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The Pender Islands Community Wildfire Protection Plan

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Executive Summary

This Community Wildfire Protection Plan (CWPP) is intended to detail how wildfire risk (the potential for damage from wildfire) will be reduced on the Pender Islands. The plan provides a foundation for future collaboration, details risk assessment results, and produces an action plan for reducing wildfire risk. Agencies collaborating on this plan included Pender Island Fire Rescue, the Capital Regional District, Parks Canada, the Islands Trust, and the Ministry of Forests and Range. The risk assessment found the highest risk areas to be centered on residential developments with evacuation problems due to very high human-caused ignition rates, and high wildfire consequences. During typical summer drought conditions, expected fire intensities were found to be low with no crowning potential. However, when outflow conditions (interior air mass moving onto coastal areas) meet with moderate to high winds and drought conditions, all fuel types except deciduous stands were predicted to sustain crown fires. Five wildfire mitigation management objectives were evaluated:

1. FireSmarting residential homes in evacuation problem areas.
2. Fuel treatment in evacuation problem areas.
3. A 50% reduction in fire ignitions.
4. Building an effective escape route from the Magic Lakes Estates.
5. Building high-volume water stations in high risk areas.

Reducing ignitions proved to be the most effective management objective, reducing total wildfire risk by approximately 50%. Building an evacuation route from the Magic Lakes Estates and FireSmarting houses in high risk areas each reduced wildfire risk by approximately 35% and building high-volume water hookups reduced risk by 30%. Fuel treatments in evacuation problem areas did not reduce wildfire risk. These results guide the wildfire risk mitigation action plan detailed on page 21.

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INTRODUCTION

PLAN PURPOSE

This Community Wildfire Protection Plan (CWPP) is intended to detail how wildfire risk (the potential for damage from wildfire) will be reduced on the Pender Islands. To do this, this CWPP will:

- Provide a foundation for future collaboration on wildfire risk mitigation efforts on the Pender Islands.
- Assess wildfire risk on the Pender Islands, identifying where risk is highest, why, and what the most effective strategies for reducing risk are.
- Produce an Action Plan for reducing risk on the Pender Islands.

CWPP PROCESS

A community wildfire protection plan can only be considered successful if it builds a community's capacity to reduce wildfire risk. In practical terms, this means building collaboration and knowledge among fire management stakeholders and commitment to implementing risk mitigation activities. A CWPP Working Group was formed to develop CWPPs for both Saturna and the Pender Islands. The group drew upon fire management perspectives from all levels of government and possessed expertise ranging from building codes to fire behavior prediction. The group was comprised of the following fire management stakeholders:

- Capital Regional District, Protective Services
- Pender Island Fire Rescue
- Saturna Island Fire Rescue
- Gulf Islands National Park Reserve
- Ministry of Forests and Range, Wildfire Management Branch
- Capital Regional District, Regional Parks
- Islands Trust, Planning
- Capital Regional District, Building Inspection

The CWPP Working Group convened on 4 occasions over a seven month period and oversaw the completion of a Wildfire Risk Assessment for each island (Saturna and the Pender Islands), the evaluation of risk mitigation management strategies for each island, and the development of a CWPP Action Plan for each island. The Working Group drew upon a new Southern Gulf Islands Wildfire Risk Assessment model developed by Simon Fraser University. The risk model incorporated expertise ranging from fire behavior specialists from Ministry of Forests and Range

to choice modeling experts from SFU. Southern Gulf Islands Risk Assessment research project membership is listed in Appendix A.

Need for a Plan

There is an average of 50 fire ignitions on the Pender Islands annually. For several decades Pender Island Fire Rescue has successfully extinguished all ignitions. Despite this success, the probability of a wildfire on the Pender Islands continues to rise because of increasingly dry conditions. Concurrent with increasing wildfire probability are increasing wildfire consequences. Property values, the number of residents and visitors, and the importance of remnant natural and cultural areas are all increasing.

Where it may not be possible to prevent or suppress all fires on The Pender Islands, a risk assessment and CWPP guides the allocation of fire prevention, suppression, and asset protection resources so as to minimize expected wildfire damages. The risk assessment predicts where forest fires are likely to do the most damage and explains why. A risk assessment can also be used to evaluate the relative effectiveness of proposed forest fire risk mitigation strategies by simulating management actions in the model and then comparing the resulting changes in risk levels.

Work To Date

There has been considerable progress towards mitigating wildfire risk on the Pender Islands. Whereas many other jurisdictions are looking to begin a program of risk mitigation with the adoption of a CWPP, leadership from the local CRD services, such as the Pender Island Fire Department, SGI Emergency Programs and CRD Building Inspection have already initiated many effective strategies to reduce the danger of wildfire. These include:

- Improved building bylaws regulating emergency access and water supply for fire fighting.
- A comprehensive neighbourhood emergency program which will increase communication within the community during a wildfire event.
- A well developed emergency management program to coordinate resources and support emergency response.
- A well-trained structural fire department with interface training.
- Annual emergency exercises (on all Southern Gulf Islands) bringing together multiple agencies involved with emergency response.

- Communication exercises for ensuring multi agency communication are preplanned.
- Public education efforts by the fire departments at BC Ferries terminals and other venues.

These efforts have reduced wildfire risk on the Pender Islands and provide a strong foundation from which to continue mitigating wildfire risk by implementing the Pender Islands CWPP Action Plan described on page 21.

CWPP Study Area Description

The Pender Islands, composed of North Pender and South Pender, are located in the Southern Gulf Islands in the Strait of Georgia between the cities of Vancouver and Victoria (Figure 1). Combined, the two islands cover just under 36 km^2 with North Pender over twice the size of South Pender. Both islands are in the Coastal Douglas-fir biogeoclimatic zone, characterized by a Mediterranean climate regime with mild winters and dry, hot summers, and Douglas-fir (*Pseudotsuga menziesii* var. menziesii) forests. Although North Pender has much more residential development than South Pender, both islands host a mosaic of rural residential areas and second-growth mixed-species forests. Forests are usually Douglas-fir leading and may contain Arbutus (*Arbutus menziesii*), Grand fir (*Abies grandis*), western redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), Rocky Mountain juniper (*Juniperus scopulorum*), bigleaf maple (*Acer macrophyllum*), or red alder (*Alnus rubra*). The Gulf Islands National Park Reserve holds several parkland properties scattered across North and South Pender.

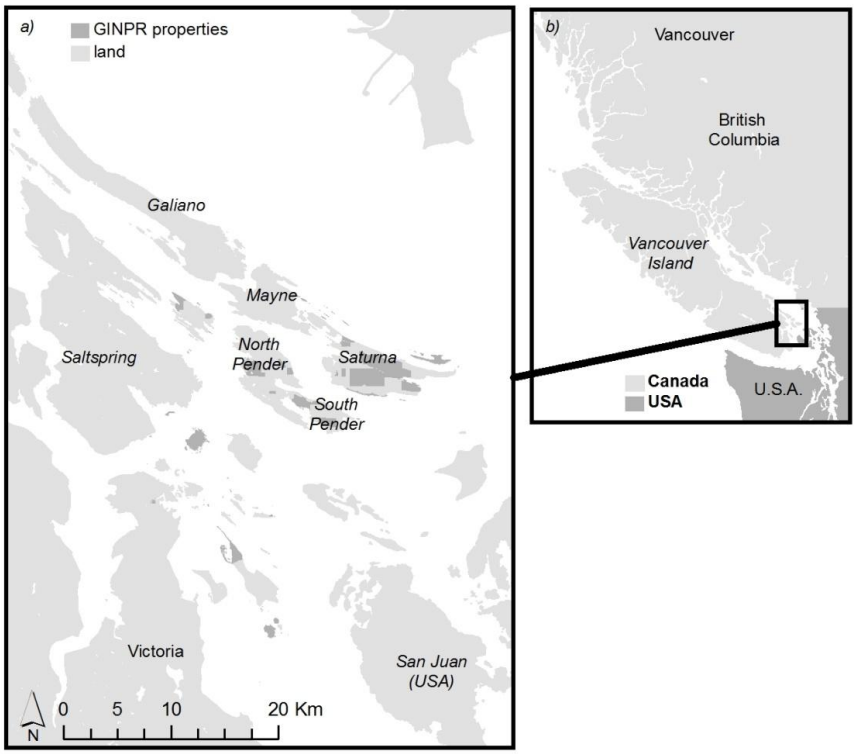

Figure 1 - North and South Pender Island *a)* are located in the southern Gulf Islands between the mainland and Vancouver Island *b)*.

Local fire managers are most concerned about human-caused fires, often originating from roads or residential development, moving into the surrounding forests. The worst-case scenario is that the fire front will grow within the forest and then move into a residential area. Human-caused ignitions in the form of escaped campfires, backyard burns, house fires, and downed power lines are far more common than lightning ignitions and are concentrated around roads and residential areas. With extensive rural development in a matrix of forest land that hosts a variety of endangered species, archaeological sites, and national park facilities, the Pender Islands host a complex landscape of values at risk. Extensive rural development, fire suppression, agriculture, and small-scale forestry have transformed forests and forest fuels such that historical fire regimes and fire behaviour are likely very dissimilar to present conditions.

The presence of three local fire halls means that local fire hall response times are low (usually less than 20 minutes) and the fire fighting capacity that can quickly be brought to bear on any ignition is higher than in many wildland areas across British Columbia. Accentuating these quick response times and rapid availability of fire equipment are is the presence of a provincial forest fire fighting base able to reach Pender within 40 minutes of fire detection. A diverse set of agencies are involved

in fire management on Pender ranging from local fire district chiefs to national park staff.

The Pender Islands have a unique local government structure where jurisdiction falls to both the Islands Trust and the Capital Regional District. In B.C. the role of local government in rural areas falls to regional districts. The Pender Islands are represented by the Southern Gulf Islands Electoral Area of the Capital Regional District (CRD). In addition to the CRD, jurisdiction for land use regulation (Part 26 of the *Local Government Act*) is granted to Local Trust Committees under the *Islands Trust Act*. Each Local Trust Area has its own Official Community Plan and Land Use Bylaws that establish the policies and regulations for land use and development (zoning), including minimum lot sizes, density, setbacks for buildings and structures, maximum lot coverage and development permit areas. Thus, the land use authority of the Islands Trust and Local Trust Committees only extends to the exterior of buildings (siting, size and dimensions) and the permitted uses for any building or structure. The authority for building construction and code requirements is under the authority of the CRD Building Inspection Services. Subdivision authority, including road requirements, is through the Ministry of Transportation and Infrastructure. Land use bylaws include subdivision regulations which are addressed through a referral process. The regulations may address a number of issues, including lot size, lot configuration (road frontage, depth to width ratio, panhandle), proof of potable water, septic capacity, drainage, road design and parkland dedication.

There are three major regulatory tools that are relevant to mitigating wildfire risk in the Gulf Islands.

- Part 26 of the *Local Government Act* allows for the creation of Development Permit Areas for protection from hazardous conditions, such as high wildfire risk locations that could require, among other things, FireSmart landscaping.
- Zoning regulations may regulate landscaping to prevent hazardous conditions.
- The CRD Building Regulations Bylaw (Capital Regional District Bylaw No. 4) which regulates building materials and construction standards, and could be used to require FireSmart construction standards and items such as interior sprinkler systems.

Risk Assessment Method

The Southern Gulf Islands Risk Assessment Model was used to complete the Pender Islands risk assessment. In this model, Wildfire Risk is equal to Wildfire Probability x Wildfire Consequences. Wildfire Probability is expressed as the product of Ignition Probability and Escape Probability. Ignition Probability and Escape Probability are expressed as relative probabilities, illustrating changes in relative event probability across the landscape rather than absolute probabilities of events. The term risk element is used to refer to factors that contribute to the evaluation of Wildfire Risk, such as fuel type, slope, or the presence of residential homes. In practice, risk elements are used as input data to the wildfire risk assessment model, providing the data needed to calculate Ignition Probability, Escape Probability, and Wildfire Consequences. Figure 2 shows the structure of the wildfire risk assessment model, listing the risk elements used to model Ignition Probability, Escape Probability, and Wildfire Consequences. It also illustrates how these probabilities and consequences are combined to produce Wildfire Probability and Wildfire Risk. The document Southern Gulf Islands Risk Assessment Model: Methods, available upon request from Fireweed Consulting, contains a detailed description of the risk assessment method used.

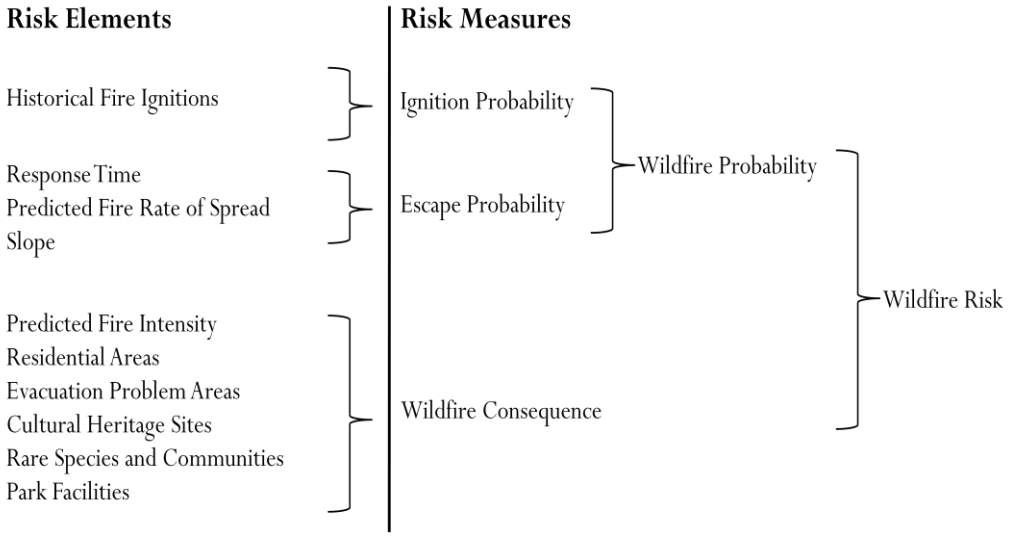

Figure 2 - The wildfire risk assessment model used.

Evaluating Risk Mitigation Management Strategies

Many risk management strategies were considered however the working group felt it would be most effective to focus on five strategies deemed most likely to mitigate risks. The completed wildfire risk assessment was used to evaluate the effectiveness of these five risk mitigation strategies at reducing total Wildfire Risk. Risk mitigation strategies were selected by the CWPP Working Group and were thought to be realistic, albeit ambitious, approximations of mitigation options being considered. The five wildfire mitigation management objectives evaluated were:

1. FireSmarting (Province of British Columbia 2005) residential homes and properties in evacuation problem areas.
2. Strategic landscape-level fuel treatment in evacuation problem areas.
3. A 50% reduction in fire ignitions.
4. Building an effective escape route from the Magic Lakes Estates development. Magic Lakes Estates is the highest density residential development in the study area and was not designed with adequate evacuation routes.
5. Building high volume water supply stations in all high wildfire risk areas.

Each mitigation objective was evaluated by revising risk element maps so they simulated the proposed mitigation objective and then running the risk model, producing new risk maps. The fuel treatment objective assumed that all forests in evacuation problem areas were thinned to the FBP C7 fuel type (ie. the fuel type map was revised). The C7 fuel type is a Ponderosa Pine – Douglas-fir multi-aged stand with an open canopy and high height to live crown distance (Canadian Forest Service 2007) and best matches the fuel characteristics of potential fuel treatments. We chose to locate the fuel treatments in evacuation problem areas because they hosted the highest consequence levels according to the consequence maps.

The FireSmart objective assumed that all developed residential buildings and surrounding properties in evacuation problem areas were treated to BC FireSmart standards (Province of British Columbia 2005). Thus, treated houses were assumed to have non-flammable roofing and siding and no flammable material adjacent to the house (ie. removal of the forest fuels surrounding the residence). FireSmarted locations were assumed to have reduced damage to houses and potential for loss of life. The Magic Lakes evacuation objective assumed that an effective evacuation route and evacuation plan was developed for Magic Lake Estates on North Pender. The Magic Lakes Estates are the highest density

residential development in the southern Gulf Islands and only have one access road. The reduced ignitions objective assumed a 50% reduction in fire ignitions across the study area. The high volume water station management objective assumed Escape Probability decreased by 0.25 to a minimum probability of 0.05 at all locations hosting a high volume station. All high risk areas (ie. locations with a Wildfire Risk >= 3) received a high volume station. Total Wildfire Risk associated with each mitigation objective was derived by adding up the Wildfire Risk for each 25 meter by 25 meter raster cell in the study area.

Risk Assessment Findings

Wildfire Risk

Risk assessment results show that it is people who are both the problem and the solution to risk and risk mitigation in the southern Gulf Islands. It is people and their influence on wildfire ignition and wildfire consequences that drive the distribution of wildfire risk. For example, wildfire risk is very high around Magic Lake Estates (Figure 3) where wildfire ignition and wildfire consequences are high. Risk is also very high around the Razor Point area and Mount Norman where consequences are high, access is difficult, and there is a history of ignition.

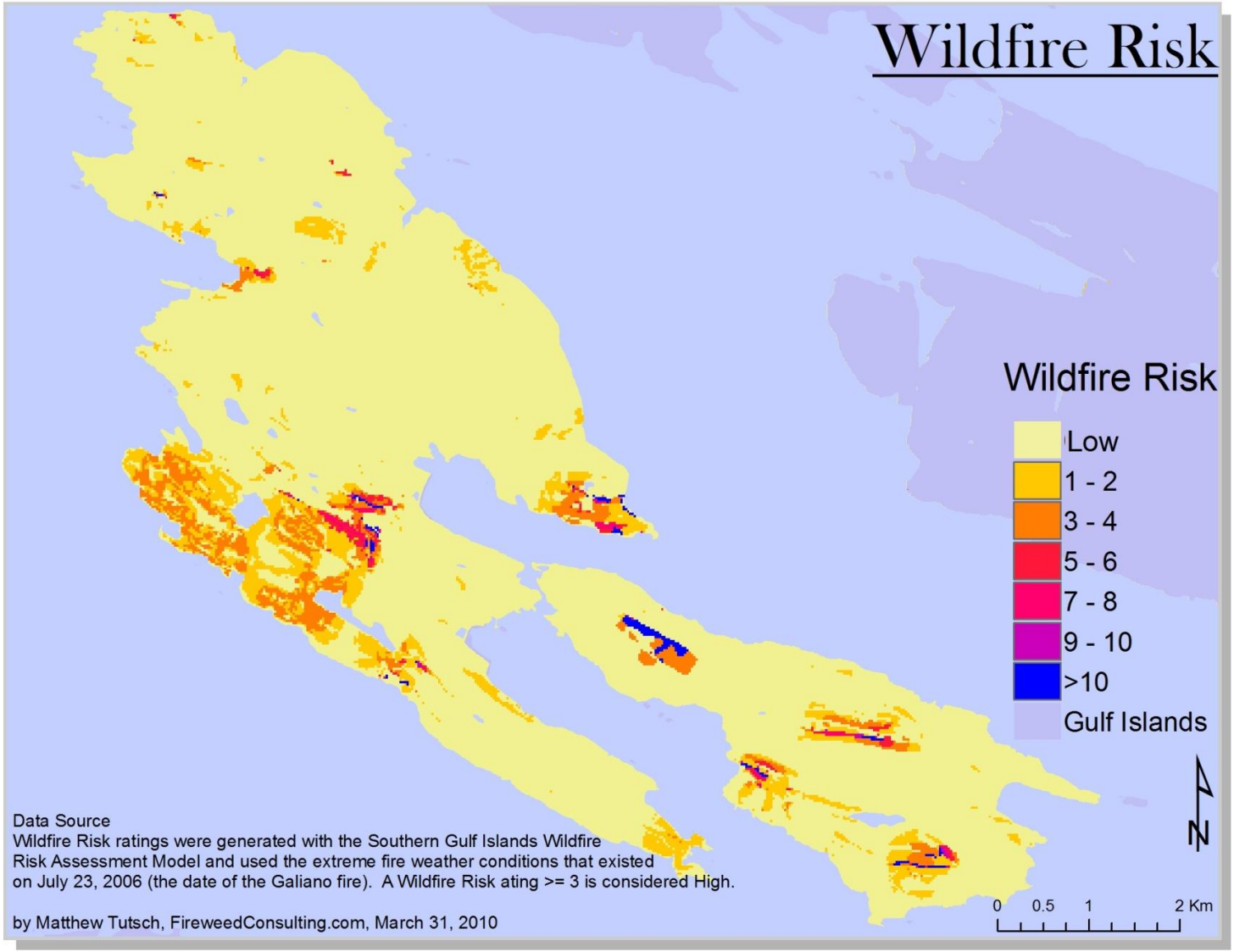

Figure 3 - Wildfire Risk on the Pender Islands

Expected Fire Behavior

When the low relative humidity associated with outflow conditions (interior air mass moving onto coastal areas) meets with moderate to high winds and drought conditions, all fuel types except deciduous stands were predicted to sustain crown fires. However, during typical summer drought conditions (90th percentile fire weather conditions), expected fire intensities were found to be generally low with no crowning potential. In some specific 90th percentile cases, typically involving alignment of slope, wind and the presence of adequate fine fuels, torching and intermittent crown fires are possible but would be topographically limited.

Wildfire Probability

Wildfire Probability is highest where areas with a history of human-caused ignitions overlap with steeper terrain, longer fire hall response times, and the lack of fire hydrants (Figure 4). Such areas include the Stanley Point Estates, the Hope Bay area, the McKinnon Road area, the Prior Park Area, and Mount Norman. Wildfire probability is calculated as the product of Ignition Probability and Escape Probability and should be considered a relative probability rather than an absolute probability.

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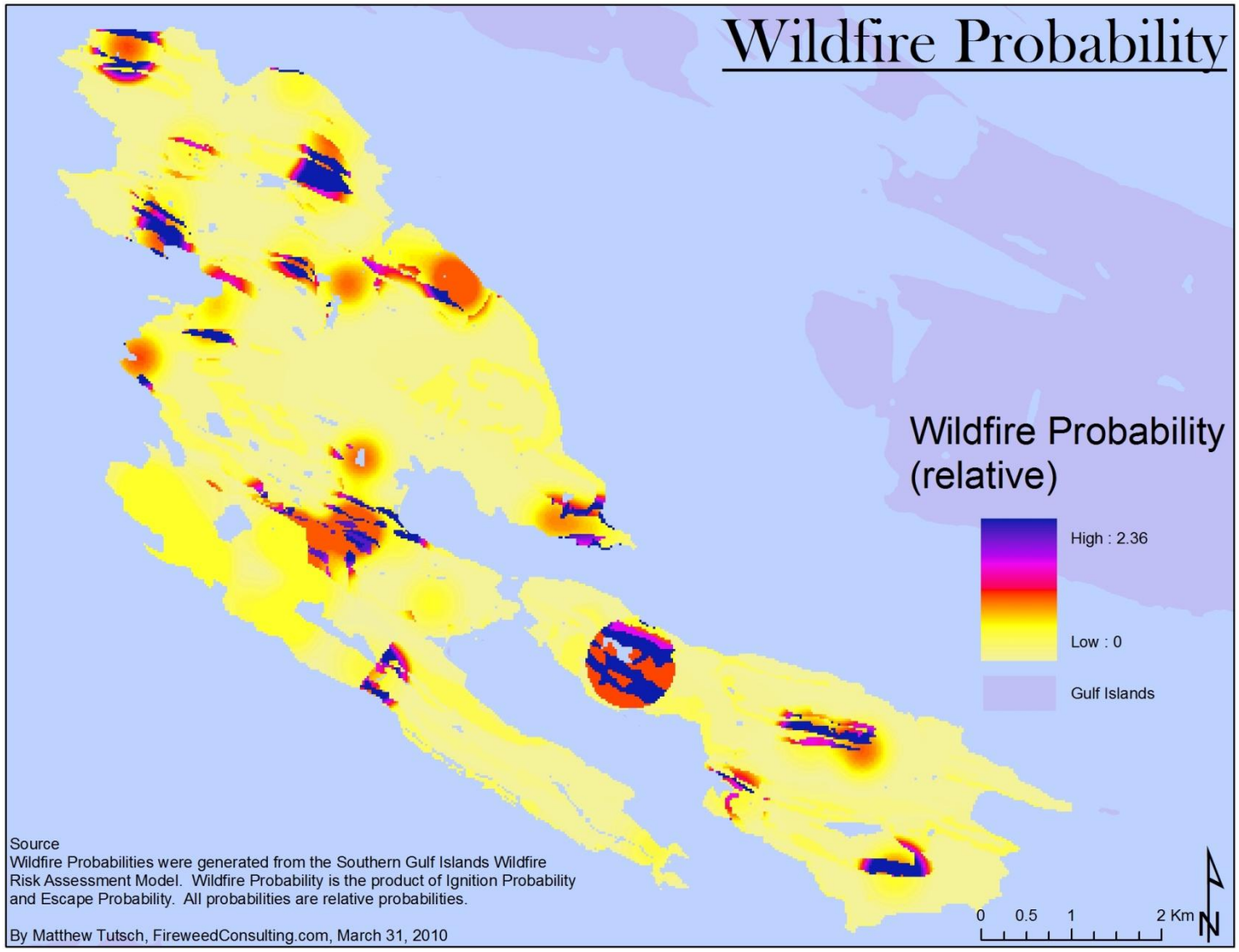

Figure 4 - Wildfire Probability on the Pender Islands

Historical ignition densities were used as a surrogate measure of Ignition Probability and ranged from 0.10 to 2.65 ignitions/year (Figure 5). All Ignition Probabilities are considered relative probabilities. Higher Ignition Probabilities were clustered around residential areas with a history of human-caused ignitions. The areas with the highest Ignition Probability are the Magic Lake Estates, the Hope Bay area, the McKinnon Road area, the Prior Park Area, Razor Point, and the Castle Road-Spalding Valley area. There were very few lightning-caused ignitions.

Escape Probability values ranged from 0.05 to 1.00 (Figure 6). Higher Escape Probability values were associated with high response times, steeper terrain, and more rapid rates of spread (Eg. Mount Elizabeth and the Ross-Smith Farm area). Changes in fuel type had minimal impact on Escape Probabilities as predicted rates of spread were consistently high due to the extreme fire weather conditions used.

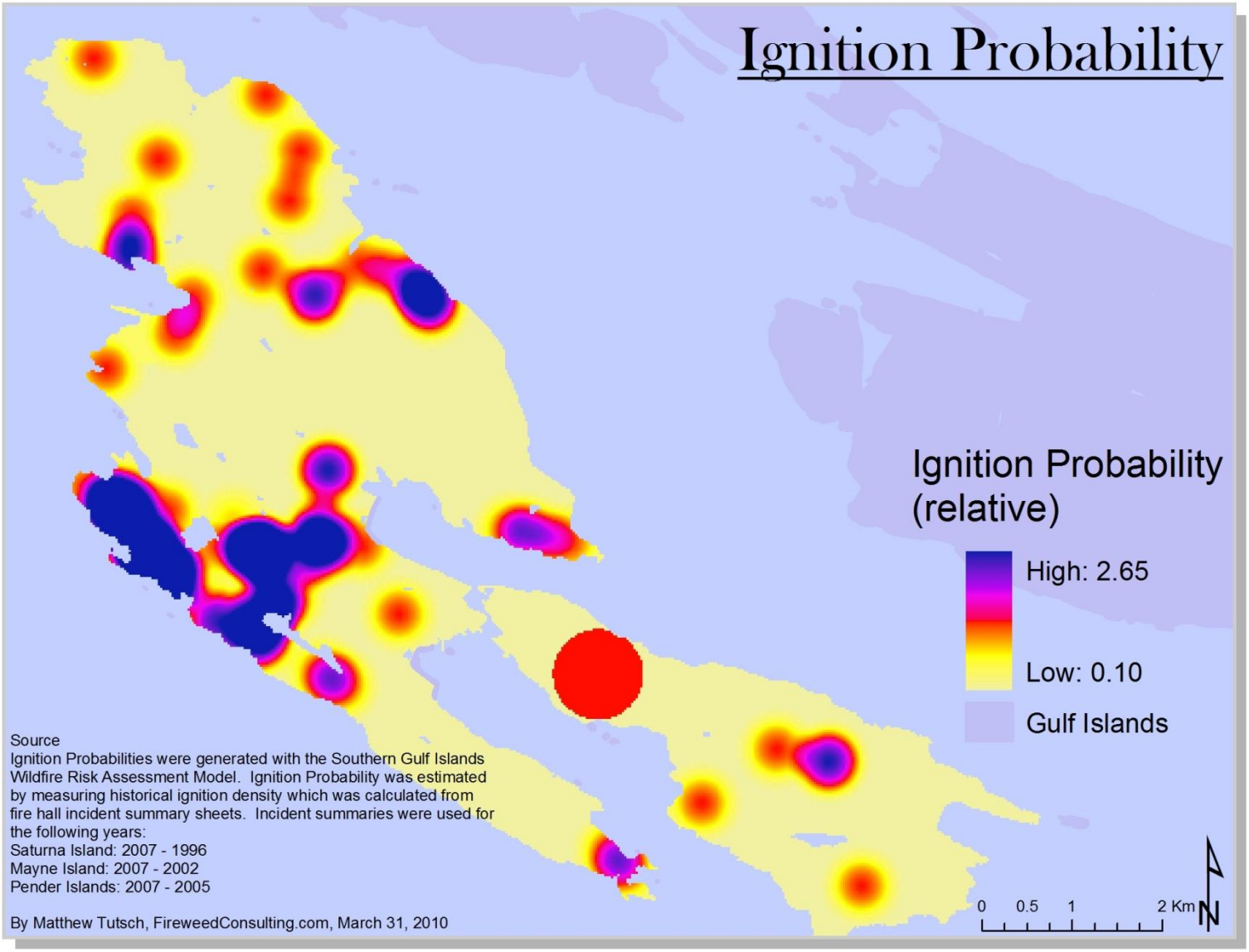

Figure 5 - Ignition Probability (relative) on the Pender Islands

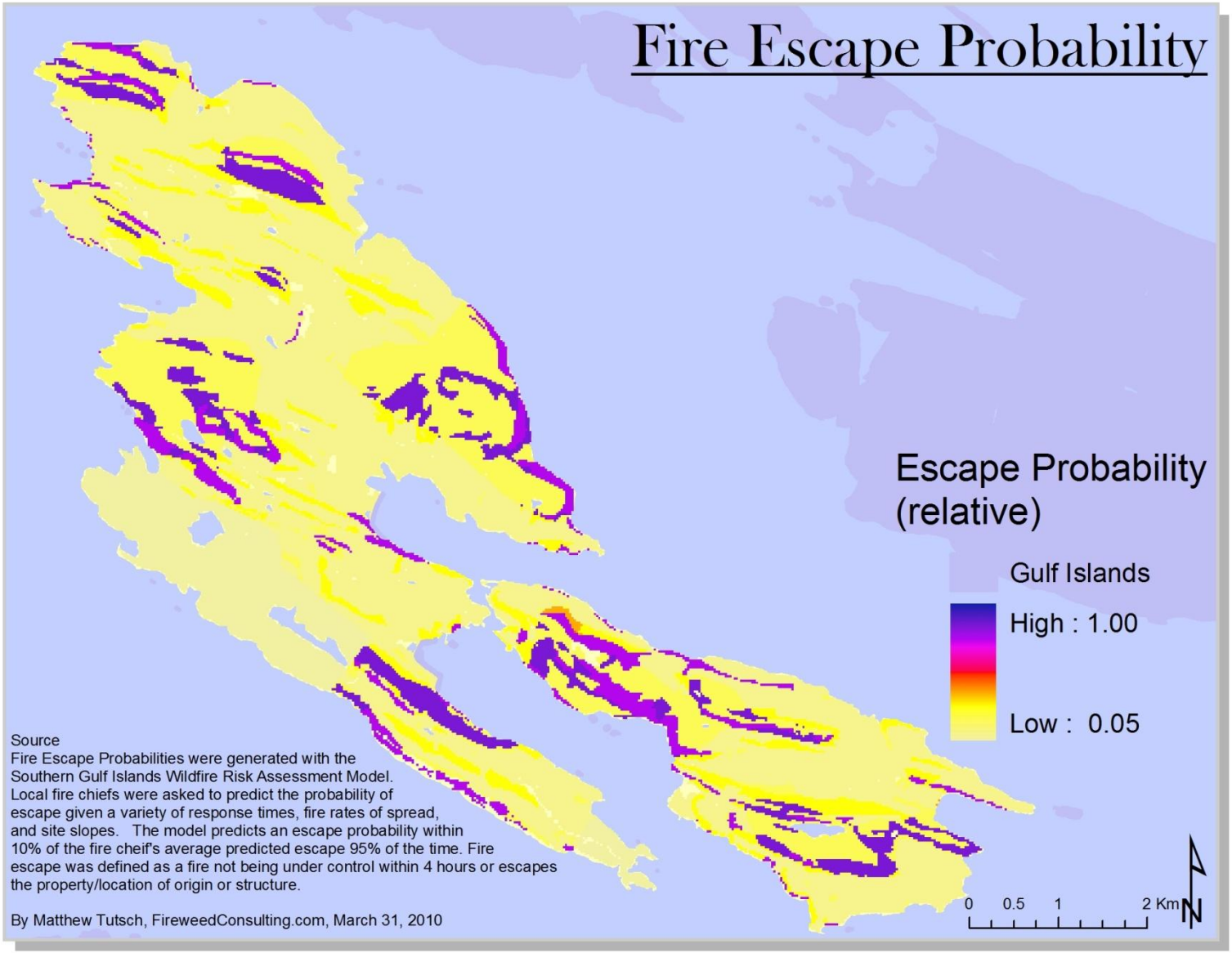

Figure 6 - Fire Escape Probability (relative) on the Pender Islands

Wildfire Consequences

The Wildfire Consequences map (Figure 7) shows a complex distribution of consequences with the highest consequence areas hosting multiple Wildfire Consequences. Wildfire Consequence values are highest in residential areas with problematic evacuation such as the Magic Lake Estates, Razor Point, Trincomali Point, and Mount Norman. Wildfire Consequence values are second highest in residential areas without evacuation problems and third highest in areas known to host endangered species (eg. The southern half of South Pender and the Trincomali Point area).

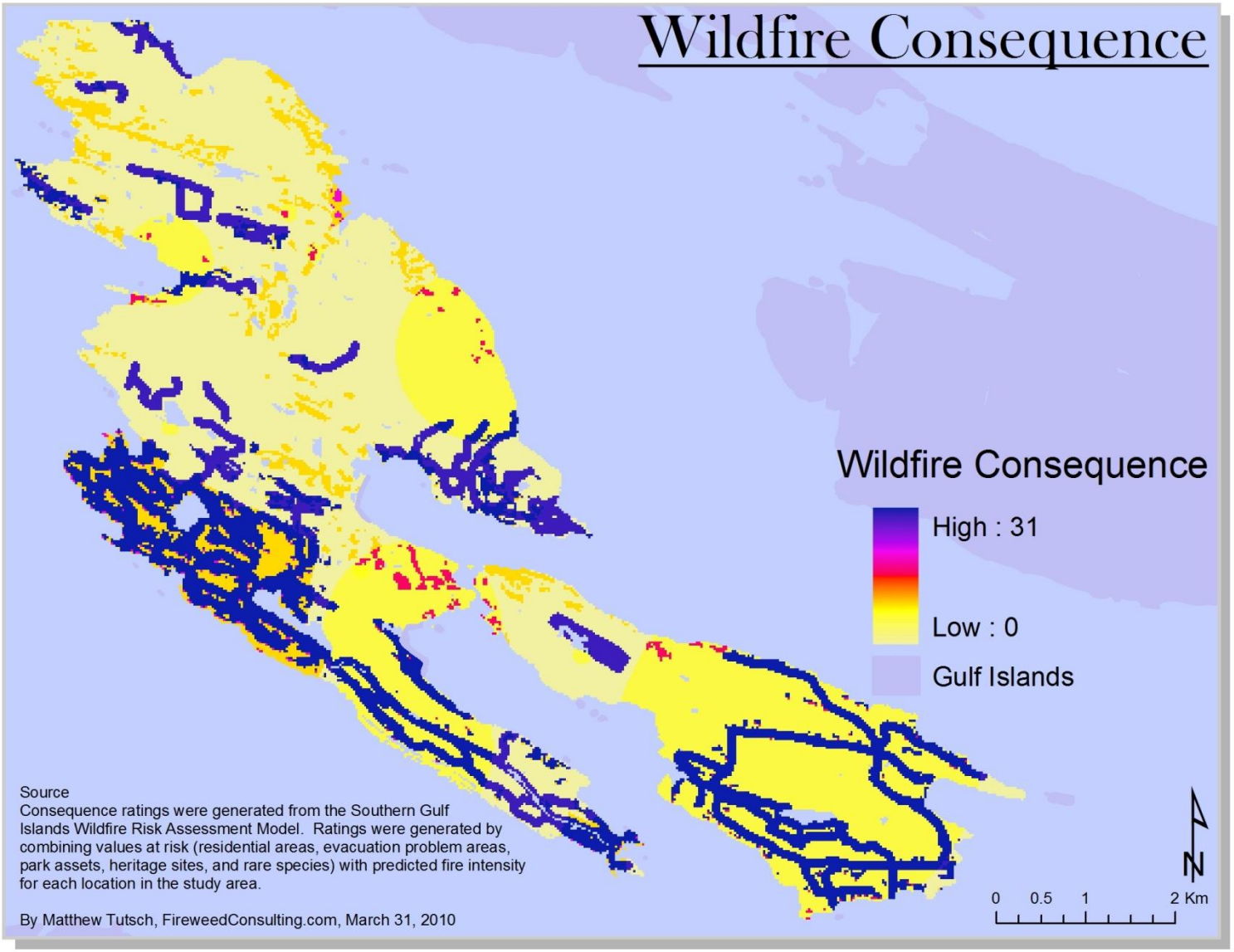

Figure 7 - Wildfire Consequences on the Pender Islands

Evaluation of Wildfire Risk Mitigation Objectives

Reducing ignitions by 50% proved to be the most effective management objective, reducing total risk by approximately 50% across the Pender Islands (Figure 8). Providing a reliable evacuation strategy for the Magic Lakes Estates was also a very effective management objective reducing total wildfire risk on the Pender Islands by approximately 35%. Although this management objective was found to be very effective at reducing total wildfire risk, it is important to note that wildfire risk outside of Magic Lakes Estates remained unchanged. FireSmarting residential areas in evacuation problem zones was the third most effective management objective for reducing wildfire risk, reducing Wildfire Consequence in the highest risk areas. Building high-volume water stations in high risk areas reduced risk by approximately 30%. The Fuel Treatment management objective had no impact on total risk as treated stands were still predicted to have fire intensities well over 10,000 KW/min. These very high fire intensities are a product of the outflow weather conditions chosen for the wildfire risk assessment.

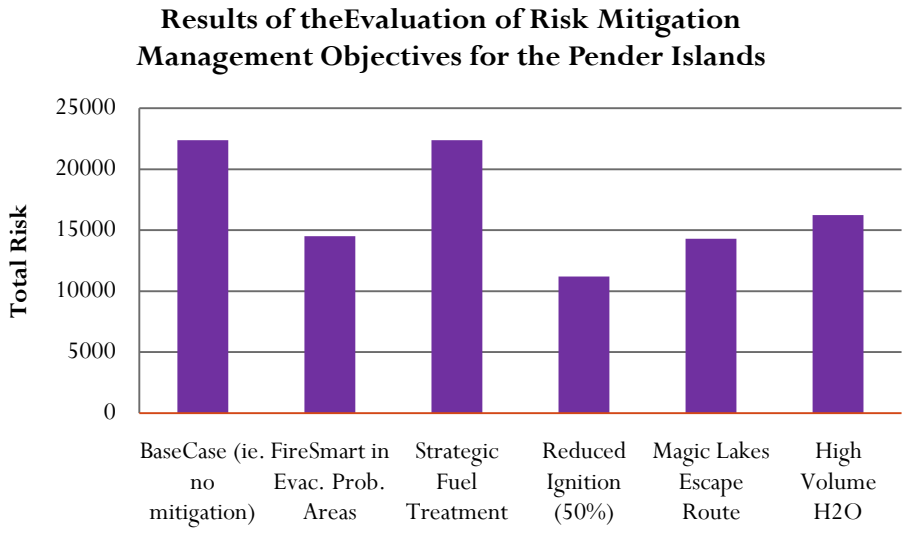

Figure 8 - Total wildfire risk on the Pender Islands resulting from the base case scenario (ie. No management) and each of the proposed mitigation objectives. Total wildfire risk associated with each mitigation objective was derived by adding up the wildfire risk for each 25 meter by 25 meter raster cell in the study area.

The Pender Islands Risk Mitigation Action Plan

The Pender Islands Risk Mitigation Action Plan's goal is to reduce wildfire risk on the Pender Islands by 50% (as measured by the Southern Gulf Islands Wildfire Risk Assessment Model). The Working Group reviewed the results of the above evaluation and chose to focus the Action Plan (Table 1) on the four most effective risk mitigation management objectives. In order of effectiveness, these were:

1. Reducing ignition by 50%.
2. A second Magic Lake Estates escape route.
3. FireSmarting homes in evacuation problem areas.
4. Building high volume water stations in high risk areas.

The first objective in the action plan is the establishment of local leadership on risk mitigation initiatives through the creation of a CWPP advisory committee because the Working Group recognized that leadership in the implementation of the Pender Islands CWPP was essential to the plan's success. The Action Plan's recommendations relate to reducing ignitions and FireSmarting took the form of both public education (ie. multimedia tools, education programs, and FireSmart demonstration sites) and legislation (ie. Wildfire risk development permit areas, building permit bylaw amendments requiring FireSmart building standards, FireSmart landscaping, sprinkler systems, vehicle access, and water supply).

Fuel Treatment Recommendations in the Action Plan

Strategic landscape-level forest fuel treatments were not recommended in the action plan because the evaluation found them to be the least efficient risk mitigation management objective and they were perceived as costly to implement and maintain. In contrast, the evaluation found FireSmart-related fuel treatments located adjacent to residential structures to be very effective at mitigating risk. Thus, the Working Group chose to focus the Action Plan's fuel treatment-related recommendations on the implementation of FireSmart landscaping surrounding residences. These recommendations take the form of requiring FireSmarting landscaping for new homes or additions and promoting voluntary adherence to FireSmart landscape standards among existing home owners through public education efforts (multimedia tools, FireSmart demonstration sites, and education programs).

Table 1- Pender CWPP Risk Mitigation Action Plan

Action Plan Goal – A 50% reduction of wildfire risk on the Pender Islands (as measured by the Southern Gulf Islands Wildfire Risk Assessment Model).		
Objective	**Sub-objective**	**Action**
To establish local leadership for addressing and mitigating wildfire risk on the Pender Islands.		Create and formalize a Pender Islands CWPP Advisory Committee to oversee implementation, identify and coordinate funding opportunities, and revise the Pender Islands CWPP as needed.
To reduce Human Ignitions by 50%.		
	To reduce the number of cigarette, campfire, and backyard burn – caused wildfire ignitions.	Continue the successful BC Ferries education program and enhance the effectiveness of messaging by creating a multimedia public education product targeted at local audiences that can be distributed via Youtube, social networking websites, email links, BC Ferries televisions, Shaw Cable, and Saturday market booths.
		Expand the existing public education program in schools, public markets, and community events. Use the same messaging and communication tools as the BC Ferries education program.
		Continue outdoor burning control measures through effective signage, messaging and permitting measures.
		Post "number of fires this year" sign next to Fire Danger sign at Firehall Number 1.
	To reduce the number of chimney fires.	Improve awareness of chimney fire hazard and proper chimney maintenance through website information on: the number of Pender chimney fires per year, proper chimney maintenance, and chimney sweep certification.
	To reduce downed power lines.	Work with BC Hydro to improve danger tree removal and downed line response action plans
To FireSmart Homes in Evacuation Problem Areas.		

	Ensure all new homes or additions have interior sprinkler systems.	Establish wildfire risk Development Permit Areas and/or amend CRD Building Permit Bylaws.
	Ensure all new homes or additions are constructed to FireSmart landscaping standards.	Establish wildfire risk Development Permit Areas and/or amend CRD Building Permit Bylaws.
	Ensure all new homes or additions are constructed with adequate water supply for fire fighting.	Establish wildfire risk Development Permit Areas and/or amend CRD Building Permit Bylaws.
	Ensure all new homes or additions constructed in high risk areas have exterior sprinkler systems.	Establish wildfire risk Development Permit Areas and/or amend CRD Building Permit Bylaws.
	Ensure all new homes or additions have adequate access for emergency vehicles.	Establish wildfire risk Development Permit Areas and/or amend CRD Building Permit Bylaws
	Ensure all new subdivisions are created in conformance with NFPA standards for rural areas including NFPA 1141 and NFPA 1142.	Ensure OCP and land use bylaws facilitate provisions to regulate requirements for fire protection infrastructure.
	Promote voluntary adherence among home owners to FireSmart standards.	Create a multimedia public education product targeted at local audiences that can be distributed via Youtube, social networking websites, email links, BC Ferries televisions, Shaw Cable, and Saturday market booths.
	Build awareness of FireSmart development standards.	Develop and maintain FireSmart demonstration sites.
Create secondary wildfire evacuation routes in support of the Pender Emergency Response and Recovery Plan (ERRP)		
		Actively pursue a secondary wildfire vehicle evacuation route out of the Magic Lake Estates.
		Evacuation planning should be consistent with the priorities of the Pender ERRP.
To build high volume water supply stations.		
	Build high volume water supply stations in high risk areas with an existing water supply.	Identify high risk areas with adequate water supply.

		Obtain water use and water access agreements with landowners.
		Purchase and install water supply systems.
	Build high volume water supply stations in lower risk areas with existing water supplies. These stations would service higher risk areas with limited water supply.	Identify lower risk areas with adequate water supply.
		Obtain water use and water access agreements with landowners.
		Purchase and install water supply systems.

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Appendix A: Southern Gulf Islands Risk Assessment research project

The southern gulf islands risk assessment research project was undertaken by Matthew Tutsch from 2006 to 2009 as part of the requirements of a Master in Resource Environmental Management and Simon Fraser University. Risk Assessment methods and results will be published in two academic peer reviewed journals. The project was funded by the Gulf Islands National Park Reserve as part of the park's fire management planning process. The following is a list of individuals that contributed expertise to the project.

Predicted Fire Behavior for the southern Gulf Islands
Nathalie Lavoie, Fire Behavior Specialist, Ministry of Forests and Range
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Jeff Francis, Mayne Island Fire Rescue
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Jeff Francis, Mayne Island Fire Rescue
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