Wells Gray Provincial Park Wildfire Risk Management Plan

FINAL REPORT

March 31, 2019

Prepared for:

Ministry of Environment and Climate Change Strategy
BC Parks
1259 Dalhousie Drive
Kamloops BC V2C 5Z5
Lindsay Vandesteeg, RPF
Land and Resource Section Head
(250) 371-6320
Lindsay.Vandesteeg@gov.bc.ca

Prepared by:

Julie Maxwell RPF
Planning Forester
Forsite Consultants Ltd.
1274 McGill Road
Kamloops, BC V2C 6N6
jmaxwell@forsite.ca
250-372-0444 ext 304

BRITISH COLUMBIA | BC Parks

FORSITE
Forest Management Specialists

Acknowledgements

This project was funded by the BC Parks License Plate program. This project was implemented by the following Planning Team:

BC Parks:

- Lindsay Vandesteeg - Land and Resource Section Head
- Tod Haughton - Area Supervisor, Thompson Northern Forest Area
- Vladimira Gat - Senior Park Ranger, Thompson Northern Forest Area
- Mike Rowden - Recreation Services Officer, Thompson Section
- Chris Nowotny - Section Head, Cariboo Section
- Lori Homstol - Conservation Specialist, Cariboo Section
- Sarma Liepins, alternate to Lori Homstol - Conservation Specialist, Thompson Section

BC Wildfire Service:

- Jim Jones- Wildfire Officer, Clearwater
- Hugh Murdoch - Wildfire Officer, Kamloops
- Mike Law – Wildfire Technician

Forsite Consultants Ltd:

- Garnet Mierau - Senior Planning Forester (Project Lead)
- Julie Maxwell - Planning Forester
- Russell Thorsteinsson – Analyst
- Randy Spyksma – Senior Planning Forester

Special thanks to all attendees of the Values Workshop; in addition to the planning team members listed above, on January 22nd, 2019:

- Dallas Ingvartsen (Simpcw First Nation)
- Don Dixon (Canim Lake Indian Band)
- Boyd Ginther (Neskonlith Indian Band)
- Stephanie Molina (Tourism Wells Gray)
- Gy Ovenden (Permittee Representative)
- Tay Briggs (Information Wells Gray)
- Sherri Madden (Thompson Nicola Regional District)
- Leslie Groulx (District of Clearwater)
- George Brcko (Wells Gray Community Forest)
- Heather MacLennan (FLNRORD – Stewardship)
- Sandy Mackenzie (FLNRORD - Recreation Sites and Trails)
- Bevan Ernst (FLNRORD – Ecosystems)
- Merlin Blackwell (Park Operator)

Executive Summary

The management of wildfire risk is of increasingly significant importance in BC. The mandate of the Ministry of Forests, Lands and Natural Resource Operations and Rural Development (FLNRORD), the strategic reports of the BC Wildfire Service (BCWS), and the recommendations of provincial initiatives such as the "Addressing the New Normal: 21st Century Disaster Management in British Columbia" provide the high-level direction for the wildfire management planning in the province.

The Wells Gray Wildfire Risk Management Plan (WRMP) was initiated in October of 2018 and involved the following key steps:

- Development of a *Terms of Reference*;
- Documentation of the internal and external *Context* to wildfire risk management;
- Conduct a *Risk Assessment*, including risk identification, analysis and evaluation;
- Development of *Management Strategies* in response to the risks identified;
- Development of the *Final Report*.

The risk of fire was analyzed using a modified burn probability. This probability was combined with a values on the landscape that are both threatened by fire and those that may benefit from fire. Spatial layers were developed that reflect the four provincial Resource Strategic Wildfire Allocation Protocol (RSWAP) categories: 1) Human Life and Safety, 2) Critical Infrastructure, 3) High Environmental and Cultural Values, and 4) Resource Values.

The assessment identified a range of wildfire risks across the landscape. Key areas of higher wildfire risk included corridors of human presence and development surrounding Wells Gray and along the Clearwater Valley Corridor. Other higher risk areas were identified across the Plan Area based on concentrations of human and/or environmental values, or where predicted fire intensity was highest.

Risk response in the form of management strategies were developed for high risk areas. These Management Strategies included recommendations in the following categories:

1. Clearwater Valley Corridor
2. Evacuation
3. First Nations
4. Communications
5. Helipads and Muster Points
6. Wells Gray Fire Management Plan
7. Ecological Values
8. Implementation

The Wells Gray WRMP is a current assessment of wildfire-related risks throughout the Plan Area. An annual progress report will be developed that documents progress against the plan. This plan was developed with a term of ten (10) years, therefore a plan renewal process should be initiated in 2029.

Contents

Acknowledgements i
Contents iii
List of Figures iii
List of Tables iv
List of Acronyms iv
1 Introduction 1
1.1 Plan Objectives 1
1.2 Scope and Deliverables 2
1.3 Timelines 3
1.4 Planning Team 3
2 Context 3
2.1 Plan Area 3
2.2 Administration Context 4
2.3 Internal Context 4
2.3.1 Key Legislative and Policy Context 5
2.3.2 Planning Context 5
2.3.3 organizational Context 6
2.4 External Context 6
2.5 Key Trends 6
3 Risk Identification and Analysis 7
3.1 Modified Burn Probability 7
3.1.1 Ignition Probability 7
3.1.2 Headfire Intensity 8
3.1.3 Modified Burn Probability Analysis 9
3.1.4 Data Limitations 9
3.2.1 Modified Burn Probability Result **Error! Bookmark not defined.**
Error! Bookmark not defined.
3.2 Consequences and Impact Criteria ..... **Error! Bookmark not defined.**
3.2.1 Impact Criteria 11
3.2.2 Wildfire Consequences **Error! Bookmark not defined.**
3.2.3 Values at Risk Analysis 14
3.2.4 Wildfire Consequence Results **Error! Bookmark not defined.**
16
3.3 Wildfire Risk 16
3.3.1 Wildfire Risk Results **Error! Bookmark not defined.**
4 Risk Evaluation 19
4.1 Risk Analysis and Evaluation 20
4.2 Areas with No Recommended Action 20
5 Risk Response 20
6 Next Steps 26

List of Figures

Figure 1: CAN/CSA-ISO 31000-10 Risk Management Process 1
Figure 2: Wells Gray WRMP Plan Area 4

Figure 3: Modified Burn Probability ..... **Error! Bookmark not defined.**
Figure 4: Values at Risk (max) 15
Figure 5: Values at Risk (cumulative) 16
Figure 6: Wildfire Risk (max) ..... **Error! Bookmark not defined.**
Figure 7: Wildfire Risk (cumulative) ..... **Error! Bookmark not defined.**

List of Tables

Table 1: Ignition Probability – Proximity to Roads and Trails 8
Table 1. Modified Burn Probability Analysis 9
Table 4: Values at Risk 13
Table 5: Risk Matrix 17
Table 6: Risk Class Table 17
Table 5: Management Strategy #2 – Evacuation 22
Table 6: Management Strategy #3 – First Nations 22
Table 7: Management Strategy #4 – Communication 23
Table 8: Management Strategy #5 – Helipads and Muster Points 24
Table 9: Management Strategy #6 – Wells Gray Fire Management Plan 24
Table 10: Management Strategy #7 – Ecological Values 25
Table 11: Management Strategy #8 – Implementation 26

List of Acronyms

BCWS	BC Wildfire Service
CRI	Community Resilience Investment program
VAR	Values at Risk
FWI	Fire Weather Index
HFI	Headfire Intensity
PSTA	Provincial Strategic Threat Analysis
RSWAP	Resource Strategic Wildfire Allocation Process
WRMP	Wildfire Risk Management Plan
WUI	Wildland Urban Interface
FLNRORD	Forests, Lands, Natural Resource Operations and Rural Development
FESBC	Forest Enhancement Society of BC
FA	Fire Analyses
SIR	Spatial Indicator Rating
FBP	Fire Behavior Prediction

1 Introduction

The management of wildfire risk is of significant importance to BC Parks. This report represents the implementation of a risk management process in Wells Gray Provincial Park and the surrounding area; referred to as the Wells Gray Wildfire Risk Management Plan (WRMP).

High-level direction and context for this WRMP and Plan Area came from the mandate of BC Parks, the strategic initiatives of the BC Wildfire Service (BCWS) and from recommendations of documents such as the BC Wildland Fire Management Strategy.

The Wells Gray WRMP is based on the CAN/CSA-ISO 31000-10 *Risk Management – Principles and Guidelines* as summarized in Figure 1. The risk management process involves the following key steps:

- Development of a *Terms of Reference*;
- Documenting the *Context* to wildfire risk management;
- Conduct a *Risk Assessment*, including risk identification, analysis and evaluation, with a focus on spatial representation of fire probability and values in support of the risk assessment;
- Development of *Management Strategies* in response to the risks identified, including the threats and opportunities associated with wildfire; and
- Development of a *Final Report* for endorsement by the Wells Gray WRMP Planning Team.

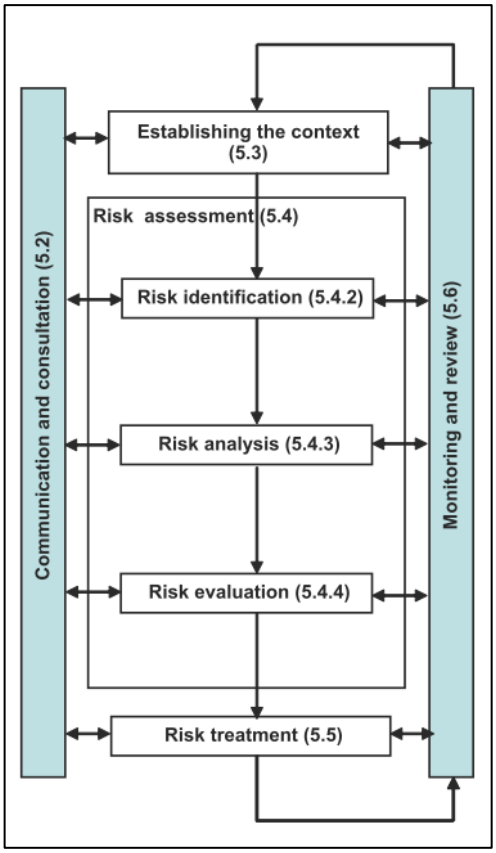

Figure 1: CAN/CSA-ISO 31000-10 Risk Management Process

1.1 PLAN OBJECTIVES

The Wells Gray WRMP objectives as defined by the Planning Team are:

OBJECTIVE 1 – Define priority strategies for wildfire prevention and mitigation activities

- Use the planning process to generate priority areas with a high risk of wildfire, and strategies to manage for wildfire risk;
- Define values at risk on the landbase;
- Support the development of resilient landscapes through fire mitigation and preparedness;
- Support landscape level mitigation of areas susceptible to catastrophic wildfire;
- Inform and be informed by other forest, land and resource planning and management processes.

OBJECTIVE 2 – Support informed wildfire response and recovery

- Build on the history, planning, and implementation of wildfire management found within the Plan Area;
- Provide detailed information on values at risk on the land base to provide general support for response and recovery decisions;
- Support Fire Analyses (FA) within BCWS and BC Parks; and

- Communicate wildfire management discussions with Indigenous peoples, appropriate regulatory agencies, governments, and stakeholders.

OBJECTIVE 3 – Support open and transparent understanding of wildfire risks and response with First Nations and stakeholders

- Engage with Indigenous communities, appropriate agencies, and major stakeholders in the planning process;
- Inform involved parties about risks, including public and shared risks; and,
- Develop materials that can be used to support ongoing engagement with the public, landowners and communities.

1.2 SCOPE AND DELIVERABLES

The key deliverables of the risk management process is a plan that identifies, analyses, and evaluates wildfire related threats and opportunities across the Plan Area, and identifies key management strategies in response to those risks. Key components of the deliverables include:

- Review of pertinent legislation, regulation, reports and plans in order to capture relevant objectives and values that should be incorporated into the risk management process;
- Engagement of a range of governmental stakeholders, within and outside of the FLNRORD, in order to identify and/or confirm overall objectives and values;
- Use of an integrated risk management approach to ensure all risks are identified, analysed, and evaluated;
- Description of the key management strategies that should be considered in response to the risks identified; and
- Development of a series of sub-reports, including Terms of Reference, Context, Wildfire Risk Management Plan, and Management Strategies, that together make up the Wells Gray WRMP.

In addition, the risk management process included:

- A range of appropriate risk management methodologies and tools for identifying, assessing, evaluating, and responding to wildfire related risk;
- Consideration of both wildfire threats (values negatively impacted by wildfire) and opportunities (values positively influenced by wildfire);
- Spatial distribution of wildfire threats, opportunities and associated values, and where fitting, management strategies;
- A general discussion of the management strategies in response to identified risks (threats and opportunities). Detailed plans associated with these management strategies will not be a part of the Wells Gray WRMP, but will be addressed through other programs and processes (e.g. License Plate Program, FESBC);
- Results including maps, background regarding data, and methods used; and
- Maps that display the spatial distribution of the wildfire risk for operational use.

1.3 TIMELINES

The development of the Wells Gray WRMP process started in October 2018, with the planned completion of a final report for March 31st 2019.

The plan was developed with a ten (10)-year term, with progress against recommended management strategies reported annually. A detailed review of the plan will occur after ten (10) years to support a risk assessment update, and will be led by BC Parks.

1.4 PLANNING TEAM

In support of the overall risk management process, a Planning Team was established for the Wells Gray WRMP that included the following representatives:

BC Parks:

- Lindsay Vandesteeg - Land and Resource Section Head
- Tod Haughton - Area Supervisor, Thompson Northern Forest Area
- Vladimira Gat - Senior Park Ranger, Thompson Northern Forest Area
- Mike Rowden - Recreation Services Officer, Thompson Section
- Chris Nowotny - Section Head, Cariboo Section
- Lori Homstol - Conservation Specialist, Cariboo Section
- Sarma Liepins, alternate to Lori Homstol - Conservation Specialist, Thompson Section

BC Wildfire Service:

- Jim Jones – Wildfire Officer, Clearwater
- Hugh Murdoch – Wildfire Officer, Kamloops
- Mike Law – Wildfire Technician, Clearwater

Forsite Consultants Ltd:

- Garnet Mierau - Senior Planning Forester (Project Lead)
- Julie Maxwell - Planning Forester
- Russell Thorsteinsson – Analyst
- Randy Spyksma – Senior Planning Forester

2 Context

The key to the implementation of the risk management process is the establishment of the context. The context identifies the current environment and situation within which the risk management process will be implemented. The Planning Team was supported by discussions with a range of internal and external stakeholders that helped develop the overall context for the risk management process.

A *Context Document* was developed that captures the environment within which the Wells Gray WRMP was completed.

2.1 PLAN AREA

The Wells Gray WRMP plan area consists of the Wells Gray Provincial Park Area (540,567 ha) and the surrounding area. The lands adjacent to the park are included in the planning process due to the

potential influence of wildfires outside the park and the potential of values in this area influencing wildfire response. To incorporate these adjacent risks and values, a 10 km buffer was applied to the park boundary to represent the total Project Area of 997,549 ha.

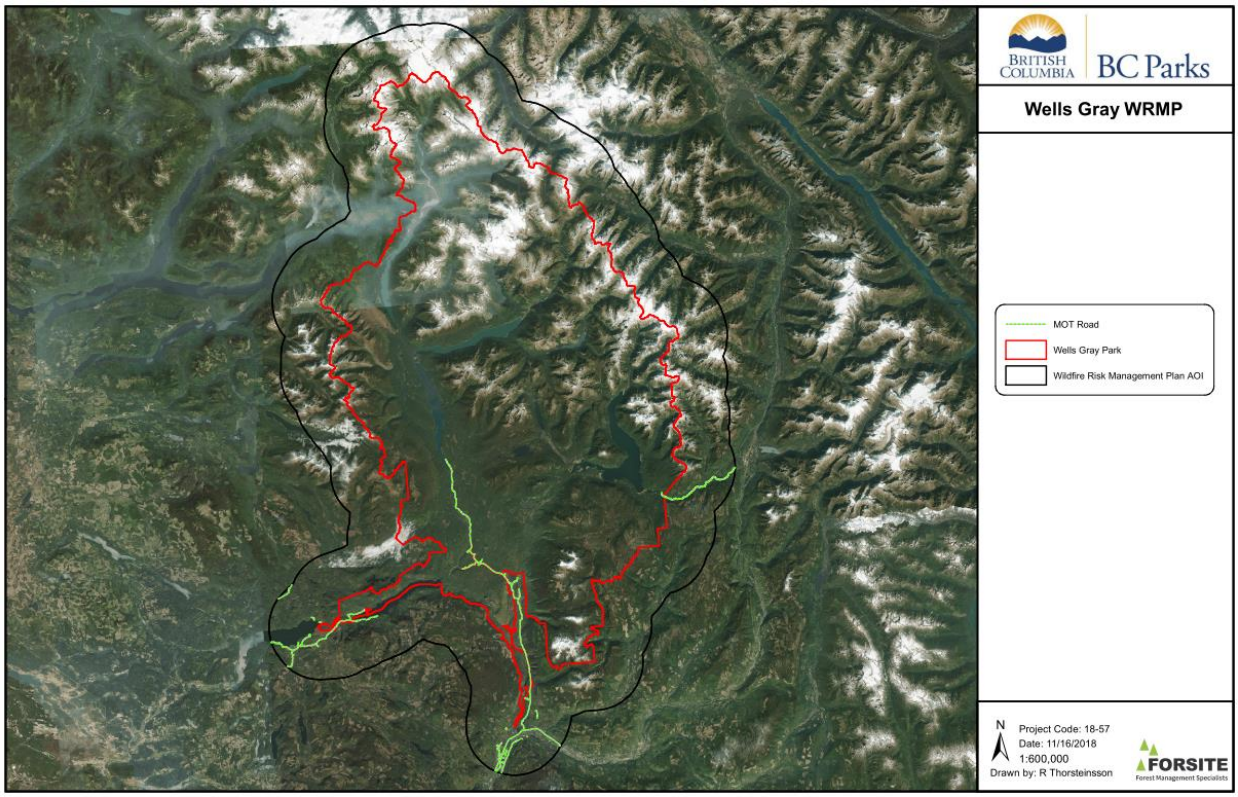

Figure 2: Wells Gray WRMP Plan Area

2.2 ADMINISTRATION CONTEXT

The Plan Area includes a range of administrative areas or jurisdictions, including:

- Populated centres (Clearwater);
- Indian Reserves;
- Thompson-Nicola Regional District;
- Cariboo Regional District
- Regional District of Fraser-Fort George
- Private Land; and
- Tenured forest land.

It is within this diverse land use situation that a collaborative approach was fostered in the development of the Wells Gray WRMP.

2.3 INTERNAL CONTEXT

The internal context refers to the environment within Wells Gray WRMP that gives rise to and influences wildfire risk management and ultimately the Wells Gray WRMP process. There are conditions and

dynamics that are both internal and external to the BCWS that influences wildfire risk management in the Plan Area and ultimately influences how the BCWS collaboratively responds to wildfire risks.

2.3.1 KEY LEGISLATIVE AND POLICY CONTEXT

The key legislative and policy contexts included the following:

- The BC Wildfire Act[1] and BC Wildfire Regulations;
- Wildfire Management Branch Strategic Plan (2012-2017)[2] ;
- BC Wildland Fire Management Strategy[3] (2010);
- Park Act (1996);
- Emergency Program Act and Regulations (1996);
- BC Parks Conservation Policy;
- Thompson Rivers District Fire Management Plan (2017); and,
- Canadian Wildland Fire Strategy[4] (2016).

2.3.2 PLANNING CONTEXT

In addition to the legislative and policy context, direction and expectations are also realized through other BC land use and planning processes. The planning context includes the following:

- Provincial Government Core Policy & Procedure Manual, Chapter 14 Risk Management (2018)[5];
- Addressing the New Normal: 21st Century Disaster Management in British Columbia (April 2018)[6];
- Fire Management Stocking Standards Guidance Document (2016)[7];
- Sendai Framework for Disaster Risk Reduction (2015)[8];
- Risk Management Guideline for the BC Public Sector (2012)[9];
- Climate Change and Fire Management Research Study (2009)[10]; and,
- BC Parks Fire Management Information for BC Wildfire Service (2018)

[1] http://www.bclaws.ca/civix/document/id/complete/statreg/04031_01

[2] http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/wildfire-management/governance/bcws_strategic_plan_2012_17.pdf

[3] http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/wildfire-management/governance/bcws_wildland_fire_mngmt_strategy.pdf

[4] http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/37108.pdf

[5] https://www2.gov.bc.ca/gov/content/governments/policies-for-government/core-policy/policies/risk-management

[6] https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/bc-flood-and-wildfire-review-addressing-the-new-normal-21st-century-disaster-management-in-bc-web.pdf

[7] http://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/land-based-investment/forests-for-tomorrow/fire_management_stocking_standards_guidance_document_march_2016.pdf

[8] https://www.unisdr.org/we/coordinate/sendai-framework

[9] http://www.bcucipp.org/sites/bcucipp.civicwebcms.com/files/media/ERM_Guideline.pdf

[10] http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/wildfire-management/governance/bcws_climate_change_research_strategy.pdf

- Wells Gray Provincial Park Master Plan (1986), Management Direction for the Clearwater River Corridor (1999), Wells Gray Recreation Area Interim Management (1991)
- BC Parks Wells Gray Action Plan (2018)
- BC Parks Zoning Framework (2012)

2.3.3 ORGANIZATIONAL CONTEXT

The mandate for the BCWS Prevention program is to provide leadership, expertise in wildfire prevention, mitigation and provide tools for wildfire response services. ISO 31000 is an internationally recognized standard that identifies a blueprint for risk management and has been adopted as policy by the province for risk based management across government. British Columbia is seeking to use the ISO 31000 standard to develop a wildfire risk framework to inform risk management in a wildfire context.

2.4 EXTERNAL CONTEXT

The external context for the Wells Gray WRMP refers to the factors or conditions outside the Plan Area that influence wildfire risk management *within* the Plan Area, and organized the context into 1) Environmental, 2) Social, and 3) Economic.

Environmental Context – Natural disturbance regimes, species at risk (SAR), and biodiversity management will be key drivers influencing the use and response to wildfire on the landscape in the future.

Social Context – The Wells Gray WRMP is a diverse region in landform and vegetation, as well as human use with significant tourism within the park boundary, and residential, industrial, and recreational development throughout the 10 km buffer. Wildfire risk management will involve different approaches in response to this diversity, with specific attention being given to First Nations and stakeholders with interests in the land and how it is managed.

Economic Context – Tourism is the most significant economic driver within Wells Gray Provincial Park. However, within the 10 km buffer, significant industrial presence exists in the following sectors:

- Utilities – electricity transmission, pipelines;
- Forestry/Timber – forest tenures and additional crown forested lands;
- Grazing/Ranching – crown land, integrated with adjacent private lands;
- Recreation – dispersed, concentrated, public;
- Tourism – scenic beauty and commercial resorts; and,
- Transportation – provincially significant highways.

2.5 KEY TRENDS

A series of key trends will influence wildfire risk management within the Plan Area in the next five (5) years:

- Forest fuels supporting increased probability of larger wildfires due in part to effectiveness of historic fire suppression and forest health issues including mountain pine beetle;
- Climate change influences on wildfire incidence, wildfire behaviour and fuel conditions, including warming and drying trends, and a reduction in fire return intervals;

- Land use and population levels will continue to increase across the Plan Area both within and outside of existing communities. Ongoing forest management activities will continue to have a significant impact on landscape-level fuels within portions of the Plan Area; and
- Collaboration and partnership will be required to deal with complex landscape-level wildfire risk conditions.

3 Risk Identification

The WG WRMP follows the principles of risk management found in the *CAN/CSA-ISO 31000-10 Risk Management – Principles and Guidelines*. Risk identification is a component of the risk assessment, which considers both the *likelihood* and the *impact* of wildfire through modeling.

The following key risk management principles were identified as priorities for the Wells Gray WRMP risk management process; Risk management:

- Identifies and protects value;
- is part of decision-making;
- explicitly addresses uncertainty;
- is based on the best available information;
- is transparent and inclusive; and,
- is dynamic, iterative, and responsive to change.

3.1 MODIFIED BURN PROBABILITY

The WG WRMP process utilized a modified burn probability methodology to support the analysis of wildfire risk. This approach combined an ignition probability analysis with the headfire intensity (HFI) layer from the Provincial Strategic Threat Analysis (PSTA) dataset[11] to determine the modified burn probability for the Plan Area.

A kernel density analysis of fire history data was used to determine ignition probability. This distance-dependant tool is limited in its ability to account for other independent variables and relationships[12]. In addition, a robust burn probability model differs from fire history data analysis due to its dependence on spatial and temporal factors[13]; it is for this reason the analysis was referred to as a "modified" burn probability analysis.

3.1.1 IGNITION PROBABILITY

Ignition probability was determined using a 20 x 20 meter (0.04 hectare) raster analysis in ESRI ArcGIS. Ignition probability was analyzed using the following three inputs (sub-components of ignition probability) (Table 2):

[11] Provided by the BCWS.

[12] https://koreauniv.pure.elsevier.com/en/publications/estimating-the-spatial-pattern-of-human-caused-forest-fires-using

[13] https://www.sciencedirect.com/science/article/pii/S0378112705000563

1. Lightning-Caused Fires – from the Provincial Fire Starts dataset, lightning-caused fire starts from 1950 to 2017 were analyzed with a kernel density analysis.[14]
2. Human-Caused Fires – from the Provincial Fire Starts dataset, human-caused fire starts from 1950 to 2017 were analyzed using with a kernel density analysis.

Both human-caused and lightning-caused wildfire kernel density layers are then normalized from 1 through 10. Normalization does not change the kernel density results, instead it allows the many GIS analysis layers to be combined evenly.

3. Proximity to Roads and Motorized Trails – this was analyzed using a series of distance based classes from the spatial indicator.

The ignition probability for a particular area was determined by calculating the weighted sum of these sub-components (fire starts and proximity to roads). Each of these sub-components have a different influence on ignition probability and therefore were weighted based on this relationship.

Ignition potential based on fuel type was not incorporated into the analysis. For the Plan Area, it can be assumed that the vast majority of the forest types have a high probability of ignition based on data for fire weather days from representative weather stations and historical fire patterns.

Table 1: Ignition Probability – Proximity to Roads and Trails

Data Source	Category Rating by Proximity Class				Subcomponent Weight
	0-100	100-250	250-500	500 +	
MOTI Roads	10	8	6	4	**40**
Permitted Roads	8	8	6	4	**30**
Other Roads	8	8	6	4	**20**
Trails	6	6	6	2	**10**

3.1.2 HEADFIRE INTENSITY

Headfire intensity is a subset of the Provincial Strategic Threat Analysis data provided by the BCWS. This layer incorporates provincial weather station data, Fire Weather Index (FWI), elevation and Fire Behavior Prediction (FBP)[15] fuel types to determine the intensity of a fire during peak burning season weather conditions. Headfire Intensity is the predicted energy output at the fire front measured in kilowatts per meter (kw/m). At 2,000 kw/m, fire intensity surpasses the capabilities of ground crews, with 4,000 kw/m being the threshold for air attack effectiveness. At 10, 000 kw/m, heavy water bombers become ineffective for fire suppression[16]. For more information on the headfire intensity layer, please visit the BCWS PSTA overview at: https://www2.gov.bc.ca/gov/content/safety/wildfire-status/prevention/fire-fuel-management/psta

The HFI was normalized into 10 distinct classes in order to be combined with the ignition probability. The PSTA datasets defined HFI into classes, however some classes were not present within the Plan Area. Therefore, the source HFI dataset was reclassified into 10 distinct classes and as a result, the HFI classes used in this analysis are not reflective of the PSTA data classes. This resulting HFI layer was used

[14] https://pro.arcgis.com/en/pro-app/tool-reference/spatial-analyst/how-kernel-density-works.htm

[15] http://cwfis.cfs.nrcan.gc.ca/background/summary/fbp

[16] http://iopscience.iop.org/article/10.1088/1748-9326/aa7e6e/pdf

as a measure of fire behavior, with the assumption that a more intense fire front would have a greater negative impact on values at risk.

3.1.3 ANALYSIS

Modified burn probability is the combination of the HFI with ignition probability (60% ignition, 40% HFI), where the presence of ignitions on the landbase are often a more significant factor in burn probability, and therefore weighted more than HFI (**Error! Not a valid bookmark self-reference.**). To support this approach, additional model runs were completed that weighed ignition probability and HFI equally (50/50), as well as HFI (**Error! Not a valid bookmark self-reference.**). To support this approach, additional model runs were completed that weighed ignition probability and HFI equally (50/50), as well as HFI more than ignition probability (60% HFI, 40% ignition). After review with BCWS, the ignition probability driven approach (60/40) was determined to be the most representative of wildfire risk, and therefore was chosen to represent wildfire risk in this risk assessment.

Table 2. Modified Burn Probability Analysis

Component (weight %)	Subcomponent (weight %)	Description	Source
Ignition Probability (60)	Lightning Caused Fires (50)	Kernal density of lightning caused fire ignition points	BC Wildfire Ignition points (BCWS)
	Human Caused Fires (30)		
	Proximity to Roads and Trails (20)	Buffered distance from roads and trails based on proximity classes	see **Error! Reference source not found.**
Headfire Intensity (40)	Headfire Intensity (100)	Headfire Intensity Classes	Provincial Strategic Threat Analysis (BCWS)

3.1.4 DATA LIMITATIONS

The wildfire risk analysis is meant to support discussions with the Planning Team and development of the WRMP. As with all models and data, there are assumptions and limitations to how data can be incorporated into an analysis based on the best available information. . Results from the WRMP analysis should be confirmed in the field prior to implementing any wildfire risk reduction activities.

3.1.5 RESULTS

The result of the modified burn probability analysis for the WRMP is shown in Figure 3. Modified burn probability is a combination of fire starts (ignition probability) and HFI, as seen in Table 1. These results represent relative burn probability within the Plan Area, and are not comparable to burn probability provincially.

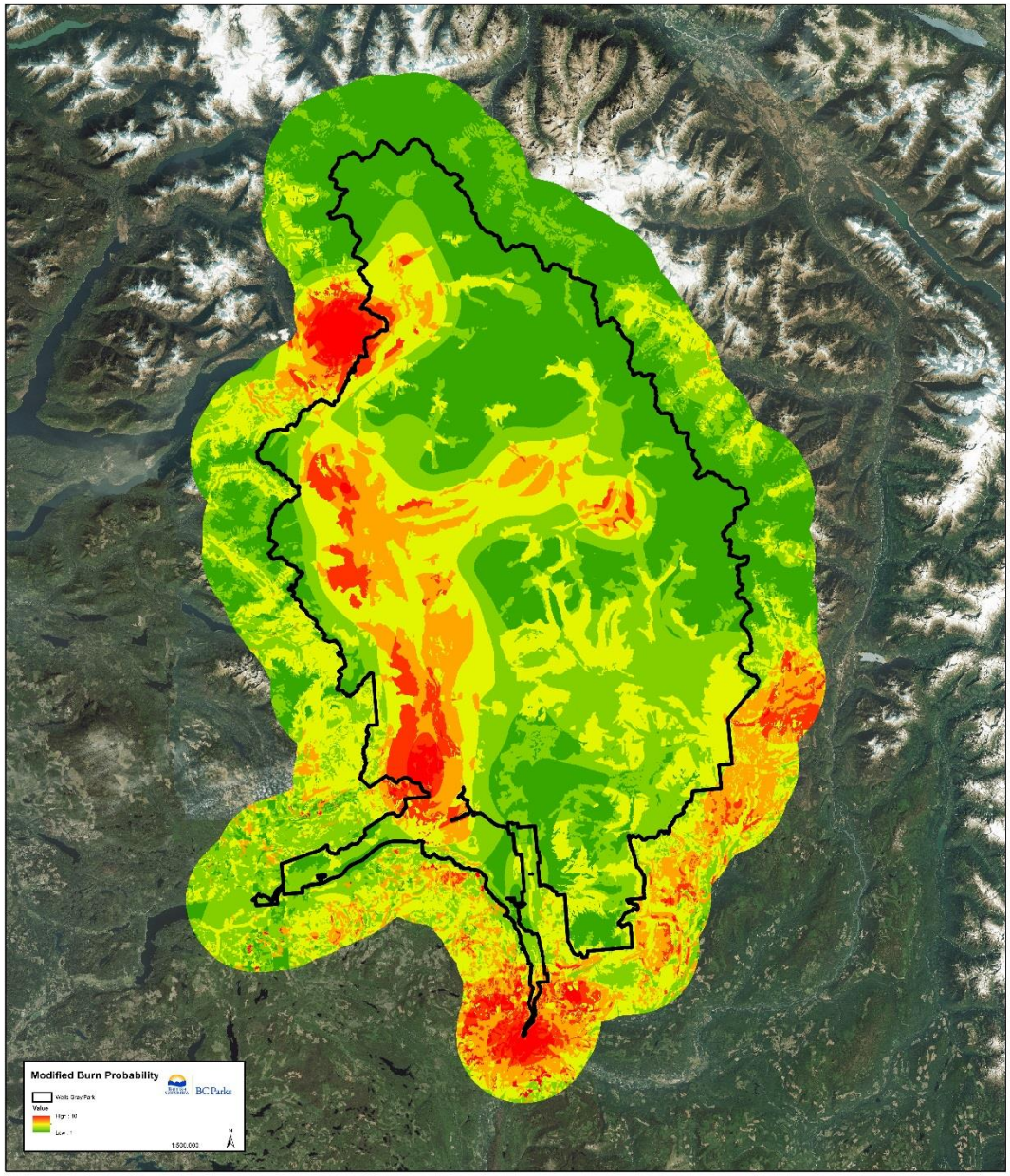

Figure 3: Modified Burn Probability

3.2 IMPACT TO VALUES AT RISK

Consequences or impacts to values are evaluated for the four (4) BCWS RSWAP categories. Spatial indicators of each of these value components are identified. Impact criteria are then applied to these spatial indicators to estimate the maximum impact that could be realized across the plan area, in relation to the presence of these values in the event of wildfire.

Impact weightings were developed by the Planning Team in conjunction with BCWS based on the description of and in some cases quantification of environmental, economic, social and operational impacts or consequences.

3.2.1 IMPACT CRITERIA

The impact (consequence) of a wildfire can be described as "the outcome of the wildfire incident on objectives". The following was developed in conjunction with BCWS to determine the relative impact of a wildfire on a spatial indicator. The WG WRMP and associated management strategies focused on "Highest", "Higher", and "Moderate" impacts (see **Error! Reference source not found.**). This impact criteria table was used to support the Planning Team in identifying and analysing values at risk across the Plan Area, and applying a spatial indicator rating to each identified value in the analysis.

Table 3: Impact Criteria

Level	Temporal Modifier	Spatial Scale	Spatial Indicator Rating (SIR)	Key Words
Highest	Permanent	Regional	**10**	Irreversible; critical; permanent; extreme social, environmental, and/or economic impacts; substantial losses; large scale
	Long/Moderate	Regional/Local	**9**	
	Short	Local	**8**	
Higher	Long	Regional/Local	**7**	Extensive; threatened; long term; requires urgent intervention; disruption; major social, environmental, and/or economic impacts
	Moderate	Regional/Local	**6**	
	Short	Local	**5**	
Moderate	Long	Regional/Local	**4**	Reversible; manageable with time/effort; localized; significant social, environmental, and/or economic impacts.
	Moderate	Regional/Local	**3**	
	Short	Local	**2**	
Lower	NA	Local	**1**	Short term; reversible; temporary
Lowest	Immediate	Local	**0**	Insignificant; temporary

3.2.2 VALUES AT RISK IDENTIFICATION

Consequences or "Values at Risk" were identified for the Wells Gray WRMP. The potential impacts to threatened values (those potentially negatively impacted by wildfire) were ranked as shown in Table 4.

The weighting of values was facilitated by a **Values Workshop** that included representatives from the following organizations:

- BC Parks

- BCWS
- Forsite Consultants Ltd.
- Simpcw First Nation
- Canim Lake Indian Band
- Neskonlith Indian Band
- Tourism Wells Gray
- Permittee Representative
- Information Wells Gray
- Thompson Nicola Regional District
- District of Clearwater
- Clearwater Community Forest
- Recreation Sites and Trails
- FLNRORD
- Park Operator

The workshop session identified subcategories for each of the four (4) categories and within these, identified indicators that could be used to represent these values. The importance of each of the indicators and the corresponding subcategories was then identified through a consensus-based ranking process that was generally based on the following factors:

- Perceived importance of the value to the public;
- Susceptibility of the threatened value to wildfire;
- Likelihood that the value or indicator would influence wildfire risk response; and,
- Availability and scale of spatial data being used to reflect the value.

Spatial datasets that were represented by a point (i.e. residence) or a line (i.e. travel corridors) were buffered by 500 metres in the analysis to account for the area immediately adjacent to the value.

Through the workshop, the group also ranked each indicator's significance with a value between 0 and 10. This rank assigned to the individual indicators allowed for the recognition of the relative significance of one indicator when compared to another.

The assigned value rankings listed in Table 2 are not reflective of established BCWS/Emergency Management BC (EMBC) fire suppression response priorities, but that of the Wells Gray WRMP process. The value ranking process is a planning tool intended to determine priority areas for management strategy discussions. Fire suppression and response priority determinations are the responsibility of BCWS and EMBC.

Table 3: Values at Risk

Category	Subcategory	Indicators	SIR
Human Life and Safety	People	Residences/Cabins/Structures	**9**
		Low Use Areas	**7**
		High Use Areas	**8**
		Travel Corridors	**9**
		High Use Trails	**8**
		Low Use Trails	**6**
	Community	Community Areas/Indian Reserves	**10**
	Evacuation	Access/Egress 1 way in 1 way out- 1 lane	**8**
		Access/Egress 1 way in 1 way out - 2 lane	**7**
		Roads(other)	**6**
		Travel Corridors	**8**
		Wood Bridges	**7**
		Key Power	**8**
		Communications	**9**
Property and Critical Infrastructure	Primary Infrastructure	Public - Critical	**8**
		Public - Other	**6**
	Parks Infrastructure	Parks Infrastructure	**7**
	Other Infrastructure	Transmission Lines	**5**
		Travel Corridors	**5**
		Wood Bridges	**4**
		Communications	**5**
Environmental and Cultural Values	First Nations Archeological Sites/ Values	First Nations Archeological Cultural Sites/Values	**Will require further engagement.**
	Cultural	Old Cabins, Historical Sites	**4**

Category	Subcategory	Indicators	SIR
	Research Site	Research Sites (Not Available)	**There are research sites in Wells Gray, however they are currently non-digital and could not be used for this project.**
	Wildlife Habitat	Ungulate Winter Range	**5**
		Caribou Range	**6**
		Wildlife Habitat Area	**5**
		SAR Occurrences	**5**
	Old Growth	OGMA	**3**
	Water	POD's Domestic	**4**
		POD's Irrigation	**3**
Resource Values	Forest Tenures	Area Based Tenures	**6**
		Available Mature Timber > 250 m3 ha	**5**
		Plantation w/ Investment from Licensees	**3**
	Watersheds	Community Watersheds	**7**
	Recreation	Campgrounds	**4**
		Recreation Sites	**4**
		Trails	**3**
		Crown Recreation Tenures	**4**

3.2.3 ANALYSIS

The weighting of individual impacts (values at risk) was used to estimate the consequence of wildfire occurring in a particular area. The values potentially threatened by wildfire were incorporated into a "values roll-up" that involved a GIS overlay of the individual spatial indicators. Two layers were generated, maximum and cumulative values, to represented values at risk for use in the analysis and to support decision making within the Planning Team.

The "maximum values roll-up" shows the maximum value rank for a given raster cell regardless of total values represented within that area. For example, if an area had a residence with a rank of 10 and was within a trail corridor with a rank of 3, that area was given a total weight of 10. In addition, a "cumulative values roll-up" was created based on the cumulative weighting of all values at risk within a particular area. In the previous example, this would result in a total weight of 13. Both of these "values roll-ups" were included in the wildfire risk analysis to support the Planning Team in evaluating risk and in determining which risks to respond to.

3.2.4 RESULTS

The results of the values roll-ups are shown in Figure 4 (maximum) and **Error! Reference source not found.** (cumulative). Based on the maximum value roll-up, key areas with values at risk are focused on where people reside (structures and residences located within the District of Clearwater as well as the surrounding area) and the travel corridors, primarily Clearwater Valley Corridor road.

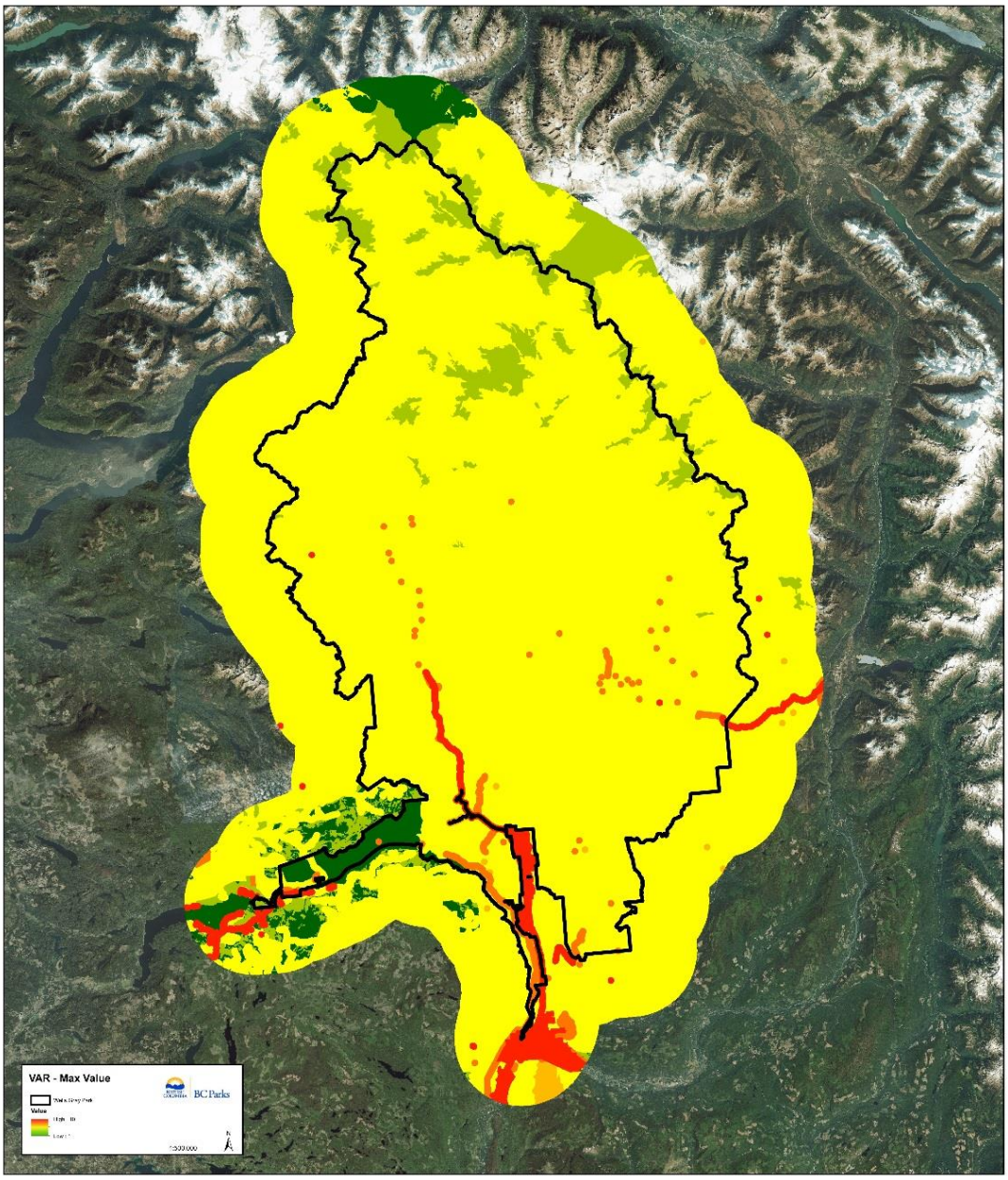

Figure 4: Values at Risk (max)

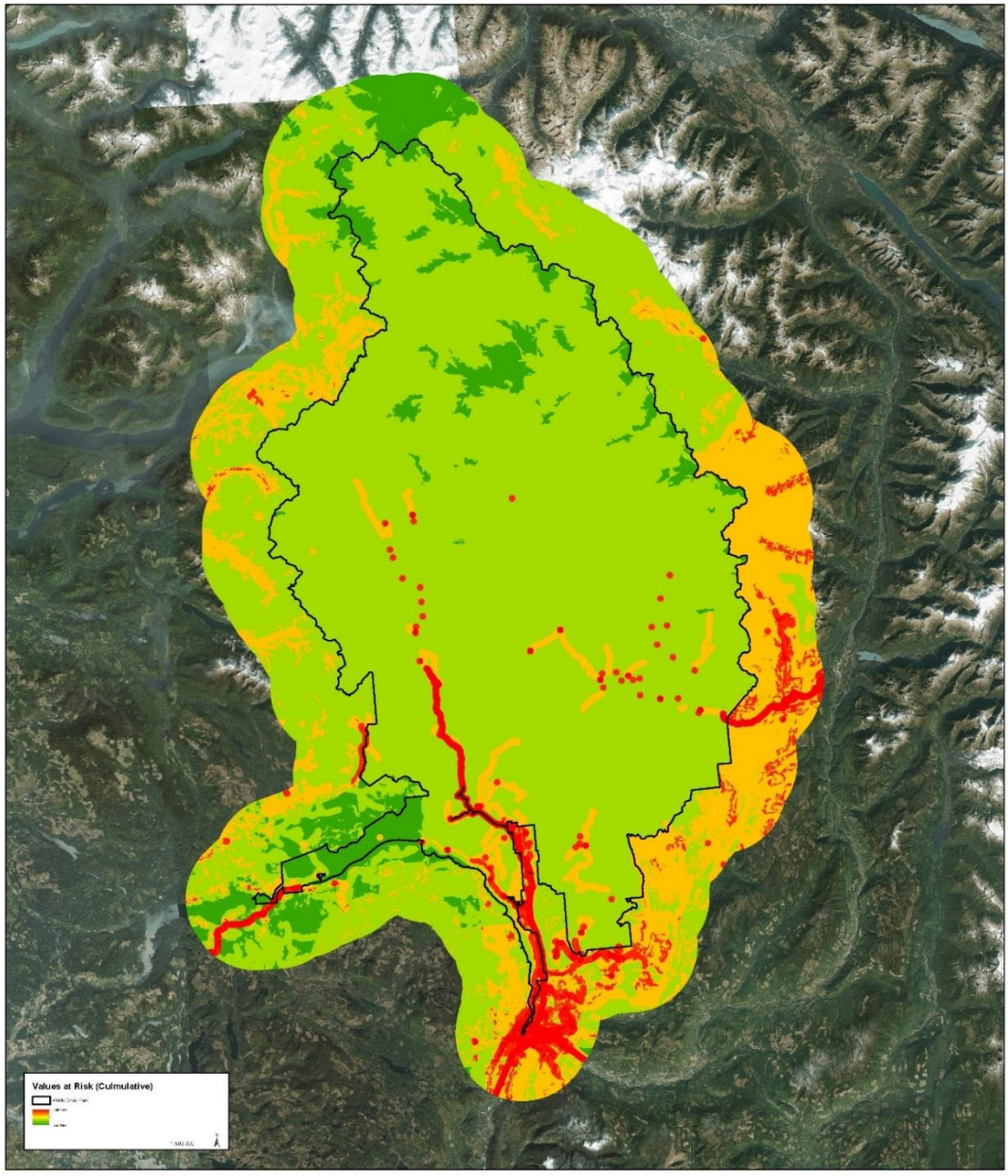

Figure 5: Values at Risk (cumulative)

3.3 WILDFIRE RISK

Wildfire risk is the combination of the consequences (impacts) with the burn probability in accordance with the risk matrix (**Error! Reference source not found.**). This risk matrix equally combines the modified burn probability with the values at risk (50/50) to identify the overall wildfire risk for the Plan Area. For example, an area with "highest" modified burn probability and the "lowest" values at risk would result in a "moderate" wildfire risk. The risk matrix is colour coded based on the risk classes defined in **Error! Reference source not found.** that documents the general acceptability and proposed response to the identified risk. This approach is based on the relative risk of one area compared to another, as opposed to a numerical classification scheme.

This process was completed using both the "maximum values roll-up" as well as the "cumulative values roll-up" to produce two wildfire risk maps (maximum and cumulative) to support the Planning Team in their evaluation of wildfire risk and to inform development of responding management strategies.

Table 4: Risk Matrix

Values at Risk	Modified Burn Probability				
	Lowest	←		→	Higher
Highest					
↑					
↓					
Lowest					

Table 5: Risk Class Table

Colour Schema	Risk Classes
Highest	Highest- risk reduction should be considered
Higher	Higher – risk reduction should be considered
Moderate	Moderate- risk reduction may be considered
Lower	Lowest– risk may require no further treatment

3.3.1 RESULTS

The resulting wildfire risk is shown in **Error! Reference source not found.** where the maximum value roll-up was used, and in **Error! Reference source not found.** based on the cumulative value roll-up. While the maximum value roll-up provided support for the Planning Team in analysing and evaluating risks, the cumulative value roll-up (and subsequently the cumulative wildfire risk) was chosen to identify areas of focus for the recommended management strategies. The cumulative values roll-up represents all values within a particular area, therefore it is an additive process where the resulting values at risk shows the total impact of a wildfire occurring in that area. In contrast, the maximum value roll-up displays the maximum rating applied to an area but does not necessarily account for multiple values being present (and potentially impacted) in that area.

This concept is demonstrated in **Error! Reference source not found.** and **Error! Reference source not found.** below. Wildfire risk based on maximum values (**Error! Reference source not found.**) results in higher wildfire risk being represented along the travel corridors, adjacent to the District of Clearwater, and few "hot spots" across the WG WRMP related to lightning causes fires within the ignition probability ("lightning corridors").

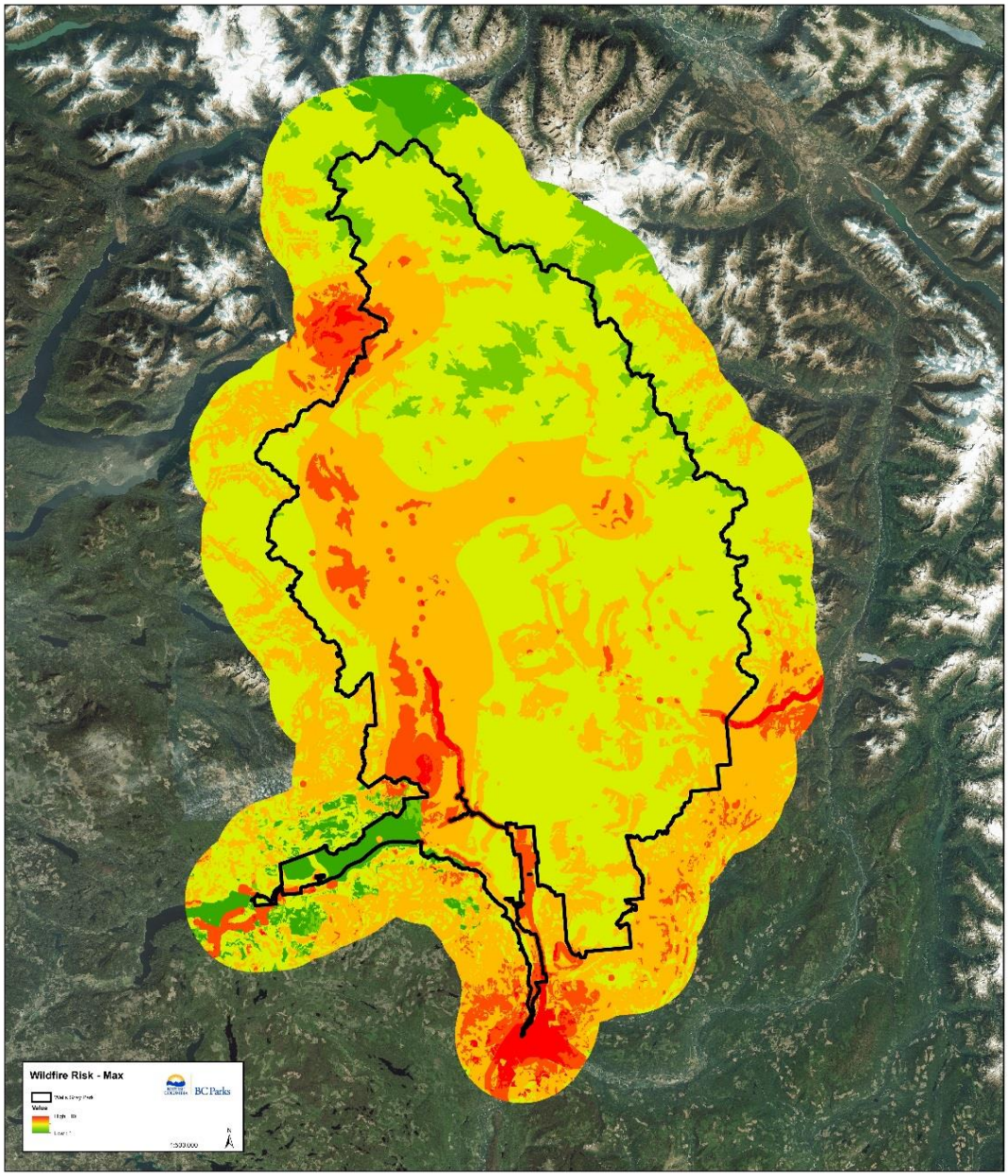

Figure 6: Wildfire Risk (max)

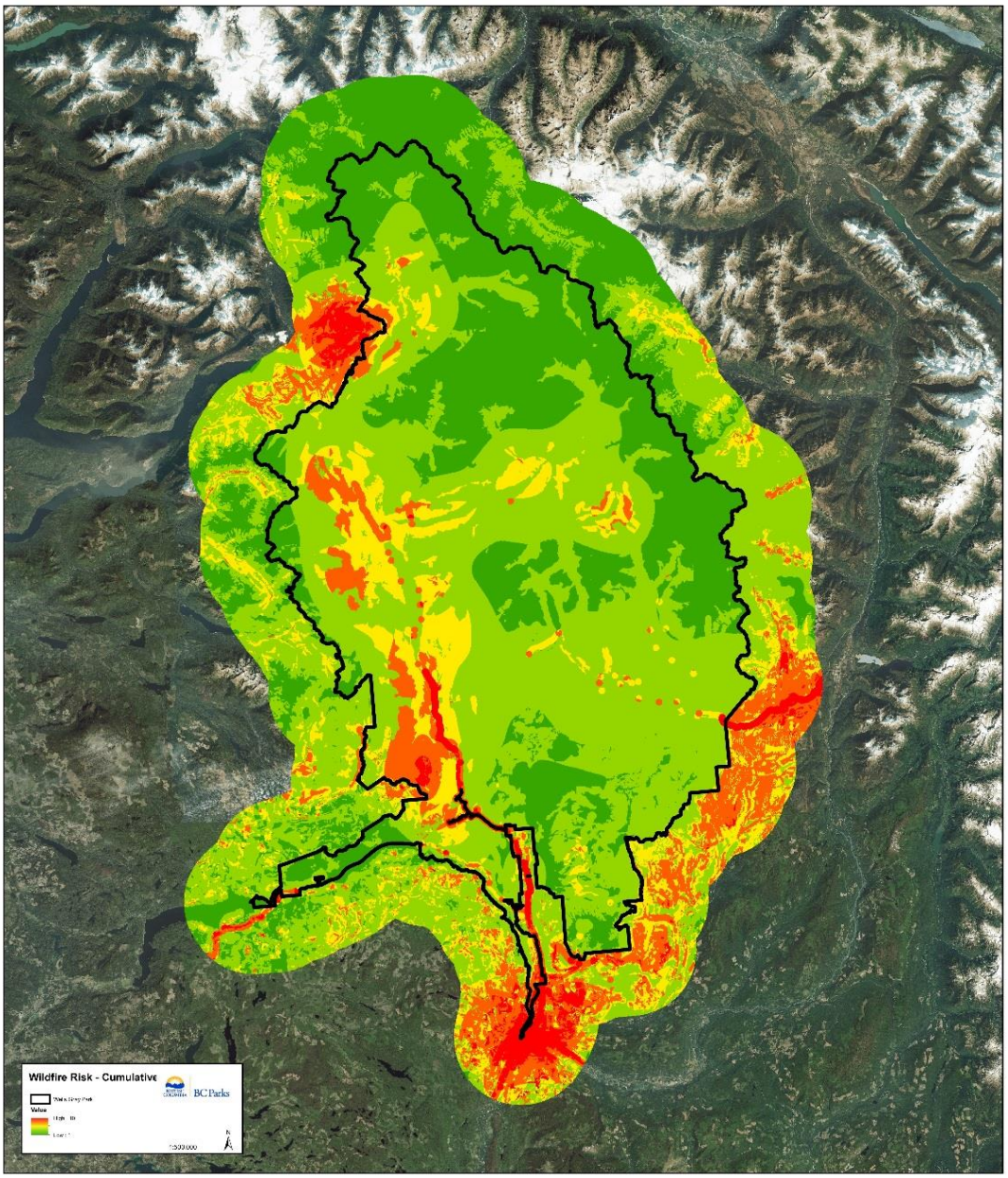

Figure 7: Wildfire Risk (cumulative)

4 Risk Analysis and Evaluation

Risk evaluation is a key component of the risk assessment. The following results were reviewed by the planning team as a product of the *risk identification.* Areas of *moderate* to *highest* risk, as informed by the risk matrix seen in Table 5, were reviewed by the planning team. These results were evaluated to determine the cause of the risk, and consider appropriate *controls*, or measures that modify risk.

4.1 RISK ANALYSIS AND EVALUATION

The Planning Team explored the risks that were identified through structured discussions carried out over a series of Planning Team meetings. These discussions involved the following concepts and questions:

- ***Assess contributing factors***:
  What is causing the model to identify the risks as it did?
  What are the contributing factors to the identified risks?
- ***Confirm risk based on local knowledge***:
  The model may have identified the risks, but does local knowledge confirm or refute this risk?
  Does local knowledge elevate or reduce the risk classification?
- ***Determine if the risk level is acceptable:***
  Some risks may be significant enough to warrant a response. In other cases the risks may be low enough that general monitoring and existing continuous improvement measures are adequate.
- ***Identify how we can influence the risk***:
  Can we influence the risks that have been identified?
  Can we influence the wildfire events from happening (change the likelihood) or if the wildfire events happen, can we interrupt the impacts from being realized (change the consequence)?
  Can we share the risk?
  Can we avoid the risk?
  Should we accept or retain the risk by choice?

The Planning Team identified specific areas across the Plan Area that warranted specific response. In addition, the Planning Team identified a number of risks (threats and opportunities) that existed across the plan area that also warranted specific attention.

4.2 AREAS WITH NO RECOMMENDED ACTION

While evaluating the risk identification results, several areas were discussed as they showed as high risk in the wildfire risk analysis results. However through discussion with the planning team these areas were not responded to for a variety of reasons related to geographic isolation from values at risk.

5 Risk Response

The Planning Team developed **management strategies** in response to the wildfire risks identified as priority for risk response. As noted, additional risks exist across the Plan Area that may be significant and may require additional response in the future. The management strategies identified here are focused on the priorities identified by the Planning Team based the capacity to implement these strategies.

Ongoing evaluation and tracking of wildfire risk across the Plan Area will ensure that priorities and actions adapt over time with changing wildfire risk conditions.

The management strategies developed in response to the wildfire risks are summarized below, with more detailed individual management strategy packages developed and provided separately. Although not documented here, the individual management strategies also defined:

- **Responsibility** – who is responsible to move the strategy and associated actions forward;
- **Partners** – what partners are expected to be involved in the implementation of the management strategy; and
- **Primary Risk Goal** – what is the risk response goal (risk reduction, risk transfer, etc.).

The completion of Management Strategy actions in Wells Gray Provincial Park is dependent on available time, resources, funding opportunities, and staff capacity.

A summary of the eight (8) management strategies are listed in the tables below. The management strategies have been provided as separate documents, and will further detail than is provided in the final report.

Table 5: Management Strategy #1 – Clearwater Valley Corridor

	Management Strategy	Description
1.1	Consider application of fuel management treatments within the Clearwater River Corridor	There is significant risk to values from wildfire within the Clearwater Valley Corridor. Fuel management is a tool to manage for this risk through a reduction of fuel loading, and wildfire behavior such as spotting and crown fire initiation
1.2	FireSmart Program	The FireSmart Canada program implements initiatives to reduce wildfire hazard to homes and communities. While there is no private land within Wells Gray Provincial Park, there are buildings within the park that could adopt FireSmart principles for both risk reduction and public education.
1.3	Include Clearwater Valley Corridor in Wells Gray Park Evacuation considerations	The Clearwater Valley Corridor Road is the main evacuation route for almost all of Wells Gray Provincial Park. The vast majority of park visitors use this corridor. During a wildfire emergency, this road will require careful management and consideration to ensure an efficient and safe evacuation.
1.4	BC Parks to discuss Mushbowl bridge with MOTI in regards to wildfire risk	The Mushbowl Bridge over the Murtle River has wooden decking that may be damaged during a wildfire event. This risk should be communicated to MOTI.

Table 6: Management Strategy #2 – Evacuation

	Management Strategy	Description
2.1	Create a consolidated evacuation plan for Wells Gray Provincial Park.	Evacuation planning has taken place in Wells Gray Park, but has been limited in scope. Consolidation and coordination of evacuation plans produced by Park Operators and Permittees would be more efficient for first responders during an evacuation event.
2.2	Conduct a table top evacuation exercise for Wells Gray Park.	Table top exercises to discuss tactical evacuation concerns can provide guidance to improve emergency management. Conducting a table top exercise for an evacuation in Wells Gray Park in conjunction with the expertise of BCWS and First Responders can assist BC Parks in identifying improvements to the consolidated evacuation plan
2.3	Designate turn around spots for large vehicles for emergency evacuation.	During an emergency evacuation large vehicles, such as buses and motorhomes, are challenging to turn around on a one way in one way out evacuation route. Designated turn around spots will alleviate this pressure and reduce the risk of road blockages during an evacuation.
2.4	Strategic gate installations for road closures.	Wells Gray Park is vast with numerous road systems. It is important to ensure that the general public is kept off road systems during an evacuation event. There are limited resources available to monitor and track visitors; gates are a cost-effective tool to control access. By installing gates at key locations, these areas can be monitored less frequently after they have been evacuated during a wildfire event
2.5	Emergency egress route	The discussion of an emergency egress route is ongoing, and out of scope for the WG WRMP. BC Parks will continue to engage with First Nations and stakeholders surrounding this issues and consider the various ecological, economic and social impacts.

Table 7: Management Strategy #3 – First Nations

	Management Strategy	Description
3.1	Engage with First Nations to better understand their values and their experience with wildfire in the	BC Parks recognizes the importance of First Nation interests in the area of Wells Gray Park.

	project area.	It is integral to the Wells Gray WRMP process to engage with First Nations to determine both threat and opportunity to values within the project area.

Table 8: Management Strategy #4 – Communication

	Management Strategy	Description
4.1	Consider the expansion of communications within Wells Gray Park.	There is limited communication within Wells Gray Park, with no cell service after Spahats turnoff on the Clearwater Valley Road. . This lack of communication poses a significant obstacle to communicating risks during a wildfire event to park visitors and staff.
4.2	Maintain and expand communication planning and protocols between BC Parks and Others	There is a previous Communication Document for permittees and Wells Gray Park staff. This plan establishes communication protocols during emergency events. Maintaining and expanding these communication protocols will ensure efficiency within emergency planning in Wells Gray Park.
4.3	Establish public-facing communication for Wildfire in Wells Gray Provincial Park.	Information sharing with the public during emergency management is critical to maintaining a consistent message and public trust. Through the establishment of emergency management communication protocols, including wildfire, Wells Gray Park can ensure efficient and timely public communication.
4.4	Integrate WRMP with Clearwater CWPP results.	The District of Clearwater is currently undergoing an update to their Community Wildfire Protection Plan (CWPP). There is overlap between the CWPP and this WRMP process and efforts should be coordinated to reduce costs and risk. Solidify partnerships amongst key players, all of whom are managing the risk to the similar set of values.

Table 9: Management Strategy #5 – Helipads and Muster Points

	Management Strategy	Description
5.1	Assess current and potential helipads to ensure they are compatible with evacuation needs	There are helipads throughout the park, and areas that may be suitable for use as helipads during an emergency evacuation. These areas should be identified for suitability and may require additional work and land clearing for use.
5.2	Determine the feasibility of muster points for emergency management in Wells Gray Park	Muster points may be a tool to help with evacuation of large groups of people. What a muster point entails, and the liability involved, may create challenges for BC Parks. Further conversation on the suitability of muster points and whether they can be used in Wells Gray is required.

Table 10: Management Strategy #6 – Wells Gray Fire Management Plan

	Management Strategy	Description
6.1	Modernize the Fire Management Plan for Wells Gray Provincial Park.	BC Parks and BCWS have previously completed a fire management plan. The vision is to create a more robust fire management plan that goes beyond "response" and starts to address wildfire management based on values at risk. The plan, with a strategic planning team, would serve as a detailed plan to determine the prevention, preparedness, response, and recovery components of wildfire planning.
6.2	Integrate decision points and decision making tools into Fire Plan to guide closures and evacuations.	There is significant social and economic impact from closures and evacuations within Wells Gray to the surrounding area. These decisions can have significant impact on the surrounding community. Integrating decision points that are strategic and rely on wildfire behavior provide strong, defendable guidance for decision makers.

Table 11: Management Strategy #7 – Ecological Values

	Management Strategy	Description
7.1	Pursue Terrestrial Ecosystem Mapping for Wells Gray Provincial Park.	Landscape level inventory data is an integral component of ecosystem and habitat conservation. The older inventory data for Wells Gray Provincial Park may have inaccuracies that affect wildfire risk modelling and management decisions.
7.2	Use improved ecosystem mapping to strategically prioritize caribou habitat.	Mountain caribou population have complex altitudinal migration patterns that encompass a large portion of Wells Gray Provincial Park. Strategically prioritizing caribou range by habitat suitability may improve decision making capability for wildfire suppression to limit the damage from landscape level fires.
7.3	Provide decision making tool to BCWS to identify high value caribou habitat.	BCWS crews are often required to respond to multiple small fire targets after lightning storms. These small fires require prioritization based on values at risk. When these fires occur primarily in high value Caribou habitat, it may be required of BCWS crews to prioritize habitat. By providing a guidance document to BCWS crews working in caribou habitat, wildfire response decisions can be prioritized.
7.4	Determine risk of fire to other species within Wells Gray Park	There is limited spatial information regarding flora and fauna species in Wells Gray Park. Many of these records exist in paper records and park use permits, but are rarely accessible from a centralized digital location. By improving these records and referencing updated ecosystem mapping, the effects and risk of fire to other species in Wells Gray Park can be clearly understood by land managers.
7.5	Integrate Wells Gray fire management planning with the Mountain Caribou Recovery Team	The management of mountain caribou is complex, and will require the input and efforts of provincial expertise. The Mountain Caribou Recovery Team is a regional group based out of Williams Lake. The scientific expertise of groups such as this recovery team are key to reasonable and ecologically appropriate decision making for wildfire management.

7.6	Determine operational guidance for post fire recovery Mountain Caribou Recovery Team	Effective guidelines for fire management within caribou zones may help to mitigate the impact of fire on the Wells Gray herd. By creating this framework prior to fire occurrence, fire management decisions regarding operational guidance can be efficient and timely.

Table 12: Management Strategy #8 – Implementation

	Management Strategy	Description
8.1	Communicate Wells gray Provincial Park Wildfire Risk Management Plan (WRMP) Results	There are a multitude of people who may be affected by wildfire threats and opportunities in the project area. It is important to communicate this information to First Nations, communities, government agencies, industry and stakeholders.
8.2	Integrate updated inventory data into wildfire threat analysis	Availability of inventory data may change analysis results. Changes in data may warrant a re-run of the wildfire threat analysis for the Wells Gray Wildfire Risk Management Plan.
8.3	Monitor Progress on the Wells Gray WRMP and Complete Updates as Needed	Tracking of risk reduction over time will ensure accountability.

6 Next Steps

BC Parks in collaboration with partners and partners, stakeholders, and indigenous communities will work to implement the management strategies that are identified above. Work plans, including in some cases funding applications, will be created to ensure that progress is made in the risk reduction efforts. Consideration of plan renewal will be made in 2029, or earlier if conditions warrant.