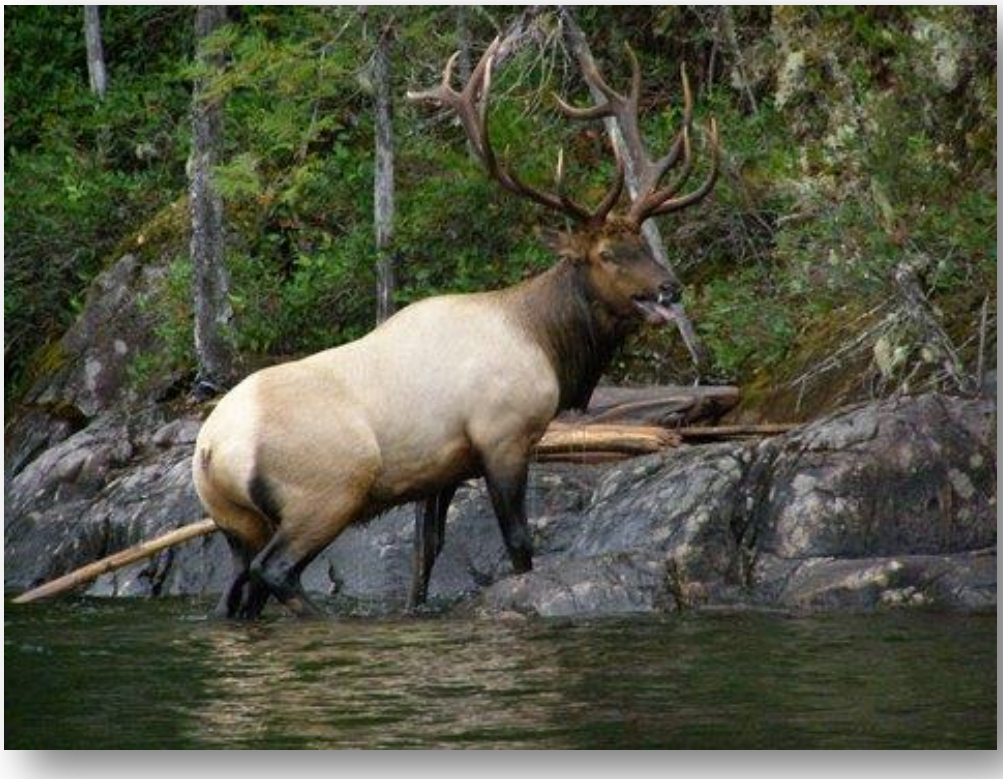
Cumulative Effects Framework

Assessing and Managing Cumulative Effects in British Columbia

Howe Sound Cumulative Effects Project

Roosevelt Elk – Current Condition Report



South Coast Natural Resource Region

Ministry of Forests, Lands, Natural Resource Operations and Rural Development

November 8, 2018

Table of Contents

Page

Executive Summary.....V

1. Introduction 1

2. Assessment Approach for Roosevelt Elk 3

3. Current Condition Assessment Results 7

a) Roosevelt Population Stability Trend 9

b) Roosevelt Elk Population Sustainability Risk: Short-Term.....10

c) Roosevelt Elk Population Sustainability Risk: Long-Term.....11

d) Indicator: Forage Cover Interspersion.....12

e) Indicator: Winter Range Requirement 13

f) Indicator: Winter Range Availability & Quality 14

g) Indicator: Forage Cover Availability..... 15

h) Indicator: Population Resiliency..... 16

i) Indicator: Predation Risk.....17

j) Indicator: Unregulated Hunting.....18

4. Supplemental Information 19

a) Protected Areas and Timber Harvesting Land base 19

b) Forest Age and Watersheds 20

c) Road Location and Classification 21

d) Total Land Disturbance 22

5. Discussion of Assessment Results 23

6. References 25

List of Appendices

Appendix I: Map of Howe Sound Cumulative Effects Project Area 26

Appendix II: Roosevelt Elk Value Description 28

Appendix III: Management Objectives for Roosevelt Elk.....32

Appendix IV: Howe Sound Context for Roosevelt Elk.....34

List of Tables

Table 1. General Condition of Roosevelt Elk Assessment Indicators by EPU.....7

Table 2. Examples of Interpretation, Further Assessment and Management Responses.....24

List of Figures

Figure 1. Conceptual Influence Diagram for Roosevelt Elk Population Sustainability.....4

Figure 2. Conceptual Model derived from Bayesian Belief Network Approach.....4

Figure 3. Cumulative Effects Framework Conceptual Model for Roosevelt Elk.....5

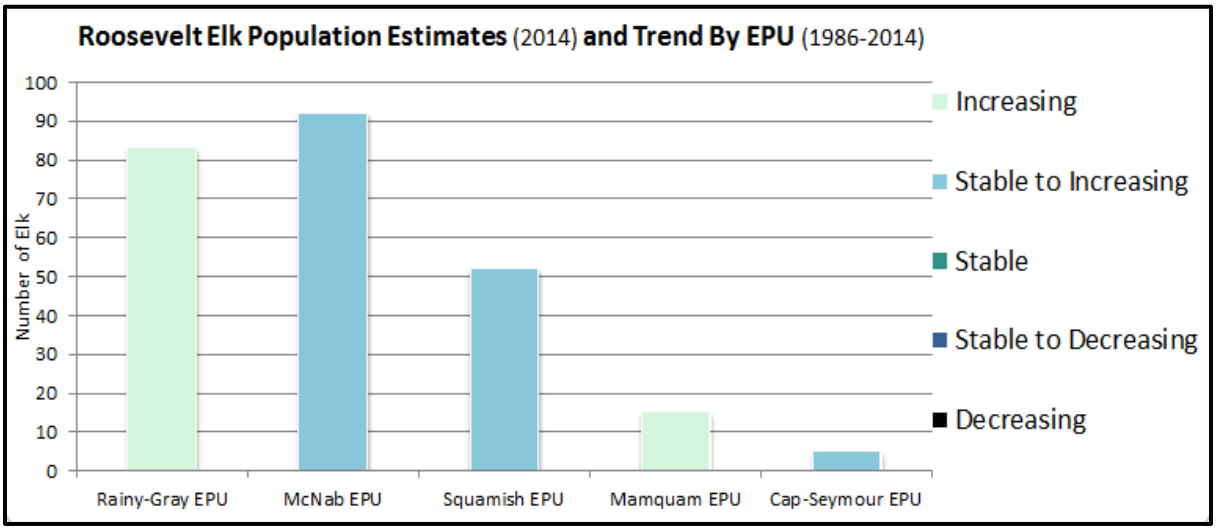
Figure 4. Estimated Distribution and Population Density of Roosevelt Elk in BC.....33

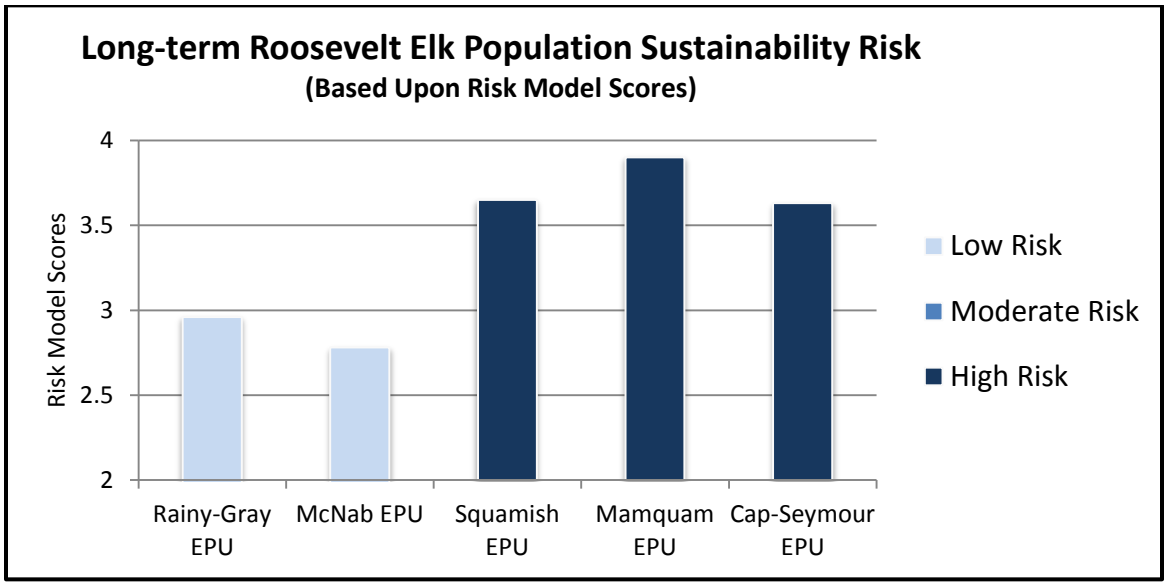
Executive Summary

The Howe Sound Cumulative Effects Project represents the Province's initial application of the Cumulative Effects Framework in the South Coast Natural Resource Region of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD). This report presents a current condition assessment of Roosevelt Elk in the Howe Sound area.

Seven key habitat and population indicators from the Roosevelt Elk CE assessment protocol and the Bayesian Belief Network Risk Model have been used to estimate the population sustainability risk for each elk population unit (EPU) in the Coast Area. The indicators include: forage cover interspersion; winter range requirement; winter range availability and quality; forage cover availability; population resiliency; predation risk; and unregulated hunting. These indicators help to estimate the risk to elk populations (by EPU) as it relates to elk provincial management objectives. This report focuses on the assessment results for the five major EPUs that fully, or partially, overlap the Howe Sound CE Project area. These EPUs range in size from 38,159 ha (McNab EPU) to 244,480 ha (Squamish EPU) and offer general assessment results that should not be used to confirm the specific impacts from individual developments.

Overall, the current condition assessment results indicate that the Roosevelt Elk populations in the Howe Sound area have been doing quite well after their recent re-introduction into the area. In 2014, it was estimated that over 240 elk were now in the 5 EPUs. The Roosevelt Elk populations in the Mamquam and Rainy-Gray EPUs have been "Increasing" over the past 30 years and populations in the other three EPUs are "Stable to Increasing". While the results indicate that the McNab and Rainy-Gray EPUs have a "Low" long-term Roosevelt Elk population sustainability risk, the Squamish, Mamquam and Cap-Seymour EPUs all indicate a "High" long-term population sustainability risk based upon all the indicators/inputs into the risk model.





FLNRORD is currently exploring a number of actions in response to these results such as: assessing the recent trends in these indicators; comparing these predictions to available site-specific habitat and population survey information; and applying these risk assessments to land and resource planning and management decisions where possible. Comparing the assessment results to available on-the-ground habitat and population surveys will more accurately confirm or reject the accuracy of the results and predictions. However, on their own, these initial assessment results do offer some general insights that can be considered immediately in certain statutory authorization decisions (i.e. major projects, urban land development, forest management) and resource management and planning (i.e. monitoring, mitigation, legal conservation designations and hunting regulations).

Overall, the results from this assessment indicate that long-term forest management should consider a more balanced forest seral stage distribution within priority EPUs to help improve healthy forage/cover attributes for elk and reduce population sustainability risk. Elk winter range requirements and seral stage distribution should be considered in the broader context of any NRS integrated management direction for other values in the Howe Sound area and explore possible management tool synergies (e.g. legal designations, wildfire management, access management, and land and forest authorizations).

The results of this assessment will also be incorporated into some new decision-support tools and processes that FLNRORD-South Coast is currently developing. These tools and processes will: integrate and communicate resource value objectives, assess how well these objectives are being achieved, and provide the basis for the development of future integrated resource management responses. However, this assessment does not tell the whole story and more investigation is required to better inform land and resource management.

1. Introduction

The Howe Sound Cumulative Effects Project represents the province's initial application of the Cumulative Effects Framework in FLNRORD's South Coast Natural Resource Region. This report presents an initial current condition assessment of Roosevelt Elk in the Howe Sound CE Project area (Appendix I). Other values being assessed for current condition in the Howe Sound area include: Aquatic Ecosystems, Old Growth Forests, Forest Biodiversity, Visual Quality, Grizzly Bear and Marbled Murrelet.

The Province of British Columbia views the assessment and management of cumulative effects as a vital part of sustainable and integrated resource management, and an important foundational piece for addressing First Nations rights and interests. As population and resource demands grow, we must be able to measure the effect of all natural resource activities, large and small, on values that are important to the people of British Columbia. In January 2014, cabinet provided direction for the development and phased-implementation of the BC *Cumulative Effects Framework* (CEF). The intent of the CEF is to incorporate the combined effects of all activities and natural processes into decision-making to help avoid unintended impacts to key economic, social and environmental values. For more, see the CEF website: http://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/cumulative-effects-framework .

The Howe Sound Cumulative Effects Project will help with the implementation of a coordinated, multi-sector approach to assessing and managing cumulative effects. This will be achieved by providing transparent decision-support information to the province, First Nations, other levels of government, and non-government stakeholders.

FLNRORD's South Coast Natural Resource Region has identified Roosevelt Elk as one of its initial regional values for CE assessment. Roosevelt Elk range over most of Vancouver Island and portions of the South Coast and are the largest ungulate in their range. They play an important ecological role as a prey species for top predators like bears, cougars and wolves, while their browsing also influences plant phenology and successional pathways. Roosevelt Elk are also important in First Nations culture and provide resident and guided hunting and viewing opportunities. Economic benefits generated by these uses benefit local communities, the region and the province. For the purpose of this assessment, habitat and population risk are key components. More information on Roosevelt Elk and management objectives can be found in Appendices II and III.

The intent of this report is to provide an initial indication of the current condition of the Roosevelt Elk value by assessing the status of some key habitat and population indicators in the Howe Sound CE Project area while also providing some additional supplemental information and environmental context. This assessment acts as a coarse filter to help direct further current condition assessment and monitoring work.

This report is largely made up of population sustainability risk maps, a series of current condition indicator maps derived from the 2016 Roosevelt Elk population sustainability risk model and some supplemental maps and contextual information (Appendix IV). The results from this assessment will be considered by FLNRORD to help inform future assessments, planning projects, management decisions and resource objectives. The current condition results provide some important information on the population sustainability risk, population stability trend and key population and habitat indicators associated with the five main EPUs that overlap the Howe Sound area. However, further validation, analysis and contextual examination is required before knowing the actual condition of the habitat and population indicators in each EPU. Therefore, the results in this assessment (relative to a high or low assessment rating) do not necessarily tell the whole story and more investigation is required to determine if special management responses are warranted.

2. Assessment Approach for Roosevelt Elk

Seven indicators have been assessed for each of five main EPUs that overlap the Howe Sound CE Project area in an effort to calculate the population sustainability risk for Roosevelt Elk in the EPUs. The indicators used in this assessment were derived from the conceptual models and procedures detailed in *Roosevelt Elk Habitat and Population Risk Models: A Cumulative Effects Framework Value Assessment*, 2016. The assessment approach is intended to provide an initial foundation for a consistent approach to assessing the short-term and long-term population sustainability risk for Roosevelt Elk in the Coast Area.

A Bayesian Belief Network (BBN) approach was used to build the conceptual model and assess elk population sustainability risks in the Coast Area. Species experts first reviewed key environmental correlates and developed a conceptual influence diagram or "ecological causal web" (Figure 1). Then an initial BBN (a more concise conceptual influence diagram) was developed to assess the risk in achieving elk population sustainability and more specifically, the risk to achieving population objectives outlined in the 2015 Provincial Roosevelt Elk Management Plan. Factors from the habitat and population components, were used in this initial value assessment. The BBN identified seven key factors influencing elk population sustainability: Elk Winter Range (EWR) Requirement; EWR Availability and Quality; Forage/Cover Availability; Forage/Cover Interspersion; Population Resiliency; Predation Risk; and Unregulated Hunting. These factors were used in the final BBN assessment model (Figure 2) which measured and assigned values for the Elk Population Units in the Coast Area. BBN modelling software was used to calculate Population Sustainability Risk estimates over the short-term (0-15yrs) and the long-term (>15yrs) as well as indicating current condition results for the seven key factors. For more detailed information on the assessment procedures please see the References section on page 27.

The results and data generated from the 2016 BBN assessment for the Coast Area were transcribed into the Provincial CEF reporting format to produce the final conceptual model (Figure 3) and maps for this Roosevelt Elk current condition report. The seven factors used in the BBN conceptual influence diagram were used as indicators in this report. These indicators serve as useful surrogates to spatially estimate the current risk of Roosevelt Elk population sustainability at a broad scale.

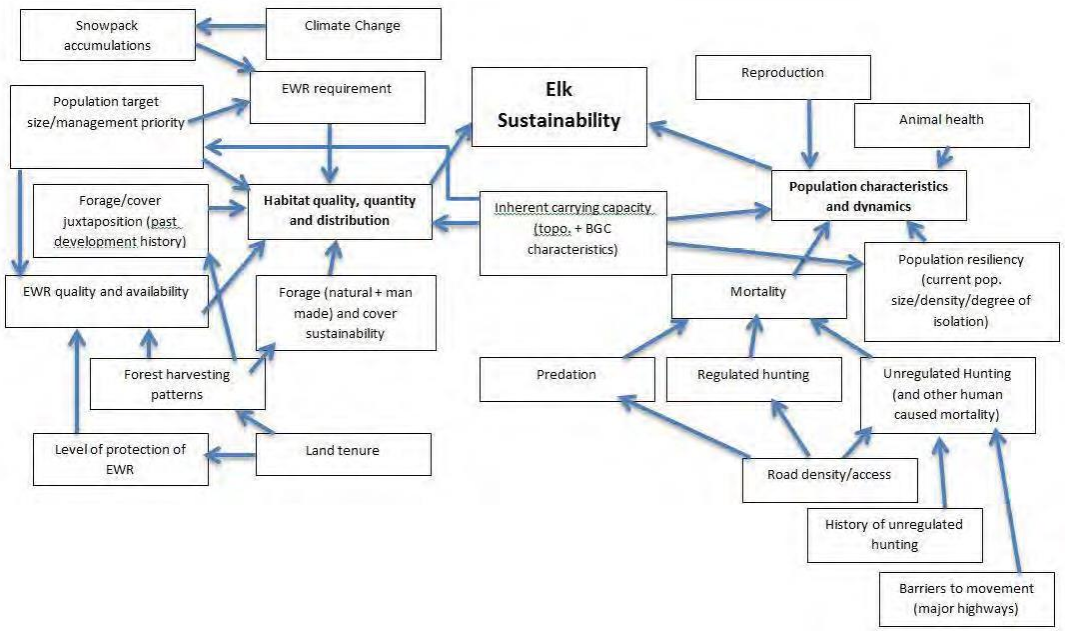


Figure 1: Conceptual Influence Diagram for Roosevelt Elk Population Sustainability

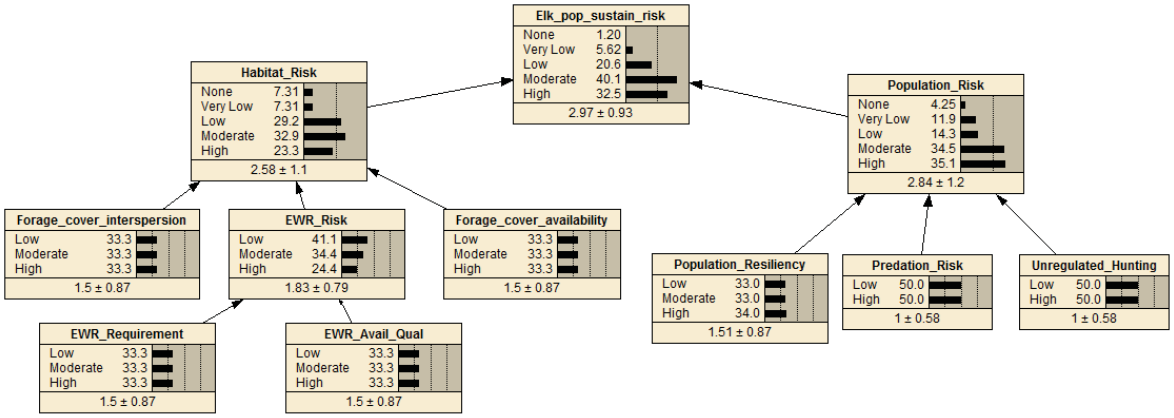


Figure 2: Conceptual Model derived from Bayesian Belief Network Approach

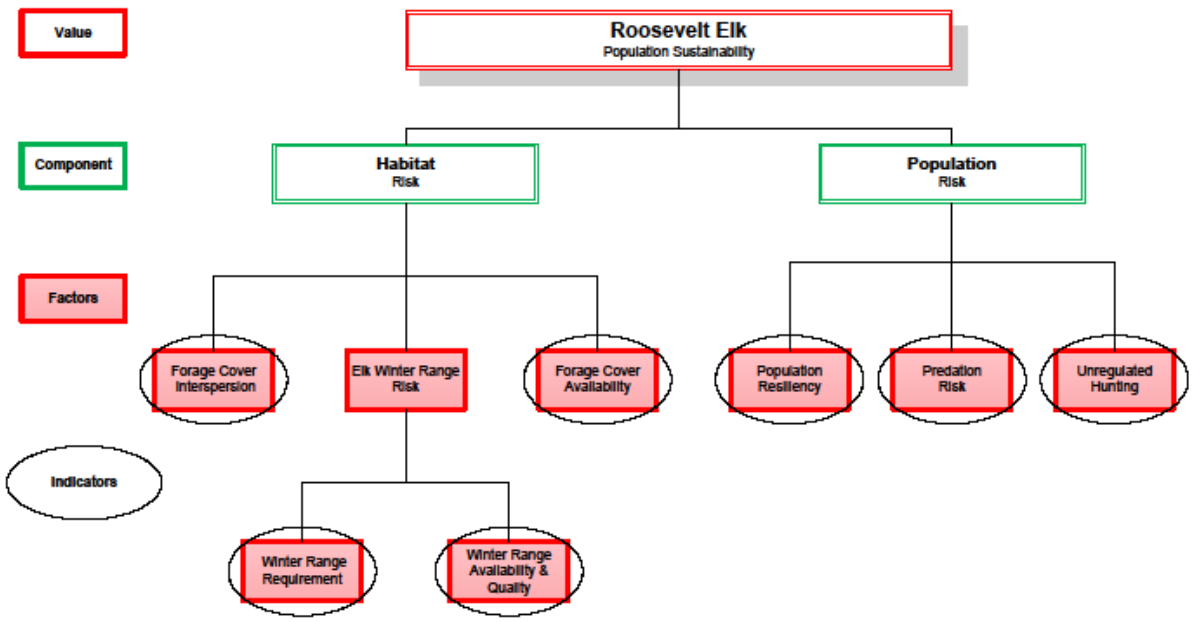


Figure 3: Cumulative Effects Framework Conceptual Model for Roosevelt Elk

Conceptual Models for values describe how components and indicators influence or interact to affect the condition of a value.

Components (**green**) are features and attributes of a value that should be measured and managed to meet objectives associated with values.

Factors (**red**) are influential processes or states that act on a component and include both positive and negative effects. They may be used as indicators.

Indicators (**black circles**) are the metrics used to directly or indirectly measure and report on the condition of a component (state indicators) or the processes that act upon or influence the condition of a component (pressure indicators).

Limitations of the CE Assessment Protocol for Roosevelt Elk

The key limitations of this initial Roosevelt Elk CE assessment protocol are:

- The data and maps used in this assessment can only provide an estimate of current condition at the broad scale used and may not reflect the actual current condition at an operational/site-specific scale. For example, some EPUs, like the Squamish EPU, can extend well beyond the Howe Sound CE Project boundary and therefore may not fairly represent the habitat and population conditions in the Howe Sound area;
- The population sustainability risk model used has yet to be well researched and verified in terms of the metrics relating various population and habitat risk calculations. However, the risk values generated from the model do align well with opinions of provincial subject matter experts familiar with the Howe Sound area;
- The outputs from the assessment model also have a significant degree of uncertainty associated with them due to the uncertainties associated with some of the input variables (e.g. unregulated hunting levels; available forest age class datasets etc.);
- The only difference between the short-term and long-term population sustainability risk models are the input variables that estimate forage (primarily) and cover resource quality and quantity. Specific future forest development patterns are generally unknown so the assessment protocol uses recent forest development patterns to extrapolate from to develop estimates of future forage/cover quality and supply;
- The benchmarks used in the assessment are not to be seen as “limits” or “thresholds” for disturbance but are simply to provide information to assist with resource planning, management and authorizations;
- All elk populations are considered equally sensitive in this population risk model and Individual elk population sensitivity factors have not been considered in this assessment; and
- All roads in datasets considered to have an equal impact when that is not likely the case in reality.

Other Considerations

Additional monitoring information, existing at various spatial scales, can be used to help validate or complement the results of this assessment. For example, complementary monitoring information can come from:

- Research and monitoring projects conducted by provincial subject matter experts and/or academic institutions;
- Monitoring projects carried out by major project proponents in order to meet Environmental Assessment Certificate Conditions; and
- Forest and Range Evaluation Program (FREP) assessments from the Ministry of Forest, Lands and Natural Resource Operations.

3. Current Condition Assessment Results

The current condition assessment results for Roosevelt Elk provide general coarse filter information about the Elk Population Units (EPUs) in the Howe Sound area. The results vary by EPU reflecting more localized conditions. While the EPUs are expected to have some degree of habitat and population variation within them, some general observations can still be derived from the current condition assessment results. Table 1 below provides an overview of the general condition of the selected indicators by EPU.

Table 1. General Condition of Roosevelt Elk Assessment Indicators by EPU

Indicators	Current Condition Assessment by EPU								
	Rainy-Gray EPU		McNab EPU		Squamish EPU		Mamquam EPU		Cap-Seymour EPU
Winter Range Requirement	Moderate		Moderate		High		High		High
Winter Range Availability/Quality	Moderate		Low		Low		Low		Moderate
Forage Cover Availability	High		Moderate		Low / Mod		Low		Low
Forage Cover Interspersion	Moderate		Low / Mod		Moderate		Low		Low
Population Resiliency	Moderate		High		Moderate		Low		Low
Predation Risk	Low		Low		High		High		Low
Unregulated Hunting	High		Low		High		High		Low

- Lower Risk - Moderate Risk - Higher Risk

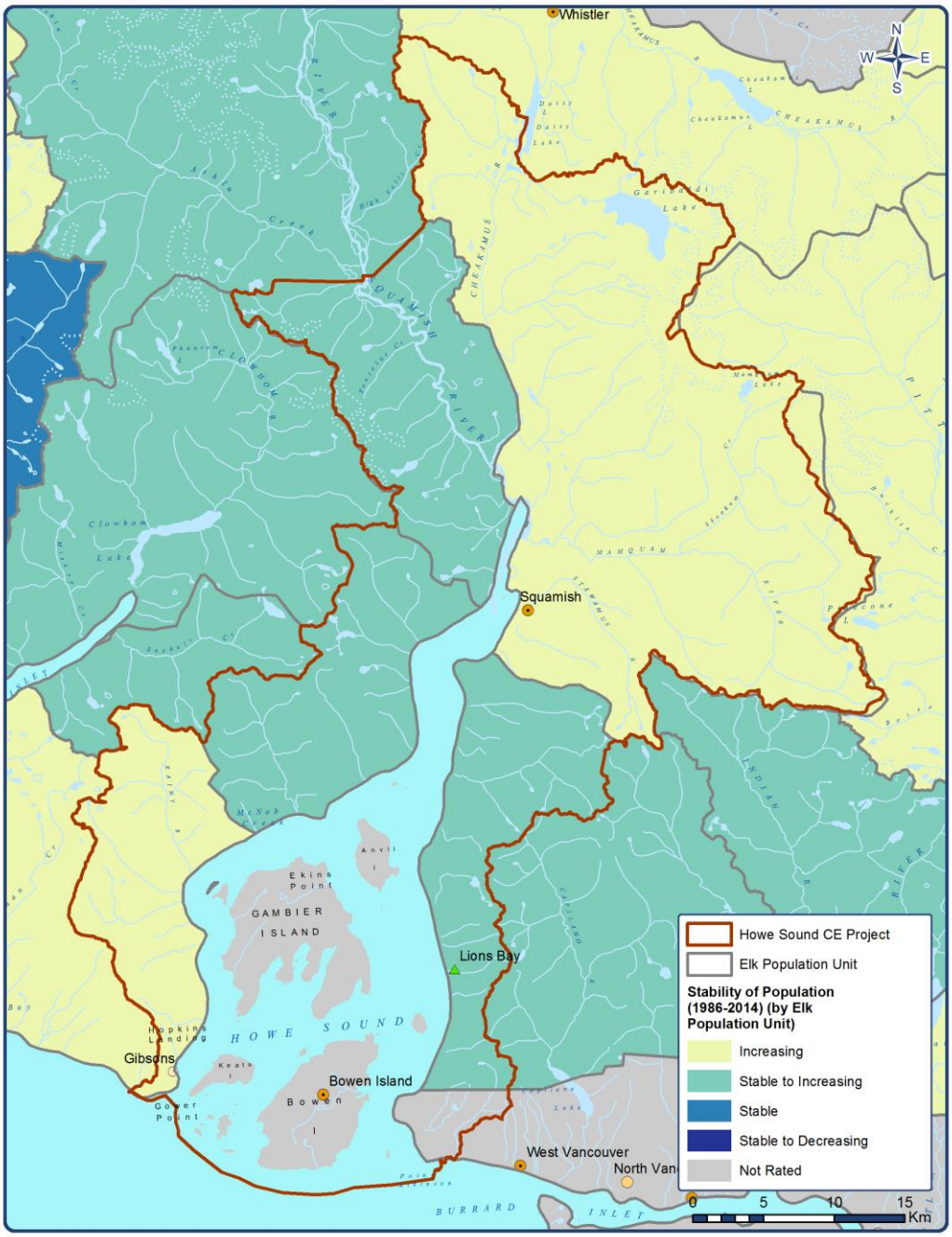
Initial Interpretation of the Current Condition Results

The following are some initial observations and possible key drivers affecting the CE results:

- The Roosevelt Elk population trend in the Howe Sound area is generally “Increasing” or “Stable to Increasing” as the populations have either reached their population target (McNab EPU) or are still in growth stages (Squamish, Rainy-Gray and Mamquam EPUs);
- The McNab and Rainy-Gray EPUs currently have a low elk population sustainability risk due to their associated localized conditions;
- The Mamquam, Squamish and Cap-Seymour EPUs have a high elk population sustainability risk due to their associated localized conditions;

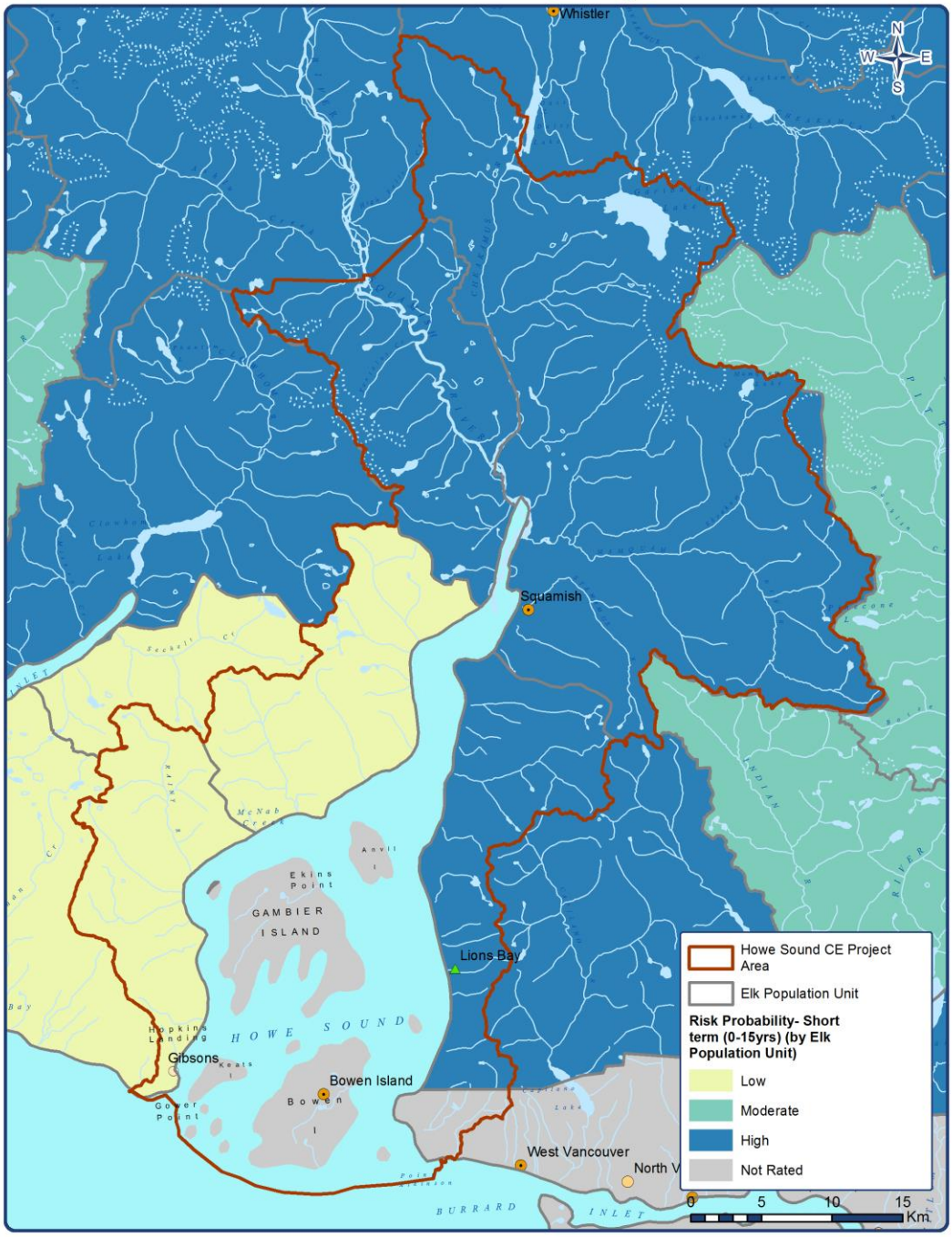
- The logging history in the Howe Sound area (harvesting scale, pattern and timing) is a key driver shaping current elk population sustainability risk. Historical forest harvesting has shaped current seral stage distribution which relates to key indicators like elk forage/cover attributes;
- EPUs with a history of large block progressive clearcutting do not provide the desired interspersion of forest cover and forage areas for elk (e.g. Mamquam Watershed).
- There is a high risk to Roosevelt Elk population sustainability (both short-term and long-term) on the eastern and northern sides of Howe Sound due to its current forest seral stage distribution (low forage/cover interspersion and low forage/cover availability) and its low population resilience rating (small populations);
- Higher risks of predation and unregulated hunting also threaten Roosevelt Elk population sustainability (both short-term and long-term) in the northern portion of the project area (Squamish and Mamquam EPUs).
- There is low risk to elk population sustainability (both short-term and long-term) on the west side of Howe Sound due to higher elk population resilience (larger populations), moderate forage/cover interspersion, moderate forage/cover availability and lower risks of predation and unregulated hunting (especially McNab EPU due to limited access);
- EPUs near major transportation corridors and with easy access roads to existing elk populations will have a greater risk of unregulated hunting (Squamish, Mamquam and Rainy-Gray EPUs)
- EPUs with little elk (Cap-Seymour EPU) or no direct road access (McNab EPU- marine access only) and are further removed from population centres have low levels of unregulated hunting;
- The east side of Howe Sound does not contain good elk habitat due to Low Forage/Cover Interspersion and Low Forage/Cover Availability.
- The EPUs with higher snowpacks at the northern and eastern sides of Howe Sound have higher elk winter range requirements; and
- EPUs with larger protected areas did not have a lower elk population sustainability risk rating as compared to those EPUs with smaller or no protected areas. The EPUs with larger protected areas did not provide the same range of elk cover/forage habitats as the EPUs with forest harvesting and smaller or no protected areas.

Population Trend for Roosevelt Elk



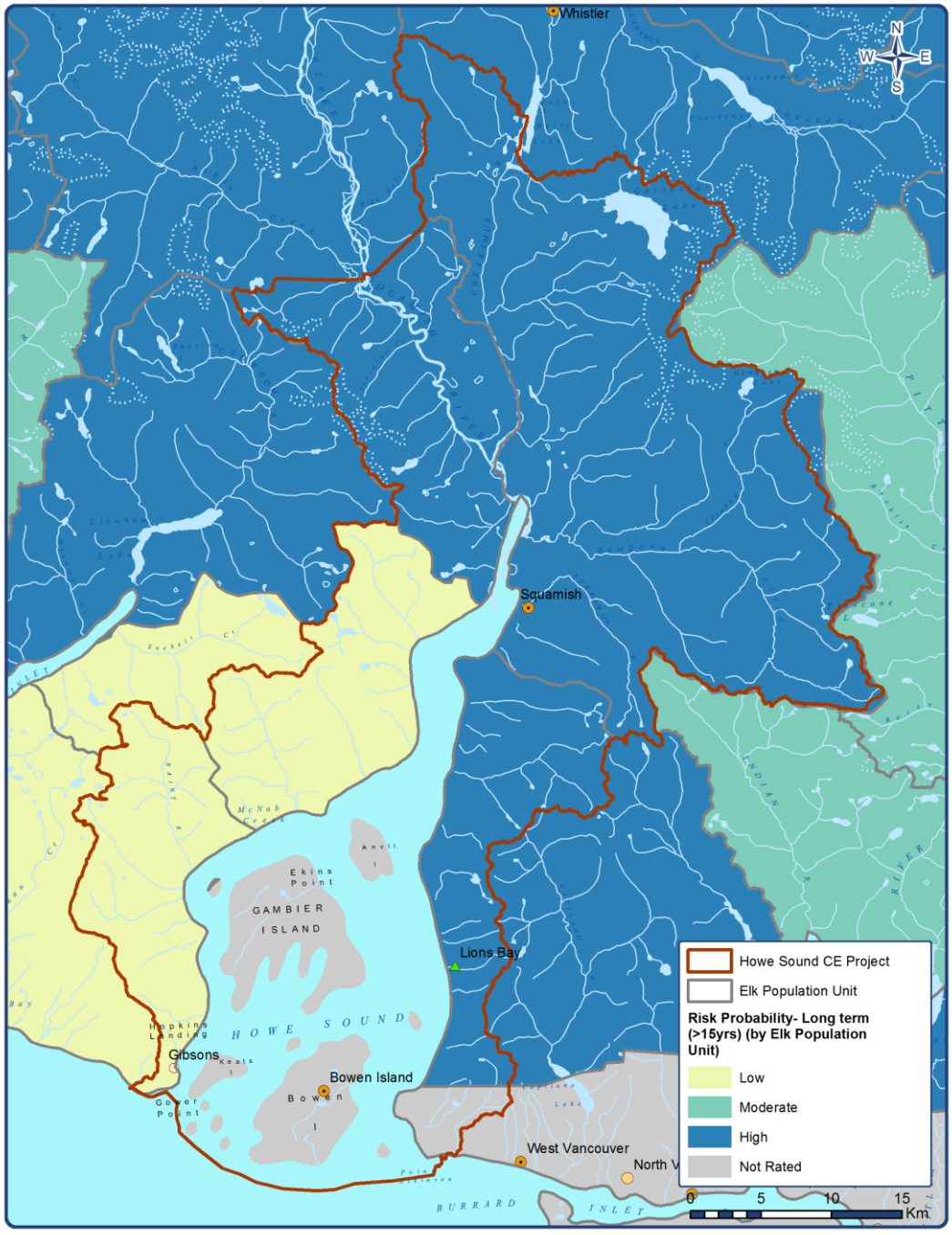
This map indicates the elk population trend in the Howe Sound area from 1986-2014 by EPU. Darker colours indicate EPUs at a higher risk of impacts and where further assessment and management may be warranted. It is estimated that Roosevelt Elk in the South Coast Region have increased in the number from less than 50 animals in 1986 to about 1,600 animals in 2014. This upward population trend is also evident in the Howe Sound area where it was estimated that in 2014 that there were over 240 elk in the area's EPUs.

Roosevelt Elk Population Sustainability Risk- Short Term



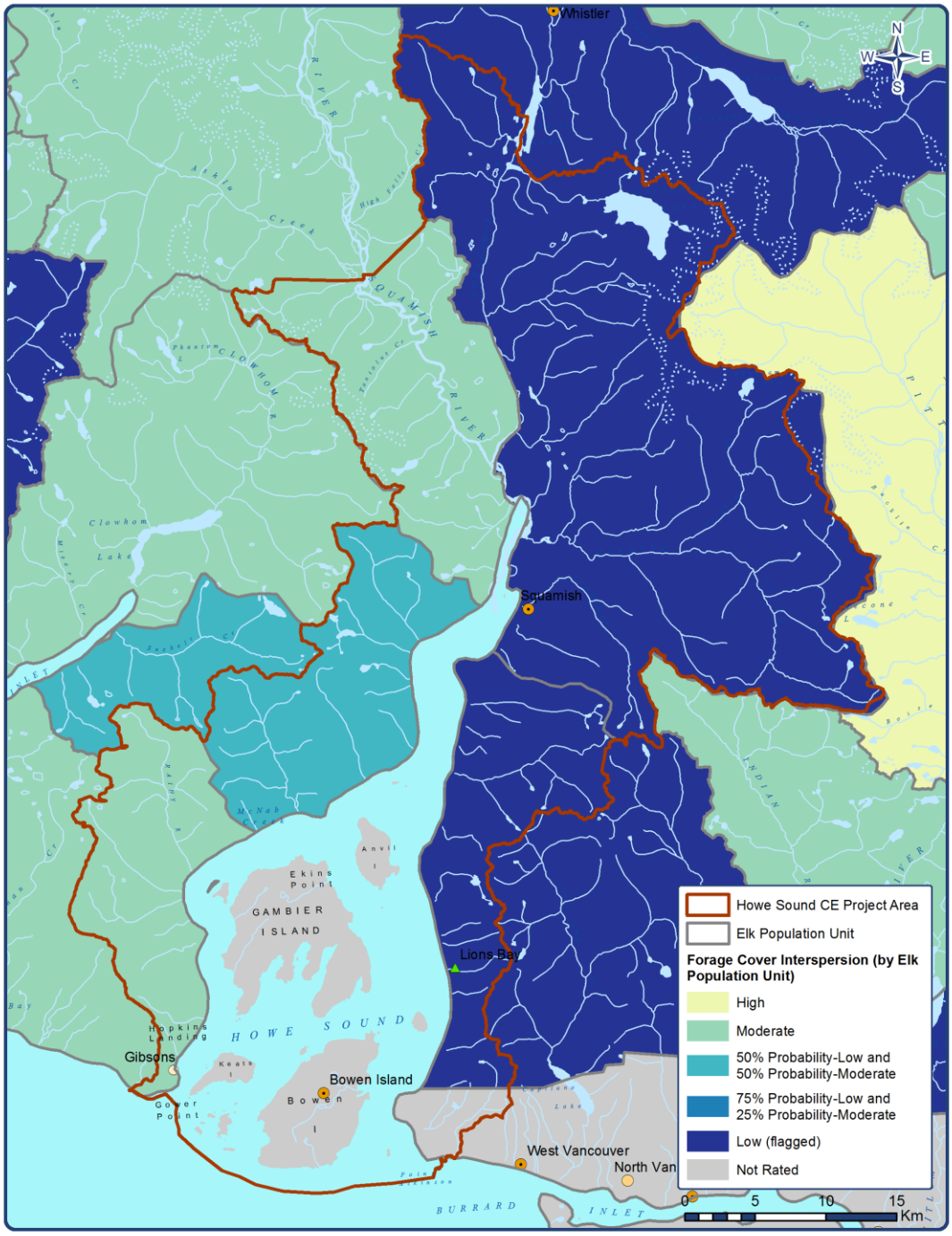
This map provides an elk population sustainability risk rating for each EPU (Risk of meeting elk management plan population objectives within 0-15 years based upon elk habitat and population risks). Low Risk =High chance of meeting objectives; Moderate Risk= Moderate chance of meeting objectives; High Risk=Low chance of meeting objectives. A darker colour indicates an EPU at a higher risk probability and where further interpretation and assessment work may be needed.

Roosevelt Elk Population Sustainability Risk- Long Term



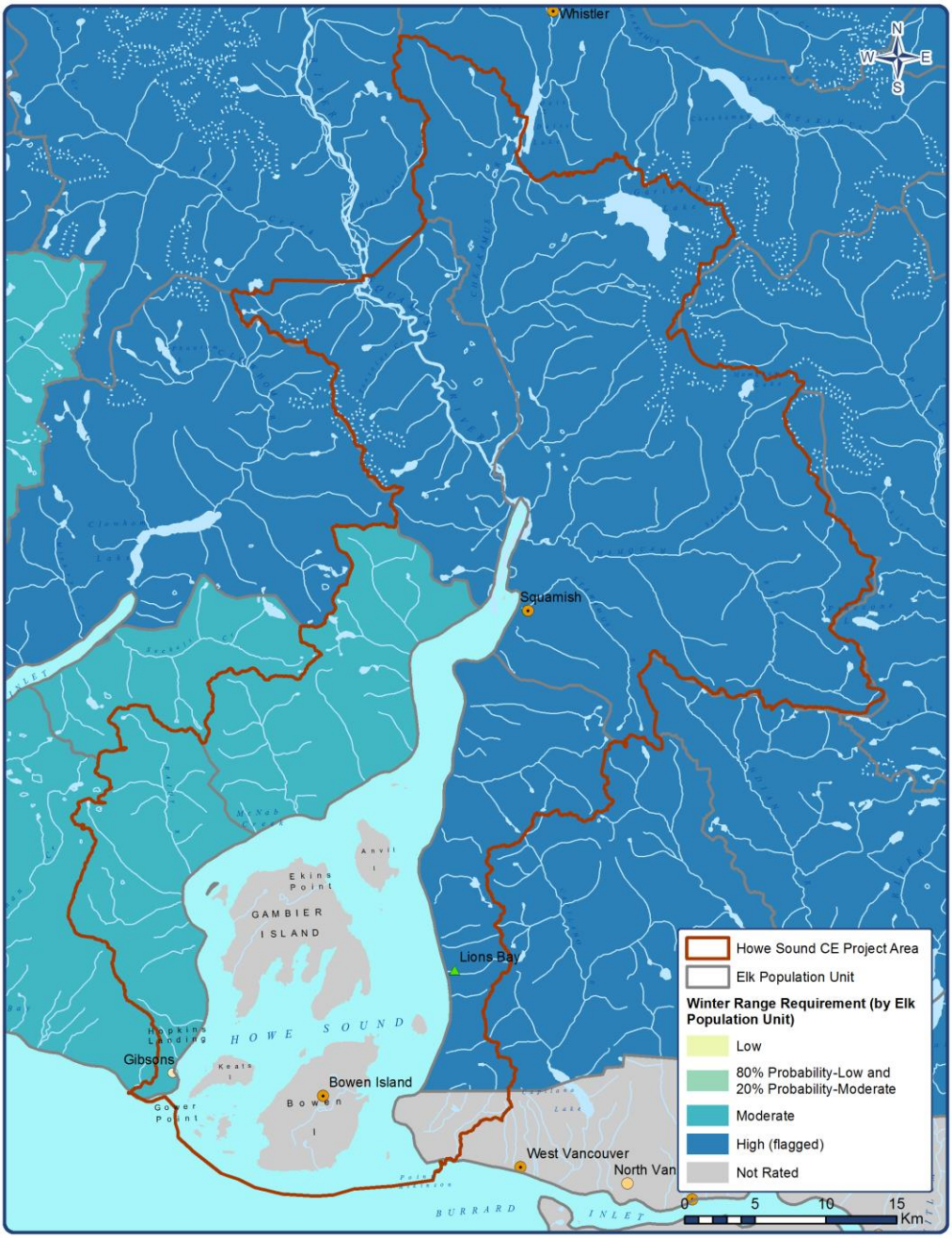
This map provides an elk population sustainability risk rating for each EPU (Risk of meeting elk management plan population objectives after 15 years based upon elk habitat and population risks). Low Risk =High chance of meeting objectives; Moderate Risk= Moderate chance of meeting objectives; High Risk=Low chance of meeting objectives. A darker colour indicates an EPU at a higher risk probability and where further interpretation and assessment work may be needed.

Indicator- Forage Cover Interspersion for Roosevelt Elk



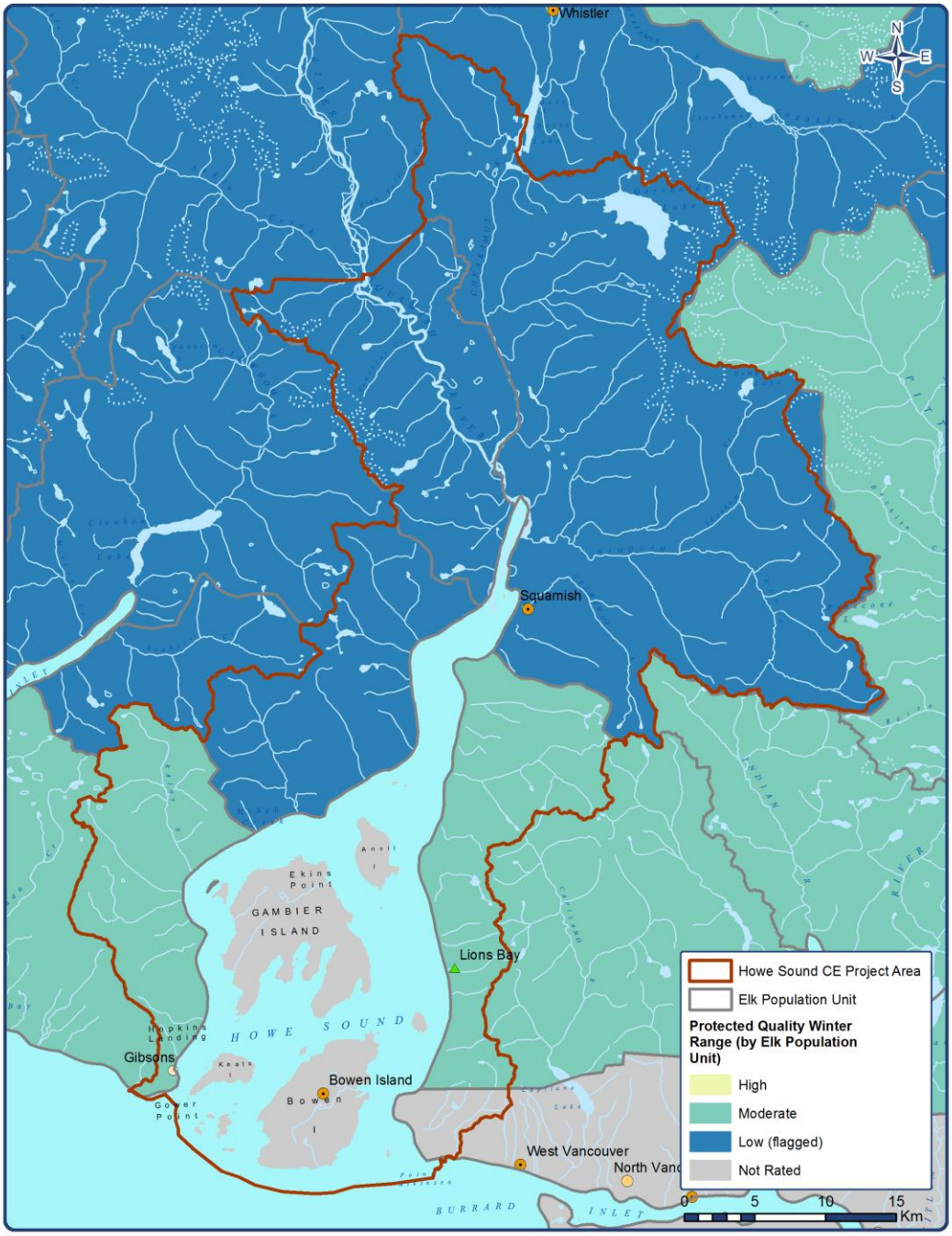
This map shows forage/cover interspersion as an indicator of elk population sustainability. It speaks to the favourable distribution of forage and forest cover across the landscape. High (lighter colour) indicates a very favourable mix of forage and cover. Low (dark blue) indicates a low level of favourable forage/cover interspersion and where further assessment and management may be needed.

Indicator- Winter Range Requirement for Roosevelt Elk



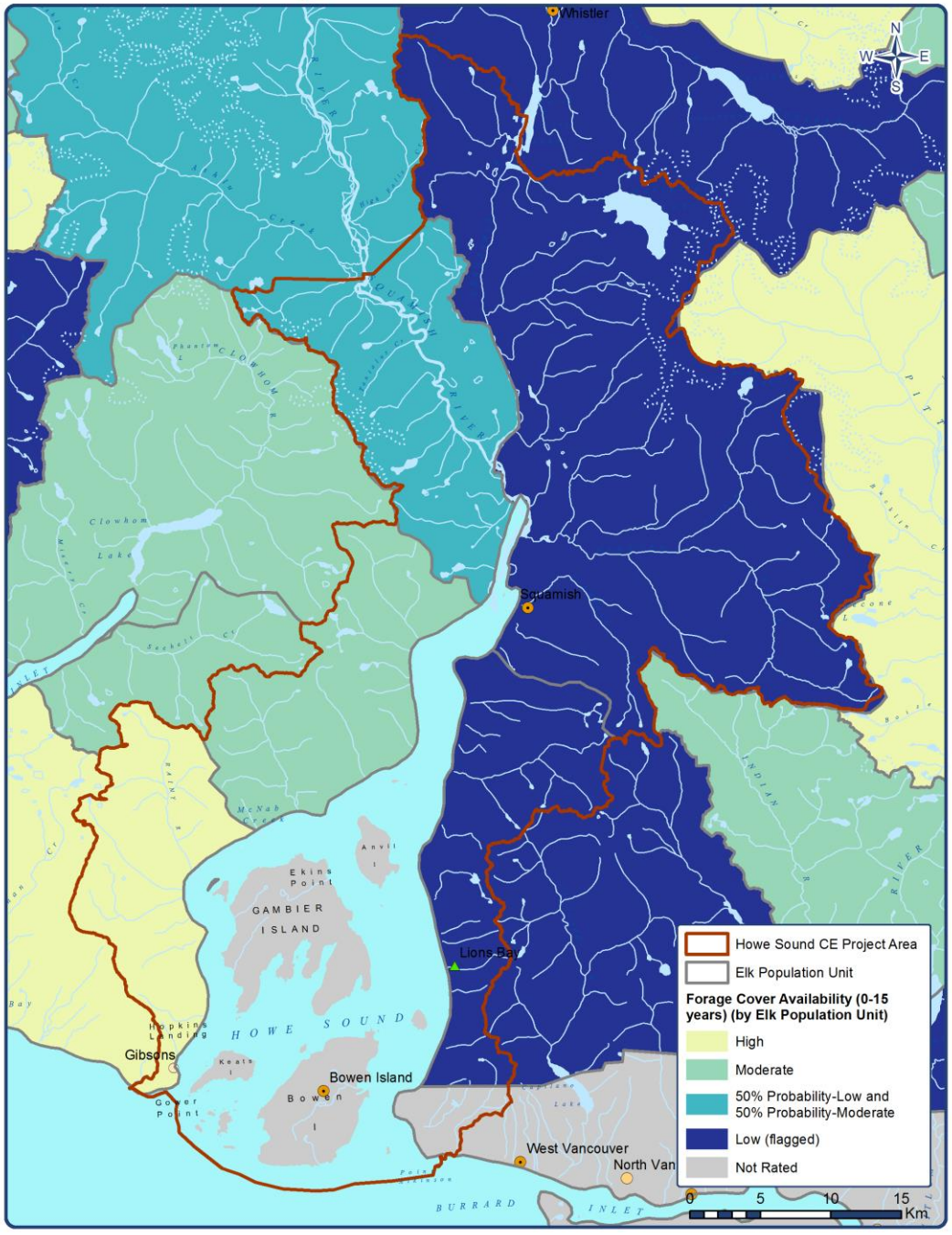
This map shows elk winter range requirement (EWR) as an indicator of elk population sustainability. It speaks to the requirement of critical winter habitat (i.e. forest thermal cover) for elk populations by EPU. Low (lighter colour) indicates little or no winter habitat requirement needed in most years. High (dark blue) indicates significant winter habitat required in most years. Areas with a High EWR add more risk to elk population sustainability model and give a general indication where further assessment and management may be needed.

Indicator- Winter Range Availability & Quality for Roosevelt Elk



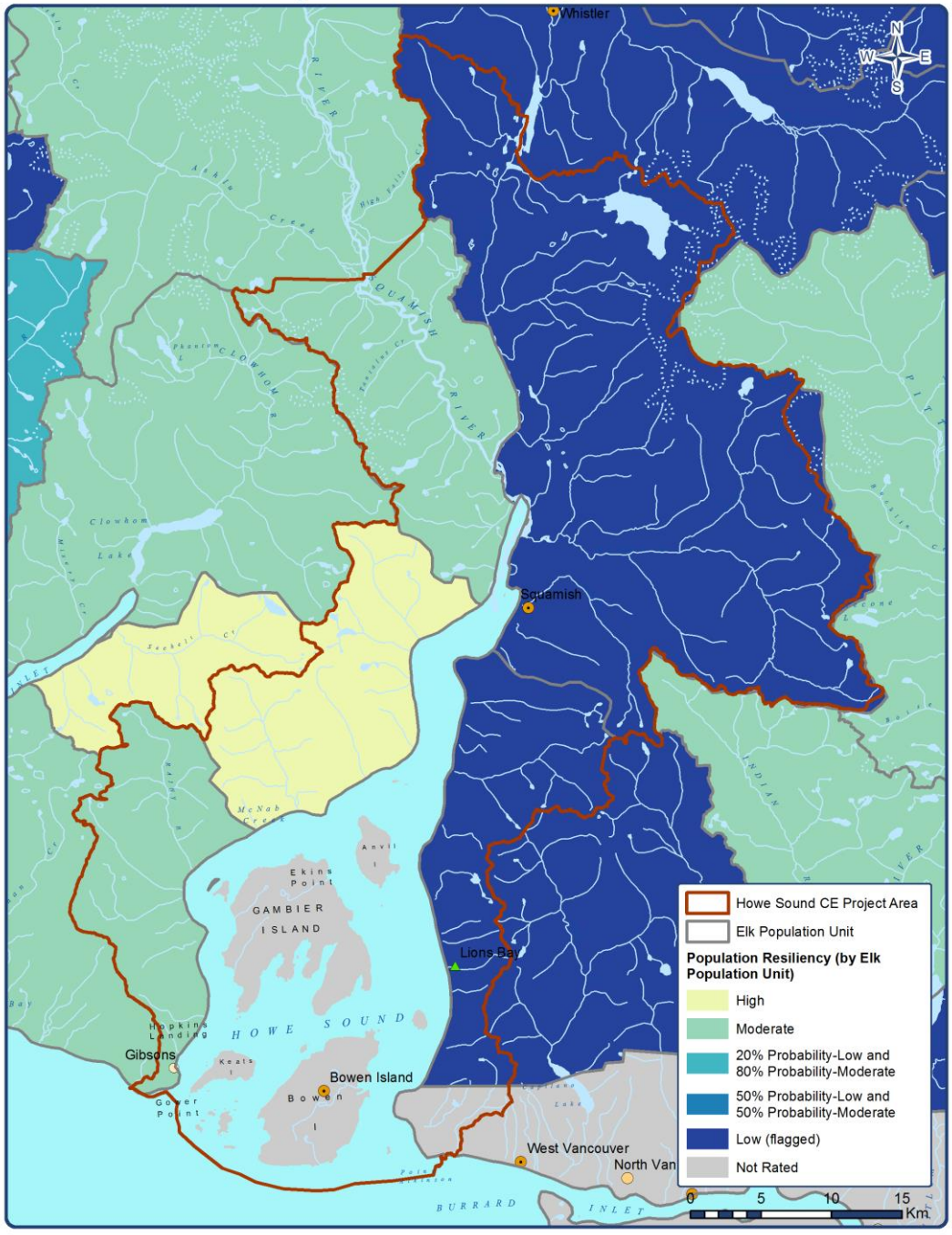
This map shows elk winter range availability and quality as an indicator of elk population sustainability. It speaks to the availability and quality of elk winter range habitat under strong land protection. High (lighter colour) indicates a relatively large amount of high quality elk winter range protected. Low (dark blue) indicates very limited or no high quality elk winter range protected and gives a general indication where further assessment and management may be needed.

Indicator- Forage Cover Availability for Roosevelt Elk



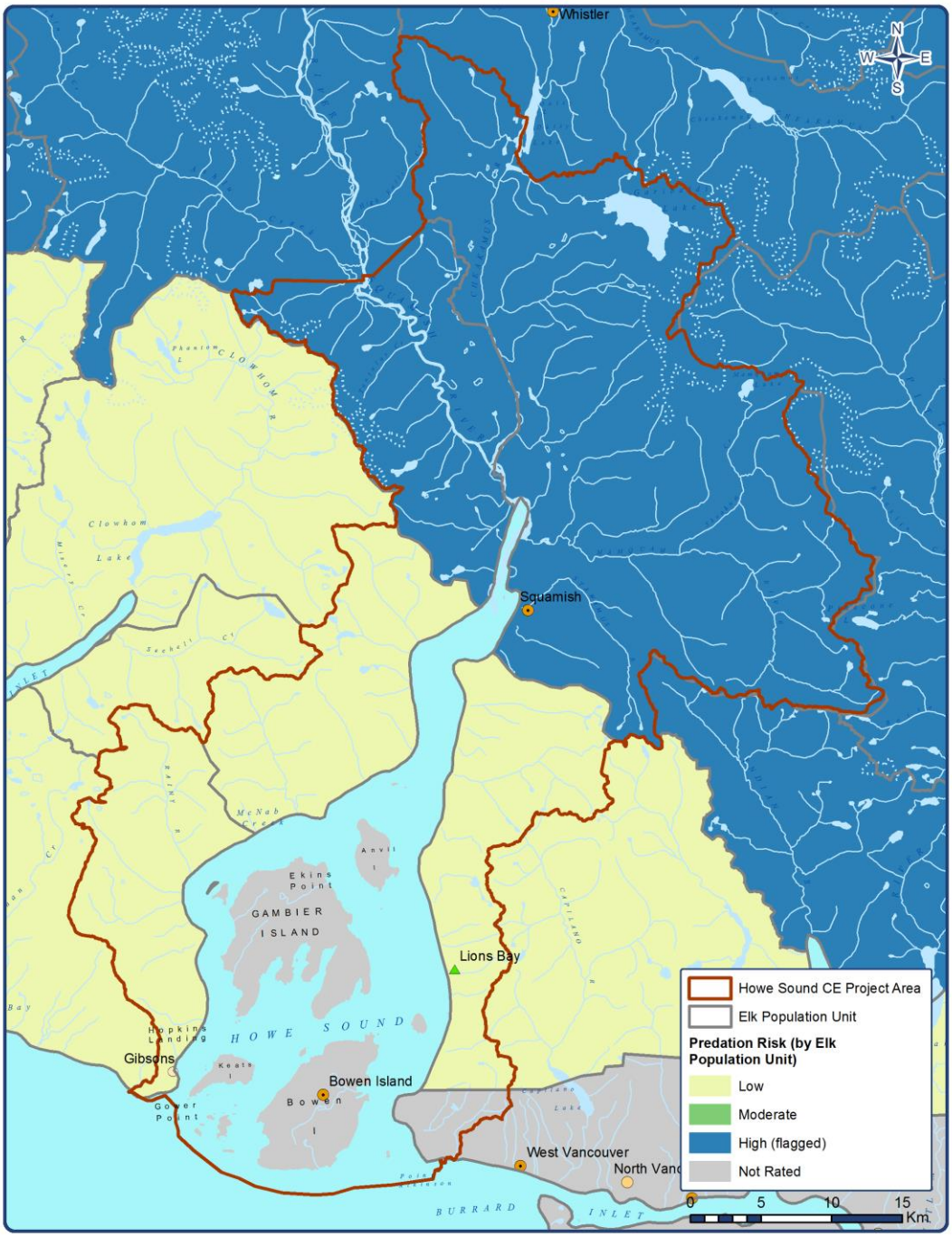
This map shows elk forage cover availability as an indicator of elk population sustainability. It speaks to the relative quality and quantity of forage (primarily) and the associated cover in the short term (0-15 yrs). High (lighter colour) indicates high levels of natural and/or human –created forage. Low (dark blue) indicates low levels of natural and/or human –created forage and gives a general indication where further assessment and management may be needed.

Indicator- Population Resiliency for Roosevelt Elk



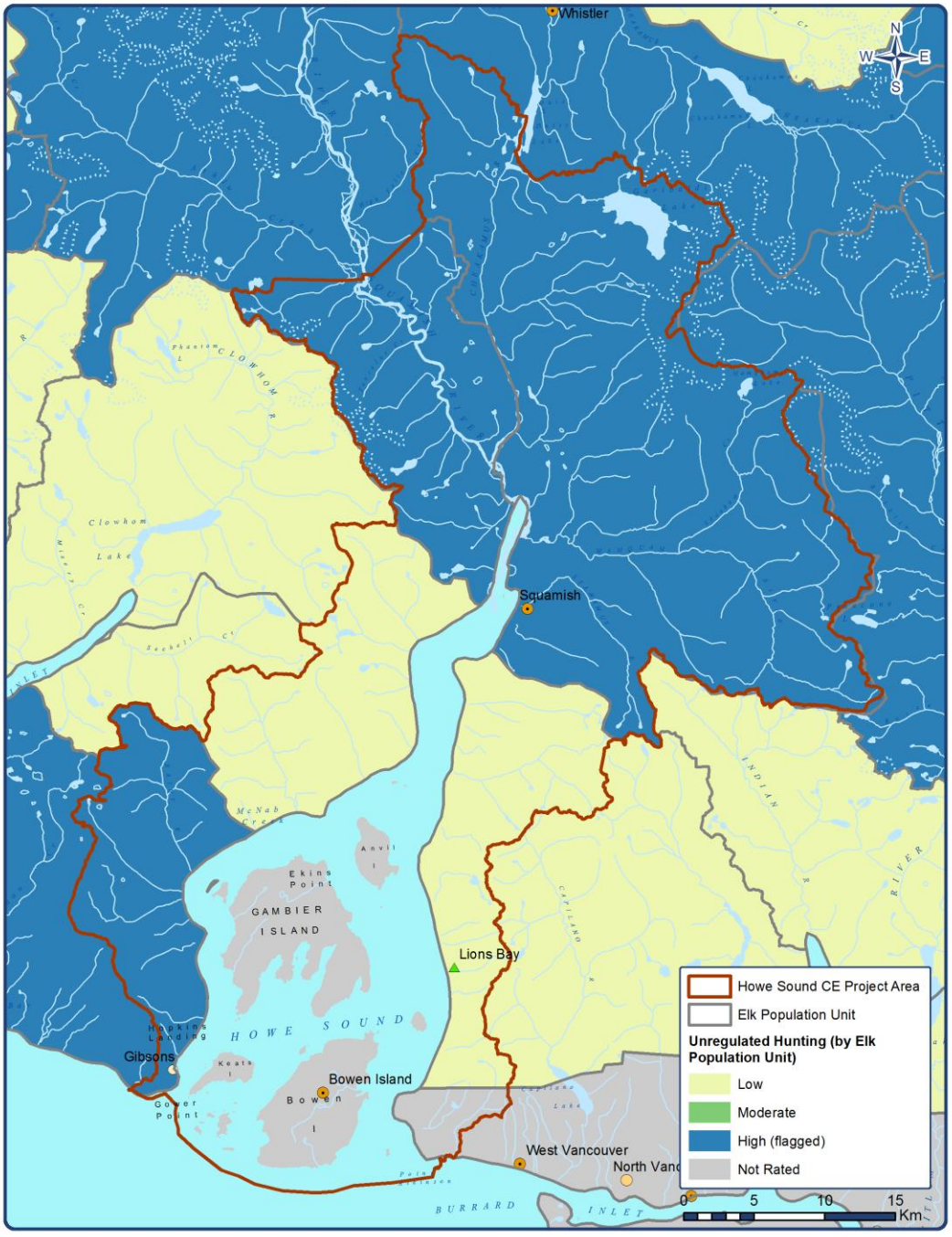
This map shows population resiliency as an indicator of elk population sustainability. It speaks to the ability to withstand population-limiting pressures. High indicates large populations (>100) with good productivity; Moderate indicates moderate populations (50-150) with good to moderate productivity; and Low indicates small populations (<70) with limited productivity and gives a general indication where further assessment and management may be needed.

Indicator- Predation Risk for Roosevelt Elk



This map shows predation risk as an indicator of elk population sustainability. It speaks to the relative level of predation risk to elk. Low (lighter colour) indicates a low risk of predation affecting the population. High (dark blue) indicates a high risk of predation affecting the population and gives a general indication where further assessment may be needed.

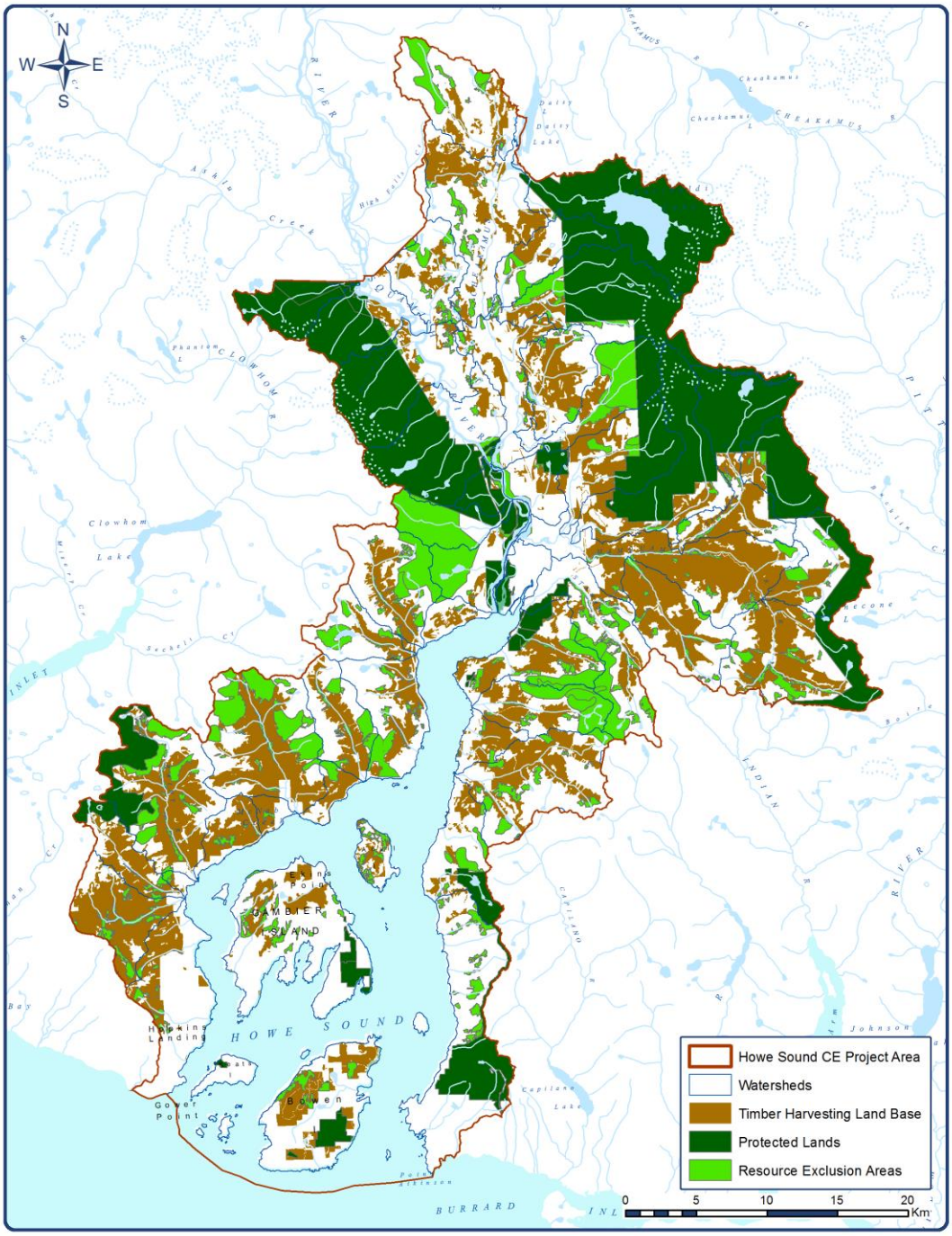
Indicator- Unregulated Hunting for Roosevelt Elk



This map shows unregulated hunting as an indicator of elk population sustainability. It speaks to the relative level of unregulated hunting in an area (EPU), currently and/or historically. Low (lighter colour) indicates low or no level of unregulated hunting. High (dark blue) indicates a moderate or high level of unregulated hunting and gives a general indication where further assessment and management may be needed.

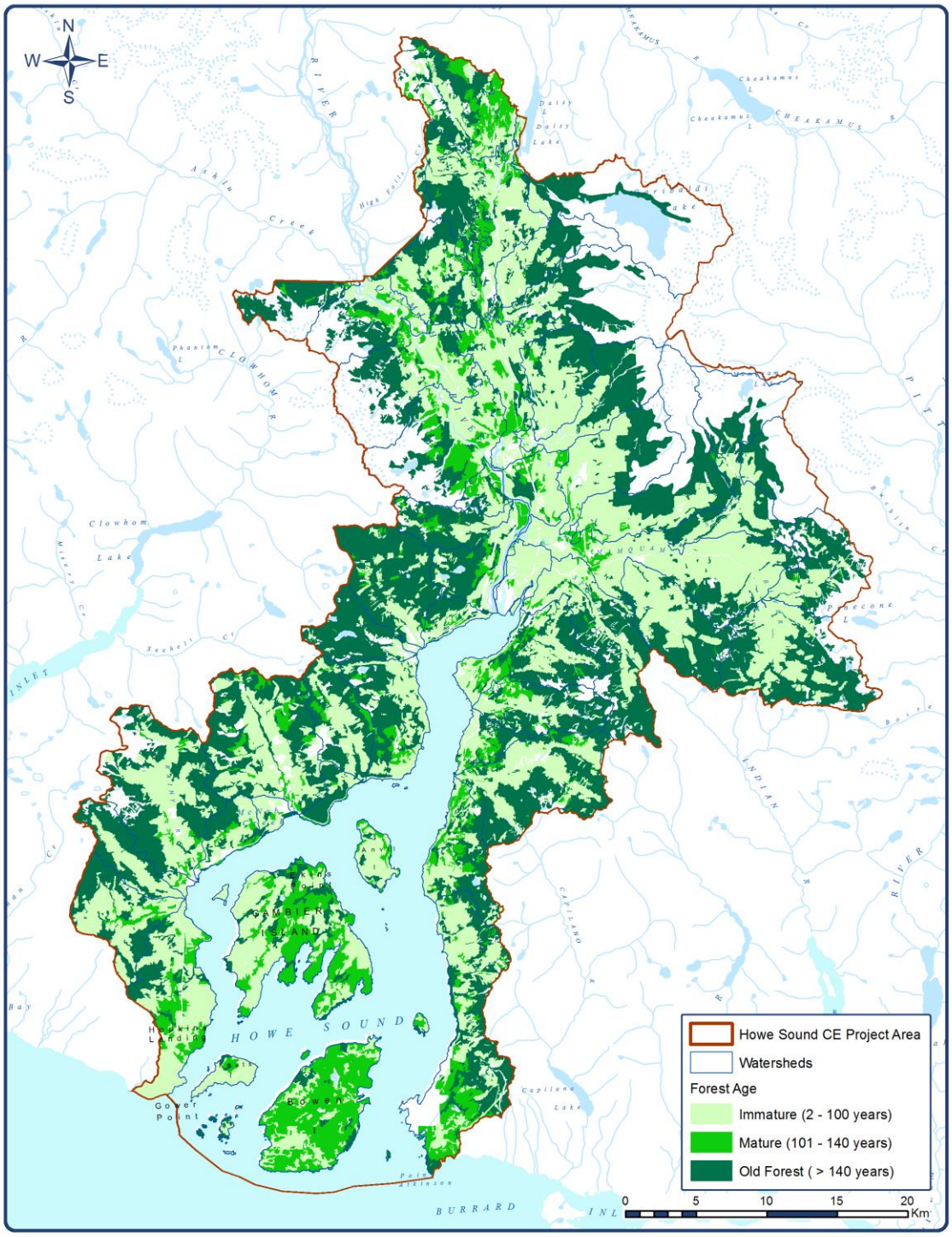
4. Supplemental Information

Protected Lands, Resource Exclusion Areas and Timber Harvesting Land Base

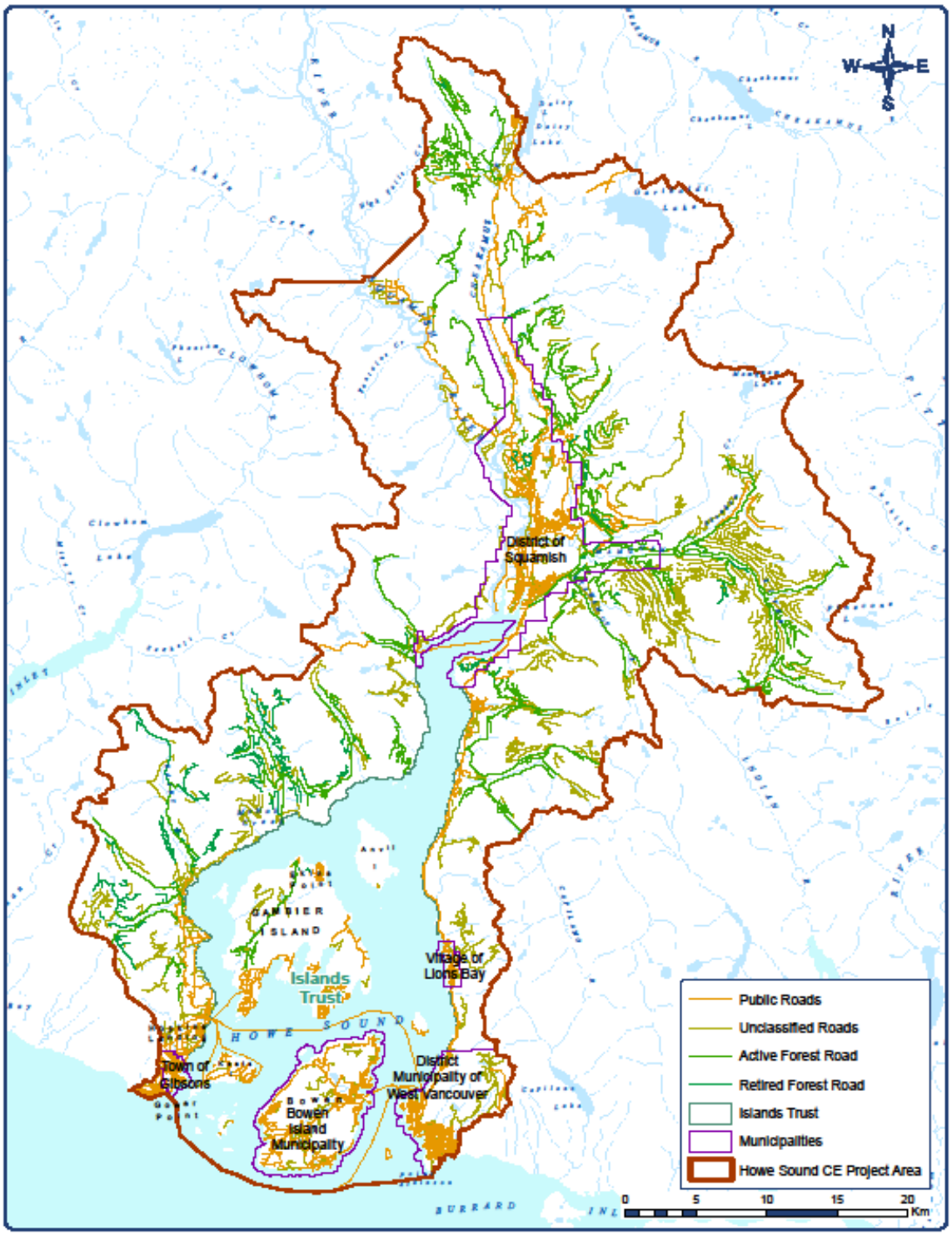


Note: For a description of *Protected Lands* and *Resource Exclusion Areas*, please go to: http://wwwd.env.gov.bc.ca/soe/indicators/land/land-designations.html

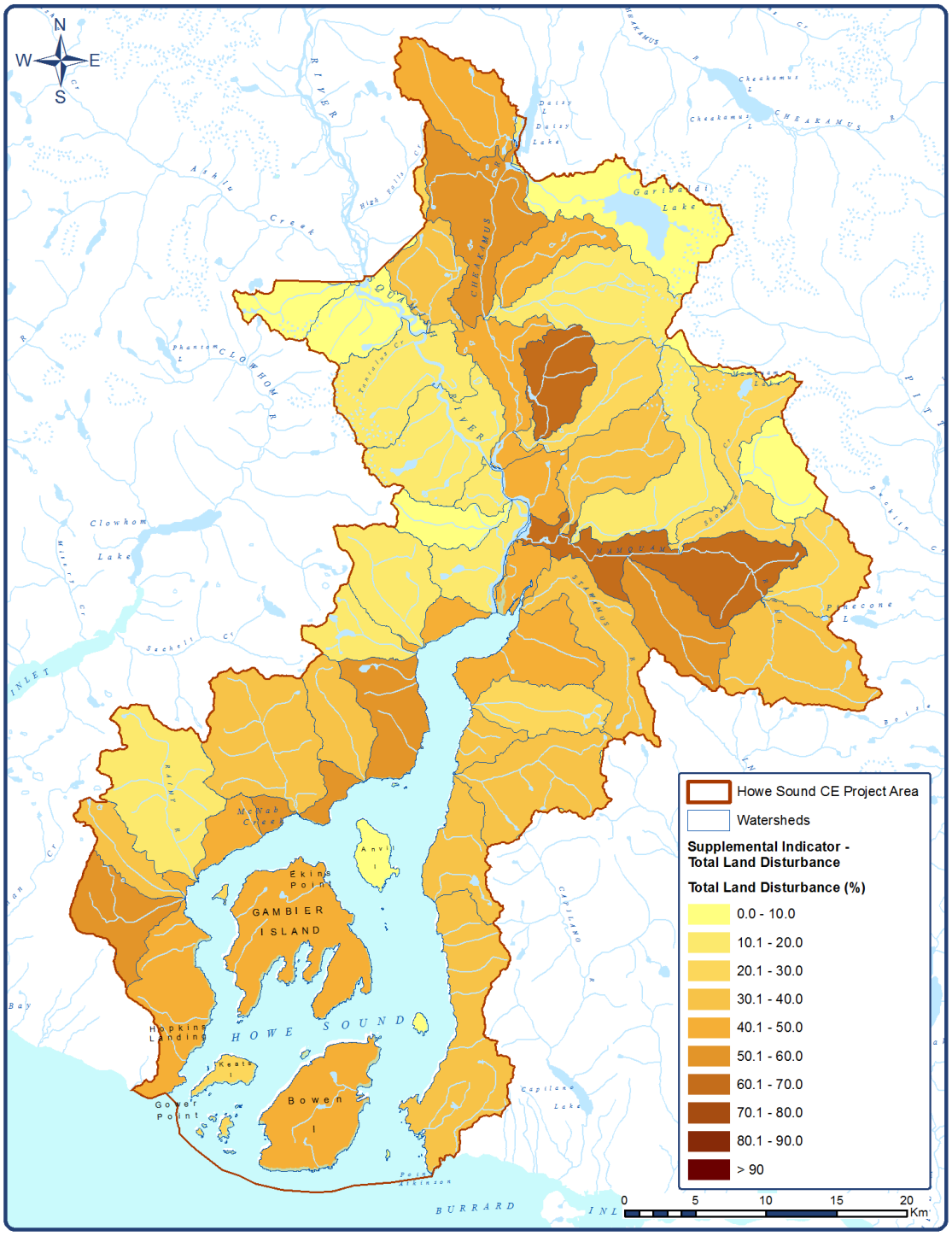
Forest Age and Watersheds



Roads and Land Jurisdiction



Total Land Disturbance



5. Discussion of Assessment Results

The current condition assessment results expressed in this report should be viewed as initial coarse filter information for consideration in strategic, tactical and operational decision-making at all levels of governance. Nevertheless, it is recognized that this initial current condition assessment has its limitations and would benefit from further validation monitoring work. These assessment results should also be considered in the context of: any trend information; First Nations' interests; economic development, recreational values, ecological function, additional wildlife values; climate change; public safety; and other important contextual information before determining if, and what kind of, a management response is warranted.

The assessment results in this report provide some general insight into where Roosevelt Elk population sustainability is potentially at higher and lower risk and what some of those risk factors are. From this assessment, it appears that the main risk factors to elk population sustainability are winter range availability, forage-cover interspersion, unregulated hunting and predation. These risk factors could receive some further attention in terms of exploring precisely what amount of risk they pose and what management actions can be taken over time to reduce those risks. Further validation work could also be conducted on some individual sample EPUs to ground truth the results and develop appropriate draft management responses.

At the individual EPU scale, the ministry is exploring a number of actions in response to these assessment results such as looking at recent trends for these indicators, comparing these predictions to available habitat and population survey information and applying these risk assessments, where possible, to land and resource management decisions. Some possible management responses could be improving elk winter range and forest seral stage distribution and better managing unregulated hunting through access management. Some examples of potential management responses are offered in a table in Table 2. The table provides some hypothetical management responses for two EPUs that were selected for their varying levels of assessed risk, to demonstrate how this information could be applied in different circumstances. The table also provides some potential interpretations of the assessment results, some types of further assessment that could be undertaken and some potential management responses to the observed risks.

Table 2. Examples of Potential Interpretation, Further Assessment & Management Responses

	***Indicators for Roosevelt Elk Value & Risk Level* (H,M,L)**						
Elk Population Unit & Interpretation	Winter Range Require.	Winter Range Avail/Qual	Forage Cover Avail.	Forage Cover Interspers	Population Resiliency	Predation Risk	Unregulated Hunting
Mamquam EPU (e.g. high access & high disturbance) 102,599 ha Population Estimate: 15	High **H**	Low **H**	Low **H**	Low **H**	Low **H**	High **H**	High **H**
Initial Interpretation	➢ Habitat risks in the LU are largely driven by historical intensive logging practices dating back to 1970's and recent land development in the corridor. ➢ Forest Harvesting history has resulted in a legacy of poor winter range availability and poor forage cover interspersion in the EPU. ➢ Recent improvements in forest management practices (cutblock size and rotation) may not yet be reflected in this current condition risk assessment. ➢ Economic development of land and resources (e.g. Housing development, commercial forestry) is high in this EPU. The Mamquam watershed is very important to the forestry sector in the S2S District. ➢ The risk of unregulated hunting is high in this EPU due to the large number of roads (especially Mamquam watershed), motorized recreationalists and easy access points.						
Recommended Further Assessment	➢ Conduct 20-year past and predicted future trend analyses of the indicators to confirm past and anticipated future direction and significance of risks to EPU. ➢ Ongoing wildlife inventory is necessary to validate assessment results and actively manage elk harvest rates in the area.						
Potential Management Responses	➢ Allow elk population recovery to occur naturally from other EPUs as this EPU is not a priority for enhanced elk population recovery due to its high long-term population sustainability risk, high recreational use and proximity to the highway; ➢ Forest managers and licensees could consider providing a more balanced forest seral stage distribution over prioritized portions of the EPU to help improve healthy forage/cover attributes for elk and to help grow the population to sustainable levels; ➢ Forest managers could explore with licensees management tool synergies through any new budgets for new natural resource sector legal designations (UWRs, WHAs, WMAs, OGMAs etc); ➢ If the population stops increasing in the EPU, forest managers could consider some practical road/access management options into the Mamquam watershed that might help to reduce the risk of unregulated hunting; ➢ Wildlife managers to keep population at 40% of Carrying Capacity through possible translocations or regulated hunting to control elk numbers along the S2S highway and public safety.						

	***Indicators for Roosevelt Elk Value & Risk Level* (H,M,L)**						
Elk Population Unit & Interpretation	Winter Range Require.	Winter Range Avail/Qual	Forage Cover Avail.	Forage Cover Interspers	Population Resiliency	Predation Risk	Unregulated Hunting
McNab EPU (e.g. low access & moderate disturbance) 32,954 ha Population Estimate: 92	Moderate **M**	Low **H**	Moderate **M**	Low / Moderate **M/H**	High **L**	Low **L**	Low **L**
Initial Interpretation	➢ The habitat risk factors in the EPU are Moderate to High due largely to historical forest harvesting in the area. ➢ The EPU has some low population risk factors like low predation risk and low unregulated hunting risk (due to limited human access-marine only) which has helped the productivity of the population. ➢ The McNab EPU is now at a sustainable population above 90 animals but habitat conditions could still be improved in the EPU through some improved forest management practices.						
Recommended Further Assessment	➢ Conduct 20-year past and predicted future trend analyses of the indicators to confirm past and anticipated future direction and significance of risks to EPU. ➢ Ongoing wildlife inventory is necessary to validate assessment results and actively manage elk harvest rates in the area.						
Potential Management Responses	➢ Forest managers and licensees could consider providing a more balanced forest seral stage distribution in the EPU to help improve healthy forage/cover attributes for elk like winter range and forage cover interspersion and thereby improving elk productivity. ➢ While several legal conservation designations already exist in the EPU, Forest managers could explore with licensees management tool synergies through any new budgets for natural resource sector legal designations (UWRs, WHAs, WMAs, OGMAs etc). ➢ The improvement of habitat conditions in the EPU could help to improve the productivity of the population and increase the hunting opportunity for local First Nations.						

FLNRORD staff are developing tools and processes designed to integrate and communicate resource value objectives, assess how well these objectives are being achieved (including results from this report) and respond with integrated resource management approaches to help achieve these objectives. In the spirit of the United Nations Declaration on the Rights of Indigenous Peoples, FLNRORD will share these assessments with key local First Nations in the Howe Sound CE Project area and collaborate on the development of any warranted management responses.

Possible Management Considerations

The following information is to be considered in future management and authorizations:

- Where elk population recovery and sustainability is desired, long-term forest management should consider a more balanced forest seral stage distribution over an EPU to help improve healthy forage/cover attributes;
- Elk winter range requirements and seral stage distribution should be considered in the broader context of any NRS integrated management for other values in the Howe Sound area to explore possible management tool synergies (UWRs, WHAs, WMAs OGMAs etc);
- Forest managers and licensees can consider the results in road/access management;
- EAO processes and any land and water authorizations in the project area should consider both current condition results and any management recommendations;
- Elk CE assessment and long-term management should consider the latest estimation of climate change impacts to the South Coast;
- The assessment results can support dialogue on elk management objectives and inform NRS strategic area based planning discussions;
- The assessment results can be used to improve the identification of priority EPUs for more detailed monitoring, assessment and research;
- The assessment results can provide estimated current condition information for specific indicators that can lead to more integrated management conversations around key provincial indicators;
- The assessment results can provide support information for consideration in the identification of general areas for project mitigation;
- Without more detailed validation/interpretation of the current condition results, the results are to be used only as an initial coarse filter for further interpretation and prioritization for CE assessment and management;
- Further interpretation, assessment and consultation are required before appropriate management direction can be determined. (For example, a darker colour mapping result does not always indicate that a strong management response is required as the assessment result could be trending in a positive direction without the need for additional management; or it may not be desirable to improve elk habitat in a particular EPU if it conflicts with other management objectives like public safety on highways);
- The current condition results from this report can be helpful to inform future dialogue with local First Nations and communities about integrated resource management in the Howe Sound area; and
- The assessment results and insights contained in this report can be considered immediately in certain statutory decisions (i.e. major projects, urban land development, forest management) and pro-active initiatives (i.e. road deactivation, silviculture practices, habitat restoration).

References

Madrone Environmental Services Ltd. 2016. *Roosevelt Elk Habitat and Population Risk Models: Cumulative Effects Framework Value Assessment*. Prepared for BC Ministry of Environment and BC Ministry of Forests, Lands and Natural Resource Operations. Unpublished. BC Ministry of Forests, Lands and Natural Resource Operations. 66pp.

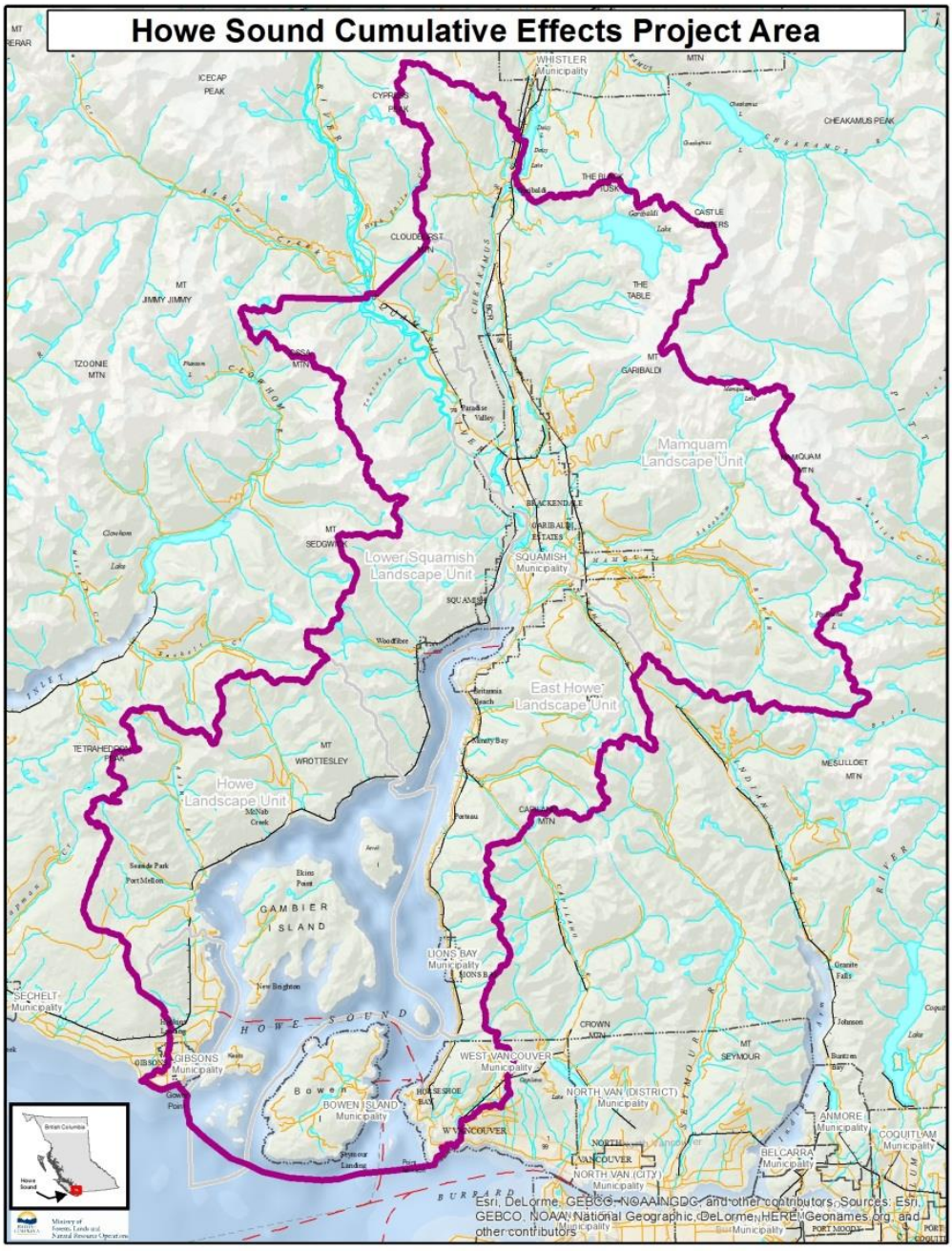
Ministry of Environment, Lands and Parks. 2000. *Elk in British Columbia: Ecology, Conservation and Management.* Province of British Columbia. 6pp. http://www.env.gov.bc.ca/wld/documents/elk.pdf

Ministry of Forests, Lands and Natural Resource Operations. 2015. *A Management Plan for Roosevelt Elk in British Columbia.* BC Ministry of Forests, Lands and Natural Resource Operations. 43pp. http://www.env.gov.bc.ca/fw/wildlife/management-issues/docs/roosevelt_elk_management_plan.pdf

Ministry of Forests, Lands and Natural Resource Operations. 2016. *Adapting Natural Resource Management to Climate Change in the West and South Coast Regions: Considerations for Practitioners and Government Staff.* South Coast Extension Note for Ministry of Forests, Lands and Natural Resource Operations. 19pp.

Appendix I

Map of Howe Sound Cumulative Effects Project Area



The Project area was tailored to the Howe Sound area to meet the expressed interests of local stakeholders. Local communities expressed a shared interest in CE value assessments that were focussed on a more natural boundary like the Howe Sound watershed instead of the three separate provincial administrative districts that straddle the Howe Sound area. The project area essentially follows the height of land around Howe Sound and aligns with Provincial Landscape Unit boundaries except at the entrance to Howe Sound where the boundary was extended to capture the area from West Vancouver around Bowen Island to Gibsons considering bathometry lines.

Appendix II

Roosevelt Elk Value Description

Roosevelt Elk Value Description

Description

Roosevelt Elk (*Cervus elaphus roosevelti*) are the largest subspecies of North American elk and are one of two subspecies of elk that exist in BC; the other BC subspecies is Rock Mountain Elk (*Cervus elaphus nelsoni*). Roosevelt Elk range over most of Vancouver Island and portions of the South Coast and are the largest ungulate in their range. They play an important ecological role as a prey species for top predators like bears, cougars and wolves, while their browsing also influences plant phenology and successional pathways.

Adult bull elk stand about 140 cm high at the shoulder and weigh 265 to 410 kg; cows stand about 130 cm high and weigh 190 to 270 kg. Elk are social animals and up to 20 or more cows, calves, and yearlings live in groups that remain apart from the smaller groups of bulls, except during the autumn mating (rutting) period.

Elk can live as long as 20 years, but most die by age 10 or 12. One of the main causes of elk mortality (mainly bulls and calves) is malnutrition during severe winters. Wolves, Cougars, and bears are the main predators of elk in British Columbia. These predators mostly take calves or adults that are weakened by severe weather, malnutrition, or injuries. Other factors affecting mortality are hunting, highway and railway accidents, and agricultural conflicts with farmers.

Habitat

The interspersion of feeding areas and security/thermal cover areas is important to elk. Optimal Roosevelt Elk habitat consists of relatively open quality forage areas interspersed with patches of dense forest or shrub cover in close proximity. Elk often forage in open areas within 80m of forest cover. Managing for elk winter range (old and mature forests for winter forage and cover) is particularly important in order to mitigate the potentially adverse impacts of extreme winters on elk populations. As result, forest management in BC can have a significant impact on the quality of elk habitat and the recovery and sustainability of elk populations.

Coastal Roosevelt Elk tend to occur in fairly small scattered herds, each one confined to a watershed where low-elevation early seral forests as well as riparian, floodplain, wetland, and estuarine meadow habitats provide winter-spring forage. They feed on sedges, grasses, and ferns, supplemented by browse from willows, elderberry, blueberries, cedar, and hemlock. In summer, most Roosevelt herds migrate upward to subalpine meadows and avalanche tracks, but a few stay year-round on valley-bottom ranges. Dense forests stands provide security cover and snow interception during winter while more open early seral stage forests and riparian areas provide high quality spring/summer forage.

Human Values and Uses for Roosevelt Elk

First Nations historically have used Roosevelt Elk for food, clothing, implements, weapons, decoration, and a medium of exchange for their communities. Several First Nations today still have a cultural interest to harvest elk. The Province recognises that many First Nations have asserted or proven aboriginal rights or treaty rights to harvest wildlife for food, social and ceremonial purposes in their traditional territories. In many areas of Roosevelt Elk range in coastal BC, the demand from First Nations to harvest elk for subsistence and cultural use currently exceeds sustainable harvest opportunities. As a result, many coastal First Nations have expressed a strong interest in seeing the recovery and growth of elk populations and see this work as part the Crown's responsibility to respect their aboriginal rights.

Roosevelt Elk are an important game animal in British Columbia that is prized for its meat and antlers. Elk hunting is closely regulated and it has created: substantial license revenue for conservation programs; income for hunting guides and their employees; economic generation from outdoor recreation; and numerous recreation days for hunters. Roosevelt Elk also provide highly sought after wildlife viewing opportunities. All these uses provide direct and indirect economic benefits to the Province, regions and local communities.

Population Distribution and Threats

Traditional ecological knowledge and other available evidence indicates that Roosevelt Elk were historically distributed more extensively throughout the South Coast of BC but were largely extirpated in the region by the end of the 19th century due to expanding human development and settlement activity along with unregulated market hunting. Through much of the 20th century, Roosevelt Elk habitat faced impacts from large scale resource extraction, farming, urbanization and road development. In particular, forest harvest regimes that did not maintain an adequate interspersion of mature and old forest types at lower elevations (critical winter range) along with early forest seral stages (quality spring/summer forage areas) have posed a major threat to elk habitats and their population sustainability. Unregulated hunting and predation risk can also pose a threat to elk populations; particularly smaller ones.

Roosevelt Elk in Coastal BC have been increasing steadily throughout their range over the past 40 years due to successful relocation programmes and improved elk management as it relates to forestry, agriculture and highways. In 1986, it was estimated that there were less than 50 Roosevelt Elk in the South Coast region. This number has increased steadily to an estimated 1,600 animals in 2014. Roosevelt Elk distribution in coastal BC is separated into three general metapopulation areas: South Mainland Coast, South Vancouver Island and North Vancouver Island. Figure 4 shows the estimated distribution and density of Roosevelt Elk in the Coast Area in 2014.

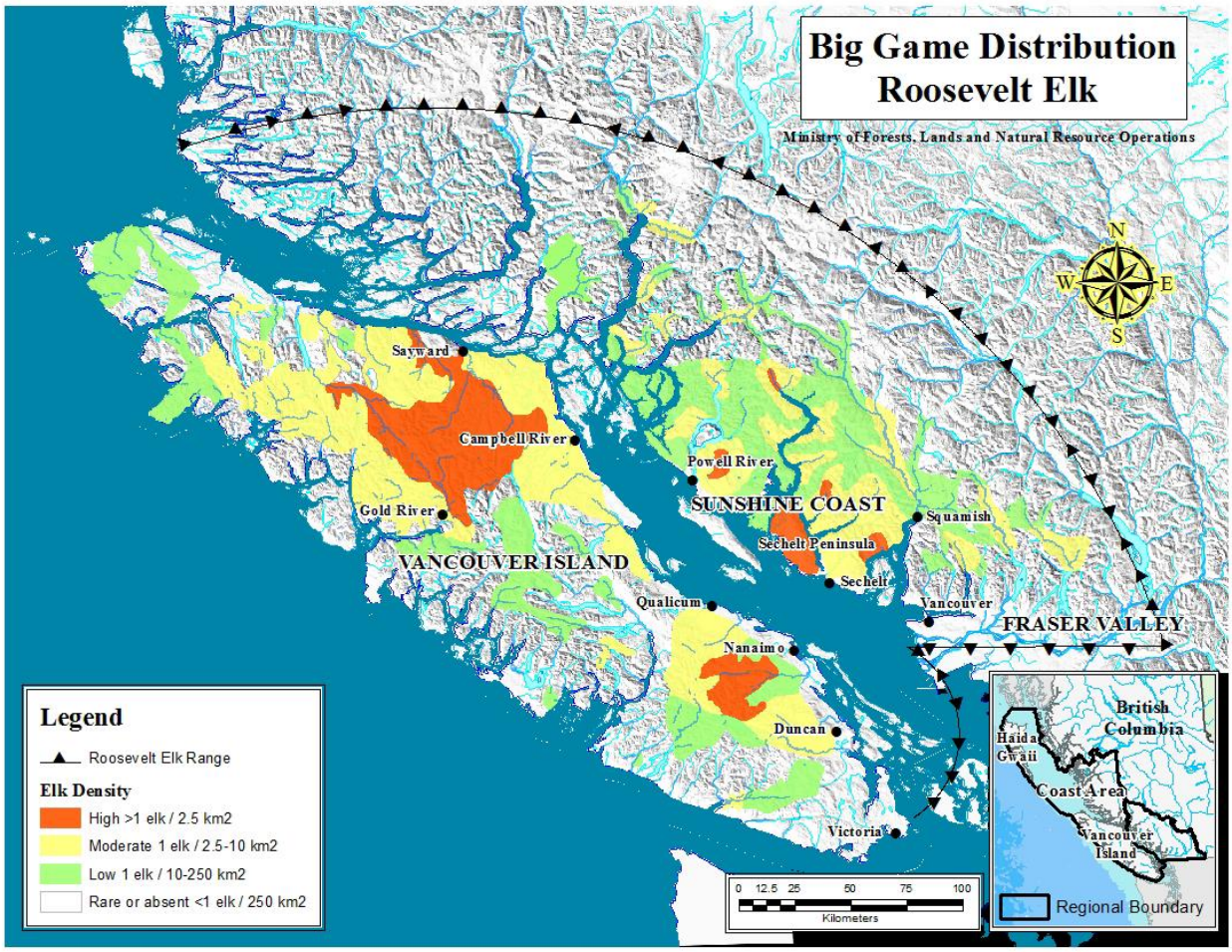


Figure 4: Estimated Distribution and Population Density of Roosevelt Elk in BC.

Conservation Status

Roosevelt Elk are currently ranked S3S4 (Vulnerable to Apparently Secure) by the BC Conservation Data Center and are a Provincially Blue-listed species (of Special Concern). Like other blue listed species, Roosevelt Elk are considered at risk and have characteristics that make them particularly sensitive, or vulnerable, to human activities and natural events.

Appendix III

Management Objectives for Roosevelt Elk

Management Objectives for Roosevelt Elk

The Province of BC developed *A Management Plan for Roosevelt Elk in British Columbia, 2015:* http://www.env.gov.bc.ca/fw/wildlife/management-issues/docs/roosevelt_elk_management_plan.pdf to prevent Roosevelt Elk from becoming further at risk and to improve cultural and recreational opportunities related to healthy and sustainable elk populations. This Plan outlined seven management objectives to guide Roosevelt Elk management until 2025:

Conservation Objectives

1. Maintain self-sustaining populations of Roosevelt Elk in throughout their current range in the South and West Coast Regions;
2. Re-establish Roosevelt Elk in historic but unoccupied ranges where ecological conditions are suitable;
3. Maintain or restore the contribution of Roosevelt Elk to natural biodiversity and ecosystem function;

Sustainable Use Objective

4. Within the ecological limits of the species, provide opportunities for consumptive and non-consumptive use;

Prevention and Mitigation Objectives

5. Mitigate public safety risk of vehicle collisions;
6. Mitigate crop depredation impacts on agricultural crops and market gardens; and
7. Mitigate conflicts with forest management objectives.

This plan outlined management strategies for each Roosevelt Elk Population Unit (EPU) in BC and included topics like: population targets; population enhancement; inventory frequency; consumptive use management; habitat management; and elk spatial containment for public interests. Long-term Roosevelt Elk habitat and population monitoring supports all these management strategies.

Appendix IV

Howe Sound Context for Roosevelt Elk

Howe Sound Context for Roosevelt Elk

Location and Topography

Howe Sound contains one of the most southern fiords on British Columbia's coast. The entrance to Howe Sound is located about 10 km northwest of the city of Vancouver and stretches from the Strait of Georgia heading north for about 43 km up to the Squamish River Estuary. The sound itself is a triangular shaped inlet bounded by steep coastal mountains ranging from 1,200 m in the south up to about 2,700 m in the north. The southern portion of the sound contains four major islands (Bowen, Keats, Gambier and Anvil) and numerous smaller islands while the northern portion of the sound narrows to a 3 km wide channel becoming a fiord for 15 km before reaching the Squamish estuary. The estuary is fed by the Squamish River and the associated Cheakamus and Mamquam river drainages.

Precipitation and Climate Change

In general, the Howe Sound area is warm and dry during the summer months and cool and very wet (snow at higher elevations) during the winter months. Annual mean precipitation in the area is influenced by orographic precipitation along the coastal mountains and ranges from 1250 mm/yr in West Vancouver to 2250 mm/yr in Squamish. In the coming years, warming from climate change is expected to affect weather conditions and seasonal precipitation in the Howe Sound area. Climate change in the South Coast will likely shift the current rain/snow-driven hydrological regime to a more rain-driven regime over the next 35 years. More winter precipitation will likely fall as rain rather than snow and result in: lower snowpacks, earlier/more rapid snowmelt and longer fire seasons. Snowfall in the South Coast is projected to decrease by 10% to 40% in the winter and 14% to 73% in the spring by the year 2050. Forest fire seasons and risk are expected to increase as periods of relative summer drought become more common. In addition, more severe winter rainstorms are projected which can lead to an increased risk of flooding, landslides and windthrow. These anticipated changes may have both positive and negative impacts on Roosevelt Elk habitat. For example, reduced winter snowpacks and warmer temperatures may reduce a key mortality factor (winter stress and malnutrition) but also reduce summer forage and water quality due to seasonal drought.

Ecology and Climate Change

The variety of terrain and watersheds that surround Howe Sound provide a range of environments that support the general ecology of the area. The unique conditions found in each watershed provide the complex physical and chemical processes and food-webs that sustain a diversity of flora and fauna, including Roosevelt Elk.

Roosevelt Elk typically use the various elevational habitats found within a watershed for seasonal habitat requirements related to forage and thermal/security cover. Key cover habitats in the Howe Sound area include lower elevation dense conifer forests. Key feeding habitats include open conifer stands, deciduous dominated stands, marshy meadows, wetlands, seepage sites, estuaries and edge areas near lakes, rivers and streams. The moist rich soils associated with these environments tend to provide preferred forage species for Roosevelt Elk.

The ecosystems in the Howe Sound watersheds are currently experiencing the cumulative impacts of natural disturbances (i.e. fire, landslides, floods), anthropogenic disturbances (i.e. energy development, resource extraction, recreation, housing development) and climate change. Climate change alone is projected to change ecosystems over the next 30 years by altering temperature, hydrological, fire and natural disturbance regimes in the South Coast**.** Current climate change projections suggest Biogeoclimatic Zones in BC will shift upslope and northward. The main Biogeoclimatic zones found in the Howe Sound area include: Coastal Western Hemlock (CWH) -found at lower forest elevations; Mountain Hemlock (MH) - found at higher forest elevations; and Coastal Mountain Heather Alpine (CMA) -found just above the treeline. By the 2050s, the CWH and MH zones are predicted to shift about 200 – 300 m upward in elevation. However, high elevation ecosystems that contain MH and CMA zones will likely experience the highest degree of stress. They are projected to lose significant area (70% and 44% respectively) by the 2050s. Conversely, the CWH zone is projected to expand inland and upslope (MFLNRO, 2016). How this will affect Roosevelt Elk is still uncertain at this point and highlights the importance of long-term monitoring and adaptive management.

Roosevelt Elk Translocation

Roosevelt Elk populations were largely extirpated in the Howe Sound area by the early 20th century due primarily to unregulated market hunting. Roosevelt Elk translocations from the broader South Coast to Howe Sound watersheds took place primarily from 2000 to 2013. More than 500 elk have been translocated from Vancouver Island and the Sechelt Peninsula to 30 different release sites in the South Coast region. Of this number, a total of 91 elk were translocated to four different watersheds in the Howe Sound area as of 2013: 31 elk to McNab Creek; 26 elk to Rainy River; 26 elk to Squamish River; and 8 elk to Mamquam River. As a result, the Rainy Creek, McNab Creek, Mamquam River and Squamish River watersheds now support small Roosevelt Elk populations that are in their early population growth stages and are increasing in numbers or are stable to increasing in numbers. As of 2014, the province estimated that there were over 240 elk in the four main EPUs in the Howe Sound Area.

Human Settlement

The Howe Sound area falls within the traditional homelands of the Coast Salish people. The Squamish Nation has numerous reserves and cultural sites within the Howe Sound area and

Squamish river watersheds. The Squamish Nation and the neighbouring Tsleil-Waututh Nation have their own traditional words for elk: *Kayi7ch* for the Squamish Nation and *q'oyiyets* for the Tsleil-Waututh Nation. Both First Nations are interested in seeing the return of elk to their traditional territories. Sustainable and healthy elk populations are important to supporting their quality and way of life and are important to their rights and interests.

Overall, about 40-50,000 people live in the Howe Sound area with the majority of people residing in the communities of Squamish, Britannia Beach, Lions Bay, Horseshoe Bay, Gibsons, and Bowen Island. To date, the topography in the area has restricted most of the settlement to the coastline, valley bottoms and lower lying islands. It is estimated that the population in the Sea-to-Sky corridor could increase by almost 30% over the next 25 years. It is anticipated that associated commercial services, tourism and recreational use will also continue to grow in the area during this period. Approximately 13,000 new dwelling units are currently being planned in the broader Howe Sound area through resort and housing development proposals located primarily on the East, North and South sides of Howe Sound. Consequently, the human ecological footprint in the Howe Sound area is expected to increase while at the same time Roosevelt Elk populations are trying to find an ecological foothold again in some of the area's local watersheds.

Land Use

The Howe Sound area, with its close proximity to Vancouver, has long been an interface area between wilderness and increasing human settlement, development and recreational activity. The area has multiple competing economic, social, cultural and environmental values and is now being exposed to a new era of development interests and potential cumulative impacts on terrestrial and marine ecosystems. The area's economy is diversifying and becoming less reliant on natural resource extraction as improved highway access and tourism infrastructure spur new resort, housing, recreation, commercial and industrial development interests. Approximately, 32% of the total watershed area in the Howe Sound Project area has had their key watershed functions disturbed by human activity or natural disturbance processes. This number is expected to increase in the coming years due to the development interests and proposals in Howe Sound.

While the forestry sector has historically had the largest impact on watersheds in the Howe Sound area through road development, timber harvesting and other industrial practices, more sensitive forest harvesting can also help with the recovery and sustainability of elk populations by providing the appropriate interspersion of capable elk habitat types (forest seral stages). About 79% of the land in the Howe Sound CE Project area is forested and about 29% of this forested land is available for timber harvesting. By contrast, 24% of the land in the project area

falls within parks and protected areas and about 37% of the land area has some form of forest protection. Much of the lower elevation forest in the CWH biogeoclimatic zone is second growth forest.

Several watersheds in the Howe Sound area are heavily roaded from a history of natural resource extraction, hydro development, industrial development and recreational access. The forestry sector has the greatest number of roads in the Howe Sound area. There are an estimated 2,300 km of total roads within the Howe Sound CE Project area and approximately 65% of these roads are active or inactive forestry roads. These roads can increase the risk of disturbance and unregulated hunting to elk populations if not managed responsibly. Overall, forest management can play a very large role in determining the capability of Roosevelt Elk habitats which affect elk population unit productivity and sustainability.

The Sea-to-Sky area, which includes most of the Howe Sound project area, is seeing an increase in backcountry recreation from visitors that primarily come from outside the Sea-to-Sky corridor. The number of existing roads and marine access points in the Howe Sound area also create access opportunities for motorized and non-motorized recreationalists into watersheds with recovering Elk populations. The increased recreational use and activity in some watersheds has the potential of having cumulative impacts on Roosevelt Elk and their habitat. Some of the recreational activities can include: unregulated hunting, motor biking, ATV use, mountain biking, and front-country and backcountry camping on non-designated sites.

Cumulative effects will need to be carefully considered by respective government decision-makers/managers in this time of increasing development, recreational use and climate change, in order to sustain recovering Roosevelt Elk populations and overall ecosystem integrity in the Howe Sound project area.