HAZARD RISK AND VULNERABILITY ASSESSMENT

REGIONAL DISTRICT OF NANAIMO

FINAL REPORT

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British Columbia

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Executive Summary

EmergeX Planning Inc. (EmergeX) conducted this Hazard Risk and Vulnerability Assessment (HRVA) for the Regional District of Nanaimo (RDN) Emergency Management Program. An HRVA is a critical part of every emergency program and is a requirement mandated by the Local Authority Emergency Management Regulation of the BC Emergency Program Act. Section 2(1) of this regulation requires local authorities to prepare emergency plans that reflect *the local authority's assessment of the relative risk of occurrence and the potential impact on people and property of the emergencies or disasters that could affect all or any part of the jurisdictional area for which the local authority has responsibility.*

No government has unlimited resources allowing them to plan for every hazard event possible, therefore some form of ranking is required when deciding which hazards are most important to plan for. Based on the aggregation in the Risk Matrix, EmergeX has identified 33 hazards that could affect the Regional District of Nanaimo. This assessment identifies the risk that each hazard presents to the Regional District, thereby allowing the RDN to plan for mitigation, response, and recovery efficiently within budgetary and other constraints. The information presented in this assessment can be used by the Regional District of Nanaimo to:

1. Update its emergency plan.
2. Allocate resources for risk mitigation of applicable hazards beginning with the highest-risk hazards.
3. Enhance community preparedness.
4. Prepare budgets for cost-effective, on-going emergency planning.

This assessment uses both quantitative and qualitative methods to determine risk ratings for various hazards. Based on the information obtained in the course of this assessment, EmergeX has assigned each hazard with a rating of *very high*, *high*, *moderate* or *low*, though this assessment did not find any hazards with a rating of *very high* in the Regional District of Nanaimo. EmergeX proprietary tools have been utilized in conjunction with Provincial emergency management standards to provide the most accurate assessment possible.

The results of this assessment identify the following hazards as *high risk*:

- Flooding
- Forest fires and Wildland Urban Interface (WUI) fires
- Human Diseases and Pandemic

The Risk Matrix on the following page shows the relative ranking of all hazards analyzed. These rankings were determined using the criteria from the PEP HRVA Toolkit and therefore may not be identical to risks assigned using other methods or criteria.

Recommendations

While there are some recommendations discussed throughout the document, there are other considerations that should be noted here.

Forest fires and WUI fires have been determined as high risk within the Regional District, and improvements can be made to manage the hazard. In terms of response, the National Fire Protection Association 1710 standard assists fire departments in evaluating and improving the levels of firefighter safety and service delivery. Specifically, it sets strict staffing level, response time, and level of service requirements for various situations including forest and WUI fire (NFPA, 2006). The meeting of this standard will assist the Regional District in maximizing response measures in case of future, high risk events.

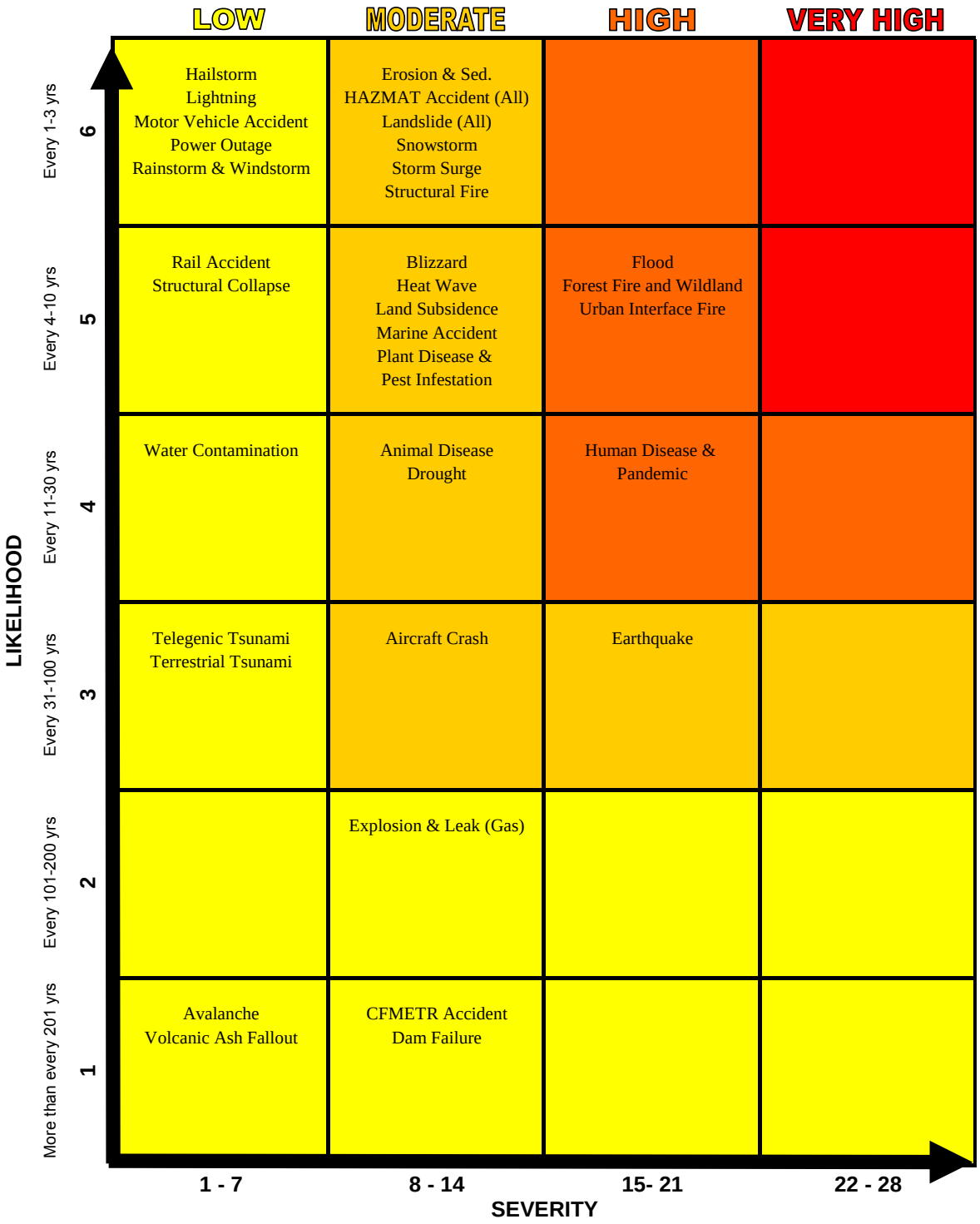
An in-depth network analysis of the fire response network is an additional option to improve the efficiency and speed of response to problem areas. This may be accomplished through a GIS, with needed information gathered from EmergeX in cooperation with Regional District planners. This would also act as a useful analysis on many levels, such as optimizing the location of a new fire hall, or determining gaps in the response network. An example of a simple network analysis for the Cranberry Fire Hall is seen in Appendix B-2.

Community Wildfire Protection Plans, as discussed in Section 6.4.2 are also useful in detailing fuel loading and potential for ignition. Currently, Horne Lake Strata Council has a CWPP underway (April 2006), and applications are in process for North Cedar, Gabriola and Cranberry (Jani Thomas, electronic mail, April 19, 2006). These initiatives, if successfully completed, will work to improve knowledge and mitigate future WUI hazard within the RDN. If it is feasible to expand these studies to all relevant areas in the RDN, the Regional District's residents and emergency planners will benefit greatly.

Concerning flood risk, there are many possible risk mitigation options that are available to the Regional District. Among these options is the continued assessment of the dike system, and evaluation of flood and erosion protection infrastructure. This has been completed to some extent concerning the Mine Road Dike and the Nash Creek Outlet Weir (BC Rivers Consulting, 2002), but where feasible may be expanded to assess additional floodplain vulnerabilities.

With respect to human disease and pandemic risk, the advancement of business continuity planning in the Regional District of Nanaimo will help to reduce the impact of a possible outbreak affecting the population. While the RDN has included business continuity planning within the Regional Emergency Plan, there is room to improve this and detail actions and procedures with a specific focus on predicted outbreak of the Avian influenza, for example. Resources such as the BC Pandemic Influenza Preparedness Plan, prepared as a guide for BC local governments, may be used as the basis for a specific RDN plan. Protecting employees, ensuring the delivery of essential service, supporting health authorities, and assisting community members are among top priorities (BCMoH, 2005).

Hazard Risk Matrix



1.0 Introduction

This Hazard Risk and Vulnerability assessment was conducted by EmergeX Planning Inc. for the Regional District of Nanaimo Emergency Program. The study was partially funded by a grant from the Union of British Columbia Municipalities.

1.1 Hazard Risk and Vulnerability Assessment

Considering **hazards** alone may lead to a skewed set of priorities for action. It is equally important to consider the **severity** of possible impacts from the hazard as well as the frequency or **likelihood** of a hazard event occurring. The combination of severity and likelihood is termed the **level of risk**.

In determining the severity of a hazard event, a community's vulnerability must be examined. Vulnerability is defined as people, property, infrastructure, industry and resources, or environments that are particularly exposed to adverse impact from a hazard event (Ministry of Public Safety and Solicitor General, 2004).

Likelihood reflects the frequency of occurrence for a particular hazard event and can range from rare events occurring every 200 years to more frequent events, which usually have a high number of recorded incidents or anecdotal evidence.

For example, a community with a fire hall located on a floodplain is more vulnerable than a similar community with a fire hall built outside the floodplain area due to the possibility that the fire hall will be out of commission as a consequence of flooding. Such as a fire hall on the floodplain (a *vulnerable facility*), a community may have areas with a high proportion of elderly or very young residents, thereby increasing the vulnerability of the community.

A Hazard Risk and Vulnerability Assessment examines the hazards that may impact a community and the risk that each hazard event poses to the community as a whole and to vulnerable elements of the community.

1.2 Scope

This HRVA is designed to provide an assessment of the hazards that may present risks to the Regional District of Nanaimo (RDN). The objective of the HRVA is to:

- Investigate prominent natural and human-caused events, and
- Identify any threats that may require a timely and coordinated response to protect lives, property, and to reduce economic losses.

The intent of this *Hazard Risk and Vulnerability Assessment* is to provide a basis from which local planners, politicians, and responders can create or update the Regional District's emergency plan, allocate resources for risk mitigation, enhance community preparedness, and prepare budgets for cost-effective, on-going emergency planning.

This assessment is based on both primary and secondary sources, and at times relies on anecdotal evidence. EmergeX verifies sources to the best of its ability given the project's time restrictions. Both quantitative and qualitative methods are used to determine hazard ratings for the area of interest. EmergeX proprietary tools have been utilized in conjunction with the Provincial Emergency Program's (PEP) HRVA Toolkit to provide the most accurate assessment possible, taking into consideration that the assessment – because it is qualitative *and* quantitative – includes subjective components. Duplication of this assessment by third parties may not yield exactly the same results.

The scope of this assessment will cover all relevant Electoral Areas (A, B, C, E, F, G, H) within the District, including Gabriola Island (Electoral Area B), which is managed under Islands Trust for land use planning and conservation measures. Due to their respective jurisdiction and individual emergency management endeavours, this HRVA **will not retain primary focus on the four municipalities within the RDN**. These municipalities are the District Municipality of Lantzville, the City of Nanaimo, the City of Parksville and the Town of Qualicum Beach. Nonetheless, the municipalities will be addressed to some extent in some instances due to mutual aid agreements, cross-boundary hazard concerns, and supporting response facilities, for example.

Factors considered in developing a list of hazards for the Regional District of Nanaimo include:

- Demographics
- Geography
- Industries and other technologies
- Transportation modes and routes
- Weather and climate

Based on aggregation seen in the Risk Matrix, EmergeX has identified 33 hazards that could affect the Regional District of Nanaimo. In selecting these events for consideration, EmergeX acknowledges the potential that other hazards might exist. However, the hazards identified in this assessment are considered more likely to impact the Regional District than others. It should be noted that the hazards described in this report are not necessarily unique to the Regional District of Nanaimo and other jurisdictions with similar industrial, economic, residential, and physical characteristics may also be subject to the same hazards as they apply elsewhere.

1.3 Methodology

In this analysis, informal interviews were cross-referenced with extensive background and historical research, as well as observational data. This information was then considered in the context of the seven impact criteria utilized by the PEP HRVA Toolkit, which are outlined in Table 1 below. The impact criteria were individually ranked on an ascending scale from one to four, one being the least severe and four being the most severe. The sum of these scores was taken to create an overall consequence score, the score was then contrasted against a likelihood rating of one to six, one being the least likely and six being most likely. Details regarding the measure of likelihood are seen in Table 2.

The aggregate score of each hazard, combined with the hazard impact consequence and likelihood (i.e. 15/4) provide the basis for a risk ranking of ***low***, ***moderate, high*** or ***very high***. All scores are provided in Appendix A within the "Hazards Table."

Table 1 – Seven Categories of Impact

Categories of Impact	Score
Fatality	1-4
Injury	1-4
Critical Facilities (Hospitals, Fire/Police Services etc.)	1-4
Lifelines (Water, Gas, Power, etc.)	1-4
Property Damage	1-4
Environmental Impact	1-4
Economic and Social Impact	1-4

(Provincial Emergency Program, 2004)

Table 2 - Measure of Likelihood

Measure of Likelihood	Return Period (yrs)	Score
Frequent or Very Likely	Every 1-3	6
Moderate or Likely	Every 4-10	5
Occasional, Slight Chance	Every 11-30	4
Unlikely, Improbable	Every 31-100	3
Highly Unlikely, Rare Event	Every 101-200	2
Very Rare Event	Every 201-300	1

(Provincial Emergency Program, 2004)

Table 3 details each level of risk rating with a description of how these ratings should be interpreted.

Table 3 – HRVA Risk Rating Interpretation

RISK RATING INTERPRETATION	
	These risks are *low*. Implementation of mitigation measures will enhance emergency preparedness, but it is of less urgency than the following hazards.
	These risks are *moderate*. These hazards have intermediate levels of frequency and severity. Hazards classified as moderate are more urgent than low risk hazards and are often commonplace concerns. Given this, moderate level hazards should be addressed with an appropriate level of urgency.
	These risks are *high*. These hazards warrant review and development of mitigation actions to reduce the risk to an acceptable level. Mitigation measures should be planned in the near future.
	These risks are *very high*. These hazards are both frequent and are of high severity. These hazards require immediate examination and mitigation measures to reduce the risk to an acceptable level.

2.0 Regional District of Nanaimo Overview

2.1 Setting

The Regional District of Nanaimo (RDN) is located on the eastern coast of Vancouver Island, and is bordered by Cowichan Valley Regional District to the south, to the west by the Alberni-Clayoquot Regional District, and to the northwest by the Regional District of Comox-Strathcona. The approximate location of the RDN on Vancouver Island, as well as a geographic breakdown of each RDN Electoral Area is depicted in Figure **1**. The Regional District was incorporated on August 24, 1967, and will celebrate its 40th anniversary in 2007. The Regional District of Nanaimo is approximately 2,035 km^2 and consists of seven electoral areas (designated A, B, C, E, F, G & H) and four municipalities including: the District of Lantzville, the City of Nanaimo, the City of Parksville, and the Town of Qualicum Beach.

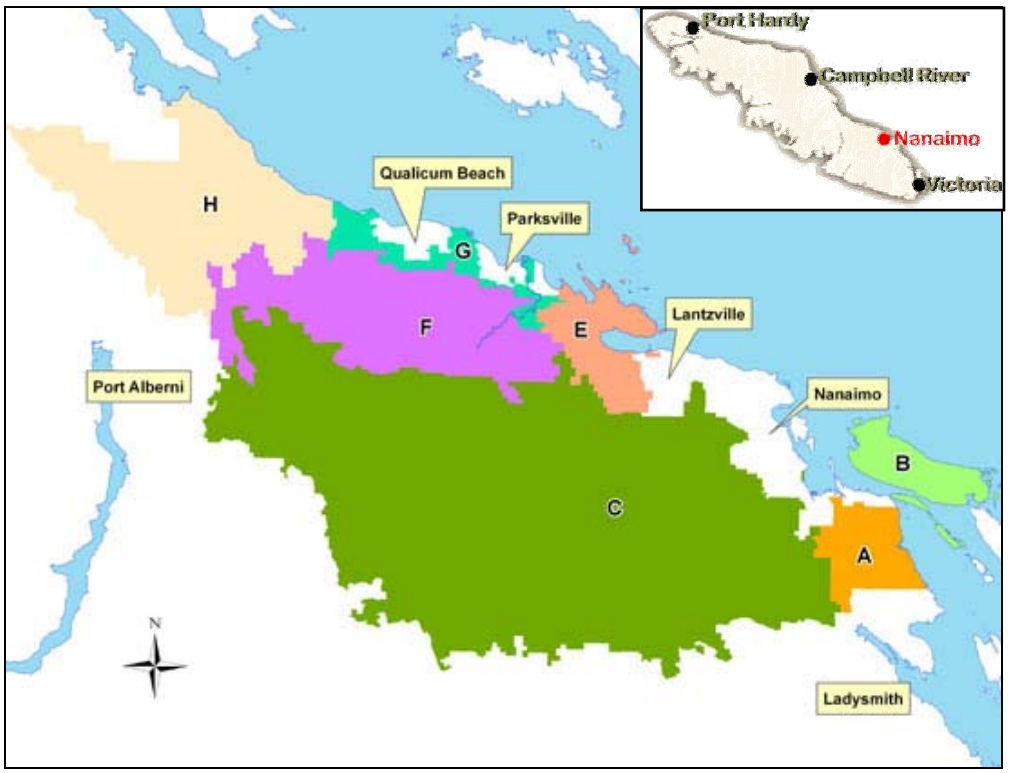


Figure 1 – Electoral Area Boundaries in the Regional District of Nanaimo
(Source: Regional District of Nanaimo, 2006)

2.2 Demographics

Demographic and background information should be considered as a vital resource to any emergency plan, as vulnerable populations may be particularly exposed to adverse impacts from a hazard event. The Regional District of Nanaimo recognizes the importance of social well-being within the Regional District and has vowed to act on this through its planning

decisions. Table 4 provides a summary of important demographic information concerning the Regional District of Nanaimo, contrasted with the province of British Columbia for comparison (Statistics Canada, 2003).

Table 4 - Regional District of Nanaimo Demographics and Background Information[1]

Demographics	**RDN**	**BC**
Land Area	2,034.94 km^2	926,492.48 km^2
Population	127,015 (2001 Census†) 141,080 (2005 estimate$^{\alpha}$)	3,907,738 (2001 Census) 4,254,522 (2005 estimate$^{\alpha}$)
Male	48%	49%
Female	52%	51%
Percentage of aged population (65 yrs and older)	19%	13%
Percentage of young population (15 yrs and younger)	18%	20%
Percent English¤	98%	90%
Percent French	0.1%	0.2%
Percent other language	1.4%	9%
Aboriginal Population	4% (5,375)	4% (170,025)
Households	**RDN**	**BC**
Total	54,260	1,534,335
Percent owned	74%	66%
Percent rented	26%	33%
Average value owned dwelling	$166,442	$230,645
Population in private households	125,260	3,858,735
Average household income	$48,421	$57,593
Incidence of low income	17.1%	17.8%
Labour Force by Top 3 Industries	**RDN**	**BC**
Experienced labour force	58,495	2,014,605
Retail trade	15% (8,555)	12% (232,960)
Health care and social assistance	11% (6,395)	10% (200,065)
Accommodation & food srv. (RDN) Manufacturing (BC)	A&FS (RDN) 9% (5,315)	Manufacturing (BC) 10% (194,360)

(Source: Statistics Canada, 2001 Census Data)

[1] EmergeX has utilized demographic information based on the most recent survey performed by Statistics Canada in 2001. However, it is recommended that the Regional District of Nanaimo update the demographics section of this report once the 2006 census data is made available from Statistics Canada.

$^{\alpha}$ According to Statistics Canada (December 2005), the populations of the Regional District of Nanaimo (including Indian Reserves) and the province of British Columbia were estimated at 141,080 and 4,254,522 respectively – this includes incorporated entities.

¤ Language statistics (English and French) are based on *home language* (single response).

† This figure includes incorporated areas; see Table 5 for Electoral Area populations excluding municipalities.

The data in Table 5 shows the population breakdown of the Electoral Areas and municipalities that make up the RDN and the respective share that each area contributes to the Regional District's population total.

Table 5 – A census profile of Electoral Areas examined within the HRVA[2]

Electoral Area	Neighbourhood / City / Town	Share of total EA population	Total Population
A	Boat Harbour, Cassidy, Cedar, Cedar-by-the-Sea, Nanaimo Band Reserve Nos. 2, 3 and 4, South Wellington, Yellow Point	19%	6,423
B	Gabriola Island, Mudge Island, DeCourcey Island	11%	3,522
C	Arrowsmith Benson-Cranberry Bright, Nanaimo Lakes, Extension, East Wellington-Pleasant Valley	8%	2,492$^{\theta}$
E	Nanoose Bay, Fairwinds, Northwest Bay	15%	4,820
F	Errington, Coombs, Hilliers	17%	5,546
G	Englishman River, French Creek, Shaw Hill, San Pariel, Dashwood	21%	7,041
H	Bowser, Deep Bay, Qualicum Bay	9%	3,108
Total population of Electoral Areas		100%	32,952

(Source: Statistics Canada, 2001 Census Data)

$^{\theta}$ Based on the amalgamation of the remainder of Electoral Area D with Electoral Area C, following the incorporation of Lantzville in 2003 (RDN, 2004).

2.3 Economy

As noted in Table 3, the Regional District of Nanaimo's top three industries include (1) Retail Trade, (2) Health Care and Social Assistance, and (3) Accommodation and Food Services (Census Canada, 2001). The economy within the Regional District of Nanaimo embraces the forestry industry, including pulp and paper, logging, sawmills and veneer production. A wide range of other economic endeavours contribute to the well-being of the RDN such as: construction, commercial fishing, non-timber manufacturing, tourism, education, agriculture and research.

[2] Total figures are based on the geographic scope of this project and do not take into account municipalities or Indian Reserves within the Regional District of Nanaimo. Electoral Areas boundaries have also shifted since the 2001 census, so population figure accuracy is affected.

3.0 Vulnerability

3.1 Social Vulnerability

Hazards such as Wildland Urban Interface (WUI) fires, earthquakes, floods and human health emergencies can have particularly serious impacts on vulnerable populations such as the elderly and very young. In this assessment, social vulnerabilities reflect "*…the degree to which societies or socio-economic groups are affected by stresses and hazards, whether brought about by external forces or intrinsic factors – internal and external – that negatively impacts the social cohesion of a [municipality]"* (United Nations Development Programme, 2000).

For the purpose of this report, social vulnerability is the ability of an individual within a household to recover from a natural hazard impact.

3.1.1 Language Groups

The vast majority of residents (> 93%) in the Regional District of Nanaimo reported English as the language spoken most at home (Statistics Canada, 2001). The small portion of those who speak neither English nor French regularly (1.4%) may require special arrangements in a response to an emergency. Of the non-English languages spoken at home within the RDN (including French), Vietnamese was the most common at 23.9% (followed by Punjabi).

3.1.2 Age groups

The senior population of the Regional District of Nanaimo is relatively high (19%) when compared to the provincial average of 13% as compiled by Statistics Canada. A breakdown of elderly population within the RDN Electoral Areas is given in Table 6. The proportion of seniors in the Electoral Area, total senior population, as well as the proportion of seniors living alone is also provided.

It is evident that Electoral Areas E, G and H hold a particularly high percentage of elderly residents, with approximately one-quarter of the total population over the age of 65. Seniors that are living alone (in absence of a family member or non-relative) are particularly present in Electoral Areas C and F, although the total senior population in Electoral Area C is only 100. Approximately 24% of seniors live alone in Electoral Areas A and B, which is considered relatively low when compared to the provincial average of 28.5%.

Table 6 – Senior population statistics within the Regional District of Nanaimo[3]

Electoral Area	Proportion of Seniors by Electoral Area	Total Senior Population	Proportion of Seniors Living Alone
A	13%	850	24%
B	20%	690	24%
C	11%	100	**30%**
E	**25%**	1,185	16%
F	10%	580	28%
G	**25%**	1,755	17%
H	24%	705	22%

(Source: Statistics Canada, 2001 Census Data)

These statistics are relevant in times of an emergency situation, as the elderly face more challenges, have greater needs, and require specialized attention. Specific challenges include transporting older adults who use assistive devices, providing appropriate health services and nutrition, meeting the needs of people with limiting conditions (such as hearing and dementia), and respecting the emotional state of senior individuals, who may experience "transfer trauma" (Wade, 2005).

Approximately 10% of the population of the RDN is nine years of age or younger, which is also important to note. Special considerations for young individuals, especially when separated from their parent or guardian, should be noted.

3.2 Critical Response and Recovery Facilities

Within this HRVA, critical facilities are defined as facilities that are essential in order for the Regional District of Nanaimo to carry out emergency response activities. However, it is important to note that there are numerous critical facilities outside of the Regional District that are essential in order for the Province to support the Regional District of Nanaimo in an emergency (e.g. the Provincial Fire Control Centre and the PEP Emergency Coordination Centre in Victoria).

The primary critical facility for coordination of any large-scale disasters or emergencies is the Regional District's Emergency Coordination Centre (ECC), located at the Regional District of Nanaimo Office. Before, during, and after a hazard event, the ECC is essential for site support, including the coordination of special resources, information, multiple departments and external agencies.

In addition to the ECC, emergency first response facilities are of critical importance to carrying out emergency response activities. These include police, fire, emergency health centres, ESS reception centres, along with other facilities.

[3] Excluding the City of Nanaimo, the City of Parksville, and the Town of Qualicum Beach.

Emergency Coordination Centre (ECC)

Regional District of Nanaimo Office
6300 Hammond Bay Rd.
Nanaimo, BC

3.2.1 External Support

Emergency Coordination Centres (ECC)

City of Nanaimo ECC – Nanaimo Fire Hall #1
Parksville ECC – City Hall
Qualicum Beach ECC – Town Hall

Emergency Volunteer Centre

Departure Bay Emergency Volunteer Centre
1413 Wingrove St.
Nanaimo, BC

3.3 Critical Infrastructure

Critical infrastructure consists of those physical and information technology facilities, networks, services and assets which, if disrupted or destroyed, would have a serious impact on the health, safety, security or economic well-being of the Regional District of Nanaimo or the effective functioning of the government. According to Public Safety and Emergency Preparedness Canada (2005), critical infrastructure spans ten sectors:

1. Energy and Utilities (e.g. electrical power, natural gas, oil production and transmission systems)

2. Communications and Information Technology (e.g. telecommunications, broadcasting systems, software, hardware and networks including the Internet)

3. Finance (e.g. banking, securities and investment)

4. Health Care (e.g. hospitals, health care and blood supply facilities, laboratories and pharmaceuticals)

5. Food (e.g. safety, distribution, agriculture and food industry)

6. Water (e.g. drinking water and wastewater management)

7. Transportation (e.g. air, rail, marine and surface)

8. Safety (e.g. chemical, biological, radiological and nuclear safety, hazardous materials, search and rescue, emergency services, and dams)

9. Government (e.g. services, facilities, information networks, assets and key national sites and monuments)

10. Manufacturing (e.g. furniture, glass, truck canopies)

Throughout the HVRA, EmergeX has highlighted four sectors of critical infrastructure for the Regional District of Nanaimo: **water**, **energy, [tele]communications** and **transportation**.

3.3.1 Water

According to Public Safety and Emergency Preparedness Canada (PSEPC), approximately 564 m^3 of water is needed to sustain a population of 141,080 (RDN 2006 estimate) for 14 days. This equates to four litres per person per day.

A major disaster may threaten the extent of coverage and quality of water supplied by the Regional District's main reservoirs, including both the loss of drinking water and the loss of water for fire fighting. To respond to water supply emergencies, the Regional District's Water Utilities Department has outlined an Emergency Response Plan (May 2005) which is discussed in Section 5.2 – Environmental Services. This report includes lists of water suppliers and emergency contacts. In addition to providing emergency water supply to all residents, the Regional District may face the challenge of organizing a water distribution system in the aftermath of a hazard event.

A general and geographic summary of water supply sources in Central Vancouver Island can be seen in Figure 2. Residents of central Vancouver Island rely on a variety of water-supply systems. Major centres make use of surface water from managed watersheds – such as the Nanaimo and Englishman Rivers. Storage reservoirs have been constructed to ensure year-round supply. The South Fork Dam is a concrete arch dam that impounds approximately 2 billion litres, while the Jump Creek Dam was constructed to hold approximately 18 billion litres. The Arrowsmith Dam, completed in 1997, provides long-term water supply to Parksville, French Creek, Nanoose Bay and Qualicum Beach (RDN, 2006a). Additional water is available for release from Arrowsmith Lake that Parksville will take advantage of during dry summer months (*ibid*).

Seven major water service areas (WSAs) exist within the Regional District of Nanaimo including: Nanoose Bay Peninsula, Decourcey, Englishman River, San Pareil, Surfside, French Creek and Melrose Terrace (RDN, 2006c). The Nanoose Bay Peninsular Water Surface Area was created in July of 2005 when seven systems were amalgamated into one. The previous sub-areas, which are still referred to in some context, are the following: Fairwinds, Arbutus Park, Madrona, Wall Beach, Driftwood, Nanoose and West Bay.

Most rural residents, including many people contained within the geographic scope of this HRVA depend on individual wells or individual surface water supplies for their supply.

RDN Water Utilities is invested in the maintenance of supply for health and security purposes. For example, in 2003 the RDN proposed the construction of a new reservoir with a capacity of 260,000 impg. to meet domestic water needs and fire protection requirements at peak demand times within French Creek - Electoral Area H (RDN, 2003).

In addition to water infrastructure, critical waste infrastructure should be highlighted within the RDN. This includes:

- French Creek Wastewater Plant, 957 Lee Road
- Church Road Transfer Station (solid waste removal), 860 Church Road
- RDN Regional Landfill site, 1105 Cedar Road
- Greater Nanaimo Pollution Control Centre, 4600 Hammond Bay Road, which receives and treats wastewater from residential and commercial Nanaimo users (RDN, 2006d).

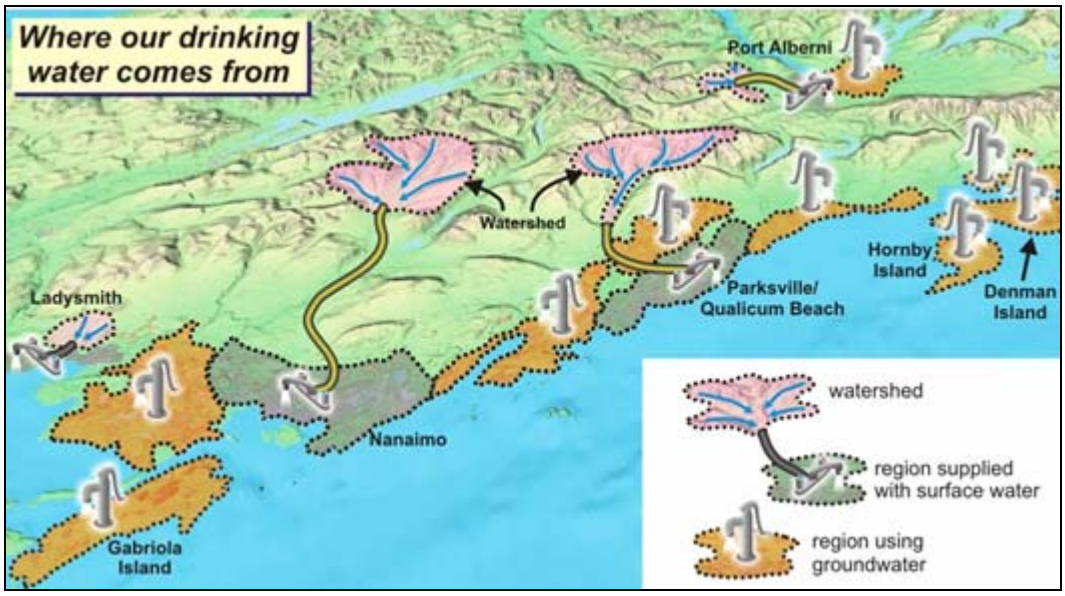


Figure 2 – Summary of water supply sourcing in Central Vancouver Island
(Source: Geoscape Nanaimo, 2006).

An additional reservoir site in Extension is in the planning phase by the City of Nanaimo. This reservoir will be an above-ground reservoir, gravity fed and approximately one million gallons in storage capacity. This site will improve support for fire flow and emergency water intake in the area (Thomas, J., 2006).

Additional information on the security and quality of water within the RDN (including the Water Utilities Emergency Response Plan) is presented in Section 6.8.4 – Water Contamination.

3.3.2 Energy

Energy related infrastructure within the Regional District includes a network of electricity and natural gas transmission lines and facilities. Gas is provided via a single pipeline between Powell River and Comox. The pipeline travels along the eastern coast of Vancouver Island with its terminus in Victoria.

BC Hydro is responsible for the distribution and restoration of electrical services in the Regional District, while Terasen Gas (formerly Centra Gas) operates facilities and gas lines in the Regional District of Nanaimo. Terasen Gas and BC Hydro both provide essential services and will support the Regional District during emergency response and recovery efforts.

Mobile generation suppliers are discussed in Section 6.8.2.

3.3.3 Telecommunications

Television and radio broadcasting, as well as cellular and land line telephones are considered essential in emergency operations. Communications infrastructure is essential for the emergency coordination centre, broadcasting systems, and front-line responders in communities in the aftermath of a disaster. Communication is necessary for: assessing damage and need; collecting information on supplies and other resources; coordinating rescue and relief activities; accounting for missing people; and motivating public, political, and institutional responses. It is important that communication infrastructure in a hazard prone area be resilient.

Telus is responsible for the provision of telecommunications service to the Regional District of Nanaimo. Telus will strive to keep its equipment operational with primary emphasis on vital communications infrastructure needed by the Regional District into order to respond effectively to a major emergency. Amateur radio services are also available, which is discussed later in Section 5.6.

3.3.4 Transportation

During and after an emergency or disaster, transportation is an essential component for effective emergency response and recovery. The Regional District of Nanaimo is accessible via water, surface, rail and air transport. A major airport exists approximately 15 minutes south of downtown Nanaimo.

Major thoroughfares for surface transportation include Highway 1, Highway 19, Highway 19A, Highway 4 and Highway 4A. Provincial Highway 19 (locally known as the Island Highway) is the main north-south route on Vancouver Island north of Nanaimo. Provincial Highway 4 (locally known as the Pacific Rim Highway) is the longest east-west major thoroughfare on the Island. Highway 1 (locally known *also* as the Island Highway) terminates in the downtown core of Nanaimo as it merges with Provincial Highway 19.

Many travellers into Nanaimo will arrive from Vancouver via BC Ferries – Tsawwassen to Duke Point and Horseshoe Bay to Departure Bay. The Departure Bay ferry terminal is served by Nanaimo Regional Transit System. Funding for this system is cost shared

between the RDN and BC Transit. Conventional and HandyDART bus service is also offered by the Nanaimo Regional Transit System. Taxi service in the RDN is available through (but not limited to) AC Taxi, Alliance Taxi, Harbour City Taxi and Swiftsure Taxi (RDN, 2006b).

There are two major airports within the Regional District of Nanaimo, the Nanaimo Airport at Cassidy (YCD) and the Qualicum Beach Airport. Nanaimo Airport is located approximately 18 km south of downtown Nanaimo, and is serviced for passenger flights by Jazz Air (Air Canada). Its runway is approximately 1524 m long with a parallel taxiway system. It is equipped with a standalone Global Positioning System (GPS), Distance Measuring Equipment (DME) and a Non-Directional Beacon (NDB), as well as an Omni Directional Approach Lighting (ODAL) system. Air traffic advisory and weather services are provided by the NavCanada at the Nanaimo Flight Service Station (Nanaimo Airport, 2006).

The Nanaimo Air Terminal handles approximately 120,000 passengers and an estimated 650 tonnes of air cargo and freight annually. Seven Jazz Air flights occur daily to Vancouver International Airport (YVR), aboard a Dehavilland Dash 8–100 or a Dash 8-300, with capacities of 37 or 50 passengers respectively.

The Qualicum Beach airport is located in the southeastern portion of the Town of Qualicum Beach jurisdiction boundaries. It has one runway (11/29) that is approximately 1087 m long and 23 m wide. Qualicum Beach Airport is serviced by KD Airlines, and is also used by approximately 30 locally based aircraft (Town of Qualicum Beach, 2006). KD Air currently (April, 2006) offers five flights from Qualicum Beach to Vancouver on a daily basis. Three main aircraft serve KD Air passengers, a Piper PA-31-350 Chieftain, a Piper PA-31-310 Navajo, and a Cessna 172 Skyhawk. The Cessna is a two-seater while the other two seat up to eight.

In addition, float plane service from the Vancouver International Airport directly to Silva Bay on Gabriola Island is available, with flights currently offered three times per day via Tofino Air. Float plane travel is also frequented into the Nanaimo region via Harbour Air, Baxter Air and Seaair Seaplanes (formerly Amigo Airways) from Vancouver. These float plane docks fall under municipal jurisdiction (City of Nanaimo) and will not be elaborated upon here.

For rail service, VIA Rail operates a Victoria-Courtenay passenger train (the Malahat) that passes through Nanaimo. The Malahat offers one departure per day in each direction (VIA Rail, 2006). This particular passenger line is elaborated upon in Section 6.6.4.

Transportation Constraints

Blockage of passage or loss of major thoroughfares listed above is likely to result in slowed or halted emergency response, especially in rural areas of the Regional District where there are limited options for ingress and egress.

An example of this is Nanaimo River Road which terminates at the Nanaimo Lakes and has limited collector roads or arterials branching from it. An additional concern is the limited routes leading into Cameron Lake and Horne Lake, which may become a possible hindrance to any potential evacuations initialized. This concern is amplified by the extreme and high fire hazard ratings in these two respective areas. In addition to route limitations, blockages or incapacitation to the various bridges throughout the Regional District is likely to delay emergency response and recovery, especially where limited alternative routes exists. On Highway 19 alone, bridges pass over the Big Qualicum, Little Qualicum and Englishman Rivers.

4.0 Response Capabilities

This section provides a summary of the Regional District of Nanaimo's response capabilities that are considered when assessing the Regional District's overall risk to the hazards discussed in Section 6.0.

4.1 Fire and Rescue

Within the boundaries defined for this report, there are a total of 12 fire departments in the various Electoral Areas, with 16 corresponding fire halls. The areas of Coombs-Hilliers, Errington, Gabriola and North Oyster each have two fire halls. There is also inter-agency support that exists from the neighbouring municipality fire departments of Lantzville, Nanaimo, Parksville and Qualicum Beach – where there are a total of 9 halls.

A list of fire halls within the RDN and their respective fire protection areas and district locations is seen in Appendix B, Table B-1. An apparatus inventory for the 12 fire departments within the RDN is detailed in Appendix B, Table B-2. A geographic overview of all 19 RDN Fire Protection Areas can be seen in Figure 3 below.

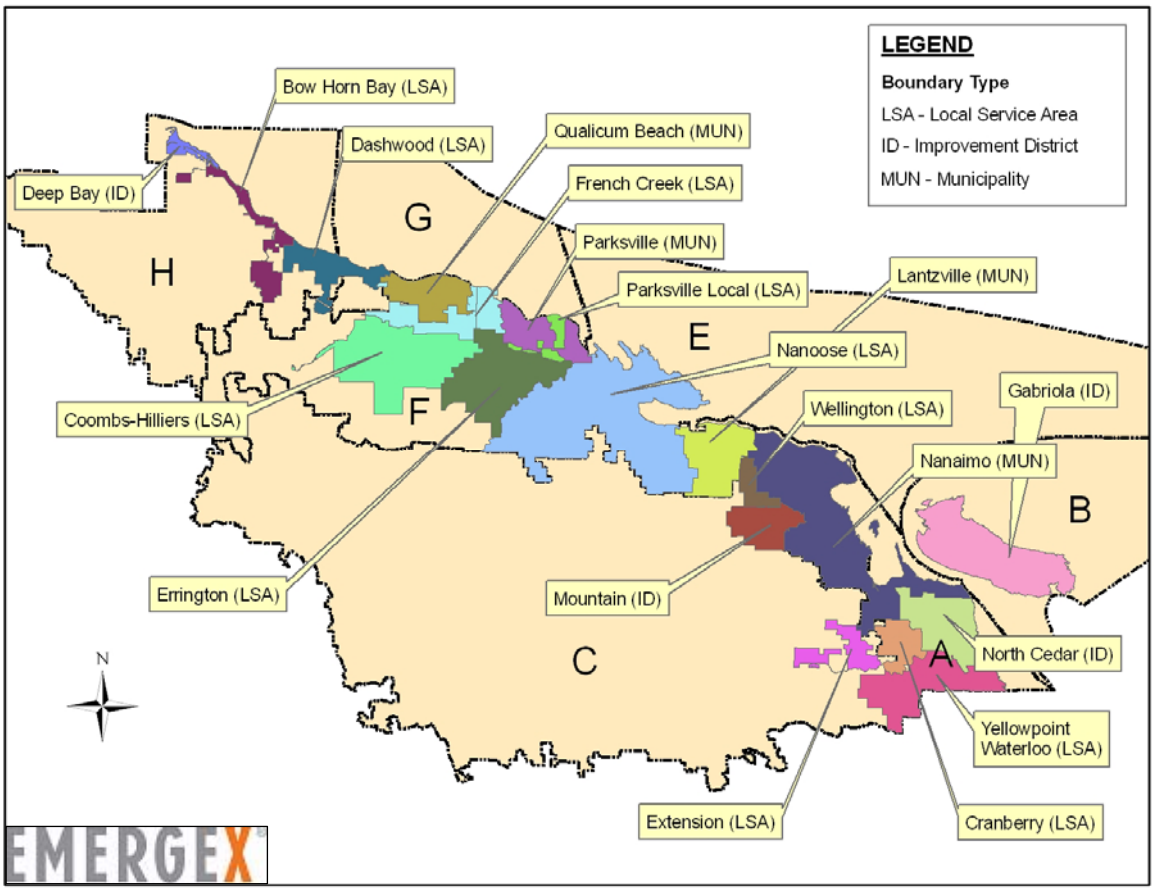


Figure 3 – Fire Protection Areas within the Regional District of Nanaimo

4.2 Police

Municipal policing is provided in the Regional District by three main detachments, located at the following addresses:

Nanaimo Detachment	**Oceanside Detachment**	**Cedar Detachment**
303 Prideaux St.	727 West Island Highway	Unit 10-A, 1830 Cedar Rd.
Nanaimo, BC	Parksville, BC	Nanaimo, BC

Community Policing Offices (CPOs) also exist within the RDN, serving the communities of Bowser, Coombs, Errington, Nanoose Bay, Parksville, Qualicum Bay and Qualicum Beach. CPO offices are composed of volunteers, and are operated under RCMP Community Policing members of the Oceanside Detachment (OCP, 2000). CPO offices can be used as command centres in a disaster event or when special policing requirement are needed. These offices are located at the following addresses:

Parksville CPO
Parksville Community Hall
132 East Jensen Ave.
Parksville, BC

Qualicum Beach CPO
Qualicum Beach Town Hall
201 – 660 Primrose Ave.
Qualicum Beach, BC

Mobile CPO
RV in Parksville Community Park
(next to Lion's Childrens Playground)
In operation May 15th – Sept. 15th

(OCP, 2000)

In addition to the above, Crimestoppers, Citizens on Patrol (COP), and Victim Services (among other organizations) exist within the Regional District of Nanaimo (Oceanside RCMP, 2006).

4.3 Ambulance

In the Regional District of Nanaimo, emergency medical service is provided by the British Columbia Ambulance Service (BCAS), which is dispatched by the regional 9-1-1 system. Locations and additional info regarding BCAS detachments within the Regional District are detailed in Table 7. The regional dispatch for the Regional District of Nanaimo is located in Victoria. In addition, there is a Provincial Air Ambulance Coordination Centre (PAACC) located just north of Victoria that will handle air-evacuations, transfers between regions, other provinces, and other countries (APBC, 2006).

Table 7 – British Columbia Ambulance Services (BCAS) stations in the RDN

BCAS station	Address	Details
Nanaimo South (1-20)	231 Prideaux St.	3 vehicles, 6000 calls p.a.†
Nanaimo North (1-22)	4415 Boban St.	6 vehicles, 6500 calls p.a.
Gabriola Island (1-53)	725 Church St.	1 vehicle, 350 calls p.a.
Parksville (1-30)	249 West Hirst St.	3 vehicles, 3600 calls p.a.
Qualicum Beach (1-38)	787 Jones St.	1 vehicle, 1700 calls p.a.
Qualicum Bay (1-73)	210 Lions Way.	1 vehicle, 800 calls p.a.

† p.a. = Per Annum

4.4 Search and Rescue

There are two main Search and Rescue (SAR) operations serving the Regional District of Nanaimo, the Arrowsmith SAR and the City of Nanaimo SAR. Arrowsmith SAR has developed over many years into a fully integrated member of District 69 services (ASAR, 2006). The volunteer organization attends to approximately 12 to 15 calls locally on average, and approximately 5 mutual aid calls from other SAR groups on Vancouver Island. Area coverage runs from the Nanoose Overhead to Deep Bay in its eastern extent. ASAR provides ground Search and Rescue, swift water rescue, tracking, avalanche rescue and rope rescue training.

An official Arrowsmith Search and Rescue Emergency Plan also exists, which states that all personnel should attempt to rendezvous at the ASAR Hall during a major emergency. The hall is located at 3241B Alberni Highway (ASAR Emergency Plan, 2005).

Nanaimo SAR Society is a volunteer organization that is responsible for ground and inland waters search and rescue activities within the jurisdiction of the Nanaimo RCMP detachment, including portions of the RDN (Nanaimo SARS, 2006). Nanaimo SAR consists of three Search Managers, five Team Leaders, and more than 25 volunteer members. Lost hikers in high alpine areas are a common concern for the Nanaimo SAR team. In January of 2002, a fatality occurred due to hypothermia on Mount Benson, a 1019-metre mountain west of the City of Nanaimo. Severe weather conditions and ill-preparedness by the hiking parties were the determined causes of the tragedy.

5.0 Emergency Support and Preparedness Organizations

In addition to primary response organizations, the Regional District of Nanaimo utilizes a number of organizations and programs to prepare for and support response and recovery in an emergency or disaster. The Regional District may also draw on the resources of several external organizations.

5.1 Emergency Coordination Centre (ECC)

The Regional District of Nanaimo Office, located at 6300 Hammond Bay Road will serve as the primary Emergency Coordination Centre. The secondary ECC has been designated as the Cranberry Fire Hall, located at 1555 Morden Road, in District 68. A tertiary ECC has also been established, designated as the Bow Horn Bay Fire Hall.

Site-specific backup power generation is in place at the primary, secondary and tertiary ECCs, which will streamline operations in the event of a power outage (Jani Thomas, electronic mail, April 6, 2006). The secondary ECC site has useful but limited supplies available such as emergency rations, forms, the Emergency Plan, as well as contact lists and a computer (*ibid*).

5.1.1 Mutual aid agreement between the RDN and its municipalities

The Regional District of Nanaimo has established an agreement with the City of Nanaimo, the City of Parksville, the Town of Qualicum Beach and the District of Lantzville to share *resources and facilities of the parties, their various departments and agencies, and all its other public agencies… to prevent and combat the effects of emergencies and disasters*. Included in the official mutual aid documentation is "ECC Operational Procedures," whereby the parties have mutually agreed to establish a Regional ECC when needed, to: *standardize ECC operational procedures between the participating jurisdictions, and to become most cost effective and efficient.*

In addition, as of February 2005, operational guidelines were developed for the use of transit buses by relevant personnel in the RDN (or by Emergency Management Agreement mutual aid partners) in the event of an emergency. Within this documentation, it is stated that *where transit operation requirements are unaffected the RDN Emergency Preparedness Coordinator (EPC) will contact the Manager of Transportation Services to obtain the use of buses on the request of the EMA partner EPCs* (RDN, 2005b).

5.2 Environmental Services

RDN Environmental Services is responsible for the coordination of sewage treatment, water utilities and waste management services throughout Electoral Areas within the Regional District of Nanaimo. The General Manager of Environmental Services will assume the role of ECC Operations Chief during events that require Environmental

Services as the lead agency, such as during a flood or snowstorm event. Specific responsibilities may include: ECC staffing, road clearing, managing traffic, alleviating water disruption issues, firefighting water provision, sewage services, spill containment, building security, garbage/debris management and equipment and vehicle supply.

Supporting resources are also available from both provincial and private sources. This includes the Provincial Regional Emergency Operations Centre (PREOC) which is located in Victoria, and various private sources within the Regional District which include (but is not limited to) the following sources. The services included here are present in the RDN Water Utilities Department Emergency Response Plan (RDN, 2005c).

Excavation services and sand / gravel

▪ Shoreline Equipment 2550 Powder Point Road, Nanoose Bay	Contact: Doug Penny (250-468-7759)
▪ Lundine Backhoe Service 1361 Lundine Lane, Qualicum Beach	Contact: Jim Lundine (250-752-6808)
▪ Ozero's Sand & Gravel 3880 Alberni Hwy., Qualicum Beach	Contact: 250-752-1482
▪ Lussier and Sons Contracting, Ltd. 2365 Avondale Pl., Nanoose Bay	Contact: 250-468-9994

Electrical contractors

▪ Canem Systems Ltd. 4386 Boban Dr. #9-B	Contact: 250-751-7760
▪ East Isle Power	Contact: Harvey (250-951-9884)
▪ TC Trades Affiliates, Ltd. 6016 Nelson Rd., Nanaimo	Contact: Tom Frenette (250-756-0077)

Water related services	
▪ Land & Water BC Nanaimo Service Centre 501 – 345 Wallace St.	Contact: 250-741-5650
▪ Water Pure & Simple (bottled supply)	Contact: 250-752-1373
▪ Water storage tanks (Express Trailer)	Contact: 250-248-2218
▪ Fyfe's Well Drilling, Ltd. 3331 Alberni Hwy., Qualicum Beach	Contact: 250-752-9358
▪ Four Star Water Works Ltd. (piping) 587 Alberni Hwy., Parksville	Contact: Leon Cake (250-954-3546)
▪ Iritex Pumps and Irrigation Inc. #12 – 1009 Allsbrook Rd., Parksville	Contact: 250-248-7028
Building supplies & miscellaneous	
▪ Windsor Plywood 4441 Boban Dr., Nanaimo	Contact: 250-758-5122
▪ Albertson's Home Centre 1187 Franklin's Gull Rd., Parksville	Contact: 250-248-6888

(RDN, 2005c)

Disaster debris removal and disposal is also a reality that surrounds various hazard events (i.e. WUI fires, structural fires, debris flows). At the time of writing, the Regional District of Nanaimo is exploring the initialization of a Disaster Debris Response and Recovery Working Group in cooperation with the City of Nanaimo and other local authorities (Jani Thomas, electronic mail, April 7, 2006). The current plan follows closely with the City of Nanaimo public works snow removal plan, and details the order of roads cleared among other valuable information (*ibid*). An issue of concern for debris removal surrounds the need for collaboration, as the landfill and solid waste stream are run by the RDN but delivery being carried out by private companies or the City of Nanaimo. With a working group scheduled to be formed in the fall of 2006, there is likely to be increased efficiency in the future regarding disaster debris management.

5.3 Emergency Social Services

The Regional District's Emergency Social Services (ESS) provides short-term (72 hours) assistance to people impacted and forced to evacuate their homes due to an emergency. Essential services are also provided to emergency workers during this time. ESS reception centres, temporary lodging, food and clothing needs, family reunification, First Aid and

other required services are provided by ESS. In the case of a small scale event, a Personal Disaster Assistance program provides support as part of the Regional District's ESS. The ESS is supported by several volunteer agencies including: Canadian Red Cross, Salvation Army, and St. John Ambulance.

There are total of 13 designated ESS reception centres within the Regional District of Nanaimo (including incorporated areas), which are detailed in Table 8.

Table 8 – ESS reception centres within the RDN (including municipalities)

Electoral Area / Municipality	Reception Centre	Address
Electoral Area A	Cranberry Hall	1555 Morden Rd.
	Cedar Community Hall	2388 Cedar Rd.
Electoral Area B	Agricultural Hall	476 South Rd.
	Gabriola Island Community Hall	2200 South Rd.
Electoral Area E	Nanoose Place	2925 North West Bay Rd.
Electoral Area H	Lighthouse Community Hall	240 Lions Way
Nanaimo, City of	Beban Park	2300 Bowen Rd.
	Bowen Park	500 Bowen Rd.
	Church of Jesus Christ of Latter-Day Saints	2424 Glen Eagle Cres.
	Moose Lodge	1356 Cranberry Ave.
Parksville, City of	Parksville Community Hall	132 East Jensen Ave.
	Parksville Fellowship Baptist Church	550 Pym St.
Qualicum Beach, Town of	Qualicum Beach Civic Centre	747 Jones St.

5.4 Health Authorities

The Vancouver Island Health Authority (VIHA) provides care to approximately 716,000 people of Vancouver Island through network of hospital, clinics, residential facilities, health units and centres (VIHA, 2005). These facilities primarily fall within the boundaries of the municipalities. The following hospital and care facilities are available for use by residents of the RDN, not including specific addiction centres:

- Nanaimo Regional General Hospital
  1200 Dufferin Cres., Nanaimo, BC.
- Nanaimo & District Home Support
  528 Wentworth St., Nanaimo, BC.
- Nanaimo Health Unit
  (Communicable Disease Clinic – Adult)
  Beaufort Centre, 8-1599 Dufferin Cres.
- Nanaimo Health Unit (Public Health)
  1665 Grant Ave., Nanaimo, BC.
- Traveller's Lodge (Elder care)
  1298 Nelson St., Nanaimo, BC
- Kiwanis Village Lodge (Elder care)
  1233 Nelson St., Nanaimo, BC
- Nanaimo Senior's Village (Elder care)
  6085 Uplands Dr., Nanaimo, BC
- Parksville / Qualicum Health Unit & Mental Health
  249 Hirst Ave., Parksville, BC
- Eagle Park Health Care Facility
  (Elder care)
  777 Jones St., Qualicum Beach
- Trillium Lodge
  (Extended & Intermediate care)
  401 Moilliet St., Parksville, BC

(VIHA, 2005a)

The Emergency Disaster Planning & Response Department of the Vancouver Island Health Authority has prepared a Disaster Plan containing a series of All-Hazard Response Manuals to enable VIHA to respond efficiently and effectively to a plethora of emergency situations (VIHA, 2005b). This plan includes an outline of the duties and responsibilities for supporting departments, as well as immediate action checklists and communication protocols, among other useful information.

5.5 HAZMAT

Hazardous materials are located at various locations within the Regional District of Nanaimo, and are transported by road and rail. The primary responsibility for on-site response to hazardous materials accidents rests with the spiller. However, local governments with their emergency services (fire, police, and ambulance) are responsible for operational support to the extent that expertise and resources are available and to the extent that the response functions are within their mandate.

There are various *in situ* fuel sites within the RDN that should be noted as a possible spill or explosion hazard, specified in Table 12, Section 6.7.1.

CANUTEC, the Canadian Transport Emergency Centre of the Department of Transport, does not respond on site, but does offer communications and data support. CANUTEC can assist in the activation of industry emergency response plans such as TEAP, the Transportation Emergency Assistance Plan, operated by the Canadian Chemical Producers' Association or on-site assistance from other industry or government specialists (Transport Canada 2005).

5.6 Amateur Radio

There are various amateur radio clubs that fall within Regional District of Nanaimo boundaries. These include (but are not limited to) the Nanaimo Amateur Radio Association (NARA), the Mid-Island Radio Association (MIRA) and the Oceanside Radio Association (ORCA). The latter two radio clubs are located in the vicinity of Qualicum Beach and Parksville respectively (MIRA & ORCA, 2006). ORCA is dedicated to emergency communications in the region and maintains focus on this, while MIRA exists for a wider range of purposes, including recreational. ORCA's primary VHF repeater is hard-linked to a UHF repeater, both located at the Parksville City Hall Emergency Coordination Centre to provide coverage to District 69 (ORCA, 2005).

The Nanaimo Amateur Radio Emergency Group (NAREG) is a volunteer public service composed of Amateur Radio operators in the Nanaimo area, including the Nanaimo Amateur Radio Association (NARA). In 2003, a communications plan was established in Nanaimo to unify operating procedures for the Nanaimo Amateur Radio Emergency Group (NAREG) in Nanaimo, BC. Frequency assignments, net operating procedures, definitions of emergency conditions, message handling procedures and prioritizing are all included within this plan (Merritt, 2003).

Within the City of Nanaimo, basic operations are intended to take place on VHF / UHF using a simplex channel of 146.52 MHz FM, VE7ISC Repeater on 146.64 MHz FM or either of two UHF repeaters.

6.0 Hazards

This HRVA is designed to provide an assessment of the hazards that may present risks to the Regional District of Nanaimo. These hazards may require site support through the Emergency Coordination Centre.

In selecting these events for consideration, EmergeX acknowledges the potential, however small, that other types of emergencies may demand site support in the future. However, the following hazards are most likely to occur and may result in significant consequences. Pearce's *British Columbia: Hazard, Risk and Vulnerability Analyses* (1993) offers an excellent overview of other hazards.

Each hazard is examined to assess the relative risks to the community and to highlight opportunities for mitigation and coordinated response. In this analysis, extensive background and historical research was compiled and considered in the context of severity and likelihood to assess the hazard risk.

6.1 ATMOSPHERIC

6.1.1 Blizzard

Blizzards combine low temperatures, high winds, and blowing snow. The effects of a blizzard are always intensified by the wind chill factor associated with the high winds, typically in the 90 to 130 km/h range. Blizzard conditions are often most severe in un-forested, rural areas where there are no trees present to break the effects of the wind. Combining strong winds, low temperatures, and poor visibility, blizzards can wreak havoc on traffic, buildings, communications, crops, and livestock, and can pose a threat to people with exposed skin and insufficient clothing for the conditions. White-out conditions occur in extreme cases and reduce visibility to such a level that even pedestrians can easily become disoriented.

In Canada, winter storms and excessive cold claim more than 100 lives every year (Environment Canada, 2002). However, blizzards are considered relatively rare throughout the Regional District of Nanaimo.

Although blizzards are rare in the Regional District of Nanaimo, the potential does exist for this type of extreme weather event. There are three main weather stations present in the Nanaimo area, with one meeting World Meteorological Organization (WMO) standards - "Nanaimo A," which is the basis of discussion here. By analyzing the weather station data at Nanaimo (A) one may notice that extreme temperatures and snowfall have reached significant levels in harsh winters of the past (see Table 9). On February 1st, 1991, a snowfall event occurred which produced more than 73 cm of snow. Temperatures in the Nanaimo area have also dipped to -20°C, although this has not occurred for many years – this extreme was recorded on December 30th, 1968.

Given the position of the Regional District on eastern Vancouver Island off the Strait of Georgia, the potential for high winds accompanying a snowstorm and developing into blizzard conditions exists.

Table 9 – Winter Climate Normals 1971-2000: Extreme Snowfall and Temperature

Location	Extreme Daily Winter Snowfall (cm)				Extreme Minimum Winter Temperature (°C)			
	Nov	Dec	Jan	Feb	Nov	Dec	Jan	Feb
Nanaimo	32.9	47.8	38.6	73.7	-16.1	-20	-17.8	-16.7

(Source: Environment Canada, 2005a – Canadian Climate Normals)

With all factors taken into consideration, the risk of blizzards to the Regional District of Nanaimo is *moderate.*

6.1.2 Hailstorm

Hailstorms consist of precipitation in the form of balls or irregular lumps of ice formed when updrafts in thunderclouds carry raindrops into extremely cold areas of the atmosphere. By convention, hail has a diameter of five millimetres or more, while smaller particles may be classified as either ice pellets or snow pellets (Natural Resources Canada 2005a). The impacts of hailstorms are often similar to those of blizzard conditions as agriculture and property can both be damaged due to hail. According to Natural Resources Canada, hailstorms are most common in the May to July period, usually with storms occurring in the afternoon, with the hail portion of a storm usually lasting from six to ten minutes (Natural Resources Canada 2005a).

Hailstorms are not uncommon in eastern Vancouver Island, but these storms are more common in elevated regions and do not normally last for extended periods of time. In addition, Vancouver Island hailstorms do not typically produce hailstones that are considered a threat to people or property. The majority of damaging hailstorms in Canadian history have taken place in Alberta and eastern provinces in Canada (NRCan, 2004), but are not a major concern in the Regional District of Nanaimo.

Due to the characteristics of hailstorms historically occurring in the RDN (among other factors), the risk of a hailstorm to the Regional District of Nanaimo is *low*.

6.1.3 Heat Wave

A heat wave can take a number of forms. Such events can be characterized by temperatures significantly above the mean for an extended amount of time, or by a combination of high temperatures with high humidity and a lack of air motion. Impacts of heat waves can range from crop losses to high mortality due to heart prostration or the aggravation of existing conditions such as high blood pressure or heart disease. The elderly and very young are particularly vulnerable to very hot and humid conditions. There is also the threat of water shortages and the danger of forest fires.

From analyzing historic climate records in the Regional District of Nanaimo region (Nanaimo weather station), a noteworthy trend exists such that the daily average maximum temperatures in June, July and August have not exceeded 25°C in all recorded years. Instances of extreme hot weather are rare in the region, with the highest temperature set in August of 1960 when it reached 36.7°C. Nonetheless, extended periods of hot weather in the high 20's and low 30's have occurred in the recent past. The summer of 2003 in the Nanaimo area brought above average temperatures, with a heat wave occurring in late July. Fortunately, there was no influx of patients in Nanaimo General Hospital due to sun stroke or severe sunburns, even among the young and elderly (Nanaimo Daily News, 2003).

It is important to note that there has been a tendency for both extreme and average monthly temperatures to increase over time in this region of British Columbia, suggesting that heat waves may become a more significant risk in the future.

With the above considerations in mind, the risk of a heat wave to the Regional District of Nanaimo is *moderate*.

6.1.4 Lightning

Lightning is caused by the union of three contingent factors: moisture laden air, the instability of existing weather systems and a triggering agent which causes air near the ground to ascend. Lightning strikes carry up to 100 million volts of electricity and leap from cloud to cloud, or cloud to ground and vice versa. Lightning tends to strike higher ground and prominent objects, especially good conductors of electricity such as metal.

A lightning strike can damage transmission lines, affect aircraft, disrupt communication systems, damage or destroy structures, and cause structure and forest fires. Lightning strikes can also cause severe or fatal injuries to people. Lightning kills an average of seven people and injures 60 to 70 others in Canada every year. However, the number of deaths and injuries from lightning strikes has decreased in the past 35 years due to improved forecasts and warnings, better lightning awareness and improved medical care.

More than 40% of forest fires in Canada are caused by lightning strikes which generally ignite in remote areas, each burning an average of 560 ha compared to 50 ha for most human-caused fires[4]. The mean annual burned area of lightning induced fires is 2.125 million ha or about 0.6 % of Canada's forested area.

The Ministry of Forests and Range (2005a) report a number of major fires in British Columbia ignited by lightning strikes. These include the Okanagan Park Fire of 2003 and the Garnet/Penticton Fire of 2004. The Okanagan Park Fire was caused by a lightning strike near Squally Point across Okanagan Lake, and forced the evacuation of 33,050 people from the communities of Naramata and Kelowna with 4,050 evacuated for a second time. The fire destroyed or damaged 238 homes, destroyed 12 wooden trestles, and damaged two other steel trestles in the historic Myra Canyon.

[4] This does not imply that lightning-initiated fires are any worse than human-caused fires. Fires started by people are usually in closer proximity to settlements, recreational areas, and forest-fire fighting resources and are therefore suppressed more readily. Remotely started fires are often left to burn in their natural course if they are not expected to negatively affect settlements, resources, or infrastructure.

The Regional District of Nanaimo is roughly divided into two biogeoclimatic zones. Along the eastern coast of Vancouver Island, a Coastal Douglas Fir (CDF) classification dominates, thriving within a "Mediterranean" type of climate. The understory primary consists of salal and / or Oregon grape (MOF, 2003). Western red cedar exists on wetter sites, and Garry oak and arbutus exists on the drier sites. The Coast Western Hemlock (CWH) Zone dominates much of the remaining stands throughout Vancouver Island, with Western hemlock and amabilis fir as the dominant species. Although the species makeup, understory and relatively mild climatic conditions within the RDN are not strongly conducive to fire from lightning strikes, the threat does exist.

In the summer of 1997, more than 7000 lightning strikes flashed in southern Vancouver Island and Greater Vancouver during a thunderstorm in July in a span of 90 minutes (Environment Canada, 2002). The risk of lightning to recreational boaters, paddlers, fishermen or swimmers has also been highlighted in and around the Regional District of Nanaimo.

Planning and preventing by checking marine forecasts, buying a weather radio, and learning basic weather reading to supplement forecasts can help to prevent a dangerous incident. In addition, five general rules exist in order to stay safe during a thunderstorm, which include: (1) Getting off the water, (2) Seeking shelter, (3) Avoiding objects that conduct electricity (e.g. paddles), (4) Monitoring the storm and (5) Applying First Aid to victims in the event that something does occur (Kinnee, 2006).

In consideration of the potential consequences of lightning strikes, the risk of lightning in the Regional District of Nanaimo is *low*.

6.1.5 Snowstorm

Normally, snowstorms vary from light dustings of snow to accumulations of several metres. Unlike blizzards, they are not associated with high winds. Snowstorms can impact many aspects of the region including transportation, power lines and communications infrastructure, and agriculture. In particular, the wide distribution networks of hydroelectric, communication lines and towers can be affected by heavy snowfall. Accumulation of snow on these lines may cause line breakage, disrupting services and power to wide areas.

According to Environment Canada historic records, the average monthly snowfall in the Nanaimo area has been 18.5 cm through the winter months (November through February). This average is skewed slightly by the mild month of November, but Nanaimo receives a relatively low amount of snowfall in the winter months regardless. December and January are the coldest months, but the average monthly temperatures are consistently above zero, at 2.9°C and 2.7°C respectively.

As seen in Table 10, the RDN has received an average snowfall exceeding 27 cm every year in the month of January. Although an extreme snow depth of 74 cm was recorded in January of 1966, there is an average of only 17.6 days per year that Nanaimo has a minimum temperature of 0°C or less. Nonetheless, this historic data highlights the potential for major snow events to take place, which may cause direct or indirect problems

to the region. In addition, some scientists point to the frequency of winter storms in Canada since the mid 70's as an indicator of an increasingly dangerous trend (David Suzuki Foundation, 2005).

Table 10 - Winter Climate Normals 1971-2000: Average Temperatures and Snowfall

Location	Daily Average Winter Temperature (°C)				Monthly Average Winter Snowfall (cm)			
	Nov	Dec	Jan	Feb	Nov	Dec	Jan	Feb
Nanaimo	5.4	2.9	2.7	4.2	7.8	22.8	27.2	16.3

(Environment Canada, Canadian Climate Normals 1971 -2000, 2005a)

An important consideration for the Regional District of Nanaimo regarding snowstorms is the potential for this type of event to cripple transportation routes. Main access routes into the Regional District of Nanaimo from the south (Cowichan Valley Regional District) include Highway 1, which turns into Highway 19A (Oceanside Route) as one drives through the northern section of the City of Nanaimo.

Bridges within the Regional District of Nanaimo are also of importance, connecting the Regional District of Nanaimo. These include bridges constructed over the following watercourses on Highway 19 alone: Nile Creek, Big Qualicum River, Little Qualicum River and the Englishman River.

Emergency response in the form of police, fire or ambulance may be seriously impeded if these routes or infrastructure are blocked in the event of a severe winter storm.

Taking into account the RDN's ability to deal with severe weather events, the risk of a snowstorm to the Regional District of Nanaimo is *moderate.*

6.1.6 Rainstorm and Windstorm

The cause of most river floods is excessive rainfall and snowmelt, which causes significant elevations in river level and ultimately the inundation of low-lying floodplain areas. Rainstorms themselves cause damage by overwhelming drainage capacities, causing saturation-induced landslides, ground slumping, erosion and debris flows. In addition, severe rainstorms hamper various forms of transportation and introduce increased potential for accident occurrence.

Rainstorms are not uncommon in the Regional District of Nanaimo, and can last for several days. The wettest time of year is typically in the fall, though periods of heavy rain are often experienced in the winter and spring months. According to Environment Canada, there is an annual average of 7.5 days when there is 25 mm or more of rain falling in the Nanaimo area. In January of 1991, 97.3 mm of rain fell in a single day, setting an extreme daily rainfall record.

Windstorms can occur that may cause trees to topple or send debris airborne, which in turn may damage critical infrastructure within the RDN and cause harm to residents.

Windstorms are not uncommon throughout Vancouver Island, with significant high wind events occurring in the past. In January of 2003, ferocious winds with gusts reaching 150 km/h across Vancouver Island knocked out power affecting many residents. A total of 30,000 BC Hydro customers, including residents of the Regional District of Nanaimo were left without power for hours (Environment Canada, 2003). Another notable windstorm occurred in the spring of 1997, toppling hundreds of old growth trees in Cathedral Grove (McMillan Park). In 2001, discussion surrounding the removal of trees in the park centred on environmental protection as well as the potential for increased susceptibility to wind damage (Times Colonist, 2001).

Due to the relatively low impact of rainstorm and windstorm events in the RDN (among other factors), the risk of rainstorms and windstorms to the Regional District is *low*.

6.2 GEOLOGICAL

6.2.1 Avalanche

An avalanche is the movement of snow and ice in response to the force of gravity down an incline. Factors such as snow type, temperature, and wind are critical factors contributing to the potential of an avalanche. Orientation of slope, steepness, terrain, and vegetation types must also be considered. Some of these variables may change on a daily and even hourly basis.

Due to the topography within the Regional District of Nanaimo, avalanches are not considered likely and have not occurred within the Regional District in the recent past. In December of 2005, a Vancouver Island Snow Avalanche Map was released by the Ministry of Environment, which outlines the relative absence of historical snow avalanches and future avalanche potential for areas within the scope of this HRVA (Guthrie, R.H., 2005). Avalanche map: http://wlapwww.gov.bc.ca/wld/documents/techpub/rr2/maps/snow_all.jpg

Mainly due to the relatively flat terrain within the RDN's geographic limits, especially where people reside, the risk of avalanches to the Regional District is *low*.

6.2.2 Earthquake

Earthquakes may cause a number of phenomena, including ground motion, surface faulting, ground failure, and liquefaction. An earthquake's magnitude reflects an earthquake's strength. Damage to buildings generally begins to occur at magnitude six, while an earthquake above magnitude seven may be a major disaster if it occurs near a populated area. In the past century, there have been eight earthquake events in Canada of magnitude seven or higher on the Richter scale.

Based on the National Building Code of 1990, the Regional District of Nanaimo is located in seismic Zone 5 and Zone 6 of six possible zones (Zone 6 being the most extreme). District 68 falls primarily within Zone 5 while District 69 falls within the highest risk area. Zones 3 through 6 are considered at high-risk from earthquake damage. The seismic zoning maps are derived from statistical analysis of past earthquakes and from advancing knowledge of Canada's tectonic and geological structure. Figure 4 gives a geographical

overview of the tectonic system within the Georgia Basin which includes the Regional District of Nanaimo.

Good evidence exists that that Juan de Fuca plate is locked with the North America plates which is causing strain to build up in the earth's crust. The squeezing of this crust causes approximately 300 earthquakes per year in southwestern BC each year and less frequent (one per decade) damaging crustal earthquakes (NRCan, 2005c). Canada's largest recorded onshore earthquake occurred west of Courtenay in June 23, 1946. Much shaking occurred, but damage was light because: few people lived in the area, most buildings were wood frame and low level, there were few dams and bridges, and children were not in school (NRCan, 2005d). Corollary effects included significant road blockage due to landslide events triggered by the earthquake.

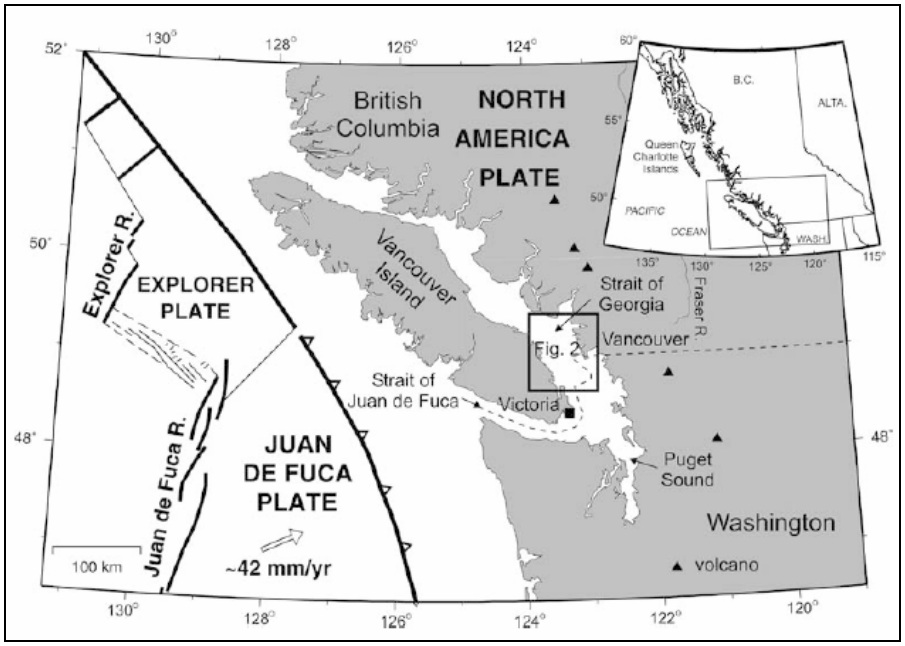


Figure 4 – Georgia Basin tectonics and regional setting *(Source: Barrie & Hill, 2004)*

The Regional District of Nanaimo is located within a high-risk earthquake zone and large magnitude earthquakes are rare occurrences. Although a rare occurrence, if a large earthquake were to occur, vulnerable infrastructure and populations would be greatly impacted and aid from neighbouring communities would be limited or non-existent as they deal with their own earthquake damage. When the next major earthquake strikes Vancouver Island, the loss of life and extent of damage is expected to be much greater than in the past (*ibid*).

The majority of the structures in the RDN are of wood frame and low level, which decreases the risk of structural collapse. Different building types are susceptible to different frequencies of earth motion, and damage is frequently associated with a resonance between earthquake ground motion and the building's natural frequency. Wood-frame buildings are considered one of the most stable buildings in an earthquake due to the flexibility of wood. Critical infrastructure may also be a cause for concern. Overhead towers and lines, water and gas supply and road networks may be damaged in the case of a seismic event, with additional possibilities of electrical and telecommunication failure.

In addition to direct damage from an earthquake, the Regional District may be indirectly affected by earthquake damage in other areas. Suppliers from outside the Regional District may be unable to offer services forcing the local community to face delays in receiving basic supplies such as food, medication, clothing, and other supplies.

Due to the geographic location of the RDN and the predicted severity of the next major earthquake, the risk of an earthquake to the Regional District is *moderate*.

6.2.3 Landslide: Debris Flow, Rock Fall & Submarine Landslide

The term landslide describes a wide variety of processes, including debris avalanches, debris flows, and other rapid mass wasting events which result in the rapid downward and outward movement of soil, rock and vegetation under the force of gravity. Rock falls occur when rocks fall freely from a cliff face. A debris flow is a rapid downward movement of a slurry of loose rocks, soil, and organic matter. Approximately one half of all damaging landslides in British Columbia being debris flows. A submarine slide is the movement of materials involving water charged and coarse-grained sediment flowing rapidly on underwater slopes or channels. If the volume of sediment is sufficient, submarine slides can potentially displace enough water to generate destructive surface waves, also known as local marine tsunamis.

Landslide events occur when the slope reaches a critical level of instability and may be triggered by rains, flooding, seismic events, and other factors. Slope instability may be variable (i.e. caused by such factors as heavy rain and changes in ground water levels), it may be transient, as in the case of seismic activity, or it may be inherent due to the weak composition of the soil or rock structures. New environmental conditions such as those resulting from the removal of vegetation due to construction may also create instability in slopes. Landslides may damage or destroy critical infrastructure such as power and telephone lines, municipal water facilities, waste water facilities, and hazardous materials storage sites.

Although many wet slopes on Vancouver Island are prone to landslide events (NRCan, 2005a), the Nanaimo Lowlands (physiographic region where the RDN is contained) is subdued in topography, and is relatively dry (~1077 mm of rain annually) in comparison to the Fjordlands of the Island, which receive close to 3000 mm of rain annually (*ibid*). Nonetheless, the threat of landslide events is evident in some areas of the RDN.

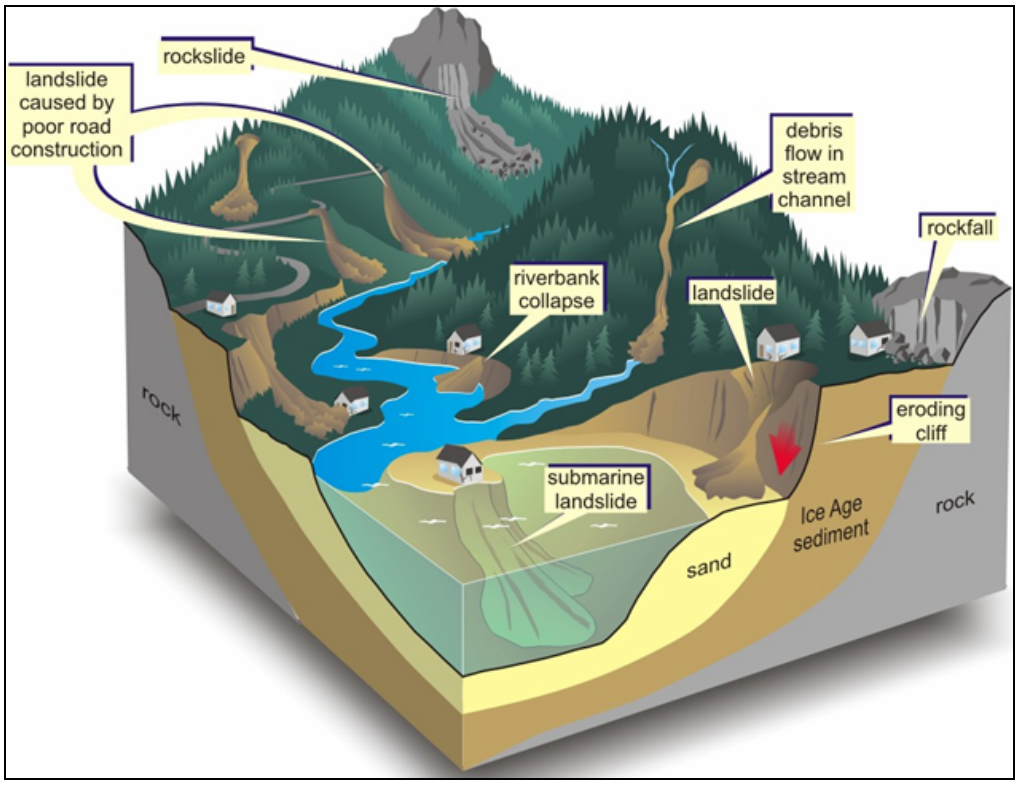


Figure 5 – Landslide possibilities within the Regional District of Nanaimo
(*Source: Malaspina University College, 2006)*

As seen in Figure 5, there are various types of landslides relevant to the RDN which may pose a threat to people and / or property. A major factor in the vulnerability of an area is the plasticity of the soil that is prevalent, particularly in areas of steep slope, generally inclines greater than 30 degrees (*ibid*). Plastic soils make up a small percentage of sediment in the Nanaimo region, and occur primarily along the coastline. However, for areas with plastic soils present (silts and clays), it is important to note that this sediment will lose strength quickly when saturated and flow as a liquid along gentle slopes. Most importantly, deeply deposited glaciofluvial *Quadra Sands* on both sides of the Georgia Basin are well documented as unstable and vulnerable to wave erosion, which have contributed to significant landslide events affecting people and property in the past (*ibid).*

A recent geotechnical study conducted by Guthrie (2005) classifies Vancouver Island into several potential Mass Wasting Zones. The Regional District of Nanaimo primarily falls within Zone IIIb – Moderately Dry Plutonic Suite, with smaller areas within the RDN classified as Zone III – Moderately Dry East Coast. This zone is characterized by relatively low landslide frequency but in these areas they have the potential to impact humans and infrastructure which are largely absent from other Mass Wasting Zones.

In addition, there have been a number of recorded cases of landslides affecting property along the Little Qualicum River in the past, including water mains, septic tank lines and agricultural property being affected (Personal communication, R. Guthrie, April 26, 2006).

The risk of landslide events discussed in this HRVA to people and property in the Regional District of Nanaimo is *moderate.*

6.2.4 Land Subsidence

Land subsidence occurs when a surface has been undermined and deformation and ground movement occur. Causes of subsidence include the mining of rocks, minerals and ores; sub-surface excavations; extraction of subterranean liquids such as water, oil or gas; and natural processes such as groundwater flowing through soluble rock like limestone. Subsidence is representative of a disruption in the natural equilibrium and can be very costly, especially when shifts in land cause damage to property and lives. Subsidence usually occurs slowly over a large area.

Vancouver Island has an extensive history of mining operations, with coal mining existing as a major industrial endeavour of Nanaimo's past. The Regional District of Nanaimo's geologic base consists of a combination of granitic, volcanic and sedimentary rock. The vast sedimentary base of the Nanaimo Group provided a solid foundation for coal production in the Nanaimo area, which was mined since the late 19th century and continued for many years. The coal industry thrived until the 1950s when coal was replaced by fuel oil, but the remnants of major coal operations remains.

The ground above abandoned coal mines in the Regional District of Nanaimo may subside and buildings, roads and other structures may subsequently be damaged from this movement. According to MINFILE (2006), there are numerous abandoned coal mines in the areas of Southwest Extension, South Wellington, east of Cinnibar Valley and north of Cassidy. Many older shafts also exist in these areas, which are normally capped after use as the mine becomes inactive. As noted in Figure 6, hidden shafts, fractures and excavated mine tunnels may all contribute to possible subsidence events.

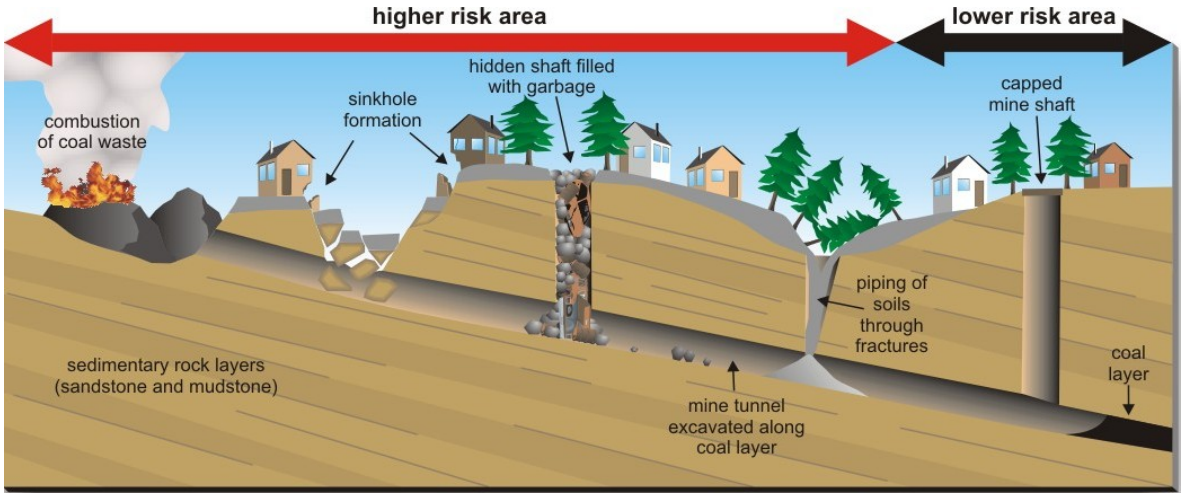


Figure 6 – Summary and comparison of risk areas following coal mining operations
(Source: Natural Resources Canada, 2005e).

Old mine shafts in the Nanaimo area have concrete caps placed on them after use, which includes one cap present under a house at present. Much of the abandoned mine infrastructure in Nanaimo is now flooded by groundwater.

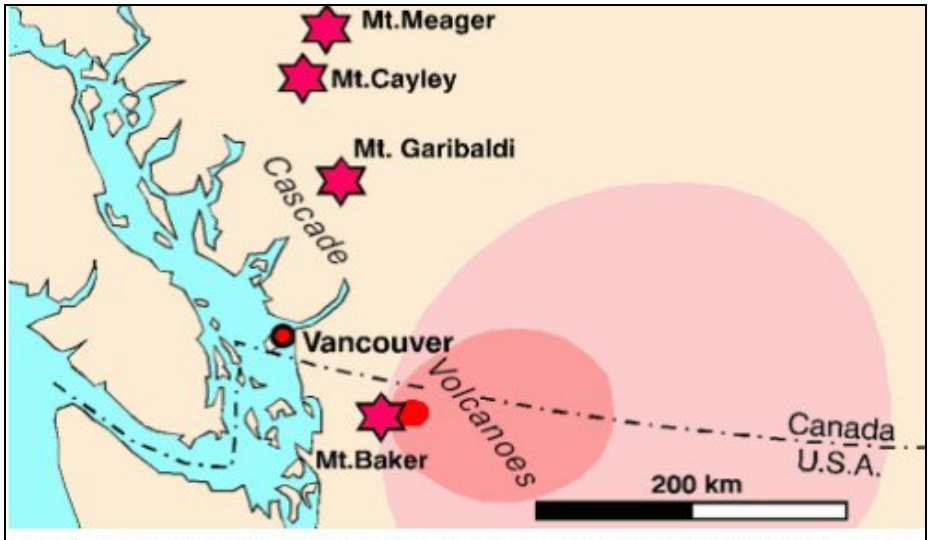
Due to the presence of abandoned mining infrastructure in the region (among other factors), the risk of land subsidence affecting infrastructure and residents is *moderate*.

6.2.5 Volcanic Ash Fallout

Volcanoes pose a serious hazard to human, animal, and plant populations, as well as to infrastructure and machinery. While the immediate areas around the volcano can be affected by lava and pyroclastic flows, in a large eruption distant areas can be impacted from the tephra (volcanic ash) fallout carried by wind for many hundreds or thousands of kilometres (Provincial Emergency Program 2005b).

Tephra is composed of pulverized rock, accompanied by a number of gases, sulphuric acid, and hydrochloric acid. Plumes injected into the atmosphere present a hazard to jet aircraft and birds, while volcanic ash that settles at ground level presents a health risk to human, animal, and plant populations, and may damage machinery or collapse buildings and infrastructure. Exposure to volcanic ash causes irritation to the eyes and upper airways (Provincial Emergency Program 2005a). Repeated exposure to high concentrations will increase risk of pneumoconiosis, especially if the particle-size distribution of volcanic ash includes a proportion of breathable-sized particles.

The Stikine Volcanic Belt is the most recently active volcanic belt in British Columbia; however, it is unlikely that small eruptions would affect an area beyond the immediate vicinity of the eruption (Provincial Emergency Program 2005a). According to the Provincial Emergency Program (2005a), Volcanoes in Washington State present the greatest risk to British Columbians.



Likely area of ash fallout in a Mt. Baker eruption, based on prevailing winds to the east
(Geological Survey of Canada image)

Figure 7 – Likely ash fallout area in the event of a Mt. Baker eruption

The 1980 eruption of Mt. St. Helens resulted in widespread transportation of volcanic ash and affected many British Columbian communities. Currently, the Geological Survey of Canada considers Mount Baker to be the greatest risk to BC residents (PEP, 2005a), but with the likely fallout heading east (as seen in Figure 7), this poses little threat to the RDN.

Due to the inherent unlikelihood of volcanic eruption, coupled with the predicted direction of ash fallout from Mt. Baker, the risk of volcanic ash fallout to the Regional District of Nanaimo is *low.*

6.3 HYDROLOGICAL

6.3.1 Dam Failure

Smaller dams do not pose as great a risk as larger dams, although there may be more probability of a small dam failure due to the lack of owner resources available for maintenance and appreciation of the possible consequences. Under the Provincial Water Act, dam owners are responsible for ensuring their dams are maintained to prevent damage to property from a dam failure. If a dam failure were to occur, it typically results in a large or rapidly increasing uncontrolled release of water from a reservoir. Dams may fail through a breach in the dam itself, its foundations, abutments, or spillway.

Major dams within the Regional District of Nanaimo include the Arrowsmith Dam, Fourth Nanaimo Lake Dam, Jump Creek Dam and South Fork Dam. All four of these dams have been classified as *high consequence* by Land and Water British Columbia, Inc (LWBC, 2005). In Schedule 1 of the Water Act, a "high" consequence rating is characterized by:

…some potential for multiple losses of life involving residents, and working, travelling and/or recreating public… with estimated fatalities less than 100. In addition, effects are likely to include *substantial economic losses affecting infrastructure, public and commercial facilities in and beyond the inundation area… with costs possibly exceeding $1 million.* Finally, in terms of environmental impact, there may be *loss or significant deterioration of regionally important fisheries habitat (including water quality), wildlife habitat, rare and/or endangered species, unique landscapes or sites of cultural significance* (Queen's Printer, 2004).

As noted in the City of Nanaimo's Water System Emergency Response Plan, a breach of the Jump Creek Dam would severely compromise the supply of water to the City, with mud and debris likely deposited in large quantities at the South Fork Dam. This would likely result in a total loss of supply (City of Nanaimo, 2005). Potential action plans are a component of the plan, with relevant stakeholders including: the Regional District of Nanaimo, the ECC, relevant fire departments, bulk water suppliers, the Village of Extension, and the Snunymuxw First Nations.

Detailed mapping was completed by consulting engineers (Klohn Leonoff Ltd, 1990) for the Jump Creek Dam and South Forks Dam concerning the possibility of dam breaches affecting the RDN. Inundation area, maximum water elevation, maximum water depth, time to maximum water elevation and flood arrival times to designated points in the

floodplain were calculated and present on the maps. The inundation maps cover the Upper and Lower Nanaimo River, and can be referred to for further details.

Due to the location of dams relative to concentrated human settlement within the RDN (among other factors), the risk of dam failure to the Regional District of Nanaimo is *low*.

6.3.2 Drought

A drought is an abnormal shortage of water which can result in crop failure, depletion of municipal water sources, an increase in forest fire risk, insufficient water flow for recreation activities, and insufficient water flow for fish movements. Impacts to the Regional District include lack of potable water for residents, a shortage of water for fire fighting, and crop failure due to lack of water for irrigation. Secondary impacts include damage to the agriculture and tourism sectors of the economy and damage from forest fires.

The Intergovernmental Panel on Climate Change (IPCC, 2001) climate models incorporate scenarios of possible future states of the global climate. The most common scenarios are based on a range of socioeconomic assumptions (e.g. future global population and Gross Domestic Product). The models project global temperature increases ranging from 1.4 ºC to 5.8 ºC by 2100 (relative to 1990), accompanied by changes in precipitation and other aspects of the climate system. In British Columbia, the average annual temperature may increase by 1 ºC to 4 ºC, with more dramatic effects in the northern portion of the province than in the southern. Even a seemingly minor increase in average annual temperature can have significant impacts on weather patterns, plant species distribution, and animal migrations, for example. These changes can impact tourism, agriculture, municipal and agricultural water supplies, forestry, and other industries.

The primary causes of drought include low rainfall or inadequate snow pack the preceding winter. However, other factors may also contribute to drought conditions including land degradation and an increase in water demand. An increase in water demand may be a result of increased population or industry, but can also result from water used for fire fighting, such as was the case during Firestorm 2003 (Land and Water British Columbia Inc., 2003). Technological failure of human-built water supply systems can also lead to drought-like conditions, though this is often of a localized nature.

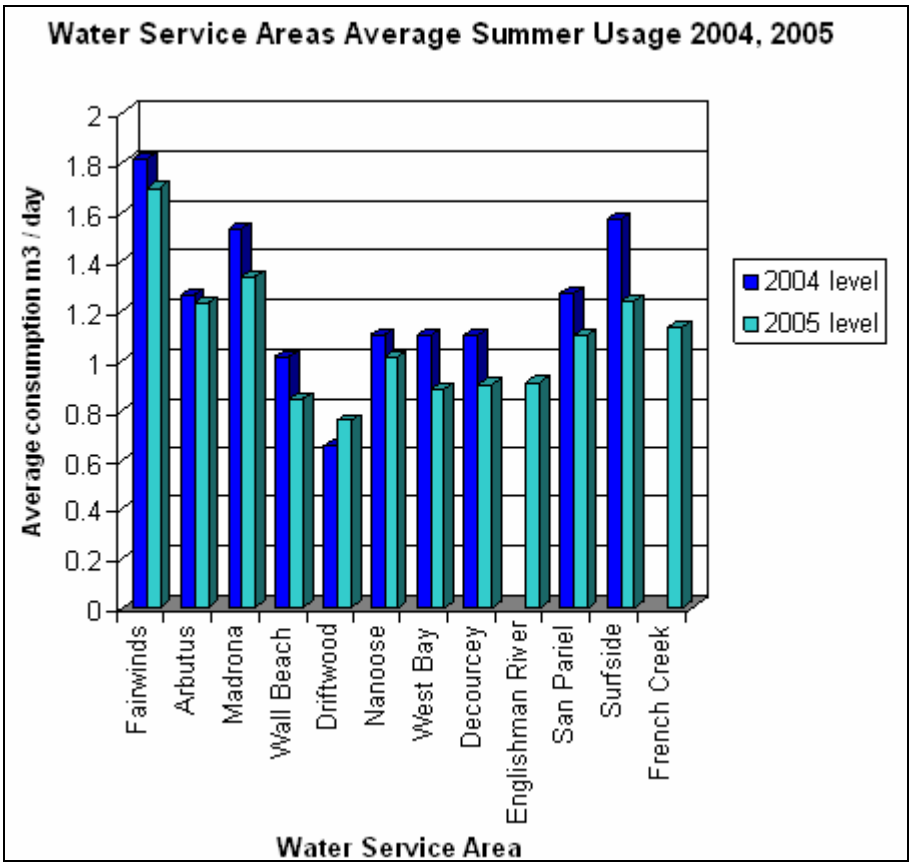


Figure 8 – Summer consumption patterns within the Regional District of Nanaimo

Community consumption and well levels are important to record in order to determine common trends to manage the water system efficiently. With the possibility of water shortage due to climatic trends, overconsumption or firefighter usage, it is useful to track this data. Average annual summer usage records from various water service areas from 2004 to 2005 are summarized in Figure 8.

As seen in Figure 8, the Regional District of Nanaimo (generally) reduced its average consumption during peak periods in the summer months[5] from the beginning of 2004 to the end of 2005. The only increase in consumption was in Driftwood, a water service area with only 12 total connections (all residential). While not all wells were recorded, fluctuation in static well levels from 2004 to 2005 is given in Figure 9. Six of the nine wells recorded showed an increase in static well levels (no pumping). Fairwinds #3 and Englishman River #2 wells decreased from 2004 to 2005, which serve a combined 451 connections (including residential and commercial). The Decourcey #1 well stayed relatively constant over this time period, although a slight decrease was recorded (from 21.2 m to 21.15 m).

[5] No summer data was available for the Englishman River and French Creek WSAs. In addition, limited data is available for Melrose Terrace, which was established in April 2005 – it was not included in Figure 5.

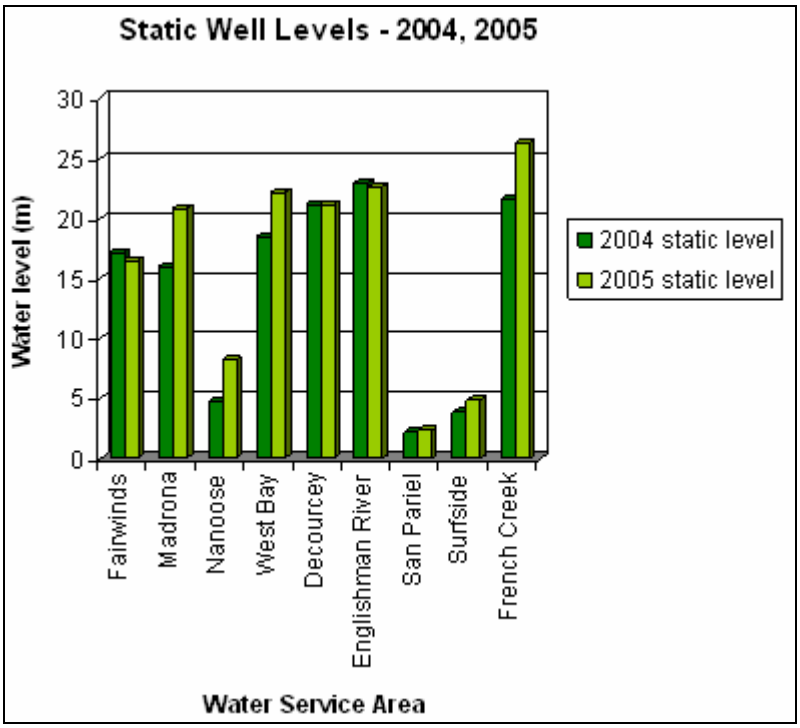


Figure 9 – Static Well Levels for select Water Service Areas in the RDN

Although average summer usage decreased over the time period discussed, and static levels also shifted in a positive manner, the threat of drought to the Regional District remains a possibility. Historically within Electoral Area 'A,' limited capacity of the water supply and water shortages have occurred, hence the continued importance of maintaining water quality and quantity within the area (RDN, 2001). Shortages occurring from private well supply is a legitimate concern throughout the RDN where applicable, though water supply volume sourced from RDN systems is not normally an issue (Mike Donnelly, electronic mail, April 18, 2006).

Taking into account potential climate trends and the ability of the Regional District to deal with water shortage, the risk of drought to the Regional District of Nanaimo is *moderate*.

6.3.3 Erosion and Sedimentation

Erosion is the wearing away of land by the action of natural forces. Riverbank erosion is the result of river currents moving riverbank material. Sedimentation is defined as the build-up of land by natural or artificial means. Erosion and sedimentation can have a high impact on aquatic environments and erosion can contribute to instability on slopes.

With the floodplains of the Nanaimo, Englishman and Little Qualicum Rivers existing throughout the Regional District, riparian erosion and sedimentation is an issue that is addressed in the RDN. Recent legislation has been put in place with the Ministry of Environment, the Union of British Columbia Municipalities and the Department of Fisheries and Oceans working together to develop it.

The Riparian Areas Regulation (RAR), enacted under Section 12 of the Fish Protection Act in July 2004, requires local governments to protect Riparian Areas during residential, commercial and industrial development through a Qualified Environmental Professional (QEP). Each RDN Official Community Plan will be modified in order to meet this new regulation through the amendment of the Watercourse Protection Development Permit Areas.

Susceptibility to erosion is a definite concern among many areas along the eastern coast of Vancouver Island where Quadra Sands are present. As discussed in Section 6.2.3, these unconsolidated sediments are particularly vulnerable to wave erosion. In addition to these coastal areas, many lakes of large and small size present potential erosion hazard throughout the RDN. Vulnerable areas include areas surrounding Horne Lake and Cameron Lake in Electoral Areas H and F respectively.

Significant lakeshore erosion mapping has been completed by regional experts to determine the cause, extent and level of hazard that lake erosion poses to areas within the Regional District of Nanaimo. Figure 10 provides two examples of excessive erosion situations. High levels of erosion occur with a combination of the following factors: prevailing wind direction, exposure to wind, soil composition, backshore soil exposure, and armouring[6] (Guthrie and Law, 2005). In the *Lakeshore Erosion Hazard Mapping* study completed by Guthrie and Law, detailed erosion assessment was completed for the shores of Horne Lake.

Figure 10 – Two examples of very high erosion hazard associated with vertical and exposed backshores consisting of non-cohesive material (*Source: Guthrie and Law, 2005)*

The Horne Lake Erosion Assessment results point to a significant number of properties interfaced with a shoreline that has been ranked as a high or very high erosion hazard, particularly in the northwest portion of the lake. This assessment also highlights various properties that have applied for shoreline protection, hence are currently exposed to negligible levels of erosion. Figure 11 provides a snapshot of erosion risk ranking surrounding Horne Lake with dashed boxes, highlighting areas of high hazard interface.

[6] A shoreline that has self-armour characteristics has increased its own beach stable angle in an effective manner, making it less vulnerable to sediment loss.

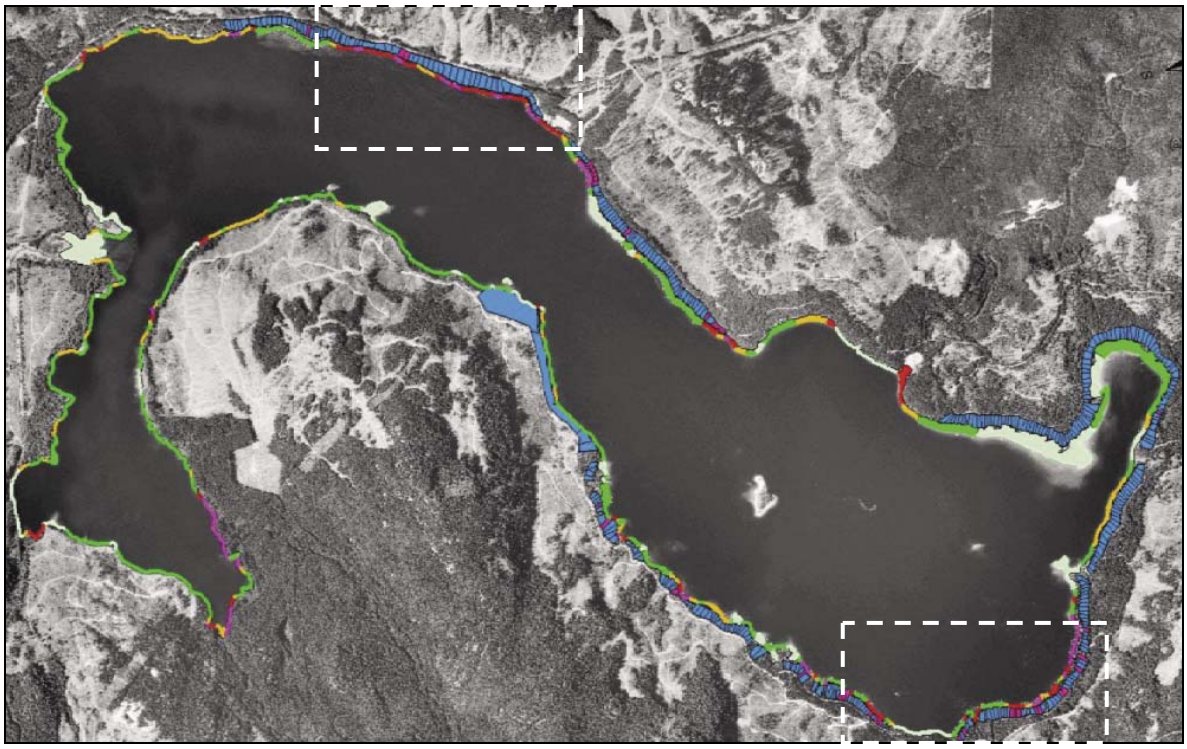


Figure 11 – Horne Lake Erosion Assessment results. Areas of red and purple have been designated as high and very high erosion hazard respectively, with blue representing lot coverage *(Source: Guthrie and Law, 2005)*

Various design constructs for the successful mitigation of lakeshore erosion hazard were also presented in the study mentioned above. While not all designs will be elaborated upon here, some of the following general elements are considered in successful erosion mitigation:

- Placement of rip-rap on beach surface
- Planting of deep rooted vegetation and compacted soil fill
- Insertion of geotextile fabric, properly secured
- Installation of deep wooden stakes driven into undisturbed soil with vegetation

(Guthrie and Law, 2005)

The conceptual tool kit for erosion protection provides much more detailed suggestions including geotechnical expertise and specific measurements, so this study should be a point of technical reference for future action plan development.

Taking into account the preventative measures implemented by the Regional District of Nanaimo, the risk of erosion and sedimentation to people and property is *moderate.*

6.3.4 Flood

According to the Regional District of Nanaimo Flood Operational Guidelines (2005), a **minor** flood is defined as *a flooding incident that involves a single or small number of single family lots / dwellings in a small geographical area… and (is) confined to a single jurisdiction.*

Minor, localized flooding is primarily caused by poor or blocked drainage, usually associated with heavy precipitation. Areas that depend on pumps and pump stations to assist with drainage can experience local flooding when water inflow surpasses the pumps' capacities. In addition, storm drains, drainage ditches, and natural drainage channels can become blocked by sediment, debris or ice causing local flooding.

Much of Canada is affected by spring freshet events. This occurs when huge quantities of water are released from snow and ice pack (or when heavy rainfall occurs) as temperatures warm in the spring. Flooding in coastal BC (including the RDN) generally occurs on the contrary in the fall and winter months, during large rain storms or rain-on-snow events (Weston *et al*, 2003).

According to the Regional District of Nanaimo Flood Operational Guideline, a **major** flood is defined as *a flooding incident that extends over a large geographical region, normally expanding outside the boundaries of a single response agency and its mutual aid agreements, and normally requiring a coordinated response from multiple agencies and/or jurisdictions* (RDN, 2005a).

The possibility of major flooding is a reality in the Regional District of Nanaimo, with significant 200-year floodplains existing around the Nanaimo, Englishman and Little Qualicum Rivers. Excessive rainfall is the basic cause behind most river floods, leading to the inundation of the low-lying river floodplain.

Possible corollary effects of a major flooding event may include:

- Injury or loss of life
- Evacuation and / or relocation of people and animals
- Hazardous materials contamination
- Disruption of essential services
- Disruption / damage to critical infrastructure and communications
- Disruption of travel
- Landslides, mudslides or debris flows
- Drinking water and food shortages

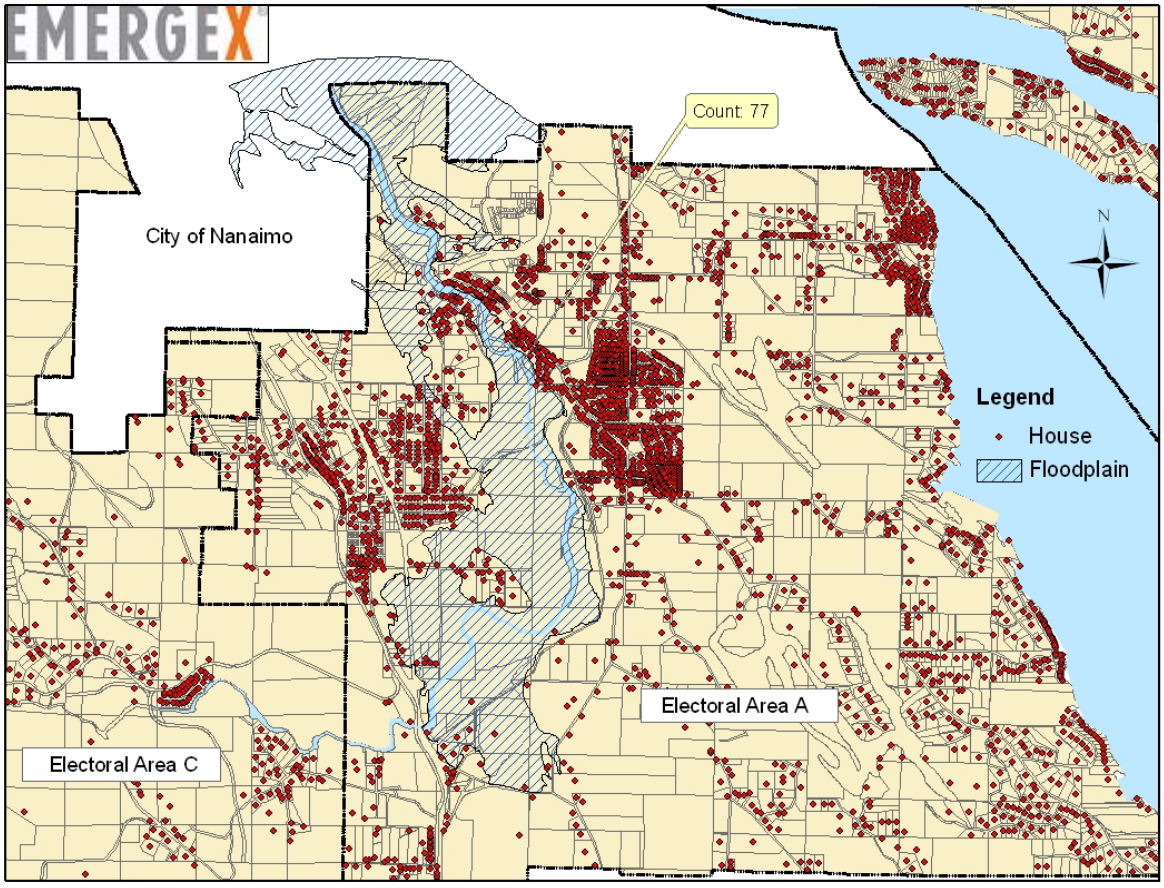


Figure 12 – Houses contained within the Nanaimo River floodplain in Electoral Area A

The floodplain for the Nanaimo River, which flows through Electoral Areas C and A, and through the City, can been seen in Figure 12. Within Electoral Area A, there are approximately 77 houses that are contained within the floodplain. Statistics Canada (2001) states that there are approximately 2.5 persons per household within Electoral Area A, which equates to 193 persons at risk from a Nanaimo River flood.

The second major floodplain within the RDN is that of the Englishman River. As seen in Figure 13, there are approximately 370 houses contained within the Englishman River floodplain that also lie in Electoral Area G. According to Statistics Canada (2001), there are approximately 2.3 people per household living in this Electoral Area, putting approximately 870 lives at risk of an Englishman River flood.

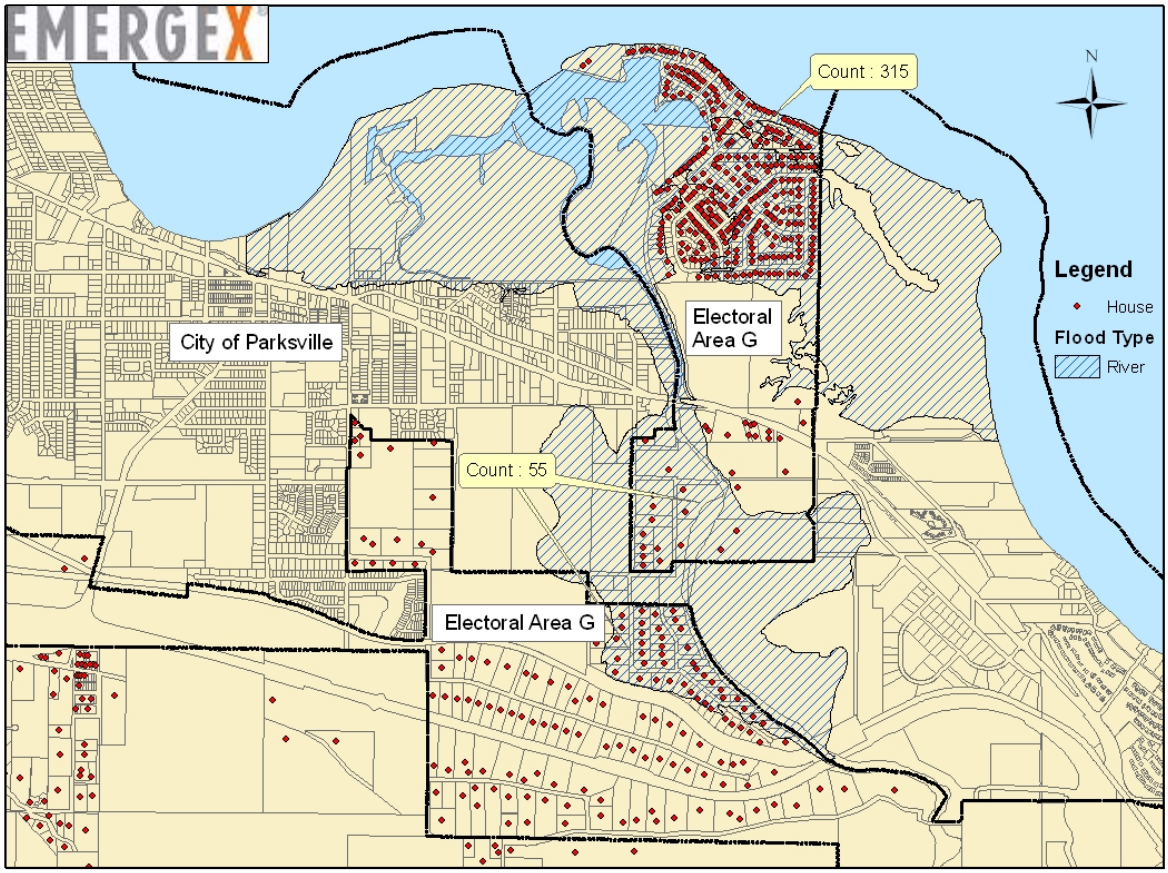


Figure 13 – Houses contained within the Englishman River floodplain in Electoral Area G

The effect of climate change on local precipitation and Englishman River hydrology has been modelled in order to determine if any significant changes in the flood regime will take place in the future. In 2003, Weston *et al.*, explored this and determined that peak annual flows will continue to increase, with notable changes to the Englishman River flood regime occurring (Weston *et al.*, 2003). Peak annual flows are estimated to by 8% larger by 2020, 14% larger by 2050 and 17% larger by 2080; this corresponds to an increase in the frequency and magnitude of flooding along the Englishman River floodplain (*ibid*). By 2080, it is expected that the 20-year floodplain will become the 10-year floodplain.

Various recommendations were made at the completion of the above study, which include (but are not limited to):

- Taking into account future changes in hydrology when designing, repairing and building civic works such as roads bridges, dikes and docks.
- Investigate watersheds similar to that of the Englishman River on the east coast of Vancouver Island to identify where human infrastructure exists. Use the methods of this study to determine if this infrastructure is vulnerable to climate change induced flooding.

- Local government responsible for civil engineering, stormwater and wastewater works in (Electoral Area G) should know that the use of climatological averages based on the past 30 years is not useful in predicting the future for design, construction and maintenance of this work.

(Weston *et al*, 2003)

With no lakes of significant size to moderate peak flows through storage, the Englishman River is quite 'flashy' in nature following rainfall events (*ibid*). On March 13, 2003, the river rose approximately two metres in 24 hours, cutting off Martingale Road and damaging homes and vehicles. Residents of Parry's RV Park in Parksville have felt the effects of Englishman River flooding tendencies, which may occur in the area three or four times per year depending of weather (Harbour City Star, 2003).

The third major floodplain existing within the Regional District of Nanaimo is that of the Little Qualicum River, which flows northeast from Cameron Lake, crossing under Highway 19 and eventually emptying into the Strait of Georgia.

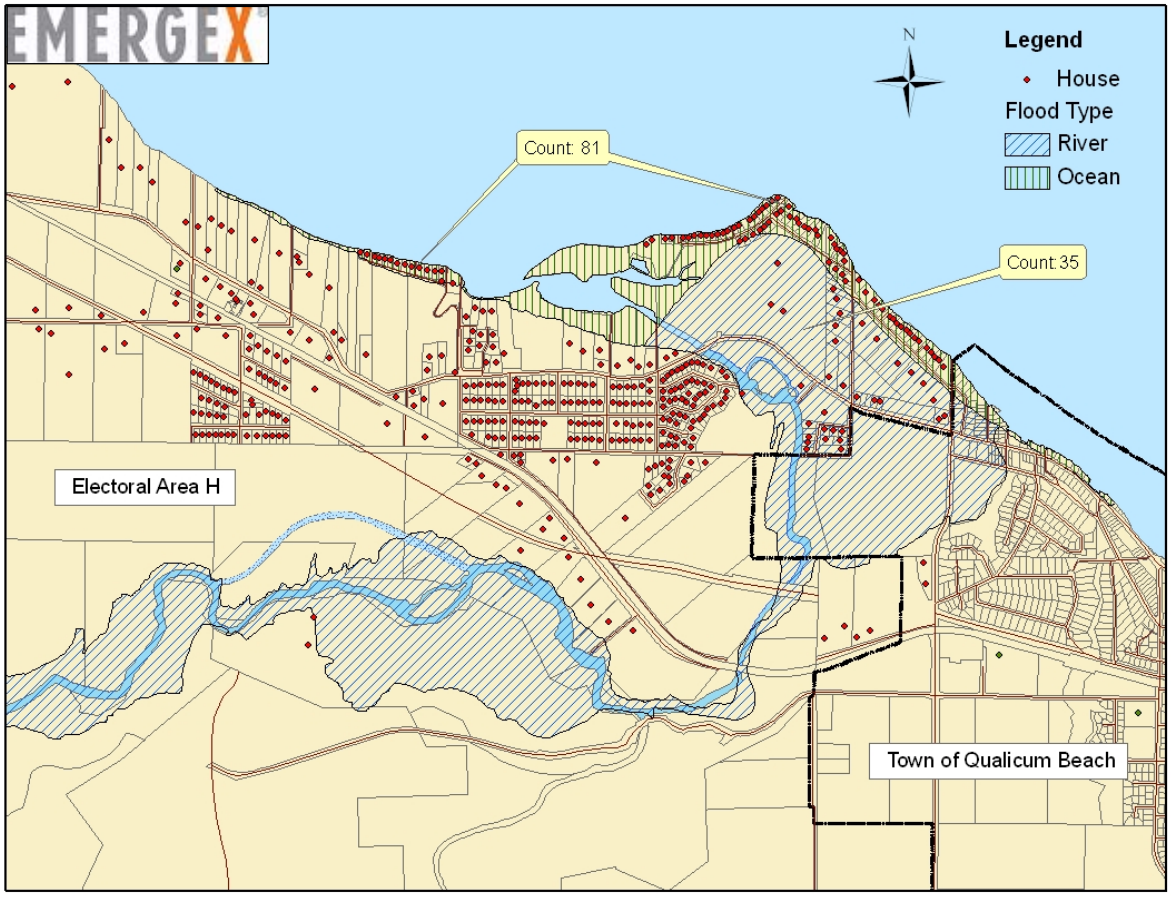


Figure 14 – Houses contained within the Little Qualicum River floodplain in Electoral Area H

As noted in Figure 14, there are approximately 35 homes at risk within the floodplain of the Little Qualicum River, with an additional 81 deemed at risk along the coast. This equates to a combined 255 people at risk in floodplain areas within Electoral Area H.

In the event of a major flood, sand bags may be needed to prevent further advance of the flood waters within the Regional District. The following sand bag resources are available within the RDN:

- Nanaimo River floodplain area: Nanaimo Airport - 3 pallets
- Englishman River floodplain area: Errington Fire Hall - 2 pallets
- French Creek: Arrowsmith SAR, rear of Coombs Fire Hall – 2 pallets
- City of Parksville – 1116 Herring Gull Way - 1 pallet

(RDN, 2005a: December)

Due to the number of people residing in floodplain areas throughout the RDN and the predicted expansion of floodplains in the future, the risk of flooding to the Regional District of Nanaimo is *high*.

6.3.5 Storm Surge

Storm surges are described as increases in water levels that exceed levels normally associated with astronomical tides. They are caused by winds driving waters shoreward and are often coupled with low-pressure systems, which in turn cause increased sea levels. Coastal land forms such as deltas, spits and backshore areas are most vulnerable to storm surge flooding.

Storm surges are typically associated with hurricane force winds and high tides. High tide season in the Nanaimo area is typically from late December to early January. Furthermore, these tides also coincide with the area's storm season. There has been controversy revolving around the assignment of the historical high water mark and the possibility of the province to re-evaluate it. This issue arose following a major storm in February of 2006, when the worst storm in 30 years hit Ucluelet (West Coast Aquatic, 2006). This issue highlights the relative unpredictability of high magnitude storm surge events, and the importance of updated setback buffers from a community perspective.

Due to the coastal location of much property and infrastructure throughout the RDN, the risk of storm surges to the Regional District is *moderate*.

6.3.6 Telegenic Tsunami

Telegenic tsunamis have distant origins and are typically generated as a result of an earthquake along a subduction zone. Depending on the size of the fault rupture, these tsunamis can be very large or very small. In the past century, several damaging tsunamis have struck the Pacific Northwest Coast (USGS, 2005).

The impact of telegenic tsunamis on the Regional District of Nanaimo will depend on a number of factors including (but not limited to): location of earthquake focus, direction of wave travel, magnitude of quake and corresponding wave size. Because the RDN is sheltered by Vancouver Island, telegenic tsunamis originating in the Cascadia Subduction Zone (southwest of Vancouver Island), the Kamchatka Subduction Zone (southeast of

Russia's Kamchatka Peninsula), or the Aleutian Subduction Zone (south of the Aleutian Islands) are not likely to cause damage to the Regional District. Clauge *et al.*, (2005), reports that much energy will be lost as the tsunami moves through narrow passages connecting Juan de Fuca Strait to Puget Sound and the Strait of Georgia. The Institute of Ocean Sciences has also confirmed this, noting that Nanaimo would experience no more than a few centimeters increase in normal tidal height (Obermeyer, 1998).

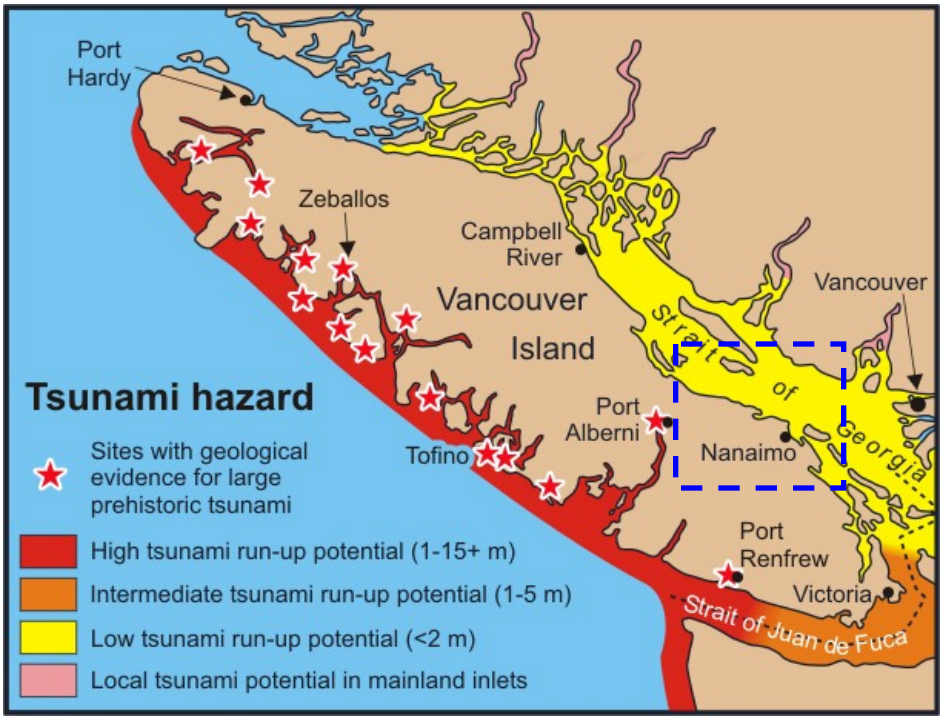


Figure 15 – Vancouver Island tsunami hazard classification
(Source: NRCan, 2005b)

Historically significant destructive telegenic tsunami events have occurred in the past, affecting the west coast of Vancouver Island. Triggered by the major Alaskan earthquake (Magnitude 9.2) in March of 1964 that lasted over three minutes, areas along the west coast were affected. In Port Alberni, major waves arrived in a seven hour period following the earthquake; homes were inundated and some floated off of their foundation into Alberni inlet (NRCan, 2005b).

Nonetheless, the eastern side of Vancouver Island and exposed communities on the mainland of British Columbia were not affected (Anderson & Gow, 2004).

With its geographic location on the eastern coast of Vancouver Island, the Regional District of Nanaimo is relatively well protected in the event of a telegenic tsunami. A depiction of this relative tsunami hazard for the Regional District of Nanaimo (and Vancouver Island) can be seen in Figure 15.

Due to the likely low severity of a major tsunami event potentially affecting the RDN, the risk of a telegenic tsunami to the Regional District is *low*.

6.3.7 Terrestrial Tsunami

Tsunamis are large wave events generated by large surface impacts, or when the floor of a water body suddenly moves, displacing the water on top of it. Local terrestrial tsunamis are caused by landslides and can occur in both oceanic and fresh water regions of British Columbia (Anderson & Gow, 2004).

While there are no such events on record, instability in the steep slopes surrounding Cameron Lake (particularly to the north) may raise the possibility of a terrestrial tsunami impacting residential developments existing at the lake's eastern extent, or any future developments in this area. Horne Lake has many more instances of residential settlement surrounding the shores of the lake, but the topography is relatively tamer than at Cameron Lake. The steepest slopes surrounding Horne Lake exist in the northwest, with a limited number of homes developed opposite this potential hazard area. Nonetheless, the potential for displacement of water and subsequent damage due to a landslide does exist.

Due to the inherent unlikelihood of a large displacement of water due to a landslide, accompanied by the limited number of homes potentially at risk, the risk of a terrestrial tsunami to the Regional District of Nanaimo is *low*.

6.4 FIRE

6.4.1 Forest Fire and Wildland Urban Interface Fire

Abnormally hot, dry weather and excessive fuel loading often make forest areas particularly vulnerable to lightning strikes and human carelessness. Once burning, a forest fire can spread quickly due to high winds and easily overwhelm the capacity of local response agencies. Aside from the environmental and economic impact, fires become particularly devastating when they encroach on human settlements and critical infrastructure. When this occurs, they are considered Wildland Urban Interface (WUI) fires and can be extremely destructive.

The British Columbia Firestorm of 2003 made the risk of WUI fires clear to communities across British Columbia. In July and August, over 2,500 fires burned throughout the interior of the province causing the loss of 344 homes and businesses and the evacuation of 45,000 people. Approximately 260,000 ha of forest were destroyed. The total cost of the Firestorm was estimated to be $700 million (Filmon, 2004). The City of Nanaimo's fire department was also one of nearly 130 fire departments and contractors that responded to the call for help from the Office of the Fire Commissioner in 2003 (OFC, 2003). The Regional District of Nanaimo considers the threat of WUI fire to be a primary concern, as specified in the Emergency Plan.

There are a various regions within the RDN that retain a significant fuel load, contributing to an increased likelihood that a forest fire may develop and interface with residents of the Regional District. Post-logging operation areas, such as the plot seen in Figure 16 is an example of this potential.

Figure 16 – Logged area on Mt. Benson presenting a potential fuel load concern – July 2004
(Source: Jani Thomas, electronic mail, March 28, 2006)

The FireSmart Hazard ratings system has been developed by the Office of the Fire Commissioner for BC, and this rating system has been implemented to rate areas in the Regional District of Nanaimo. Although these rated polygons lack in absolute accuracy, they are a useful indication of the relative risk of WUI fire within the RDN. This data can also be accessed online by the public through the RDNMAP service at: http://rdn.bc.ca/cms.asp?wpID=419 or from a static PDF file at: http://rdn.bc.ca/cms/wpattachments/wpID761atID643.pdf.

Risk is designated by four main classifications ranging from "Low" to "Extreme," with equivalent graduated colors. This portion of the HRVA will highlight areas within the RDN with ratings of "Extreme" fire hazard. Figure 17 details the WUI fire hazard rating for Electoral Area B.

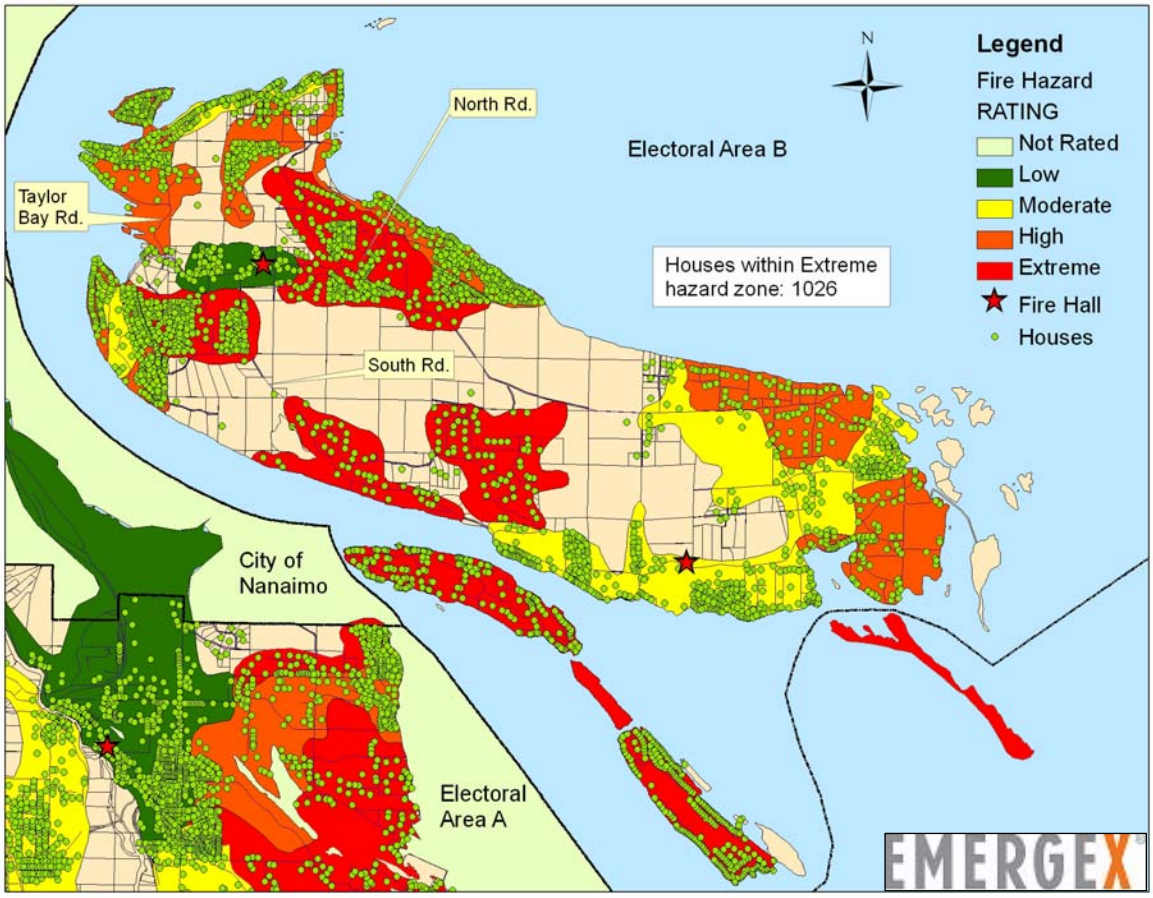


Figure 17 – Areas of "Extreme" Fire Hazard Rating in Electoral Area B

Significant sections of "Extreme" fire hazard exists along North Road and South Road on the northwest side of Gabriola, as well as in south-central Gabriola. Additional high hazard zones exist on the western side of the Island surrounding Taylor Bay Rd at the eastern extent of the Island. Mudge Island is also rated Extreme, characterized by scattered homes surrounded by dense forest, with limited access (boat only) and no fire protection.

Two fire halls exist in Electoral Area B, Gabriola Fire Hall #1 and #2. There are a significant number of homes that lie within Extreme hazard zones on Gabriola Island – with an average of 2 people per household in Electoral Area B (StatsCan, 2001), the number of lives at risk is equal to 2052, as 1026 homes are contained with the Extreme fire hazard zone.

In addition to Gabriola Island, there are significant sections of "Extreme" interface fire risk in Electoral Areas H and F. The first plot surrounds Horne Lake, and while not densely populated, there are houses directly surrounded by forest, and logging is being practiced in the area. In addition, this zone lies outside the Bow-Horn Bay designated Fire Protection Area. There is also significant risk posed to homes south of Highway 19 along Spider Lake Road. This area is characterized by scattered development and limited access within Spider Lake Provincial Park, with various homes lying within this zone.

This area is contained within the Bow Horn Bay Fire Protection Area. These plots are depicted in Figure 18.

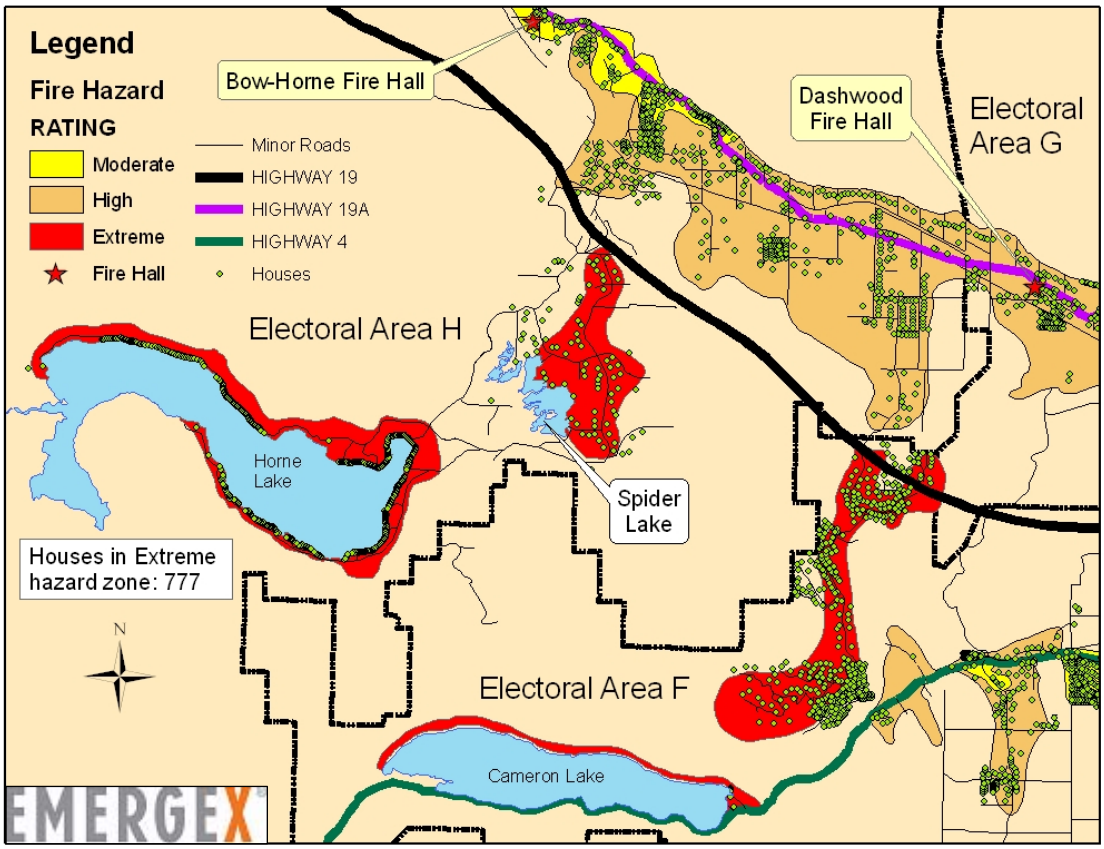


Figure 18 – Areas of "Extreme" Fire Hazard Ratings in the Spider Lake / Cameron Lake Area

Also in Figure 18, a significant hazard exists in Electoral Area F south of Highway 19 beginning down Corcan Road and extending down Meadowood Way into the Little Qualicum Estates that straddle Spider Lake. The northern shores of Cameron Lake have also been designated as an "Extreme" WUI fire hazard. This hazard designation follows closely with the path of the Esquimalt and Nanaimo (E&R) Railway through this high recreation area. Mainly cabins exist near the lake, with little fire protection – much of this area falls outside the Coombs-Hilliers Fire Protection Area. There are a total of 777 houses contained within the Extreme hazard zones, 462 in Electoral Area H and 315 in Electoral Area F. This equates to 1772 people at risk in Extreme hazard areas within these two Electoral Areas by taking into account their respective census data.

Other areas that have been labelled as "Extreme" include various plots surrounding the Nanaimo Lakes Area in Electoral Area C, which are depicted in Figure 19. The "Extreme" designation to the west, surrounding the Nanaimo Lakes is characterized by an area of very high recreation, with small summer cabins present and no fire protection – it falls outside the Extension Fire Protection Area. In addition, this area is encompassed by a Timberwest logging operation and has limited access via Nanaimo River Road.

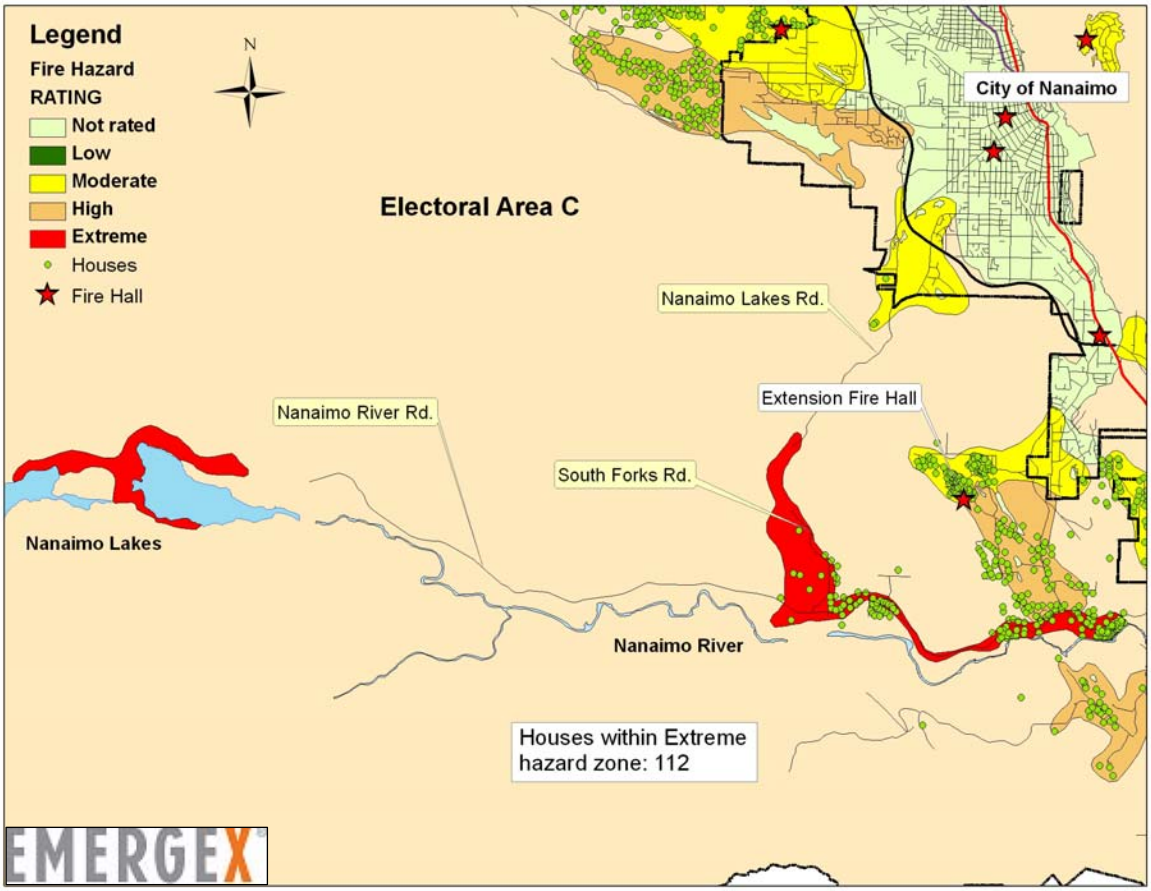


Figure 19 – Areas of "Extreme" Fire Hazard Rating in the Nanaimo Lakes Area

As noted in Figure 19, there are 112 homes at risk within the areas rated as "Extreme" WUI fire risk. According to Statistics Canada (2001), this equates to 269 persons at risk in this zone.

The largest Extreme fire hazard plot exists in Electoral Area A, which can be seen in Figure 20. There are 488 houses at risk in Extreme zones within this Electoral Area, which equates to approximately 1220 residents in this zone.

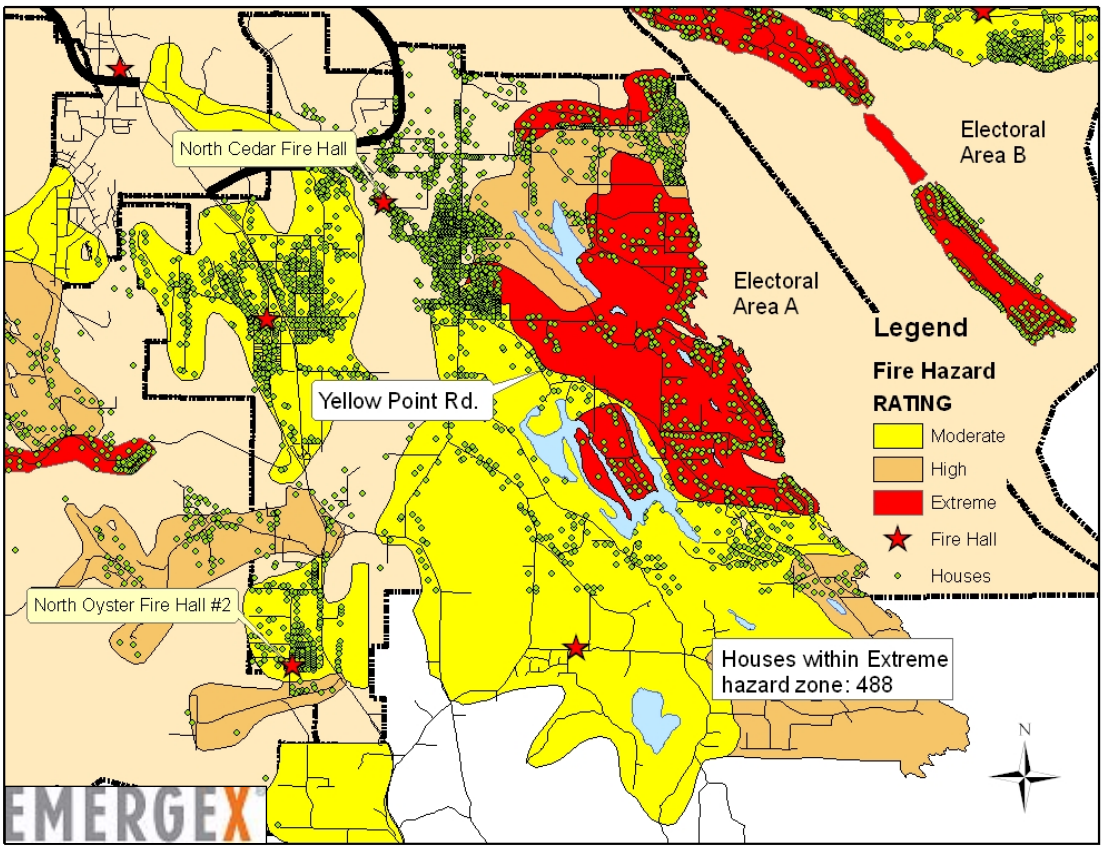


Figure 20 – Areas of "Extreme" Fire Hazard Rating in Electoral Area A

A summary of the approximate number of homes and corresponding populations at risk within Extreme hazard zones is given in Table 11 below.

Table 11 – Vulnerable population summary: Extreme WUI fire risk

Electoral Area	Number of homes within Extreme zone	Population at risk
A	488	1220
B	1026	2052
C	112	269
F	315	756
H	462	1016

6.4.2 Community Wildfire Protection Plans Completed in the RDN

Beginning in 2005, two Community Wildfire Protection Plans (CWPPs) were undertaken by Strathcona Forestry Consulting for the communities of Errington and Extension, BC. They were completed in February and March of 2006 respectively, detailing WUI hazard ratings for the region.

According to the Fire Interface Hazard Assessment map[7] for Errington, there is a significant portion of the community that is given an "extreme" rating (east-central and south-central region). 30% of total area within the Errington fire protection boundary was classified with an "extreme" rating, following by 57% classified with a "high" rating (Strathcona Forestry Consulting, 2006a). Errington is part of a mutual aid agreement with neighbouring departments in the RDN for fire suppression, which may include areas on the fringe or outside the fire protection boundaries for which the Errington Volunteer Fire Department is responsible for.

It is important to note that the community of Errington has been fortunate in recent years due to the lack of significant fires in the area, and the lack of winds to fan them (*ibid*). Detailed historical data and common occurrence sites can be found within the Errington CWPP (2006). Residents of Errington are provided with a high fire protection insurance rating, equivalent to a hydrant-protected community (*ibid).* In July of 2005, the Errington Fire Department achieved a "Superior Tanker Shuttle" (STS) rating from the Fire Underwriters Survey (FUS). The ability for the fire department to haul water to a fire at the same rate as a residential hydrant is impressive; Errington is the first fire department west of Ontario to achieve the STS rating.

Wildland-Urban Interface fire hazard in the Extension area is also a reality, with 85% of area within Extension fire protection boundaries classified as "high" hazard. No areas were classified as being under "extreme" hazard, but the vast areas classified as "high" certainly highlight the risk to the community. Section 6 of the Extension CWPP provides various recommendations and mitigation strategies for the area, ranging from awareness and vegetative management to structural modifications and private water supply (Strathcona Forestry Consulting, 2006b).

With all factors taken into consideration, the risk of forest fire and WUI fire to the Regional District of Nanaimo is *high.*

6.4.3 Structure Fire

A structure fire occurs in residential, commercial, or industrial buildings or structures. Of particular concern are nursing homes and residential centres for the elderly. Fires can be ignited by a number of causes, such as faulty electrical wiring, cooking and heating equipment, and cigarettes. In some cases, fires may also be ignited intentionally.

Structure fires are a reality within any Electoral Area in the RDN and have the capacity to spread quickly to adjoining structures. Due to the agricultural endeavours of many residents within the RDN, particularly in Electoral Areas E and F, many barns exist in isolated areas that lack fire protection. In the event of an accident causing structure fire, response may be delayed and corollary effects may include forest fire ignition and WUI hazard.

Due to the Regional District's response capabilities (among other factors), the risk of structure fires to the Regional District of Nanaimo is *moderate.*

[7] Included as a pull-out map in Appendix 1 of the Errington Community Wildfire Protection Plan.

6.5 DISEASES, EPIDEMICS, PANDEMICS

6.5.1 Animal Disease

Animal disease can be classified into non-infectious, infectious, and parasitic disease and can spread from animal to animal and from animal to human. Animal disease is primarily a concern for farmers who often suffer severe economic impacts as a result of such a hazard. Nonetheless, the potential for cross-species contamination means that there is a significant health concern for human populations. Examples include: foot and mouth disease; rabies; West Nile Virus (WNV); Bovine Spongiform Encephalopathy (BSE or 'mad cow disease' which can cause Creutzfeldt - Jakob Disease – CJD – in humans); and avian influenza.

It is important to note that WNV activity has not been reported anywhere in British Columbia as of May 1, 2006 (BCCDC, 2006). However, it should also be noted that historically there have been confirmed cases of deaths attributed to WNV within Canada. For example, in 2003, there were six deaths attributed to the mosquito-borne infection and 326 suspected and confirmed cases in Saskatchewan (Vancouver Sun, 2003). Of all large land mammals, horses are particularly susceptible to West Nile virus. In 2003 in Canada a total of 445 confirmed cases of West Nile virus in horses were reported to the Canadian Food Inspection Agency. There have been confirmed and/or probable cases of infected horses in Nova Scotia, Quebec, Ontario, Manitoba, Saskatchewan and Alberta, but none in British Columbia (Public Health Agency of Canada 2005a).

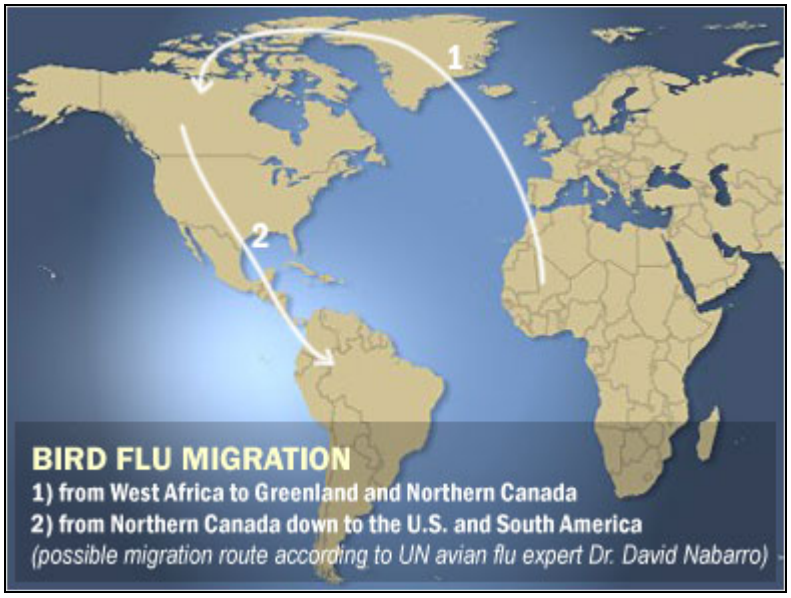


Figure 21 – Predicted migration of Avian Influenza to Canada

Avian influenza has recently become an increased concern for many, especially in areas with significant poultry farming operations. The H5N1 strain of the Avian influenza is one of sixteen varieties of the virus, the only one that has shown ability to pass from one human to another. Figure 21 suggests, based on expert opinion that migration of the bird flu is likely to occur through Canada, possibly affecting Western Canada including the RDN. Although the most dangerous strain of the virus has been most active outside North

America, the virus has been detected in Canada, including a strain of H5 found on various commercial farms in BC (CBC News, 2006).

Each disease, bacteria or virus has a different vector and aetiology, which complicates group classification and risk ranking. Status of the West Nile Virus is shared through interaction with the Vancouver Island Health Authority (VIHA), the BC Centre for Disease Control (BCCDC) and other local and regional governments.

In 2005, the West Nile Mosquito Vector Surveillance Program was initiated to analyze all relevant Electoral Areas within the Regional District of Nanaimo. This study excluded the four municipalities, areas of Crown lands, First Nations lands and private land (D.G. Regan and Associates, 2005). Main objectives of the 2005 program were to:

- Identify priority larval mosquito development habitats
- Monitor the development of potential WNV vector mosquito species
- Provide the BCCDC with standardized breeding site and mosquito monitoring data
- Prioritize breeding sites for treatment based on the potential risk posed to the public
- Increase public awareness
- Provide information on adulticide control of adult mosquitoes

(D.G. Regan and Associates, 2005)

Results of the program noted 58 open-water mosquito breeding sites (39 public and 19 private). Of these 58 sites, larvae were identified to species from 24 sites which are listed in Table 2 and 3 of the program summary report. The firm concluded that no locations within the RDN are likely to manifest concentrations of WNV adult mosquitoes[8]. If control of adult mosquitoes is considered an appropriate step in limiting occurrence of WNV in the local mosquito population, an aerosol ultra low volume of pesticide might be applied into the air either by aircraft or ground-based foggers (*ibid).*

Appendix 3 of the report, the Emergency Response Plan, focuses on *an efficient approach to control and eliminate WNV mosquito larvae rapidly in the event that the disease is determined to occur locally, or is imminently expected*. Additional recommendations are given by D.G. Regan & Associates to monitor breeding sites in detail in coming seasons to assist in identifying other location to add to the Plan.

Given the current risks associated with avian influenza outbreaks and West Nile virus and the fact that the H5N1 pathogen is easily transmitted between bird species (water fowl, wild birds and farmed poultry), the risk of animal disease to the Regional District of Nanaimo is *moderate.*

[8] D.G. Regan & Associates note that their searches have not been exhaustive and additional locations may be found in future seasons (e.g. When weather conditions are more conducive to larval development).

6.5.2 Human Disease and Pandemic

Yearly epidemics cause serious illness and death, especially among those who have weakened immune systems due to age or underlying medical conditions. A pandemic is an epidemic that affects a very large geographic area and is often global.

Influenza is a common infection that affects large numbers of people annually. Among the general population, influenza is recognized as a very uncomfortable but self-limiting, and ultimately benign, illness. However, occasionally the virus mutates and becomes much more dangerous to humans. The last 100 years has seen three occasions of worldwide pandemic outbreaks of severe influenza. The worst of these pandemics was the infamous Spanish Flu of 1918 which killed an estimated 20 to 40 million people around the globe – more than the casualties of the First World War. The Spanish Flu of 1918 is considered to be the most devastating pandemic in world history. According to the BC Centre for Disease Control (BCCDC), pandemics occur every 20 to 40 years. With today's global transportation networks, the potential for a pandemic to spread rapidly is high.

The BCCDC estimates that 20 to 50 per cent of the BC population will become infected with the next influenza pandemic, with 15 to 35 per cent becoming clinically ill. The rate of hospitalizations is estimated at 40 to 400 people per 1000 people. These estimates are based on the impacts of the 1957 and 1968 pandemics which were relatively mild when compared to those of the 1918 Spanish Flu. Actual rates of the next pandemic may be significantly higher and it should be noted that disease agents other than influenza, such as SARS, may also be the cause of a pandemic.

Due to the unusually high number of hospitalizations during a pandemic, local health authorities will likely be overwhelmed. Municipalities should work with local health authorities to create contingency plans on how they will handle the surge in patients. In addition, municipalities will need to continue providing essential services and support to residents. As employees of the Regional District may also become infected and be unable to work, contingency plans to operate with a reduced workforce are very useful. The RDN has explored business continuity planning on a regional

Due to the widespread nature of pandemics, neighbouring communities may not be able to provide assistance regardless of the presence of mutual aid agreements. Due to the Regional District of Nanaimo's geographic characteristics, the disease may be detected on the provincial mainland or in cities higher up on the urban hierarchy (i.e. Vancouver) before it arrives in the Regional District. This may provide some advanced warning to the Regional District; however, with today's transportation networks, the mobility of today's population and numerous points of access to the Regional District, this should not be relied upon, especially during high season for visitors.

Vaccination of susceptible individuals will be a primary line of defence against a flu pandemic in Canada. Health Canada has contracted with a supplier, Shire Biologics, to make the vaccine and has identified the priority groups receiving the vaccine. Health care workers and essential services personnel would be vaccinated before the general population. However, according to Vancouver Island Health Authority, it takes about five to six months to develop a flu vaccine for a new strain of flu virus, so vaccinations would

not be readily available. It could take up to a year to make enough vaccine for all Canadians. While it is difficult to rate the risk of a pandemic due to advances in medicine since the last major pandemics, a pandemic would still have a wide impact on the Regional District.

Due to current predictions associated with the next pandemic and its likely severity (among other factors) the risk of human disease and pandemic to the Regional District is considered *high.*

6.5.3 Plant Disease and Pest Infestation

Plant diseases are generally defined as any series of harmful physiological processes caused by irritation of the plant by some invading agent. These agents are typically referred to as plant pathogens and include viruses, bacteria, fungi, and algae. Government agricultural departments routinely handle outbreaks of plant diseases and infestations though on occasion they become difficult to control and may require an emergency response by various agencies.

The gypsy moth, a native insect to Europe and North Africa, sometimes occurs across Asia to Japan. British Columbia's first record of the moth was in 1911, although it is thought that it may have appeared three years earlier. Over the past decades there have been several infestation outbreaks with a newsworthy incident in 1991, where federal inspectors found egg masses of the Asian race on Russian ships at Vancouver waiting to load grain; male moths were subsequently trapped on shore. British Columbia, therefore, now faces the threat of gypsy moth introductions from sources to the east, south and west. (Ministry of Forests and Range, 2004)

Within the Regional District's boundaries is the sensitive Garry Oak ecosystem which is also found on the southeast coast of Vancouver Island and southern Gulf Islands. An ecosystem of white-top aster (*Sericocarpus rigidus*) occupies a small portion of the Coastal Douglas-fir zone with a concentrated area on Harmac lands, southeast of Nanaimo. Unfortunately, the Garry oak is a food of choice for the gypsy moth. The Garry Oak ecosystem is vulnerable in several ways, and it is currently under pressure from two other introduced insects.

Figure 22 - Gypsy moth late stage, mid-June to July (left). Female (white) and male (brown) adult gypsy moths (right). *(Source: Ministry of Forests and Range, 2004)*

Thus, any establishment of a gypsy moth population may kill large numbers of these trees and put the Garry Oak ecosystem at severe risk (Ministry of Forests and Range, 2004). A depiction of the gypsy moth is seen in Figure 22.

The Nanaimo area has a history of gypsy moth inhabitation but has been controlled with trapping and spraying. The Regional District has remained vigilant over the years ensuring this pest is managed well.

In addition to the infestation listed above, the Mountain Pine Beetle (*Dendroctonus ponderosae)* epidemic has infected much of British Columbia, affecting more than 5.7 million hectares of forest in British Columbia. The Mountain Pine Beetle attacks primarily lodgepole pine, which is also present in the Regional District of Nanaimo and has been affected in certain areas. Figure 23 depicts the extent of Mountain Pine Beetle attack throughout BC, including southeastern Vancouver Island and the RDN.

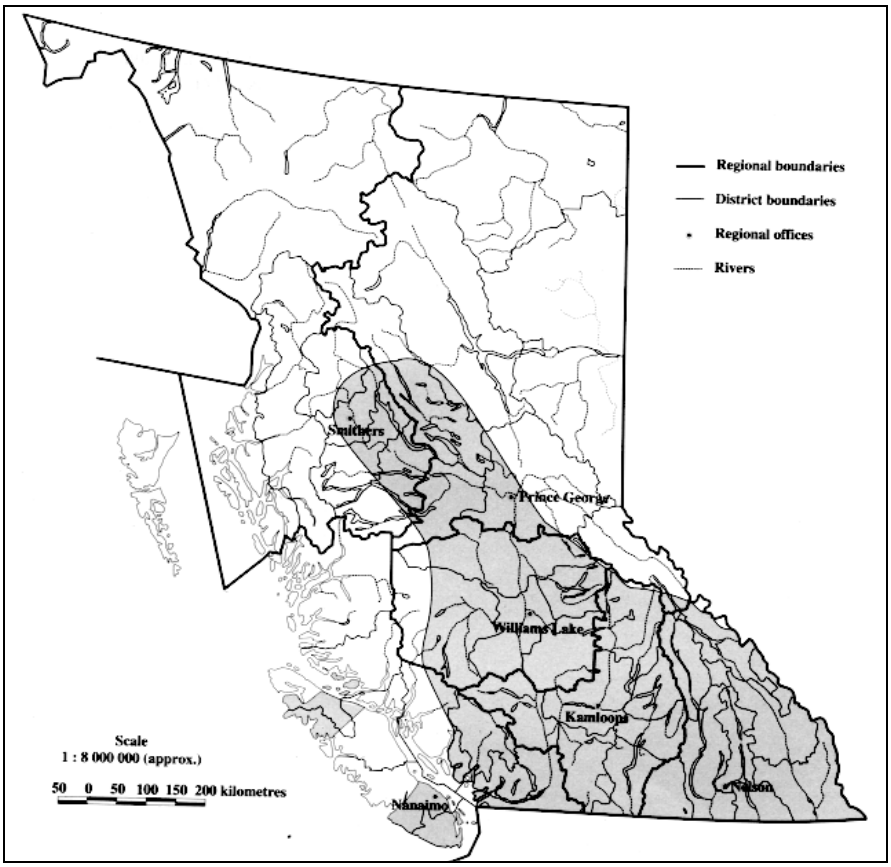


Figure 23 – Primary Mountain Pine Beetle attack areas within British Columbia

Taking into account potential for economic losses (among other factors), the risk of plant disease and pest infestation in the Regional District is *moderate*.

6.6 ACCIDENTS

6.6.1 Aircraft Crash

An aircraft crash creates the potential for multiple explosions and can result in an intense fire, which can lead to injuries, fatalities, and the destruction of property at and adjacent to the impact point. The location of the crash has a significant effect on the number of dead and injured among people on the ground.

Due to the emotional trauma associated with such a catastrophe, the survivors, family members and friends, nearby residents, and emergency responders will likely require mental health support.

A large number of people within BC use small commercial and personal planes to fly from one location to another. Every year some of these light planes crash or go missing. In addition to the risk of aircraft damage and injury to passengers, an aircraft crash may have other effects on the Regional District of Nanaimo residents. A wildfire may be started by an aircraft crash, causing damage to property and resources, and possible evacuation of residents.

An Emergency Response Plan for the Nanaimo Airport was completed in 1997, which includes emergency procedures in the event of a crash, structural fire, hazardous material incident, bomb threat, hijacking, and other incidents. The North Oyster Volunteer Fire Department has been designated as the primary fire response body within these plans (Nanaimo Airport, 1997). The Nanaimo Airport, in cooperation with local emergency services tested their Emergency Response Plan on May 14, 2004 during a mock exercise. A bomb threat and hijacking was staged, with 53 passengers on board (Hunter, 2004).

Qualicum Beach Airport authorities advise that only local pilots familiar with the local terrain should use the Qualicum Beach Airport during hours of darkness due to the presence of 30 m trees located approximately 3000 feet from threshold 29 (Town of Qualicum Beach, 2006).

Due to regular flight occurrence over and near the Regional District, the risk of aircraft crash (albeit commonly smaller aircraft) to the Regional District of Nanaimo is *moderate*.

6.6.2 Marine Accident and Marine Spill

Due to the coastal location of the Regional District of Nanaimo, there are many points of entry involving marine watercraft, with the majority of access involving the Port of Nanaimo, the only all-purpose port on Vancouver Island.

The Nanaimo Port Authority manages and controls marine traffic within Nanaimo harbour, and has signed a charter with the City of Nanaimo to collaborate on issues such as the funding and provision of effective policing and emergency services. This includes emergency planning and response in the Port and in adjacent areas of the City (Nanaimo Port Authority, 2006). Due to the Port falling under City jurisdiction, it will not be further elaborated upon here.

Other areas within the RDN that are accustom to marine traffic include Deep Bay ("G"), Nanoose Harbour ("E") and Gabriola Island ("B"). Deep Bay and Gabriola are both popular locations for boating and fishing excursions, with both areas offering sightseeing and fishing excursions, for example. Marine accidents involving smaller recreational watercraft are dealt with at the organizational level in the respective Electoral Area.

Nanoose Harbour differs from the minor marine activity along the eastern coast of the RDN, since it is home to the Canadian Forces Maritime Experimental Test Range (CFMETR). Regarding the possibility of a marine spill, the DND at CFMETR has been active in the preparation for this type of event occurring. In June of 2004, Burrard Clean Operations (BCO) in cooperation with the Department of National Defense at CFMETR staged a marine spill exercise. Main objectives surrounding this spill exercise were to test the CFMETR Emergency Plan and the Queen's Harbour Master (QHM) Pollution Contingency Plan (BCO, 2004). More specifically, the exercise intended to familiarize DND participants with their roles and responsibilities, with a scope covering the first 6-8 hours of the initial response phase.

The scenario on June 15, 2004 involved a visiting CF frigate spilling 5000 litres of Naval Distillate while transferring to their day tank (*ibid*). Heavy contamination "took place" with threats to the oyster beds residing to the west and the sensitive estuary to the north. An anticipated action plan was detailed and procedures were followed and documented based on Incident Command System standards (*ibid*). Details regarding CFMETR nuclear capable vessel operations and emergency planning are elaborated in Section 6.8.1.

With CFMETR operations considered and the severity of a potential marine spill, the risk of a marine accident in the RDN is *moderate*.

6.6.3 Motor Vehicle Crash

Motor vehicle accidents involve the collision of a motor-powered vehicle with another moving or stationary vehicle or object. Motor vehicle accidents can damage one or more automobiles, people, or structures. The possibility of an accident involved dangerous goods is also important to note. Refer to Section 6.7.2 for discussion of dangerous goods transport.

Motor vehicle crashes can result in the need for site support when they involve large numbers of people. Most occurrences result in property damage requiring site clean-up. Some crashes lead to major injuries or fatalities that require specialized response. For example, a transport truck struck a tour bus on the Trans Canada Highway near Revelstoke, in 2000, killing six people. Some motor vehicle crashes may cause collateral emergencies, such as dangerous goods spills, that may require evacuation and sheltering efforts.

Traffic statistics from 1999 to 2003 can be accessed from the following website: http://www.icbc.com/Library/research_papers/Traffic/index.asp. Since these statistics exist on a municipal, detachment basis, these will not be elaborated upon here. Multi-vehicle or large truck related accidents constitute a less frequent but more severe hazard that has the potential to effect residents of the Regional District of Nanaimo as well.

The risk of motor vehicle accident to the Regional District of Nanaimo is *low*.

6.6.4 Rail Accident

VIA Rail operates a passenger line, the Malahat, which passes through the RDN as it runs from Victoria to Courtenay. This also includes a spur that extends from Parksville to Port Alberni as seen in Figure 24. The Malahat runs on the E&N Railway, which was under the ownership of the Canadian Pacific Railway and RailAmerica Inc. (Nanaimo to Parksville to Port Alberni stretch) until 2006. Now, the Island Corridor Foundation has 100% control of the line (Vancouver Sun, 2006).

Freight service also existed on the E&N line until 2001, when this service ended. Wood, coal, chemical and general cargo were among the freight previously transported. Use of the line for passenger service continues, but has dwindled with just one passenger car (Budd Rail Diesel) travelling one departure each day from Victoria to Courtenay in each direction (Globe and Mail, 2006).

Island Corridor control will help to preserve rail service and make the corridor available for power lines, hiking trails and pipelines.

Figure 24 – The Malahat rail line

The line is also likely to receive upgrades, with discussion now surrounding a commuter rail service in the south (Times Colonist, 2006). Although freight traffic has largely disappeared and passenger travel is limited, the successful setup of the proposed commuter rail will significantly increase train traffic which is likely to increase the risk of a rail accident and increased rail-automobile interface.

Given the current limited operation of the Malahat and the lack of significant cargo transport on the E&N railway, the risk of rail accidents to the Regional District of Nanaimo is *low*.

6.7 EXPLOSIONS AND LEAKS

An explosion may be caused by the ignition of flammable gases or vapours when mixed with air. Common explosion sources include pipelines and utility ducts, propane storage tanks, soil-generated gases, blasting equipment, and hazardous chemicals (discussed below). A malfunction in any of a number of technical systems in the community could lead to an explosion. Vapour explosions are possible where flammable gases, such as natural gas, may leak and collect.

Gas leaks and explosions occur when natural gas or gasoline pipelines rupture, by accident or due to poor design or corrosion. Gas leaks can also be caused by natural hazards, such as earthquakes or landslides. Gasoline vapours from spills or leaks from underground tanks can lead to a dangerous situation. Sewer blasts occurred in Winnipeg in August of 1988 and in Montreal in May of 1988.

Containers storing liquids in closed systems, such as propane tanks, could undergo a BLEVE (Boiling Liquid, Expanding Vapour Explosion) under certain circumstances, especially if exposed to extreme heat. Flammable liquids could collect in storm drain systems, leading to an explosion of flammable vapours. Some hazardous materials that may be vulnerable to explosion are listed in the next section.

These incidents are infrequent and of a localized nature, therefore the risk of gas leaks and explosions to the Regional District of Nanaimo is *low*.

6.7.1 Hazardous Material Accident - In Situ

A hazardous material is any substance that may be explosive, flammable, poisonous, corrosive, reactive, or radioactive. A hazardous materials accident involves the uncontrolled release of a hazardous material during storage, use, or transport (see Section 6.7.2), and can have a wide range of impacts depending on the nature of the material released. Possible impacts range from road closures to widespread evacuation and injury requiring hospitalization.

In extreme cases with large amounts of released materials or small amounts of highly toxic materials, the accident may be fatal. In addition, hazardous materials accidents often have damaging impacts on the environment.

The Southwest Extension chlorination plant located at 2209 Bramley Road currently has inside leak monitoring only, with a light that flashes on the outside of the building in the event of a leak (*ibid*). Following a stakeholders meeting in March of 2006 it was determined that an outside sensor will be installed. Leak alerts will be communicated to the City of Nanaimo's main office and an audible alarm with also warn residences in the immediate vicinity, which number approximately one hundred. It is important to note that the Extension fire department does not have appropriate HAZMAT background to deal with an incident at this site directly.

Significant fuel storage sites within the Regional District in Nanaimo (municipal plots) are listed in - but not limited to - Table 12.

Table 12 – Selected Fuel Storage Sites within the Regional District of Nanaimo

Name of Site	Location	Type of Fuel
Nanaimo Regional Airport	3350 Spitfire Rd.	Aircraft
CFMETR	3400 Fairwinds Dr.	Marine (large vessel)
Brechin Esso Fuels	2000 Zorkin Rd.	Aircraft and marine
Petro Canada	1605 Trans-Canada Hwy.	Gas / diesel / propane
Duke Point Ferry Terminal	400 Duke Point Hwy.	Propane and marine

Since the majority of recorded fuel storage exists within the boundaries of the municipalities, the list given above is not extensive due to the scope of this HRVA. Significant industrial zoning exists in the northeast portion of Electoral Area F near the boundary of the City of Parksville, as well as in Electoral Area A in its north-western limits, where various types of industry reside. These sites may contain hazardous materials or fuels that if spilled or ignited could have the potential cause harm to local workers and residents of the RDN.

The potential impact of a hazardous materials accident can vary depending on the type of substance released. The frequency of hazardous materials accidents is low and their impact is often localized; nonetheless, this risk is considered *moderate*.

6.7.2 Hazardous Material Accident - Dangerous Goods Transport

A major accident involving a vehicle transporting dangerous goods can necessitate the evacuation of surrounding communities and homes. Depending on the location of an accident, access and evacuation may be impaired and alternative means of moving people and resources between communities and municipalities should be considered. If evacuation is not possible due to incident location or type of incident (i.e. chlorine spill), Shelter in Place (SIP) options should be considered. In such instances, local residents must be informed as to what SIP means, how to do it and how to access situation updates on response and recovery. This information is provided on the Regional District of Nanaimo website at http://www.rdn.bc.ca/cms.asp?wpID=1011.

On February 8, 2005 a large tanker truck carrying 20,000 litres of gasoline and 5,000 litres of diesel overturned on Turner Road in Nanaimo, with gasoline leaking from a vent (PEP, 2005). This is in close proximity to Highway 19A, which receives a significant amount of dangerous goods transport traffic along with Highway 1.

The chlorination plant in Southwest Extension (Electoral Area "C") requires transport of chlorine, which is regulated and managed by certified transporters. The chlorine is delivered on weekdays only from 0800-1630 with a mandatory requirement of two certified chlorine technicians at the plant to receive delivery (Thomas, J., 2006). In addition, these hazardous material transport trucks have capping and repair kits on board, and the tanks are bomb proof. Eight one-ton cylinders are normally transported at once, with total transport capacity set at twelve.

Given the major routes transporting dangerous goods through the RDN, the risk of an incident involving dangerous goods transport is *moderate.*

6.8 OTHER HAZARDS

6.8.1 *Canadian Forces Maritime Experimental Test Range (CFMETR) Accident*

CFMETR is a test facility that is located on the north side of Nanoose Harbour on the east side of Vancouver Island in Electoral Area E. They are responsible for testing a variety of devices including sonobuoys, sonar systems and torpedoes. CFMETR is under the authority of the Department of National Defense (DND) and is staffed by members of the Canadian Navy and Navy civilian employees, as well as a small number of US Navy civilian employees (Wikipedia, 2006).

CFMETR operations are discussed in this section of the HRVA due to the multiple hazards that potentially face the Regional District of Nanaimo with the activity of this test facility. Hazardous material explosions, hazardous material spills, marine accidents and terrorism events are all a potential reality at the CFMETR site. These concerns exist in addition to historical environmental debate about the effects of debris deposited due to testing at the facility, and similar issues.

On March 31, 2006, CFMETR released an up-to-date Nuclear Emergency Response (NER) Plan, with a main objective to determine – in accordance with MARCORD 66-12 – the capability to respond to nuclear emergencies involving Nuclear Powered Vessels (NPV) and Nuclear Capable Vessels (NCV). Execution of this plan involves CFMETR designating a team composed of specifically trained members of CFMETR permanent staff and additional members from the CFB Esquimalt NER team. Further details of this extensive plan are available in hard copy from CFMETR, the Regional District of Nanaimo, or PEP (among others).

The probability of a fission product release into the environment has been assessed at lower than 1 in 10 million years (CFMETR, 2005). Nonetheless, if such an event does occur, all levels of government have mandated responsibilities. The Base Commander, Canadian Forces Base Esquimalt, and the Commanding Officer CFMETR are the designated Nuclear Emergency Commanders (NECs) in the event of a military NPV / NCV nuclear emergency at CFB Esquimalt and Nanoose Harbour (*ibid*).

With marine spill consideration aside (see Section 6.6.2), the risk of a nuclear incident at CFMETR is *low*.

6.8.2 Power Outage

Electricity is considered an essential service to maintain heat and to provide water and cooking facilities. Minor power outages cause few problems in the Regional District. However, prolonged outages can have more serious consequences, especially when they coincide with periods of extreme temperatures in areas that rely on electricity for heating and cooling. Causes of power outages include damage to hydro poles from heavy winds, ice storms, snowstorms, falling trees or other debris, vehicle impacts, landslides, and

earthquakes. Overuse of electrical power or mechanical problems can also cause substation or transformer equipment to fail, leading to brownouts or reduced electrical capacity.

As the 1998 ice storm in eastern North America demonstrated, a prolonged power outage could lead to severe conditions for local residents and businesses. Residents without electricity may put themselves at risk by using alternate forms of indoor heat, including propane and poorly ventilated kerosene heaters. In January, 2004, Aquila Networks almost initiated rotating blackouts in the Okanagan after record lows prompted energy consumption to spike (Wylie, 2004).

Many residents in the Regional District of Nanaimo have wood-burning stoves or fireplaces that are used as either primary or secondary sources of heat, therefore a power outage may have less impact on residents with alternative sources of heat. However, other devices requiring electricity such as cordless phones, computers, television, stoves, microwaves, lights, etc., will likely be off-line. If a major disaster were to occur during a time of power outage, some of the Regional District's critical facilities would be impacted.

It should be noted that during a power outage support for other incidents may be limited or more difficult relative to when power is fully available. Site-specific backup generation is available for use at the Regional District of Nanaimo primary ECC, located at 6300 Hammond Bay Rd, as well as at the secondary ECC located at 1555 Morden Road.

If mobile generation is needed in the event of a power failure and demand exceeds supply, they may be rented from the following locations:

- Ajac's Equipment - 160 Cliff St., Nanaimo Tel. 250-754-1931
- Harbour City Motorsport – 1613 Bowen Rd., Nanaimo Tel. 250-754-3345
- Westwood Power & Marine – 3653 Shenton Rd., Nanaimo Tel. 250-758-5285

In December of 2005, a study was conducted regarding the Vancouver Island Transmission Reinforcement Project (VITR) and the Expected Energy Not Served (EENS). The purpose of this study was to update evaluation of the EENS for the VITR project concerning a 230kV line. The update was spurred by many factors, including the fact that the new load forecast for Vancouver Island shows demand increases, along with a small increase in total generation capacity. Results indicate that the new line will provide an essential improvement from 2008 to 2022, the study period analyzed (Li, 2005).

Although risk will increase with the length of the outage, the overall risk of a power outage to the Regional District of Nanaimo is *low*.

6.8.3 Structural Collapse

Structural collapse may be caused by engineering, construction problems, metal fatigue, or changes to the load bearing capacity of the structure. When buildings collapse, there may be a significant number of injuries or fatalities and fires may result. Such events also cause damage to infrastructure, such as gas lines, electricity, water, sewer, and telephone lines.

The primary buildings of concern include older structures that were poorly designed or have not been maintained. Buildings that hold large numbers of people, such as schools or recreation complexes present the greatest consequence. There have been no significant incidences of structural collapse in the Regional District.

Due to historical occurrence and corollary impact to people and property, the risk of structural collapse to the area within the scope of this HRVA is *low*.

6.8.4 Water Supply Contamination

Drinking contaminated water has affected tens of thousands of North Americans in the last decade. The protozoa parasite *Giardia lamblia* was the agent most commonly implicated in outbreaks. *Shigella sonnei* was the most commonly implicated bacterial pathogen in major water-borne disease events in the last ten years. In outbreaks caused by this pathogen, water supplies were found to be contaminated with human waste.

Cryptosporidium contamination of a chlorinated, filtered public water supply has also caused outbreaks of disease in North America, most recently in North Battleford, Saskatchewan (spring of 2001).

In May of 2000, the small community of Walkerton, Ontario, was hit by an outbreak of E. coli found in the public water supply. It is believed that approximately eleven persons died from this disease, and more than 1000 people were infected. Tampering with public water supplies has also surfaced in BC in the recent past, with incidents reported at Ladysmith and Kaslo (PEP, 2001).

The Regional District of Nanaimo has not had any incidences of water supply contamination in the history of its operation. Supplied water continues to meet Ministry of Health and Canadian Drinking Water Standards, although water quality may vary slightly over time and geographic area (Mike Donnelly, electronic mail, April 18, 2006). RDN Water Utilities performs removal of iron and manganese deposits as well as stale water pockets from the system, which may cause discoloration and odour to accompany water supply under rare circumstances. The following incidents (each with respective action items and contacts) are addressed in the RDN Water Utilities Emergency response plan:

- Contamination of source (Spills, accidents)
- Loss of source (reservoir or supply lines)
- Failure of pumps
- Backflow or back siphonage
- Reservoir damage due to vandalism (possible contamination as well)
- Flood conditions (potential contamination, loss of pumps)
- Broken water mains
- Chlorination failure
- Power failure affecting supply
- High bacteria count

(RDN, 2005c)

In October of 2004, the Regional District finalized a Drinking Water Protection Action Plan that was completed as a result of a Drinking Water Protection Initiative Workshop that took place beginning in 2003. This plan examines utilities, growth strategies and a set of seven main issues that came to the forefront during the workshop proceedings. These issues include the transparency of water quality information and protection of water sources through regulation. The RDN remains very proactive in the maintenance and protection of drinking water in all the relevant service areas, and has kept this process transparent to the public. Current and archived water quality reports for each WSA can be found on their website at http://www.rdn.bc.ca/cms.asp?wpID=842.

Given historical occurrence, consistent testing and other factors, the risk of water supply contamination to the Regional District of Nanaimo is *low.*

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Appendix A – Hazards Table

Appendix B – RDN Fire Response and Capabilities

Table B-1 – Regional District of Nanaimo fire halls and associated Fire Protection Areas

Electoral Area	Fire Hall	Address	Fire Protection (FP) Delineation
A	Cranberry	1555 Morden Rd.	Cranberry FP District
	North Cedar	2100 Yellow Point Rd.	North Cedar FP Area
	North Oyster No. 1	4821 Yellow Point Rd.	*Outside RDN boundaries*
	North Oyster No. 2	3500 Hallberg Rd.	Yellowpoint-Waterloo FP Area
B	Gabriola No. 1	760 North Rd.	Gabriola FP District
	Gabriola No. 2	2400 South Rd.	
C	East Wellington	2331 East Wellington Rd.	Mountain FP District
	Extension	2201 Bramley Rd.	Extension FPA
E	Nanoose Bay	2471 Nanoose Rd.	Nanoose FPA
F	Errington No. 1	960 Errington Rd.	Errington FPA
	Errington No. 2	1930 Errington Rd.	
	Coombs-Hilliers No. 1	992 Ford Rd.	Coombs-Hilliers FPA
	Coombs-Hilliers No. 2	3241 Alberni Hwy.	
G	Dashwood	230 Hobbs Rd.	Dashwood FPA
H	Bow Horn Bay	220 Lions Way	Bow Horn FPA
	Deep Bay	5031 Mountain View Rd.	Deep Bay Fire FPA

Table B-2 - Fire response in RDN neighbouring municipalities

Municipality	Fire Hall	Address	Fire Protection Delineation
Lantzville, District of	Lantzville	7580 Lantzville Rd.	Lantzville FPA
Nanaimo, City of	Nanaimo Fire Hall No.1	666 Fitzwilliam St.	1. Nanaimo FPA (Municipality) 2. Wellington FPA
	Nanaimo Fire Hall No. 2	2499 Dorman Rd.	
	Nanaimo Fire Hall No. 3	6230 Hammond Bay Rd.	
	Harewood	191 Fourth St.	Nanaimo FPA
	Protection Island	26 Pirates Lane	
	Chase River	1400 Cranberry Ave.	
Parksville, City of	Parksville Fire Hall	160 Jensen Ave.	1. Parksville Local Fire Protection (District 69) 2. Parksville (Municipality)
Qualicum Beach, Town of	Qualicum Beach	124 Harlech Rd.	1. Qualicum Beach FPA 2. French Creek FPA

Table B-3 – Regional District of Nanaimo Fire Department Apparatus Inventory

Cranberry Fire Department

Ford Freightliner

Truck #2

Ford F550 4x4 King Cab – 300 gal. tank, CAFS system

[Updated apparatus to be inserted by RDN]

North Cedar Fire Department

2000 HME Pumper - 1000 gal. capacity, 1250 gpm, 330 hp Cummins, seats 6, enclosed cab
1990 Ford Pumper –1000 gal. capacity, 1050 gpm, seats 7
2000 Ford F-350 Crew Cab – First responder/Rescue Vehicle, Triton V-10
1985 GMC Tanker –1200 gal. capacity, 350 gpm pump, seats 3
1 Mini-pumper (acquired late 2005 – at time of writing, not prepared for use)
HAZMAT training: Awareness level

North Oyster Fire Department

Engine #1 – 1000 gal. capacity, 840 gpm	2 portable radios
400 ft. of 1.5" hose, 750 ft. of 2.5" hose	4 MSA firehawks
1200 ft. of 4" line	Tankering capability
Engine #3 – 1000 gal. capacity, 1050 gpm	2 portable radios
400 ft. of 1.5" hose, 750 ft. of 2.5" hose	4 MSA
1200 ft. of 4" line	Tankering capability
Foam Pro	
Tender #4 – 1000 gal. capacity, 450 gpm	2 portable pumps
400 ft. of 1.5" hose, 300 ft. of 2.5" hose	1 portable radio
1200 ft. of 1" forestry hose	2 MSA
200 ft. of ½" forestry hose	Misc. forestry equipment
	(fittings, nozzles, eductors, etc.)
Tender #5 – 1400 gal. capacity	3 portable pumps
300 ft. of 1.5" hose, 250 ft. of 2.5" hose	1 portable radio
Rescue #1 – 250 gal. capacity, 250 gpm	Cascade system:
100 ft. of 1.5" hose, 100 ft. of 2.5" hose	3 bottle, 2 fill stations
Full Jaws System:	Swiftwater:
Holmatro cutters, spreaders, ram	4 complete sets with rope bags, etc.
Full blocking	
8000 lbs winch with A-frame	2 MSA
Hand tools	
Manual spreaders, ram system	
Pickup Truck (Chief's vehicle)	
Forestry equipment:	Kestrel unit
350 ft. of ½" line, 300 ft. of 1" line	Various tools / fittings, etc.
9 sprinkler kits	GPS unit

Gabriola Fire Department

Hall 1
#2 Truck – Tender
1500 gal. capacity porta tank, 10" dump valves with fittings / adapters
300 gpm Honda portable pump
200 ft. of 4" hose

Hall 1
#4 Truck – Bush
Ford F450, 300 gal. capacity tank
400+ ft. of attack line
CA Foam unit, various forest equipment (backpacks, hose, chainsaw)
FR medical equipment

Hall 1
#5 Truck – Chief / Duty Officer response
First response to all calls

Hall 1
#8 Truck
3500 gal. capacity tank, 300 gpm Honda porta pump, 10" dump valve
1500 gal. porta tank
600 ft. of 2.5 ft. hose, 400 ft. of 4" hose
Ladder – 2 stage

No HAZMAT training, limited industrial concerns on Gabriola

Hall 2
#1 – 1990 Ford (single axle pumper)
1000 gal. capacity tank, 840 gpm Hale front mount pump
Foam injection on 1" – 2.5" discharge
1200 ft. of 3" hose, 400+ ft. of 1.75" attack line, truck radio, 4 portable radios
4 SCBA, P.P.V. fan, chainsaw, shovels, brooms, misc. equipment, nozzles/adaptors
FR medical equipment, portable generator
Ladders (1 two stage, 1 single, 1 attic)

Hall 1
#3 Truck – Pumper
1000 gal. capacity, 625 gpm Barton front mount pump
2.5" hose, 1.5" attack line, 10" water dump
Former pumper used for water supply

Hall 1
#5 Truck
2000 gal. capacity, Darley 1050 gpm Auto CAFoam
1200 ft. of 3" hose, 400+ ft. of 1.75" attack line, 4 SCBA, 4 portable radios
Truck radio, FR medical equipment
Jaws of Life - Amkus spreader, cutter, ram & pump
Cribbing, various hand tools, nozzles, adaptors, shovels, brooms
P.P.V. fan, chainsaw, 5kW generator & lights

Hall 1
#12 Truck – Medical response
SCBA air supply – 6 bottle cascade system
Spine boards, clamshell stretcher, medical equipment
2 SCBA, drinking water, truck radios
VHF & UHF, 4 UHF portables
Oil spill equipment (limited), cell phone

Hall 2
#11 Truck – Pumper
1500 gal. capacity, 300 gpm PTO pump, 300 gpm Honda pump
1500 gal. porta tank
200 ft. of 4" hose, truck radio and handheld

East Wellington Fire Department

[To be inserted by RDN]

Extension Fire Department

[To be inserted by RDN]

Nanoose Bay Fire Department

#11 - 1990 International Pumper
800 gal. capacity, 840 gpm
750 ft. of 1.5" hose, 600 ft. of 2.5" hose
2200 ft. of 4" hose

#12 – 1990 Chevrolet 1-Ton Crew Cab 4x4
Bush truck, medical calls
First responder equipment, defribrillator
1000 ft. of 1.5" forestry hose

#13 – 2002 International Tanker
1300 gal. capacity, 415 gpm
Foam Pro 1600 electronic Class A foam injection system
1000 ft. of 1.5" forestry hose

#14 - 1995 Freightliner FL-60 Pumper
400 gal. capacity, 250 gpm
Foam injection system, cascade system, 4000 watt gen. set
Jaws of Life / Auto Ext.

#15 – 1998 Wells Cargo trailer
Storage of HAZMAT and containment materials

#16 – 1999 International Pumper
1100 gal. capacity, 1050 gpm
750 ft. of 1.5" hose, 500 ft. of 2.5" hose

#17 International Tanker
1700 gal. capacity, 415 gpm
Foam Pro 1600 electronic Class A foam injection system
1000 ft. of 1.5" forestry hose

Additional info:
First responder training:
15 - Level 3 First Responders (with AED & spinal)
Limited HAZMAT training, cleanup supplies only
Jaws tool and ram

Errington Fire Department

Engine 211 – 1995 Freightliner FL-70
Hall 1 Primary Attack Pumper
625 igpm, 4 SCBA packs
150 ft. of 1" hose, 400 ft. of 1.5" hose
200 ft. of 2.5" hose, 2000 ft. of 4" forward lay supply line

Sprinkler Protection Unit (SPU) Trailer
Hall 1
2500 ft. of various hose
80 sprinkler heads for bushfire use
7 Wajax Mark 3 pumps

Engine 212 – 1995 Freightliner FL-70
Hall 2 Primary Attack Pumper
625 igpm, 4 SCBA packs
400 ft. of 1.5" hose, 400 ft. of 2.5" hose
1000 ft. of 4" forward lay supply line

POD Truck 209 – 1999 Freightliner FL-80
Hall 1 Service and supply transport
Available PODs include 2000 gal. Rigid tank with pump, 2700 gal. tank and air recharge / generator (65kW) unit.

POD Truck 213 – 1999 Freightliner FL-80
Hall 2 Service and supply transport
Available PODs include 2000 gal. Rigid tank with pump, 2700 gal. tank

Engine 214 – 1996 Ford 4X4
Hall 2
Bush truck / Tow vehicle with 4000 psi pump and 200 gal. tank

Coombs-Hilliers Fire Department

[To be inserted by RDN]

Dashwood Fire Department

Engine 1 – 5 seat, SCBA
1,050 gpm pump, 1,000 gal. capacity
750 ft. of 1.5" hose, 500 ft. of 2.5" hose
1000 ft. of 4" hose, 2 reciprocating saws, auto-stabilizing blocking

3/4 ton Crew Cab – 6 seat
First responder equipment, forestry shovels and axes
Additional equipment:
11 portable radios

Tanker – 3 seat
450 gpm pump, 1,400 gal. capacity
600 ft. of 1.5" hose, 200 ft. of 2.5" hose
150 ft. of 4" hose, portable pump
1500 gal. & 1000 gal. port-a-pond, forestry hose

Training:
All fire fighters are Level 3 first responders, all have HAZMAT awareness level,
3 officers at HAZMAT operations level

Bow Horn Bay Fire Department

Pumper
800 gal. capacity, 1050 gpm
1200 ft. of 1.5" hose
1200 ft. of 2.5" hose
600 ft. of 4" hose

Tanker 1 – Freightliner FL-80
1500 gal. capacity
2" + 11/2" forestry pump
Stretcher

Training:
Primarily related to structure-vehicle fire suppression with the Basic Wildland fire course for some senior members (Chief Steve Anderosov, electronic mail, April 1, 2006).

Tanker 2 – Freightliner FL-80
1500 gal. capacity, 75 gpm (pressure mode) and 160 gpm (volume mode)
550 ft. of 1.5" hose, 100 ft. of 2.5" hose

Command Vehicle
Ford F-450 cube van
Cascade system (SCBA bottle filling station)

Additional items:
Porta-Tank – 3:
1200 gal., 1500 gal., 1800 gal.
11/2" Hale Porta-pump (floating)
1.5" portable pump (recently acquired)
Two 2.5" portable pumps (recently acquired)
Three man 4X4 ATV with 800 lb. capacity tilt-box (pump/hose transport)

Deep Bay Fire Department

Truck 8-1 – Freightliner FL 80
Seats 6, 1050 gal. capacity
1600 ft. of 2.5" hose, 600 ft. of 1.5" hose
Water cannon system, generator
First responder gear

Other:
12 portable radios in total
Chief trained in HAZMAT

Truck 8-2
Chevrolet 1 ton cube van, seats 5
Complete Jaws of Life set-up
Air bags for lifting, First responder gear

Truck 8-3
Rescue truck
GMC 1 ton, Seats 8
First responder gear, flagging gear

Appendix B-2 – Network & Response Analysis

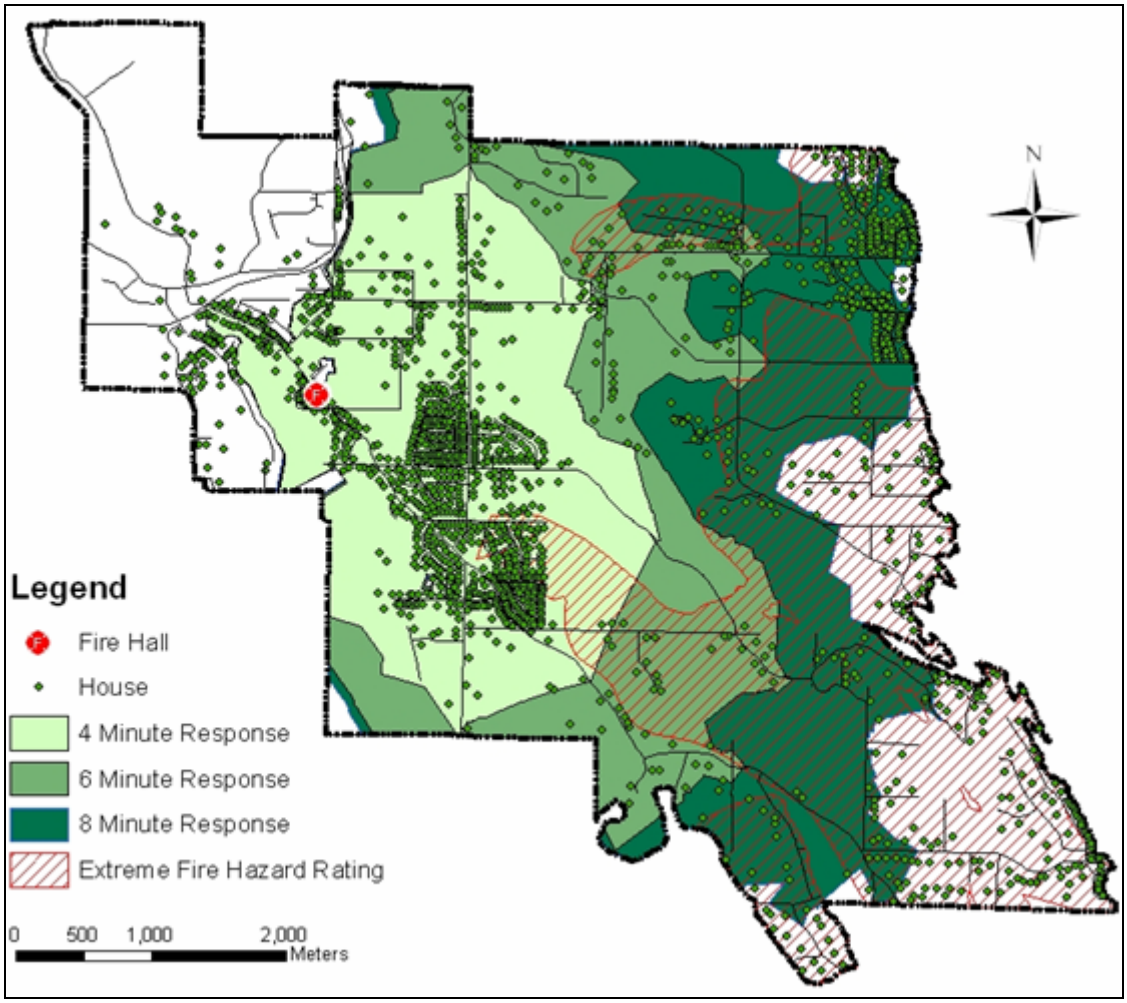

Figure 25 – Fire Response Analysis for Cranberry Fire Hall in the North Cedar Improvement District

A generalized fire response analysis for the North Cedar Improvement District is depicted in Figure 25. This output was provided as an example of the type of analysis that can be done in the Regional District of Nanaimo concerning fire response but is not a comprehensive analysis. It is based on the assumption of a 45 km/h response speed with no hindrances assigned such as one way access or limited extent of roads. It also assumes full connectivity between turns, and does not factor in differences between local, secondary and major roads. All of these concerns would be addressed in great detail if a comprehensive Network and Response Analysis was undertaken, providing greater accuracy and precision than the example shown here.

As mentioned in the Executive Summary, the completion of a full scale Network and Response Analysis may help to answer many important questions. This may include determining the optimal location for a new fire hall (or other critical response facility), improving the speed and efficiency of emergency response, or analyzing limitations in the RDN transportation network. An additional advantage to a Network and Response Analysis is to take in account cross-boundary mutual aid and the coverage gaps between response agencies involved in a potential incident.