

Cumulative Effects Assessment for the Merritt Operational Trial^{1 2}

DRAFT v3.0

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This draft report from the Cumulative Effects Framework Project summarizes work that has been completed to date. It is intended to facilitate discussion and solicit feedback, and does not represent a formal position or commitment of the Government of British Columbia

¹ The formatting of this assessment follows a template developed by the NE Operational Trial.

² This cumulative effects assessment has a limited scope for the express purpose of trialling a new process associated with the BC Cumulative Effects Framework.

Executive Summary

The Government of British Columbia is conducting an operational trial of a cumulative effects assessment (CEA) and management approach in the Thompson-Okanagan Region. Cumulative effects are defined as “changes to environmental, social and economic values caused by the combined effect of past, present and potential future activities and natural processes.”

Considering effects on only a project- or sector-specific basis can allow unintended impacts to accumulate over time. To address this issue, a broad-scale CEA of a bounded³ set of values is being conducted that will result in information that supports integrated resource management.

The purpose of the Merritt Timber Supply Area CEA is to assess risk to resource values and consider the potential implications for government resource management discussions, actions, decisions, mitigations and policy review. Post CEA, the data and maps from these assessments are intended to support proactive identification of risk for new project proposals, First Nations consultation, tactical planning and stewardship. The CEA evaluated the current condition, historic trends and near-term future condition of six resource values:

- Fish Stream Habitat,
- Moose Populations,
- Mule Deer Populations,
- Visual Quality Objectives,
- Grizzly Bear Populations, and
- Old Growth Management Areas (OGMA).

Watershed condition is also assessed and presented; however, it is a hazard model that can contribute to risk assessments for fish habitat, drinking water quality, risk to people and property (from high peak flows) and/or aquatic biodiversity.

One or more factors (e.g., habitat, predation) that affect a value were evaluated using a risk assessment approach. Sometimes a factor corresponded with a legal or policy objective, which was also assessed as to whether expectations had been met.

An evaluation of legal or policy objectives associated with moose habitat, mule deer winter range and OGMA indicates the number of areas meeting expectations has improved. Visual condition has declined, possibly because policy requirements are not clear enough and there are complications associated with harvesting stands affected by the mountain pine beetle.

Risk assessments that consider multiple factors indicate that mule deer and moose populations are stable. The risk to some populations has increased due to limited winter habitat, exposure to hunting through increased road density, and portions of habitat policy that are unclear. The grizzly bear population is reported to be functionally extirpated, in part due to the effects of a variety of unmitigated hazards that have been in place since the late 1800s.

The fish habitat assessment was limited to the range of salmon and trout at risk (i.e., Nicola watershed). Results indicate significant risk linked to forest clearing adjacent to non-fish bearing streams. This hazard may affect fish habitats downstream, and this has increased

³ This assessment is bounded to a select set of values to focus our efforts on testing the business process of assessment and management.

over the last 10 years. Other exacerbating factors include the plethora of roads and crossings that were substantial 10 years ago, and have increased slightly since. Outside of the Nicola watershed, the results of a watershed assessment procedure evaluated hazards associated with riparian clearing, sediment input and peak flows. Hazards have increased over the last 10 years due to the cumulative effect of natural resource development and natural disturbance.

A preliminary assessment of near-term future condition explored the frequency of resource activity in the parts of the landscape that have objectives to guide forestry activity (OGMAs, mule deer habitat, visuals and moose habitat). Results indicate non-forestry resource project proposals in 12% of OGMAs, 18% of mule deer planning cells, 20% of visual quality areas, and 90% of moose planning cells⁴. These results indicate the need for policy guidance for all resource sectors to ensure that expectations for the value can be maintained. Additional work is expected to assess variance in risk to all values based on the near-term development proposals.

Recommendations from this CEA land in one or more of three categories:

1. The need for more information (monitoring, more detailed assessment, research);
2. Those targeted at resource management practices; and
3. Policy (review, refinement, development).

Most recommendations from this report are directed at government, either for more information (i.e., confirming risk assessments via monitoring) or for policy review/revision/development. Recommendations for internal action are expected to be considered in the next business planning cycle (2015).

⁴ Planning cells are not legally designated for moose; however, government utilizes these to assess whether the intent of broad scale objectives for moose have been met.

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Introduction

British Columbia continues to experience growth in many natural resource sectors (NRS), with development sometimes overlapping and competing for the same land base and resources. Natural resource decision-making has historically been hindered by a fragmented regulatory framework, which involves multiple decisions by multiple agencies enabled by different legislation. This has resulted in some unintended cumulative effects on industry, communities, First Nations interests and environmental values when evaluated collectively over broad scales. The challenge and opportunity is to improve natural resource management decisions⁵ to favour positive effects while avoiding or mitigating negative impacts.

The recent reorganization of the BC natural resource ministries creates an opportunity for improved natural resource management decisions through the establishment of a coordinated land and resource management framework for the NRS. This consolidates:

- Resource management/stewardship of values;
- Policy development/review, to ensure expectations of the NRS are consistent and appropriate; and
- Decision-making under a “one window, one team, one process” approach.

This integration aims to improve both the quality and efficiency of natural resource management/decision-making and to provide operating certainty on the land base. However, it also raises new challenges. Resource management, policy, and decision making will need to consider the cumulative effects of multiple resource sectors and their interaction with economic, social and environmental values.

The Thompson-Okanagan (T-O) Region is one of three regions tasked to trial a business process focused on cumulative effects assessment and management. This approach includes:

- Establishing the necessary governance structures;
- Developing tools for assessment (coordinated provincially when appropriate);
- Testing varied resource decision contexts; and
- Completing a broad scale CEA.

This report presents outcomes of a broad scale CEA of a limited set of values for the Merritt Timber Supply Area. Rationale for values selection followed corporately endorsed rationale⁶. The CEA purpose is to assess the current condition and trend, and near-term risks associated with NRS development on a limited set of resource values. The CEA focused on the following values:

- fish stream habitat;
- moose populations;
- mule deer populations;

⁵ Natural resource management decisions include NRS project authorizations as well as government decisions about the management of values (e.g., monitoring, revising NRS expectations, research priorities, policy review, etc.).

⁶ Rationale for value selection is available in the BC CEF Overview report:

http://www2.gov.bc.ca/gov/DownloadAsset?assetId=F2A8B8AE894348DBA4CF7942EC592762&filename=overview_report_addressing_cumulative_effects.pdf

- grizzly bear populations;
- visual quality; and
- old growth management areas.

Watershed condition is also assessed and presented; however, it is coarse filter hazard model that can be input into risk assessments for fish habitat, drinking water quality, risk to people and property (from high peak flows) and/or aquatic biodiversity.

The intended audiences for the assessment are:

- The T-O Values Teams (e.g., Fish Habitat, Moose, Mule Deer, etc.), Resource Management Section Heads, and T-O Director of Resource Management.
- The T-O CEA Management Team, who will review, add, and confirm recommendations; T-O Regional Executive Director, and T-O Inter Agency Management Team.
- First Nations and NRS stakeholders in the Merritt Timber Supply Area.

Cumulative Effects Assessment

Cumulative effects are defined as the “changes to environmental, social and economic values caused by the combined effect of past, present and potential future activities and natural processes.” Considering effects on only a project- or sector-specific basis can allow unintended impacts to accumulate over time.

Cumulative effects generally refer to the impact on environmental (e.g., water quality, species), social/cultural (e.g., treaty rights and interests) and economic (e.g., resource capability) values as a result of multiple decisions to allow resource development. Each may have relatively small impacts on values, but collectively they may result in unintended effects.

Cumulative effects can be caused by one or more of the following issues⁷:

- Insufficient information about the current state of values and stressors;
- Insufficient understanding of the additive or interactive effects of resource development and other natural or anthropogenic stressors on the condition of values; and/or,
- Insufficient or uncoordinated regulation to ensure that resource development is consistent with clear and measurable objectives set by managing agencies or governments.

The values assessed in the CEA are representative of government policy objectives and/or are *associated* with First Nations interests; however, they are not intended to represent First Nations views. Key considerations associated with the application of information from this report include:

- ✓ Assessment outcomes are not used to evaluate compliance with regulation because it includes effects from multiple resource sectors as well as natural disturbance.
- ✓ Assessments are GIS based and strategic in nature and thus are used to convey potential risk rather than actual risk.

⁷ Referenced from the NE CEA Report.

- ✓ All outcomes have uncertainty inherent within them. Increased confidence in assertions of risk comes with inclusion of on-the-ground monitoring information and alignment with staff experience.
- ✓ On-the-ground monitoring data was used to parameterize some value assessments (e.g., moose harvest surveys) or as additional sources of information (e.g., FREP monitoring).
- ✓ Assessments are the best available information from the Ministry of Forests, Lands and Natural Resource Operations (FLNR), are repeatable, and will be annually reviewed and updated.
- ✓ Assessment results and mitigation options are offered as a starting point for discussion and management action, not as the unconditional answers or direction.
- ✓ Assessments at a strategic scale necessarily render down complex landscape dynamics into the essential elements that can be utilized to guide strategic management discussions and actions. Thus, the strategic assessments are intended to complement expertise applied at tactical (planning) or operational (on-the-ground) levels, but not replace them.

Two types of assessment are undertaken (Table 1) as sometimes one or both are required to support decision-making processes and resource management:

1. Legal/Policy Evaluation (objectives) – the extent to which policy objectives, for one or more factors that affect a value, are met or not met.
2. Risk Assessment – considers a broad range of factors of natural and human factors that affect a value.

Table 1: Values and types of assessment.

Value	Objective Assessed	Risk Assessed
Fish Habitat		✓
Mule Deer	✓	✓
Moose	✓	✓
Visuals	✓	
Grizzly Bear		✓
OGMA	✓	
Watershed Assessment		✓

Figure 1 identifies the conceptual CEA approach of management response to risk. Dotted lines between risk classes are reference points that result in management action. Management actions that result from risk assessment generally fall into three categories:

1. The need for more information (monitoring, more detailed assessment, research),
2. Recommendations targeted at resource management practices, and
3. Policy review, refinement or development.

Application of this information is intended to support processes associated with:

1. Resource authorizations,
2. Resource management decisions,
3. First Nations consultation, and
4. Strategic discussions with NRS operators.

Some values have objectives that were established to address a key limiting factor (of a value). An assessment of whether objectives are being met is an additional requirement (beyond more fulsome values assessments) of the CEF. The minimum expectations for the objective constitute a management trigger, a threshold set by government *via* a balanced social decision.

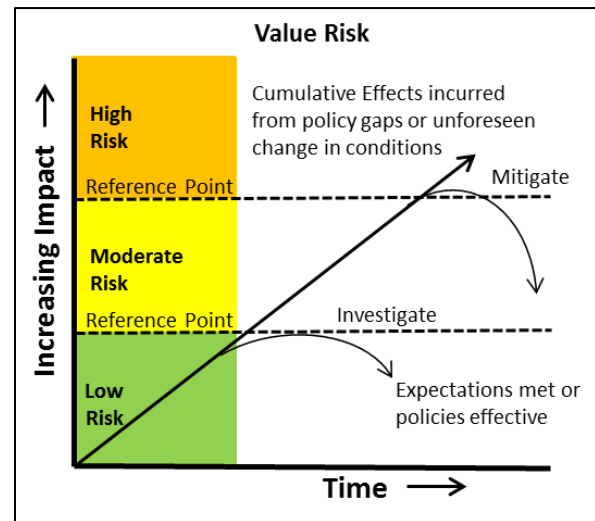


Figure 1: Conceptual management of values under the cumulative effects framework. The goal is to implement strategies to maintain or mitigate to lower levels of risk. For objectives, the goal is to manage or mitigate to acceptable limits.

Risk Assessment Approach

A risk-based approach was used to evaluate the condition and trends for some values as a transparent and consistent approach to assessing effects of land use development and change on values. Risk concepts and terminology are consistent with those described in *Landslide Risk Case Studies in Forest Development Planning and Operations: Land Management Handbook 56: Wise et al. 2004a*⁸ with particular references to Chapter 2 (Wise et al. 2004b) and Chapter 3 (Vandine et al. 2004). The document by Wise et al. 2004 provides useful concepts and terminology and examples from a natural resource management context that are consistent with Canadian Standards Association (CSA 1997)⁹.

		Consequence Rating		
		Low	Moderate	High
Hazard Rating	Low	Very low	Low	Moderate
	Moderate	Low	Moderate	High
	High	Moderate	High	Very high

Figure 2: Generalized risk matrix for use in risk assessment.

⁸ Wise et al. 2004a found online at: <http://www.for.gov.bc.ca/hfd/pubs/docs/lmh/Lmh56.htm>

⁹ Canadian Standards Association. 1997. Risk Management Guidelines for Decision-Makers. CAN/CSA-Q850-97. 54 pp.

Consistent with Wise et al 2004a, **Risk** is defined as “the chance of injury or loss as defined as a measure of the probability and the consequence of an adverse effect to health, property, the environment, or other things of value” (Wise et al. 2004, adapted from CSA 1997). Risk is the product of hazard and consequence defined by the risk equation (***Risk = Hazard x Consequence***) as illustrated in Figure 2.

For ease of application to management actions, very low risk was grouped with low risk management actions, and very high grouped with high risk.

CEA – Time Periods Assessed

This CEA assessed the current condition of values as well as the near-term trend from 10 years before now (2004). Archived data from 2004 that was comparable to contemporary information was the driving consideration for selecting this time period. The trend from this time period is also useful because of the significant changes in:

- legislation (e.g., the *Forest and Range Practices Act*);
- policy (new objectives implemented for some values);
- natural conditions (e.g., mountain pine beetle epidemic);
- economy (e.g., influx of clean energy applications, rising of gold and copper prices driving exploration and mine development); and
- other factors that have an influence on the landscape and values.

Assessment methods for current condition and trends are provided on a value-by-value basis in this report. Assessing future condition is a key part of CEA and although work to develop standard methodology is underway, there are two broad categories of future assessments; near-term potential development (within five years) or long-term scenarios (approximately 100-year assessments)¹⁰. This project selected near-term potential development due to the anticipated challenges caused by the aforementioned development scenarios and widespread natural disturbance. A brief description of near-term potential development is below.

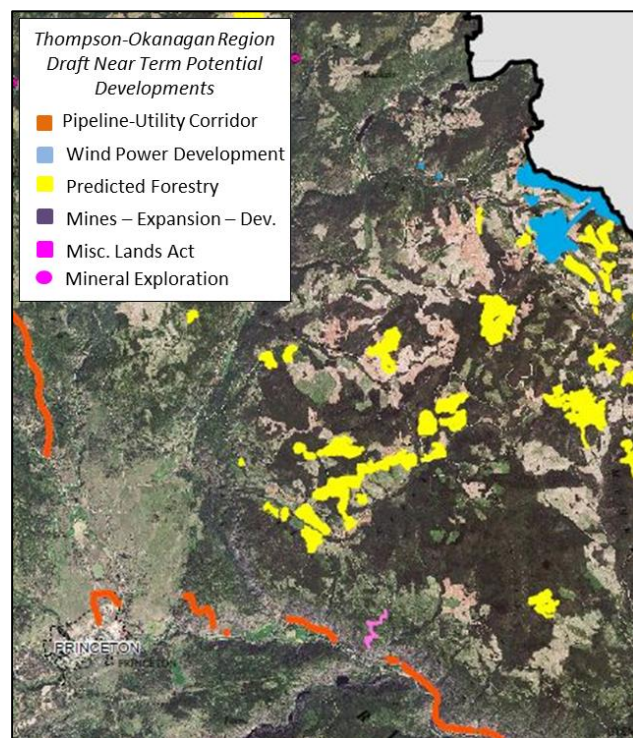


Figure 3: Illustration of near-term potential development near Princeton, BC.

¹⁰ Future scenarios are addressed in the CEF Overview Report: http://www2.gov.bc.ca/gov/DownloadAsset?assetId=F2A8B8AE894348DBA4CF7942EC592762&filename=overview_report_addressing_cumulative_effects.pdf

Future Trends – Near-Term Potential Development

Future near-term potential development was characterized in the Merritt TSA to consider potential cumulative effects on the set of values. Spatial mapping of proposed activities is currently (as of November 2104)

very limited. Forestry activity was limited to anticipated harvest for 2014 because an Annual Allowable Cut (AAC) review was scheduled for early 2015 that may result in changes to the volumes of forest harvested. In no way does this mapping or analysis infer that these projects are or will be approved. The CEA team worked with staff from Cascades Resource office, T-O Major Projects, Clean Energy, Lands and the Ministry of Mines to spatially characterize

near-term development (approximately one to three years) (Figure 3). See Appendix 1 for methodology. The near-term potential NRS development data included spatialized proposals for: forestry, clean energy, miscellaneous *Land Act* applications, mines, pipeline development, utilities, mineral exploration and major projects. The proportion of footprint by sector is in Figure 4.

SECTOR	Area (ha)	% of Dev	% of TSA
Forestry	10,846.09	63%	1.00%
Mining (expansion, new)	1,636.09	10%	0.10%
Misc. Land Tenure	90.44	1%	0.00%
Utilities_Pipelines	3,875.27	23%	0.30%
Windpower	755.32	4%	0.10%
Total Development	17,203		
Total TSA	1,131,166		

Figure 4: Footprint areas by sector for near term potential development.

The assessment of future condition will include two phases:

1. A frequency analysis of NRS near-term potential development within of those portions of the landscape that have legal or policy objectives within them. This includes moose forage/cover objectives, mule deer winter range, visual quality polygons and OGMAs.
2. An evaluation of whether those developments result in changes to the risk to the value.

This assessment reports the results of phase 1 of the future analysis; phase 2 will be completed in the near future.

Assessment Area

The assessment area (Figure 5, approximately 1.13 million ha.) has diverse natural resource management activity e.g., forestry, mining (gold, copper, silver and coal), mineral exploration, clean energy (wind), agriculture, guide outfitters, recreation, tourism and other sectors. The area has also been significantly affected by natural disturbances (e.g., wildfire, spruce budworm, mountain pine beetle), contains high numbers of species and ecosystems at risk and has identified interests by many First Nations.

Like much of the southern interior of BC, the area is subject to many overlapping tenures that in aggregate covers about four times the land base. In addition, existing development is ongoing and new development proposals are being considered. The TSA is scheduled for an Annual Allowable Cut determination (early 2015) that will set harvesting limits for the forestry sector.

The following sections summarize the cumulative effects assessment for each of the resource values and include:

- background and policy context;
- assessment methods for current condition and 10-year trend and future near-term potential development;
- results, discussion and conclusions; and
- management recommendations.

These assessments, in some cases, are summarized from broader reports that are referenced when appropriate.

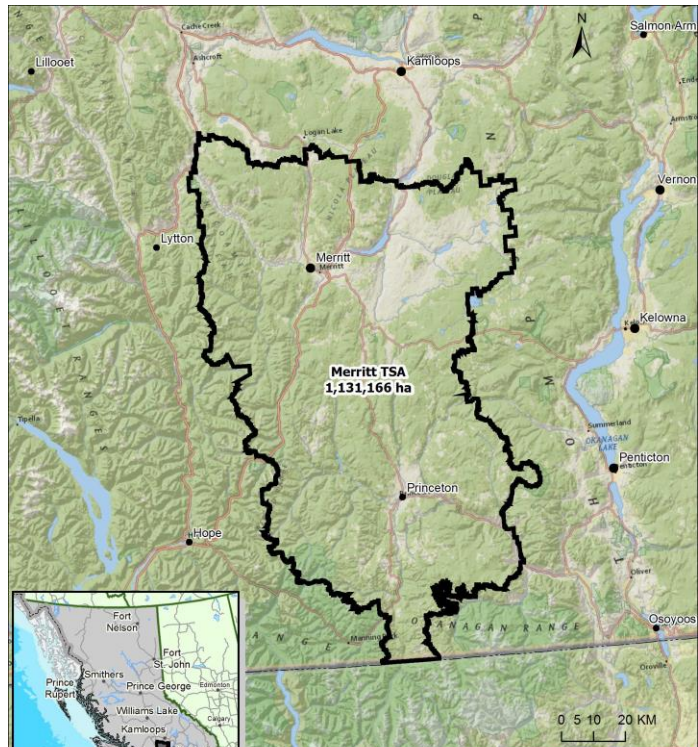


Figure 5: The cumulative effects assessment area corresponds to the Merritt TSA area.

Fish Stream Habitat Risk

SUMMARY

Watershed-level risk for salmonid habitat was analysed in the Nicola watershed due to the presence of fish (salmonid) species at risk and one species at risk of extirpation (bull trout). This assessment associates watershed condition with risks to salmonid habitat. Results indicate significant risk in most watersheds, especially with regard to riparian disturbance and sedimentation factors. Key drivers of this risk have been forest harvesting and extensive road networks near or crossing streams. Risk has increased over the last 10 years as new hazards accumulate with older impacts. Impacts to fish habitat have been detected with field-based monitoring. Assuming there is effective implementation of current policies; results suggest gaps in fish habitat management policy.

BACKGROUND AND POLICY CONTEXT

- The purpose of this assessment was to evaluate watershed-level risk to fish habitat (e.g., bull trout, salmon, and steelhead; hereafter, salmonids¹¹) and assess potential implications for the Merritt TSA.
- Stream fish are at risk from dispersed land use activity and natural disturbance over broad landscapes because watersheds accumulate and concentrate the effects over space (i.e., downstream) and through time¹².
- The Province recognizes that First Nations have strong aboriginal interests in fishing both freshwater and anadromous¹³ fish, and FLNR has consistently heard from First Nations that sound stewardship of these fish is very important to them.

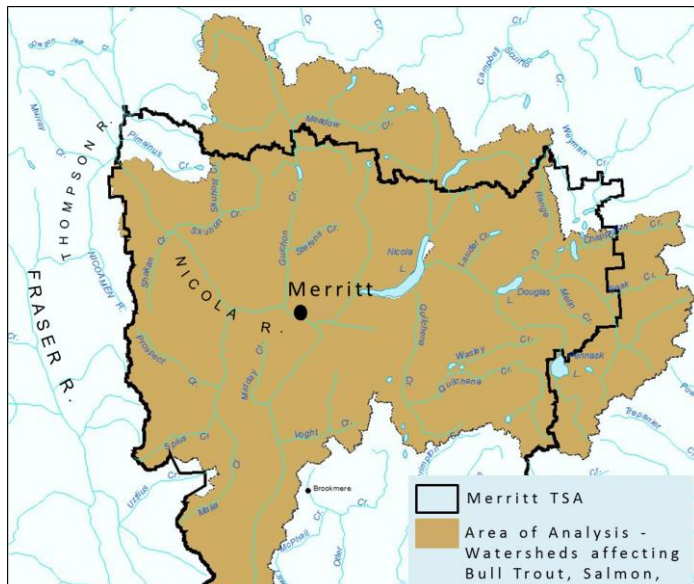


Figure 6: Study area for the Fish Habitat Assessment.

- Assessment was limited to the watershed units that affect the range of salmonids in the Nicola watershed (Figure 6), which constitutes critical spawning and rearing habitat (for all salmonids) as well as foraging and over-wintering habitat for bull trout.
- Bull trout are blue listed in British Columbia and identified as a high priority for management and conservation by Ministry of Environment Conservation Framework¹⁴ (CF;

¹¹ Salmonidae is a family of ray-finned fish, and includes salmon, trout, charrs, freshwater whitefishes and graylings.

¹² Fausch, K.D., Torgersen, C.E., Baxter, C.V., and Li, H.W. (2002) Landscapes to riverscapes: bridging the gap between research and conservation of stream fishes. Bioscience, 52(6), pp. 483-498.

¹³ Anadromous fish migrate from salt water to fresh water to spawn.

¹⁴ MOE Conservation Framework. Accessed online Nov 2013 at: <http://www.env.gov.bc.ca/conservationframework/>

rank 2 out of 6). Chinook, coho and steelhead are ranked similarly. More specifically; the Nicola bull trout population is reported to be at risk of extirpation¹⁵.

- All watersheds in the area of analysis were assessed equally if they supported some salmonid life stage in any part of the watershed. However, it is recognized that some watersheds have more extensive habitat and higher levels of habitat utilization than others.
- Effective management of salmonids require both landscape-level and site-level considerations. However, this assessment of habitat risk is limited to the landscape level and follows policy guidance identified in the BC Identified Management Strategy (IWMS)¹⁶. This guidance associates watershed condition with risk to fish habitat.
- This guidance is based on multiple studies which have connected (i.e., landscape-scale statistical associations) watershed condition with fish habitat condition.
- Bull trout distributions have also been closely linked with climate¹⁷ and research suggests that populations are at increased risk of habitat loss and isolation in the future due to climate change¹⁸ (i.e., warming stream temperatures).
- This assessment spatially evaluated the current (2013) risk to salmonid habitat and historic trend (10 years before now) using the outputs of a watershed desktop procedure and relevant monitoring data.

DATA SOURCE AND MODELLING

- Policy guidance from the IWMS includes: maintain properly functioning condition of fish (bull trout) habitats¹⁹ by:
 - preventing/minimizing sediment input to streams;
 - avoiding cumulative hydrologic impacts that may affect channel stability and structure; and
 - maintaining riparian habitats to ensure large woody debris recruitment and shading.
- We use a GIS-based watershed assessment procedure (WAP) to assess the potential hazards associated with effects identified above. The three hazard categories of the WAP include:
 - water quality (for potential sediment input);
 - water quantity – peak flow (hydrologic impacts); and
 - riparian hazard (clearing of near-stream areas).
 -
- The consequence portion of this risk assessment (see Figure 2) was linked to presence of salmonids in watersheds. Without a process to determine higher or lower consequence

¹⁵ Hagen and Decker 2011. Status of Bull Trout in BC: A synthesis of available distribution, abundance, trend and threat information. Ministry of Environment.

¹⁶ BC Identified Wildlife Management Strategy: Bull Trout. Accessed online at:

http://www.env.gov.bc.ca/wld/frpa/iwms/documents/Fish/f_bulltrout.pdf

¹⁷ USFS. 2013. Bull Trout and climate change. Accessed online at:

http://www.fs.fed.us/rm/boise/AWAE/briefing/AWAE_Science_Briefings-BullTroutAndClimateChange.pdf

¹⁸ Porter, M. and M. Nelitz. 2009. A future outlook on the effects of climate change on bull trout (*Salvelinus confluentus*) habitats in the Cariboo-Chilcotin. Accessed online at:

www.researchgate.net/publication/274721587_A_future_outlook_on_the_effects_of_climate_change_on_bull_trout_Salvelinus_confluentus_habitats_in_the_Cariboo-Chilcotin

¹⁹ Habitat features include cover, substrate quality, pool depth and volume, groundwater flow, water quality, temperature, channel structure, and hydrologic characteristics.

between watersheds or specific species, a default consequence of moderate was assigned to all watersheds with salmonid presence.

- The outputs of the risk assessment were represented as a three-class system of risk (high, moderate, low) and generated at multiple scales (e.g., watershed, sub-watershed, basin and sub-basin scales).
- The differences in risk classes indicate increased likelihood of adverse sedimentation, cumulative hydrologic impacts and effects to riparian habitats that can negatively affect salmonid habitats:
 - Low risk: Habitat conditions likely to sustain salmonid populations.
 - Moderate risk: Habitat conditions about as likely as not to sustain salmonid populations.
 - High risk: Habitat conditions not likely to sustain salmonid populations.

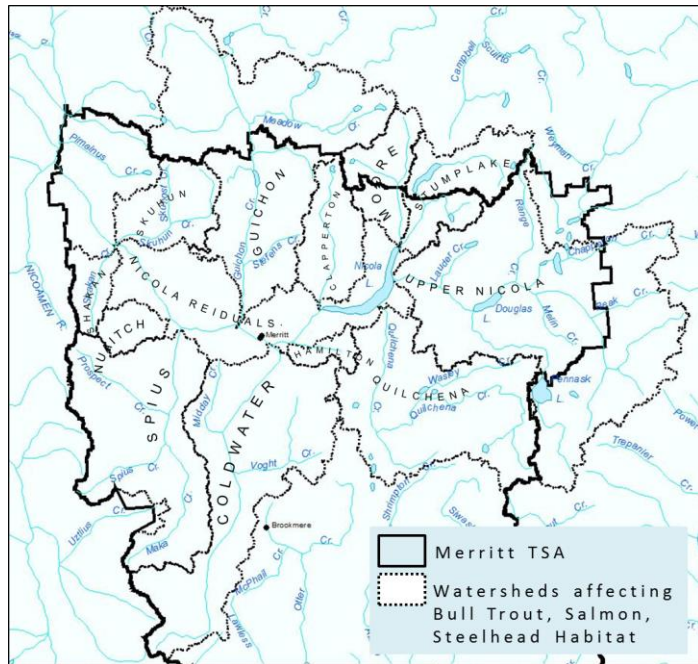


Figure 7: Watersheds that contain or affect bull trout, salmon and steelhead habitat.

- The highest hazard category score was considered as the highest risk for fish habitat.
- The indicators driving water quality and riparian hazard scores tend to be the most influential on fish and fish habitat^{20 21}; however, increases in peak flow may also result in risk for salmonids through increased sedimentation and loss of pool habitats.
- Mitigation recommendations may be specific to a broader-scale unit (e.g., watershed or sub-watershed) (Figure 7) made up of multiple basins or sub-basins.
- Mitigation recommendations are prompted by moderate or high-risk levels.
- Spatial and temporal trends in risk are illustrated with a 'flattened file' that show the finest unit of resolution possible (e.g., sub-basin, basin or residual portions of watersheds and sub-watersheds).
- Existing monitoring information (e.g., Fish Passage Monitoring, FREP Riparian and Water Quality Protocols) were considered as context for analysis outputs, as the protocols assess similar hazards at the site level.

²⁰ Valdal, E.J. and M.S. Quinn. 2011. Spatial analysis of forestry related disturbance on westslope cutthroat trout (*Oncorhynchus clarkii lewisi*): implications for policy and management. *Applied Spatial Analysis and Policy*, 4:2. Pp. 95-111.

²¹ Baxter, C.V., C.A. Frissel and F.R. Hauer. 1999. Geomorphology, logging roads and the distribution of Bull Trout spawning in a forested river basin: implications for management and conservation. *Transactions of the American Fisheries Society*. 128:5. pp. 854-867.

RESULTS

Results are summarized by:

1. Current Condition and Trend
2. Future Condition Qualitative Assessment (dependent on base case availability)

Current Condition and Trend

Table 2: Hazard levels and Salmonid risk for Nicola Watersheds.

Salmonid Habitat Risk - Nicola Watershed 2013				
Watershed	Peak Flow Hazard	Sediment Hazard	Riparian Hazard	Salmonid Risk
Skuhun	H	H	H	HIGH
Clapperton	H	H	H	HIGH
Coldwater	L	H	H	HIGH
Nicola R. Resid.	L	H	H	HIGH
Guichon	M	M	H	HIGH
Stump-Moore	L	L	H	HIGH
Upper Nicola	L	L	H	HIGH
Moore	L	L	M	MODERATE
Spus	L	L	M	MODERATE
Shakan	L	M	L	MODERATE
Quilchena	L	L	M	MODERATE
Nuaitch	L	M	L	MODERATE
Hamilton	L	L	L	LOW

- Twelve of 13 watersheds are at moderate risk or higher and trigger mitigation recommendations (Table 2 and Figure 8).
- Seven watersheds (including the Nicola Residuals) are in a high risk class.
- The mainstem Nicola is affected not only by the residuals but watersheds upstream.
- Two of the watersheds have high risk across all hazard categories. Four watersheds have both high risk for sediment and riparian hazards.
- The most prevalent hazard is riparian (10 of 13 watersheds) although the sediment hazard is

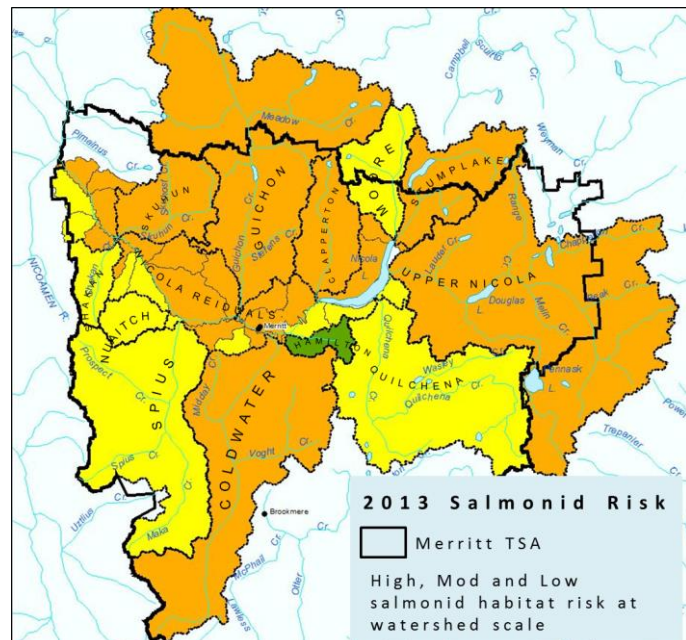


Figure 8: Salmonid habitat risk levels by watershed.

- At the sub-unit scale, a mosaic of high and moderate risk throughout the larger watersheds results in risk being incurred throughout (Figure 9). This is especially noteworthy in those watersheds that have salmonid habitat up toward their headwaters.
- Historic trends (from 2003) indicate that habitat risk was present before now (Figure 10); however, the trend at the watershed sub-unit level has been that risk has significantly increased over the last decade (Figure 11).
- At the sub-unit scale, increasing risk over the last 10 years is largely due to elevated riparian hazard followed by increases in peak flow hazard.



- The result of this analysis suggests that FLNR and Ministry of Environment (MOE) can improve policies to better manage the hazards that affect salmonid habitat.
- Considering the levels of risk assessed, IWMS policy guidance (for bull trout) is to conduct more detailed ground-based assessments to determine mitigation strategies for the hazards; however, for the purpose of TSR5, mitigation recommendations are proposed assuming that the hazards are present.
- Ground-based monitoring^{22,23} within the TSA indicates that industrial practices have impacted stream function and/or



²³ Targeted sample (i.e., not random) of natural resource development collected by the Thompson-Okanagan Integrated Monitoring Team for the Cumulative Effects Assessment Pilot Project

loss of habitat. Although there is limited monitoring data within the range of bull trout/salmon/steehead, the TSA extent results can be considered in an aspatial sense and thus broadly reflective of practices within the range of salmonid habitat (Figure 12).

- Each hazard category is driven by a combination of indicators. However, the primary factors for each hazard category are the subject of some mitigation recommendations, for example:
 - riparian clearing for the riparian hazard;
 - roads and crossings for sediment hazard; and
 - equivalent clear-cut area for peak flow hazard.

Riparian

- The vast majority of riparian disturbances are on S6 streams²⁴ although there is extensive private land and ranching-based riparian disturbance in the lower ends of watersheds.
- According to monitoring data (n=28), current practice²⁵ in S6 Riparian Management Zones is retention on average of 3.9 m with a range of 0 m to >10 m. Forty-six percent of all S6 monitoring sites had almost no buffer (<1 m); 28% of samples had at least a 10 m buffer.
- Nordin et al. (2009)²⁶ found significant downstream impacts from harvesting of non-fish bearing riparian zones, and recommended a riparian reserve zone on non-fish bearing streams to mitigate downstream impacts.
- Rex and Maloney (2010)²⁷ found that in-stream conditions were affected by upstream riparian harvesting 20 to 30 years after activity. Recommendations include increased riparian management zone conifer retention to 10 m on non-fish bearing streams as consistent with the BC Riparian Management Zone guidebook²⁸.
- Peatt and Peatt (2013)²⁹ summarized from a study of 3000 interior BC harvested areas that

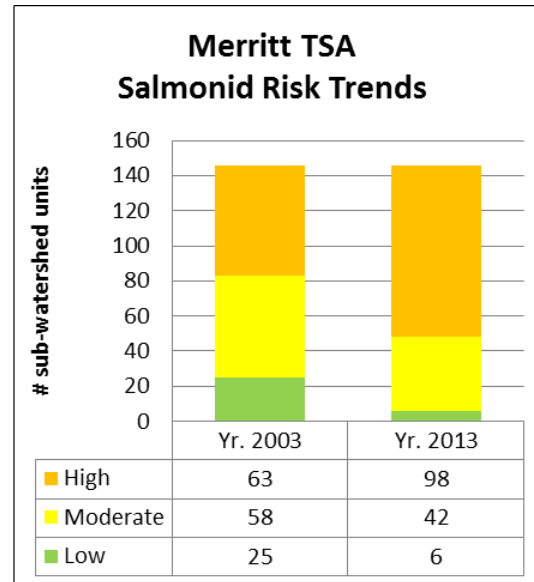


Figure 11: Salmonid habitat risk trends at the watershed unit scale.

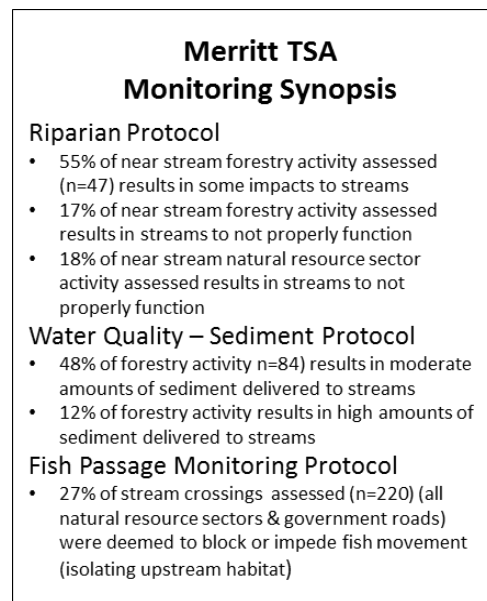


Figure 12: Merritt TSA monitoring synopsis.

²⁴ S6 streams are less than or equal to 3 m wide and are not fish bearing.

²⁵ As per Forest and Range Evaluation Program (FREP) monitoring results (Sep 2014).

²⁶ Nordin, L.J., D.A. Maloney and J.F. Rex. 2009. Detecting effects of upper basin riparian harvesting at downstream reaches using stream indicators. BC Journal of Ecosystems and Management 10(2):123–139.

www.forrex.org/publications/jem/ISS51/vol10_no2_art11.pdf

²⁷ Project website: http://www.for.gov.bc.ca/hre/ffip/bowron.htm#Summary_of_Main_Findings

²⁸ BC Riparian Management Zone Guidebook: <https://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/riparian/rip-toc.htm>

²⁹ Peatt and Peatt (2013). Draft summary report on Nicola watershed temperature sensitive streams evaluation pilot.

a minimum 10 m riparian reserve provided the best combination of channel stability, temperature mitigation and windthrow resistance.

Water Quality - Sediment

- Sediment hazard is prevalent in the results of this analysis, and is partially mitigated both with the recommendations for riparian but also through practices recommendations to conduct level 2 or level 3 watershed assessments³⁰.

Table 3: Trends in equivalent clear-cut area.

Trends in Equivalent Clear Cut Area		
Watershed	Yr. 2003	Yr. 2013
Guichon	11%	32%
Clapperton	15%	44%
Skuhun	6%	31%

Peak Flow - Equivalent Clear-Cut Area

- The risk of increased peak flow hazard in Guichon, Clapperton and Skuhun watersheds has in part been driven by increases in equivalent clear-cut area (ECA) (Table 3).

CONCLUSIONS

The cumulative effects analysis evaluated hazards to key fish habitat in the Nicola watershed to understand the potential implications for resource management. Our findings suggest there are some regulatory or policy gaps that should be evaluated in more detail. The importance of this value stems from its association with:

- First Nations Rights and Interests;
- Species at Risk management;
- Integrated Wildlife Management Strategy; and
- Environmental Mitigation Policy.

Management Recommendations

- FLNR to take actions to validate risk assessment with on-the-ground monitoring (in progress with T-O Integrated Monitoring Team, Nov. 2014).
- CEA team to develop briefing note for regional executive, to review the implications of the fish habitat assessment and outcomes of recommendation 1.1. Options for policy review and targeted monitoring will be provided. The briefing note will include both fish habitat and watershed assessment outcomes.
- NRS operators to manage non-fish bearing stream³¹ riparian management areas to a 10 m buffer where those streams are connected downstream to fish-bearing reaches.
- FLNR extend outcomes of this analysis and watershed assessment procedure to forest licensees and other operators with significant developments within watersheds.
- FLNR-MOE to develop region-wide fish habitat management strategy to address the risk to fish habitat including hazards not considered in this assessment (due to data limitations).
- FLNR to make risk mapping and e-Guidance available through Front Counter BC.

³⁰ Level 2 and Level 3 assessments as per the BC Interior Watershed Assessment Procedure Guidelines: <https://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/iwap/chap1.htm#lee>

³¹ That are connected to downstream fish-bearing streams.

Moose Populations Risk

SUMMARY

A strategic assessment was completed for moose populations in the Merritt TSA. Moose populations are stable to increasing in this area. The assessment considered predation (primarily wolves), regulated and non-regulated hunting, forest harvesting and wildfire effects on forage and thermal cover, and livestock effects on forage in wetlands. The assessment also considered whether legal habitat objectives were being achieved. Results indicate that there are low to moderate levels of risk for moose populations. Over the last 10 years there has been improvement in meeting legal (forage) habitat objectives. Although moose populations are stable, the risk is increasing in some planning cells due to loss of thermal cover and exposure to hunting from increased road access. An assessment of near-term potential future developments identified 20 (or 90%) of moose planning cells that may be affected by development proposals.

BACKGROUND

- A strategic level assessment was conducted for moose populations in the Merritt TSA to provide decision support for the Chief Forester's AAC determination.
- Moose populations are affected by habitat alterations from dispersed land use activity and natural disturbance, predation (primarily wolves), and regulated and non-regulated hunting activity over broad landscapes.
- Moose are not a threatened species in BC, but are identified as an ungulate species that may require management of winter range habitats for winter survival³². Moose are also an important game species that provide significant socio-economic benefits to the province.

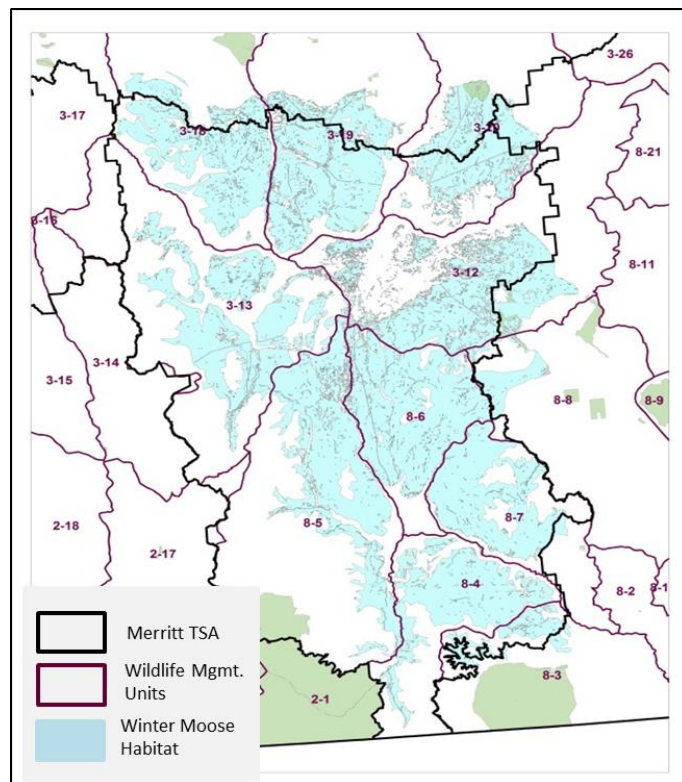


Figure 13: Merritt TSA moose winter range.

- The Province recognizes that First Nations have stated strong aboriginal interests in sustenance hunting of moose, and FLNR has consistently heard from First Nations that sound stewardship of moose populations and habitat is very important.
- Assessment was completed over the capable winter habitat portion of the entire Merritt TSA (Figure 13) which provides winter forage and thermal cover.

³²BC Identified Wildlife Management Strategy <http://www.env.gov.bc.ca/wld/frpa/species.html>

- Effective management of moose populations requires both landscape-level and site-level considerations. However, this assessment of moose population risk is limited to the landscape level and considers habitat, predation and hunting-related effects on the population.

EXISTING LEGAL OBJECTIVES AND REGULATIONS

- Legal objectives for identified moose winter range in the Merritt TSA exist under section (7) of the *Forest Planning and Practices Regulation* (FPPR)³³ and include measures related to distribution of foraging habitat and cover through moose winter ranges by:
 - Maintaining a minimum of 15% of the net forested land base in early seral stands (<25-35 years); and
 - Maintaining tree cover of at least 16 m in patches of 20 ha or greater in close proximity to important riparian features.
- Authorization of hunting permits by Wildlife Management Unit (WMU) are allocated through the *Wildlife Act of BC* Hunting Regulations and include:
 - Restrictions on hunting females (cows) and young (calves) through Limited Entry Hunting to ensure adequate adult female survival and population recruitment; and
 - Restrictions on timing and age and sex (spike fork harvest) for General Open Seasons.

ASSESSMENT APPROACH

- This assessment spatially evaluated the current (2014) risk to moose populations and historic trend (10 years before now) using an expert judgment-based (expert) model³⁴, developed for the Thompson-Okanagan Region by regional wildlife and habitat experts, and relevant inventory and monitoring data.
- We used the expert model to assess the potential hazards associated with the following threats:
 - Habitat conversion including amount of forage and thermal cover;
 - Regulated and non-regulated hunting (road access and vulnerability to hunting); and
 - Predation (density of wolves and concentration on winter ranges).
- The relative contribution of each threat to overall risk was calibrated based on expert input. Key assumptions included:
 - Predation is the main factor affecting risk to moose populations by reducing adult female survival and calf recruitment.
 - Regulated hunting, including General Open Seasons and Limited Entry Hunts, are assumed to have limited population impacts as hunting seasons are targeted primarily at males (bulls), are monitored and adjusted annually, and harvest a small proportion of the population annually.

³³ http://www.env.gov.bc.ca/esd/distdata/ecosystems/frpa/Approved_FRPR_sec7_WLPPR_sec9_Notices_and_Supporting_Info/UWR/Timber_Supply_Areas/Merritt_TSA/Notice/

³⁴ Wilson, S.F. 2014. Thompson-Okanagan moose Bayesian Belief Model report.

- Non-regulated hunting is less selective by age or gender and is assumed to have greater impacts on female adult survival and calf recruitment.
- Habitat alteration may affect populations in situations with very low levels of early seral (foraging) habitat, or extensive loss of mature forest canopy affecting winter thermal (shading) cover. Extensive loss of mature forest canopy can also increase moose vulnerability to hunting.
- The consequence portion of this risk assessment (see Risk Assessment Approach section under Cumulative Effects Assessment above) was assigned a moderate rating as a default across all planning cells.

REPORTING ASSESSMENT RESULTS

- The outputs of the expert model were represented as a three-class system of risk (high, moderate, low).
- The differences in risk classes indicate increased likelihood of population decline to a level that is unable to sustain regulated or non-regulated (aboriginal) hunting.
 - Low risk: Increasing to stable population, likely that population can sustain hunting.
 - Moderate risk: Stable population, about as likely as not to sustain hunting.
 - High risk: Declining population, unlikely that population can sustain hunting.

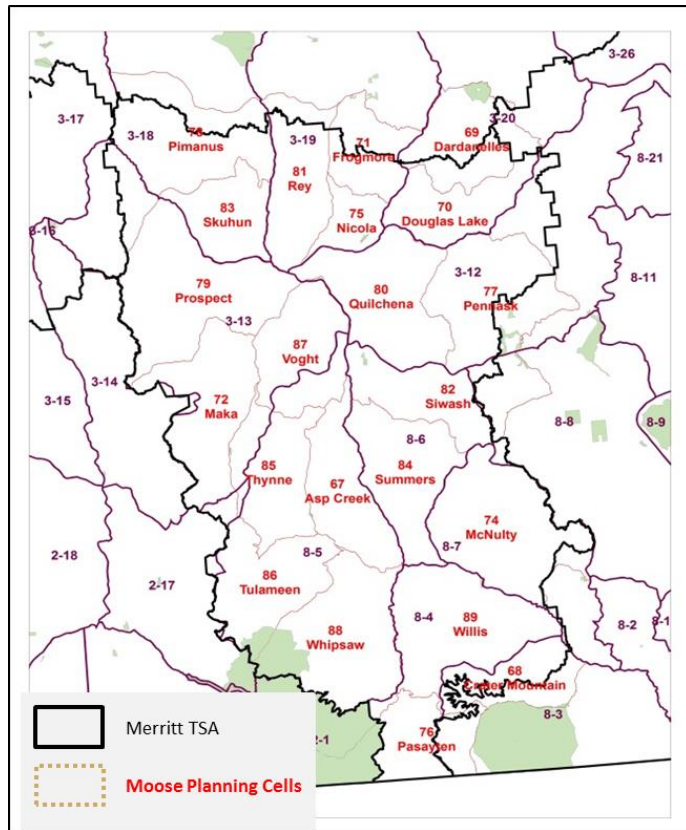


Figure 14: Merritt TSA moose planning cells.

- The outputs of the expert model are reported at a non-legal planning cell level (Figure 14). Planning cells were delineated based on main roads/highways, linear corridors or water features and are intended to support implementation of certain mitigation measures (e.g., access management).
- Mitigation recommendations may be specific to planning cells or broader scale Wildlife Management Units (Figure 13).

USE OF INVENTORY AND MONITORING DATA TO VERIFY ASSESSMENT RESULTS

- Existing inventory or monitoring information was used to help verify expert model results. The following inventory and monitoring sources were used:
 - Hunter Reporting
 - Hunter success and hunter effort (# of days) reported annually since 1984
 - Aerial Composition Survey
 - Bull/Cow/Calf ratio
 - Rough population estimate based on # of moose counted
 - Aerial Stratified Random Block Survey
 - Stratify habitat by quality (low, moderate, high)
 - Count # of moose spotted from aircraft in each strata
 - Population estimated (corrected) based on # of moose spotted
 - Also provide a composition estimate (Bull/Cow/Calf)
- Hunter reporting (hunter success from Limited Entry Hunts) is used to estimate population abundance using a statistically derived relationship, and provides evidence of trends over time.
- Aerial composition survey and stratified random block survey data is used to estimate population abundance at a given time, and provides increased confidence when used with hunter reporting data.
- Composition estimates provide additional evidence of trends in the proportion of males to females (cow/bull ratio) or young to adult females (cow/calf ratio). This information provides insight into whether effects are related to predators (adult female survival or calf recruitment), or hunting pressure affecting primarily males (cow/bull ratio).

RESULTS

Current Condition and Historic Trend

- The minimum forage requirement objective for moose was achieved in 2014 (see early seral column in Table 4). However, measuring thermal cover objectives is not possible with the available information at this time.
- In general, risk to moose populations is low across the Merritt TSA, but has increased from 2003 to 2014 (Figure 15).
- Three planning cells have moderate risk (Pennask, Nicola, Dardanelles) related to extensive salvage of stands affected by mountain pine beetle, reduction in mature forest canopy thermal cover, and increased regulated and non-regulated hunting related threats due to improved hunter access on expanded open road networks.
- Two planning cells show moderate predation hazard, due to a moderate concentration of wolves on winter range.

Table 4: Summary of habitat hazard, predation hazard, hunting hazard and overall moose risk by planning cell for the Merritt TSA.

Moose Population Hazard and Risk - Merritt TSA 2003 - 2014											
Planning Cell	% Early Seral (0-3m)		Habitat Hazard		Predation Hazard		Hunting Hazard		Cons.	Moose Risk	
	2003	2014	2003	2014	2003	2014	2003	2014		2003	2014
Asp Creek	8.6	18.2	L	L	L	L	L	L	MOD	LOW	LOW
Crater Mtn.	1.6	14.3	L	L	L	L	L	L	MOD	LOW	LOW
Dardanelles	12.1	33.6	L	M	L	L	L	M	MOD	LOW	MOD
Douglas Lake	6.7	8.3	L	L	L	L	L	L	MOD	LOW	LOW
Frogmore	10.1	28	L	L	L	L	L	L	MOD	LOW	LOW
Maka	4.4	4.6	L	L	L	L	L	L	MOD	LOW	LOW
McNulty	17.1	27.2	L	L	L	L	L	L	MOD	LOW	LOW
Nicola	19.4	33.3	L	M	L	L	L	M	MOD	LOW	MOD
Pasayten	9.6	8.8	L	L	L	L	L	L	MOD	LOW	LOW
Pennask	9.5	30.5	L	M	L	L	L	M	MOD	LOW	MOD
Pimanus	9	29.7	L	L	L	L	L	L	MOD	LOW	LOW
Prospect	1.9	4.4	L	L	L	L	L	L	MOD	LOW	LOW
Quilchena	5.7	16.1	L	L	L	L	L	L	MOD	LOW	LOW
Rey	5.1	18.9	L	L	L	L	L	L	MOD	LOW	LOW
Siwash	12.3	28.9	L	L	L	L	L	L	MOD	LOW	LOW
Skuhun	9.9	27.9	L	L	L	L	L	L	MOD	LOW	LOW
Summers	12.8	26.6	L	L	L	L	L	L	MOD	LOW	LOW
Thynne	8.4	10.3	L	L	L	M	L	L	MOD	LOW	MOD
Tulameen	2.8	4.5	L	L	L	L	L	L	MOD	LOW	LOW
Voght	3.5	12.5	L	L	L	L	L	L	MOD	LOW	LOW
Whipsaw	24.8	14.0	L	L	M	M	L	L	MOD	MOD	MOD
Willis	17.1	18.2	L	L	L	L	L	L	MOD	LOW	LOW
Average:	9.6	19.1	OVERALL RATING							LOW	LOW

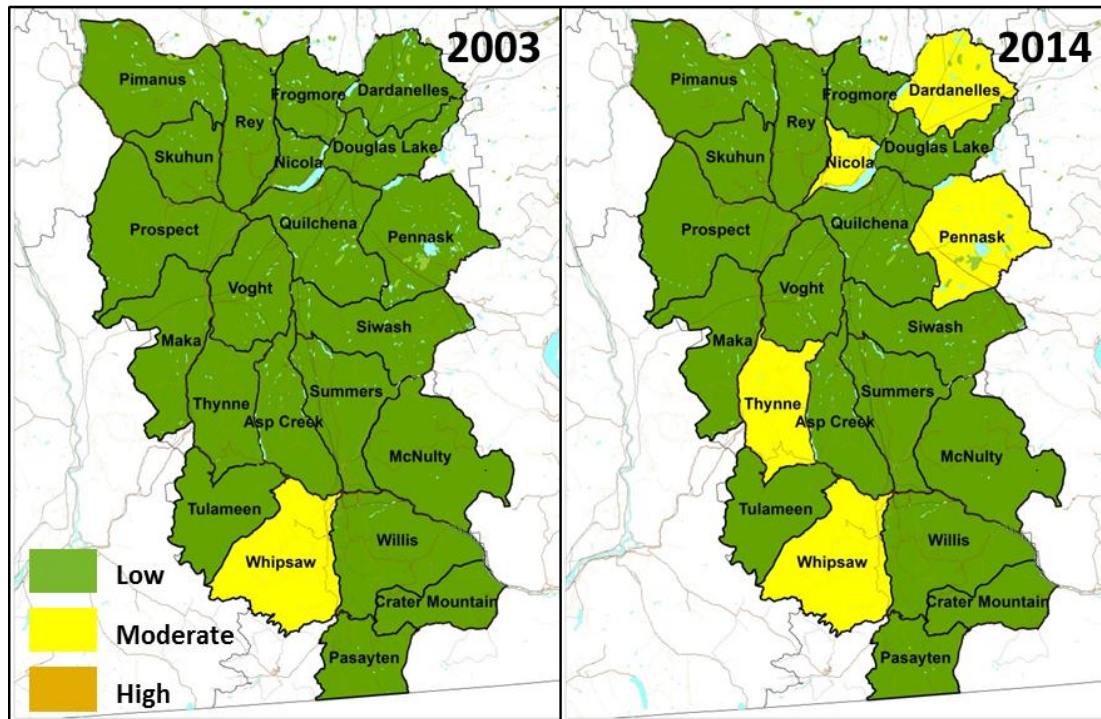


Figure 15: Moose population risk themed by planning cell in the Merritt TSA.

FUTURE CONDITION AND TREND

- Several moderate risk planning cells will remain at this risk level for up to two decades until regenerating forests provide visual screening.
- Other planning cells currently at low risk but experiencing mountain pine beetle salvage may be elevated to moderate risk.
- The density of wolves on moose winter ranges in the Merritt TSA may increase in the future based on trends to date.
- An assessment of near-term potential future developments identified that 20 (or 90%) of moose planning cells may be affected by development proposals.

CONCLUSIONS

- From 2003 to 2014, results from the expert model show moose populations in the Merritt TSA have remained stable to increasing.
- Results of the expert model have been verified by monitoring information from hunter reporting and aerial surveys.
- Regional moose experts believe moose populations have generally benefited from the increase in early seral winter foraging habitat created through wildfire and salvage logging of forests affected by the mountain pine beetle.
- However, extensive salvage harvesting and the increase in road access have facilitated hunter access, increasing vulnerability of moose to regulated and non-regulated hunting pressure.
- Predation from wolves has remained low in the Merritt TSA from 2003 to 2014; however, wolf populations have been increasing in the region and moving south from 2003 to 2014.

Recent anecdotal reports of wolf packs in the Merritt TSA have been received by FLNRO wildlife staff.

- The density of wolves on moose winter ranges in the Merritt TSA is expected to increase in the future based on trends to date.
- The current stable and generally low-risk condition for moose in the Merritt TSA could change if wolves increase, resulting in a declining moose population in portions of the TSA as observed in other parts of the region (e.g., Kamloops TSA).

Management Recommendations

- Refine objectives for moose habitat, that include:
 - The amount and spatial distribution of thermal cover on moose winter range at a planning cell level.
 - The identification of important wetlands for moose in key planning cells. Minimum visual screening requirements around important wetlands should be developed.
 - Evaluation of the need for access constraints around important wetland complexes, which will increase in importance as early seral forests decline with succession.
- FLNR develop policy to expand the consideration of this objective(s) to the other NRS sectors such that future (non-forestry) development can consider addressing this value in development plans or mitigation strategies.
- FLNR to make risk mapping and e-Guidance available through Front Counter BC.

Mule Deer Populations Risk

SUMMARY

A strategic-level assessment of factors limiting to mule deer populations was conducted in the Merritt TSA. Mule deer populations are currently stable in this area. The assessment included minimum mature forest canopy objectives that are critical for winter survival, the amount of suitable winter survival habitat available over broader areas, levels of access for regulated and non-regulated hunting, and proximity to predators (i.e., cougars and wolves). Results indicate that there are moderate levels of risk for mule deer populations in moderate to heavy snow years. There has been improvement over the last 10 years in meeting legal habitat objectives. However, there is still a mosaic of habitat areas that do not meet minimum requirements due to existing landscape conditions prior to legal objectives being established. An assessment of near-term potential future developments identified 198 (or 18%) mule deer planning cells that may be affected by project proposals. Results indicate the importance of the habitat objectives and monitoring changes in predation levels.

BACKGROUND

- A strategic level assessment was conducted for mule deer populations in the Merritt TSA to provide decision support for the Chief Forester's AAC determination.
- Mule deer populations are affected by habitat alterations from dispersed land use activity and natural disturbance, predation (primarily cougar and wolves), and regulated and non-regulated hunting activity over broad landscapes.
- Mule deer are not a threatened species in BC, but are identified as an ungulate species that may require management of winter range habitats for winter survival³⁵. Mule deer are also an important game species that provide significant socio-economic benefits to the Province.
- The Province recognizes that First Nations have stated strong

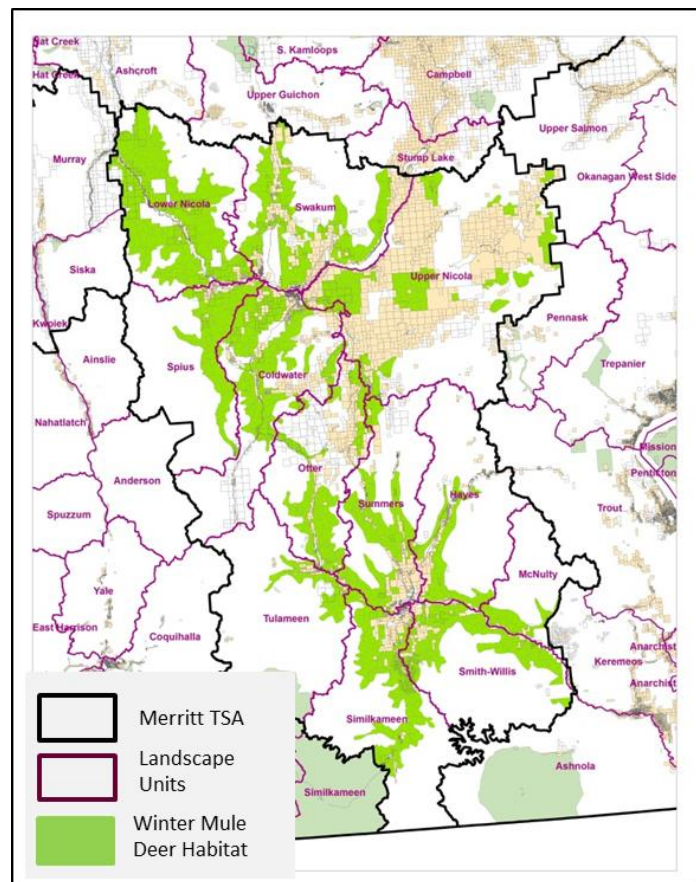


Figure 16: Merritt TSA mule deer habitat area.

³⁵ BC Identified Wildlife Management Strategy <http://www.env.gov.bc.ca/wld/frpa/species.html>

aboriginal interests in sustenance hunting of mule deer, and FLNR has consistently heard from First Nations that sound stewardship of mule deer populations and habitat is very important.

- Assessment was completed over the capable winter habitat portion of the entire Merritt TSA (Figure 16), which provides winter forage, snow interception and thermal cover.
- Effective management of mule deer populations require both landscape-level and site-level considerations. However, this assessment of mule deer population risk is limited to the landscape level and considers habitat, predation and hunting related effects on the population.

EXISTING LEGAL OBJECTIVES AND REGULATIONS

- Legal objectives for managing identified mule deer winter range habitat in the Merritt TSA exist under General Wildlife Measures (GWM) within Government Actions Regulation (GAR) Order # U3-003 of the *Forest and Range Practices Act* (FRPA)³⁶, and include measures related to:
 - Maintaining a minimum amount and type of snow interception cover at a planning cell depending on the average snowpack depths (shallow, moderate, deep);
 - Maintaining foraging habitat; and
 - Distributing snow interception cover and foraging habitat through a planning cell.
- Authorization of hunting permits by Wildlife Management Unit (WMU) are allocated through the *Wildlife Act of BC* Hunting Regulations, and include:
 - Restrictions on hunting females (does) through Limited Entry Hunting to ensure adequate adult female survival and population recruitment; and
 - Restrictions on timing and age (four-point only harvest) for General Open Seasons for males (bucks).

ASSESSMENT APPROACH

- This assessment separately evaluated for both the current year (2013) and historic trend (10 years before now):
 - GAR mature forest canopy snow interception cover objectives.
 - Risk to mule deer populations using a judgment-based expert model (Wilson 2013)³⁷, developed for the Thompson-Okanagan Region by regional wildlife and habitat experts, and relevant inventory and monitoring data.
- Key hazard assessments that were inputs into the expert model included:
 - Level of hazard (low, moderate, high) associated with the amount of mature forest canopy snow interception cover within planning cell scale.

³⁶ http://www.env.gov.bc.ca/wld/frpa/uwr/approved_uwr.html

³⁷ Wilson, S.F. 2013. Integrated habitat and population hazard model for mule deer – West Okanagan Nicola Cumulative Effects Demonstration Project. 9 pp.

- An evaluation of cumulative habitat hazard, within a landscape unit (LU) relative to the amount of winter range habitat available in that LU.
 - Regulated and non-regulated hunting (road access and vulnerability to hunting).
 - Predation (density of cougars and presence of wolf packs).
- The consequence portion of this risk assessment (see page 13 for a description) was assigned a moderate rating as a default across all landscape units.
- The relative contribution of each threat to overall risk is calibrated based on expert input. Key assumptions include:
 - The main factor affecting mule deer is loss of snow interception habitat. Mule deer are vulnerable to deep and prolonged snow accumulations. Deep snow can restrict movement, limiting ability to forage, and can result in starvation or poor reproductive health. Deep snowpack also concentrates animals, limiting their ability to evade predators. Both factors affect female adult survival and fawn recruitment.
 - Predation affects mule deer populations by reducing adult female survival and fawn recruitment. Cougar are the primary predator. Additional concentrated predation from wolf packs can increase localized mortality.
 - Regulated hunting, including General Open Seasons and Limited Entry Hunts, are assumed to have limited population impacts as hunting seasons are targeted primarily at males (bucks), are monitored and adjusted annually, and harvest a small proportion of the population annually.
 - Non-regulated hunting is less selective by age or gender and is assumed to have greater impacts on female adult survival and recruitment. Both regulated and non-regulated hunting success is assumed to be facilitated by road access.
- The outputs of the expert model were represented as a three-class system of risk (low, moderate, high).
- The differences in risk classes indicate increased likelihood of population decline to a level that is unable to sustain regulated or non-regulated (aboriginal) hunting.
 - Low risk: Increasing to stable population, likely that the population can sustain hunting.
 - Moderate risk: Stable population, about as likely as not to sustain hunting.
 - High risk: Declining population that is unlikely to sustain hunting.
- The outputs of the expert model for mule deer populations are reported at two scales:
 - A legally defined planning cell level for management of snow interception cover habitat on defined winter ranges.
 - A non-legal Landscape Unit (LU) level that incorporates habitat, predation and hunting effects.
- Mitigation recommendations may be specific to planning cells or broader-scale Landscape or Wildlife Management Units.
- Mitigation recommendations to address hazards are directed at management actions that exceed existing legal requirements. Mitigation recommendations were characterized as:

- Timber supply related (e.g., incremental constraints to the THLB³⁸),
- NRS practices related (e.g., effects of silviculture practices on forage or recruitment of snow interception cover), or
- NRS management related (e.g., access management).

RESULTS

Results are summarized for mule deer habitat at a winter range planning cell level and for mule deer populations at a Landscape Unit level by:

- Current Condition and Trend, and
- Future Condition.

Current Condition and Trend

Mule Deer Habitat – Winter Range Planning Cells

- 778 (74%) of the 1045 winter range planning cells were found to be meeting expectations (Figure 17), with levels of snow interception habitat meeting or exceeding the minimum GAR targets in the Section 7 Notice for the Merritt TSA.
- The number of cells in low or low-moderate risk, and meeting GAR targets, has increased slightly from 725 (69%) in 2003.
- The number of high hazard cells changed little between 2003 and 2014 from 164 to 161, whereas the number of moderate-high decreased more substantially from 161 to 111 in that same period (Figure 18).

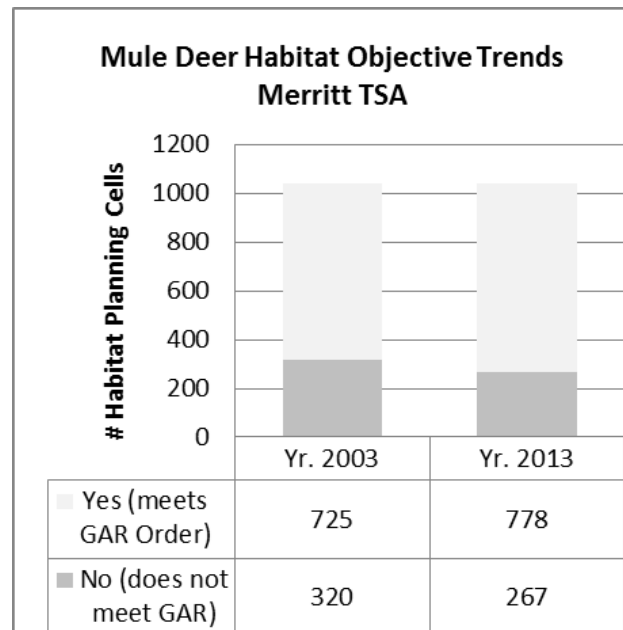


Figure 17: Merritt TSA mule deer habitat objectives met or not met by planning cell.

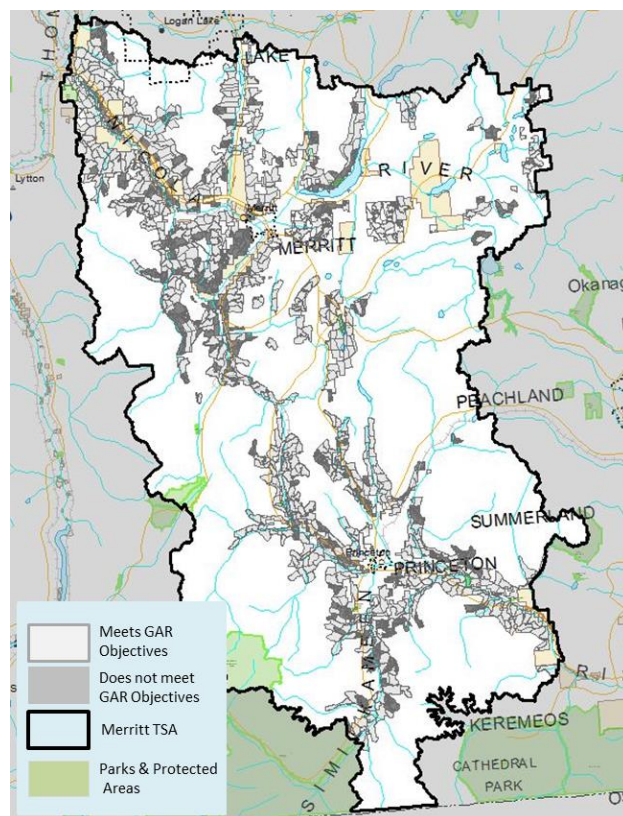


Figure 18: Merritt TSA mule deer habitat objectives met or not met by planning cell.

³⁸ THLB – Timber Harvesting Land Base.

Mule Deer Populations – Landscape Unit Level

Overall there is a moderate risk of mule deer population decline in the Merritt TSA, resulting in loss of hunting opportunities and associated socio-economic impacts. The explanation for this overall rating is based on:

- Low-moderate predation hazard – Cougar populations are at high levels; however, cougar predation rates are considered sustainable and additional predation from wolves is nil to low as established wolf packs are absent in the Merritt TSA.
- Moderate hunting hazard – Open road networks that increase mule deer vulnerability to hunting pressure have increased from 2003 to 2014.
- Low-moderate habitat hazard – Adequate snow interception cover is available at an LU level to minimize impacts to deer populations.

Table 5: Summary of habitat hazard, predation hazard, hunting hazard and overall mule deer risk by landscape unit for the Merritt TSA. The moderate hazard category was split in two (L-M, M-H) to explore positive or negative trends.

Mule Deer Population Risk - Merritt 2003 and 2014								
Landscape Unit	Habitat Hazard		Predation Hazard		Hunting Hazard		Mule Deer Risk	
	2003	2014	2003	2014	2003	2014	2003	2014
Coldwater	M-H	M-H	L-M	L-M	M-H	M-H	Moderate	Moderate
Hayes	M-H	M-H	L-M	L-M	L-M	L-M	Moderate	Moderate
Lower Nicola	M-H	L-M	L-M	L-M	L-M	L-M	Moderate	Moderate
McNulty	L-M	L-M	L-M	L-M	L-M	L-M	Moderate	Moderate
Otter	L-M	M-H	L-M	L-M	L-M	M-H	Moderate	Moderate
Similkameen	L-M	L-M	L-M	L-M	L-M	M-H	Moderate	Moderate
Smith-Willis	L-M	L-M	L-M	L-M	L-M	L-M	Moderate	Moderate
Spus	M-H	L-M	L-M	L-M	L-M	M-H	Moderate	Moderate
Summers	L-M	L-M	L-M	L-M	L-M	M-H	Moderate	Moderate
Swakum	M-H	M-H	L-M	L-M	M-H	M-H	Moderate	Moderate
Tulameen	L-M	Low	L-M	L-M	L-M	L-M	Moderate	Moderate
Upper Nicola	M-H	M-H	L-M	L-M	L-M	L-M	Moderate	Moderate

FUTURE CONDITION AND TREND

Mule Deer Habitat - Planning Cells

At the planning cell level, habitat hazards are expected to be maintained at current levels, or increase depending on natural disturbance activity. Despite post-mountain pine beetle forest harvesting activity directed in dry, lower elevation Douglas-fir forests, forest harvesting is expected to comply with existing GAR orders to maintain snow interception cover. Expected

future natural disturbances such as wildfire may impact snow interception cover if disturbances occur in planning cells.

Assessment of overlap of near-term potential developments suggests that approximately 198 (or 18%) of mule deer planning cells may be affected by project proposals. Assessment of whether habitat objectives will be maintained is still outstanding.

Mule Deer Populations

At the Landscape Unit level, risk to mule deer populations is expected to be maintained at current levels, or possibly increase, due to:

- No expected change in habitat hazard with future forest harvesting activities (see above), but increased hazard is possible if natural disturbance affects snow interception cover habitats in multiple planning cells within an LU;
- Continued annual management of regulated hunting pressure on mule deer harvest allocations at a WMU level through hunting regulations; or
- No expected changes in non-regulated hunting pressure.

Risk to mule deer populations may increase if the density of wolves on mule deer winter ranges in the Merritt TSA increases or if wolf packs become established in the Merritt TSA. Anecdotal evidence has confirmed increased sightings of wolves, and established packs have shifted their distribution south over the past 10 years, such as in the Kamloops TSA.

CONCLUSIONS

- From 2003 to 2014, the overall condition of snow interception cover habitat in mule deer winter planning cells has improved.
- From 2003 to 2014, the overall risk to mule deer populations has remained low to moderate.
- In the future, post-mountain pine beetle forest harvesting will be directed into dry lower-elevation Douglas-fir forest types; however, continued compliance with GAR orders will ensure a low-moderate habitat hazard is maintained.
- In the future, continued habitat management in combination with ongoing hunter harvest allocation management should continue to manage risk at or below current levels.
- Increased future risk to mule deer populations is only expected if natural disturbances impact extensive portions of winter habitat or if wolf packs become established in the Merritt TSA resulting in increased predation.

Management Recommendations

- Due to the importance of habitat objectives in minimizing risk to mule deer populations, we recommend that FLNR develop policy to expand requirements for the NRS to address the intent of this objective in development plans or mitigation strategies.
- FLNR to make risk mapping and e-Guidance available through Front Counter BC.

structures within the identified visual quality areas, but are not bound by regulation to consider this value.

- The strategic assessment is intended to be more wide ranging but complementary to the visual quality monitoring protocol that monitors the achievement of VQOs and other program goals.
- This assessment spatially evaluated the current (2013) expectations for visual quality as well as the historic trend (10 years before now) based on relevant data from that time period to provide additional context for resource management consideration.

EXISTING LEGAL OBJECTIVES AND REGULATIONS

- Scenic areas and VQOs are established at the local level by a resource district manager using the Government Actions Regulation (GAR) Sections 7.1 and 7.2.
- Section 1.1 of the Forest and Range Planning Regulation (FPPR) defines the five categories of alteration (VQOs): preservation, retention, partial retention, modification, and maximum modification.
- Established scenic areas and VQOs trigger requirements:
 - A Forest Stewardship Plan (FSP) must identify any scenic areas that are in effect. FRPR 14(2) & (3)(e).
 - A FSP must specify intended results/strategies, in relation to Objectives Set by Government (OSBG) for visual quality or for established VQOs. FRPA 5(1)(b)(i)&(ii),
 - The results/strategies must be consistent with OSBG for visual quality and with VQOs. FRPA 5 (1.1).
 - The holder of an FSP or a woodlot licence plan must ensure that the intended results specified in the plan are achieved, or the strategies are carried out. FRPA Section 21(1).
- The main factors considered are forest harvesting and road building including: the amount of area impacted, the type of harvest (clear-cut or partial cut), and the location and design characteristics of harvested openings within the main lines of force and characteristics of specific scenic landscapes.
- Natural disturbances such wildfires or defoliating insect outbreaks are considered natural and temporary and are not considered in Visual Quality Class (VQC) ratings when assessed.

ASSESSMENT APPROACH

- To assess the extent of forest harvesting in each visual polygon we used the current GIS-based approach *Procedures for Factoring Visual Resources into Timber Supply Analyses*, Ministry of Forests, 1998.
- This approach addresses the amount of forest harvesting (denudation) within a visual quality polygon (Table 6), but does not consider the design of the harvesting or road building.

Table 6: The percent denudation range of visual area allowed in each Visual Quality Class (From Table 3, page 6, Ministry of Forests 1998).

Visual Quality Class	% Denudation range for use in timber supply analyses
Preservation	0 – 1%
Retention	1.1 – 5%
Partial Retention	5.1 – 15%
Modification	15.1 – 25%
Maximum Modification	25.1 – 40%

- Areas with slopes <10% were adjusted to exclude harvested areas from the analysis that are unlikely to be viewable. Information on the extent of forest harvesting and projected tree height was obtained from the province's Vegetation Resources Inventory (VRI) classification system.
- VRI information on harvested openings and tree height from 2003 and the 2012 dataset was updated from most recent cut-block and natural disturbance datasets to represent the current condition of the forested land-base.
- The likelihood of exceeding accepted limits established in VQOs was based on the degree of deviation from the denudation range for each visual quality class provided in Table 6.
- Given uncertainty in the accuracy of two-dimensional GIS-based analyses correctly interpreting the actual VQC assigned through ground-based observation, a range was applied to the percent denudation.
- Polygons well below accepted limits were assigned an Expectations Met rating, denudation ranges close to the maximum were assigned a Caution Rating, and polygons well outside the accepted denudation range were assigned an Expectations Not Met rating.

RESULTS

Current Condition and Historic Trend

- Results identify that approximately 22% (229 of 1003) of the visual quality polygons are likely not meeting expectations established under FRPA (Figure 20).
- The visual quality area not meeting expectations is approximately 33% (15,925 ha) (Figure 20) of the total amount of area designated for visual quality management.
- Both the number and area of visual polygons not meeting expectations have increased significantly in the last ten years (Figure 21).

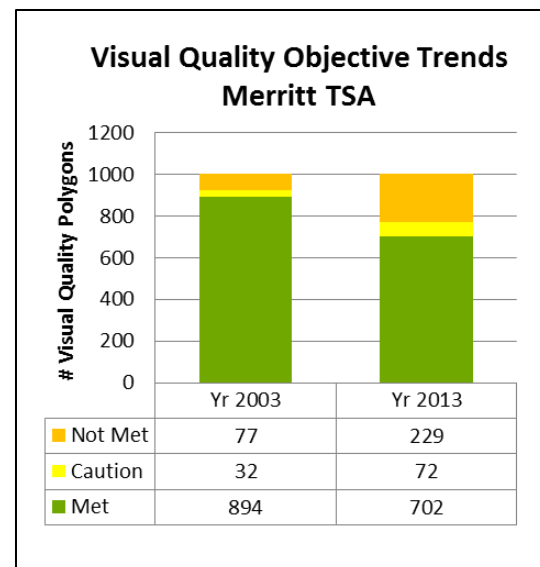


Figure 20: Merritt TSA trends in visual quality objectives.

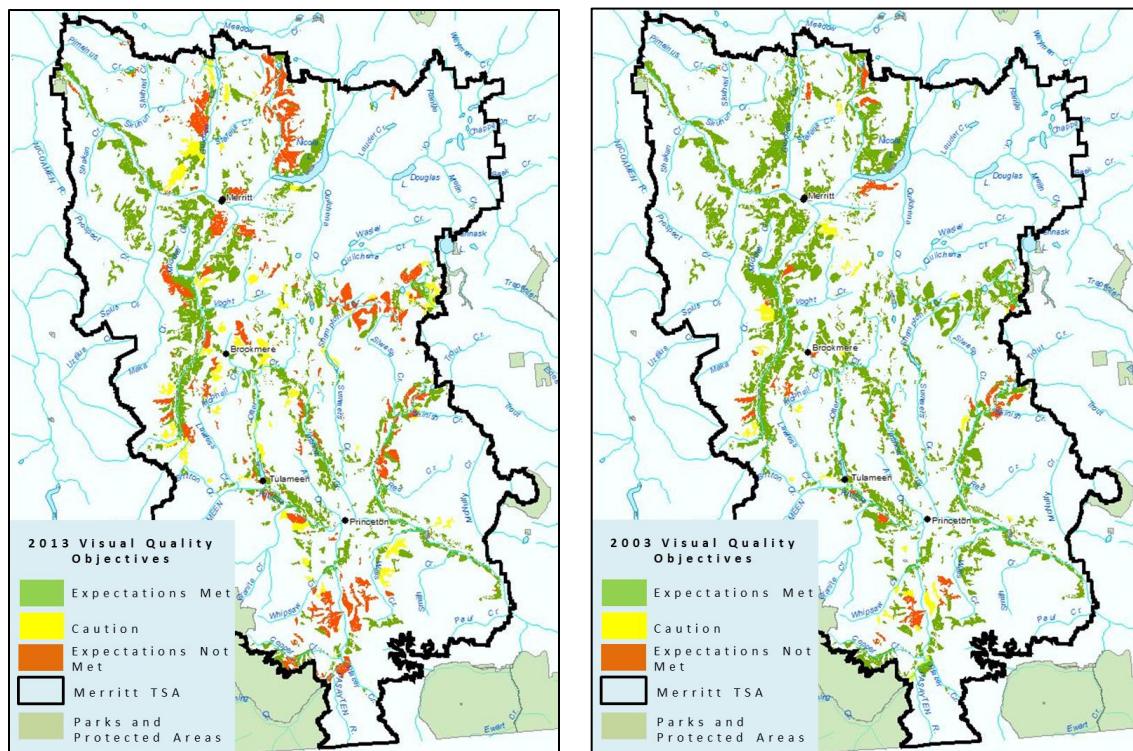


Figure 21: Merritt TSA visual quality polygons - expectations met vs. not met. Left panel – current condition (2013), right panel – historic condition (2003)

Future Condition

- An assessment of near-term potential future developments identified 203 (or 20%) visual polygons that may be affected by project proposals.
- An assessment of the future condition of visual polygons is still outstanding.

DISCUSSION

- On-the-ground monitoring results⁴⁰, from randomly selected samples (n=23), suggest that there is a higher rate of expectations not being met when the FREP visual quality monitoring protocol is utilized compared to GIS assessment (field samples from 2005 to 2013).
- Both the GIS assessment and monitoring protocol consider the amount of alteration of the forested landscape within a visual quality polygon; however, the monitoring protocol also assesses visual design principles.
- Forest tenure holders operating under approved FSPs are required to commit to following these principles and limiting the percent alteration of the forested landscape, to the extent practicable, to achieve the intent of the VQOs.

⁴⁰ Merritt TSA Monitoring (Multi-Value Resource Assessment (MRVA)) Report, November 2013.

- Such limitations may not apply (i.e., not practicable) when timber harvesting is being conducted for safety reasons or to recover timber damaged by fire, insect, wind, etc. However, the practicability is dependent on interpretation, which may vary based on a number of safety, environmental, forest stand and economic factors.
- Further challenges to managing for visual quality come with the fact that multiple forestry operators may operate within the same visual quality polygon (all are separate decisions) that may also include non-replaceable forest licences (NRFL), or other sector development.
- Thus, there is a pragmatic need to have coordination within these areas and/or expectations set for tactical planning to ensure objectives are maintained.
- Also absent is a requirement for non-forestry sectors that develop within visually sensitive areas to address objectives in development plans or mitigation strategies.

CONCLUSIONS

- The salvage of forests affected by the mountain pine beetle has been a significant factor with regard to impacts to visual quality expectations within the Merritt TSA.
- This has highlighted a lack of process to compel coordinated tactical planning and understanding among stakeholders.
- It has also highlighted a lack of policy to compel other sectors to address visual quality management expectations, even though there have been ad hoc successes with some development proposals and mitigation plans (e.g., clean energy).

Management Recommendations

- FLNR develop policy to expand requirements for the NRS to address the intent of this objective in development plans or mitigation strategies.
- FLNR to make risk mapping and e-Guidance available through Front Counter BC.

Grizzly Bear Populations

SUMMARY

A strategic-level assessment of risk to grizzly bear recovery was conducted in the Merritt TSA portion of the North Cascades Population Unit (NCPU). The NCPU extends into the Chilliwack and Okanagan-Shuswap Districts and south into the United States. The assessment builds from the 2004 NCPU Grizzly Bear recovery plan, and focuses on some strategic-level factors that affect grizzly bears, but not all factors. Factors considered included habitat capability, current suitability, and open road access. The latter affects vulnerability to non-regulated hunting, direct habitat loss and displacement. During the course of the assessment, concurrent MOE population monitoring determined the population to be functionally extirpated (i.e., less than two reproductive females). Results of the assessment suggested an increase in road development over a 10-year period increased open access and negatively affected habitat and populations. The approach developed would be useful to prioritize the location of recovery efforts (e.g., access closures, habitat recovery) should there be a co-operative trans-boundary (i.e., US and Canada) decision to recover the North Cascades grizzly bears.

BACKGROUND

- A strategic-level assessment was conducted for grizzly bear populations in the Merritt TSA.
- Grizzly bear populations are primarily threatened by human interactions over broad landscapes through displacement from suitable habitats adjacent to human activity and/or direct human-caused mortality (e.g., hunting, incidental killing through protection of life or property, or traffic accidents).
- Grizzly bears are a species of special concern in BC⁴¹. The North Cascades Grizzly Bear population is currently listed as threatened, and a recovery plan, completed in 2004, was not endorsed by government.
- Recent input from provincial grizzly bear experts suggests the population is functionally extirpated, and a decision on whether to recover/reintroduce is being considered.
- The current status of grizzly bear in the

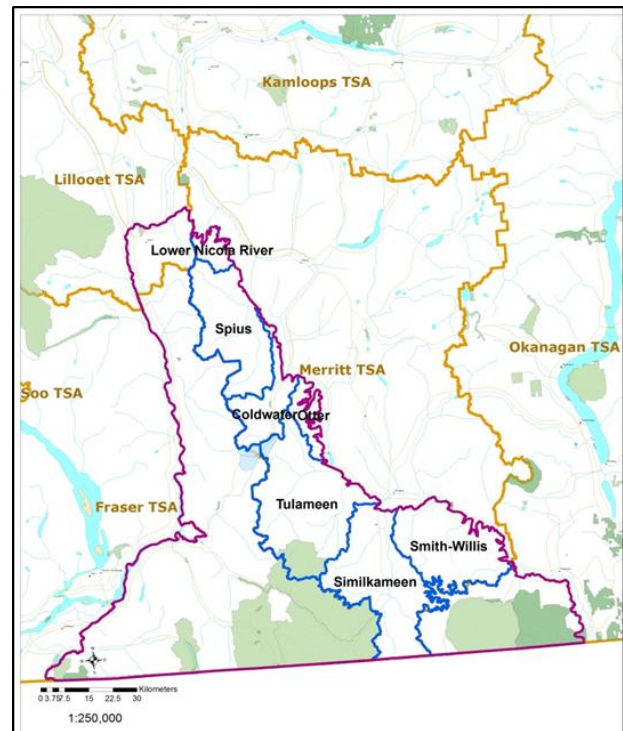


Figure 21: North Cascades grizzly bear population unit and Merritt TSA sub-unit areas.

⁴¹ BC Species and Ecosystems Explorer (<http://www.env.gov.bc.ca/atrisk/toolintro.html>) - accessed January 2014. Special concern or Blue-listed species are vulnerable to extirpation or extinction.

North Cascades is believed to have been significantly influenced by historic human-caused mortality in the late 1800s to early 1900s from which the population has never recovered⁴².

- The Province recognizes that First Nations have stated strong aboriginal interests in grizzly bear, and FLNR has consistently heard from First Nations that sound stewardship and recovery of grizzly bear populations and habitat is very important.
- Assessment of the ability of the landscape condition to support a viable grizzly bear population, consistent with the North Cascades Grizzly Bear Recovery Plan, was completed over the capable grizzly bear habitats located within six sub-population units of the North Cascades grizzly bear population that fall within the southwest portion of the Merritt TSA (Figure 21).
- Effective recovery/reintroduction of grizzly bear populations will require both landscape-level and site-level considerations. However, this assessment of grizzly bear population risk is limited to the landscape level, and considers the potential effects of human-related habitat displacement and mortality on the population.

EXISTING LEGAL OBJECTIVES & REGULATIONS

- Several Wildlife Habitat Areas (WHAs) are designated in the Merritt TSA.
- There are also FRPA section 7 notices for habitat management⁴³.
- The North Cascades Grizzly Bear Recovery Plan provides broader landscape-level direction, but has not been approved by Cabinet. As a result, the plan remains draft policy advice for statutory decision-makers to consider when issuing tenures, approving permits, or managing the land and resources for which they are responsible. The goal of the recovery plan is to restore the North Cascades grizzly bear population to a viable status.

The specific objectives and



Figure 22: Merritt TSA grizzly bear planning cells.

⁴² See pages 6 and 7 in: North Cascades Grizzly Bear Recovery Team. 2004. *Recovery Plan for Grizzly Bears in the North Cascades of British Columbia, June 1, 2004.*

⁴³ FRPA Section 7 notice for grizzly bears can be found at:
<http://www.env.gov.bc.ca/esd/distdata/ecosystems/frpa/Approved FRPR sec7 WLPPR sec9 Notices and Supporting Info/Species at Risk/Cascades FD/Notice/Cascades%20FD SAR.pdf>

strategies outlined in the plan are:

1. Provide habitat in sufficient quantity and quality to support a viable population.
2. Prevent population fragmentation and maintain genetic isolation.
3. Increase the number of grizzly bears.
4. Minimize the potential for grizzly bear/human conflict.
5. Minimize human-caused mortality of grizzly bear.
6. Increase public knowledge of, and support for, grizzly bear recovery.
7. Facilitate interagency cooperation and management.

ASSESSMENT APPROACH

- This assessment spatially evaluated the current (2013) risk to grizzly bear using an expert judgment-based analysis developed with expert input from MOE.
- The assessment considered the following threats:
 - Habitat displacement due to avoidance of suitable habitats adjacent to open resource roads, based on an indicator of the amount of effective habitat.
 - Direct human-caused mortality due to the potential for bear-human conflicts on open resource roads, based on an indicator of the amount of secure core habitat >10 km².
- The outputs of the analysis are reported at a draft non-legal planning cell level (Figure 22).
- Planning cells were delineated based on main roads/highways, linear corridors or water features, and are intended to support implementation of certain mitigation measures (e.g., access management).

REPORTING ASSESSMENT RESULTS

- For each planning cell, the outputs of the analysis were represented as a three-class system of risk (high, moderate, low).
- The differences in risk classes indicate the likelihood of grizzly bear displacement/mortality.
 - Low risk: Unlikely that grizzly bear displacement/mortality will occur.
 - Moderate risk: About as likely as not that grizzly bear displacement/mortality will occur.
 - High risk: Likely that grizzly bear displacement/mortality will occur.
- A Minimum Management Option (MMO) was required to evaluate whether the goal and objectives of the North Cascades Grizzly Bear Recovery Plan are likely to be achieved across the broader North Cascades grizzly bear area within the Merritt TSA.
- The MMO represents a recommended minimum landscape condition required to support recovery/reintroduction of a viable grizzly bear population.

- The MMO results in each grizzly bear planning cell being assigned an acceptable level of risk (Figure 23). The acceptable level of risk assigned to each planning cell is informed by:
 1. Habitat quality, amount and adjacency to capable habitats in other planning cells; and
 2. Mitigation opportunity that considers amount, type and proximity of incompatible land uses within the planning cell.
- The MMO recommends that >70% of highly capable habitats located in 16 planning cells be managed to a low-risk condition, 11 planning cells (approx. 25% of capable habitats) to a moderate risk level, and three planning cells (approx. 5% of capable habitat) at a high-risk level.
- The evaluation of the ability of the landscape condition to support a viable population is based on the difference between the recommended MMO and current risk.

RESULTS

Current Condition

- The current landscape condition is considered unable to support a viable grizzly bear population.
- Of the 16 planning cells recommended to be in a low-risk condition to ensure that >70% of highly capable habitats are in a condition considered necessary to support recovery/reintroduction of grizzly bears, only two are currently in a low-risk condition.

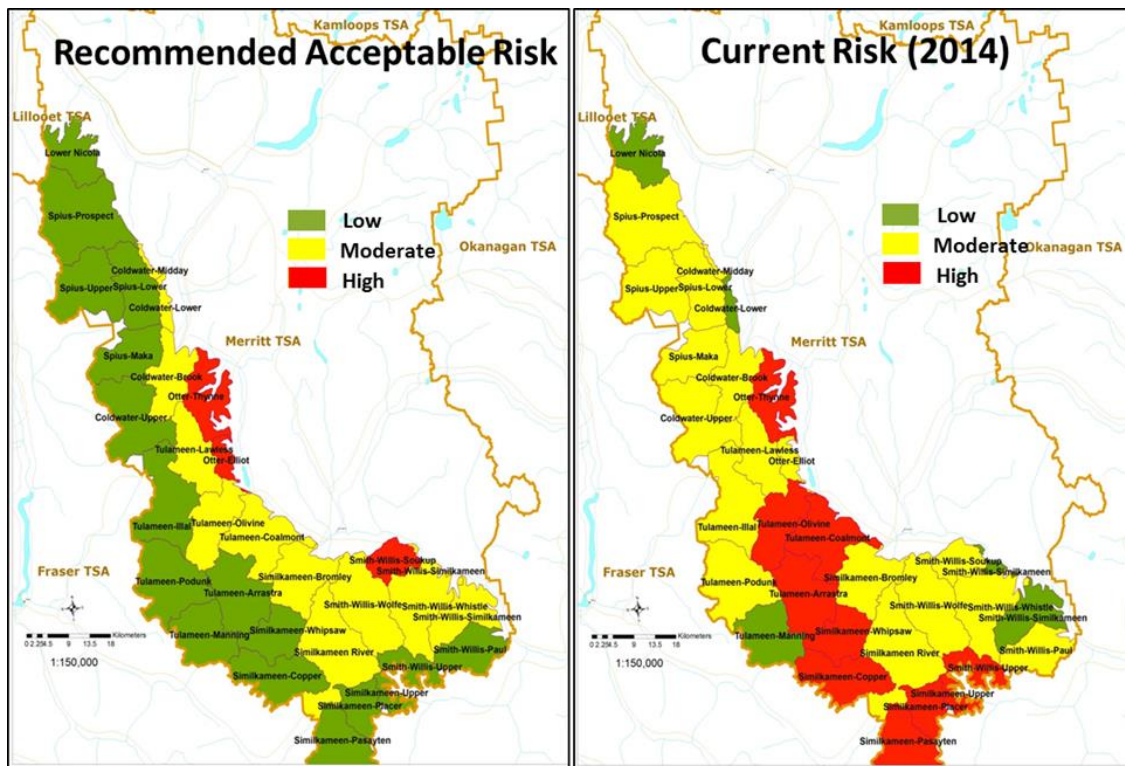


Figure 23: Left: Recommended acceptable levels of risk by grizzly bear planning cell considered necessary as a minimum management target necessary to support recovery/reintroduction. Right: Current risk by grizzly bear planning cell in the Merritt TSA.

FUTURE CONDITION AND TREND

- Future condition is not expected to change significantly as existing road networks are expected to remain open.
- Additional road networks may be expanded or improved to provide access to mid-term timber supply along the south and west boundary of the Merritt TSA.

CONCLUSIONS

- Provincial grizzly bear experts believe grizzly bear in the Merritt TSA portion of the North Cascades Grizzly Bear Population Unit to be functionally extirpated.
- Results suggest the current landscape condition is considered unable to support recovery or reintroduction of a viable grizzly bear population.
- A decision by government on whether to recover or reintroduce grizzly bears in the North Cascades or portions of the North Cascades is pending.

Management Recommendations

- No incremental management recommendations over current guidelines are recommended until there is a government decision to recover grizzly bears in the NCPU.

Old Growth Management Areas

SUMMARY

An assessment of natural resource sector (NRS) incursions into Old Growth Management Areas (OGMA) was conducted by a T-O Integrated Monitoring Team. OGMA are one of many tools to manage for landscape-level forest biodiversity; however, a broader forest biodiversity assessment protocol is under development and was not part of this analysis. This assessment evaluated the level to which OGMA were designated and the percentage of incursions within them. An assessment as to whether they are *effective* at managing for old growth was out of scope. Results of the regional assessment found that objectives were met and incursions were minor (< 1%) and within acceptable limits. Some *Land Act*-based incursions were observed with field-based monitoring. An assessment of future potential developments and OGMA was completed. Outcomes of this assessment identified 230 (or 12%) OGMA that may be affected by (potential) future development.

BACKGROUND

- Managing for old-growth forests is a critical component of implementing measures to conserve ecosystems and species biodiversity because they are difficult to reproduce once lost⁴⁴.
- In 1999, the BC Landscape Unit Planning Guide identified retention of old-growth forest as a priority for biodiversity planning. It recommended developing objectives for old-growth retention by establishing spatially located and mapped OGMA that will ensure retention and/or recruitment of old-growth structure over time.
- In Merritt TSA, OGMA are mapped areas that generally contain old-growth attributes and were identified by teams that involved First Nations, forest licensees and government staff (Figure 24).
- They were established in 2007 when it was determined that work completed to date and

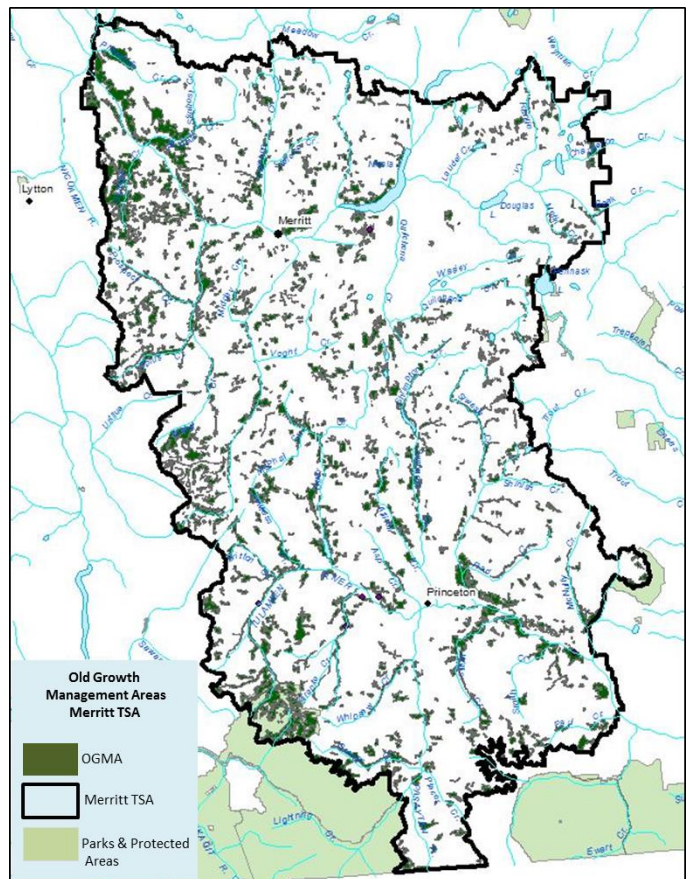


Figure 24: Old Growth Management Areas in Merritt TSA.

⁴⁴ Summarized from the BC mid-term timber supply review: http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/mid-term-timber-supply-project/Old_growth_summary_june_11.pdf

published as spatialized non-legal OGMAs in government's spatial data warehouse met the intent of BC's Spatial Old Growth Order⁴⁵.

- Guidance was developed by government in 2007⁴⁶ that addressed the reasons why harvesting might occur in an OGMA, best practices, incursion limits, replacement criteria, etc.
- Government has not formally managed or monitored the data or objective since 2007, although there has been informal sharing of this information.
- The Thompson-Okanagan Integrated Monitoring Team conducted an assessment⁴⁷ to confirm the status of OGMAs, in part as a response to concerns raised by the Forest Practices Board⁴⁸ and the BC Auditor General's report on Biodiversity⁴⁹.
- The T-O CE Team assessed OGMAs against near-term potential development to assess the implications for resource management.

Approach and Methods

- The three key questions driving the regional monitoring report included:
 - Whether original digital map layers of OGMAs created and stored in the government spatial data warehouse still exist, and whether their extents and composition are comparable to currently mapped areas.
 - Whether a sufficient area of replacement OGMAs has been identified to replace those areas where harvest incursions have occurred.
 - Whether current data management practices meet government's contemporary needs now that resource management ministries have reorganized to be more integrated.
- Out of scope for the assessment was evaluating whether the OGMAs were effective for the purpose of managing landscape-level biodiversity.
- Detailed methodology for the above work can be found in the referenced T-O Integrated Monitoring Team report.
- This cumulative effects assessment leveraged the work identified above and assessed OGMAs for potential future impact in two phases:
 - The number of overlaps that potential future development may have with OGMAs; and
 - Whether the amount of overlap exceeds incursion guidelines.
- The first phase of assessment has occurred and the second phase is expected in February 2015.
- Methods for determining potential the near-term development footprint is in Appendix 1.
- Phase 1 assessment of OGMAs and near-term development implications was a simple GIS exercise evaluation of the number of footprint overlaps.

⁴⁵ The BC Old Growth Order can be found at: http://www.for.gov.bc.ca/tasb/slrp/policies-guides/old-growth/Old_Growth_Order_May18th_FINAL.pdf

⁴⁶ BC Government guidance for OGMAs can be found at:

http://www.for.gov.bc.ca/tasb/slrp/pdf/srmp/ILMBogma_guidanceTOAug2007.pdf

⁴⁷ The Thompson-Okanagan Integrated Monitoring Team report can be found at: <https://spc-flnr.gov.bc.ca/torim/SitePages/Home.aspx> - External to government: contact Leith McKenzie.

⁴⁸ The BC Forest Practices Board report on old growth can be found at: <http://www.bcfpb.ca/reports-publications/reports/conserving-old-growth-forests-bc-implementation-old-growth-retention>

⁴⁹ BC Auditor General. An Audit of Biodiversity in B.C. 2013. www.bcauditor.com/pubs/2013/report10/audit-biodiversity-bc-assessing-effectiveness-key-tools

RESULTS

Integrated Monitoring Assessment

- 99% of OGMA's remained unchanged in Cascades District (includes Merritt TSA).
- There was an increase of 445 ha in OGMA-designated areas between 2007 and 2013.
- Levels of harvest incursions were minimal (<1%), and replacements were sufficient.
- Levels of non-forestry incursions were minimal (<1%); however, incursions from the natural resource sector are not tracked.

Potential Future Development

- In Merritt TSA, phase 1 future assessment identifies 230 (or 12%) old growth management areas that may be affected.

DISCUSSION

Select items from Integrated Monitoring Team Report (see report for full list)

- Only a small portion (2,979 ha or 0.54%) of the 2007 OGMA's were harvested prior to 2013. Over 99% of the original OGMA area is still in existence and the area of harvesting was replaced with sufficient hectares of replacement OGMA's.
- Given that minimal harvesting has occurred in OGMA's, and forest licensees are tracking, managing and following the guidance as set out in 2007, the project team believes there is a low risk to the OGMA values due to forest licensee harvesting between 2007 and 2013.
- The 10% harvest/replacement threshold is more commonly causing licensee replacements than the 10-hectare threshold due to the small area of many OGMA's.
- All licensees reported that they are not tracking non-forest sector impacts on OGMA's.
- There is not a consistent process to capture OGMA deletions and replacements by government to incorporate changes into the government spatial data warehouse.

Reasonably Foreseeable Future Assessment

- There is a significant amount of non-forestry activity (i.e., 35% of near-term potential development area) in the Merritt TSA (as well as elsewhere in the T-O Region) and there is a significant amount of overlap between non-forestry activity and OGMA's (12%).
- Direction by government is to take steps toward common objectives for all natural resource sector operators to address objectives in development.
- This would require new policy direction for non-FRPA guided development and information access (e.g., data, digital mapping) for potential project proponents to know where the OGMA's are and what the expectations are in those areas.

MANAGEMENT RECOMMENDATIONS

- FLNR develop policy to expand the consideration of this objective to the other natural resource sectors such that future non-forestry development can consider addressing this value in development plans or mitigation strategies.
- FLNR to make OGMA mapping and e-Guidance available through Front Counter BC.

Watershed Condition

SUMMARY

Watershed hazards related to the likelihood of harmful changes to stream-flow (spring peak flows), sediment input and riparian function was analysed across a range of catchment sizes from sub-basins, basins, watersheds to large watersheds. The analyses considered multiple factors including inherent catchment sensitivity to alteration, and type and extent of land use. Results indicate an increased likelihood of harmful changes in stream-flow in some catchments due primarily to timber harvesting, exacerbated by mountain pine beetle activity over the past 10 years, whereas the likelihood of increase levels of harmful sediment have changed very little. The likelihood of loss of riparian function, primarily due to mountain pine beetle salvage around headwater streams, has increased most dramatically in the 10-year period. Results indicate greatest potential for impacts due to loss of riparian function may occur at broader scales (watersheds and large watersheds) where extensive mountain pine beetle salvage along headwater streams in upstream catchments combines with existing livestock grazing and downstream private land riparian impacts. Mitigation options for natural resource sector operators include coordinated watershed assessment and planning. Policy refinement and improved guidance for coordinated watershed assessment, planning and mitigations are recommended for FLNR.

BACKGROUND

- A strategic-level assessment was conducted for watershed condition in the Merritt TSA to:
 - Provide watershed hazard analyses to assist in fish habitat risk assessment; and
 - Evaluate watershed condition and make management recommendations through the CEA review process.
- The assessment uses hazard ratings for three hydrologic hazards commonly used to evaluate watershed condition including:
 - 1) **Streamflow** effects
 - 2) **Sediment** generation and delivery
 - 3) **Riparian Function**
- Factors that contribute to the streamflow, sediment and riparian hazard ratings include both the inherent hydrologic and geomorphic characteristics of individual catchments used to express their sensitivity to change, and the type and extent of natural disturbance and land use or activities.

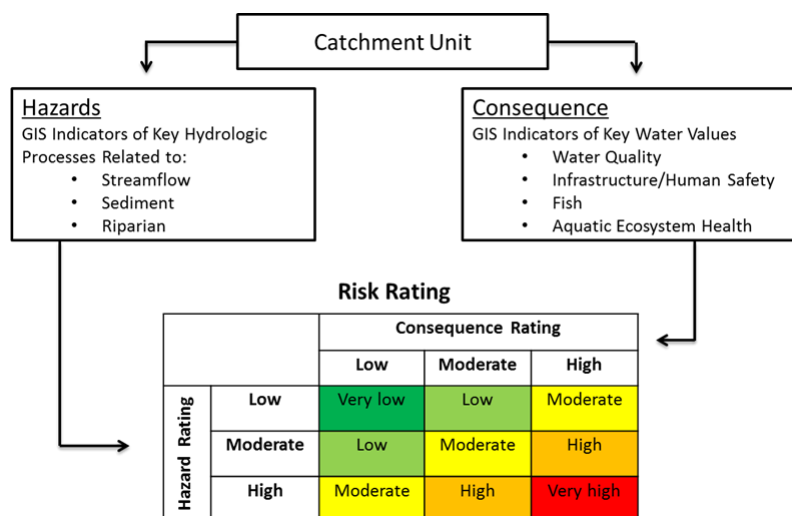


Figure 1832: Hazard and consequence ratings derived for downstream risk ratings.

- The hazard ratings are intended to be used with consequence ratings derived for downstream ecological and socio-economic values to derive risk ratings (Figure 25).
- The Province recognizes that First Nations have stated strong aboriginal interests in downstream values (e.g., fisheries, water quality) associated with watershed condition, and FLNR has consistently heard from First Nations that sound stewardship of watershed condition is very important to maintain the integrity of those values.
- Assessment was completed over the entire Merritt TSA (Figure 26) and portions of watersheds outside the area that flow into the TSA.

EXISTING LEGAL OBJECTIVES AND REGULATIONS

- Current legal objectives related to managing hydrologic hazards at a watershed scale only exist under FRPA in legally designated watersheds. These include community watershed (CW), fisheries sensitive watershed (FSW) and temperature sensitive stream (TSS) designations⁵⁰.
- Currently, only two legally designated CWs exist in the Merritt TSA (Dillard, Brookmere), while FSW and TSS designations are currently being prepared for a number of other watersheds.
- Current FSP strategies related to objectives set by government for water in community watersheds (FPPR s.8.2) generally specify⁵¹ the following:
 1. Completion of a hydrologic assessment by a qualified professional, where a licensed water-work exists through which water is being diverted for human consumption and has an equivalent clear-cut area (ECA) exceeding, or will exceed, 25% with the planned development.
 2. Conduct primary forest activities consistent with the recommendations of the assessment.
 3. Not to exceed limits on harvesting or road construction recommended in the assessment.
- Outside of legally designated watersheds, greater reliance is placed on forest professionals to determine if activities will impact downstream values, if and when a hydrologic assessment is to be completed, and the extent to which recommendations from an assessment should be followed. An FSP need not specify results and strategies outside of legally designated areas for a cutting permit to be approved by government.
- Prior to 2004, government officials had a greater role in overseeing management of hydrologic hazards in watersheds of concern under the *Forest Practices Code*, with greater discretion regarding which watersheds to consider for assessment, how to complete assessments, and approval of forest development considering effects on watershed condition.
- To evaluate whether existing legal objectives and non-statutory expectations are being met is difficult given the transition of government oversight on potential forest harvesting impacts on hydrologic hazard from the Code to FRPA.

⁵⁰ Other policy objectives exist, such as water quality objectives, but are applied at a project-level within permit requirements existing regulations.

⁵¹ Strategies here are generalized statements intended to describe the approach taken by licensees and are summarized from specific content outlined in the following FSPs; Tolko Industries Ltd Thompson Nicola Forest Stewardship Plan (2012-2017; Amendment #1, Feb. 19, 2013).

- For simplicity, the assessment assumes the intent under both the Code and the current FRPA regulatory framework is to manage hydrologic hazards to a moderate or lower rating, based on interpretation of this past legislation, current guidance and practices.
- As a result, this assessment reports out on the extent to which high and very high hazard ratings exist, to reflect potential hydrologic impacts that may occur at a TSA scale. These ratings are not likely to meet the intent of existing legal objectives and non-statutory expectations.
- Therefore, the mitigation recommendations resulting from this assessment reflect mitigation activities necessary to maintain hazard ratings to a moderate or less hazard.

ASSESSMENT APPROACH

- This assessment spatially evaluated the current (2014) watershed condition and historic trend (10 years prior to 2014) using an existing GIS indicator-based watershed assessment procedure (Lewis et al. 2013)⁵² developed for the Southern Interior. The spatial outputs from the timber supply review base case were then qualitatively assessed in consultation with regional hydrology and aquatic ecosystems experts for their direct or indirect effects on watershed condition.
- We used the GIS watershed assessment procedure to assess the potential hazards associated with the following harmful situations:
 - **Streamflow** – increases the frequency and magnitude of hydro-geomorphic events (floods, bank erosion, channel instability, debris floods and debris flows);
 - **Sediment** – reduced water quality as a result of sediment or other deleterious material input to streams from roads, landslides or other upslope sources; and
 - **Riparian Function** – loss of riparian functions such as stream bank stability, shading and large wood inputs resulting from clearing of riparian vegetation and livestock grazing on private and Crown land.

⁵² Lewis, D., M.J. Milne and B. Grainger. 2013. A GIS indicator based watershed assessment procedure for assessing cumulative hydrologic impacts. Unpubl. Rep., ver. 1, July 16, 2013. 39 pp.

REPORTING ASSESSMENT RESULTS

- The outputs of the watershed assessment procedure hazard ratings were represented as a five-class system of hazard (very low, low, moderate, high and very high).
- The differences in hazard classes indicate increased likelihood of harmful changes in hydrologic processes will occur.
 - Very low: Very unlikely (<10% chance) that a harmful situation will occur.
 - Low: Unlikely (<33% chance) that a harmful situation will occur.
 - Moderate: About as likely as not (33-66% chance) that a harmful situation will occur.
 - High: Likely (>66% chance) that a harmful situation will occur.
 - Very high: Very likely (>90% chance) that a harmful situation will occur.
- The outputs of the watershed assessment are reported at a multiple, overlapping catchment unit level (Figure 26) consisting of sub-basins, basins, watersheds, large watersheds (hereafter referred to as catchments).
- Mitigation recommendations to address hazards are directed at management actions that exceed existing legal requirements. Mitigation recommendations were characterized as:
 - Timber supply related (e.g., incremental constraints to the THLB⁵³),
 - NRS practices related (e.g., maintaining standing timber along roads or wetlands as visual and thermal cover), or
 - NRS management related (e.g., access management).

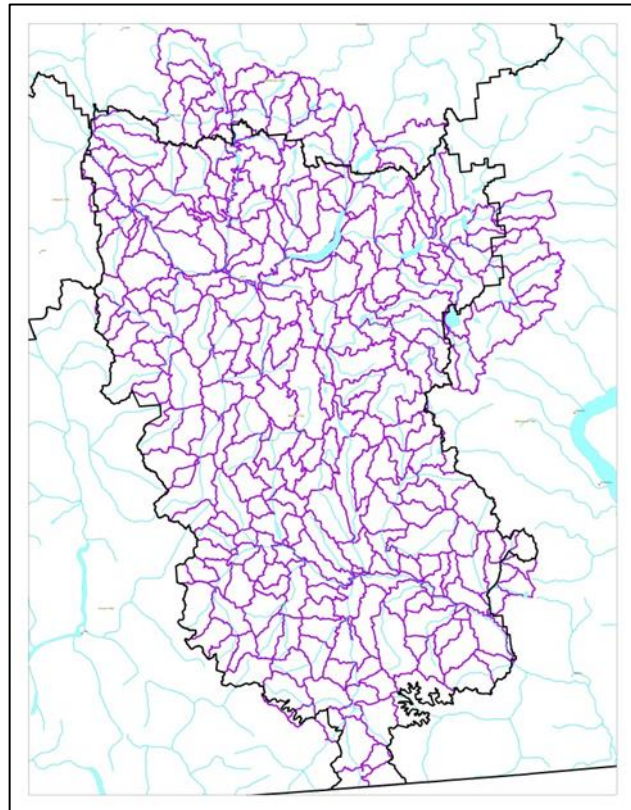


Figure 3080: Overlapping catchment unit level consisting of sub-basins, basins, watersheds and large watersheds.

⁵³ THLB – Timber Harvesting Land Base.

USE OF INVENTORY AND MONITORING DATA TO VERIFY ASSESSMENT RESULTS

RESULTS

Current Condition and Historic Trend

- In general, risk to watershed condition has increased in the Merritt TSA from 2003 to 2014.
- The number of catchments with a high and very high riparian hazard increased the greatest in this time period, followed by streamflow hazards.
- The primary factor contributing to elevated riparian and streamflow hazard is extensive salvage of forests affected by the mountain pine beetle over the past decade resulting in elevated equivalent clear-cut area (ECA) and harvesting adjacent to streams in higher elevation sub-basins, basins and watersheds.
- Upstream harvesting-related effects on riparian buffers accumulate with livestock grazing and private land to contribute to increased likelihood of reduced riparian function in watersheds and large watersheds.

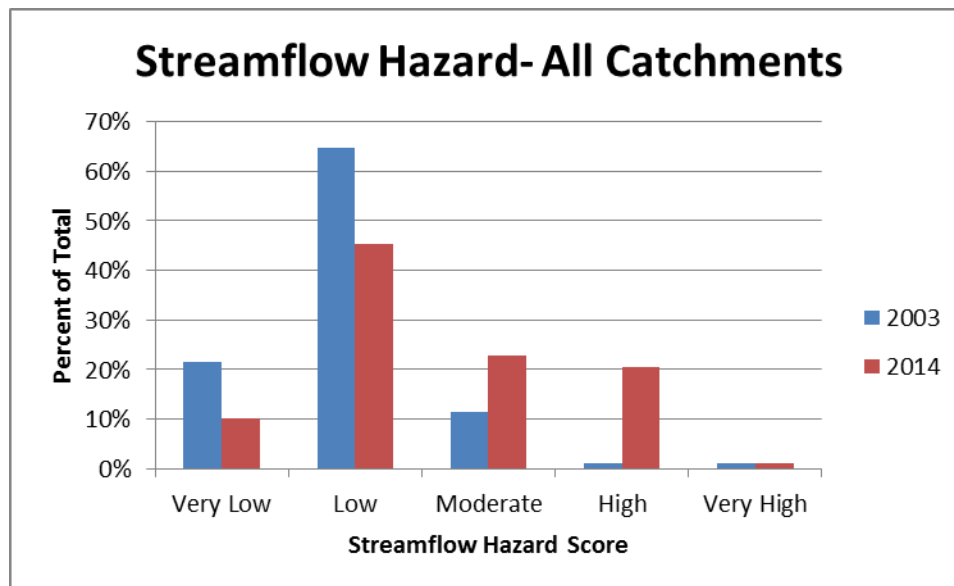


Figure 3656: Summary of change in streamflow hazard for all catchment units in the Merritt TSA between 2003 and 2014. Note: individual catchment units overlap.

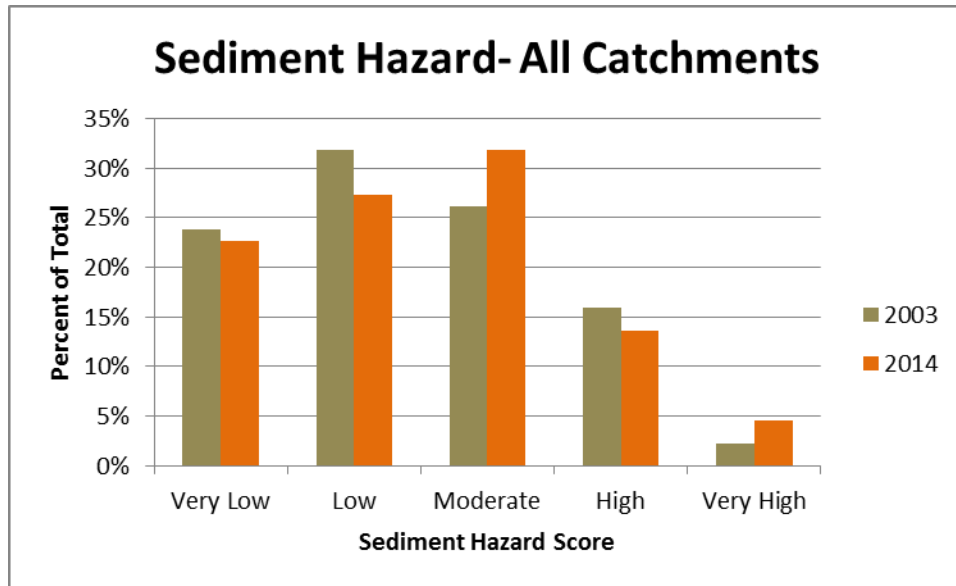


Figure 3657: Summary of change in sediment hazard for all catchment units in the Merritt TSA between 2003 and 2014. Note: individual catchment units overlap.

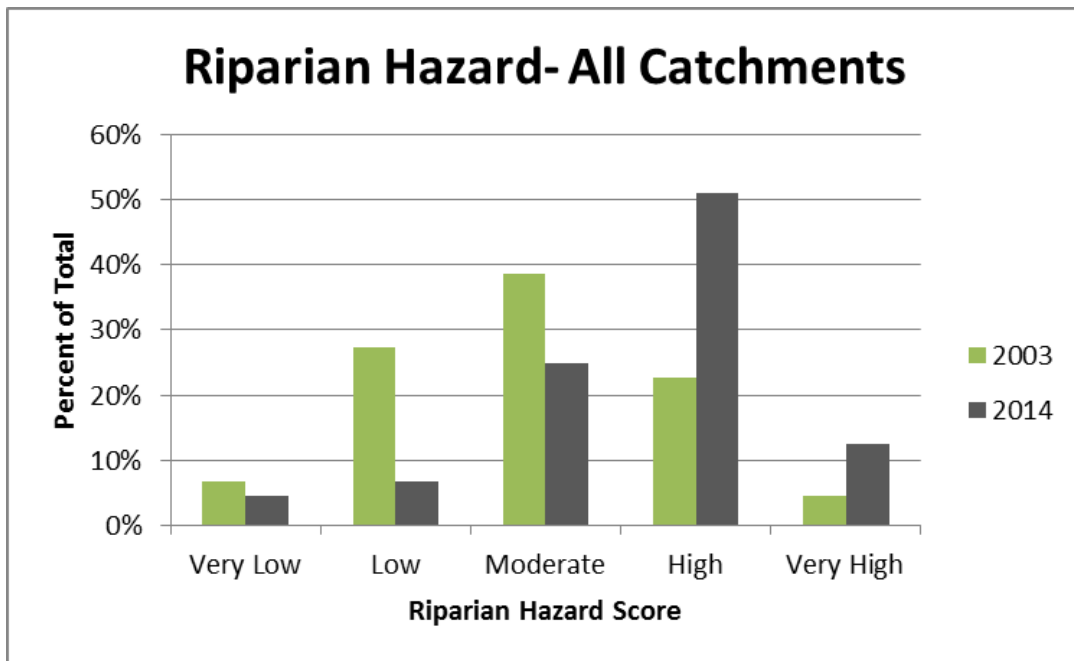


Figure 3658: Summary of change in riparian hazard for all catchment units in the Merritt TSA between 2003 and 2014. Note: individual catchment units overlap.

FUTURE CONDITION AND TREND

- The current streamflow and riparian hazards are expected to persist for the next 20 to 30 years at a minimum until regeneration of harvested areas occurs, and recovery of hydrologic function of forests and riparian vegetation returns.
- Future streamflow, sediment and riparian hazards will depend on the amount and spatial distribution of forest sector development and other resource sector or land use activities.

CONCLUSIONS

- From 2003 to 2014, results from the watershed assessment procedure show an increase in risk to watershed condition in the Merritt TSA.
- The number of catchments with high and very high hazard ratings have increased from:
 - <5% of catchments to >20% for streamflow hazard;
 - largely unchanged for sediment hazard, based on a limited increase in new roads adjacent to water; and
 - <30% to >60% of all catchments for riparian hazards.
- The primary factor contributing to increased hazard has been extensive salvage of mountain pine beetle-affected forests in upland basins and watersheds, coupled with existing land uses (private land and livestock grazing).
- The current streamflow and riparian hazards are expected to persist for the next 20 to 30 years at a minimum until regeneration of harvested areas occurs and recovery of hydrologic function of forests and riparian vegetation returns.
- Future riparian hazard will depend on the amount and spatial distribution of forest sector development and other resource sector or land use in or adjacent to riparian areas.

Management Recommendations

- FLNR to take actions to validate risk assessment with:
 - On-the-ground monitoring (in progress by Thompson-Okanagan Integrated Monitoring Team); and
 - Coordinate targeted sampling with provincial Integrated Monitoring Initiative (e.g., FREP monitoring).
- CEA team to develop briefing note for regional executive, to review the implications of the watershed assessment and outcomes of recommendations for policy review and targeted monitoring will be provided. The briefing note will include both fish habitat and watershed assessment outcomes.
- FLNR extend outcomes of this analysis and watershed assessment procedure to forest licensees and other operators with significant developments within watersheds.
- FLNR to make risk mapping and e-Guidance available through Front Counter BC.

Appendix 1

Data Collection for Potential Future Disturbance Footprints: Merritt TSA

Summary Prepared by Sasha Lees
October 2014

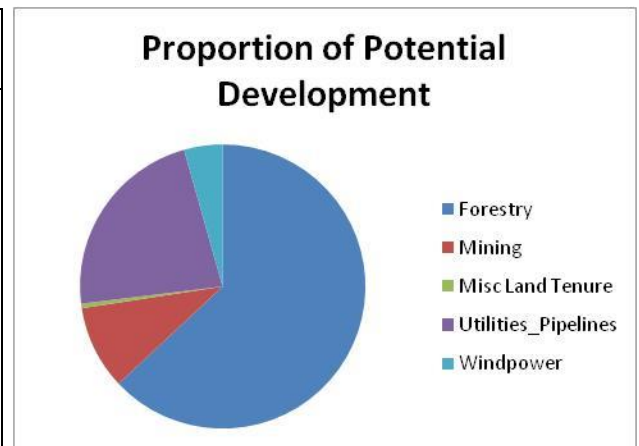
Objective

To collate potential future disturbance footprints or potential expansion areas for 2014 and the reasonably foreseeable future (within two to five years) into one GIS dataset for the Merritt TSA for the following information:

- Forest Harvesting and Related Roads
- Mining
- Land Tenures
- Major Projects/Utilities
- Clean Energy Projects - Windpower

Below is a breakdown of the proportion of 'potential developments' for the Merritt TSA:

SECTOR	Area (ha)	% of Dev	% of TSA
Forestry	10,846.09	63%	1.0%
Mining	1,636.09	10%	0.1%
Misc Land Tenure	90.44	1%	0.0%
Utilities_Pipelines	3,875.27	23%	0.3%
Windpower	755.32	4%	0.1%



Total Development	17,203
Total TSA	1,131,166

Methods and Results

The spatial footprints for these sectors do not exist in a consolidated, up-to-date, comprehensive, readily available form.

While existing mineral and lands tenure polygons usually outline a general area, they may or may not indicate within that area where actual disturbance has or will take place. When harvesting or road building is involved, a Licence to Cut or Road Permit is usually required – this information may be in the Forest Tenure (FTEN) datasets; however, there is no time requirement for when proponents must submit this information for future developments. Future disturbance data is rarely available, so must be interpreted, collected or derived by working with business experts.

Additional details of the data collection/derivation by sector follows.

Harvesting and Roads

A listing of potential harvest volumes for the Merritt TSA for 2014 was provided by the Merritt Forest District office (Martin Ponsioen). Volume was allotted by Landscape Unit (LU) and licensee.

Potential Future Harvesting post 2013 was derived from two main sources in order to contribute towards the volume allotments:

1. Proposed blocks from within FTEN and RESULTS spatial databases were extracted for any available polygons with a proposed harvest year older than 2013. At the time of data extraction, this resulted in potential blocks from January 1 to June 30, 2014. Volume was based on the Vegetation Resource Inventory (VRI) live volume attribute LIVE_STAND_VOLUME_125.
2. A Timber Supply Review (TSR) forecasting dataset to 2022 was prepared by Reg Davis (Forsite Consultants) that identified potential harvesting by two-year time periods. From this, volume was selected in a random fashion, using the first available time period to fill the allotment, then moving to next period if there was not sufficient volume. Additional assumptions:
 - Polygons greater than one hectare (ha) within 100 m of each other were considered as one 'block' (by period).
 - Larger blocks were selected first.
 - A maximum over-harvest of 1000 m³ (~3 ha) was allowed, assuming an average of approx. 300-350 m³/ha. This was to account for the fact that the volume per polygon would not necessarily meet the exact allotment number.
 - Ungulate Winter Range (UWR), First Nations no-go areas (e.g., Stoyoma Mountain), and existing harvest areas were avoided.

Using these two data sources, the result was that 9 of 29 LU/licensee units were fully allotted using FTEN/RESULTS blocks, and in fact were often over-allotted. Note that some proposed harvesting occurs outside of the allotted areas, and FTEN harvest areas may include non-licensee cutting permits, but were not differentiated at this time. The remaining volume (50% of the full allotted volume) was selected from the TSR file.

Roads to the proposed blocks were modelled based on a simple least-cost path raster approach based on slope cost: slopes 0-15% were considered as ideal, and steep slopes > 30% were considered most restrictive, on a cost scale from 1 to 10. From existing roads (approx. 24,500

km) roads were modelled to the centre (centroid) of potential new blocks, based on the least slope cost path. This resulted in approximately 152 km of potential new roads (72 km to the blocks, 78 km within the blocks) in the TSA (0.6% of existing roads). Generally, blocks were within 100 m of an existing road, to a maximum of 1.5 km away. The road modelling is a very rough approximation.

Mining

When investigating the availability of mine footprints, several data sources were examined. The data sources and a brief description of the applicability for determining footprints are as follows:

Mineral Tenures	These represent broad areas for which tenure may be established, but activity or disturbance is not spatially distinguished. Activity may or may not be initiated within a tenure.
Notice of Work (NOW) Points	The spatial area associated with a NOW point is difficult to determine. A NOW may be represented by a single point even though work may cover a larger area. There may be several GPS points taken for where work may occur, but only one point may be submitted for the spatial NOW. Therefore, it is a very rough estimate, and may not accurately represent where disturbance may occur. Applying a generic buffer would be very inaccurate to show location; however, disturbance areas associated with NOW are generally small (1-5 ha).
Ministry of Energy and Mines (MEM) BC Geological Survey (BCGS) Open File Maps	MEM provides provincial maps showing the point location of major exploration projects and producing metal, coal and industrial mineral mines in 2013. These are point locations that can be used for general reference.
Terrain Resource Information Management (TRIM)/VRI and Baseline Thematic Mapping (BTM)	Polygons may be within TRIM, VRI, and BTM representing mines, tailings, and quarries for example. However, when compared against imagery, these areas were found to be incomplete.

The most comprehensive approach was to use the above sources as a guide, and then verify the footprints against best available imagery in consultation with the local mining expert (Jim Britton). The local expert was able to provide information on the status for potential expansions or new developments.

Note that future disturbance or mine expansions should be indicated within a mining plan which must be submitted to Energy and Mines and approved before any work can begin. The plans may not be digital. Plans were not tracked down at this time.

Mine footprints identified in the Merritt TSA are for existing mines, with varying degrees of activity. Of the seven mines, Copper Mountain and Highland Valley are the largest operational mines. Bud and Elk (Siwash) mines are two small operations. The remaining three (Craigmont, Treasure Mountain, and Basin) are currently not operating, and future plans are unknown.

Land Tenures

The Tantalus spatial database tracks Crown land tenures across the province. Generally, harvesting and road building activities associated with tenures should have an occupant Licence to Cut (LTC) or road permit established, and this information should be captured in FTEN data systems. Harvest volumes under 50 m³ may be obtained under a Free Use Permit.

To identify potential future disturbance for which LTC and road permits had not yet been submitted, we examined tenure applications and replacements since Jan.1, 2013 – excluding notations of interest, marine, and clean energy tenures. These tenure areas were reviewed with a local land officer (Jerry Johnson) and against imagery to verify their potential development status. Major utility expansion and clean energy projects (CEPs) were investigated in separate processes (see below).

Communication, utilities, industrial, transportation and quarrying tenures were assumed to have some sort of hypothetical future land clearing activity associated with them. The polygons which had no indication of existing development (compared with imagery and FTEN) were used as potential future footprints. Note that the accuracy of land tenure polygons may vary – only a lease has to be surveyed.

Barring major projects (see below), the estimated remaining potential developments within land tenures were negligible.

Major Projects/Utilities

Polygons for major projects overlapping with the Merritt TSA were identified by working with the Major Projects Lead Susan Fitton. If data pertaining to these projects was available in Tantalus, it was extracted. Otherwise, data was obtained from separate Crown lands files, digitized from maps, or shape files were obtained from the proponents.

Four major utility projects were identified.

1. Interior to Lower Mainland Transmission Line - BC Hydro
2. Merritt Area Transmission Line - BC Hydro
3. Trans Mountain Pipeline Expansion - Kinder Morgan
4. Kingsvale to Oliver Natural Gas Pipeline Expansion - Fortis

These represent expansions to existing rights-of-way. Three of these have some certainty of expansion, while the Kingsvale to Oliver expansion is uncertain at this time.

Clean Energy Projects - Windpower

Windpower projects overlapping with the Merritt TSA are largely investigative. Only two areas have progressed to the initial development stage: Pennask West and Shinish Creek.

For all areas, hypothetical development footprints were developed based on consultation with knowledge experts to determine the placement and size criteria. Potential development considered the following features:

Type	Placement	Size
Wind Turbine	Place along height of land ridges with minimum 360 m separation. Ridges should be < 20% slope with min 100 m wide. Minimum 1350 m separation between rows.	90 x 90 m
Access/Service roads	From existing roads, where slopes generally < 30% and max grade <15%.	20 m ROW
Electrical Collector Network Between Turbines	Shortest distance between turbines. Avoid OGMAs, WHAs, parks, wetlands.	20 m ROW
Local Substation	Connects collector and transmission line.	110 x 110 m
Operations Building	Place near to access roads and close to collector and transmission line	60 x 60 m
Transmission Line to BC Hydro System	Assume transmission lines use the shortest practical route (near to existing access roads or utilities and not too steep) to existing BC Hydro transmission lines with sufficient capacity to carry the generated power.	30 m ROW

The hypothetical footprints for 30 investigative areas covered approx. 7,800 ha in the TSA (< 0.7%).

Only Pennask West and Shinish Creek will be used for near-term potential disturbance analysis. These shapes were obtained from Tantalus and represent approx. 755 ha (< 0.1% of the TSA).

Further details...

Detailed documentation is available for each sector outlining the footprint data collection/derivation:

\\spatialfiles.bcgov\work\srm\kam\Workarea\ksc_proj\CumulativeEffects\dataInputs:

- \TSR_Modeling\Merritt\work\LicPlan2014\[README Harvest Road modelling.docx](#)
- \Mining\Region\[README Mining Developments.docx](#)
- \LandTenures\Merritt\[README LandTen.docx](#)
- \Utilities\Merritt\[README Utility Expansions.docx](#)
- \CEP\Merritt\[README Merritt TSA Windpower Footprints.docx](#)

Acknowledgments:

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