

Memo



Date: May 11, 2011
File No.: 1200-40
To: City Manager
From: Policy and Planning
Subject: Community Wildfire Protection Plan
Report Prepared By: Graham March, Planner Specialist

RECOMMENDATION:

THAT Council receives, the report from the Policy and Planning Department dated May 11, 2011, with respect to the Community Wildfire Protection Plan (CWPP);

AND THAT Council direct staff to report back on staff and budget implications of the CWPP recommendations pertaining to initiatives not currently being undertaken.

Purpose:

To provide Council an update on the Community Wildfire Protection Plan, have Council direct staff to report back on the staff and budget implications of carrying out the 'Priority A' recommendations in the report, as well as have Council endorse the Wildland Fire Hazard Development Permit Area map for inclusion in the Official Community Plan.

BACKGROUND:

In 2004, the City of Kelowna undertook a review of lands within the city to assess the risk of wildfire, the subsequent threat to structures and natural features, as well as fire suppression constraints. The outcome from this review was the Community Wildfire Protection Plan (CWPP).

It is generally accepted that the CWPP and the information used to develop the document is only valid for a five year period to remain current with changes in forest cover, new developments within interface areas, areas that have received treatment, etc.

The City received funding through a UBCM grant to assist with completion of a CWPP. As part of the CWPP update, the Wildland Fire Development Permit Area map has been revised to

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reflect changes in the interface area. The Plan also provided recommendations for mitigating wildland fire hazards as part of future community planning and design.

The CWPP report provides key recommendations which have been prioritized for implementation within the next 20 years (Attachment 1 - CWPP report). Priority A items are recommended for implementation within the short-term (1 - 5 years), Priority B within the mid-term (6-10 years) and Priority C within the long-term (10-20 years). Since it is commonly accepted that a CWPP should be updated every five years, this report only highlights the 'Priority A' recommendations.

The City is currently actively responding to the following 'Priority A' recommendations that were outlined in the CWPP report as part of regular ongoing mitigation:

Number	Action Item	Priority
Rec # 6	Treat all City owned interface polygons that were identified as posing a risk of moderate or greater	A
Rec # 8	All fuel treatments carried out in the wildland/urban interface should follow a "Fuel Treatment Prescription" developed and submitted to the City by a Professional Forester	A
Rec # 9	Monitor the pine beetles and be proactive to remove all dead and dying pine in the urban/wildland interface	A
Rec # 13	Basic suppression equipment should be kept in strategic locations around the City	A
Rec # 18	Ensure that grass is maintained and that all tree cutting is cleaned up adequately along roadways	A
Rec # 19	Ensure all roads constructed in interface areas meet standards required for suppression vehicles	A
Rec # 32	The FireSmart guidelines should be considered as the minimum standard any new development proposed within the Wildland Fire Hazard Development Permit Areas must adhere to	A
Rec # 37	Summaries of this report and associated maps should be posted at strategic public locations	A
Rec # 39	A representative from the District Parks Department and the Fire Department should be present at public events that take place in or near natural areas	A

The following are the 'Priority A' recommendations from the report that the City is not currently undertaking but are recommended for completion within the next five years:

Number	Action Item	Priority
Rec # 7	Pursue opportunities for Fuel Reduction Pilot Projects through the UBCM	A
Rec # 16	Ensure that all forest licensees address the fuel hazard associated with any harvesting in interface areas	A
Rec # 34	Wildfire awareness signs should be posted along major transportation corridors, at camp sites, recreation areas and high use trail heads that specify how to report a wildfire	A
Rec # 35	The City should develop a public education and awareness program for wildfire management	A
Rec # 36	Distribute educational material to all private land owners within 100 m of the Wildfire DP areas	A
Rec # 38	A series of public presentations should be planned once this CWPP is adopted	A
Rec # 41	Digital media including video and the City's website should be updated to include this plan	A
Rec # 44	Pursue funding sources to undertake pilot projects to treat the City owned interface polygons recommended in Appendix B	A

As recommended to Council, staff will investigate and report back on the time and budget necessary to undertake each of the 'Priority A' recommendations.

In addition to providing recommendations, the CWPP updated fire hazard mapping to reflect new development and forest conditions in interface areas. The updated mapping has been reflected in the revised Wildland Fire Hazard Development Permit Area map (Attachment 2), which is part of the 2030 Official Community Plan which will be going to Public Hearing on May 24, 2011.

LEGAL/STATUTORY AUTHORITY:

Local Government Act - Section 919.1(1)(b)

EXISTING POLICY:

Official Community Plan Bylaw 7600 includes Wildland Fire Hazard Development Permit Area Designation - Map 7.2

Draft Official Community Plan Wildfire DP Area - Map 5.7 (is at First Reading)

FINANCIAL/BUDGETARY CONSIDERATIONS:

This report seeks Council's direction to investigate the costs associated with carrying out each of the 'Priority A' recommendations that are not currently being actively pursued.

There is no cost associated with endorsing the Wildland Fire Hazard Development Permit Area Map for inclusion in the OCP (OCP map 5.7).

PERSONNEL IMPLICATIONS:

This will be an interdepartmental initiative primarily involving Parks, the Fire Department, as well as Policy & Planning. This report seeks Council's endorsement to further investigate the personnel and time implications associated with carrying out the 'Priority A' recommendations not currently being undertaken.

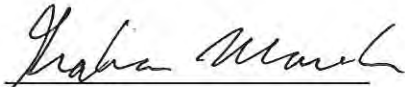
INTERNAL CIRCULATION TO:

Manager of Parks Services
Assistant Fire Chief

Considerations that were not applicable to this report:

LEGAL/STATUTORY PROCEDURAL REQUIREMENTS:**EXTERNAL AGENCY/PUBLIC COMMENTS:****TECHNICAL REQUIREMENTS:****COMMUNICATIONS CONSIDERATIONS:****ALTERNATE RECOMMENDATION:**

Submitted by:



G. March
Planner Specialist



G. Stephen
Long Range Planning Manager

Approved for Inclusion:

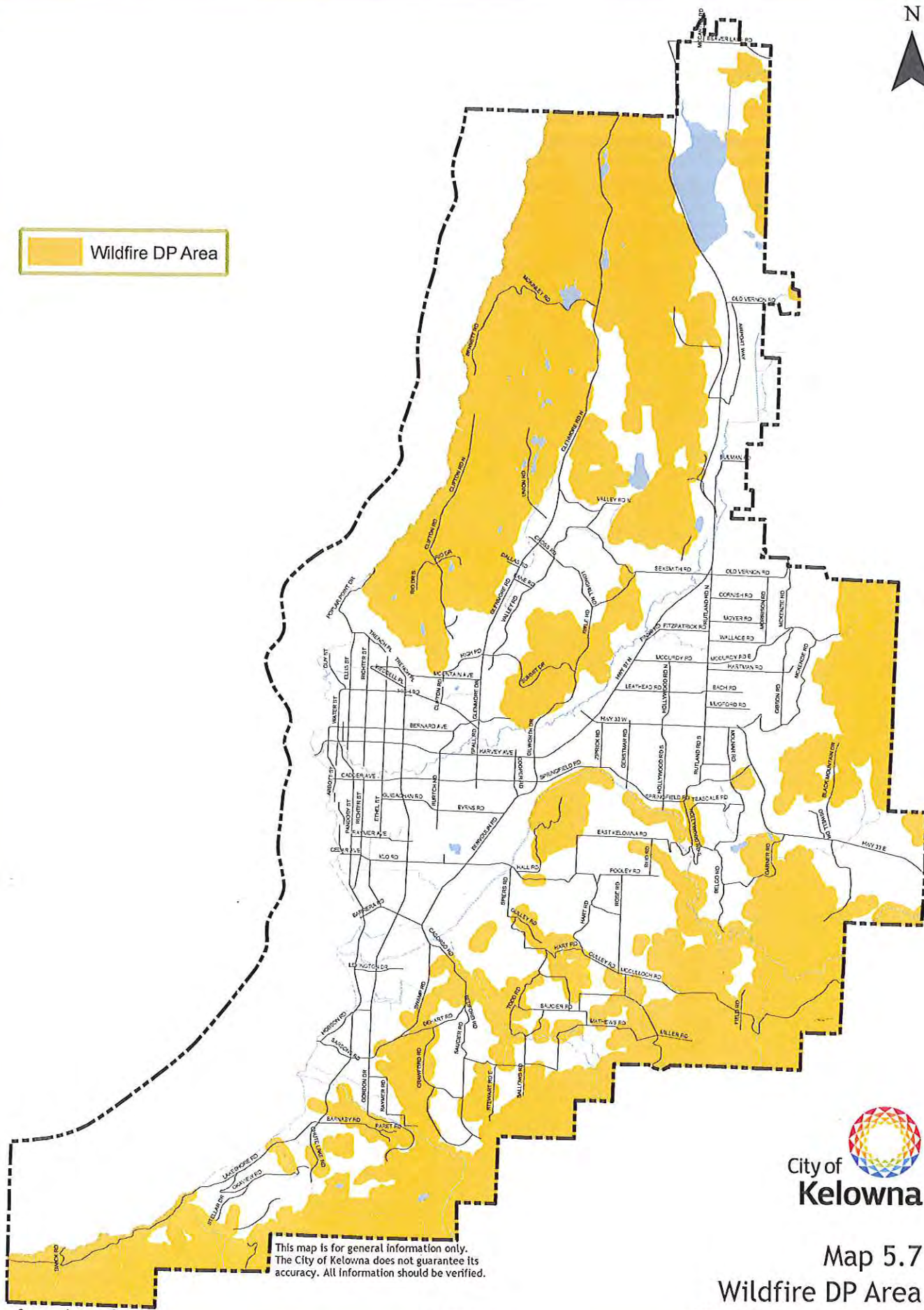


Director of Policy and Planning

Cc: Manager of Parks Services
Assistant Fire Chief



 Wildfire DP Area



This map is for general information only.
The City of Kelowna does not guarantee its
accuracy. All information should be verified.



Map 5.7 Wildfire DP Area

Official Community Plan 2030

Rev. Feb 14/11



Community Wildfire Protection Plan

May 11, 2011



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ACKNOWLEDGEMENTS

Diamond Head Consulting Ltd. would like to thank the City of Kelowna for its generous, ongoing support to prepare this Community Wildfire Protection Plan. City staff has provided valuable review and comments during preparation of draft reports, much of which has been integral to developing the final Plan and recommendations. Specifically, Blair Stewart (Urban Forestry Operations Manager), Ian Wilson (Park Services Manager), and Thomas Doherty (Kelowna Fire Department).

1.0 EXECUTIVE SUMMARY

Hazardous fuel accumulations in our forests, and the related threat from wildfires, are a growing concern across the province. The Firestorm 2003 Provincial Overview (Filman 2003) emphasized the need to recognize this threat and focus our efforts on reducing wildfire risk within the wildland/urban interface. This report provides a background review of the fire environment within the City of Kelowna, identifies the level of wildfire risk and provides recommendations on how to prescribe and prioritize treatments to reduce this risk. A wildfire risk analysis was completed that evaluated the probability (fire behaviour potential) and consequence (risk to human life, structures and natural features) of a wildfire occurrence. This landscape level analysis identified a number of areas that pose a significant risk. Risk mitigation options have been provided for these areas.

In addition to a landscape level analysis, all forested areas that are publicly owned and within 100 meters of any structures were assessed for fuel loading and wildfire behaviour potential. These areas were ranked using a fuel hazard assessment procedure that was developed specifically for assessing forest fuels in BC. The results of this assessment were used to prioritize public areas for fuel treatments.

Wildfire Development Permit (DP) Areas were delineated for the City on private lands where wildfire behaviour potential was moderate or greater. Within these Wildfire DP Areas, developers will be required to retain a professional forester with wildfire management experience to conduct a fuel hazard assessment and develop a report outlining recommendations for mitigating these hazards.

This report provides recommendations for future community planning and design. This includes the treatment of adjacent vegetation and water sources, and standards for construction and landscaping. Broad recommendations have also been included to reduce wildfire risk through preparedness, public education and interagency co-operation.

Emergency pre-planning is recommended in the event of a wildfire. This includes identification of areas with poor access, assessing local water bodies as water sources for wildfire suppression purposes, and establishing an evacuation plan or protocol. Additionally, working with the Wildfire Management Branch and other emergency services on joint exercises and training would allow the City to respond quickly and more effectively in the event of a wildfire incident.

The City's infrastructure and wildfire environment is continually changing. This report should be updated within five (5) years to reflect these changes. Adaptive management should be adopted to incorporate new scientific knowledge to monitor, evaluate and improve the inventories and recommendations in this report.

2.0 SUMMARY OF KEY RECOMMENDATIONS

Key recommendations from this report have been prioritized in the following table for implementation within the next 20 years. Priority A recommendations are to be implemented with the short-term (1-5 years), Priority B within the mid-term (6-10 years) and Priority C within the long-term (10-20 years).

Number	Action Item	Priority
Rec #1	Review the Vision Statement at least every five years to ensure that it continues to represent the community's principles and values.	B
Rec #2	Evaluate the City's performance every five years based upon accepted ecological, community and management based criteria.	B
Rec #3	This CWPP is a living document that should be reviewed and updated every five years.	B
Rec #4	The natural features at risk map should be reviewed and updated every five years.	B
Rec #5	The archaeological features map should be reviewed and updated every five years.	B
Rec #6	Treat all City owned interface polygons that were identified as posing a risk of moderate or greater.	A
Rec #7	Pursue opportunities for Fuel Reduction Pilot Projects through the UBCM.	A
Rec #8	All fuel treatments carried out in the wildland/urban interface should follow a "Fuel Treatment Prescription" developed and submitted to the City by a Professional Forester.	A
Rec #9	Monitor the pine beetles and be proactive to remove all dead and dying pine in the urban/wildland interface.	A
Rec #10	Develop recreation trails in strategic locations within the urban/wildland interface that act as surface fuel breaks and improve access for suppression resources.	B
Rec #11	The City should acquire two smaller ATV/UTV suppression vehicles.	B
Rec #12	All City staff who work in the interface areas should receive basic level fire suppression training (S-100) at least once every two years.	B
Rec #13	Basic suppression equipment should be kept in strategic locations around the City.	A
Rec #14	Interagency wildfire suppression training should be coordinated between the Wildfire Management Branch and the City Fire Department.	B
Rec #15	Coordinate with the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) to ensure that any new policy and harvesting activities adjacent to the City are not contributing to the wildfire risk.	B
Rec #16	Ensure that all forest licensees address the fuel hazard associated with any harvesting in interface areas.	A
Rec #17	Ensure that BC Hydro and FortisBC abate fuel hazards during their vegetation management operations along their transmission right of way.	B
Rec #18	Ensure that grass is maintained and that all tree cutting is cleaned up adequately along roadways.	A
Rec #19	Ensure all roads constructed in interface areas meet standards required for suppression vehicles.	A
Rec #20	Identify interface communities with one access route or cul-de-sac roads. Explore options to build alternative access to these areas.	C

Number	Action Item	Priority
Rec #21	Encourage strategic recreation trail development in parks to a standard that supports ATV/UTVs.	B
Rec #22	Gates should be installed on roads and trails that run through natural areas to minimize access by unauthorized users, especially those using motorized vehicles.	B
Rec #23	Identify area with poor water availability and install hydrant systems or alternative water reservoirs.	B
Rec #24	Identify and map alternative water sources including reservoirs, lakes and rivers.	C
Rec #25	Fire hydrants should be located to serve all new developments and in existing interface areas that are deficient.	B
Rec #26	Road side ditches and medians that contain grasses should be mowed prior to the fire season.	B
Rec #27	Wildfire awareness signs should be posted along major transportation corridors, camp sites, recreation areas and high use trail heads during the summer showing the fire danger rating and emphasizing the need to fully extinguish campfires and not discard cigarettes.	C
Rec #28	Engage in public education programs to reduce human caused ignition focusing on private residents that live in the urban/wildland interface.	B
Rec #29	Work with BC Hydro and FortisBC to ensure that distribution lines and transmission corridors are assessed regularly for tree risk and that the associated fuel hazards are abated.	B
Rec #30	Recognize Wildland Fire Hazard Development Permit Areas in the OCP and ensure all development in those areas submit and comply with a Wildfire Management Plan.	B
Rec #31	Inspect construction sites during the fire season and ensure construction contractors are aware of their responsibilities as described within the Wildfire Act.	C
Rec #32	The FireSmart guidelines should be considered as the minimum standard any new development proposed within the Wildland Fire Hazard Development Permit Areas must adhere to.	A
Rec #33	Develop and distribute neighbourhood evacuation plans for all high risk interface areas.	B
Rec #34	Wildfire awareness signs should be posted along major transportation corridors, at camp sites, recreation areas and high use trail heads that specify how to report a wildfire.	A
Rec #35	The City should develop a public education and awareness program for wildfire management.	A
Rec #36	Distribute educational material to all private land owners within 100 m of the Wildfire DP areas.	A
Rec #37	Summaries of this report and associated maps should be posted at strategic public locations.	A
Rec #38	A series of public presentations should be planned once this CWPP is adopted.	A
Rec #39	A representative from the District Parks Department and the Fire Department should be present at public events that take place in or near natural areas.	A
Rec #40	Establish a school education program to engage youth in wildfire management.	B
Rec #41	Digital media including video and the City's website should be updated to include this plan.	A
Rec #42	Designate awards to individuals or groups that demonstrate commitment to wildfire management planning.	B
Rec #43	In the event of a wildfire, a post-fire ecosystem impact assessment and rehabilitation plan should be completed.	B
Rec #44	Pursue funding sources to undertake pilot projects to treat the City owned interface polygons recommended in Appendix B.	A

TABLE OF CONTENTS



ACKNOWLEDGEMENTS.....	I
1.0 EXECUTIVE SUMMARY.....	II
2.0 SUMMARY OF KEY RECOMMENDATIONS.....	III
3.0 INTRODUCTION.....	1
4.0 PROJECT HISTORY.....	1
5.0 A VISION FOR WILDFIRE MANAGEMENT PLANNING.....	3
6.0 GUIDING PRINCIPLES.....	4
7.0 ASSESSMENT CRITERIA AND INDICATORS.....	5
7.1 A LIVING DOCUMENT – TIMING AND ADAPTIVE MANAGEMENT.....	8
8.0 EXISTING POLICY AND GUIDELINES.....	9
8.1 THE CITY OF KELOWNA OFFICIAL COMMUNITY PLAN BYLAW #7600.....	9
8.2 CITY OF KELOWNA TREE PROTECTION BYLAW NO. 8041.....	10
8.3 THE CITY OF KELOWNA'S AIR QUALITY PROGRAM.....	10
9.0 METHODOLOGY.....	10
10.0 PROJECT STUDY AREA.....	11
10.1 NATURAL ENVIRONMENT.....	13
10.2 ARCHAEOLOGICAL FEATURES.....	16
10.3 NATURAL DISTURBANCE REGIME.....	18
11.0 THE CURRENT FIRE ENVIRONMENT.....	19
11.1 HISTORIC FIRE WEATHER ANALYSIS.....	19
11.2 FIRE HISTORY.....	21
11.3 LOCAL FUEL TYPES.....	22
11.3.1 Fuel type O1b – Open Grass.....	24
11.3.2 Fuel type C-7 – Open Ponderosa Pine Stands.....	25
11.3.3 Fuel type C-3 – Mature Lodgepole Pine.....	25
11.3.4 Fuel type C-2 – Mixed Multi-Canopied Coniferous Stands.....	25
11.3.5 Fuel type D-1 – Deciduous Dominated Stands and Shrub.....	25
11.3.6 Fuel type C-4 – Young Dense Pine Stands.....	26
11.4 THE MOUNTAIN AND WESTERN PINE BEETLES.....	26
12.0 LANDSCAPE-LEVEL WILDFIRE RISK ANALYSIS.....	27
12.1 WILDFIRE RISK ASSESSMENT.....	27
12.2 DISCUSSION OF RESULTS.....	27
12.2.1 Fire Behavior Potential.....	27
12.2.2 Value at Risk Component.....	33
12.2.3 Risk of Ignition.....	33
12.2.4 Suppression Constraints.....	35
12.2.5 Final Wildfire Risk Analysis.....	33
13.0 STRATEGIES TO REDUCE WILDFIRE RISK.....	38
13.1 MODIFYING THE FUELS PROFILE.....	39
13.1.1 Interface Fuel Treatments.....	39
13.1.2 Fuel Treatment Options.....	39
13.1.3 Fuel Treatment Prescriptions and Target Stand Conditions.....	39
13.1.4 Further Treatment of Thinned Stands.....	43
13.1.5 Fuel Treatments and Forest Health.....	39
13.1.6 Surface Fire Fuel Breaks.....	44
13.1.7 Landscape Level Fuel Breaks.....	44
13.2 WILDFIRE SUPPRESSION.....	45
13.2.1 Wildfire Detection and Reporting.....	46
13.2.2 Initial Attack Preparedness.....	46
13.2.3 Inter-Agency Cooperation.....	4



13.2.4 Improving Access.....	8
13.2.5 Water Availability.....	49
13.3 REDUCING SOURCES OF IGNITION.....	50
13.4 WILDFIRE LEGISLATION.....	52
13.5 FIRESMART COMMUNITY PLANNING AND DESIGN.....	53
13.6 EVACUATION PLANNING.....	55
13.7 PUBLIC EDUCATION.....	56
13.8 POST FIRE EVALUATION AND REHABILITATION.....	57
13.9 FISCAL RESPONSIBILITY.....	60
14.0 CONCLUSION.....	61
15.0 REFERENCES.....	62
16.0 APPENDIX A - WILDFIRE RISK ANALYSIS METHODOLOGY.....	66
16.1 COMPONENT #1 – FIRE BEHAVIOUR.....	66
16.1.1 Fuel Types.....	66
16.1.2 Weather Inputs.....	67
16.1.3 Fire Intensity.....	39
16.1.4 Rate of Spread.....	39
16.1.5 Crown Fraction Burned.....	39
16.2 COMPONENT #2 – RISK OF IGNITION.....	68
16.3 COMPONENT #3 – VALUES AT RISK.....	69
16.4 COMPONENT #4 – SUPPRESSION CONSTRAINTS.....	70
16.5 FINAL WILDFIRE RISK RATING.....	71
17.0 APPENDIX B –INTERFACE FUELS ASSESSMENTS OF CITY OWNED LANDS.....	72
17.1 OBSERVATIONS AND RECOMMENDATIONS.....	72
17.2 SUMMARY OF POLYGONS.....	72
17.3 PHOTOS OF POLYGONS.....	80
18.0 APPENDIX C –FIRESMART DEVELOPMENT RECOMMENDATIONS.....	95
18.1 VEGETATION MANAGEMENT.....	95
18.2 BUILDINGS AND CONSTRUCTION.....	97
18.3 UTILITIES-ELECTRIC AND GAS.....	99
18.4 HOME SPRINKLER SYSTEMS.....	100



LIST OF TABLES

Table 1 – Assessment Criteria and Performance Indicators - Ecological Factors.....	5
Table 2 – Assessment Criteria and Performance Indicators - Community Factors.....	6
Table 3 – Assessment Criteria and Performance Indicators - Management Factors.....	6
Table 4 – Climatic Characteristics of the PP and IDF Zones within the City Of Kelowna (Meidinger and Pojar 1991).....	13
Table 5 – Blue and Red-Listed Species Recorded within the City of Kelowna.....	15
Table 6 – MFLNRO Weather Stations.....	19
Table 7 – Fire Weather Indices Between the Months of May to September.....	20
Table 8 – The Fuel Type Classification and Representative Areas Found within the City of Kelowna.....	22
Table 9 – Summary of Fire Behavior Potential for Natural Areas.....	28
Table 10 – Summary of Fire Behaviour Potential within the Urban/Wildland Interface (100 m from structures).....	32
Table 11 – Summary of Target Post Treatment Stand Conditions by Site Ecology and Exposure.....	42
Table 12 – Apparatus Used for Interface Fires.....	47
Table 13 – MFLNRO Weather Stations.....	67
Table 14 – Fire Weather Indices Used for Fire Behavior Modeling.....	67
Table 15 – Fire Behavior Units and Weighting.....	68
Table 16 – Risk of Ignition Units and Weighting.....	69
Table 17 – Values at Risk Units and Weighting.....	70
Table 18 – Suppression Constraints Units and Weighting.....	71
Table 19 – Final Wildfire Risk Weighting and Hazard Class.....	71
Table 20 – Interface Polygon Assessment.....	73

LIST OF FIGURES

Figure 1 – Project Location and Boundary.....	12
Figure 2 – Natural Features at Risk.....	16
Figure 3 – Archaeological Features at Risk.....	17
Figure 4 – Wildfire History in Kelowna.....	21
Figure 5 – Fuel Types.....	24
Figure 6 – Wildfire Behaviour Potential.....	30
Figure 7 – Values at Risk.....	33
Figure 8 – Risk of Ignition.....	34
Figure 9 – Suppression Constraints.....	36
Figure 10 – Wildfire Risk Analysis.....	38
Figure 11 – Recommended Area for the Creation of a Landscape Level Fuel Break.....	45
Figure 12 – Water Availability from Fire Hydrants (100 m Buffer) and Riparian Areas.....	51
Figure 13 – Wildland Fire Hazard Development Permit Areas.....	54

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"Substantial development in the urban wildland interface is increasing the risk from wildfires."

3.0 INTRODUCTION

The City of Kelowna (City) is one of the fastest growing communities in British Columbia and is the largest in the Central Okanagan. Population growth is expected to continue with substantial development of residential neighbourhoods in the outer regions of the City. This is expanding the City's urban wildland interface area and increasing the subsequent risk from wildfires.

The City is located on the Southern Interior Plateau of the Central Okanagan. The Coastal Mountains to the west of Kelowna cast a strong rain shadow. As a result, the regional climate is one of the driest and warmest summers in the province. Wildfire is a fundamental and natural process within the forested landscapes of the BC interior and the ecological communities found in the Central Okanagan have evolved and adapted in response to the influence of periodic wildfires. Wildfire exclusion over the past century has resulted in unnaturally high accumulations of surface and crown fuels and the slow encroachment of forests into historical grassland or open forest communities. The condition of these interface fuels has been magnified by the recent outbreak of western and mountain pine beetle.

The risk that wildfire poses to our communities is expected to increase in the coming decades as a result of continued development within the interface area, the influences of climate change and impacts to the fuel profile from the mountain pine beetle infestation. While the risk of wildfire cannot be eliminated, we can effectively prepare for wildland fires by reducing wildfire behaviour potential in fire-prone areas. This Community Wildfire Protection Plan (CWPP) has been developed to address the threat of wildfires in the wildland/urban interface zone (WUI) in the City.

4.0 PROJECT HISTORY

The City has completed a number of planning studies related to the risk of wildfire since the devastating wildfires of 2003. These include:

- A Wildfire Hazard Analysis and Methodology Report (2004);
- A Fuel Management Strategy for City owned lands (2004);
- Review of Policies, Procedures and Bylaws Relating to Wildland Fire (2006); and
- An Addendum to the Fuels Management Study to incorporate the impacts of the Mountain Pine Beetle outbreak (2007).

"The CWPP is a guiding document which provides a clear vision of how the risk from wildfire can be managed over the long term within the City of Kelowna."

The wildfire environment in the City has dramatically changed since these reports were completed. New residential developments have been completed within the wildland/urban interface, the City has carried out fuel treatments on City owned lands and the western and mountain pine beetles have contributed to a large amount of tree mortality. The City recognizes that these wildfire planning documents require periodic updating as the wildfire environment changes.

This CWPP was developed with financial support from the Union of BC Municipalities. It follows standards and methodologies adopted and endorsed by the Wildfire Management Branch of the Ministry of Forests, Lands and Natural Resource Operations. Wildfire risk has been assessed on a landscape level and within the urban interface. Recommendations aim to reduce the risk to human life and structures and to ensure an adequate state of preparedness and availability of proper resources for wildland fire suppression.

The CWPP is a guiding document which provides a clear vision of how the risk from wildfire can be managed over the long term within the City of Kelowna. Clear, meaningful and achievable management goals are provided. It is also an adaptive plan that will evolve over time to provide a sense of community stewardship for residents.





5.0 A VISION FOR WILDFIRE MANAGEMENT PLANNING

A long-term, sustainable vision for wildfire management in the City of Kelowna is a prerequisite to the development of appropriate supporting policies, guidelines, and short and long-term management plans. The vision should exemplify an inspired concept for wildfire management in the City, considering both its present state and the future perspective. The vision should respond to the community's needs while recognizing the management challenges associated with future population growth, fiscal constraints, land use and environmental change.

The following Vision Statement should be reviewed in the future to ensure that it continues to represent the community's principles and values:

"The City of Kelowna recognizes the potential challenges and risks related to population growth, changing land use patterns and liability. The City is committed to becoming a "FireSmart" community, leading by example towards ensuring the safety of its citizens, buildings and infrastructure. This will be accomplished strategically over time, recognizing both the need to support sustainable development while protecting the natural values that help to define the City."

Number	Action Item	Priority
Rec #1	Review the Vision Statement at least every five years to ensure that it continues to represent the community's principles and values	B



6.0 GUIDING PRINCIPLELS

The guiding principles of this CWPP are the fundamental beliefs that guide its operation.

Guiding Principles	
Public Health and Safety	Public safety is the foremost priority. All wildfire management activities must reflect this commitment.
Protection of Infrastructure	The City will implement measures to protect the community infrastructure from wildfire including private property, public structures and facilities.
Sustainable Planning	The City of Kelowna supports a unique diversity of natural features which help to define the character of the City. Protection of these features requires a framework for growth that supports a harmonious balance between long term social, economic and environmental values.
Environmental Protection and Enhancement	The ecosystems found within the City support a high level of biodiversity and environmentally sensitive features. This plan recognizes the importance of protecting and enhancing these environmental values.
Interagency Co-operation and Policy	Wildfire management planning, preparedness, prevention, suppression, ecosystem rehabilitation, and education will be conducted in co-operation between the City, the City Fire Department, the Ministry of Forests, Lands and Natural Resource Operations, First Nations, RDCA, and other local governments.
Public Awareness, Education and Advocacy	Public awareness, education and advocacy are integral to fostering respect for the risk that exists from wildfire. Agencies will enhance understanding and support of wildfire management policies and practices through internal and external communication and education programs.
Adaptive Management	There are significant challenges in establishing a "Firesmart" community during a period of rapid growth and changing environmental climate. An adaptive management approach must be adopted that includes a monitoring function to evaluate the effectiveness of initiatives, modify actions as required, and incorporate new approaches and decision-making processes.
Financial Responsibility	The plan recognizes that many of the recommendations to be adopted are costly and will be implemented over time as budgets and funding sources allow. Limited budgets will require that a variety of initiatives be explored to implement all of the recommendations in the plan. Long term success of the plan depends on reliable and sustainable funding strategies within the context of developing innovative partnerships, priority setting and cost/benefit considerations.



"Criteria and Indicators provide a roadmap for achieving an optimal state for wildfire preparedness."

7.0 ASSESSMENT CRITERIA AND INDICATORS

Successful implementation and long term monitoring of the CWPP requires that a foundation of assessment criteria and performance indicators be adopted. These are summarized in the following tables which correlate to specific ecological, community or management factors. The key objectives provide guidance to City managers, private industry, and the community as to how the City of Kelowna intends to manage the risk from wildfire. Criteria and indicators provide a measure of the state of the City.

These tables are meant to provide a road map for achieving an optimal state for wildfire preparedness. The objectives in these tables help to direct and prioritize the recommendations made in the CWPP document.

Table 1 Assessment Criteria and Performance Indicators – Ecological Factors

Key Objective	Assessment Criteria	Performance Indicators			
		LOW	MODERATE	GOOD	OPTIMAL
Minimize ecological impacts of fuel treatment activities	Ecological integrity of treatment areas	No consideration of ecological sensitivities during planning and operational activities; Impacts are high	General landscape considerations for ecological impacts; Ecological impacts are evident but not high	Site specific ecological sensitivities identified and protected during operational activities; Low impacts to site	Site specific ecological sensitivities identified and protected during operational activities; Site impacts are insignificant
Minimize ecological impacts of suppression activities	Ecological integrity of areas impacted by suppression activities	No consideration of ecological sensitivities during suppression; Impacts including site degradation are high	General landscape considerations for ecological impacts; Ecological impacts are evident but not high	Site specific ecological sensitivities identified and protected during operational activities; Low impacts to site	Site specific ecological sensitivities considered during suppression; Site impacts are insignificant.
Restore all natural areas impacted by wildfire management activities	Implementation of restoration plans and programs	No restoration of impacted areas	<50% of degraded areas restored within one year following disturbance	>50% of degraded areas restored within one year following disturbance	Restoration of all degraded areas is initiated within one year following disturbance

Table 2 Assessment Criteria and Performance Indicators – Community Factors

Key Objective	Assessment Criteria	Performance Indicators			
		LOW	MODERATE	GOOD	OPTIMAL
Develop public education programs to support the goals of the CWPP	Public understanding of wildfire planning and suppression	No education programs directed towards wildfire planning and suppression; Little to no public awareness of issues	Public generally aware of CWPP but not detailed recommendations	Education initiatives targeted to priority recommendations in the CWPP	Proactive education initiatives in place; Public highly aware of CWPP goals
Involve the public in the implementation of the CWPP	Public involvement and community stewardship	No public involvement or stewardship in CWPP initiatives	Limited public involvement in CWPP initiatives	Community engaged and participates in implementation of priority recommendations (e.g. Risk mitigation) in CWPP	Community actively engaged and participates in implementation of all aspects of the CWPP

Table 3 Assessment Criteria and Performance Indicators – Management Factors

Key Objective	Assessment Criteria	Performance Indicators			
		LOW	MODERATE	GOOD	OPTIMAL
Develop and implement a comprehensive CWPP	Implementation of a CWPP	No CWPP in place	CWPP in place with 50% of recommendations implemented	CWPP in place with all recommendations implemented	CWPP in place with all recommendations implemented; CWPP updated every 5 years
City departments cooperate to implement CWPP goals and objectives	Interdepartmental cooperation	No communication or consultation protocols between departments in place	Relevant departments have general awareness of CWPP management and planning activities	Relevant departments work together to implement the recommendations in the CWPP	Coordinated and cooperative management approach by relevant departments to implement the CWPP
CWPP goals and recommendations are recognized in municipal plans and policy	Integration of CWPP in municipal planning and development process	No recognition of CWPP in municipal planning process	Priority recommendations in CWPP recognized and supported by relevant municipal policy	CWPP goals and recommendations supported by relevant municipal policy and incorporated in development planning process	Municipality and private developers fully cooperate to achieve CWPP goals and objectives

Table 4 Climatic Characteristics of the PP and IDF Zones within the City of Kelowna (Meidinger And Pojar 1991)

Key Objective	Assessment Criteria	Performance Indicators			
		LOW	MODERATE	GOOD	OPTIMAL
Develop and maintain adequate funding to implement the CWPP	Budget available to support the recommendations in the CWPP	No budget allocation to support the recommendations in the CWPP	Insufficient budget to address more than ad hoc initiatives and demand requests	Sufficient funding available for basic management objectives	Secured, annual funding available to meet all CWPP recommendations
Ensure adequate staff and resources to implement CWPP	City staffing and resources	No staff and/or inadequate resources	No training of existing staff; resources available	Qualified individuals on staff with regular professional development; Sufficient resources available	Multi-disciplinary team; required resources available on demand
Reduce wildfire risk in public owned interface areas	% of high risk public interface areas treated	<25% interface fuel treatment polygons treated and maintained	25-75% interface fuel treatment polygons treated and maintained	>75% interface fuel treatment polygons treated and maintained	All interface fuel treatment polygons treated and maintained
Reduce wildfire risk in private owned interface areas	% of high risk private interface areas treated	<25% interface fuel treatment polygons treated and maintained	25-75% interface fuel treatment polygons treated and maintained	>75% interface fuel treatment polygons treated and maintained	All interface fuel treatment polygons treated and maintained
Water supply is available for suppression to all structures within the Wildfire Permit Areas	Proximity of water source to structures within the wildland interface	Water sources available to less than 50% of structures within the wildland interface	Water sources available for 50-75% of structures within the wildland interface	Water sources available to greater than 75% of structures within the wildland interface	Water sources available to all structures within the wildland interface
Interface areas with a high risk of ignition are identified	Risk of ignition	No knowledge of the type and location of ignition sources	General understanding of the types of ignition sources; No spatial mapping of high risk areas	Comprehensive understanding of the risk of ignition within interface areas; partial spatial mapping of high risk areas in GIS	Comprehensive understanding for the risk of ignition across the city; spatial mapping of all high risk areas in GIS
There is adequate access, ingress and egress routes to all communities within the interface	Presence of ingress/egress routes in all communities	<60% of communities have greater than one ingress/egress route	60-90% of communities have greater than one ingress/egress route	>90% of communities have greater than one ingress/egress route	All communities have greater than one ingress/egress routes

Key Objective	Assessment Criteria	Performance Indicators			
		LOW	MODERATE	GOOD	OPTIMAL
Implement a monitoring program for wildfire risk in interface areas	Frequency of monitoring	No monitoring program	Infrequent monitoring of high risk interface areas	Regular monitoring of high risk interface areas	Regular monitoring of all interface areas

Number	Action Item	Priority
Rec #2	Review the Vision Statement at least every five years to ensure that it continues to represent the community's principles and values	B

7.1 A LIVING DOCUMENT – TIMING AND ADAPTIVE MANAGEMENT

Developing a CWPP within the context of a natural ecosystem is challenging as forest stand conditions are continually changing with growth, regeneration and forest pest and disease influences. The rate of landscape change in urban environments must also be considered. Development patterns in Kelowna have resulted in considerable change. A growing population will continue to put stress on local ecosystems as demand for land, water and resources increases. In addition, future impacts to the landscape resulting from potential climate change scenarios, which are difficult to predict, will likely have a lasting, but as of yet undetermined, impact on the natural forested communities.

Many of the recommendations contained within the CWPP are likely not achievable within a short time frame. As such, this plan provides an initial 20 year framework to help guide the City of Kelowna towards becoming a Firesmart community. The plan begins with the assumption that it will take the City many years to reach what would be considered an optimal state. As such, this plan is a living document that is based upon a 20 year planning cycle with anticipated plan updates every five (5) years.

An adaptive management approach is one of continual learning and integrates new management initiatives, scientific research, monitoring results and community input. Specific management initiatives are monitored and the results are used to better inform and strengthen the plan by making necessary adjustments where appropriate. Periodic review and updating of the plan will facilitate integration of an adaptive management approach. This ensures that the plan continually follows best management practices and reflects the current vision of the community.

Number	Action Item	Priority
Rec #3	This CWPP is a living document that should be reviewed and updated every five years.	B



8.0 EXISTING POLICY AND GUIDELINES

Following is a summary of some of the municipal and provincial policies and guidelines that relate to wildfire management and fuel treatments.

8.1 THE CITY OF KELOWNA OFFICIAL COMMUNITY PLAN BYLAW #7600

The Official Community Plan (OCP) provides policy framework and direction for future growth and land use. The OCP is currently under review and will be updated with a vision through to the year 2030. OCP policies related to the management of trees and wildfire include the following:

City of Kelowna OCP Section 7.5 – Tree Policies

- 7.5.1 Forest Areas. Pursue further co-operative initiatives with the appropriate provincial ministry or agency regarding planning and management of forested areas within and around the periphery of the City.
- 7.5.2 Vegetation Management. Consider undertaking a study to inventory vegetation elements within the City (i.e., trees, shrubs, and other green areas). Consider preparing guidelines to minimize loss of vegetation within the City and to sustain an overall balance of vegetation.
- 7.5.3 Loss of Vegetation. Encourage a balance of vegetation in proposed development areas. Encourage increased vegetation in areas of previous development that are identified as being deficient and encourage tree planting in general throughout the City.
- 7.5.4 Heritage Trees. Encourage the retention of mature trees, including the Heritage Trees identified in the Heritage Trees of Kelowna - Rutland Sector and Inner City Inventories.

City of Kelowna OCP Section 7.13 – Development Permit Guidelines for the Protection of Development from Hazardous Conditions

This section of the OCP identifies Wildland Fire Hazard Development Permit Areas. Guidelines are provided for development in hazardous areas including:

- Remove and dispose of all dead trees and continue to keep the land free of accumulation of any dead trees.
- Locate building sites in the flattest areas and avoid gullies or draws that accumulate fuel and funnel winds.
- Remove and dispose of all tree limbs and shrubs that overhang roofs or grow under building eaves and maintain this condition.



- Establish a defensive space around all buildings by:
 - Spacing of all coniferous trees and maintaining and pruning of all remaining trees.
 - Remove and dispose of all needles, dead twigs and branches and maintain the lands free of such accumulation.
 - Retaining or planting acceptable vegetation such as watered/mowed lawns, low shrubs, deciduous trees and pruned/spaced coniferous trees
 - Clean up and dispose of combustible material remaining from construction as soon as construction is complete.

8.2 CITY OF KELOWNA TREE PROTECTION BYLAW NO. 8041.

This bylaw regulates the management of trees located on City-owned property. It specifies that no person shall remove, transplant, prune, deface or otherwise injure a tree on City-owned property without the written permission of the City of Kelowna Parks Department. The City may remove trees that are hazardous or diseased or in conflict with City infrastructure.

8.3 THE CITY OF KELOWNA'S AIR QUALITY PROGRAM

The program is a joint initiative between the City of Kelowna, Regional District of the Central Okanagan (RDCO), District of Peachland, District of West Kelowna, and the District of Lake Country. This program was developed to ensure that the air quality is protected in the Okanagan as the region grows. Outdoor burning is allowed with a permit between October and April as long as the property is greater than 1 ha and when Air Quality is 25 or lower and Venting is 65 or higher.

9.0 METHODOLOGY

This CWPP was developed in consultation with the City of Kelowna and the City of Kelowna Fire Department. A landscape level wildfire risk analysis and site specific ground assessments were completed within the urban/wildland interface as part of the plan.

The "Wildfire Risk Analysis" is a GIS based model that spatially quantifies and analyzes the relationships that exist between wildfire behaviour potential, values at risk and constraints to suppression capabilities (Appendix A). This was used to highlight City-wide concerns and to develop landscape level recommendations.



A detailed fuel hazard assessment was completed within the interface of City owned lands using the provincial assessment system, "Rating Interface Wildfire Threats in BC" (Morrow, Johnson, Davies). This ranking system was used to determine where fuel treatments will effectively reduce wildfire threat and to prioritize these areas for treatment. These two risk assessments provided a foundation for developing treatment strategies on both a broader landscape level and specific treatments adjacent to structures at risk. The resultant priorities from this assessment are included in Appendix B.

The funding acquired from the UBCM to develop this CWPP does not include the development of detailed fuel treatment prescriptions for areas identified for treatment. However, general fuel treatment strategies have been provided for the typical fuel profiles found across the study area, including a standardized approach for developing and monitoring fuel treatment prescriptions. In addition, recommendations are made for the proper planning of future developments and development of standards for wildfire preparedness and public education.

As criteria for funding for this project, the UBCM requests that there be continuity between adjacent CWPPs. A CWPP was developed for the adjacent District of West Kelowna. In March of 2010, a CWPP was completed for the Regional District of Central Okanagan (RDCO) which surrounds the City of Kelowna. The GIS spatial data from the RDCO project was used for the 3 km buffer that was analysed surrounding the City of Kelowna. Recommendations in this CWPP are consistent with those in the CWPPs for the RDCO and the District of West Kelowna.

10.0 PROJECT STUDY AREA

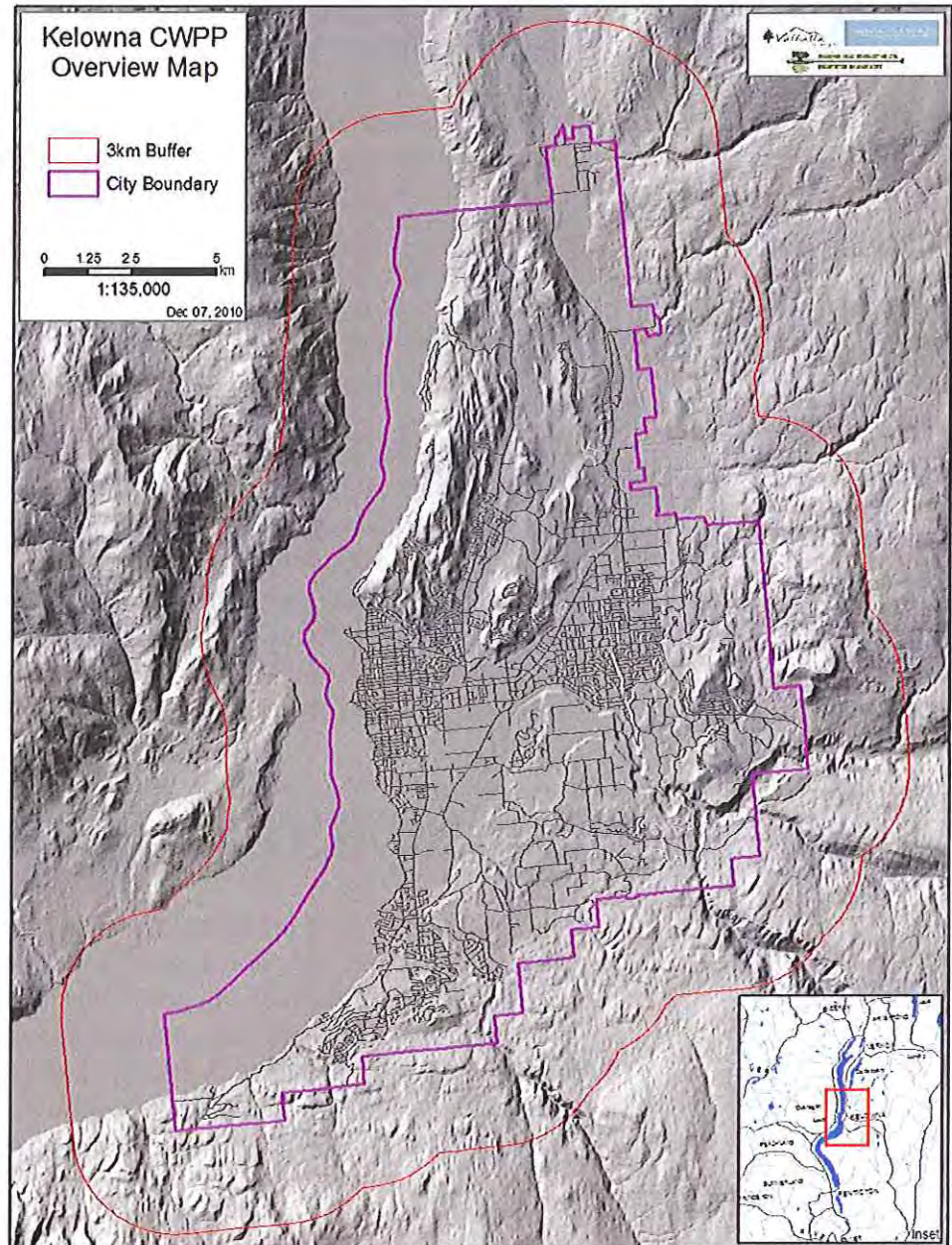
The City of Kelowna is on the Southern Interior Plateau of the Central Okanagan. It has a total land area of 214 km². Lake Okanagan forms its western border. The District of Lake Country is located to the north and lands governed by the RDCO surrounds the remainder of the City. Kelowna has a population of 107,000 (Statistics Canada Census, 2006). The City is a very popular summer vacation destination and experiences a significant increase in population during the summer months.

The City's downtown core is located in the middle of town adjacent to the Lake. There are numerous residential core communities throughout the City. Those with the highest density close to the wildland/urban interface include: Glenmore, Dilworth, Quail Ridge, Toovey Heights, Gallaghers Canyon and Southeast Kelowna.

A majority of the City is developed for residential, commercial or agriculture use. Almost 70% of the City does not support natural areas that would support a wildfire. Remaining areas consist of scattered smaller urban parks with continuous tracts of natural areas north of the City centre and along the southern perimeter of the City.

FIGURE 1.

Project Location
and Boundary





"The Okanagan experiences the driest and warmest summers in the province"

10.1 NATURAL ENVIRONMENT

The Coastal Mountains to the west of the Okanagan create a strong rain shadow effect that causes this area to experience some of the driest and warmest summers in the province. The ecological communities found in the Central Okanagan have evolved and adapted to long moisture deficits in the summer months and with the influence of periodic wildfires.

There are two Biogeoclimatic subzones that are found within the City of Kelowna. The majority of the western portion of the City is classified as the Very Dry Hot Ponderosa Pine Subzone (PPxh). The eastern portion of the City is classified as two variants of the Very Dry Hot Interior Douglas-fir Subzone (IDF_{xh1} and IDF_{xh1a}). Both of these subzones are characterized by very warm and dry summers with common moisture deficits during the growing season. The IDF_{xh} subzone has a slightly milder climate receiving more precipitation and experiencing cooler temperatures in comparison.

Table 4 Climatic Characteristics of the PP and IDF Zones within the City of Kelowna (Meidinger and Pojar 1991).

Biogeoclimatic Zone	Annual Precip. (mm)	Summer Precip. (mm)	Annual Snowfall (cm)	Summer avg. Temp. (°C)
Ponderosa Pine Zone (PP)	335	136	97	10.5
Interior Douglas-fir Zone (IDF)	476	195	170	5.0

Vegetation complexes found in the Ponderosa Pine zone consist of a combination of grassland and open forest communities with Ponderosa Pine (*Pinus ponderosa*) dominating most forest stands with minor components of Douglas-fir (*Pseudotsuga menziesii*). Forest structure ranges from open grasslands with scattered trees on dry, south facing slopes to denser stands approaching a closed forest on cooler and wetter exposures. Deciduous dominated stands are sparse and generally found in riparian areas and on floodplains.

Vegetation types found in the Interior Douglas-fir Zone are generally dominated by closed stands dominated by Douglas-fir with varying components of Ponderosa pine. Grassland communities are scattered on warmer exposures, particularly in the IDF_{xh1a} variant. Deciduous species are more common in the IDF zone; however, they are still isolated within mostly riparian areas and on floodplains.

The grassland, open forest communities, rock faces and lakes and rivers in and adjacent to Kelowna provide a high diversity of habitat for wildlife and plants. Lower elevation grassland and open forest communities are associated with about one half of the Red (endangered or threatened) and Blue-listed (of special concern) wildlife species in the Okanagan. These communities have been heavily impacted by human influences including development, agriculture, grazing and invasive species.



Riparian areas provide critical habitat for wildlife and plants. The health of riparian areas is of particular concern in the Okanagan, where the majority of the landscape is dry and hot during the summer months. While the City borders Lake Okanagan, there are a number of smaller lakes and creeks within the City. The most notable include Ellison, Walroy and Robert Lakes. These have 30 meter buffers to highlight the critical riparian zones to be considered for protection. The two most significant creek systems include Mission Creek and Mill Creek but there are numerous other smaller creeks and tributaries.

The BC Conservation Data Centre (CDC) has identified BC's most vulnerable vertebrate animals, vascular plants and ecosystems, each of which is assigned to a provincial Red or Blue list according to their provincial conservation status rank. Species or populations at high risk of extinction or extirpation are placed on the red list and are candidates for formal endangered species status. Blue-listed species are considered vulnerable to human activity and natural events. A search of the BC Ministry of Environment Conservation Data Center database showed 12 occurrences of a Red-listed plant and animal species and 10 Blue-listed species.



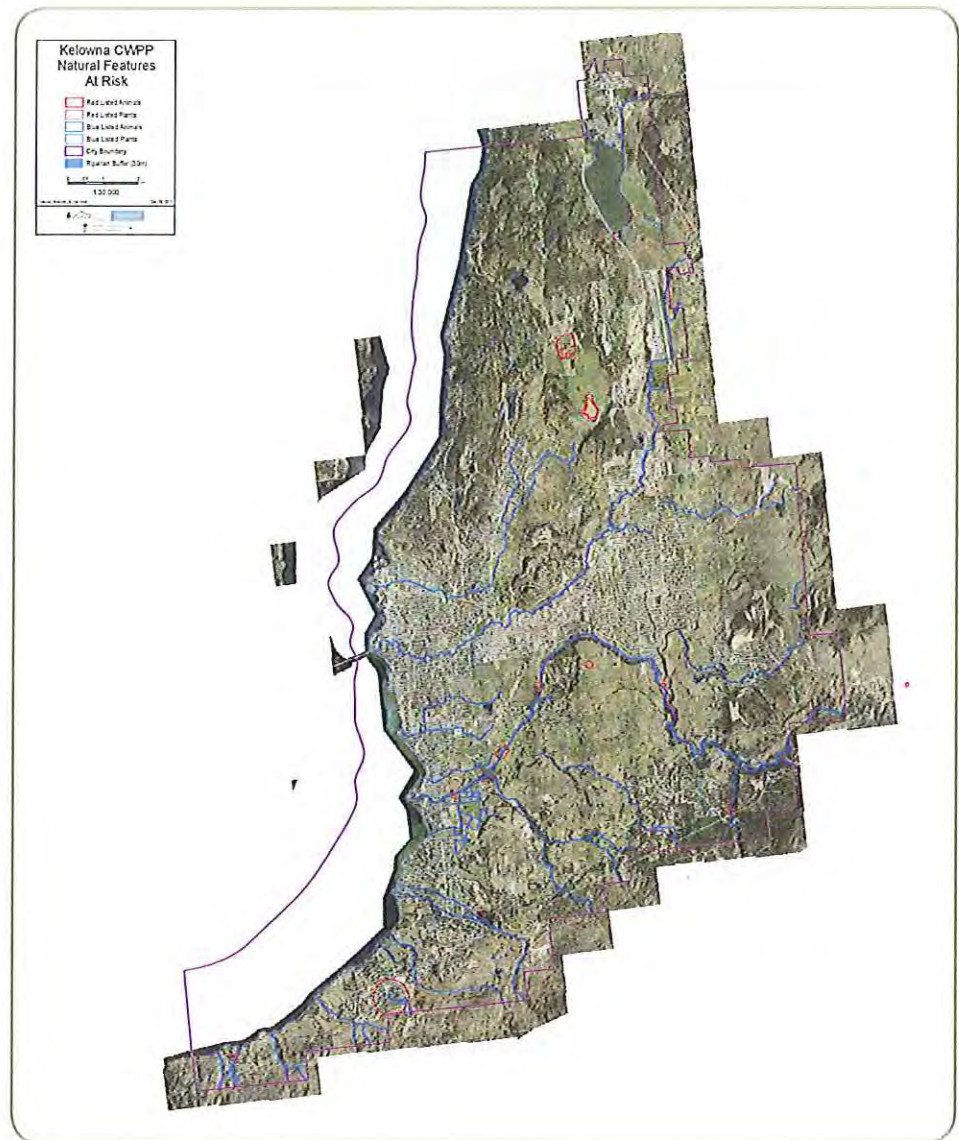
Table 5 Blue and Red-listed Species Recorded within the City of Kelowna

Common Name	Scientific Name	Category	BC List
Englemann's spike-rush	<i>Eleocharis engelmannii</i>	Vascular Plant	Red
near navarretia	<i>Navarretia propinqua</i>	Vascular Plant	Red
hairy water-clover	<i>Marsilea vestita</i>	Vascular Plant	Red
slender hawksbeard	<i>Crepis atribarba</i> ssp. <i>atribarba</i>	Vascular Plant	Red
peach-leaf willow	<i>Salix amygdaloides</i>	Vascular Plant	Red
yellowseed false pimpernel	<i>Lindernia dubia</i> var. <i>dubia</i>	Vascular Plant	Red
red-rooted cyperus	<i>Cyperus erythrorhizos</i>	Vascular Plant	Red
ovate spikerush	<i>Eleocharis ovata</i>	Vascular Plant	Red
Lewis's Woodpecker	<i>Melanerpes lewis</i>	Vertebrate Animal	Red
American Avocet	<i>Recurvirostra americana</i>	Vertebrate Animal	Red
Western Screech-Owl	<i>Megascops kennicottii macfarlanei</i>	Vertebrate Animal	Red
Western Screech-Owl	<i>Megascops kennicottii macfarlanei</i>	Vertebrate Animal	Red
false-mermaid	<i>Floerkea proserpinacoides</i>	Vascular Plant	Blue
obscure cryptantha	<i>Cryptantha ambigua</i>	Vascular Plant	Blue
three-flowered waterwort	<i>Elatine rubella</i>	Vascular Plant	Blue
northern linanthus	<i>Leptosiphon septentrionalis</i>	Vascular Plant	Blue
awned cyperus	<i>Cyperus squarrosus</i>	Vascular Plant	Blue
many-headed sedge	<i>Carex sychnocephala</i>	Vascular Plant	Blue
awned cyperus	<i>Cyperus squarrosus</i>	Vascular Plant	Blue
freckled milk-vetch	<i>Astragalus lentiginosus</i>	Vascular Plant	Blue
Great Basin Spadefoot	<i>Spea intermontana</i>	Vertebrate Animal	Blue
Spotted Bat	<i>Euderma maculatum</i>	Vertebrate Animal	Blue

Significant natural features found within the City are illustrated on Figure #2 – Natural Features at Risk. These features must be considered and protected during wildfire suppression efforts and fuel treatment projects. This inventory of natural features should be updated every five years.

Number	Action Item	Priority
Rec #4	The natural features at risk map should be reviewed and updated every five years.	B

FIGURE 2.
Natural
Features at Risk



10.2 ARCHAEOLOGICAL FEATURES

Features of historical and cultural significance have been identified and should be considered for protection during wildfire planning and suppression activities.

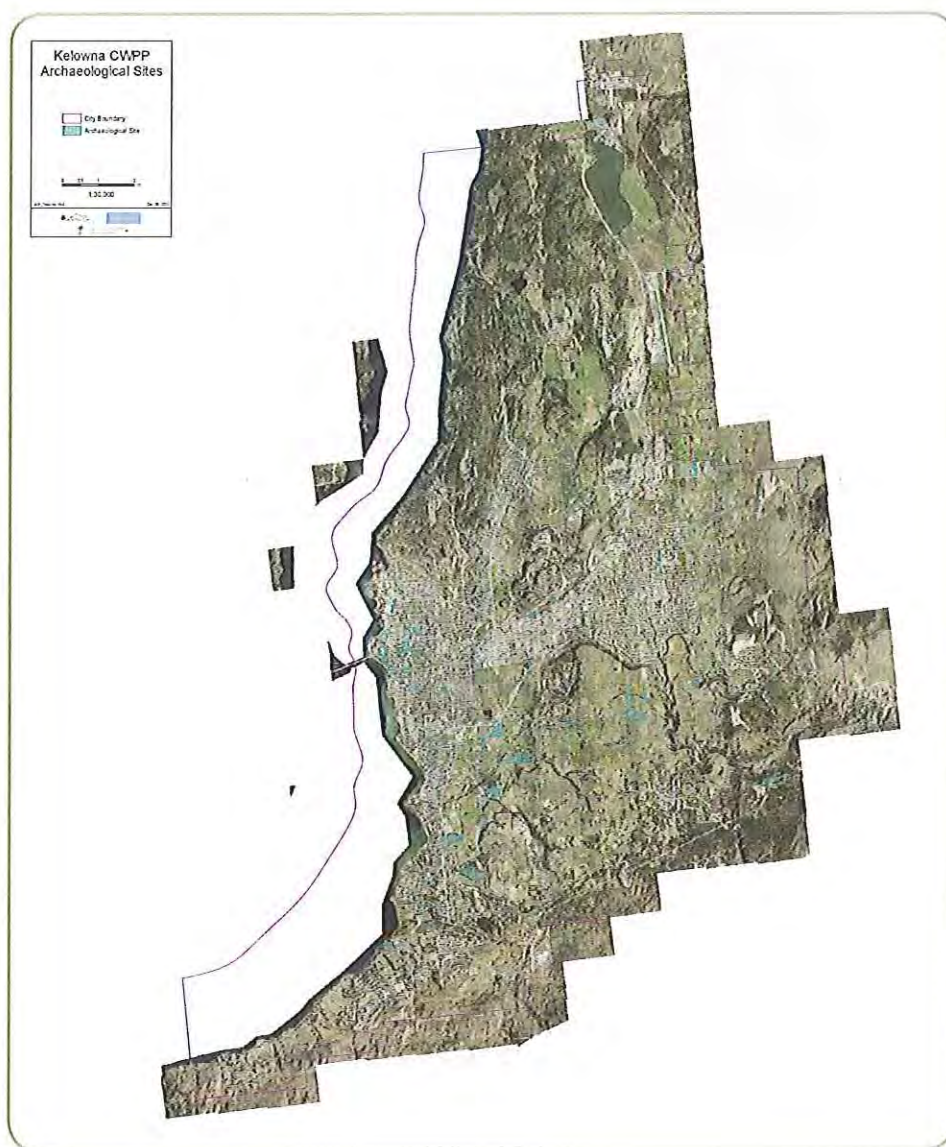
It should be noted that there is little public information available for these features. Also, First Nation values are often not available through the provincial government data bases due to the sensitive nature of the information. In the event there is a wildfire, or fuel treatments are planned and implemented, the local First Nations should be contacted to ensure the local knowledge of cultural features is obtained.

Archaeological features found within the City are illustrated on Figure #3 – Archaeological Features at Risk. These features must be considered and protected during wildfire suppression efforts and fuel treatment projects. This inventory of natural features should be updated every five years.

Number	Action Item	Priority
Rec #5	The archaeological features map should be reviewed and updated every five years.	B

FIGURE 3.

Archaeological
Features at Risk





10.3 NATURAL DISTURBANCE REGIME

All ecosystems are influenced by periodic disturbances that vary in size, severity and frequency. Common disturbances include: wildfire; windthrow; ice and freeze damage; water; landslides; insect and disease outbreaks; as well as human caused events such as logging. These disturbances influence the successional progress of an ecosystem.

Historically, agents of disturbance were viewed as a threat to the integrity of the forest resource and, as such, it was standard policy to suppress all wildfire and to eliminate forest pests. As a result, many of these ecosystems are now becoming degraded by the loss of organisms and early seral-stage vegetation communities. Additionally, many fire dependent ecosystems are developing biological and physical instabilities such as hazardous fuel accumulation and pest outbreaks.

Wildfire is often the most dramatic disturbance type and has the ability to immediately and significantly alter the physical and biological characteristics of an ecosystem. It can change the structure and species composition of a forest, remove some or the entire forest floor organic layer, and alter the chemical properties of the soil. In ecosystems where natural wildfires are frequent, fire helps to prepare seed beds, recycle nutrients, alter plant succession, maintain a diversity of seral stages across the landscape, control insect and disease outbreaks and reduce fuel accumulations. Many of the native plant species found in fire-dominated ecosystems depend on fire for their existence.

All biogeoclimatic subzones are categorised into five natural disturbance types (NDT) based upon the size and frequency of natural disturbances that historically occur:

- NDT 1 Ecosystems with rare stand-initiating events
- NDT 2 Ecosystems with infrequent stand-initiating events
- NDT 3 Ecosystems with frequent stand-initiating events
- NDT 4 Ecosystems with frequent stand-maintaining fires
- NDT 5 Alpine Tundra and Sub-alpine Parkland ecosystems

The subzones in the Southern Interior Plateau of the Central Okanagan are classified as NDT 4 – Ecosystems with frequent stand maintaining fires. These ecosystems have evolved with frequent wildfires and are characterized by fire-dependent or fire-resistant species and a relatively young age class distribution.

Prior to European settlement, the forests found in the Kelowna area were

"These changes in the forest structure have increased the probability of large, high intensity stand initiating fires."

characterized by open stands of mature and old ponderosa pine with gaps occupied by grassland communities (Feeney 1998). Frequent, low intensity surface fires, occurring every 2 to 20 years, helped maintain these conditions (Feeney 1998, Stone et al. 1999, Wright 1978). Wildfire maintained these stand conditions by consuming surface fuels, rejuvenating fire adapted herb and shrub species, thinning out in-growth regeneration, and raising the height of tree crowns. Large stand initiating crown fires did occur but were less frequent, occurring every 150-200 years.

Forests currently found in these ecosystems have been dramatically altered by fire suppression, grazing and logging (Taylor, Baxter and Hawkes 2004). Forests have become denser and more uniform with a greater abundance of younger trees established in the understory (Arno 1988). Additionally, fire exclusion has resulted in a build-up of surface and ladder fuels and has contributed to the establishment of invasive species (Steele et al. 1986, McIver et al. 2001). These changes in the forest structure have increased the probability of large, high intensity stand initiating fires (Weatherspoon and Sinner 1996).

A recent study of the changes in the forest/grassland communities in the southern interior of BC has shown a 50% reduction in the total area of grassland and open forest communities within the past 40 years. At the current rate, these communities are expected to disappear completely by 2032. Additionally, the proportion of areas susceptible to a fire with greater than 50% crown consumption increased from 7 to 14% and is expected to increase to 29% by 2032 (Taylor, Baxter and Hawkes 2004).

11.0 THE CURRENT FIRE ENVIRONMENT

11.1 HISTORIC FIRE WEATHER ANALYSIS

Weather conditions used to calculate fire behaviour were derived from historic records dating back to 1970 for three MFLNRO weather stations:

Table 6 MFLNRO Weather Stations

Station #	Station Name	Station Name	Latitude	Longitude	Elevation (m)	Start Year	End Year
298	Fintry	IDF xh 1	50.2067	-119.48	670	1989	2006
328	Penticton RS	BG xh 1	49.5183	-119.553	427	1970	2006
289	Kal Lake Vernon	IDF xh 1	50.2	-119.3	4	1986	1990

Historical weather data for the City was statistically analyzed for the months of May to September. The 80th percentile indices were used to represent the worst-case scenario for fire weather conditions (Table 2). This information, along with ground fuel plot data, was used to model fire behaviour characteristics.

Table 7 Fire Weather Indices Between the Months of May to September.

Station	Fine Fuel Moisture Code	Duff Moisture Code	Drought Code	Initial Spread Index	Build Up Index	Fire Weather Index	Relative Humidity	Precip. (mm)	Temp.
#298 - Fintry									
80th Percentile	91.9	89.4	716.1	7.3	129.6	27.4	63	1.0	26.2
Average	80.0	66.8	520.7	4.5	95.1	15.5	48.4	1.0	20.5
Maximum	96.6	972.0	1187.0	35.3	414.0	81.7	100	31.5	35.6
#328 - Penticton									
80th Percentile	92.1	92.2	649.6	9.4	130.6	31.3	56	0.8	25.6
Average	83.1	65.0	471.2	6.5	91.4	19.6	43.9	1.0	20.7
Maximum	100.4	383.3	1193.0	135.0	425.1	165.4	100	75.0	35.7
#289 - Kal Lake Vernon									
80th Percentile	92.7	105.5	623.3	8.6	143.6	31.2	54	0.8	26.1
Average	83.3	71.6	433.7	5.7	97.5	19.1	42.0	1.1	21.6
Maximum	97.7	201.1	802.3	29.4	214.7	62.3	92	26.2	33.4

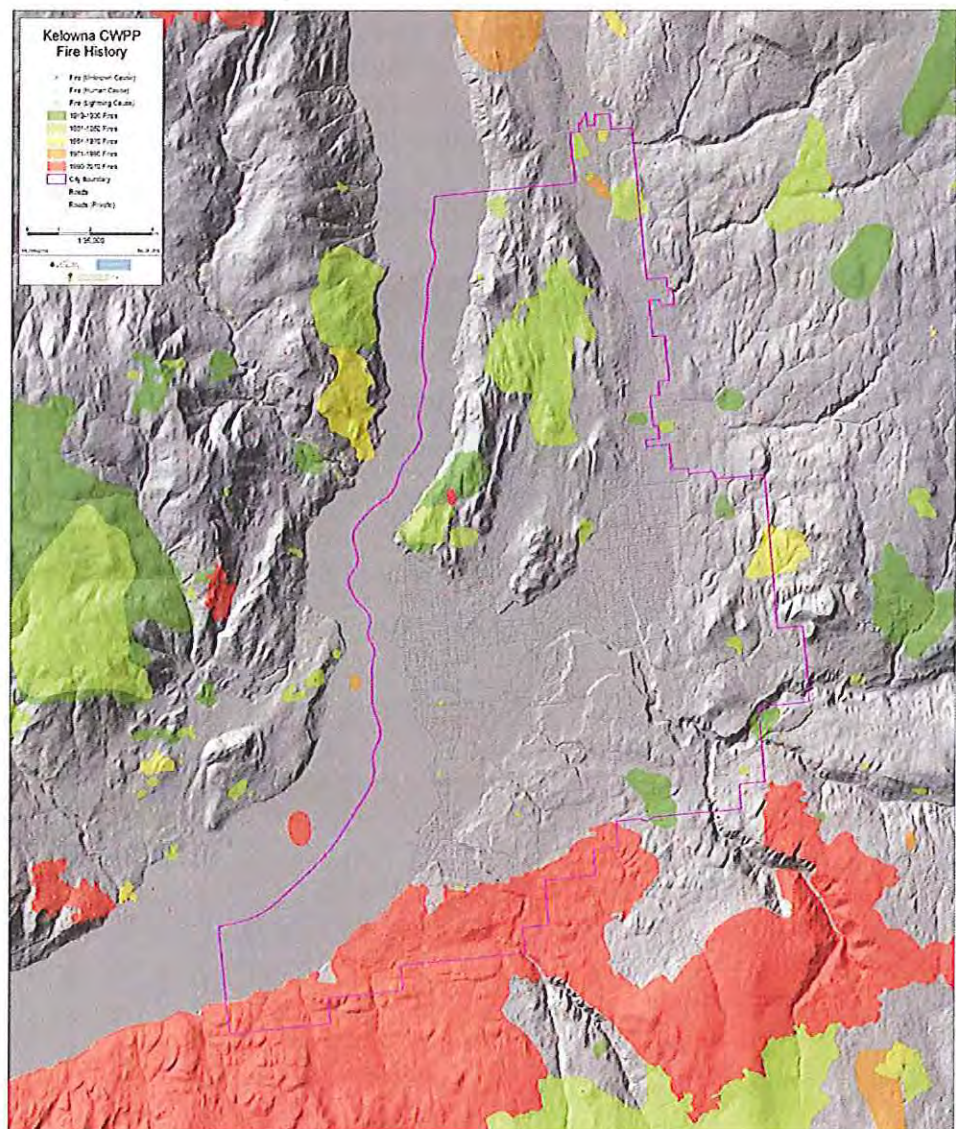
During the fire season, the Wildfire Management Branch collects hourly weather station data and uses it to evaluate the fire behaviour potential. This is categorised into a Danger Class Report that is posted for the entire province. The Danger Class Rating is categorised as: Low I, Moderate II, High III and Extreme IV. When the Danger Class is High or Extreme, forest fuels are very dry and the risk from wildfire is significant. Under these conditions, wildfire can start easily and spread quickly.

For the three weather stations that best represent the conditions in the City of Kelowna, the average number of days per year that reach a Danger Class value of three or greater is between 120 and 130. This is based on a 10 year average of historic data. These statistics show that for about 4 months of the year in the summer, there is a high risk of a significant wildfire event.

11.2 FIRE HISTORY

The Ministry of Forests, Lands and Natural Resource Operations maintains a record of all historic wildfires that have occurred within the province. There have been a large number of wildfire that have occurred in and adjacent to the City. The distribution and frequency emphasizes the natural role of wildfire in this region. The most notable and well known wildfire took place in August and September of 2003. This wildfire consumed 25,000 ha to the south and east of the City and destroyed 239 homes. There have also been wildfire of significant size that occurred on Knox Mountain and north of the landfill.

FIGURE 4.
Wildfire History
in Kelowna



"For about four months of the year in the summer, there is a high risk of a significant wildfire event."

11.3 LOCAL FUEL TYPES

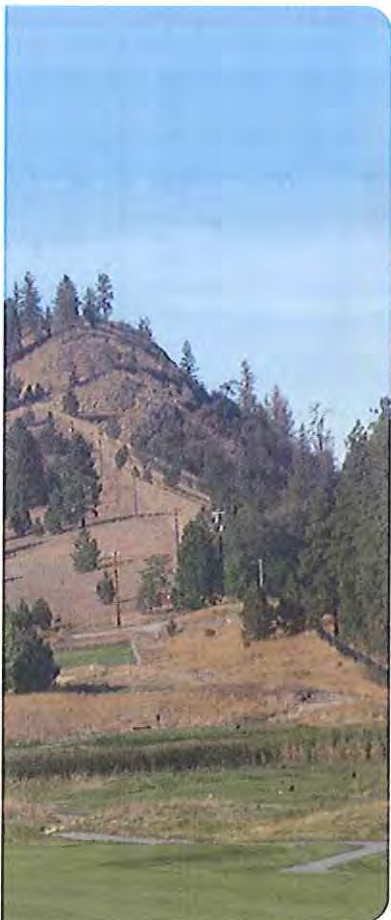
Sixteen national benchmark fuel types are used by the Canadian Fire Behaviour Prediction System. This system divides fuels into five major groups and 16 more specific fuel types. These groups are used to describe fuels according to stand structure, species composition, surface and ladder fuels and the organic (duff) layer.

Fuel types were derived by running the vegetation resources inventory database for this area through an algorithm. These areas were updated using field reconnaissance and air photo interpretation. It should be noted that each fuel type represents a fire behaviour pattern and may not necessarily match the fuel types described in the classification system. In addition, many of the fuel profiles are not exact matches; however, they are the closest profiles available using FBP97 as a fire behaviour model. Fuel type designation is illustrated on Figure #5 – Fuel Types.

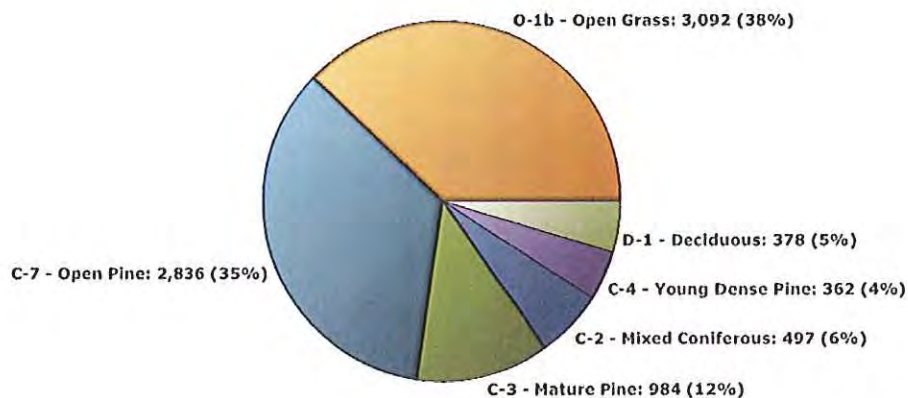
Table 8 *The Fuel Type Classification and Representative Areas Found within the City of Kelowna*

Fuel Type Classification	Total Area (ha)	% of total area	% of natural area
O-1b – Open grass	3,092	12%	38%
C-7 – Open ponderosa pine stands	2,836	11%	35%
C-3 – Mature pine stands	984	4%	12%
C-2 – Mixed multi-canopied coniferous stands	497	2%	6%
C-4 – Young dense pine stands	362	1%	4%
D-1 – Deciduous dominated stands and shrub	378	1%	5%
N – Non fuel areas	13,282	51%	
W – Water	4,695	18%	
Total	26,130		



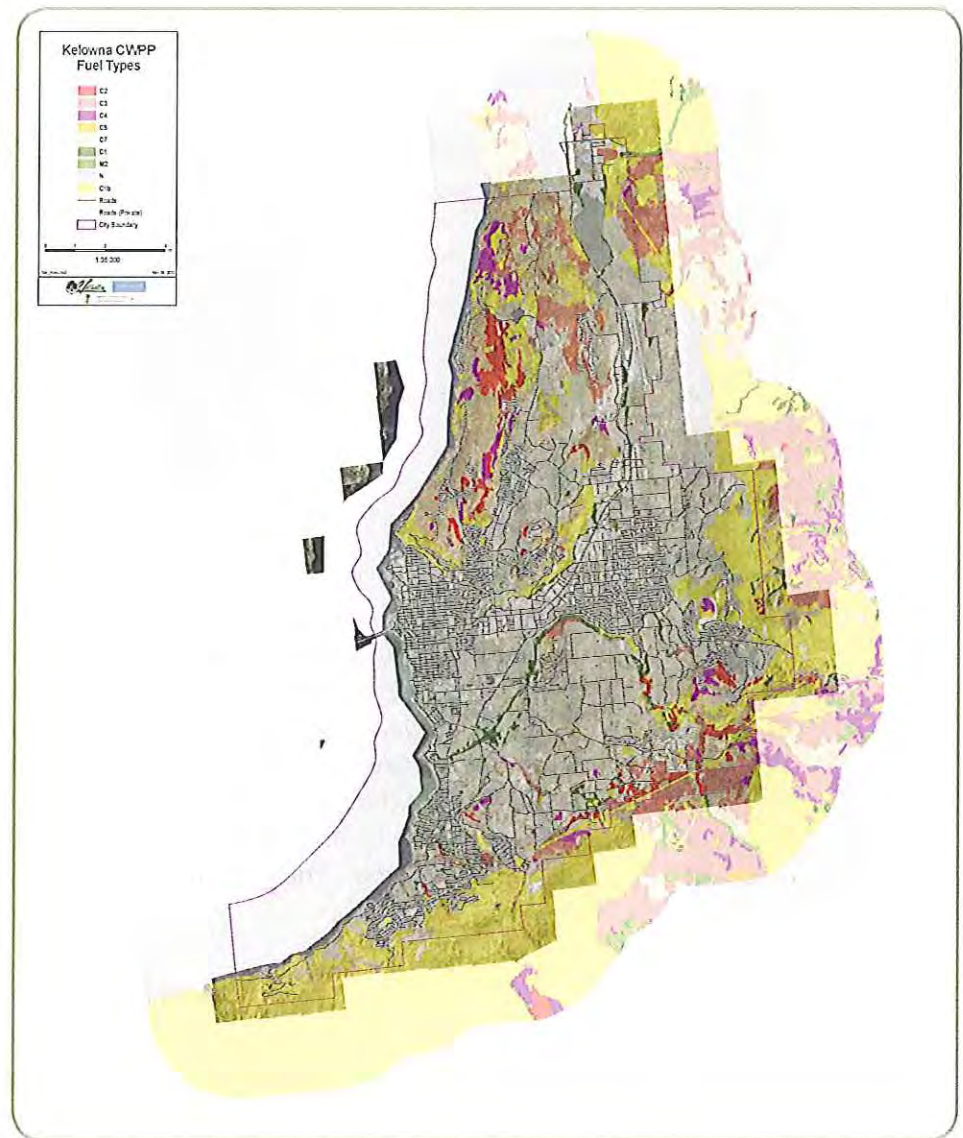


Area (ha) of Fuel Types



The largest natural area components found within the City are classified as grasslands or open Ponderosa pine stands. These areas generally have the potential to carry a fast moving low intensity ground fire. These types of ground fires pose the greatest risk of carrying a fire into adjacent, more volatile fuels. The fuel types that pose the greatest risk include the closed coniferous stands classified as C2, C3 and C4. These together cover 7% of the land area and 22% of the natural area. . These fuel types are the focus for risk mitigation.

FIGURE 5.
Fuel Types



Fuel Type O1b

11.3.1 Fuel Type O1b - Open Grass

This fuel type includes areas that are dominated by grasses. These natural grassland communities are found throughout the Okanagan Region. These fuels tend to dry out in the summer months and result in a fuel source that ignites easily, spreads quickly, but has a quick burn out time. These fuels tend to present the greatest hazard when they act as kindling for larger fuels.



Fuel Type C-7

11.3.2 Fuel Type C-7 – Open Ponderosa Pine Stands

This fuel type is characterized by uneven-aged open stands of mature Ponderosa pine. Stands are open with occasional clumpy thickets and individual trees. Canopy closure is less than 15% overall, although thickets are often closed and dense. Woody surface fuel accumulations are light and scattered. Dense pockets of conifers associated with this fuel type have a high fire behaviour potential, but fuel continuity is usually low. In the City, areas are classified as C7 where they have been selective thinned out. These stands pose a low to moderate fire behaviour potential.



Fuel Type C-3

11.3.3 Fuel Type C-3 - Mature Lodgepole Pine

This fuel type is characterized by pure, fully stocked Ponderosa pine stands with mixed components of Douglas-fir that have achieved complete crown closure. Stands can have a low to very high coverage of shrub and/or grass complexes depending on subzone, aspect and canopy closure. Surface fuel loading can vary depending on past thinning activities and overstory mortality. Height to the main canopy is generally greater than 3 m, but the presence of understory conifers or tall shrubs can contribute to ladder fuels. Canopy fuel loading is variable and can range from moderate and patchy to high and continuous depending on ingrowth. These stands generally pose a high fire behaviour potential.



Fuel Type C-2

11.3.4 Fuel Type C-2 – Mixed Multi-Canopied Coniferous Stands

These mixed coniferous stands are moderately well-stocked. Stands tend to be dominated by a mix of pine, Douglas-fir and western redcedar. They have dense crowns that extend to, or near, the ground. This low crown provides a ladder fuel layer that allows surface fire to move easily into the crown fuel layers. Low to moderate volumes of downed, woody material are often present.



Fuel Type D-1

11.3.5 Fuel Type D-1 – Deciduous Dominated Stands And Shrub

Within some of the riparian and wetland areas of the City, there are stands with a varying composition of deciduous species. Deciduous species are not as flammable as conifer species. Therefore, they do not contribute to a high fire behaviour potential, particularly in wetter ecosystems. Understory vegetation can be lush and rich with a high moisture regime throughout the year. These stands pose a low fire behaviour potential and have proven to be effective canopy fuel breaks due to their lower volatility and their association with wetter understory environments



Fuel Type C-4

11.3.6 Fuel Type C-4 –Young Dense Pine Stands

This fuel type is characterized by very dense Ponderosa pine stand with a minor component of Douglas-fir. Stands have a very high number of stems per hectare (>1000) and are generally less than 50 years old. Trees are not very tall (<25 m in height) and can have branches extending down to or near ground level. Natural thinning mortality causes a large quantity of standing dead stems and dead downed woody fuel. The shrub layer is sparse to moderately developed due to high crown closure and there is often a moderate level of ground fuel loading. Crown loading and ladder fuels are high and continuous. These stands pose a high to very high fire behaviour potential.

11.4 THE MOUNTAIN AND WESTERN PINE BEETLES

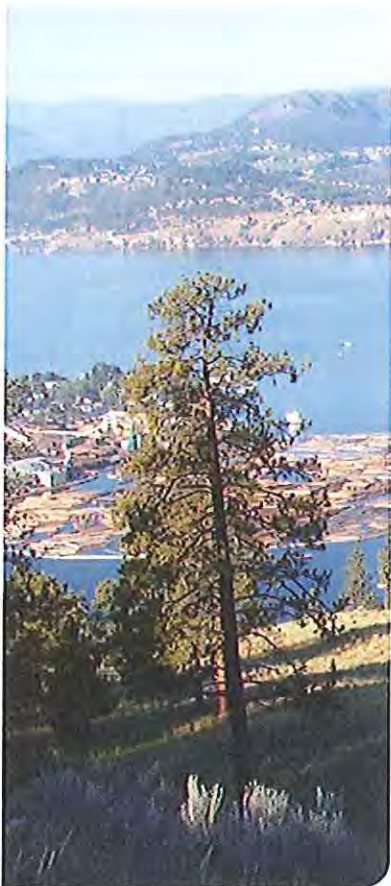
Continuous tracts of even aged forests create uniform conditions that are prone to insect and disease outbreaks. Pest outbreaks can often naturally be controlled by agents such as wildfire. Fire suppression and a warmer climate have negated this balance and created unstable conditions that have resulted in the largest outbreak of Mountain pine beetle (MPB) recorded in North America.

An intricate and cyclical relationship between wildfire and the MPB exists. While the beetle depends on lodgepole pine dominated forests for habitat, beetle outbreaks contribute to fuel build-ups which make the forest more prone to wildfire. These resulting stand-replacing fires control the MPB outbreak, but ensure the regeneration of lodgepole pine (an early seral stage species in these ecosystems). Although the beetle creates conditions detrimental to its short-term population, it ensures the long-term survival of the species by maintaining forests of its own species. Similarly, lodgepole pine provides a habitat for the MPB, contributing to its own mortality, but in turn creates conditions favouring the regeneration of its own species.

In general, beetle kill found within natural stands in the City of Kelowna is present but not yet at significantly high levels. A large portion of the beetle kill is attributed to the western pine beetle which is currently at natural historical levels experienced in the region. The extent of western pine beetle infestation has diminished after having peaked in 2008. There are localised pockets of mountain pine beetle that have established in the Kelowna area; however, they have not yet reached the epidemic levels experienced in other areas of the province.

The influences of mountain and western pine beetles have the potential to cause widespread forest mortality in Kelowna. This type of impact would have a dramatic influence on fuel conditions and associated fire risk in and around the City.

"The pine beetles have the potential to cause widespread forest mortality in the City of Kelowna dramatically increasing wildfire risk"



12.0 LANDSCAPE – LEVEL WILDFIRE RISK ANALYSIS

12.1 WILDFIRE RISK ASSESSMENT

The “Wildfire Risk Analysis” (WRA) is a GIS based model that spatially quantifies and analyzes the relationships that exist between the critical factors affecting wildfire risk. The objective of this model is to provide a decision making tool that spatially identifies the severity of wildfire threat on a landscape level. The overall hazard ranking spatially determines wildfire threat by incorporating four key components as follows:

1. Fire behaviour characteristics (40% of the weighting);
2. Risk of ignition (10% of the weighting);
3. Threat to structures, natural features and cultural features of significance (25% of the weighting); and
4. Suppression constraints (25% of the weighting).

These four components are calculated from contributing factors, each of which is represented by a layer in the Geographic Information System. Wildfire hazard for each component is calculated by overlaying the relevant contributing factors. Layers representing these four components are subsequently overlain to produce the final wildfire risk rating. A detailed description of the methodology for this analysis can be found in Appendix A.

12.2 DISCUSSION OF RESULTS

The objective of the WRA is to provide a landscape level overview of the risk posed by a potential wildfire. The WRA provides valuable direction for land use planning on a broad scale. However, due to the coarse scale of the input data, its application to site specific treatments is often limited. The results from the WRA should be used to identify high risk areas and to highlight the factors that are contributing to this risk. All areas within a 3 km buffer around the City have been included in this analysis.

12.2.1 Fire Behavior Potential

The results from this fire behavior modeling is illustrated on Figure #6 – Fire Behavior Potential. These values are calculated using a Canadian software model that accounts for fuel classification, slope, aspect and high risk weather conditions typical of the area. The fire behaviour map can be used in three ways: to determine the location of high fire behaviour areas that require treatment, to assist in the safe development of future neighbourhoods and to demonstrate to the public and private landowners where fire risk and fuel hazards exist. Overall fire behaviour potential is not high for open forest and grassland complexes. However, all forested coniferous



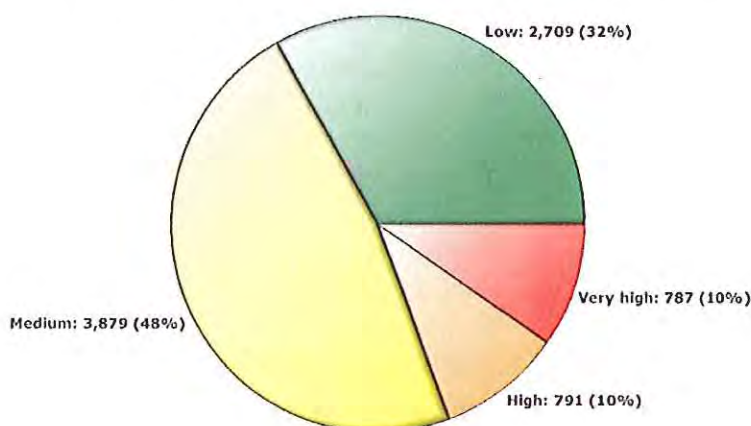
stands have moderate to high fire behaviour potential. This is a result of the extreme fire weather conditions experienced during the summer months. Results from this analysis also show that fire behaviour potential increases dramatically with the slope of the terrain.

One third of natural areas analysed have a fire behaviour potential that is low. This includes mostly grassland and open forest communities typically found on south and west facing slopes. The remainder of natural areas have a significant wildfire risk, with 20% posing a high to very high risk. This emphasizes the potential severity of wildfire in the City during the summer months.

Table 9 Summary of Fire Behavior Potential for Natural Areas

Fire Behaviour	Total Area (ha)	% of total area
Low	2,709	33%
Medium	3,879	48%
High	791	10%
Very High	787	10%

Fire Behavior Potential of Natural Areas (ha)





Large, contiguous tracts of forested natural area in and adjacent to the City are the priority for fire management. Fragmented natural areas are easier to control and less likely to build up to a considerable size. Larger tracts of forested land have the potential to build quickly and have a higher spotting potential into the interface areas.

Within City limits, there are two areas with relatively contiguous forested natural that pose a significant risk on a landscape level. The first is an area that extends north from Knox Mountain to the City limits. This area is mostly to the west of Glenmore Drive in the south and then above the Landfill and west of Ellison Lake. The natural areas are fragmented by development of varying densities. Neighbourhoods at risk include Clifton, Glenmore Highlands and McKinley Landing.

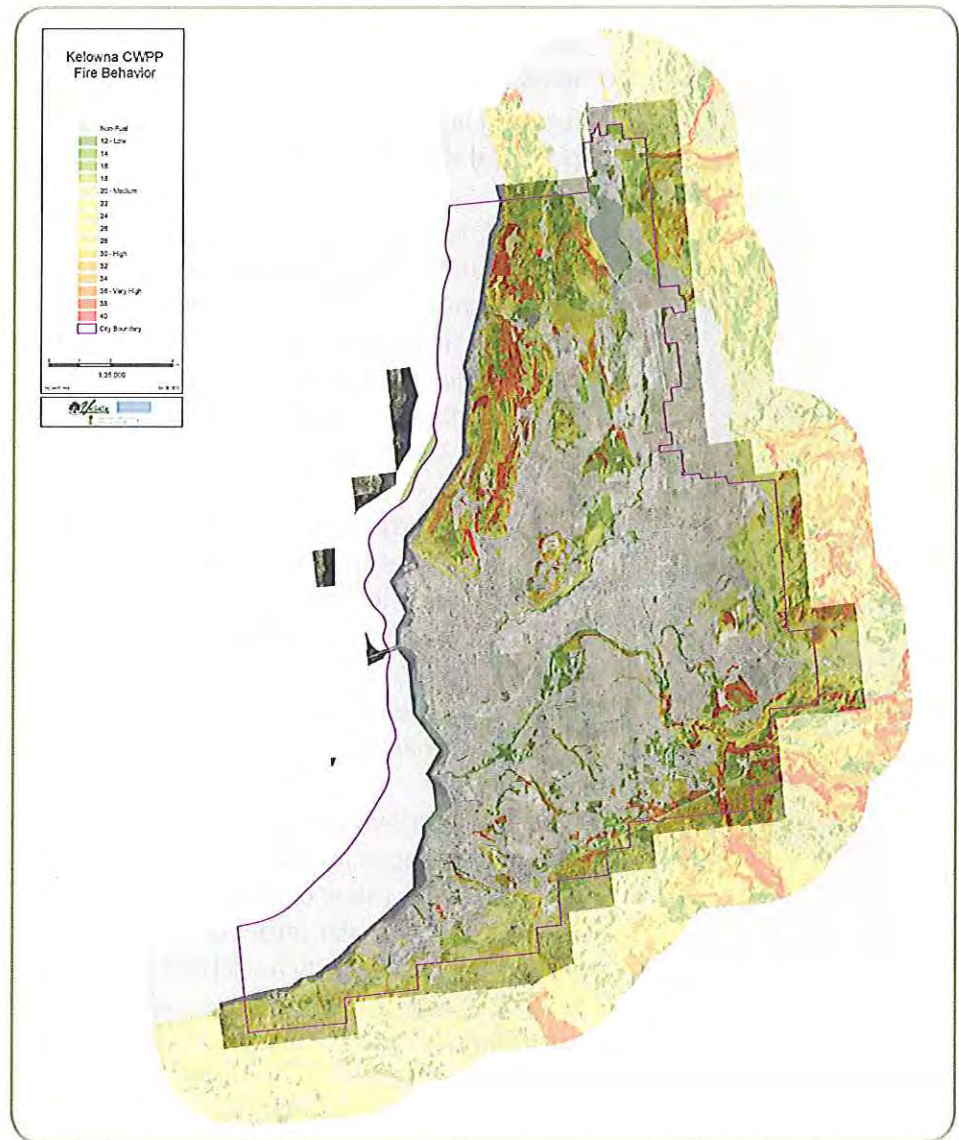
The second large area of concern is in Southeast Kelowna. The Southern boundary of Kelowna is dominated by grasslands that are a result of the 2003 wildfires. To the east of the old fire there are larger continuous forested areas that extend south and east. Neighbourhoods at risk include Southeast Kelowna, Gallaghers Canyon and Black Mountain. The hydro right of way provides an excellent landscape level fuel break through much of this high risk area.

Dilworth is a developed community that is notable because it has moderate to high slopes and includes extensive interface zones with fragmented forested areas, many of which are owned by the City. These areas were identified as high risk interface areas during the 2004 fuels assessment. Subsequently, the majority have been thinned and pruned. There are specific areas that still pose a moderate risk and have been identified for further treatment.

East of the City limits there are continuous natural areas with few fire breaks and moderate to high fire behaviour potential. Most of these natural areas are well buffered from structures at risk by agricultural lowland that provides effective fire breaks.

FIGURE 6.

Wildfire Behaviour Potential



12.2.2 Values at Risk Component

The Values at Risk component incorporates significant man made structures and critical natural and archaeological features that would be detrimentally impacted by a wildfire.

Developments at risk from a wildfire are indicated on the maps by 100 m buffers around structures and infrastructure at risk. This component illustrates the concentration of values that are at risk in the interface areas. It defines what the potential consequence of a wildfire would be and helps to prioritise resources for reducing risk in the City. The results from this analysis are illustrated on Figure #7 – Values at Risk.





There is very little natural forest area remaining throughout the lower elevation valley bottom of the City. This area is generally well developed by residential, commercial and agricultural development. The majority of the wildland/interface areas are where development is encroaching on adjacent, more mountainous terrain. These areas are found predominantly in the neighbourhoods north from Knox Mountain, including Clifton, Glenmore Highlands and McKinley Landing. Neighbourhoods in the southeast of the City include Southeast Kelowna, Gallagher's Canyon and Black Mountain. There also numerous smaller interface natural areas that are fragmented in the City. The most significant areas are found on Dilworth, Quail Ridge and Hall Road.

The majority of structures in the interface are single unit residential developments. There is very little commercial development within the interface. Density of these areas is variable. There are low to moderately dense rural 'intermix' areas (>1 structure/ha). These properties have larger lot sizes with more forested areas between structures and a less defined perimeter. Intermix areas are tactically more challenging to protect. They can experience vegetation ignitions on all sides, from nearby adjacent structures and from spotting.

Most higher density neighbourhoods have a clearly defined interface perimeter. These types of interface areas have a more uniform, and potentially less complex, perimeter to defend. Fuel breaks established in preparation for a wildfire can prove effective for reducing the behaviour of an approaching wildfire, protecting interface structures from radiant heat and providing safe defensible space from which suppression personnel can anchor their suppression activities.

All structures within the urban/wildland interface have been inventoried as a part of this analysis. Natural areas within 100 m of structures have been categorised by fire behaviour potential. Just over one half of the urban interface poses a moderate to very high fire behaviour risk. These areas should all be analysed and strategies implemented to reduce this risk.

Table 10 Summary of Fire Behaviour Potential within the Urban/Wildland Interface (100 m from Structures)

Fire Behaviour	Total Area (ha)	% of total area
Low	894	44%
Medium	845	41%
High	171	8%
Very High	131	7%
Total Area	2042	



Fire Behavior Potential in the Urban/Wildland Interface (ha)

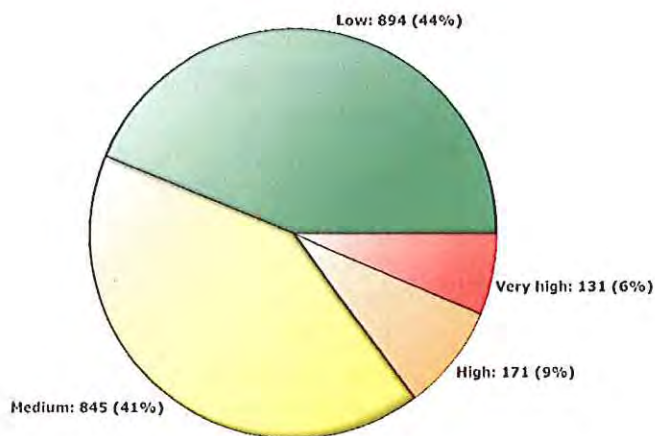
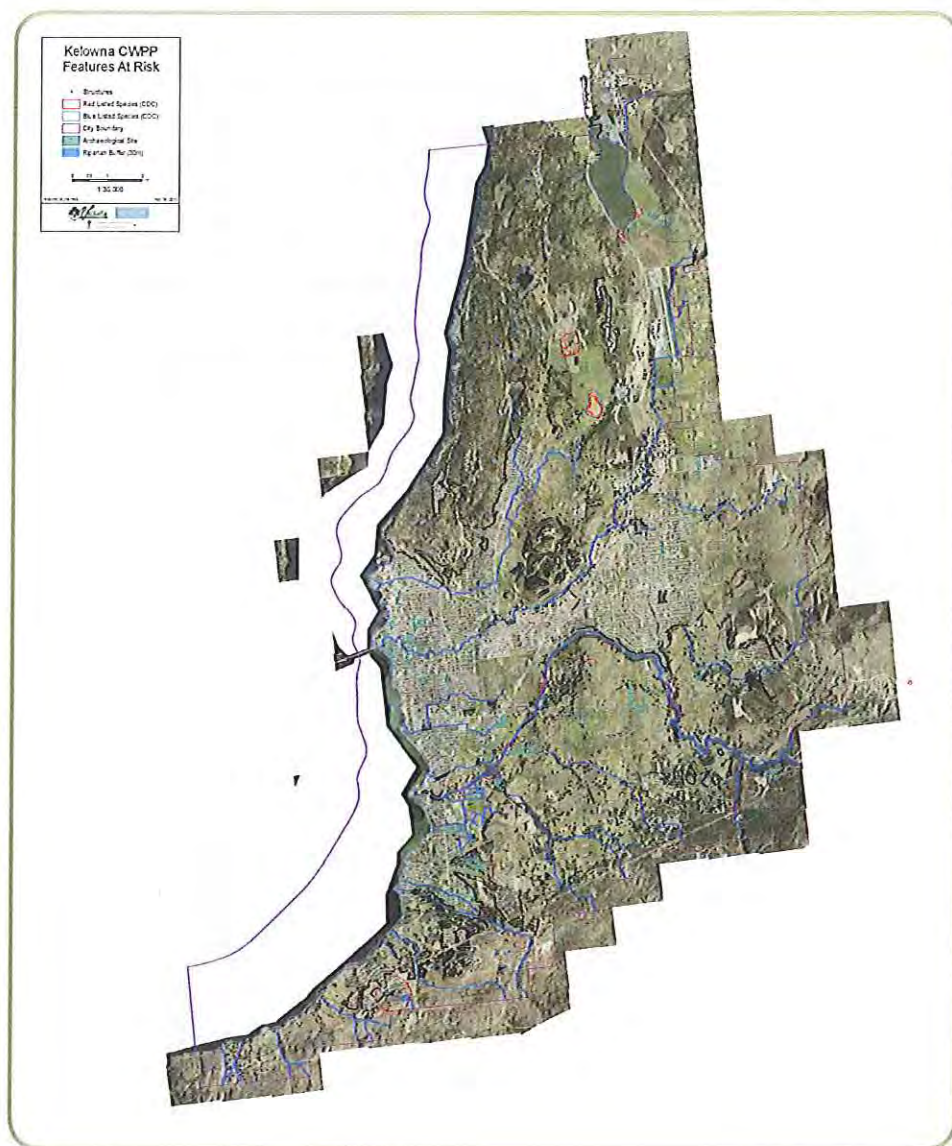


FIGURE 7.
Features at Risk



12.2.3 Risk of Ignition

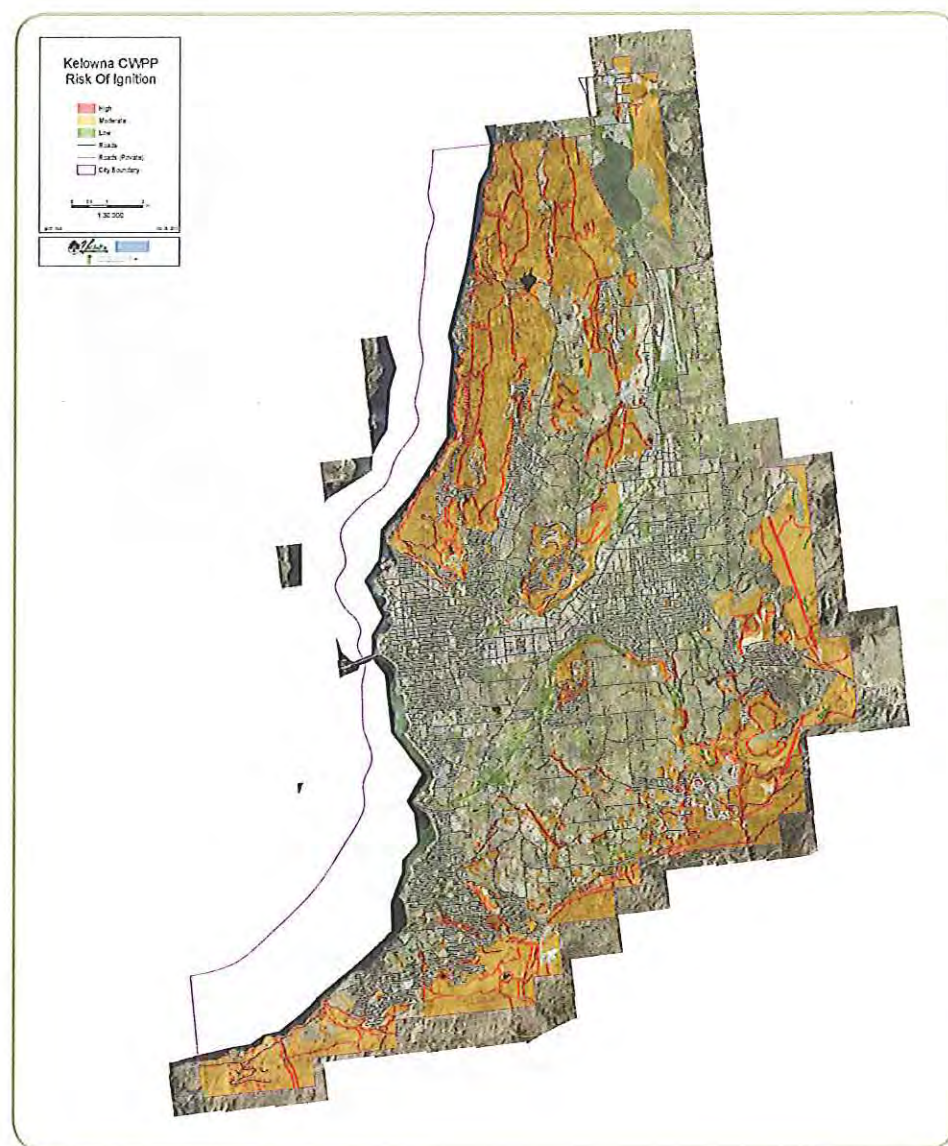
The Risk of Ignition component accounts for both human caused and lightning caused ignitions. The results from this analysis are illustrated on Figure #8 – Risk of Ignition.

Lightning caused ignitions pose a moderate risk across most natural areas that support tree cover. There are no topographical features within the City that would cause the risk of ignition to be concentrated anywhere specific. Within an urban area there is an abundance of human caused ignition sources including:

- Heavy industry activity
- Discarded cigarettes and matches
- Vehicle traffic
- House related fires
- Power lines
- Camp fires
- Vandalism
- Railways

The most common human caused sources of ignition is from machinery and discarded cigarettes along the extensive road system and recreation trails that run through forested landscape. These areas are clearly highlighted. Also, development that is intermixed in natural areas poses a significant risk from sources such as house fires, BBQs and landscaping equipment.

FIGURE 8.
Risk of Ignition





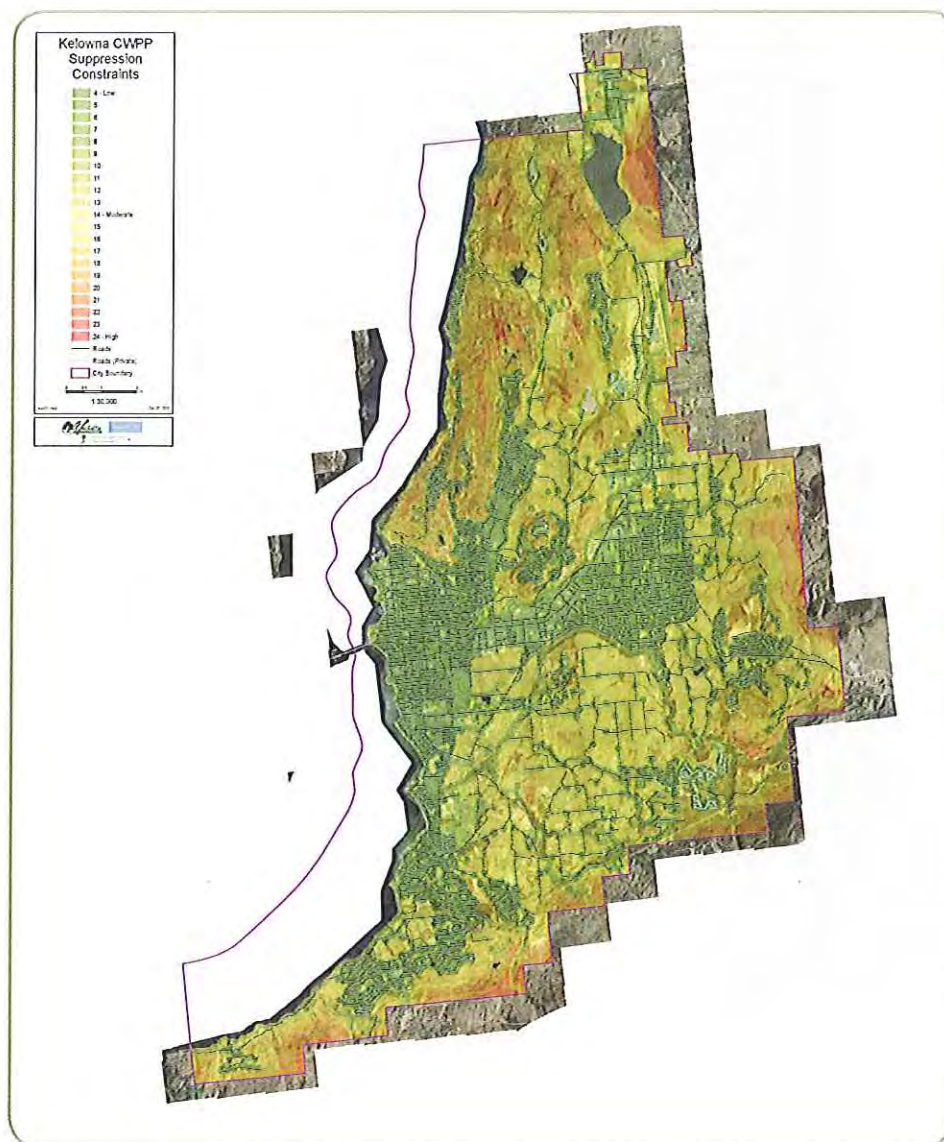
12.2.4 *Suppression Constraints*

Suppression Constraints indicate areas for which there will be difficulty undertaking suppression activities. These areas are generally associated with poor access, steep slopes or a lack of water sources. Overall, suppression constraints in the City are low in well developed areas which have an established water hydrant system and extensive road network. The results from this analysis are illustrated on Figure #9 – Suppression Constraints.

Areas of concern include the larger isolated natural areas north of Knox Mountain and the eastern and southern boundaries of the City that interface with the adjacent natural landscapes. Recommendations for mitigation of suppression constraints must consider fire behaviour potential. Many of the areas that are highlighted as being of concern are dominated by grass complexes or are isolated by effective fuel breaks.

The primary concerns which are related mostly to access include the forested landscapes north of the landfill and west of Ellison Lake. Also, the forested perimeter areas in the southeast edge of the City adjacent to the neighbourhoods of Gallagher's Canyon and Southeast Kelowna.

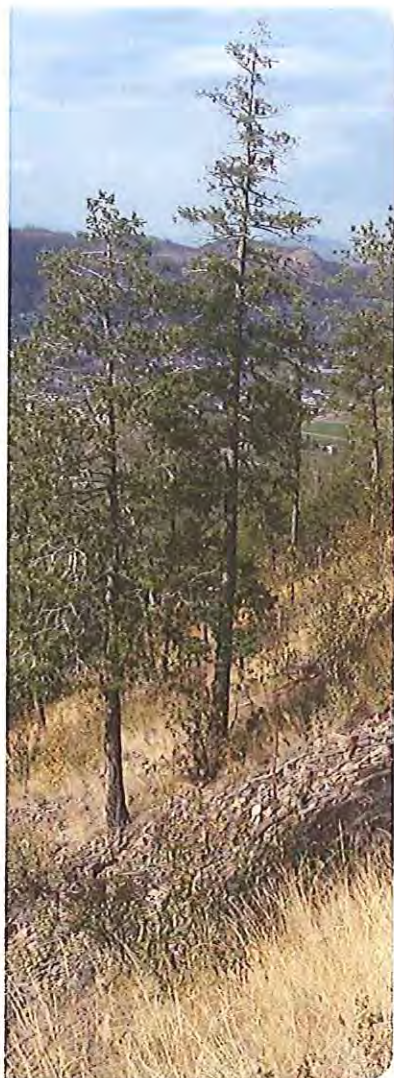
FIGURE 9.
Suppression
Constraints



12.2.5 Final Wildfire Risk Analysis

The final wildfire risk analysis is a compilation of the four contributing components. The results from this analysis are illustrated on Figure #10 – Wildfire Risk Rating. Higher weighting is given to the fire behaviour analysis and the structures at risk. These two components emphasize the probability of a fire occurring and the consequences.

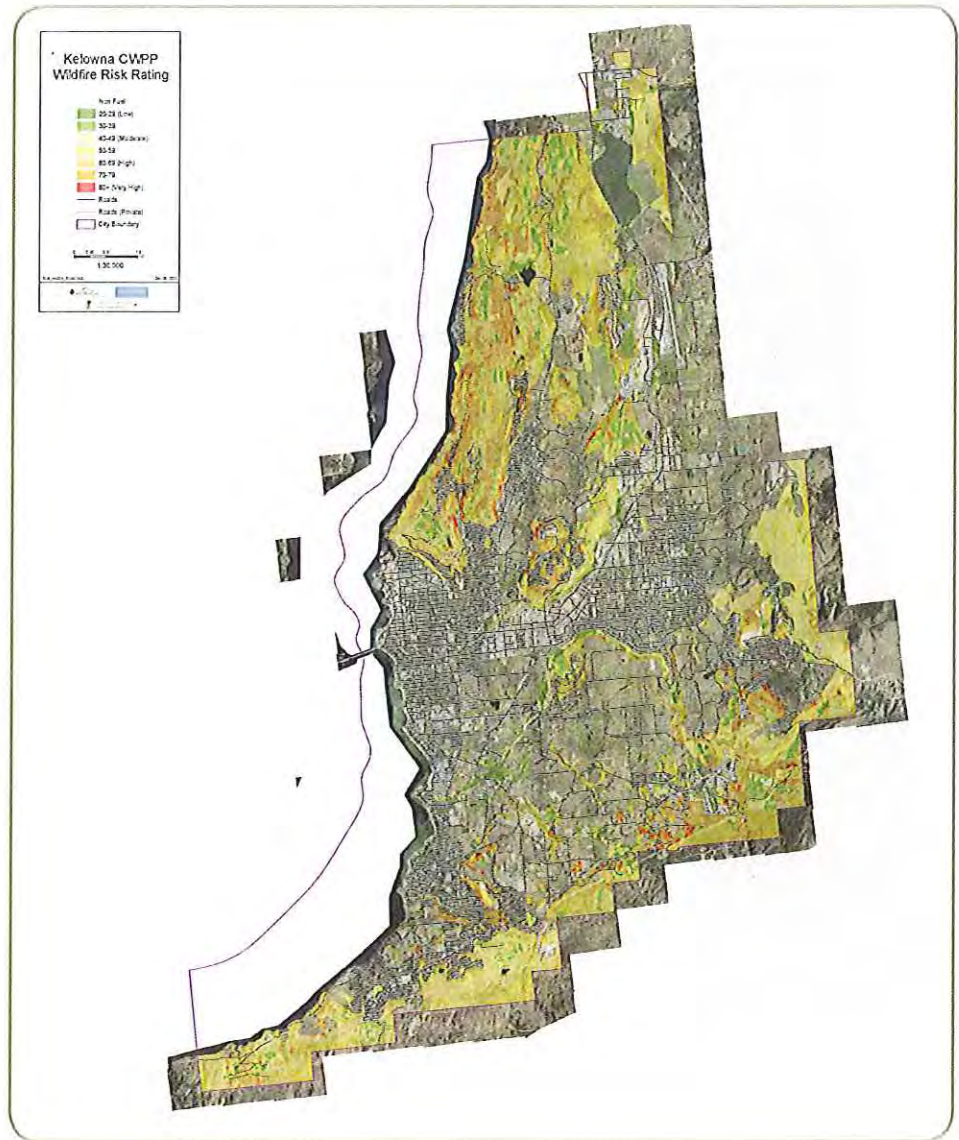
Forested areas within 100 m of any structures are highlighted as high risk areas. This emphasizes the importance of managing interface fuels as new areas are developed. Risk is best mitigated through fuel treatments within



this interface area. However, most of these areas are private land and require public education, partnerships and support from the City to meet management objectives.

Many of the continuous densely forested areas with limited access for suppression resources are also highlighted. There are two larger areas with relatively continuous forested natural that pose a moderate or greater risk. These include the forested areas that extend north from Knox Mountain to the City limits. This area is mostly to the west of Glenmore Drive in the south and then above the Landfill and west of Ellison Lake. Neighbourhoods at risk include Clifton, Glenmore Highlands and McKinley Landing. Also, the forested natural lands to the southeast of the City which Southeast Kelowna, Gallagher's Canyon and Black Mountain. The risk in these areas is mitigated through larger landscape level fuel breaks and improving suppression capabilities.

FIGURE 10.
Wildfire Risk
Analysis



13.0 STRATEGIES TO REDUCE WILDFIRE RISK

Of the factors that contribute to the overall wildfire risk, we have the ability to modify only certain ones. Terrain, weather conditions, or the location of existing structures are difficult to change. Land use planning strategies should focus on addressing those contributing factors that can be easily modified and will have significant impacts in terms of risk reduction to effectively abate wildfire risk. These include strategies that cause a change to fuel profiles, improve access, increase water availability and reduce the number of ignition sources.

13.1 MODIFYING THE FUELS PROFILE

13.1.1 Interface Fuel Treatments

Fire behaviour potential can be effectively reduced through the alteration of the fuel profile (the density, vertical and horizontal continuity) in high risk areas. This can be accomplished through treatments such as harvesting, thinning, pruning and the abatement of surface fuel loading (pile burning, prescribed burning, chipping/grinding, etc).

The City has carried out the majority of interface fuel treatments that were recommended for City owned lands in the 2004 Fuels Management Strategy. These included thinning and treatment of residual waste in forested areas located within 30 m of structures.

As part of this CWPP, all City owned lands were revisited and assessed using the Interface Fuel Hazard Assessment methodology. Results and recommendations from this re-assessment are summarised in Appendix B. The City should treat all polygons that were identified in this assessment as posing a risk that is moderate or greater.

A majority of the interface areas that pose a high risk are not owned by the City. Treatment of these areas will require extensive public education and consultation with private landowners. In these areas, a representative of the City and the Fire Department should meet with landowners in high risk areas and discuss in detail the recommended treatments to create a defensible space around their property.

Number	Action Item	Priority
Rec #6	Treat all City owned interface polygons that were identified as posing a risk of moderate or greater.	A
Rec #7	Pursue opportunities for Fuel Reduction Pilot Projects through the UBCM.	A

13.1.2 Fuel Treatment Options

All resource management activities in fire-dependent ecosystems should aim to strategically restore the natural mosaic of seral stages across the landscape. Ideally these conditions would be achieved over time through the reintroduction of frequent low-intensity surface fires. However, this treatment is difficult to implement within the wildland/urban interface zone. Therefore, the majority of stand objectives are conventionally accomplished through mechanical fuel treatments including thinning, pruning and surface fuel removal.





While there is no fuel treatment that can produce a 'fireproof' forest stand, it is feasible to move stands toward a more 'firesafe' condition by altering species composition, stand structure and the characteristics of fuel loads such that a crown fire is unlikely to occur. The City has successfully accomplished this in the majority of the City owned lands that were identified as high risk in 2004. The following photos illustrate two successfully treated stands within the interface on City owned land

Fuel treatments general involve stand thinning as well as pruning of residual trees. Thinning treatments should reduce the stand density enough that a crown fire cannot spread from crown to crown. Suppressed and intermediate trees are usually removed to remove fuels in the lower canopy. Trees that are left should be pruned to remove live or dead branches that could act as ladder fuels to carry flames from the ground to the canopy. Pruning also increases the crown base height which reduces the chances of a ground fire reaching the canopy.

Residual material from treatments must be either chipped on site or removed and disposed of. Chipping should be managed so that chips are discontinuous and do not reach a depth of greater than 5 cm. Fuel treatments that include controlled burning such as prescribed fires and pile and burning are not possible within the City boundaries due to risk management and air quality restrictions.

FireSmart recommends treatments around structures in three 'priority zones'. Treatments in these zones involve fuel removal, fuel reduction, and fuel conversion. Priority zones are based on distance from the structure, and the slope below the structure, and are defined as:

- Priority Zone 1 (within 10 m from structures): Establish a fuel-free zone immediately adjacent to all buildings. Remove all flammable fuels from this area.
- Priority Zone 2 (10-30 m from structures): Increase fuel modified area by reducing flammable vegetation through thinning and pruning and produce an environment that will only support low-intensity surface fires
- Priority Zone 3 (30-100 m+ from structures): Eliminate the potential for a high-intensity crown fire through thinning and pruning, thereby slowing a fires approach towards structures.

The area within 30 meters of the structures (priority zones 1 and 2) should be treated aggressively to create a defensible space between the structures and the adjacent stand. Treatments in priority zone 3 should not be as intensive as those in adjacent to the structures but should still reduce the potential for a crown fire.



The slope of the terrain has a strong influence on fire behavior. The rate of spread (ROS) of a fire doubles for every 30% increase in slope up to 60%. The recommend treatment zone distances around structures should be adjusted accordingly. Steeper slope should be treated to a further distance, thinning should be to a lower density and pruning height should be higher. The distance and extent of treatment should be determined by a fire behavior specialist and clearly described in the fuels treatment prescription.

In addition, treatments should not be implemented uniformly, but should mimic natural stand structure by producing canopy gaps to help break up the canopy fuel mass. The shape, size and distribution of these gaps should be strategically placed to help slow the spread towards the structures or other adjacent hazardous fuels.

The FireSmart Wildland/Interface Planner should be consulted for a more detailed and comprehensive discussion regarding fuel treatment theory and treatment recommendations.

13.1.3 Fuel Treatment Prescriptions and Target Stand Conditions

The primary goals of interface fuels treatments are to prevent the occurrence of a crown fire, reduce surface fire intensity and to improve suppression capabilities. In addition, treatments should attempt to mimic natural disturbance regimes and re-create historical stand conditions. An objective-driven Fuel Treatment Prescription should be carefully developed and followed to achieve these goals. A proper prescription includes a detailed description of the present stand, target stand conditions, and operational activities to be implemented. It will also outline a monitoring program to help determine the success of the project. These prescriptions should be developed by a Professional Forester with wildfire management experience.

Number	Action Item	Priority
Rec #8	All fuel treatments carried out in the wildland/urban interface should follow a "Fuel Treatment Prescription" developed and submitted to the City by a Professional Forester.	A

Specific target stand conditions (TSC) should be developed that will reduce fire behaviour enough to minimize the potential of a crown fire under hazardous (90% percentile) fire weather conditions. These TSCs will vary with each site depending on the existing stand, site ecology, topography and the presence of structures and natural features at risk.

The following four categories have been developed to assist in the establishment of these TSCs. A range of TSCs (based upon the Biogeoclimatic zone and site exposure) have been recommended including stand composi-

tion, vertical and horizontal structure and opening size distribution. These fuel types represent characteristics of the most common stands; however, not all stands will clearly fall into one of these categories. These are meant as guidelines and the final target stand conditions must be clearly described in each prescription on a site by site basis.

All fuel treatments on hot and dry aspects (TSC 1 and 3) should promote grassland and open forest stands. The main canopy should be thinned to produce a scattered distribution of individual and small groups of the oldest trees. All suppressed and intermediate trees should be removed. Target stand densities should be less than 150 stems/ha with a very low crown closure. There should be very little surface fuel loading and all trees should be pruned to a minimum of 3 m.

On cooler aspects (TSC 2 and 4) low to moderately dense stands can be left as long as their crowns are discontinuous and broken up by irregular shaped canopy openings. Some intermediate and suppressed trees can be left, however all ladder fuels should be pruned to a minimum height of 3 m. Target stand densities can range up to 400 stems/ha as long as the crown is discontinuous and all ladder fuels are treated. There can be scattered accumulations of ground fuels as long as they are discontinuous.

Table 11 Summary of Target Post Treatment Stand Conditions by Site Ecology and Exposure

Ecosystem Type	Target Stand Conditions	Stand Density*	Canopy Gap Size Distribution	Surface Fuel Load Distribution kg/m ²
TSC #1 Ponderosa Pine Zone on hot, dry south and west facing slopes	Grassland and open forest communities	< 100 st/ha dominated by ponderosa pine with a crown closure of <10%	Open grasslands with scattered individual trees or small groups of trees.	Small fuels <0.2 Large fuels < 1
TSC #2 Ponderosa Pine Zone on cooler north and east facing slopes	Low to moderate density forest communities with associated grassland communities	50-300 dominated by ponderosa pine with a crown closure of 15-35%	Scattered irregular shaped, medium sized openings (25 to 50% of landscape are openings 0.1 to 0.5 ha in size).	Small fuels <0.5 Large fuels < 2
TSC #3 Interior Douglas-fir Zone on hot, dry south and west facing slopes	Low density, open forest communities with associated grassland communities	50-150 of both ponderosa pine and Douglas-fir with a crown closure of 10-25%	Scattered irregular shaped, small to medium sized openings (25 to 50% of landscape are openings 0.5 to 1 ha in size)	Small fuels <0.5 Large fuels < 2
TSC #4 Interior Douglas-fir Zone on cooler north and east facing slopes	Moderate density forest communities with associated small grassland communities	200-400 of both ponderosa pine and Douglas-fir with a crown closure of 15-35%	Scattered irregular shaped, small sized openings (< 30% of landscape are openings < 0.1 ha in size)	Small fuels <0.5 Large fuels < 3



13.1.4 Further Treatment of Thinned Stands

The majority of the City owned interface areas have been treated since they were identified in 2004. Operational crews attempted to achieve target stand conditions while meeting other objectives such as visual quality of the adjacent residences. Target stand densities are 100-150 stems/ha.

Many of the treated areas have been reduced to 100-500 stems/ha. Areas that were partially thinned but still have >300 stems/ha could be thinned further. Many of the residual trees in these treated areas have branching that extends to the ground. Also, many suppressed trees were left and contribute to the ladder fuel loading. Treatments were usually uniform spatially with no crown fuel breaks. Thinning density also did not change in relation to structure proximity. Following are considerations and recommendations for future treatments on City owned lands.

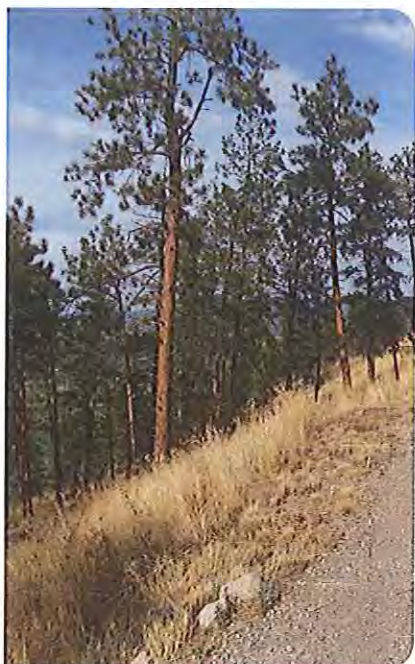
- Thinning within 30 meters of structures should be to a lower density, 50-150 stems/ha.
- Create an effective defensible space within 10 meters from structures. The majority of standing fuels should be removed from within this area.
- Where feasible, surface firebreaks should be created within 30 m of structures to stop the spread of surface fires.
- The height of pruning should be dependent on the slope of the terrain and the surface fuel loading. Generally, 2-3 m is usually adequate on flat ground; however, this should be increased to 3-5 m on steeper slopes. Target pruning heights refer to the lowest part of each branch.
- Thinning should generally be less uniform with scattered canopy gaps to create crown fuel breaks and to promote the establishment of small grassland communities within the constructed stand gaps.



13.1.5 Fuel Treatments and Forest Health

Mountain pine beetle, western pine beetle and Douglas-fir tussock moth are actively impacting stands throughout the Okanagan. Pine beetle induced mortality contributes to a fuel hazard both in the short term and, if no abatement work is performed on the dead trees, in the long term as well. In the short term, red needled trees have reduced foliar moisture making them more susceptible to ignition. Stands of red trees have a high potential for crown ignition and high probability of sustaining a crown fire. Over the longer term, as dead trees decay and fall to the ground, a potential surface fuel hazard is created that is very dry and ignitable and more difficult to treat. It also contributes to a fuel complex, and associated fire behavior, that is both difficult and dangerous to work within and around.

Fuel management treatments should be used to both remove beetle killed



trees and to reduce the fuel hazard associated with other species. Treatment costs for the removal of dead pine is generally cheaper when trees are standing. This is due to the ability to fall the trees in such a fashion and direction that facilitates and eases their removal from the site. Trees that are allowed to fall down on their own can result in a stand of criss-crossed stems that are not only difficult to remove but also dangerous to work around and within. This can result in higher costs for tree removal. The City should continue to be proactive with standing dead pine tree removal.

Number	Action Item	Priority
Rec #9	Monitor the pine beetles and be proactive to remove all dead and dying pine in the urban/wildland interface.	A

13.1.6 Surface Fire Fuel Breaks

Once an area has been treated to minimize the potential for a crown fire, there is still the potential for a low intensity surface fire. In the summertime, after grasses cure and shrubs start to dry out, they are easily ignitable and have high spread rates. Although these fuels tend to burn out quickly, they provide resident heat to ignite larger fuels. There is a risk of a surface fire spreading into, or in from, adjacent properties not under control of the local government. In these areas, strategic surface firebreaks can be created to help stop the spread of potential ground fires.

Ground firebreaks are continuous areas of exposed mineral soil that are wide enough to stop the spread of a low intensity surface fire. These breaks can be created in parks to establish new trails for recreation. These trails should be developed wide enough to support an ATV to facilitate access for suppression. If these trails are not used frequently, grasses will naturally re-establish on the trail surface and as such may require ongoing maintenance.

Number	Action Item	Priority
Rec #10	Develop recreation trails in strategic locations within the urban/wildland interface that act as surface fuel breaks and improve access for suppression resources.	B

13.1.7 Landscape Level Fuel Breaks

Treatment of fuel hazards within the urban/wildland interface will result in protection of structures and the provision of defensible space for suppression efforts. However, landscape level fuel treatment projects should also be considered. These fuel breaks should be large scale treatments immediately adjacent to the interface boundary. They would serve to slow fire spread and provide a safer location from which professional forest fire

fighters could anchor their suppression activities. Landscape level breaks are most efficiently undertaken along existing linear features like transmission corridors and road systems.

One priority area for creation of landscape level fuel breaks has been identified. This includes the treatment of forested areas that are adjacent to the south of the existing transmission right-of-way that runs east to west along the southern portion of the City. Forested areas to the south of here are relatively continuous. There is a significant landscape level risk from a crown fire spreading north toward the neighbourhoods of Gallagher's Canyon and Southeast Kelowna. The fuel prescription for this area would include select thinning and pruning to reduce the density and continuity of the crown fuels. The goal of this treatment would be to alter the fuels profile so that an approaching crown fire would turn to a ground fire and allow suppression crews to control it from the transmission right of way.

FIGURE 11.

Recommended Area (Blue Shaped Polygon) for the Creation of a Landscape Level Fuel Break



13.2 WILDFIRE SUPPRESSION

When a catastrophic wildfire occurs, lack of preparation can quickly lead to panic and disorganization. This greatly increases the risk to human lives, structures and natural resources. Planning to manage a wildfire involves a great deal of uncertainty as it is difficult to predict the behaviour of the wildfire and the public. Decision-makers must be highly organized and prepared so that evacuation and suppression response can occur as quickly and efficiently as possible.



*"Provincial Forest
Fire Reporting
Center 1-800-663-
5555 or *5555 on a
cellular phone"*

13.2.1 Wildfire Detection and Reporting

The B.C. Ministry of Forests, Lands and Natural Resource Operations is the agency that is responsible for wildfire detection. Fires are located through the lightning locator system, aerial patrols and public observation. In an urban center such as Kelowna, a wildfire is most likely to be detected and reported quickly by the public. Wildfire awareness signs should be posted at strategic locations (major transportation corridors, camp sites, recreation areas and high use trail heads) that specify how to report a wildfire in the City.

All wildfires should be reported to the Provincial Forest Fire Reporting Center in Victoria through their toll free number 1-800-663-5555 or *5555 on a cellular phone. The agent will then collect as much information as possible regarding the fire and its characteristics including:

- The exact location of the fire;
- Its estimated size;
- The type of fuel burning;
- How fast the fire is spreading and in what direction;
- The colour of the smoke; and
- The location of any structures or lives at risk from the fire.

13.2.2 Initial Attack Preparedness

The closest Forest Protection Fire Crew base is in Vernon (~45 km north). This base includes two initial attack crews (each with three crew members) and one unit crew of 20 people. Crew response departure times can vary from 5 to 60 minutes depending on alert status and weather conditions.

Within the City of Kelowna, City Fire Department and Staff are trained to respond and control a wildfire that starts in or close to the urban/wildland interface. The Department has seven fire stations located strategically throughout the City. There are 117 full time personnel and 59 paid-on-call volunteers. Each station has a full compliment of modern, up-to-date vehicles and equipment. Apparatus specifically designed for interface fires include four bush trucks. All equipment that would be used in the case of an interface fire are summarised in Table 12.



Table 12. Apparatus Used for Interface Fires

Unit and Specifications	Number of Units
Type 1 Engines: 1000+ GPM pump, 400+ gallons of water, hose and master stream.	6 as front line units and 2 in reserve
Type 3 Engine: 120+ GPM pump, 250+ gallons of water and hose.	1 as front line unit
Type 4 Engine (Bush truck): 50+ GPM pump, 200+gallons of water and hose	3 as front line response units and 1 available from the regional district mainly operated by Kelowna Fire Department
Type 1 Water Tender (Tanker): 2000+ gallons of water and 250+ GPM pump	2 as front line units
Marine Rescue/ Fire boat: 175 GPM pump and master stream. Ability to pump lake water inland for wild land applications	1 owned by the Regional District and operated by Kelowna Fire Department

It is recommended that the City acquire two smaller ATV/UTV suppression vehicles that are able to quickly access remote areas with recreation trails and old forest service roads. This will improve the City's ability for initial attack and suppression of wildfires that are isolated in more remote natural areas.

Proper training, equipment and suppression protocol will ensure an efficient and effective response. All City staff who work in the interface areas should receive basic level fire suppression training at least once every two years. This training will ensure that if a staff member is the first on site, they will have the knowledge and ability to safely extinguish or control the fire until more resources arrive. There are a number of training courses available through the BC MFLNRO Protection Branch. The required level of training is the S-100 "Basic Wildland Fire Suppression and Safety."

Standard suppression equipment should be kept in strategic locations around the City. This equipment should be inspected and maintained annually. At a minimum, strategic locations should include stands outlined in the "Wildfire Act" and equipment should include basic hand tools, fire extinguishers and communication devices.

Number	Action Item	Priority
Rec #11	The City should acquire two smaller ATV/UTV suppression vehicles..	B
Rec #12	All City staff who work in the interface areas should receive basic level fire suppression training (S-100) at least once every two years.	B

Number	Action Item	Priority
Rec #13	Basic suppression equipment should be kept in strategic locations around the City.	A

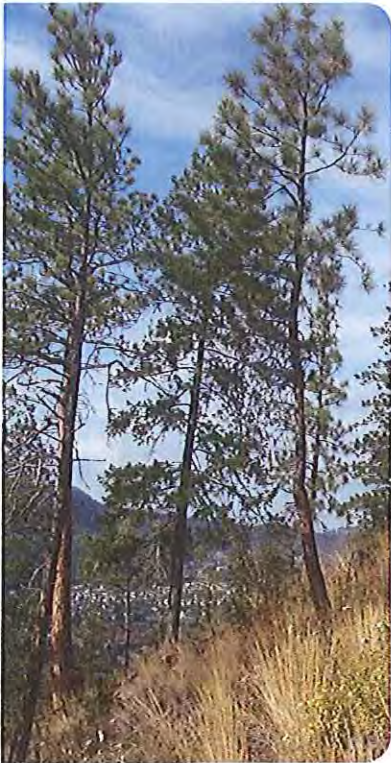
13.2.3 Inter-Agency Cooperation

The Wildfire Management Branch (WMB) mandate is to fight forest fires throughout the province. Local municipal governments are mandated through the Local Government Act to establish fire departments that are responsible for fire prevention and suppression. Municipal fire departments are better equipped to fight structural fires, whereas the WMB is trained in wildland fire suppression and maintains equipment that is more suited to suppressing wildland fires. Interface fires, however, involve both wildland and structural fires. A large wildfire event will require the cooperation between both agencies. Therefore, ongoing interagency training should take place between the local WMB and the City Fire Department.

Forest operations on crown land is the responsibility of the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO). The City should ensure it monitors new forest policies where they will directly affect the wildfire risk to the City. The City should be aware of timber sales and harvesting activities adjacent to the City and ensure these activities are not contributing to a future wildfire risk. Where possible, timber harvesting activities should be promoted in strategic locations that will create landscape level fuel breaks and suppression control points. There is a transmission line and an associated linear right of way that runs east to west across the southeast corner of the City. This transmission line and right of way represents a value at risk, an ignition source and a potential fuel hazard. FortisBC is also actively developing substations and transmission corridors in the City to meet the electrical demands of new development in the interface areas. Vegetation management is required along all transmission right of ways. Woody debris left on-site can become a fire risk to both the adjacent community and the transmission lines. The City should ensure that BC Hydro and FortisBC abate this fuel hazard during their vegetation management operations.

Vegetation adjacent to transportation corridors acts as an ignition source and a fuel hazard. This includes cured grass and woody material from tree removals. The City should ensure that grass is maintained and that all tree cutting is cleaned up adequately along roadways.





Number	Action Item	Priority
Rec #14	Interagency wildfire suppression training should be coordinated between the Wildfire Management Branch and the City Fire Department.	B
Rec #15	Coordinate with the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) to ensure that any new policy and harvesting activities adjacent to the City are not contributing to the wildfire risk.	B
Rec #16	Ensure that all forest licensees address the fuel hazard associated with any harvesting in interface areas.	A
Rec #17	Ensure that BC Hydro and FortisBC abate fuel hazards during their vegetation management operations along their transmission right of way.	B
Rec #18	Ensure that grass is maintained and that all tree cutting is cleaned up adequately along roadways.	A

13.2.4 Improving Access

The road network into and within a community serves several needs including providing access for emergency vehicles, escape routes for residents and fuel breaks. Communities with narrow driveways and dead-end streets impede fire suppression efforts. Wildfire risk can be reduced by careful planning of access systems (road and trails) within and adjacent to the development. Access roads can act as fuel breaks for surface and crown fires, and can also provide control lines for suppression efforts.

Following is a list of required road standards that will facilitate suppression vehicles and public evacuation in the case of a wildfire:

- Roads should provide safe simultaneous access for emergency vehicles and public evacuation with a minimum width of 6.1 metres excluding parking;
- Road curvature radius should be at least 30 metres, measured from the centre line;
- Road gradient should not exceed 10 percent;
- Dead-end roads should have a turnaround at the terminus having no less than 36 metres outside diameter of traveled way;
- Kelowna fire service personnel shall be provided with keys to any locking mechanism on any gate restricting access to any road.

There are numerous cul-de-sac or dead end roads within the urban/interface. These are of particular concern for fire suppression. The City should look for opportunities with future development and parkland acquisition to build alternative access to these areas. These can be recreation trails that are



built to support vehicle access and isolated with gates.

Recreational trails are generally not as effective as fuel breaks when compared to roads and do not necessarily provide emergency vehicle access. They do, however, facilitate access for ground crews and act as fuel breaks to help stop the spread of ground fires. In protected areas where tree removal and road building are not options, establishment of new recreation trails should be considered. Trail-building standards should be wide enough to provide ATV/UTV access.

It should be noted that improving access through the establishment of new roads and trails can also increase the risk of human caused ignitions. Gates or other site access restrictions should be in place to minimize access by unauthorized users, especially those using motorized vehicles. All trails constructed for wildfire risk reduction purposes should have wildfire awareness signs posted.

Number	Action Item	Priority
Rec #19	Ensure all roads constructed in interface areas meet standards required for suppression vehicles.	A
Rec #20	Identify interface communities with one access route or cul-de-sac roads. Explore options to build alternative access to these areas.	C
Rec #21	Encourage strategic recreation trail development in parks to a standard that supports ATV/UTVs.	B
Rec #22	Gates should be installed on roads and trails that run through natural areas to minimize access by unauthorized users, especially those using motorized vehicles.	B

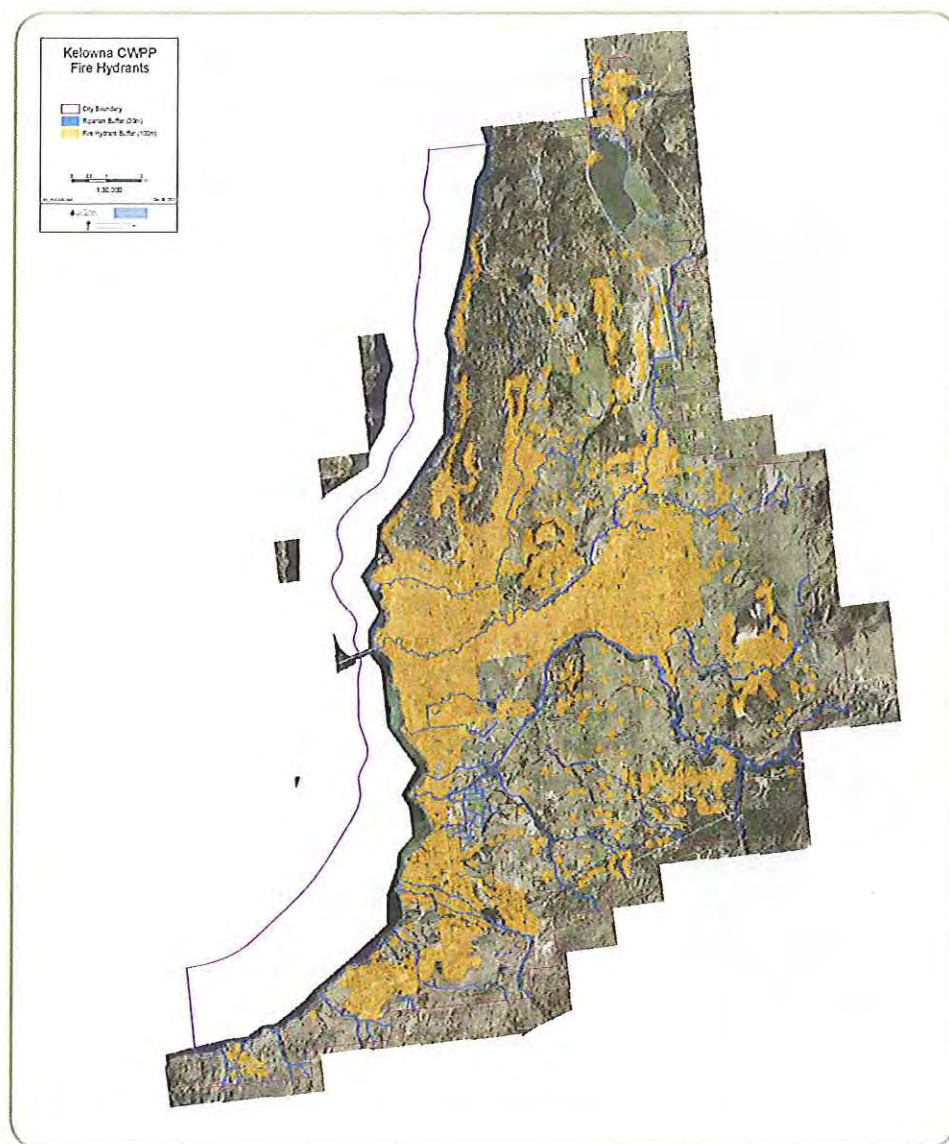
13.2.5 Water Availability

Water is the single most important resource for suppression activities. Where hydrant coverage is limited, particularly in rural settings, alternative water sources such as reservoirs, lakes and rivers should be located, assessed and mapped. These provide sites for helicopter bucketing and pump sites for suppression crews.

In addition, when new areas are proposed for developments, an adequate number of fire hydrants should be established in strategic locations in the interface zones. Existing interface areas that do not have sufficient hydrant coverage are illustrated in Figure #12 - Water Availability from Fire Hydrants (100 m Buffer) and Riparian Areas.

FIGURE 12.

Water
Availability from
Fire Hydrants
(100 m Buffer)
and Riparian
Areas



Number	Action Item	Priority
Rec #23	Identify area with poor water availability and install hydrant systems or alternative water reservoirs.	B
Rec #24	Identify and map alternative water sources including reservoirs, lakes and rivers.	C
Rec #25	Fire hydrants should be located to serve all new developments and in existing interface areas that are deficient.	B

13.3 REDUCING SOURCES OF IGNITION

Sources of ignition can be human and lightning caused. Lightning caused ignition is difficult to predict or manage. Human caused ignitions however can be prevented and are the source of about one half of all provincial wild-fires. The most common sources of human caused fires include:

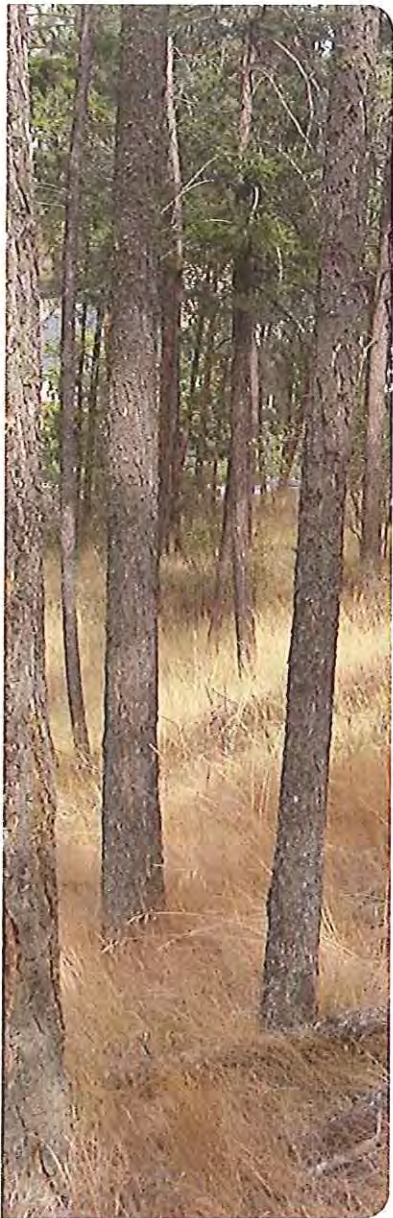
- Campfires;
- Industrial activity;
- Discarded cigarettes and matches;
- Vehicle traffic;
- Railways;
- House related fires;
- Power lines; and
- Vandalism.

Predicting and preventing human caused ignitions is the most cost effective component of any fire prevention program. This is best achieved through ongoing public education campaigns. To reduce the risk, road side ditches and medians that contain grasses should be mowed prior to the fire season. This will reduce fuel loading (standing cured grass) and reduce the ignition potential associated with vehicles, heavy machinery and cigarettes during the fire season. Signs should be posted at camp sites, recreation areas and high use trail heads during the summer showing the fire danger rating and emphasizing the need to fully extinguish campfires and not discard cigarettes.

There is also ignition potential from the numerous residences that back up against the interface. Private residents adjacent to wildlands (grass or forested) should be reminded through literature, such as public bulletins or media notices, as to the common risks of ignition in these forested landscapes.

Dead and dying trees also pose a high risk of falling on power lines and starting fires. This risk is managed primarily by utility companies with regular assessments and tree hazard mitigation programs. The City should continue dialogue with BC Hydro and FortisBC to ensure they are removing all beetle killed hazard trees prior to the forthcoming fire season.





Number	Action Item	Priority
Rec #26	Road side ditches and medians that contain grasses should be mowed prior to the fire season.	B
Rec #27	Wildfire awareness signs should be posted along major transportation corridors, camp sites, recreation areas and high use trail heads during the summer showing the fire danger rating and emphasizing the need to fully extinguish campfires and not discard cigarettes.	C
Rec #28	Engage in public education programs to reduce human caused ignition focusing on private residents that live in the urban/wild-land interface.	B
Rec #29	Work with BC Hydro and FortisBC to ensure that distribution lines and transmission corridors are assessed regularly for tree risk and that the associated fuel hazards are abated.	B

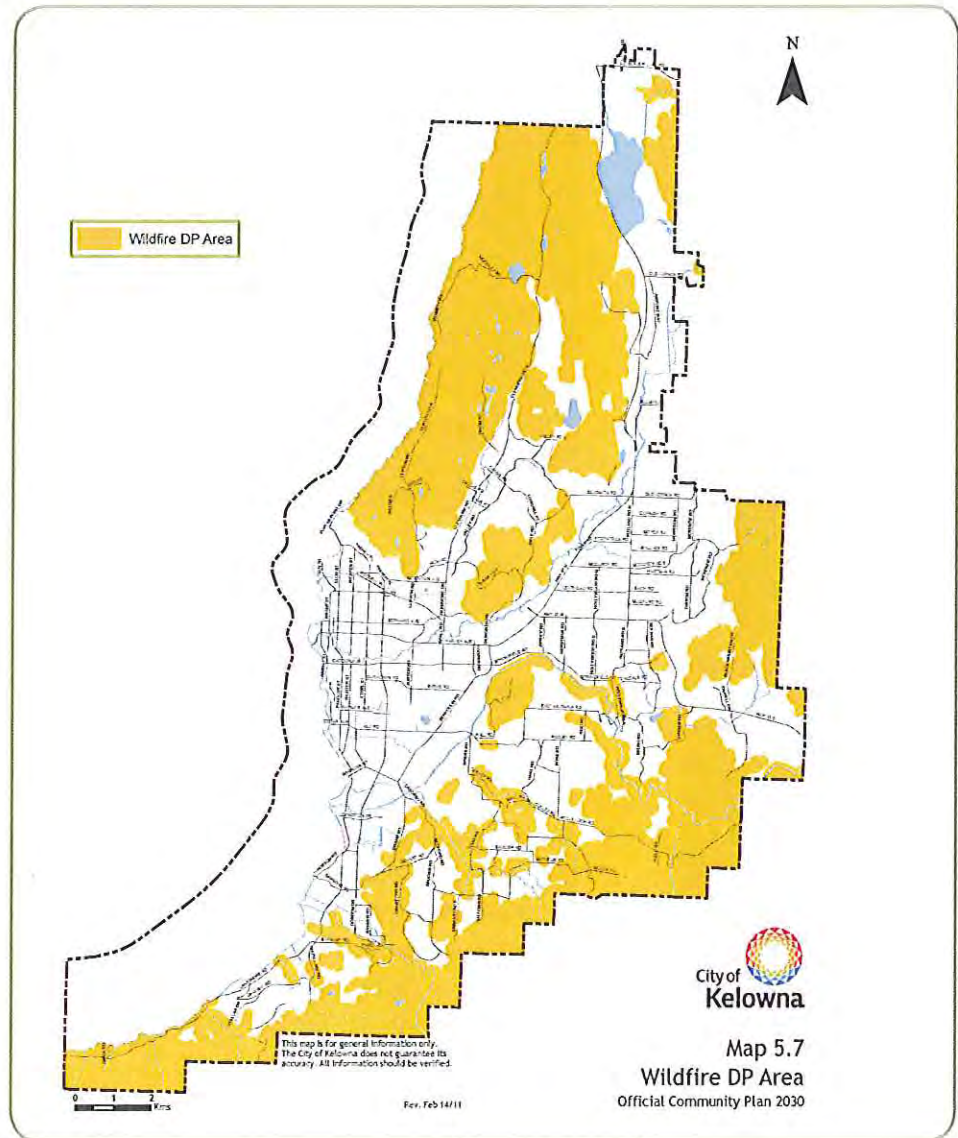
13.4 WILDFIRE LEGISLATION

Wildfire management is primarily addressed through the City of Kelowna Official Community Plan Bylaw #7600. This OCP provides policy framework and direction for future growth and land use. Section 7.13 of this document identifies Wildland Fire Hazard Development Permit Areas. All development in these areas require a "Hazardous Condition" Development Permit.

The existing OCP document is currently being updated. The new specification for the Hazardous Development Permit is drafted under Chapter 13: Hazardous Conditions DP Guidelines. Wildland Fire Hazard Development Permit area boundaries have been identified by the City and the City Fire Department using the updated location of structures, fuel typing and fire behaviour analysis. The DP areas are illustrated on Map 5.7 of the Draft OCP.

FIGURE 13.

Wildland
Fire Hazard
Development
Permit Areas



In these DP areas, all stands within 100m of planned structures or infrastructure must be assessed by a Professional Forester with experience in wildfire risk management. A wildfire management plan must be developed and submitted to the City for review. This plan should include specifications for fuel treatments to ensure a defensible space is established around the development. It should address suppression constraints including access and water requirements, construction and landscaping standards and long term maintenance. A summary of these principles are provided in Appendix C.



The Wildfire Act places the responsibility for preventing wildfires clearly on the public, construction operators, and/or developers and provides an avenue for the government to charge for suppression costs and damages caused by an accidental ignition. The City should require written proof from developers and construction contractors they are aware of this responsibility when they are applying for development related permits. The City could inspect construction sites during the summer months to ensure contractors are complying with wildfire management plans and are managing the risk of ignition from their sites.

Number	Action Item	Priority
Rec #30	Recognize Wildland Fire Hazard Development Permit Areas in the OCP and ensure all development in those areas submit and comply with a Wildfire Management Plan.	B
Rec #31	Inspect construction sites during the fire season and ensure construction contractors are aware of their responsibilities as described within the Wildfire Act.	C

13.5 FIRESMART COMMUNITY PLANNING AND DESIGN

The FireSmart Wildland/Interface planner was developed to provide guidelines to individuals, communities and planners on how to reduce the risk of a wildfire to their homes. These guidelines describe interface hazards (structural and vegetative), provide mitigation strategies and techniques, and include regional planning solutions.

New developments have historically been designed and built with little consideration for the potential consequences of a wildfire. A responsible development plan should consider prevention of two types of wildfire interface scenarios. The first is that of a wildfire starting in the forest and spreading into the interface community, the second is that of a fire starting from human activity in the urban environment and spreading into the adjacent forest.

Responsible development planning must consider the prevention of both scenarios in the short and long term. Short-term measures during the construction phases include the prevention of potential ignition sources and ensuring suppression resources are available in case of a wildfire. Long-term planning includes the strategic placement of structures and roads within the development, as well as treating interface fuels to reduce the fire behaviour, potential and creating defensible spaces around structures within the interface.

Planners, architects and developers should consider the risk from wildfire during the planning and design phases of a development since factors such as the location of alternate water sources, road access and hydrant location may have a major influence on the overall design.

An overview of the general guidelines and recommendations within the FireSmart Planner are summarized in Appendix C. The FireSmart guidelines should be considered as the minimum standard any new development proposed within the Wildland Fire Hazard Development Permit Areas must adhere to.

Number	Action Item	Priority
Rec #32	The FireSmart guidelines should be considered as the minimum standard any new development proposed within the Wildland Fire Hazard Development Permit Areas must adhere to.	A



13.6 EVACUATION PLANNING

The primary concern when dealing with a wildfire is public safety. The objective of an evacuation plan is to minimize the loss of life and to facilitate effective wildfire control measures. After a wildfire is detected, the threat that it poses to the public should be quickly evaluated. The location, direction and rate of spread of the fire will indicate where the greatest risk is to public safety. The Protection Branch and the Office of the Fire Commissioner, in communication with the District, will decide at what point during the wildfire event an evacuation is justified. The RCMP and local fire department is then responsible for implementing the evacuation.

The City should be aware of all special populations living in the town that may require assistance to evacuate such as students, care homes and hospitals. All departments within the City should be aware of their responsibilities during an evacuation. This includes, but is not limited to: the police department, fire department, public works, utilities and parks and recreation.

During a wildfire event, the movement of residents and suppression resources is critical. Road systems that have dead ends are a concern for evacuation. There are a high number of residential neighbourhoods within the urban/wildland interface that only have one access road. Alternative access routes to these areas should be considered during future land use planning. Also the development of recreation trails and roads should consider connections with these areas.



It is recommended that neighbourhood specific evacuation plans be developed for the identified high risk interface areas. These should be distributed to the residents of these neighbourhoods as a part of the public education program. These evacuation plans should include a public warning system, detailed evacuation procedures for the neighbourhood, evacuation routes and marshalling points.

Evacuation plans should be developed for the area that extends north from Knox Mountain to the City limits. This area is mostly to the west of Glenmore Drive in the south and then above the Landfill and west of El-lison Lake. The natural areas are fragmented by development of varying densities. Neighbourhoods at risk include Clifton, Glenmore Highlands and McKinley Landing. Also evacuation plans should be developed for neighborhoods along the southeastern boundary of the City which includes Southeast Kelowna, Gallagher's Canyon and Black Canyon.

Number	Action Item	Priority
Rec #33	Develop and distribute neighbourhood evacuation plans for all high risk interface areas.	B

13.7 PUBLIC EDUCATION

A majority of the hazardous fuel areas within the urban interface are privately owned. Therefore, building public awareness and promoting stewardship of the City's natural areas and its many values is a key component of an effective wildfire program. The following are general recommendations to be considered for development of a public education program. Chapter 6 of the Firesmart Planner provides detailed recommendations for developing a public communications plan.

There are two main goals of a comprehensive public education and awareness strategy. These are:

1. Raising knowledge and awareness of wildfire risk and prevention; and
2. Developing and encouraging stewardship opportunities for individuals and community-based volunteer organizations.

Changes in behaviour often come about because people believe that there is an advantage for doing so and also, that they can achieve it. Therefore, gaining support or acceptance for a specific course of action often relies upon both education as well as persuasion. Furthermore, research has demonstrated that these types of initiatives are more likely to effect changes in behaviour when they are targeted at the community level using direct engagement. Upon the completion of this CWPP, a public

presentation should be planned. This should include a summary of the findings and the major recommendations.

When large planned events take place in or near natural areas, a representative from the District Parks Department and the Fire Department could be present to hand out educational material and help raise wildfire awareness.

Youth engagement is sometimes overlooked as a public education strategy, but it is a key to meeting long-term management goals. By actively engaging the youth, the City can ensure that the next generation of citizens will be educated and active in wildfire planning and management. In addition, educated youth will often effectively pass on this information to older generations in their family that are more difficult to directly engage.

The City should explore educating opportunities within the City of Kelowna School system. The fire department should be invited to make classroom presentations. Also, stewardship initiatives such as young wardens programs are recommended to instill a sense of responsibility to the younger generations. Field trips with school groups can be organized to raise awareness of wildfire risk and strategies for its mitigation. Educational and interactive self walking tours can be established in fuel treatment areas.

When a fuel treatment program is planned, an open house should be organized and used as a forum to inform and educate local residents. This will provide an opportunity to be proactive and raise awareness of issues and options that local residents have to mitigate risk on their properties.

A summary of this CWPP, the wildfire risk maps and the Homeowners Firesmart Manual should be widely distributed. A copy should be distributed to all residents that live within the Wildfire DP areas. These materials should also be made available at public locations including City Hall, the parks department, post offices, fire departments, community centres and libraries. The wildfire risk maps should also be printed and posted at some of these locations.

Technology is an important avenue to communicate ideas and information. This is particularly true of on-line and electronic media. The Cities website currently includes a section on interface wildfire protection. This should be updated to include this report and associated maps. This site should be updated regularly to include future interface fuels treatments and education events. The webpage functions as a virtual open house giving residents information, and the flexibility to participate on their timeline. This is also an effective means of communicating with individuals who do not have time or cannot physically participate in open house and local events.





On line sources of education that should be considered include videos that can be linked to the webpage. YouTube is a free and effective means to distribute educational material. A variety of videos can be posted to update the public of upcoming events and to showcase successes in the City.

Wildfire awareness signs should be placed in and around the City to raise awareness of the risks of wildfire. These should indicate the current Fire Danger level, restrictions during the fire season as well as the emergency number to call when a fire is detected (1-800-663-5555 or *5555 from a cellular phone). Signs should be bold and placed in clear view, particularly at all major through routes into the City and all recreation sites in natural areas.

Recognition is very important as an incentive to encourage volunteer efforts. The City should establish an awards program. This program would recognize individuals or groups who have demonstrated outstanding commitment to reducing the risk from wildfire.

Number	Action Item	Priority
Rec #34	Wildfire awareness signs should be posted along major transportation corridors, at camp sites, recreation areas and high use trail heads that specify how to report a wildfire.	A
Rec #35	The City should develop a public education and awareness program for wildfire management.	A
Rec #36	Distribute educational material to all private land owners within 100 m of the Wildfire DP areas.	A
Rec #37	Summaries of this report and associated maps should be posted at strategic public locations.	A
Rec #38	A series of public presentations should be planned once this CWPP is adopted.	A
Rec #39	A representative from the District Parks Department and the Fire Department should be present at public events that take place in or near natural areas.	A
Rec #40	Establish a school education program to engage youth in wildfire management.	B
Rec #41	Digital media including video and the City's website should be updated to include this plan.	A
Rec #42	Designate awards to individuals or groups that demonstrate commitment to wildfire management planning.	B

13.8 POST FIRE EVALUATION AND REHABILITATION

When a wildfire within or adjacent to the interface area in the City has been suppressed, a post-fire ecosystem impact assessment and rehabilitation plan should be completed. A qualified professional should visit the fire site and make observations regarding the impact of the fire on the ecosystem including, but not limited to, the following:

- The estimated area burned;
- The species and size of surviving trees;
- Potential overstory mortality;
- Erosion issues;
- Expected vegetation response;
- Potential soil erosion issues;
- The presence of invasive species or potential for introduction; and
- The estimated number of hazard trees created per hectare.

A summary of the suppression events should be documented. This should include the management decisions made and actions taken, in addition to any incidents of concern. A log of all interface fires should be compiled for future reference.

Wildland fire may create hazard trees and these should be assessed immediately post fire. Any hazard trees that pose a striking danger to adjacent roads and trails should be removed immediately. If the wildfire causes extensive degradation of the organic horizons on a steep slope or within a riparian area, the site should be assessed for slope stability and the need for erosion control.

Wildfire is a natural disturbance agent in Okanagan ecosystems. If invasive plant species or erosion is not a concern, the site could be left to rehabilitate naturally. The only types of damage that should be addressed are those caused by suppression activities such as the construction of fire breaks and the use of heavy machinery within the stand.

Number	Action Item	Priority
Rec #43	In the event of a wildfire, a post-fire ecosystem impact assessment and rehabilitation plan should be completed.	B





13.9 FISCAL RESPONSIBILITY

Pilot projects should be pursued to treat the City owned interface polygons recommended in Appendix B. Landscape level fuels mitigation should be addressed in co-operation with the Ministry of Forests, Lands, and Natural Resource Operations, BC Timber Sales, First Nations, BC Transmission Corporation, and FortisBC. The City should work with these groups (either through monetary contribution or general support) to undertake fuel hazard reduction within the interface areas. The UBCM provides 50% in-kind funding for local governments to undertake fuel management pilot projects. In addition to the UBCM funding, there are many other funding sources that the District may be able to access to address the wildfire risk. Some such sources include:

- First Nations Emergency Social Services;
- Canadian Forest Service (National Research Council);
- UBCM;
- Community Futures; and
- Mountain Pine Beetle Initiative.

Number	Action Item	Priority
Rec #44	Pursue funding sources to undertake pilot projects to treat the City owned interface polygons recommended in Appendix B.	A

14.0 CONCLUSION

There have been significant wildfires within the Okanagan in the past 15 years. The risk of interface fires is expected to increase as development into the interface continues, weather conditions are influenced by climate change and the fuels profile is altered by the pine beetle. This risk can be managed in the City of Kelowna through careful planning and treatment operations. Success of this plan will require cooperation between agencies, public support and designation of sufficient resources. By implementing the recommendations in this document, the City will decrease the potential for a catastrophic wildfire, maintain recreational opportunities, and improve the survivability of the developments within its jurisdictional boundaries.

The City should commit to becoming a "FireSmart" community and embrace this opportunity to exemplify an inspired concept for wildfire management. By adopting the recommendations in this plan the City will lead by example towards ensuring the long term safety of its citizens, buildings and infrastructure.

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16.0 APPENDIX A - WILDFIRE RISK ANALYSIS METHODOLOGY

The following document is an overview of the methodology followed to produce the landscape level Wildfire Risk Analysis (WRA) for the City of Kelowna and adjacent area. It is meant to provide some baseline knowledge of the ranking system structure and how the results are presented.

The WRA is a GIS-based model that spatially quantifies and analyzes the relationships that exist between the critical factors affecting wildfire risk. The objective of this model is to provide planners with a decision making tool to spatially identify the severity of wildfire threat on a landscape level. This information allows planners to analyze and explore the implications of different management activities in relation to wildfire risk.

The overall hazard ranking spatially determines wildfire threat by incorporating four key components as follows:

1. Fire behaviour characteristics (40% of the weighting);
2. Risk of ignition (10% of the weighting);
3. Threat to structures, natural features and cultural features of significance (25% of the weighting); and
4. Suppression constraints (25% of the weighting).

These four components are in turn calculated from contributing factors, each of which is represented by a layer in GIS. The wildfire hazard of each of the components is calculated by overlaying the relevant contributing factors. The layers representing these four components are subsequently overlain to produce the final wildfire risk rating.

16.1 COMPONENT #1 - FIRE BEHAVIOUR

The fire behaviour component of the WRA measures how wildfire will behave under extreme weather conditions. The Canadian Fire Behaviour Prediction System (FPB) provides quantitative outputs of selected fire behaviour characteristics for the major Canadian fuel types (Hirsch 1996).

16.1.1 Fuel Types

Sixteen national benchmark fuel types, which are divided into five categories, are used by the Canadian Fire Behaviour Prediction System to forecast how wildfire will react. These fuel types were defined using the forest inventory and guidelines developed by the MFLRNO. Six fuel types were identified in the study area. It is important to note that these fuel types represent a type of behaviour pattern and their generic names do not



accurately describe the type of stand that is found. These descriptions are referenced from the MFLNRO Wildfire Management Branch website.

16.1.2 Weather Inputs

Weather conditions used to calculate fire behaviour were derived from historic records dating back to 1970 for three MFLNRO weather stations within the vicinity of Kelowna.

Table 13 MFLNRO Weather Stations

Station #	Station Name	BEC zone	Latitude	Longitude	Elevation (m)	Start Year	End Year
298	Fintry	IDF xh 1	50.2067	-119.48	670	1989	2006
328	Pentiction RS	BG xh 1	49.5183	-119.553	427	1970	2006
289	Kal Lake Vernon	IDF xh 1	50.2	-119.3	4	1986	1990

This data was compiled and statistically analyzed to determine the average 80th percentile fire weather indices for the months of May to September. Fire weather inputs were as follows:

Table 14 Fire Weather Indices Used for Fire Behavior Modeling

Fine fuel moisture code (FFMC)	Build-up index (BUI)	Wind (km/h)
91	109	10

Topographical attributes required to predict fire behaviour include slope and aspect. The study area was delineated into polygons based on slope breaks of 10% intervals and aspects of 45 degrees. The cardinal wind direction was calculated from the aspect so that it was blowing upslope and the elapsed time was set at 24 hours.

All of the data pertaining to fuel types, topographical attributes, and fire weather was compiled for the entire study area. This information was then run through the modelling software (Remsoft FPB97) to create the three output fire behaviour layers: fire intensity, rate of spread and crown fraction burned.

16.1.3 Fire Intensity

This layer is a measure of the rate of heat energy released per unit time per unit length of fire front and is based on the rate of spread and the predicted fuel consumption. The units for this layer are kilowatts per meter.

16.1.4 Rate of Spread

This layer is a measure of the speed at which a fire extends its horizontal dimensions. It is based on the hourly Initial Spread Index (ISI) value and is adjusted for the steepness of slope, the interactions between slope and wind direction and increasing fuel availability as accounted for through the Build Up Index (BUI). The units for this layer are meters per minute.

16.1.5 Crown Fraction Burned

This layer is a measure of the proportion of tree crowns involved in the fire. It is based on the rate of spread, the crown base height and the foliar moisture content and is expressed as a percentage value.

The weightings of the fire behaviour layers were designated as follows with a total maximum value of 40 and categorized into risk categories as follows: 6-19 = Low; 20-29 = Medium; 30-40 = High.

Table 15 Fire Behavior Units and Weighting

Layer	Units	Unit Value	Weight
Fire Intensity	Kilowatts per meter (kW/m)	>0-500	4 – Very Low
		501-1000	8 – Low
		1001-2000	10 – Low
		2001-4000	12 – Medium
		4001-10,000	16 – Medium
		10,001-30,000	18 – High
		>30,000	20 – Very High
Rate of Spread	Meters per minute (m/min)	>0-5	2 – Very Low
		6-10	4 – Low
		11-20	6 – Medium
		21-40	8 – High
		>40	10 – Very high
Crown Fraction Burned	Percent of canopy crown burned (%)	0	0 – None
		1-9	3 – Low
		10-49	6 – Medium
		50-89	8 – High
		90-100	10 – Very high

16.2 COMPONENT #2 – RISK OF IGNITION

Fires are ignited by either human causes or lightning. The most common source of human caused ignition includes the use of motorized machinery, discarded cigarettes and matches from smoking, fires started in houses, campfires lit within natural areas, sparks from railways and trees falling and striking hydro distribution and transmission lines. These causes are accounted for by buffering all areas where these causes are most likely to occur. A 30-meter buffer has been established around all roads, structures, hydro





lines and railways. Where these areas run through fuel types that are likely to sustain a fire ignition, the area has been assigned a high-risk ranking.

It is difficult to predict the risk of lightning striking across a landscape. Therefore, all fuel types that are likely to sustain a fire ignition due to a lightning strike have been identified and assigned a moderate risk ranking. All deciduous fuel types have been assigned a low ranking and non-fuels have been assigned a weighting of 0.

The weightings of the risk of ignition were designated as follows with a total maximum value of 10 and categorized into risk categories as follows: 1 = Low; 5 = Medium; 10 = High.

Table 16 *Risk of Ignition Units and Weighting*

Layer	Units	Weight
Risk of Human Caused Ignition	Areas within 30 meters of	10
	• Structures	
	• Trails/Camping areas	
	• Hydro Transmission lines	
Risk of Lightning Caused Ignition	• Railways	5
	All fuel types except deciduous or non-fuels (C2, C3, C4, C7, M2)	
	All Deciduous fuels (D1/D2)	1
	All non-fuels (W, I, U, N)	
		0

16.3 COMPONENT #3 – VALUES AT RISK

The 'values at risk' component of the model identifies human structures which are at risk of being damaged or destroyed by wildfire. All structures within the wildland interface were identified using orthophotos and buffers of 30 m, 100 m and 2 km were then created around these structures. Weightings were assigned to these buffers as per the table below.

The weightings of the structures and natural features at risk were designated as follows with a total maximum value of 25 and categorized into risk categories as follows: 5 = Low; 10-25 = High.



Table 17 Values at Risk Units and Weighting

Layer	Units	Weight
Structures and facilities at risk	Areas within 30 meters of any structures	25
	Areas within 100 meters of any structures	20
	Areas within 2km of any structures	5

16.4 COMPONENT #4 – SUPPRESSION CONSTRAINTS

The ability to suppress a wildfire depends on a number of factors including terrain characteristics, accessibility and the availability of suppression resources. Four factors were used to determine the overall rating for suppression capability: proximity to roads, proximity to water sources, initial attack time and steepness of terrain.

16.4.1 Proximity to Roads – Access

This layer accounts for the accessibility of suppression resources to fight a wildfire by creating 100 m, 500 m and 1000 m buffers along all roads in and adjacent to the study area. These buffers were assigned threat weightings that decreased with their proximity to roads.

16.4.2 Proximity to Water Sources

This layer is a measure of the availability of water sources for fire suppression. It was derived by creating 100 m buffers around all fire hydrants and perennial rivers, creeks and lakes. Fire hydrants were designated the lowest weighting of 2, perennial water sources (ponds, reservoirs, lakes, rivers) were designated a weighting of 6 and all other areas were designated a weighting of 10.

16.4.3 Steepness of Terrain

Steepness of terrain influences the timely ability of ground crews to access the fire and construct fire lines. Areas were weighted based on their average slope class derived from the municipality ecosystem mapping database. Designated weights increase relative to the steepness of the slope.

Weightings of the suppression constraints were designated as follows with a total maximum value of 25 and categorized into risk categories as follows: 0-9 = Low; 10-19 = Medium; 20-25 = High.



Table 18 – Suppression Constraints Units and Weighting

Layer	Units	Unit Value	Weight
Proximity to Roads	Distance from roads in meters	0-100 from roads	1
		101-500 from roads	3
		501-1000 from roads	6
		>1000 from roads	10
Proximity to Water Sources	Distance from water sources in meters	<100m from perennial water sources (ponds, reservoirs, lakes, rivers)	5
		>100 meters from perennial water sources (ponds, reservoirs, lakes, rivers)	10
Steepness of Terrain	% Slope	0-20	1
		21-40	2
		41-60	3
		60-100	4
		>100	5

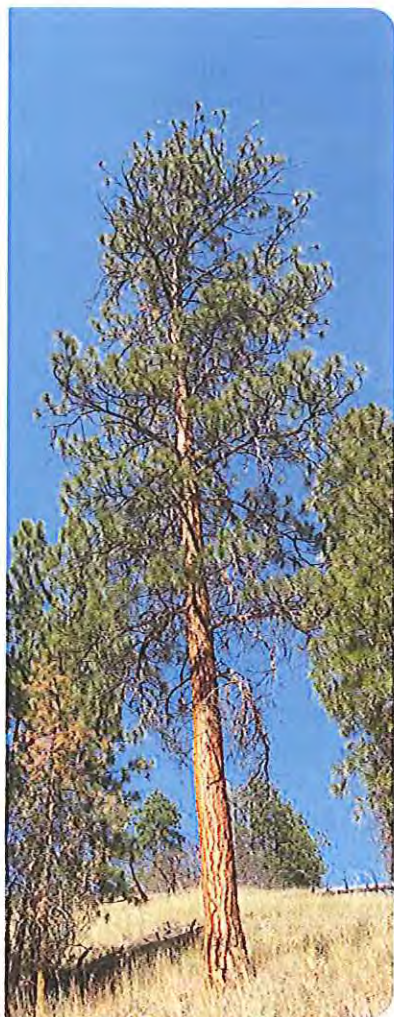
*The entire area was weighted based on distance from roads. Then the risk was reduced by three if the area was accessible by a trail.

16.5 FINAL WILDFIRE RISK RATING

The final wildfire hazard rating has been calculated by adding together the ratings of the four primary components to produce a final weighting out of 100. The final weightings have been categorized as follows:

Table 19 – Final Wildfire Risk Weighting and Hazard Class

Final Weight	Wildfire Hazard
0-39	Low
40-59	Moderate
60-79	High
.80	Very High



17.0 APPENDIX B – INTERFACE FUELS ASSESSMENTS OF CITY OWNED LANDS

All City owned forested lands (>150 stems/ha) within 100 m of any structures were identified as candidate polygons requiring an interface fuel hazard assessment. These included areas previously treated following the recommendations made in the 2004 report "City of Kelowna Fuel Management Strategy." If no further treatment was required to mitigate fuels, photos were taken to document the sites condition. If treatment was required, the area was evaluated using the provincial assessment system outlined in the "Rating Wild-fire Interface Threats in British Columbia" (MOFR 2008). The rankings from this assessment resulted in a prioritized list of areas for treatment. These treatment areas were then compiled along with their attributes into a GIS database and labelled according to their priority ranking.

All areas ranked as high priority (Polygons 1-2) contain fuels with a high fire behavior potential and are located adjacent to structures without adequate defensible space. Areas that are ranked as moderate (Polygons 3-17) have a moderate fire behavior potential. Some of these areas have been previously treated but target stand conditions were not met and further treatment is recommended. Areas ranked as low (Polygons 18-36) have a low fire behavior potential however there are some low intensity treatments such as selective thinning and higher pruning that could be done to further reduce the risk.

17.1 OBSERVATIONS AND RECOMMENDATIONS

A large number of the interface polygons have already been treated. Most forested areas within 30 meters from the structures were thinned uniformly down to 150-400 stems/ha and pruned to 2-3 meters. The treatments were usually thinned uniformly with little to no breaks created in the crowns. The density of thinning also did not change with the proximity to the structures. The following are considerations and recommendations for future treatments on City owned lands.

- Thinning within 30 meters of structures should be to a lower density 50-150 stems/ha.
- Create an effective defensible space within 10 meters from structures. The majority of standing fuels should be removed from within this area.
- Where feasible, surface firebreaks should be created within 30m of structures to stop the spread of surface fires.
- The height of pruning should be dependent on the slope of the terrain and the surface fuel loading. Generally, 2-3 m is usually adequate on flat ground, however, this should extend to 3-5m on steeper slopes. Target pruning heights refer to the lowest part of each branch.
- Thinning should generally be less uniform with scattered canopy gaps to create crown fuel breaks and to promote the establishment of small grassland communities within the constructed stand gaps.

17.2 SUMMARY OF POLYGONS

The following table is a summary of the areas that were visited in the field. The polygon number and ranking are provided along with the results of the interface rating.

Comments	Priority for treatment	Fire_Hazard Rating	Type of Development	Position_of Structure	Terrain	Slope	Aspect	Historical Wildfire	BEC Zone	Forest_Health	Continuous Forest Land	Conifer Ladder Fuels	Conifer Crown Base Ht	Decid Crown %	Conifer_Crown %	Large Woody	Fine Woody	Veg Fuel Comp	Surface Veg %	Duff Depth	Polygon #
Previously thinned to 50-350st/ha and pruned to 2-3m. Thin out remaining intermediate and suppressed trees down to 150 st/ha and prune to 4m. Remove all trees within 15m of houses.	L	106	5	5	3	12	12	15	20	0	5	1	5	10	2	0	1	5	4	1	18
Previously thinned to 200-400st/ha and pruned to 2-3m. Thin further to 200st/a prune to 4m. Remove all trees within 15m of structures.	L	103	8	15	3	5	2	15	20	0	2	1	2	10	5	0	5	5	4	1	19
Previously thinned to 50-300st/ha and pruned to 3-4m. Thin out remaining intermediate and suppressed trees down to 150 st/ha and prune to 4m. Remove all trees within 15m of houses.	L	105	8	15	3	10	2	15	20	0	2	1	2	10	2	0	5	5	4	1	20
Previously thinned to 100-250st/ha and pruned to 2-3m. Thin out remaining intermediate and suppressed trees down to 150 st/ha and prune to 4m. Remove all trees within 15m of houses.	L	112	8	15	3	10	12	15	20	0	2	1	2	10	2	0	2	5	4	1	21
Previously thinned to 100-250 stems/ha. Could be further thinned down to 100 stems/ha.	L	110	12	8	3	5	10	15	20	0	5	1	2	10	2	2	5	5	4	1	22
This is a flat area supporting mature pine with high crowns. There is a dense shrub layer. Some beetle killed trees have been removed. Currently 200-500 st/ha. Thin out the intermediate and suppressed trees. Prune to 3m and remove trees within 15m of structures.	L	112	8	12	3	1	10	15	20	0	5	3	0	10	10	2	5	2	4	2	23
Moderately dense multi storied stand. There has been minor treatment by homeowner. There is a good surface break behind the homes. Thin to 150st/ha and prune to 3m.	L	103	5	5	7	15	5	15	20	0	5	4	8	0	5	0	1	5	2	1	24
Moderately open stand that has been treated in some areas. High use recreation area with risk of ignition. Thin out further to 100 st/ha and remove trees within 15m of houses.	L	100	8	15	1	1	15	15	20	0	5	1	5	0	5	0	1	5	2	1	25

Comments	Priority for treatment	Fire_Hazard Rating	Type of Development	Position_of Structure	Terrain	Slope	Aspect	Historical Wildfire	BEC Zone	Forest_Health	Continuous Forest Land	Conifer Ladder Fuels	Conifer Crown Base Ht	Decid Crown %	Conifer_Crown %	Large Woody	Fine Woody	Veg Fuel Comp	Surface Veg %	Duff Depth	Polygon #
Moderately open stand that has been treated in some areas. Thin out further to 100 st/ha and remove trees within 15m of houses.	L	104	5	12	7	10	12	15	20	0	5	2	2	0	5	0	1	5	2	1	26
Previously treated in some areas, Moderately dense stand with high crowns. Thin to 100 st/ha and prune to 4m.	L	115	8	15	7	15	12	15	20	0	5	2	2	0	5	0	1	5	2	1	27
This entire slope was previously thinned to 100-250st/ha and pruned to 2-3m. Remove suppressed trees on middle slope and reduce density to 100-150 st/ha. Prune to 4m.	L	118	8	15	3	12	5	15	20	0	2	1	5	10	5	2	5	5	4	1	28
Value is a cement water reservoir with low risk of being damaged. Steep gappy stand that would be difficult to treat. All adjacent fuels have been treated. If possible thin and prune to 4m.	L	127	12	15	3	15	5	15	20	0	5	3	8	10	5	2	2	2	4	1	29
Previously thinned to 200-350 stems/ha. Could be further thinned down to 100 stems/ha.	L	100	8	8	3	1	10	15	20	0	5	1	2	10	5	0	2	5	4	1	30
Values are hydro substation and houses. There is a 25m fuel free buffer. Thin to 100-150 and prune to 4m.	L	109	5	5	3	1	10	15	20	0	10	2	5	10	10	2	2	5	2	2	31
Structure is an old barn isolated by a 40m fuel free break. Stand is currently 250-400st/ha. Thin out suppressed and intermediate trees to 100-200st/ha and prune to 4m.	L	102	5	5	3	5	5	15	20	0	10	1	5	10	5	0	2	5	4	2	32
This area was previously burned. The public beach below is a risk of ignition and the home is upslope from these fuels. There is a 30m fuel free buffer between the stand and the home. However, due to the slope and risk of ignition, the stand should be thinned to 100st/ha and pruned to 4m.	L	120	8	12	3	15	12	15	20	0	5	3	8	0	10	0	2	2	4	1	33



Comments	Priority for treatment	Fire_Hazard Rating	Type of Development	Position_of Structure	Terrain	Slope	Aspect	Historical Wildfire	BEC Zone	Forest_Health	Continuous Forest Land	Conifer Ladder Fuels	Conifer Crown Base Ht	Decid Crown %	Conifer_Crown %	Large Woody	Fine Woody	Veg Fuel Comp	Surface Veg %	Duff Depth	Polygon #
Previously thinned and pruned. No further thinning required. Prune higher to 4m in height due to steep slope.	L	124	8	15	3	10	12	15	20	0	5	1	5	10	2	2	5	5	4	2	34
Open stand with some dense pockets of pine. Thin out suppressed trees in dense pockets and prune to 4m.	L	118	8	15	7	10	12	15	20	0	5	4	8	0	5	0	1	5	2	1	35
Open stand with homes downslope. Thin to 100 stems/ha and prune to 4m.	L	93	5	5	7	12	5	15	20	0	5	1	2	0	5	0	1	5	4	1	36
This is a moderately dense multi storied stand with a mix of species. It poses a high fire risk but is an ecological reserve (Woodhaven-regional park). Manage this risk through suppression preparedness and public education	N	112	5	8	1	1	10	15	20	0	5	3	10	10	15	0	1	2	5	1	37
This stand is adjacent to homes and a playground. It has been thinned and pruned. No further treatment required.	N																				38
Previously thinned and pruned adjacent to structure. Trail provides ground fuel break. No further treatment required.	N																				39
Previously thinned to 150 st/ha and pruned to 3m. No further treatment required.	N																				40
Scattered individual trees. No treatment required.	N																				41
Previously thinned to 100-150st/ha and pruned to 2-3m. Fuel free buffer between stand and structures. No further treatment required.	N																				42
Top 30 m of slope has been thinned to 50-150 stems/ha and pruned. No further treatment required. An access road has been created along a section of this slope providing great access for suppressions efforts.	N																				43

Comments	Previously thinned to 150 st/ha and pruned to 3m. No further treatment required.	Small pocket of mature pine. Isolated by road and grasslands.	Landscaped area. Only a kiosk present. No treatment required.	Steep slope 80% with eroding gullies. Only 30% ground fuel cover and scattered trees at 100 sat/ha. Road acts as fuel break upslope. These are riparian trees important for slope stability. No treatment recommended.	Open stand that has been thinned and pruned within 50m of homes.	Scattered tree with colluvial slopes. No treatment required.	Previously thinned to 100-250st/ha and pruned to 2-3m. No further treatment required.	Previously thinned to 100-250st/ha and pruned to 2-3m. No further treatment required.	Previously thinned to 100-250st/ha and pruned to 2-3m. No further treatment required.	Scattered individual trees. No treatment required.
Priority for treatment	N	N	N	N	N	N	N	N	N	N
Fire_Hazard Rating										
Type of Development										
Position_of Structure										
Terrain										
Slope										
Aspect										
Historical Wildfire										
BEC Zone										
Forest_Health										
Continuous Forest Land										
Conifer Ladder Fuels										
Conifer Crown Base Ht										
Decid Crown %										
Conifer_Crown %										
Large Woody										
Fine Woody										
Veg Fuel Comp										
Surface Veg %										
Duff Depth										
Polygon #	44	45	46	47	48	49	50	51	52	53



Comments	Mature pine stand with high crowns. Few ladder fuels. Dense deciduous shrub layer. Creek acts as fuel break between stand and houses. High value riparian area. No treatment recommended.	The base of this slope has been thinned and pruned. No further treatment required.	Previously thinned to 100-250st/ha and pruned to 2-3m. No further treatment required.	Previously thinned to 100-250st/ha and pruned to 2-3m. No further treatment required.	Mature Douglas-fir Cottonwood stand. Dense brush complex. Steep slopes with stability issues indicators. Scattered individual trees with high crowns. No treatment required.	This is a landscaped urban park. Mature pine with high crowns. No treatment required.	This area is on the interface of the previously burned area. There are scattered individual trees. No treatment recommended.
Priority for treatment	N	N	N	N	N	N	N
Fire_Hazard Rating							
Type of Development							
Position_of Structure							
Terrain							
Slope							
Aspect							
Historical Wildfire							
BEC Zone							
Forest_Health							
Continuous Forest Land							
Conifer Ladder Fuels							
Conifer Crown Base Ht							
Decid Crown %							
Conifer_Crown %							
Large Woody							
Fine Woody							
Veg Fuel Comp							
Surface Veg %							
Duff Depth							
Polygon #	54	55	56	57	58	59	60

17.3 PHOTOS OF POLYGONS

Polygon	Photos	
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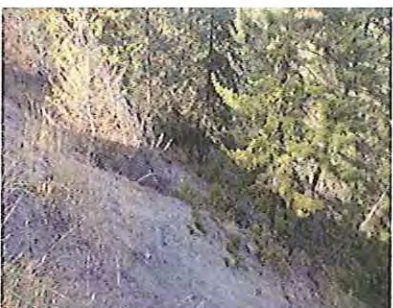
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18.0 APPENDIX C – FIRESMART DEVELOPMENT RECOMMENDATIONS

The FireSmart manual was developed to provide guidelines to individuals, communities and planners on how to reduce the risk of loss from interface fires. The following is a summary of these guidelines related to development planning.

18.1 VEGETATION MANAGEMENT

FireSmart recommends treatments around structures in three 'priority zones'. Treatments in these zones involve fuel removal, fuel reduction, and fuel conversion. The objective in these zones is to create 'defensible' space around a home from which to suppress a wildfire. Survivability of a home is often dependent on the distance from the structure to the adjacent forest. Detailed goals and treatments can be found in the FireSmart manual in Chapter 3. Priority zones are based on distance from the structure, and the slope below the structure, and are defined as:

- Priority Zone 1 (within 10 m from structures): Remove fuel and convert vegetation to fire resistance species to produce an environment that does not support combustion.
- Priority Zone 2 (10 to 30 m from structures): Increase fuel modified area by reducing flammable vegetation through thinning and pruning and produce an environment that will only support low-intensity surface fires
- Priority Zone 3 (30 to 100 m+ from structures): Eliminate the potential for a high-intensity crown fire through thinning and pruning, thereby slowing the approach of a fire approach towards structures.

The area within 30 meters of the structures (priority zones 1 and 2) should be treated heavily enough to create a defensible space between the structures and the adjacent stand. Treatments in priority zone 3 need not be as intensive as those adjacent to the structures but should still reduce the potential for a crown fire under 90th percentile weather conditions.

The slope of the terrain has a strong influence on fire behavior. The rate of spread (ROS) of a fire doubles for every 30% increase in slope, up to 60%. The recommended treatment zone distances around structures should be adjusted accordingly. Steeper slopes should be treated to a further distance, thinning should be to a lower density and pruning height should be higher. Typically, slopes of 30% below buildings should have the priority zone 2 extended to 60 m below the structure and to 45 m side slope. On a 55% percent slope, priority zone 2 should be extended to 120 m down slope of the structure and 60 m horizontal. The necessary distance and extent of

treatment should be determined by a fire behavior specialist and clearly described in the fuels reduction prescription.

Priority Zone 1-Fuel Free Zone (10 m from buildings)

A fuel free zone should be created around all homes and outbuildings. The fuel free zone should extend 10 m from the structure, or further if the terrain is sloped. The following guidelines should be considered:

- There should be enough defensible space to protect buildings from approaching wildfire and to reduce the potential for a building fire spreading to the wildland.
- Annual grasses within 10 m of buildings should be mowed to a height of 10 cm or less and watered regularly during the summer months.
- Surface litter and downed trees should be removed regularly.
- Dead, and dying trees should be removed.
- Structures at the top of a slope will need a minimum of 30 m of defensible space.
- Vegetation within this zone should be of a fire-resistant species
- Trees within this zone should be pruned to a height of 2 to 3 m and not overhang the house or porch.
- Remove all piled debris (firewood, building materials, and other combustible material) outside of the fuel free zone.
- Defensible space should be provided by the developer and maintained by the property owner.
- Community Strata rules should enforce the maintenance of this zone.

Priority Zone 2-Fuel Reduction Zone (10 to 30 m from buildings)

Fuel modification in this zone should include thinning and pruning to create an environment that will not support a high intensity crown fire. A surface fire may occur in this zone but it will be of low intensity and easily suppressed. Guidelines for this zone are as follows:

- Actions in this zone should be oriented towards fuel reduction rather than removal.
- Deciduous composition in the overstory should be promoted (i.e. Deciduous species should not be thinned out).
- This zone should be extended as slope increases. The 20 m concentric distance from the boundary with priority zone 1 should be corrected for slope.
- Thin trees for two tree lengths from buildings.



- Treatments within this zone will include thinning of the canopy, thinning the understory and pruning lower branches
- Leave trees should be the largest on site and canopy heights should be pruned to a height of 2 to 3 m.
- Remove all dead and dying trees.
- Dispose of all slash created by treatments through pile and burning or removal from the site.
- This zone should be constructed by the developer and maintained by the property owner.
- Community strata rules should enforce the maintenance of this zone.

Priority Zone 3-Fuel Reduction and Conversion (30 to 100 m from buildings)

The strategies for this zone are similar to those of priority zone 2 with the distance being slope dependent. This environment should be one that does not support a high-intensity crown fire. A surface fire may occur, but it will be of low intensity and easily extinguished. Vegetation management should concentrate on vegetation conversion and reduction rather than removal. The following are guidelines for this zone:

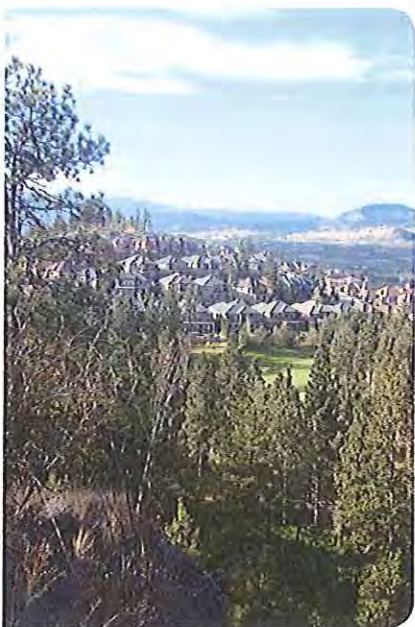
- Fuel management in this zone should only be undertaken if there are high hazard levels from heavy continuous fuels and steep topography.
- Deciduous species should be promoted.
- On sloped terrain, the width of this zone will need to be corrected for slope distance.
- Thinning and pruning
- This zone should be constructed by the developer and maintained by the property owner.
- Community Strata rules should enforce the maintenance of this zone.

18.2 BUILDINGS AND CONSTRUCTION

During an interface fire, homes usually burn down as a result of burning embers landing on and igniting the roof. Alternatively, embers land on or in a nearby bush, tree or woodpile and, if the resulting fire is near the home, the walls of the home will ignite through radiant heat. Small fires in the yard can also spread towards the home and beneath porches or under homes. Therefore, the building material and construction techniques are a paramount concern for homes in the WUI.

The FireSmart Manual provides guidelines for safer construction methods. These include materials, building techniques and maintenance. The following is a summary of these construction and landscaping specifications that should be incorporated into the design guidelines for building on site.





Roofs

- Use only fire retardant material (Class A materials) on roofs; and
- Keep roofs clean of all combustible material.

Wood Chimneys

- All chimneys should have approved spark arrestors (securely attached and made of 12-gauge welded or woven wire mesh screen with mesh opening of less than 12 mm);
- Chimney outlets should have at least 3 meters clearance from all vegetation and obstructions; and
- Chimney outlets should be 0.6 m higher than any part of the roof within 3 meters.

Siding

- Siding should be predominantly fire resistant material; and
- Siding should extend from the ground level to the roofline.

Windows and Door Glazing; Eaves, Vents and Openings

- Remove vegetation from within 10 meters of glazed openings unless there are solid shutters to cover the glazing;
- All eaves, attics, and underfloor openings need solid, non-flammable protective covers; and
- Laminated glass and 20 minute rated door assemblies should be used on building surfaces facing the forest interface.

Balcony, Decks and Porches

- Deck surface material should be made of predominantly non-combustible or fire-resistant materials such as wood composite products;
- Slotted deck surface allow needle litter to accumulate beneath the deck. Provide access to this space to allow for removal of this debris.

Guidelines during Construction

- During construction of houses, all waste construction materials including brush and land clearing debris needs to be cleaned up on a regular basis to minimize the potential risk. No combustible materials should be left at the completion of construction;
- Prior to construction of any wood frame buildings, there must be fire hydrants within operating range.





Landscaping

The majority of high risk fuels are planned to be cleared for the construction of buildings and associated infrastructure. It is important to plan landscaping to ensure that adequate defensible spaces are maintained adjacent to all structures in the long term. All areas to be landscaped within 20 meters of buildings should adhere to the following guidelines.

- All flammable trees and shrubs growing within 20 meters of any structures should be removed and replaced with fire resistant species. The most flammable species include those that accumulate dead foliage and branches and have a high content of oils and resin.
- Characteristics of fire resistant species to be replanted include the following:
 - Deciduous species;
 - Low growing plants;
 - Plants with thick woody stems;
 - Plants that accumulate low amounts of dead vegetation;
 - Plants with low resin content (deciduous species);
 - Plants that retain high moisture content.

18.3 UTILITIES-ELECTRIC AND GAS

Overhead transmission and distribution lines are a major ignition risk. Falling trees or branches can knock a powerline to the ground, where it will remain charged and potentially start a fire. Primary distribution lines are the most problematic as they are remote and difficult to inspect and maintain. Secondary lines contain less voltage but are more susceptible to being overgrown by vegetation, which can lead to arcing and ignition. Underground power lines are the most FireSafe.

When planning new developments, underground power line systems should be considered. Where such a system is not feasible, overhead utility lines should have a clearance of at least 3 m from vegetation.

Propane tanks surrounded by vegetation are potential hazards. Combustion adjacent to these tanks could increase the internal pressure causing the tank to vent through a relief valve. The resulting fire can be one of a high-intensity and with the potential to destroy adjacent buildings. Hence, when positioning tanks, the relief valves should point away from buildings. Faulty relief valves will not allow pressure to discharge resulting in a boiling liquid explosion dangerous to those within 300 m.



Propane tanks should have surrounding vegetation cleared for at least 3 m in all directions. Tanks should be located at least 10 m from any building. Future development around the tank should respect this distance and be monitored by the development strata.

18.4 HOME SPRINKLER SYSTEMS

When designing new developments, particularly those in remote locations some distance from emergency services, some consideration should be given to the installation of underground sprinkler systems. These systems can serve as both a method of irrigation as well as an interface suppression tool. Sprinklers can be located on the rooftops of homes and outbuildings. In the event of a wildfire, the sprinklers would be engaged and would increase the relative humidity around the house as well as increase the fuel moisture content of any fuel adjacent to the home resulting in lower flammability and fire behavior potential. Rooftop sprinklers are also recommended for homes in the interface that do not have fire resistant roofing or siding.



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**DIAMOND HEAD
CONSULTING LTD.**

342 West 8th Avenue
Vancouver, BC V5Y 3X2
T: 604.733.4886 F: 604.733.4879
www.diamondheadconsulting.com

