very low" or "low" harvest-related impact, indicating that soil management objectives were achieved; 32% were rated as "high" harvest-related impact.

Causal Factors:

Excessive soils disturbance, both in roadside work areas and outside work areas, is a major factor that contributes to "highly" affected soil productivity. Several sites also show a lack of rehabilitated access roads.

Overall Stewardship Trend: Not enough historical monitoring has taken place to establish a trend.

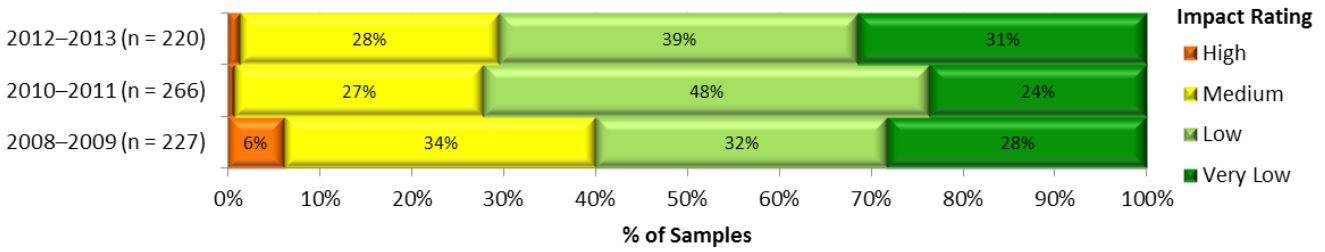
Opportunities for Improvement:

- Plan operations in and outside roadside work areas to minimize soil disturbance
- Implement road and structure rehabilitation for permanent deactivation

3.6 *South Coast Natural Resource Region*

The intention of FREP monitoring is to evaluate the effects of resource development at a stand or site level, rather than the overall condition of the resource value. This information is an important element in helping resource managers determine the appropriate balance between ecological, social and economic factors. The FREP results also identify when stand-level values are not being managed sustainably, identifying areas that warrant improvement of on-the-ground resource management practices. The following section presents the outcomes of site-level FREP monitoring in the South Coast Natural Resource Region.

South Coast Water Quality: Resource Development Impacts



Data Source: Water quality data (potential for fine sediment generation) was collected by Ministry staff using the FREP water quality monitoring protocol. Sampling sites consist of roads (and [or] areas of mass wasting) connected to fish habitat and (or) drinking water sources that originate at randomly selected, recently harvested cutblocks. Stewardship trends are based on survey years to capture the effects of road traffic and maintenance.

Summary: Of 713 road segments, 68% were rated as "very low" or "low" road-related impact.

Causal Factors:

See opportunities for improvement on road segments with "high" or "medium" impact ratings. Some opportunities will apply to ongoing maintenance issues, whereas others mainly apply to new road construction.

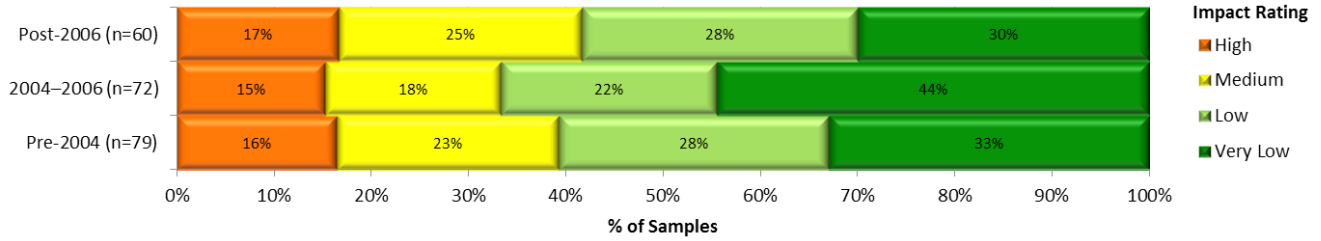
Overall Stewardship Trend: A statistical difference (p = 0.00) was evident between the three sampling eras, with slight improvement in outcomes in the latter two eras.

Opportunities for Improvement and (or) Continuation of Practices that Help Minimize Sediment:

The most frequent suggested solutions to improve road segments with "high" or "medium" impact ratings are:

- Increase the number of strategically located culverts
- Use cross-ditches and kickouts
- Armour, seed, and protect bare soil as soon as possible after disturbance
- Remove berms that channel water down the road towards streams

South Coast Riparian: Resource Development and Natural Impacts on Stream Function



Data Source: Stream riparian data was collected by Ministry staff using the FREP riparian monitoring protocol. Sampling sites consist of randomly selected cutblocks with streams in or adjacent to cutblock boundaries. The largest stream of sufficient length is sampled. Stewardship trends are determined by harvest era.

Summary: Of 211 streams, 62% were rated as "very low" or "low" harvest-related impact.

Samples by Stream Class and Impact Rating

Class	High	Medium	Low	Very low	Total
S1			1		**1**
S2		5	1	6	**12**
S3		2	10	12	**24**
S4	3	1	2	3	**9**
S5	1	2	7	22	**32**
S6	30	36	34	33	**133**
Total	**34**	**46**	**55**	**76**	**211**

Causal Factors:

% of total	Most common specific impact in order of frequency
Logging 64% *Low retention* *Falling and yarding*	• Riparian vegetation decreased • Large woody debris process altered • Large woody debris supply decreased • Stream or riparian blockages increased
Natural events 15% *Torrents* *High natural sediment*	• Moss levels decreased • Invertebrates decreased • Stream or riparian blockages increased • In-stream sediments increased
Roads 13% *Erosion causing sedimentation and channel infilling*	• In-stream sediments increased • Stream or riparian blockages increased • Moss levels increased • Invertebrates increased
Upstream factors 6% *Logging* *Natural events* *Roads*	• In-stream sediments increased • Moss levels decreased • Stream or riparian blockages increased • Invertebrate decreased
Other human-caused 2% *Invasive plants* *Brushing* *Shake blocks* *Bike trail*	• Riparian vegetation decreased • Large woody debris supply decreased • Moss levels decreased

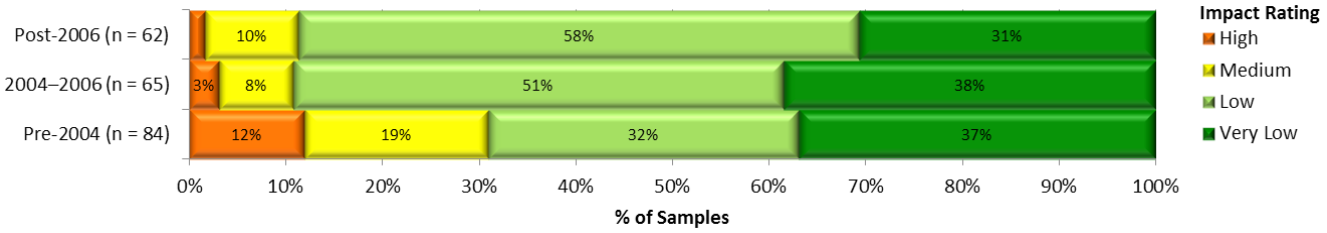
Near-stream human actions (logging, roads, other) caused 77% of the impacts on streams. Natural events caused 15% of impacts with torrents as a main factor.

Overall Stewardship Trend: No statistical difference ($p = 0.72$) was evident between the three harvest eras.

Opportunities for Improvement and (or) Continuation of Practices that Protect Stream and Riparian Conditions:

- Minimize introduction of fine and coarse sediment from roads and maintain natural drainage patterns by keeping streams clear of logging slash
- Maintain deep-rooted vegetation near stream banks
- Increase retention generally on small streams, especially those wider perennial streams that make significant contributions of water, sediment, debris, and nutrients to downstream fish habitats and watershed function

South Coast Stand-level Biodiversity: Resource Development Impacts



Data Source: Stand-level biodiversity data was collected by Ministry field staff using the FREP stand-level biodiversity monitoring protocol. Sampling sites consist of randomly selected, recently harvested cutblocks. Impact rating considers total treed retention, retention quality, and coarse woody debris quantity and quality. Stewardship trends are based on differences in outcomes between harvest years.

Summary: Of 211[25] cutblocks, 81% of sites were rated as "very low" or "low" harvest-related impact. The table below shows the percentage of all sampled cutblocks by impact category and average cutblock size by category.

	High	Medium	Low	Very low
% of blocks	6	13	45	36
Average gross (ha)	13	12	18	24

Causal Factors:

92% of all cutblocks had 3.5% or more tree retention. This was higher for the later samples (2004–2006 and post-2006 harvest eras) at 97% and 96% of samples with greater than 3.5% retention, respectively. The density of large snags retained is lower than baseline data (timber cruise) and potentially decreasing in the post-2006 harvest era. The density of large diameter trees (> 70 cm dbh) is potentially increasing, although still slightly lower than baseline. The count of live tree species is increasing and is now close to baseline amounts. The volume of coarse woody debris left on cutblocks is increasing.

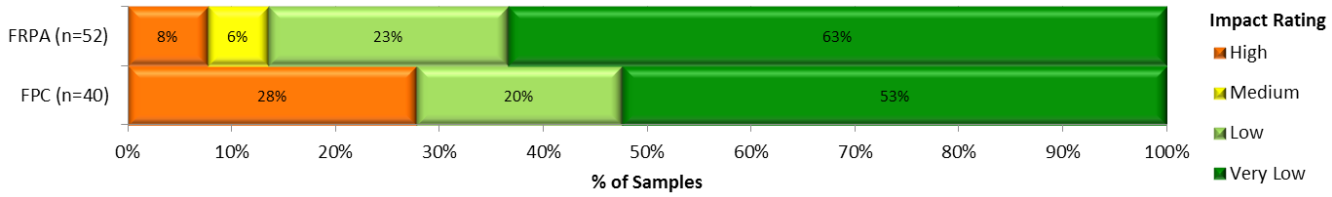
Overall Stewardship Trend: A statistical difference (p = 0.00) was evident between harvest eras, with a small improvement in the latter two eras. Retention averaged 19.8% for cutblocks harvested before 2004, 25.9% for blocks harvested during 2004–2006, and 20.0% for blocks harvested after 2006. Retention quality increased in the later harvest years, partially related to higher densities of retained large diameter trees and increased tree species diversity.

Opportunities for Improvement and (or) Continuation of Practices that Effectively Manage Stand-level Biodiversity:

- Continue trend to leave at least low levels of retention on every cutblock with a diversity of tree species
- Look for opportunities to leave large snags safely as ecological anchors within retention patches

25 An additional 31 cutblocks were assessed for individual indicators but could not be ranked because of a lack of baseline data, or cutblocks with retention patches had no sample data from the patch (likely related to safety issues).

South Coast Visual Quality: Resource Development Impacts on Achievement of Visual Quality Objectives



Data Source: Visual quality assessment data was collected by Ministry field staff using the FREP visual quality monitoring protocol. Sampling sites consist of landforms with visual quality objectives located in randomly selected, recently harvested cutblocks. Stewardship trends are based on comparisons of samples collected under *FPC* forest development plans versus *FRPA* forest stewardship plans.

Summary: Of 92 landforms, 81% were rated as "very low" or "low" harvest-related impact. Existing data suggest that the visual value is not at risk in this region.

Causal Factors:

The level of visual design did not change appreciably between the *FPC* and *FRPA* samples. The improvements observed, moving from the *FPC* to *FRPA*, may be the result of smaller openings and the documented increase in good retention within openings, from 8% under the *FPC* to 17% under *FRPA*.

Number of Samples by Visual Quality Objective (VQO) and Impact Rating

VQO[a]	High	Medium	Low	Very low	Total
M	1		5	12	**18**
PR	12	2	15	40	**69**
R	2	1		2	**5**
Total	**15**	**3**	**20**	**54**	**92**

[a] M = Modification, PR = Partial Retention, R = Retention

Overall Stewardship Trend: A statistical difference (p = 0.04) was evident between the two eras, indicating an improving trend in the *FRPA* cutblocks.

Opportunities for Improvement Based on Viewscapes that Meet Visual Quality Objectives:

Districts are encouraged to continue FREP visual quality sampling to monitor trends.

- Reduce opening size in retention and partial retention VQO areas
- Use visual design techniques to create more natural-looking openings and better achieve VQOs
- Use retention cutting to keep higher levels of volume per stems.

South Coast Timber: Resource Development Impacts on Stand Health and Productivity

Data Source: Timber resource data for stand health and productivity was collected by Ministry field staff and contractors using the FREP stand development monitoring protocol. Sampling sites consist of randomly selected harvested areas greater than 5 hectares, 20–40 years old, and declared "free-growing."

Summary: The 37 polygons sampled represent 2.8% of the sampling population area. Average polygon age is 28 years (range: 18–42 years). Table A summarizes stand information by leading species for all biogeoclimatic zones combined.

Table A. Stand Metrics for Four Leading Species

Species	Total tree sample (%)	Total basal area (%)	Average site index[26]
Amabilis fir	34	21	18
Western hemlock	21	16	19[27]
Western redcedar	17	13	25
Douglas-fir	12	26	35

Table B. Total and Well-spaced Stems per Hectare by Layer

Layer[28]	Total live stems per ha	Total live stems per ha (%)	Well-spaced live stems per ha (%)
L1	515	16	41
L2	558	17	29
L3	2156	67	29
Total	**3229**	**100**	**100**

Table B shows that 67% of the total trees and 29% of the well-spaced trees are in layer 3. A large component of potential crops harvested in the mid to long term will consist of natural ingress of these layer 3 trees. The two leading forest health factors were:

- Armillaria root disease
- Hemlock dwarf mistletoe

Table C shows the species most affected by these forest health factors: amabilis fir with 17% of trees affected (i.e., non-acceptable) (total 2063 trees), and Douglas-fir with 14% of trees affected (total 774 trees).

Table C. Total, Acceptable, Non-acceptable, and Dead Trees by Species

Species	Total stems per ha	Acceptable live trees (%)	Non-acceptable live trees (%)	Dead trees (%)
Amabilis fir	2063	81	17	2
Western hemlock	1360	82	7	4
Western redcedar	1348	90	11	7
Douglas-fir	774	78	14	8
Average	**3384**	**80**	**15**	**5**

Opportunities for Improvement:

Amabilis fir and western hemlock are the two leading species in the South Coast Region. Douglas-fir contributes most to the basal area on average and, including coastal western redcedar, has the highest site productivity. Because forest health factors are not a significant concern on the Coast, higher-valued species should be favoured in the species planting mix.

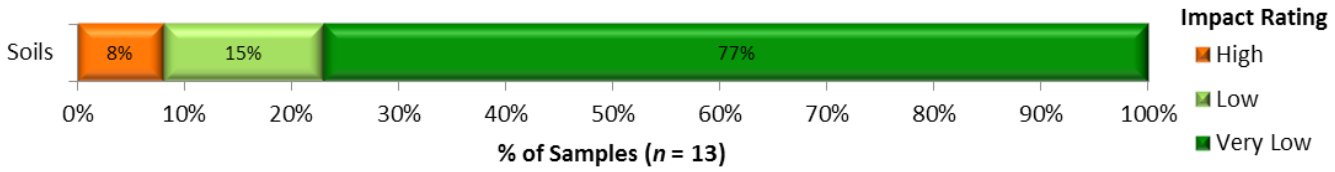
- Promote species that are less impacted by forest health factors and have higher productivity to benefit future timber supply

26 Site index indicates productivity, as seen by the tree height at age 50 (based on biogeoclimatic zones with ≥ 30 polygons)

27 Because there was insufficient data to base site index on only those biogeoclimatic zones with ≥ 30 polygons, site index for western hemlock and western redcedar is from the total sample of polygons.

28 Layer 1: > 12.5 cm dbh; layer 2: 7.5–12.49 cm dbh; layer 3: < 1.3 m high and < 7.49 cm dbh.

South Coast Soils: Resource Development Impacts on Soil Productivity and Hydrologic Function



Data Source: Soils data for assessments of soil productivity and hydrologic function was collected by provincial and regional soils experts using a FREP expert elicitation methodology. Sampling sites consist of randomly selected, recently harvested cutblocks. Assessments are based on high-resolution air photo analysis.

Summary: Of 13 cutblocks, 92% were rated as "very low" or "low" harvest-related impact, indicating that soil management objectives were achieved; 8% were rated as "high" harvest-related impact.

Causal Factors:

Although soil disturbance is less of an issue in this region, access construction or maintenance that led to (or increased the potential for) mass movement or erosion contributed to the high ratings.

Overall Stewardship Trend: Not enough historical monitoring has taken place to establish a trend.

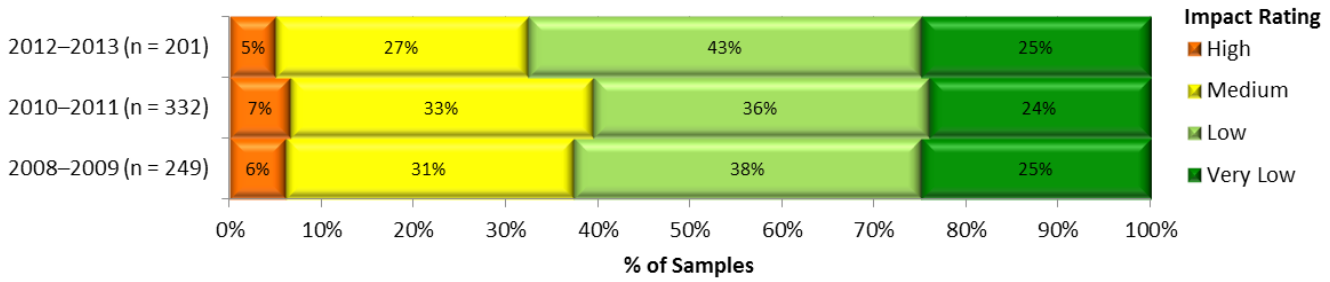
Opportunities for Improvement:

- Full road rehabilitation has the potential to alleviate the risks associated with abandoned roads; however, these techniques should be tried on a wide range of materials, including those that are assumed impossible to rehabilitate.

3.7 *Thompson–Okanagan Natural Resource Region*

The intention of FREP monitoring is to evaluate the effects of resource development at a stand or site level, rather than the overall condition of the resource value. This information is an important element in helping resource managers determine the appropriate balance between ecological, social and economic factors. The FREP results also identify when stand-level values are not being managed sustainably, identifying areas that warrant improvement of on-the-ground resource management practices. The following section presents the outcomes of site-level FREP monitoring in the Thompson-Okanagan Natural Resource Region.

Thompson–Okanagan Water Quality (fine sediment): Resource Development Impacts



Data Source: Water quality data (potential for fine sediment generation) was collected by Ministry staff using the FREP water quality monitoring protocol. Sampling sites consist of roads (and [or] areas of mass wasting) connected to fish habitat and (or) drinking water sources that originate at randomly selected, recently harvested cutblocks. Stewardship trends are based on survey years to capture the effects of road traffic and maintenance.

Summary: Of 782 road segments, 63% were rated as "very low" or "low" road-related impact.

Causal Factors:

See opportunities for improvement on road segments with "high" or "medium" impact ratings. Some opportunities will apply to ongoing maintenance issues, whereas others mainly apply to new road construction.

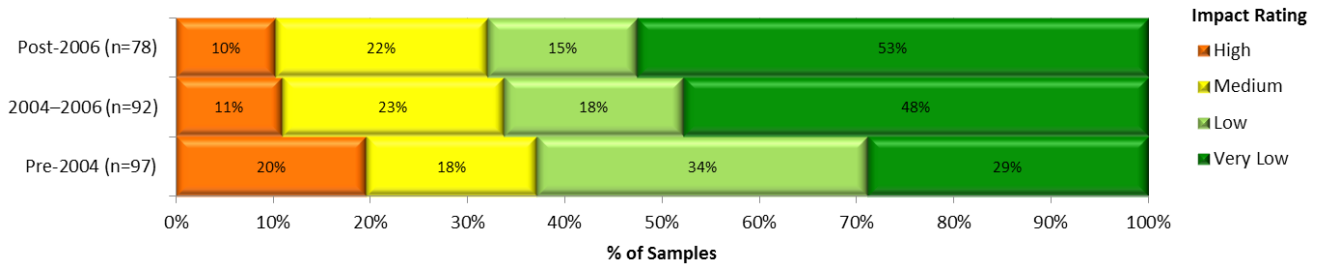
Overall Stewardship Trend: No statistical difference ($p = 0.78$) was evident between the three sampling eras.

Opportunities for Improvement and (or) Continuation of Practices that Help Minimize Sediment:

The most frequent suggested solutions to improve road segments with "high" or "medium" impact ratings are:

- Use cross-ditches and kickouts
- Remove berms that channel water along the road towards water bodies
- Increase the number of strategically located culverts
- Armour, seed, and protect bare soil as soon as possible after disturbance

Thompson–Okanagan Riparian: Resource Development and Natural Impacts on Stream Function



Data Source: Stream riparian data was collected by Ministry staff using the FREP riparian monitoring protocol. Sampling sites consist of randomly selected cutblocks with streams in or adjacent to cutblock boundaries. The largest stream of sufficient length is sampled. Stewardship trends are determined by harvest era.

Summary: Of 267 streams, 66% were rated as "very low" or "low" harvest-related impact.

Samples by Stream Class and Impact Rating

Class	High	Medium	Low	Very low	Total
S2				10	**10**
S3	3	3	13	25	**44**
S4	4	8	8	15	**35**
S5		2	1	7	**10**
S6	30	42	40	56	**168**
Total	**37**	**55**	**62**	**113**	**267**

Causal Factors:

% of total	Most common specific impact in order of frequency
Logging 46% *Low retention* *Windthrow* *Falling and yarding*	• Riparian vegetation decreased • In-stream sediments increased • Stream or riparian blockages increased • Moss levels decreased • Bare erodible ground increased
Natural events 27% *Wind* *High natural sediment* *Beetle kill* *Organic stream bed*	• Moss levels decreased • In-stream sediments increased • Stream or riparian blockages increased
Roads 14% *Erosion causing sedimentation*	• In-stream sediments increased • Bare erodible ground increased
Cattle 8% *Trampling* *Excessive grazing*	• In-stream sediments increased • Bare erodible ground increased • Moss levels increased • Stream or riparian blockages increased
Upstream factors 4% *Natural impacts* *Logging* *Roads*	• In-stream sediments increased • Moss levels increased

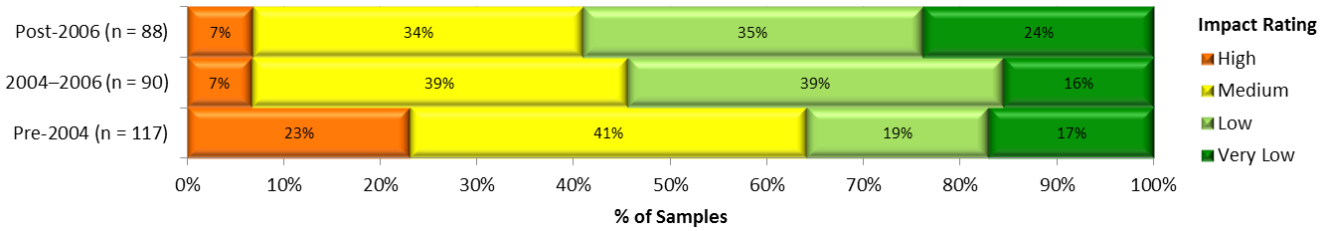
Near-stream human actions (logging, roads, cattle) caused 68% of stream impacts. Natural events caused 27% of stream impacts, with wind the main cause.

Overall Stewardship Trend: A statistical difference (p = 0.00) was evident between the three harvest eras. Some of the improvement may be from a combination of higher percentage of S6 streams in the early harvest-era and better S6 stream outcomes in later eras.

Opportunities for Improvement and (or) Continuation of Practices that Protect Stream and Riparian Conditions:

- Minimize introduction of fine and coarse sediment from roads and generally discourage cattle use of riparian areas
- Reduce windthrow by increasing buffer widths if narrow buffer strips are a problem, or use more selective harvest practices if windthrow-prone timber is an issue
- Increase retention generally on small streams, especially those wider perennial streams that make significant contributions of water, sediment, debris, and nutrients to downstream fish habitats and watershed function

Thompson–Okanagan Stand-level Biodiversity: Resource Development Impacts



Data Source: Stand-level biodiversity data was collected by Ministry field staff using the FREP stand-level biodiversity monitoring protocol. Sampling sites consist of randomly selected, recently harvested cutblocks. Impact rating considers total treed retention, retention quality, and coarse woody debris quantity and quality. Stewardship trends are based on differences in outcomes between harvest years.

Summary: Of 295[29] cutblocks, 48% of sites were rated as "very low" or "low" harvest-related impact. The table below shows the percentage of sampled cutblocks by impact category. It also shows the average size of cutblock by category, with smaller cutblocks potentially more likely to be in the "high" impact category.

	High	Medium	Low	Very low
% of blocks	13	38	30	19
Average gross (ha)	18	26	38	46

Causal Factors:

82% of all cutblocks had 3.5% or more tree retention. This value increased to 86% for the 2004–2006 harvest era cutblocks and 88% for the post-2006 harvest era cutblocks. The density of big diameter trees (> 40–50 cm dbh depending on biogeoclimatic zone) retained is lower than baseline data (timber cruise) for the ESSF,[30] ICH, and IDF biogeoclimatic zones, although similar for the MS zone. The number of tree species retained is similar or higher than baseline for IDF and MS cutblocks, but lower for ESSF and ICH cutblocks.

Overall Stewardship Trend: A statistical difference (p = 0.00) was evident between harvest eras, likely driven by lower percentages of "high" impact cutblocks in the later harvest eras. Retention was an average of 15.7% for blocks harvested before 2004, 13.9% for blocks harvested during 2004–2006, and 14.3% for blocks harvested after 2006. Retention quality was constant between eras. Coarse woody debris quality slightly increased in later eras.

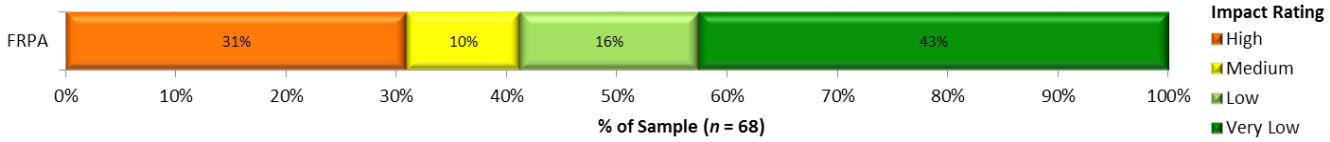
Opportunities for Improvement and (or) Continuation of Practices that Effectively Manage Stand-level Biodiversity:

- Leave at least low levels of retention on every cutblock
- Retain some large diameter trees for the site
- Look for opportunities to leave large snags safely as ecological anchors within retention patches

29 An additional six cutblocks were assessed for individual indicators but could not be ranked because of a lack of baseline data.

30 Biogeoclimatic zones mentioned in this section are: Engelmann Spruce–Subalpine Fir (ESSF), Interior Cedar–Hemlock (ICH), Interior Douglas-fir (IDF), and Montane Spruce (MS).

Thompson–Okanagan Visual Quality: Resource Development Impacts on Achievement of Visual Quality Objectives



Data Source: Visual quality assessment data was collected by Ministry field staff using the FREP visual quality monitoring protocol. Sampling sites consist of landforms with visual quality objectives located in randomly selected, recently harvested cutblocks. Stewardship trends are based on comparisons of samples collected under *FPC* forest development plans versus *FRPA* forest stewardship plans.

Summary: Of 68 landforms, 59% were rated as "very low" or "low" harvest-related impact. Current data suggest that the visual value is at risk in this region.

Causal Factors:

Extensive use of operational exceptions (i.e., self-exemptions) without providing alternative results has given rise to large, poorly designed openings that contain inadequate in-block retention amounts.

Number of Samples by Visual Quality Objective (VQO) and Impact Rating

VQO[a]	High	Medium	Low	Very low	Total
M	1	1	4	13	**19**
PR	15	7	7	16	**45**
R	5		1	2	**8**
Total	**21**	**8**	**12**	**31**	**72**

[a] M = Modification, PR = Partial Retention, R = Retention

Opportunities for Improvement Based on Viewscapes that Meet Visual Quality Objectives:

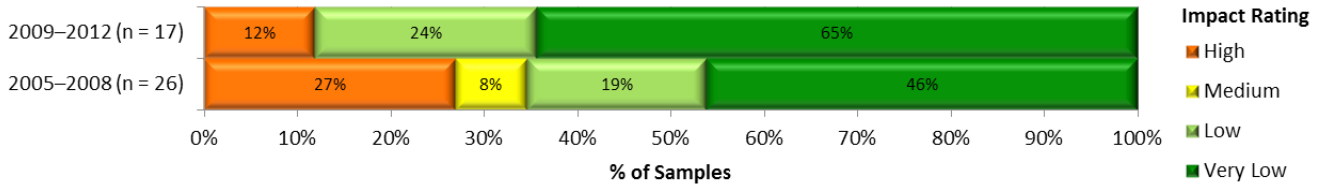
Districts are encouraged to increase FREP visual quality sampling to determine whether change is occurring. Now that the mountain pine beetle is no longer at an emergency response level, more management options are available.

- Eliminate self-exemption language from forest stewardship plans at time of renewal
- Where exemptions are necessary, use the appropriate tools within *FRPA* (i.e., *Forest Planning and Practices Regulation* sections 12(7) or 25.1(1).[31] In addition, *FRPA* Bulletin 25 provides advice on how to write defensible practicable statements[32]
- Reduce opening size in retention and partial retention VQO areas
- Use visual design techniques to create more natural-looking openings and better achieve VQOs
- Use partial cutting to retain higher levels of volume per stems

31 See: http://www.bclaws.ca/civix/document/id/complete/statreg/14_2004.

32 See: https://www.for.gov.bc.ca/ftp/HTH/external/!publish/web/frpa-admin/frpa-implementation/bulletins/frpa-general-no-25-comparison-of-fsp-results-or-strategies-flexibility-options-jul-21-2011.pdf.

Thompson–Okanagan Cultural Heritage: Resource Development Impacts



Data Source: Data for cultural heritage assessment was collected by Ministry field staff, often with the assistance of local First Nations. Sampling sites consist of a minimum of 50% randomly selected sites and up to 50% targeted sites (First Nations and [or] licensees requests) based on recently harvested cutblocks with known cultural heritage resource values.

Thompson–Okanagan Region samples are from the Cascades Natural Resource District.

Summary: The impact rating accounts for both overall block management of cultural heritage resources and protection of individual cultural features. Of 43 cutblocks, 53% were rated as "very low" impact, 21% as "low," 5% as "medium," and 21% as "high."

Considering the two components of the impact rating score, 54% of cutblocks were considered "well" to "very well" managed, 26% were "moderately" managed, and 21% were "poorly" to "very poorly" managed. At the cultural feature level, 58% of cutblocks showed no evidence of harvest-related damage, whereas 42% showed evidence of damage; 32% of the damaged features were rendered unsuitable for continued use.

Causal Factors:

Best outcomes were associated with stubbing and flagging of culturally modified trees, avoidance of features, and use of reserves and buffers. On sites with impacts, the primary causes of damage were windthrow, harvesting activity causing damage to cultural trails, and removal of cultural features.

Opportunities for Improvement:

Opportunities for improvement are associated with the following practices that resulted in the best cultural heritage resource outcomes:

- Knowing, understanding and documenting local First Nations preferred management practices and outcomes through direct contact with local First Nations
- Review of cultural heritage resource documentation during planning and operations
- During pre-harvest site inspection, identify cultural features with flagging tape for easy recognition during operations
- Avoid cultural features through use of windfirm reserves, such as wildlife tree patches, machine-free zones, and block boundary modification; combine reserves with visual quality objectives, retention, or other reserve needs
- Stub dead pine culturally modified trees above cultural marks to avoid future windfall or breakage
- Avoid skidding across cultural trails (in some cases, use of designated crossings)
- Consider harvesting during winter (e.g., frozen ground) to protect cultural plants
- Locate burn or slash piles well away from cultural features and reserves

Thompson–Okanagan Timber: Resource Development Impacts on Stand Health and Productivity

Data Source: Timber resource data for stand health and productivity was collected by Ministry field staff and contractors using the FREP stand development monitoring protocol. Sampling sites consist of randomly selected harvested areas greater than 5 hectares, 20–40 years old, and declared "free-growing."

Summary: The 104 polygons sampled represent 3.8% of the sampling population area. Average polygon age is 25 years (range: 15–40 years). Table A summarizes stand information by leading species for all biogeoclimatic zones combined.

Table A. Stand Metrics for Four Leading Species

Species	Total tree sample (%)	Total basal area (%)	Average site index[33]
Lodgepole pine	44	56	19
Spruce	11	12	22
Douglas-fir	8	11	26
Subalpine fir	15	9.5	18[34]

Table B. Total and Well-spaced Stems per Hectare by Layer

Layer[35]	Total live stems per ha	Total live stems per ha (%)	Well-spaced live stems per ha (%)
L1	260	7	18
L2	629	17	35
L3	2750	76	48
Total	**3639**	**100**	**100**

Table B shows 76% of the total trees and 48% of the well-spaced trees are in layer 3. A large component of potential crops harvested in the mid to long term will consist of natural ingress of these layer 3 trees. The three leading forest health factors were:

- Western gall rust
- Armillaria root disease
- White pine blister rust

The MSdm2 and MSxk[36] biogeoclimatic subzones were most impacted by western gall rust, the ICHmw3 subzone was most affected by armillaria root disease and white pine blister rust, and the ICHwk1 subzone was most affected by white pine blister rust. The species most affected by these forest health factors is: lodgepole pine with 18% of trees affected (i.e., non-acceptable) (total 8762 trees).

Table C. Total, Acceptable, Non-acceptable, and Dead Trees by Species

Species	Total stems per ha	Acceptable live trees (%)	Non-acceptable live trees (%)	Dead trees (%)
Lodgepole pine	8762	78	18	5
Spruce	2224	90	6	4
Douglas-fir	1497	91	5	4
Subalpine fir	2858	97	3	1
Average	**3782**	**86**	**10**	**4**

Opportunities for Improvement:

Lodgepole pine is a predominant species in the Thompson–Okanagan Region and has been impacted most by forest health factors. The productivity of interior Douglas-fir and spruce is significantly higher than lodgepole pine and could play an increasing role in mixed species planting prescriptions. Promote species that are less impacted by forest health factors and have higher productivity to benefit timber supply.

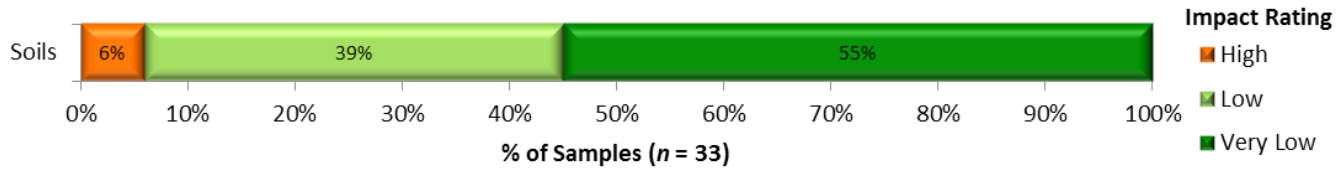
33 Site index indicates productivity, as seen by the tree height at age 50 (based on biogeoclimatic zones with ≥ 30 polygons)

34 Because there was insufficient data to base site index on only those biogeoclimatic zones with ≥ 30 polygons, site index for subalpine fir is based on total polygons.

35 Layer 1: > 12.5 cm dbh; layer 2: 7.5–12.49 cm dbh; layer 3: < 1.3 m high and < 7.49 cm dbh.

36 The biogeoclimatic subzones mentioned in this section are: Montane Spruce dry mild variant 2 (MSdm2), Montane Spruce very dry cool (MSxk), Interior Cedar–Hemlock moist warm variant 3 (ICHmw3), and Interior Cedar–Hemlock wet cool variant 1 (ICHwk1).

Thompson–Okanagan Soils: Resource Development Impacts on Soil Productivity and Hydrologic Function



Data Source: Soils data for assessments of soil productivity and hydrologic function was collected by provincial and regional soils experts using a FREP expert elicitation methodology. Sampling sites consist of randomly selected, recently harvested cutblocks. Assessments are based on high-resolution air photo analysis.

Summary: Of 33 cutblocks, 94% were rated as "very low" or "low" harvest-related impact, indicating that soil management objectives were achieved; 6% were rated as "high" harvest-related impact.

Causal Factors:

For those sites with high impact ratings, excessive soil disturbance, both in roadside work areas and outside work areas, is a major factor that contributes to "highly" affected soil productivity.

Overall Stewardship Trend: Not enough historical monitoring has taken place to establish a trend.

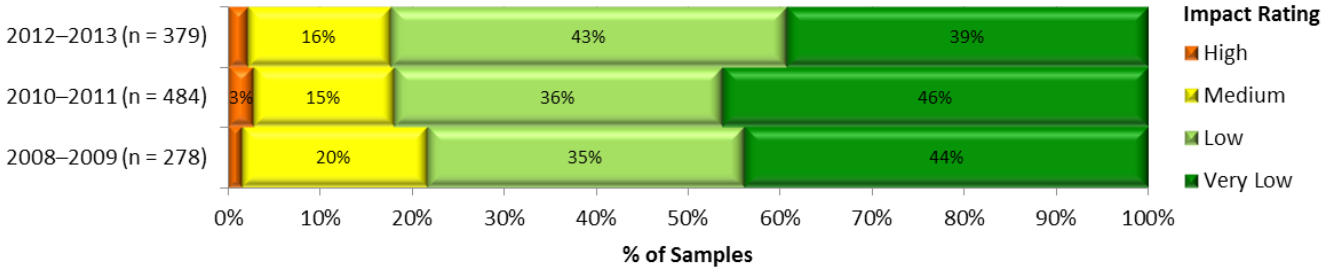
Opportunities for Improvement:

- Plan operations in and outside roadside work areas to minimize soil disturbance

3.8 *West Coast Natural Resource Region*

The intention of FREP monitoring is to evaluate the effects of resource development at a stand or site level, rather than the overall condition of the resource value. This information is an important element in helping resource managers determine the appropriate balance between ecological, social and economic factors. The FREP results also identify when stand-level values are not being managed sustainably, identifying areas that warrant improvement of on-the-ground resource management practices. The following section presents the outcomes of site-level FREP monitoring in the West Coast Natural Resource Region.

West Coast Water Quality: Resource Development Impacts



Data Source: Water quality data (potential for fine sediment generation) was collected by Ministry staff using the FREP water quality monitoring protocol. Sampling sites consist of roads (and [or] areas of mass wasting) connected to fish habitat and (or) drinking water sources that originate at randomly selected, recently harvested cutblocks. Stewardship trends are based on survey years to capture the effects of road traffic and maintenance.

Summary: Of 1141 road segments, 81% were rated as "very low" or "low" road-related impact.

Causal Factors:

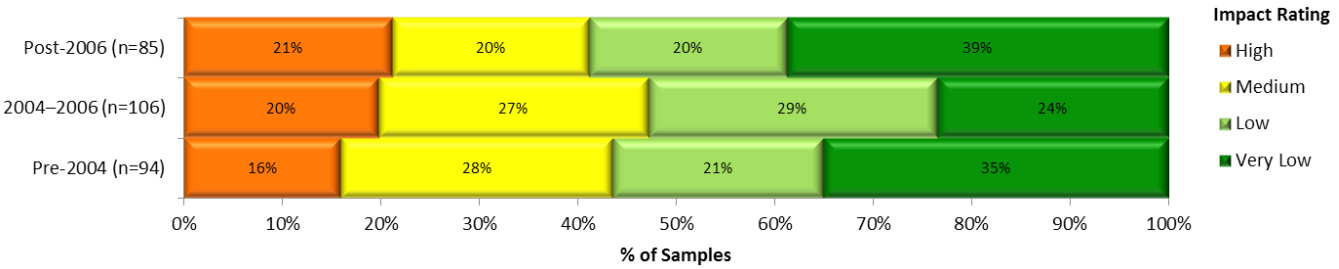
See opportunities for improvement on road segments with "high" or "medium" impact ratings. Some opportunities will apply to ongoing maintenance issues, whereas others mainly apply to new road construction.

Overall Stewardship Trend: A marginal statistical difference (p = 0.10) was evident between the three sampling eras, with minor fluctuation in potential for sediment generation.

Opportunities for Improvement and (or) Continuation of Practices that Help Minimize Sediment:

For road segments with a "high" and "medium" impact rating, generally pay attention to berms and cross-ditches.

West Coast Riparian: Resource Development and Natural Impacts on Stream Function



Data Source: Stream riparian data was collected by Ministry staff using the FREP riparian monitoring protocol. Sampling sites consist of randomly selected cutblocks with streams in or adjacent to cutblock boundaries. The largest stream of sufficient length is sampled. Stewardship trends are determined by harvest era.

Summary: Of 285 streams, 56% were rated as "very low" or "low" harvest-related impact.

Samples by Stream Class and Impact Rating

Class	High	Medium	Low	Very low	Total
S1				2	**2**
S2		5	7	15	**27**
S3	3	5	10	17	**35**
S4	3	2	7	5	**17**
S5	8	12	7	31	**58**
S6	41	48	37	21	**147**
Total	**55**	**72**	**68**	**91**	**286**[37]

Causal Factors:

% of total	Most common specific impact in order of frequency
Logging 76% *Falling and yarding* *Low retention*	• Stream or riparian blockages increased • Large woody debris process altered • Riparian vegetation decreased • Large woody debris supply decreased
Natural events 15% *Wind* *High natural sediment* *Torrents*	• Stream or riparian blockages increased • In-stream sediments increased
Roads 4% *Erosion, sediment, and channel infilling*	• In-stream sediments increased • Stream or riparian blockages increased
Upstream factors 3% *Logging* *Natural impacts* *Roads*	• Stream or riparian blockages increased • In-stream sediments increased • Channel banks altered
Other human-caused 1%	• In-stream sediments increased

Near-stream human actions (logging, roads, other) caused 80% of stream impacts, whereas natural events were responsible for 15%.

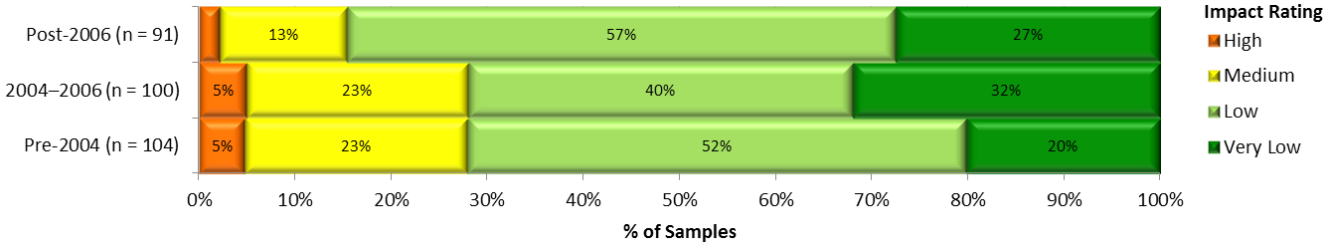
Overall Stewardship Trend: No statistical difference (p = 0.24) was apparent between the three eras.

Opportunities for Improvement and (or) Continuation of Practices that Protect Stream and Riparian Conditions:

- Maintain natural drainage patterns by keeping streams clear of logging slash
- Maintain deep-rooted vegetation near stream banks
- Increase retention generally on small streams, especially those wider perennial streams that make significant contributions of water, sediment, debris, and nutrients to downstream fish habitats and watershed function

37 One S4 "high" impact stream had an unknown harvest year.

West Coast Stand-level Biodiversity: Resource Development Impacts



Data Source: Stand-level biodiversity data was collected by Ministry field staff using the FREP stand-level biodiversity monitoring protocol. Sampling sites consist of randomly selected, recently harvested cutblocks. Impact rating considers total treed retention, retention quality, and coarse woody debris quantity and quality. Stewardship trends are based on differences in outcomes between harvest years.

Summary: Of 295[38] cutblocks, 76% were rated as "very low" or "low" harvest-related impact. The table below shows the percentage of sampled cutblocks by impact category. It also shows the average size of cutblock by category, with very small cutblocks potentially more likely to be in the "high" impact category.

	High	Medium	Low	Very low
% of blocks	4	20	49	26
Average gross (ha)	4	21	25	28

Causal Factors:

Overall, 95% of all cutblocks had 3.5% or more tree retention. This value was 94% for the 2004–2006 harvest era cutblocks and 98% for the post-2006 harvest era cutblocks. The density of big diameter trees (> 70 cm dbh) retained is lower than baseline data (timber cruise), as is the density of large snags (> 30 cm dbh and > 10 m height). The number of tree species retained is somewhat lower than baseline, particularly in the latest harvest era. Coarse woody debris quantity and quality (i.e., volume from pieces > 30 cm diameter at transect crossing, and big pieces of > 20 cm diameter and > 10 m long) is high and has increased in the later harvest eras.

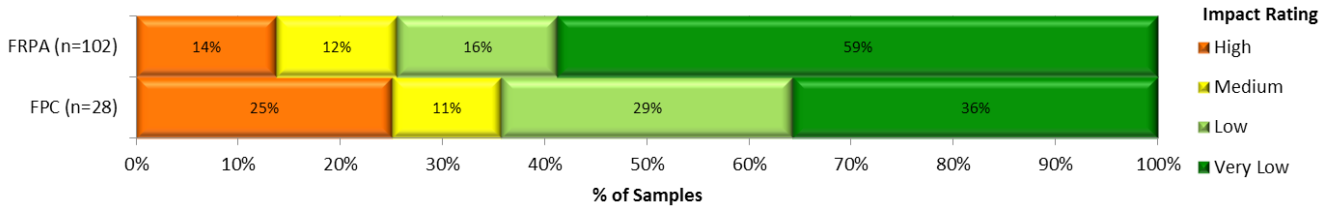
Overall Stewardship Trend: No statistical difference (p = 0.13) was evident between harvest eras. Retention averaged 17.2% for cutblocks harvested before 2004, 19.4% for blocks harvested during 2004–2006, and 17.0% for blocks harvested after 2006. Retention quality was basically consistent between the harvest eras. Coarse woody debris quality increases were the main factor in a slight increase in cutblocks with a "low" impact rating in the post-2006 harvest era.

Opportunities for Improvement and (or) Continuation of Practices that Effectively Manage Stand-level Biodiversity:

- Continue trend of leaving at least low levels of retention on every cutblock
- Retain some large diameter trees for the site
- Look for opportunities to leave large snags safely as ecological anchors within retention patches

38 An additional five cutblocks were assessed for individual indicators but could not be ranked because of a lack of baseline data.

West Coast Visual Quality: Resource Development Impacts on Achievement of Visual Quality Objectives



Data Source: Visual quality assessment data was collected by Ministry field staff using the FREP visual quality monitoring protocol. Sampling sites consist of landforms with visual quality objectives located in randomly selected, recently harvested cutblocks. Stewardship trends are based on comparisons of samples collected under *FPC* forest development plans versus *FRPA* forest stewardship plans.

Summary: Of 130 landforms, 68% were rated with "very low" or "low" harvest-related impact. Existing data suggest that the visual value is not at risk in this region.

Causal Factors:

The level of good in-block tree retention has not improved appreciably from the *FPC* to *FRPA*.

The improvements observed, moving from the *FPC* to *FRPA*, may be the result of smaller openings and improved design.

Number of Samples by Visual Quality Objective (VQO) and Impact Rating

VQO[a]	High	Medium	Low	Very low	Total
MM			1	5	**6**
M		6	5	22	**33**
PR	17	12	11	40	**80**
R	5	1	3	2	**11**
Total	**22**	**19**	**20**	**69**	**130**

[a] MM = Maximum Modification, M = Modification, PR = Partial Retention, R = Retention

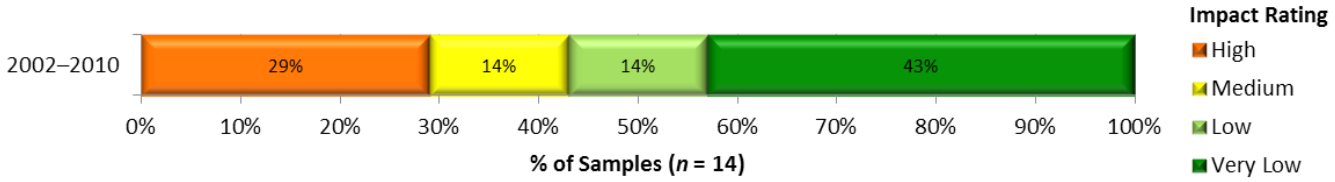
Overall Stewardship Trend: A statistical difference (p = 0.04) was apparent between the two eras, with improvement in the *FRPA* samples.

Opportunities for Improvement Based on Viewscapes that Meet Visual Quality Objectives:

Districts are encouraged to continue FREP visual quality sampling to monitor trends.

- Use existing visual design techniques to create more natural-looking openings and better achieve VQOs
- Use retention cutting to keep higher levels of volume per stems
- Reduce opening size in retention and partial retention VQO areas

West Coast Cultural Heritage: Resource Development Impacts



Data Source: Cultural heritage assessment data was collected by Ministry field staff, often with the assistance of local First Nations. Sampling sites consist of a minimum of 50% randomly selected sites and up to 50% targeted sites (First Nations and [or] licensees requests) based on recently harvested cutblocks with known cultural heritage resource values.

West Coast Region samples are predominantly from the Haida Gwaii Natural Resource District (80%), with lesser amounts from North Island and South Island natural resource districts.

Summary: The impact rating accounts for both overall block management of cultural heritage resources and protection of individual cultural features. Of 14 cutblocks, 43% were rated as "very low" impact, 14% as "low," 14% as "medium," and 29% "high."

Considering the two components of the impact rating score, 43% of cutblocks were considered "well" managed, 29% were "moderately" managed, and 29% were "poorly" to "very poorly" managed. At the cultural feature level, 56% showed no evidence of harvest-related damage, whereas 44% showed evidence of damage; 50% of the damaged features were rendered unsuitable for continued use.

Causal Factors:

Best outcomes were associated with the use of reserves and buffers. On sites with impacts, the primary causes of damage were windthrow, road building, harvesting activity causing damage to cultural features, and removal of features.

Opportunities for Improvement:

Opportunities for improvement are associated with the following practices that resulted in the best cultural heritage resource outcomes:

- Knowing, understanding and documenting local First Nations preferred management practices and outcomes through direct contact with local First Nations
- Review of cultural heritage resource documentation during planning and operations
- Avoid features through the use of windfirm (some topping used) reserves, such as wildlife tree patches, machine-free zones, and block boundary modification
- Combine cultural heritage resource reserves with other reserves such as wildlife tree patches
- Use of culturally modified tree management zones with higher levels of retention

3.9 *Resource Value Stewardship Results Comparison*

Table 3 provides the ratings of stewardship effectiveness for the eight natural resource regions. Effectiveness is shown by the percentage of samples with a "very low" or "low" resource development impact rating. Only the values with sufficient sampling data to allow for comparisons between most regions are presented below.

Table 3. Stewardship effectiveness by natural resource region as determined by resource development impact rating

Resource value	Percentage of "Very low" + "Low" Resource Development Impact Ratings[a]							
	Cariboo	Kootenay–Boundary	Northeast	Omineca	Skeena	South Coast	Thompson–Okanagan	West Coast
Riparian – all data	**76** (263)	**65** (186)	**61** (139)	**69** (318)	**79** (256)	**62** (211)	**66** (267)	**56** (285)
post-2006 harvest years	70 (37)	39 (28)	48 (27)	74 (90)	83 (72)	58 (60)	68 (78)	59 (85)
2004–2006 harvest years	73 (93)	72 (65)	58 (40)	64 (76)	78 (63)	67 (72)	66 (92)	53 (106)
pre-2004 harvest years	80 (133)	68 (93)	68 (72)	68 (152)	76 (121)	61 (79)	63 (97)	56 (94)
Water quality – all data	**81** (388)	**73** (506)	**61** (108)[b]	**58** (524)	**70** (594)	68 (713)	**63** (782)	**81** (1141)
2012–2013 sample years	82 (106)	75 (71)	40 (40)	53 (150)	65 (210)	70 (220)	68 (201)	82 (379)
2010–2011 sample years	75 (110)	80 (164)	ID (13)	53 (116)	80 (210)	72 (266)	61 (332)	82 (484)
2008–2009 sample years	84 (172)	68 (271)	78 (55)	63 (258)	63 (174)	60 (227)	63 249)	78 (278)
Stand-level biodiversity – all data	**68** (277)	**45** (244)	**46** (128)	**44** (304)	**50** (275)	**81** (211)	**48** (295)	**76** (295)
post-2006 harvest years	82 (55)	59 (46)	79 (29)	46 (67)	57 (83)	89 (62)	59 (88)	85 (91)
2004–2006 harvest years	71 (90)	50 (94)	32 (34)	49 (89)	53 (76)	89 (65)	54 (90)	72 (100)
pre-2004 harvest years	59 (132)	34 (104)	38 (65)	41 (148)	44 (116)	69 (84)	36 (117)	72 (104)
Visual Quality								
FRPA	67 (48)	39 (36)	—	73 (59)	71 (88)	86 (52)	59 (68)	75 (102)
FPC	62 (31)	68 (50)	ID (8)	56 (43)	55 (53)	73 (40)	ID (4)	46 (28)

a ID = insufficient data; sample sizes in brackets.

b Peace District only for Northeast Region water quality.

4.0 PROVINCIAL RESULTS

The following sections provide provincial information and context for evaluations that were not conducive to regional-level reporting at this time.

4.1 *Water Quality Range Evaluation*

Between 2008 and 2013, the water quality effectiveness evaluation protocol was used to assess 4767 randomly selected sites. Using multiple resource value assessment scoring, 34% of these sites had a "very low" resource development impact on water quality, 37% were rated as "low," 24% were rated as "medium," and 5% were rated as "high." When evaluations were conducted on a subset of 493 sites located upstream of drinking water intakes, the results were similar: 28% of the sites had a "very low" resource development impact on water quality, 39% were "low," 29% were "medium," and 4% were "high."

During the assessment process, challenges related to road management (and associated solutions) focussed on the following five operational areas.

1. Location
2. Design (roads and cutblocks)
3. Construction and harvesting
4. Maintenance
5. Deactivation

The importance of addressing the reduction of fine sediment is apparent through all stages of a road's life, especially when roads are located near a stream.

The use of appropriate techniques for the design, construction, and maintenance of road networks can mitigate many potential negative impacts on water quality. Generally, the risk of fine sediment generation ends only when a road is properly deactivated. The water quality assessment procedure evaluates how the generation and transport of road and (road-related) fine-textured sediments could affect natural water bodies. In addition to the more than 4700 evaluations for potential in-stream sediment linked to forest harvesting, 199 range evaluations took place. These evaluations assess the potential for cattle-related impacts on water quality in areas with livestock and the presence of downstream domestic water intakes. The range evaluations were completed between 2008 and 2013 in six of the eight natural resource regions, although the majority of samples were in Thompson–Okanagan, Kootenay–Boundary, and Cariboo regions. Approximately 69% of the samples indicated a potential for impacts on water quality by fecal contamination. The main indicators identified as leading to a risk of fecal contamination were:

- evidence of livestock drinking directly from a stream;
- evidence of livestock standing in a streambed;
- the presence of livestock feces immediately adjacent to stream banks;
- recent pugging and un-vegetated hummocks; and
- bank erosion or collapse from heavy livestock use.

Use of livestock control structures that limit livestock access to a water source is rare, found on 7% of the sites assessed as having potential livestock impacts on water quality, or 12% of the full sample of 199 range-assessed sites.

4.2 *Range (Forage)*

Table 4 shows a summary of outcomes for rangeland sites evaluated from 2001 through 2013. Reporting of this data at a regional level is not possible at this time.[39] Approximately 25% of uplands and wetlands and 20% of streams are functioning below acceptable levels and require some form of remediation.

For uplands to recover, more residual cover should be left on the soil after grazing, and plants given a longer rest time after a grazing event. Surface litter and live plant cover moderates site conditions and temperatures, allows germination of new grass seedlings, and an improvement in soil conditions. Additional rest helps to restore plant vigour. In some cases, livestock numbers are adjusted downward based on the average available forage (as determined through forage clipping and forage analysis on a pasture and range unit basis) and a safe level of use.

For wetlands, low snowpack and runoff has caused drawdown of many interior wetlands, leaving bare soils and a trampled margin as livestock attempt to forage and

39 Range data collected before 2009 is not available digitally and changes to regional boundaries has made regional reporting difficult with current resources.

access drinking water. Spring snowfalls are particularly important in recharging these wetlands and these typically are high in water content and do not lose much to sublimation.

Most of the issues with streams and non-classified drainages arise because of timber harvesting that removes live trees and debris from the riparian area, allowing cattle easy access and travel corridors along these streams.

Since 2012, the Range Program has been placing an emphasis on stream and wetland protection in the form of exclusion fencing, woody debris barrier placement, and the development of alternative water sources. Best Management Practices have been approved for livestock management in community watersheds where drinking water is the highest priority.

Table 4. A summary of sites by functionality[a]

	Uplands				Wetlands				Streams			
Sample year	Sample size	Healthy (%)	At risk (%)	Unhealthy (%)	Sample size	Healthy (%)	At risk (%)	Unhealthy (%)	Sample size	Healthy (%)	At risk (%)	Unhealthy (%)
2001–2008	448	53	16	31	140	59	8	33	277	56	14	30
2009	439	56	11	33	117	68	5	27	56	63	25	13
2010	129	70	13	17	48	63	10	27	24	58	25	17
2011	149	83	13	3	26	65	19	15	23	91	9	0
2012	146	66	22	12	55	64	20	16	246	67	21	13
2013	368	69	16	14	134	73	6	21	118	79	10	11
Totals	**1679**	**62**	**15**	**23**	**520**	**66**	**9**	**25**	**744**	**65**	**17**	**18**

a "Healthy" is equivalent to "properly functioning condition" or "slightly at risk"; "at risk" is equivalent to "moderately at risk"; "unhealthy" is equivalent to "non-functional" or "highly at risk."

5.0 SUMMARY

As a regional-level summary of FREP monitoring results to date, this fifth annual report communicates continuous improvement perspectives and recommendations to natural resource professionals, managers, and decision makers. This information is intended to support and promote dialogue necessary to achieve short- and long-term sustainable resource management goals in British Columbia. Natural resource professionals, managers, and decision makers are strongly encouraged to consider this information in their practice, along with other FREP reports (i.e., local Multiple Resource Value Assessment Reports), extension notes, monitoring protocols, and other relevant data. This information should help resource professionals understand the outcomes associated with their plans and practices and also inform their recommendations and decisions, particularly where these need to balance environmental, social, and economic values.

To ensure the resource management community gains the maximum value from FREP, natural resource professionals and managers are encouraged to:

1. Carefully review this report in the context of your specific roles and responsibilities.
2. Contact your resource district to discuss local results and get into the field as a group of licensees and government staff to talk about the results and appropriate actions.

3. Ask for your data and do your own analysis and interpretation. Local data and support is available to individual licensees by contacting Nancy Densmore (Nancy.Densmore@gov.bc.ca).
4. Contact any of the FREP Resource Value Team Leads (see Table 1) for detailed information on monitoring protocols, indicators, and results.
5. Review the FREP monitoring protocols. These documents identify the best available information on key attributes and indicators of forest and range resource health and sustainability.
6. Visit the FREP website at http://www.for.gov.bc.ca/hfp/frep/index.htm.
7. Send any feedback or questions relating to this report, or FREP in general, to Peter Bradford (Peter.Bradford@gov.bc.ca or by telephone at 250-356-2134).