HAZARD, RISK AND VULNERABILITY ASSESSMENT

DISTRICT OF SUMMERLAND

FINAL REPORT

FEBRUARY 2006

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District of Summerland
British Columbia

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Executive Summary

EmergeX Planning Inc. conducted this Hazard, Risk, and Vulnerability Assessment (HRVA) for the District of Summerland's 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 from which the local authority has responsibility.*

No municipality 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. EmergeX has identified 37 hazards that could affect the District of Summerland. This assessment identifies the risk that each hazard presents to the District, thereby allowing the District to plan for mitigation, response, and recovery efficiently within their budgetary and other constraints. The information presented in this assessment should be used by the District of Summerland to:

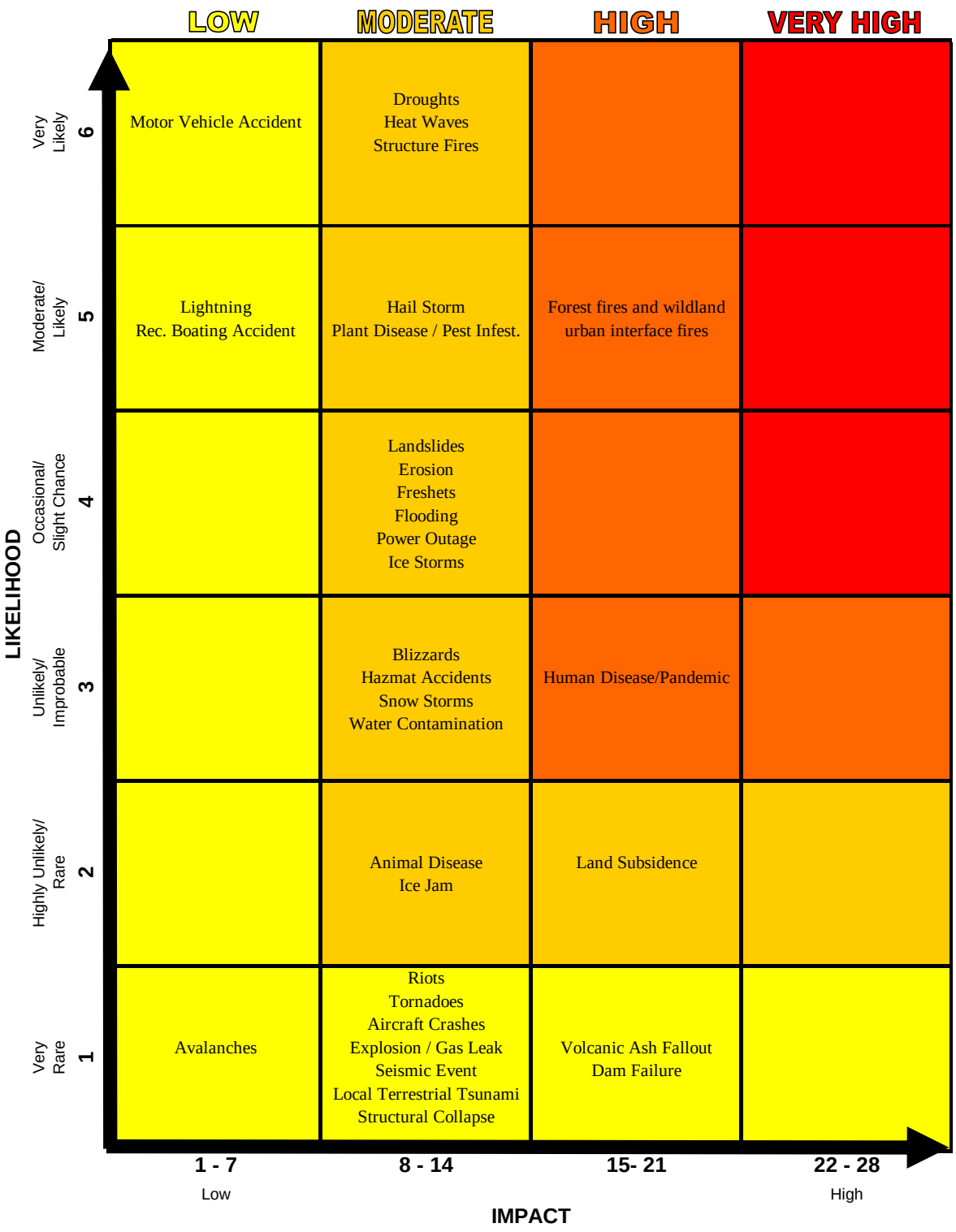
1. update its emergency plan,
2. allocate resources for risk mitigation of applicable hazards beginning with the highest-risk hazards,
3. enhance community preparedness, and
4. prepare budgets for cost-effective, on-going emergency planning.

This HRVA uses both quantitative and qualitative methods to determine risk ratings for various hazards. Based on the information obtained in the course of this analysis, EmergeX Planning Inc. (EmergeX) has assigned each hazard with a rating of *very high*, h*igh*, *moderate* or *low*, though this assessment did not find any hazards with a rating of *very high* in the District. EmergeX proprietary tools have been utilized in conjunction with the Provincial Emergency Program's (PEP) HRVA Toolkit to provide the most accurate assessment possible.

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

- Forest fires and wildland urban interface fires
- Human Diseases and Pandemics

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.


LOW
MODERATE
HIGH
VERY HIGH
LIKELIHOOD
Very Likely
6
Moderate/ Likely
5
Occasional/ Slight Chance
4
Unlikely/ Improbable
3
Highly Unlikely/ Rare
2
Very Rare
1
Motor Vehicle Accident
Droughts
Heat Waves
Structure Fires
Lightning
Rec. Boating Accident
Hail Storm
Plant Disease / Pest Infest.
Forest fires and wildland urban interface fires
Landslides
Erosion
Freshets
Flooding
Power Outage
Ice Storms
Blizzards
Hazmat Accidents
Snow Storms
Water Contamination
Human Disease/Pandemic
Animal Disease
Ice Jam
Land Subsidence
Avalanches
Riots
Tornadoes
Aircraft Crashes
Explosion / Gas Leak
Seismic Event
Local Terrestrial Tsunami
Structural Collapse
Volcanic Ash Fallout
Dam Failure
1 - 7
8 - 14
15- 21
22 - 28
Low
High
IMPACT

1.0 Introduction

This hazard, risk, and vulnerability assessment was conducted by EmergeX Planning Inc. for the District of Summerland's Emergency Program. The study was partially funded by a grant from the Union of British Columbia Municipalities.

1.1 Hazard, risk, and vulnerability analysis

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 (Provincial Emergency Program, 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 (Ministry of Public Safety and Solicitor General, 2004).

For example, a community may have a professional full-time fire department making it less vulnerable to a structure fire event than a similar community without a fire department. Likewise, a community with a fire hall located on a flood plain is more vulnerable than a similar community with a fire hall built outside the flood plain area due to the possibility that the fire hall will be out-of-commission as a consequence of flooding. Like the fire hall on the flood plain (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 Corporation of the District of Summerland (herein referred to as *the District of Summerland* or *the District*). 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 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.

For this study, a number of sources and knowledgeable persons contributed information. The Provincial Emergency Program provided a copy of *British Columbia: Hazard, Risk and Vulnerability Analysis,* 1997.

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

- Demographics
- Geography
- Industries and Other Technologies
- Transportation Modes and Routes
- Weather and Climate

EmergeX has identified 37 hazards that could affect the District of Summerland. 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 District than others. These hazards are outlined in Provincial Emergency Program HRVA Toolkit. It should be noted that the hazards described in this report are not necessarily unique to the District of Summerland and other jurisdictions with

similar industrial, economic, residential, and physical characteristics may also be subject to some of these 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 (see Appendix B). 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. Each hazard was given an aggregate score that combined impact consequence and likelihood (i.e. 15/4). This aggregate score provided the basis for a risk ranking of ***low***, ***moderate, high*** or ***very high*** (see Appendix C).

2.0 District of Summerland Overview

2.1 Setting

The District of Summerland is located in the heart of the Okanagan Valley in south-central British Columbia. The District's municipal boundaries encompass 67.34 km^2 of land and are bounded to the east by Lake Okanagan. Figure 1 shows the location of the District of Summerland.

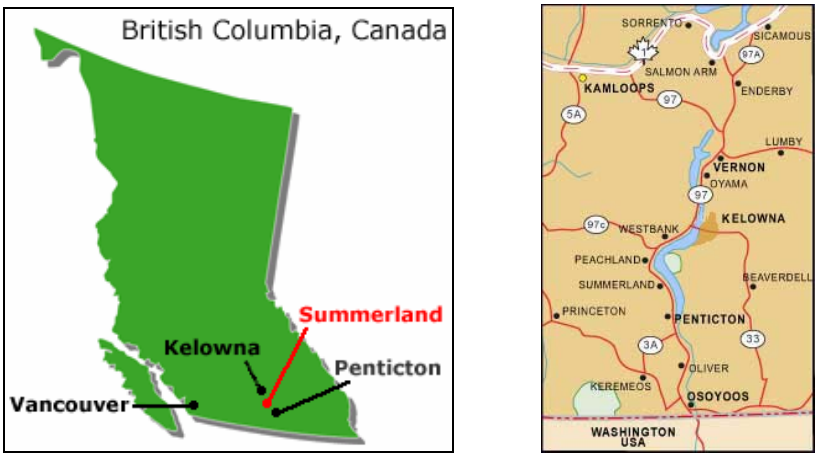


Figure 1 Geographic setting of the District of Summerland within the province of British Columbia (left) and in relation to nearby towns and cities (right). (District of Summerland, 2005)

2.2 Population

The most recent Census of Canada reports 10 713 residents in the District (Statistics Canada, 2001), however, more recent estimates place the number at approximately 12 000 (District of Summerland, 2004, p7). Over the next 20 years, an average population growth rate of 3.0% per year is predicted, meaning the population is expected to grow to over 16 000 by the year 2010 (District of Summerland 1996). Approximately 26% of the population is 65-years or older which is indicative of Summerland being a popular destination for retirees. Table 1 gives a demographic overview of the District.

Table 1 Demographic profile for the District of Summerland (District of Summerland 2005a; Statistics Canada 2005)

DEMOGRAPHICS	DISTRICT OF SUMMERLAND
Population in 2001	10 713
Population in 1996	10 584
1996 to 2001 population change (%)	1.2
Projected population 2005	13 995
Projected population 2010	16 225
Total private dwellings	4 669
Population density per square kilometre	153
Population under 15 years of age	1 725 (16%)
Population over 65 years of age	2 780 (26%)

2.3 Economy

The District of Summerland has a well-established agricultural industry based on fruit growing and processing. In addition, many light industries also exist providing the District with a diverse and relatively solid economic base. Tourism is also a major industry, especially in the summer months.

The largest single employer in the District is School District No. 67 with approximately 200 employees. Other large employers include The BC Fruit Packers Cooperative (100 employees), Agriculture Canada Research Station (90 employees), and the Municipality of Summerland (75 employees) (District of Summerland Chamber of Commerce 2002).

2.4 Emerging issues

The District of Summerland has three new developments either currently being developed or approved. The Summerland Hills Golf Course and related residential areas is located to the west of the main town developments. Summerland Hills is approximately 420 ha containing a golf course, 1115 homes, and 650 tourist accommodations. Due to its location, the Summerland Fire Department has raised concerns over the response time to fires in this area which is especially important due to its classification as an *interface fire hazard* zone (Noble 2005).

The other two developments, Summerland Vista hillside residential development and Lakeshore Commercial Zone are both within an acceptable travel time from the Summerland Fire Department. However, the Lakeshore Commercial Zone may be at risk from landslide related hazards due to the silt bluffs in the area.

3.0 Vulnerability

3.1 Social Vulnerability

This HRVA focuses on certain aspects of social vulnerability and their role in contributing to the risk from hazards. Generally, the term social vulnerabilities reflects "…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, vulnerability is defined as the ability of an individual within a household to recover from a natural hazard impact.

Social vulnerability information is particularly relevant and should be considered a key element of any emergency plan. Numerous hazards such as floods, interface fires, earthquakes and human health emergencies can have serious impacts on vulnerable populations (e.g. the very old and the very young), just as certain types of disasters can have a tremendous impact on the housing market and local economy.

Of particular concern are areas with a high concentration of ethnic, non-English-speaking or low income residents. In such areas, preparedness materials and/or official advisories issued by emergency officials may need to be customized so that all residents can understand them.

3.1.1 Language Groups

The majority (88%) of residents of the District of Summerland reported knowledge of English in 2001 (Statistics Canada 2005). The 1% of the population (80 persons) who speak neither English nor French may require special arrangements in a response to an emergency.

3.1.2 Age groups

Of particular importance in considering the age characteristics of the District's population are the elderly and the very young segments of the population. These groups are specifically vulnerable to many hazards (such as disease and heat waves) and may require special aid or assistance during evacuations. Nearly 26% of the District's population is 65 years of age or older and 16% of the population is under the age of 15 (Statistics Canada 2005). The proportion of residents within the 65+ group will likely grow in coming years as the District is a destination for many retirees.

3.2 Critical Facilities

Within this HRVA, critical facilities are defined as facilities that are essential in order for the District of Summerland to carry out emergency response activities. However, it is important to note that there are numerous critical facilities outside of the District that are

essential in order for the Province to support the District of Summerland in an emergency (e.g. the Provincial fire control centre and the PEP ECC in Victoria).

The primary critical facility for coordination of any large-scale disasters or emergencies is the District's EOC, located at the City Hall. Before, during, and after a hazard event, the EOC is essential for site support, including the coordination of special resources, information, multiple departments and external agencies.

In addition to the EOC, emergency first response facilities are of critical importance to carrying out emergency response activities. These include police, fire and emergency health centres, along with shelter facilities including:

- Public Works Yard, 9215 Cedar Avenue
- RCMP, 8709 Jubilee Avenue East
- E.O.C., City Hall, 13211 Henry Avenue
- Fire Hall, 10115 Jubilee Ave West
- Summerland Health Centre, 12815 Atkinson Road
- Reception Centre #1, Summerland Arena, 8820 Jubilee Road East
- Reception Centre #2, Pacific Agri-Food Research Centre, 4200 Highway 97
- Summerland Secondary School, 9518 Main Street
- Summerland Middle School, 13611 Kelly Avenue
- Giants Head Elementary School, 10503 Prairie Valley Road
- Trout Creek Elementary School, 5811 Nixon Road

(District of Summerland 2003)

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 District of Summerland or the effective functioning of the government. 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)

(Public Safety and Emergency Preparedness Canada 2005)

Through the HVRA process, EmergeX has identified four sectors of critical infrastructure for the District of Summerland: **water**, **energy, communication** and **transportation**.

3.3.1 Water

According to Public Safety and Emergency Preparedness Canada (PSEPC), a population of 10 700 people requires a total supply of 43 m^3 per day or a total of over 600 m^3 of water over 14 days. This equates to four litres per person per day.

The District of Summerland's municipal water supply consists of three separate water systems:

- Trout Creek System (with an approximate capacity of 11.4 million m^3)
- Garnet Lake System (with an approximate capacity of 2.49 million m^3)
- District Emergency Wells at the Summerland Rodeo Grounds (with an approximate pumping rate of 3 600 L per minutes)

In addition to these three systems, the District has the capability to pump water directly from Okanagan Lake into a domestic storage tank at a rate of approximately 1 800 L per min.

A major disaster may threaten the extent of coverage and quality of water supplied by the District's three systems, including both the loss of drinking water and the loss of water for fire fighting. To respond to water supply emergencies, the District has a water quality emergency response plan.

In addition to providing emergency water supply to all residents, the District faces the challenge of organizing a water distribution system in the aftermath of a disaster event. Key water infrastructure in the District of Summerland includes:

- Trout Creek Watershed Dams: Thirsk Dam, Headwaters #1 Dam, Headwaters #2 Dam, Headwaters #3 Dam, Headwaters #4 Dam, Crescent Dam, Whitehead Dam, Canyon (Isinktok) Dam, and Tshu (Deer) Dam.
- Garnet Lake Watershed Dams: Garnet Valley Dam, Big Eneas Dam.
- Domestic Storage Tank (Lower Town Tank), Latimer Avenue, 190 000 L water storage
- Domestic Storage Tank (Deer Ridge Tank), 530 000 L water storage
- Domestic Storage Tank (Trout Creek Tank), Hillborn Avenue, 450 000 L storage supply
- Waste Water Treatment Plant, with auxiliary power to run entire plant, 7630 Dunn Street
- Chlorination Station, with auxiliary power, Garnet Valley Road
- Chlorination Station, with auxiliary power, 16500 Aileen Avenue
- Sanitary Lift Station, with auxiliary power, 12301 Lakeshore Drive South
- Sanitary Lift Station, with auxiliary power, 1487 Lakeshore Drive South
- Sanitary Lift Station, **no auxiliary power**, 7311 Lakeshore Drive North, Intersection of Slater Road and Lakeshore. (Note: A portable Gorman Rupp pump is available for use at this station when main power is disrupted.)
- Sanitary Lift Station, with auxiliary power, 910 Powell Beach Road
- Sanitary Life Station, with auxiliary power, 2611 Landry Crescent
- Sanitary Lift station, with auxiliary power, north end of Dale Meadows Park
- Domestic Pumphouse, **no auxiliary power**, 13415 Lakeshore Drive South
- Domestic Pumphouse, **no auxiliary power**, Agri-Canada, 4201 Hwy 97C
- Domestic Pumphouse, **no auxiliary power**, 8209 Simpson Road
- Domestic Pumphouse, **no auxiliary power**, Simpson Road and Gillman Road junction.

- Domestic Pumphouse #1, **no auxiliary power**, Dale Meadows Road
- Domestic Pumphouse #2B, **no auxiliary power**, 13000 Hermiston Drive
- Domestic Pumphouse #2A, **no auxiliary power**, 12601 Morrow Avenue
- Domestic Pumphouse #2, **no auxiliary power**, 11050 Rutherford Avenue
- Domestic Pumphouse #4, **no auxiliary power**, 12001 Loomer Road
- Domestic Pumphouse #3, **no auxiliary power**, 9850 Gillard Avenue

(District of Summerland 2003)

Due to the lack of auxiliary power at the domestic pumphouses, a power failure in the District of Summerland will result in the loss of water for fire fighting in certain areas of the District.

In addition, one or more fire hydrants do not meet the current FUS standard for minimum flow of *two hours at 528 gallons per minute* (approximately 2000 L per minute). This may hinder fire fighters from effectively fighting fires when relying on these hydrants.

3.3.2 Energy

Energy related infrastructure within the District of Summerland includes a network of electricity and natural gas transmission lines and facilities. FortisBC operates and maintain the main 60kV transmission line that provides power to the District of Summerland. The District of Summerland maintains the Trout Creek and Prairie Valley Electrical Substations. Terasen Gas operates facilities and gas lines within the District. Other energy-related infrastructure within the District of Summerland includes:

- Propane tank, Super Save Gas Station, Highway 97
- Propane tank, Summerland Rental Centre, 10008 Victoria Road South
- Propane tank, Public Works Yard, 9215 Cedar Avenue
- Generator Building (for Lift Stations only), intersection of Shaungnessy Ave and Lakeshore Drive
- Gasoline Storage, Summerland Yacht Club, Lakeshore Road
- Gasoline Storage, Propane, Trout Creek Gas Bar, 6011 Highway 97
- Gas Station, Esso, 14404 Rosedale Avenue
- Gas Station, Chevron/Macs Convenience, 14405 Rosedale Avenue

- Gas Station, Super Save, 13802 Highway 97
- Gas Station, Trout Creek Esso, 6011 Highway 97
- Gas Station, Summerland Shell, 9507 Main Street
- Gas Station, Public Works Storage Yard, gasoline and diesel storage for city vehicles

(District of Summerland 2003)

3.3.3 Communications

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 operations 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 with built-in redundancy.

The District of Summerland has one radio station (CHOR) broadcasting on AM 1450. While it primarily plays oldies and easy listening music, CHOR can be utilized as a medium to communicate critical information to the public in times of localized emergency or widespread disaster. The City of Penticton has two radio stations CJMG on FM 97.1 and CIGV 100.7 FM which also have coverage in the District.

There are a number of Amateur Radio operators and clubs in the District of Summerland and surrounding area. Section 5.4 below discusses Amateur Radio's role in emergency communications.

Radio communications between the various municipal and emergency services is currently fragmented, with each department or service having incompatible systems. This can greatly impact effective response during emergencies or widespread disasters when multiple agencies are required to work together.

3.3.4 Transportation

During and after an emergency or disaster, transportation is an essential component for effective emergency response and recovery. Access to the District of Summerland is limited to surface transport, though an airport exists in nearby Penticton.

Surface transportation takes place primarily via Highway 97, though the District is also accessible by water on Lake Okanagan and via backcountry and logging roads connecting it to Penticton to the south and to Princeton via secondary highway 40 to the west. The Summerland Transit System is connected to Penticton Transit by bus route #1. While not a

full service bus route, route #1 provides door-to-door service for elderly and disabled residents to visit specialists in Penticton. The District is also serviced by Summerland Taxi. Intercity bus service is provided by Greyhound Bus Lines.

The Penticton Regional Airport (YYF) provides regular scheduled service from Air Canada Jazz, and charter services are provided by Southern Skies Aviation Ltd., Eclipse Helicopters Ltd., and CHC Helicopter Corporation. The airport has a class C runway and is equipped for instrument landing. An additional turf runway of restricted use is available.

4.0 Response capabilities

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

4.1 Fire

The Summerland Fire Department (SFD) consists of three full-time staff and 25 paid on-call firefighters. The full-time staff includes a Fire Chief, an Assistant Fire Chief, and an Operations Assistant. The SFD services include: fire suppression, fire investigation, fire safety inspections, by-law enforcement (as it relates to fire prevention), a full spectrum of fire & rescue training, public education, complete rescue services, Provincial Emergency Program coordination and response, and municipal disaster planning and training. Incidents are reported through the Regional Fire Dispatch 9-1-1 system and located in Penticton's Fire Hall #1.

The SFD equipment includes a 2002 Ford F-550 Crew Cab Forestry Truck with 1135 L tank, 1999 Freightliner Water Tanker with 1600 L/min pump and 6810 L tank, 1996 Ford Explorer, 1995 Chevy 4x4 pick-up, a 1995 Freightliner Rescue Vehicle, 1992 Pierce Dash 4730 L/min pumper with 2270 L tank, 1999 Ford F-550 4x4 mini-pumper with 1060 L compressed air foam system, 1989 4x4 Suburban, 1982 International 3975 L/min pumper with 3025 L tank, 15 MSA breathing apparatus, 3 chain saws, 1 masonry saw, 4 x 110 V/100 W generators, 10 x 100 V flood lights, and 2 portable pumps. There are approximately 416 public and private fire hydrants throughout the District.

The SFD is able to respond to two simultaneous structure fires or one structure fire and one other minor incident. Upon responding to the second incident, mutual aid may be requested from either Penticton or Peachland. Mutual aid may also be requested when responding to a major industrial or commercial fire. The request for mutual aid is made at the discretion of the Duty Officer in charge.

When fighting fires for extended periods, other fire departments can be scheduled to relieve the SFD through the Regional District Mutual Aid system. The SFD has very dedicated paid on-call fire fighters and most, because of their local jobs, can commit for extended periods of time.

Annex K of the District's Municipal Emergency Plan lists mutual aid agreements with the City of Penticton and the District of Peachland, and a number of other communities (including Naramata, Kaledan, Town of Oliver, Town of Osoyoos, Town of Princeton, and the Hedley Improvement District) through an agreement with the Regional District of Okanagan-Similkameen.

The SFD has full responsibility for all wildland/forest fires within the District's borders. The Ministry of Forests and Range has primary responsibility for wildland/forest fires

outside the District, however, a March 14, 2003 memorandum (file: 14620-07) exists between the Ministry of Forests and Range's Kamloops Fire Centre and the District of Summerland that states the SFD will respond to nearby wildland/forest fires outside the district until MoFR fire crews arrive. The nearest MoFR crews are based in Penticton. Throughout the forest fire season, response time from Penticton MoFR crews is between 20 minutes and one hour.

4.2 Police

Municipal policing is provided by the RCMP's Summerland Municipal Detachment located at 8709 Jubilee Road East, Summerland. Additional support is provided through the RCMP's E Division. The detachment is made up of 1 sergeant, 1 corporal, 7 constables, and 2 stenos. The detachment has 5 vehicles.

4.3 Ambulance

Emergency medical service is provided by the British Columbia Ambulance Service (BCAS) which is dispatched by the regional 9-1-1 system. The District has two units based at the ambulance station located at 14202 Rosedale, Summerland. The District is cross-covered by the stations in Peachland and Penticton. Critical Care Transport (CCT) is provincially coordinated through the British Columbia Air Ambulance Service.

4.4 Search and Rescue

The Penticton and District Search and Rescue (PENSAR) provides search and rescue services to areas around Penticton, including the District of Summerland. PENSAR consists of 45 volunteer members certified in several wilderness search and rescue disciplines. Activation of PENSAR would be coordinated through the RCMP.

5.0 Emergency support and preparedness organizations

In addition to primary response organizations, the District of Summerland utilizes a number of organizations and programs to prepare for and support response and recovery in the case of an emergency or disaster. These include the District's Emergency Management Operation Centre (EOC) and the District's Works and Utilities department. The District may also draw on the resources of several external organizations.

5.1 Municipal Emergency Operations Centre

The Emergency Operations Centre (EOC) is located at the City Hall. Before, during, and after a hazard event, the EOC is essential for coordinating resources, information, multiple departments and external agencies. In order for the effective operation of the EOC, personnel from various departments must be trained in EOC operations. In addition, the EOC should be activated in a simulated emergency in order to test current practices, reinforce procedures, and identify any shortfalls or problems.

It should be noted that the EOC does not currently have backup power, a municipal EOC plan, nor trained personnel. It is critical for personnel from all major municipal departments to be trained in EOC operations and to participate in simulation exercises. A number of alternates for each EOC function should also be trained so that they can relieve each other during lengthy EOC activation and act as backups should the primary person be unable to attend.

5.2 Public Works and Utilities

The Works and Utilities Department is responsible for the operation, maintenance and capital construction of the District's roads, solid waste, and cemeteries, in addition to the District's water, sewer, and electric utilities. However, additional support resources are available from both provincial and private sources.

The Argo Road Maintenance Inc., based in Penticton, BC, is an additional provincial resource available to support public works in the District of Summerland. Support for septic, excavation and earth-moving services is provided by several private contractors:

- Septic vacuum trucks: Budget Septic and Sump, Dick's Septic Service
- Backhoes and dump trucks: Dave Miller Trucking, D. Knight Trucking, Dave's Backhoe Service, R. Beggs Trucking/Backhoe, Minty Bulldozing.
- Excavators: Inglis Enterprises, Summerland Excavation Services, Rental Excavator, Gar McLean Excavator.

(District of Summerland 2004a)

5.3 Emergency Social Services (ESS)

The District's Emergency Social Services consists of approximately 20 volunteers who provide short-term assistance to people who are forced to evacuate their homes due to an emergency. In case of a wide-spread emergency, the primary reception centre will be located at the Summerland Arena.

The ESS team is under the direction of the Summerland Fire Department. **However, in the event of an emergency, the SFD will be unable to manage and coordinate the ESS team as they will be responding directly to the incident site.**

5.4 Amateur Radio

The South Okanagan Radio Amateur Club provides backup emergency communications to the District of Summerland and has a radio room located in the Summerland Fire Hall. In addition to backup communications within the District, Amateur Radio operators can provide communications links to Provincial Regional Emergency Operations Centres (PREOCs) and to other municipalities (e.g. to request mutual aid or share critical information) when other forms of communications are unavailable.

5.5 Health Authorities

The District of Summerland is serviced by the Okanagan Health Service Area of the Interior Health Authority. Interior Health is the administrative organization responsible for providing all publicly funded health services to the people of the Southern Interior of British Columbia (Interior Health Authority 2005b). Interior Health serves a large geographical area, covering 200 000 km^2, from Williams Lake in the north, east to the Alberta border and south to the US border, with a client population of over 700 000 people (Interior Health Authority 2005a). Figure 2 shows the Interior Health Authority service areas.

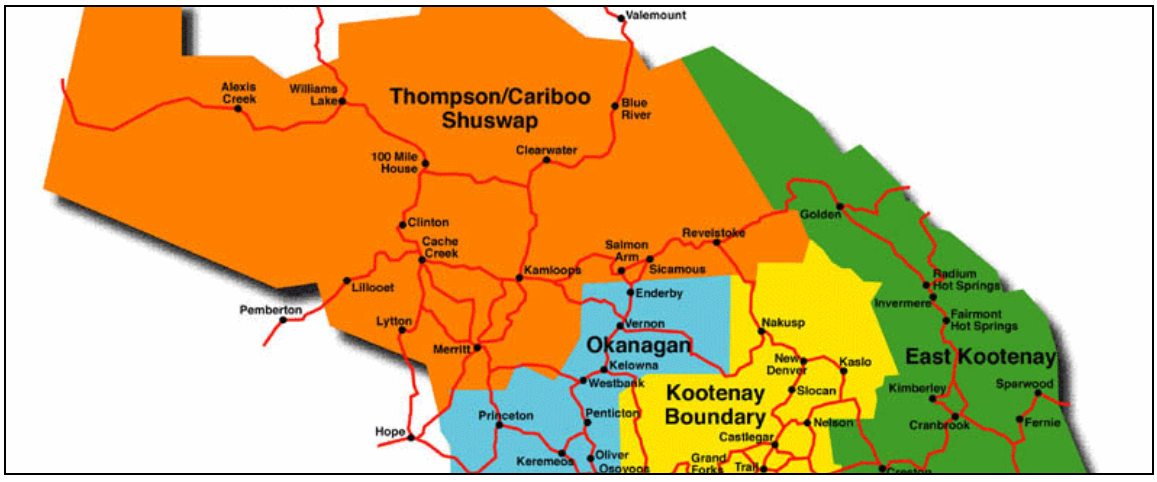


Figure 2 Interior Health Authority Service Areas (Source: Interior Health Authority)

The District of Summerland itself is serviced by a total of 12 physicians and three dentists with hospital privileges (District of Summerland 2004 - Annex "F"). Facilities that may be able to play a local support role include Rosedale Medical Walk-in Clinic, and the Extended Care Unit (50 beds) (District of Summerland 2003).

The limited health resources within the District of Summerland suggest support may be required from surrounding communities. The Penticton Regional Hospital is the primary health facility servicing the District, however Kelowna General Hospital to the north may be the only accessible hospital if Highway 97 between Penticton and Summerland is blocked due to a landslide or other incident. A regional facility with responsibilities for administration of health services is located across from the Penticton Regional Hospital. In addition to the hospital there are a number of private facilities in Penticton which include three medical centers: The R. B. White Clinic with 16 Physicians and Specialists, The Carmi Medical and Dental Building with 12 physicians and specialists, and the Skaha Medical Centre with 33 physicians on a scheduled basis, numerous dental laboratories, three naturopathic physicians and 10 Chiropractors (City of Penticton 2005).

5.6 HAZMAT

There are hazardous materials located at various locations throughout the District of Summerland (District of Summerland 2003). 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.

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).

6.0 Hazards

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

In selecting these events for consideration, the Emergency Planning Committee acknowledges the potential, however small, that other types of emergencies may demand site support in the future. 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 impact and likelihood.

6.1 ATMOSPHERIC

6.1.1 Blizzards

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.

According to Environment Canada, on average there are approximately 116 days per year when the temperature reaches 0 °C or below. The District's extreme minimum temperature of -30 °C was recorded in January, 1950. Records indicate that snowfall (> 0.2 cm) occurs on average on 28 days per year in the period between November and April, but more rain falls over the course of the same period. Most of this snow does not accumulate. The average snowfall in the month of December is 22.1 cm, with January yielding an average of 21.8 cm. Wind direction is difficult to predict, but maximum gusts can exceed 95 km/h on average during the winter months suggesting that blizzards can occur.

While blizzards are not a common occurrence in the District of Summerland (Noble 2005; Palmer 2005), the District does have sufficient snow-removal equipment for dealing with such events (Palmer 2005).

The risk of a blizzard to the District of Summerland is *moderate*.

6.1.2 Hail Storms

Hail storms 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).

The interior of BC receives an average of three hailstorms per year, with large pellet storms more common on the eastern slope of the Rockies. The Okanagan Valley experienced a major hailstorm near Penticton in 1946 which caused $2 million of damage to pear and apple crops. Another devastating storm took place on July 21, 1997, in the Okanagan damaging much of the crop, resulting in 40% of the crop deemed unsuitable for fresh market. The rain and hail was accompanied by strong winds gusting up to 100 km/h, capsizing boats and causing power outages and traffic accidents (Environment Canada 2002).

While hail storms occur annually, most are not as damaging. Some climate scientists point to the increased frequency of large hailstorms in cities such as Calgary as an indication that western Canada will experience more negative effects from these storms in the future.

The risk of a hail storm to the District of Summerland is *moderate*.

6.1.3 Heat Waves

A heat wave can take a number of forms. Such events can be characterized by temperatures significantly above the mean for an extended period of time, or by a combination of high temperatures with high humidity and lack of air motion. Impacts of heat waves can range from crop losses to high mortality due to heat stroke 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.

According to historic climate data collected by Environment Canada (2005), the daily average summer temperature during the months of June, July and August is approximately 19.3 °C. The maximum daily temperature was approximately 40 °C on July 16, 1941. On average, there are less than 0.6 days in the summer months with a maximum temperature greater than 35.0 °C.

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.

Some homes in the District of Summerland, especially older homes, may not have air conditioning systems. While this may not post a great risk for the healthy, elderly and sick residents may require re-location to cooler facilities during a heat wave. Additionally, care

facilities which require air conditioning for the well-being of their residents and patients should ensure they have contingency plans in case of an extended power outage.

The risk of a heat wave to the District of Summerland is *moderate*.

6.1.4 Ice Storms

An ice storm combines high wind, freezing temperatures and freezing rain or drizzle. The freezing rain and drizzle builds up as ice on roads, buildings, trees, power lines, and other infrastructure. The weight of this ice build-up can cause the structures to collapse. The disruption of transportation systems, communication and power infrastructure can have serious and potentially fatal consequences.

Major ice storms in Canada include the Montreal Ice Storm in 1961, the Ottawa Ice Storm in 1986, and the Eastern Canada Ice Storm in 1998 (Canadian Broadcasting Corporation). The Ottawa storm in 1986 left 1 in 4 homes without power while the 1998 storm in Eastern Canada toppled power lines leaving 3.8 million people without power for extended periods (Canadian Broadcasting Corporation 1986).

The District of Summerland experiences a few minor ice storms (Miskiman 2005; Noble 2005). These may disrupt local transportation networks as roads will become very slippery making driving especially hazardous and accidents likely on the District, especially on the District's many hills. Vehicles left outdoors may also become frozen in place.

In the event of an ice storm, the District does have equipment to sand and clear ice from affected roads (District of Summerland 2005b). If power is disrupted due to ice build-up causing the collapse of power lines, the lack of backup power to the EOC may affect the District's ability to respond to incidents requiring site support (i.e. the activation of the District's EOC).

Due to the widespread nature of ice storms and the potential for collateral impacts, the risk of an ice storm to the District of Summerland is *moderate.*

6.1.5 Lightning

Lightning is caused by the union of three contingent factors: moisture laden air, the instability of existing weather systems and triggering agent which causes air near the ground to ascend. Lightning strokes 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 percent of forest fires in Canada are caused by lightning which generally ignite in remote areas, each burning an average of 560 hectares compared to 50 hectares for most human-caused fires[1]. The mean annual burned area of lightning induced fires is 2.125 million hectares or about 0.6 percent 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 1994. The Okanagan Park Fire, which burned across Okanagan Lake from the District of Summerland, caused 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.

In addition to forest fires and wildfires, lightning can cause structural damage. In June 2002, lightning struck a property in Summerland three times with one strike hitting an underground natural gas pipeline resulting in a massive explosion that destroyed a home and killed two people. The blast knocked pictures off the walls of houses up to a kilometre away (Canadian Press 2002).

While lightning is common, most strikes do not damage property, start fires, or injure people. Therefore, the risk of lightning is considered *low*.

6.1.6 Snowstorms

Snowstorms can result in the accumulation of several decimetres to several metres of snow. Unlike blizzards, they are not associated with high winds. Populations in areas that do not usually receive much snow on an annual basis may be severely impacted by even moderate accumulations of snow. The wide distribution of hydroelectric and communication lines and towers are also affected by heavy snowfall. Accumulation of snow on these lines may cause breakage, disrupting service and power to wide areas.

According to Environment Canada (2005a), the two months with the greatest snowfall are December and January with 22.1 and 22.8 cm of snowfall, respectively. The extreme maximum snow depth of 58 cm was recorded in January 19, 1972.

In the event of a snowstorm, transportation to the District of Summerland may be interrupted or delayed due to snow accumulation and/or low visibility. The resulting driving conditions will increase the risk of motor vehicle accidents. Disruption to air transportation services may also be caused. These incidents combined may be sufficient to burden local response agencies such as highway rescue, fire, police, ambulance and public works.

According to the SFD (Miskiman 2005) and Environment Canada (2005a), heavy snowfalls are not common in the District of Summerland but they do occur. In 1995, a

[1] 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.

massive snowstorm in the Okanagan Valley resulted in the Kelowna Airport being closed for most of the day (CTV, 1995). While heavy snowfall may not be common in the lower elevations of the District, snowfall in the watersheds which house the District's water sources and reservoirs may accumulate causing transportation difficulties and impede access to District water facilities. In the event of snow accumulation, the District has equipment to sand and clear roads (District of Summerland 2005b; Palmer 2005), though the District's snow removal capacity may be overwhelmed during times of heavy snowfall and there may be a delay in snow removal, especially to non-arterial streets.

The risk of snowstorms to the District of Summerland is *moderate*.

6.1.7 Tornadoes

A tornado is a very rapidly rotating air funnel hanging from a cumulonimbus cloud and usually takes the form of a funnel. The risk of tornadoes is greatest in areas where there are frequent thunderstorms and hot, humid weather. Small forms of tornadoes such as waterspouts are reported in the Vancouver and Victoria areas, especially during the summer months.

As Figure 3 shows, every province in Canada is subject to the risk of tornadoes but tornadoes are rare in most of British Columbia. According to the SFD (Miskiman 2005; Noble 2005), there have been no tornadoes in recent memory within the District of Summerland or area.

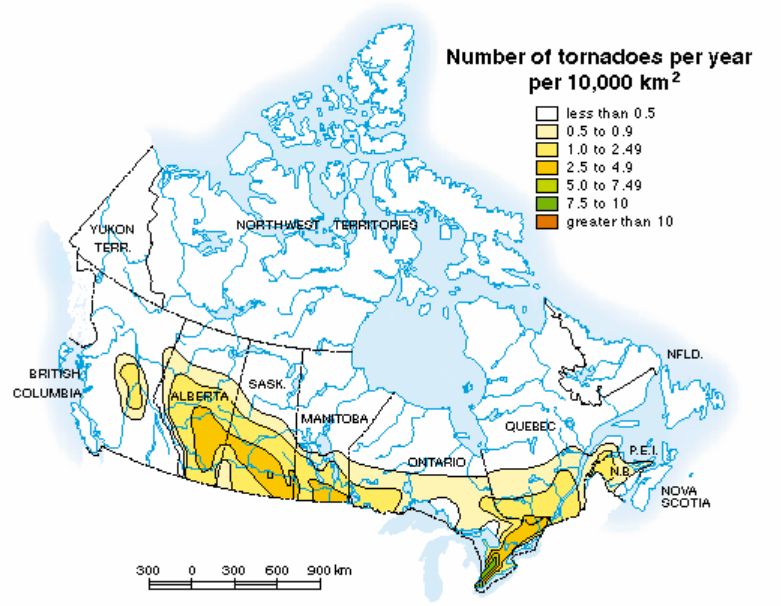


Figure 3 Distribution of tornado events in Canada (Source: Environment Canada 2005c)

Small local mini-tornadoes called dust devils, however, do occur in and around the District of Summerland. While not technically tornadoes, their appearance is similar but on a much smaller scale. They result from gusting winds and can cause forest fires and wild fires to

act erratically. Dust devils, caused by gusting winds, resulted in fires jumping fire containment lines and highways during the 2003 Firestorms (Canadian Press 2003b).

The risk of tornadoes in the District of Summerland is *low.*

6.2 GEOLOGICAL

6.2.1 Avalanches

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 District's topography and low snowfall, avalanches are not considered likely and have not occurred within the District in the recent past (Miskiman 2005; Noble 2005). The risk of Avalanches to the District of Summerland is *low*.

6.2.2 Landslides: Debris Flows, Debris Avalanches, and Rock Falls

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, while a debris avalanche is an extremely rapid debris flow of mud, rock, brush, trees, and other debris often under torrential rain conditions. Approximately half of all damaging landslides in British Columbia are debris flows (Evans et al 2002).

These 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.

The District Summerland contains a number of silt bluffs that are susceptible to landslides and have experienced slides in the past. These areas have been designated as *high hazard areas* under Section 945(4)(b) of the Municipal Act and are shown in detail on the maps in Schedule G of the District of Summerland Official Community Plan 1996. Figure 4 gives an overview of the high hazard areas. Development in these areas requires special approval due to the high risk of landslides.

The two damaging slides involving the District's silt bluffs took place in 1970 and 1992 along Lakeshore Drive (Evans et al. 2002). The 1970 slide occurred on Sept 27 and destroyed three homes killing one person. A 60 m stretch of Lakeshore Drive was covered with 4 m of silt. The second slide occurred on Sept 15, 1992, approximately 600 m south of the 1970 incident. A 45 m stretch of Lakeshore Drive was covered with about 5 m of silt and cars and boats inside a damaged garage were destroyed. No one was injured.

A landslide on the silt bluffs along highway 97 may cut-off highway access to the District of Summerland from either the north or the south. A landslide closing access to/from the south will force all emergency medical (ambulance) transport to go to the hospital in Kelowna rather than the closer Penticton hospital.

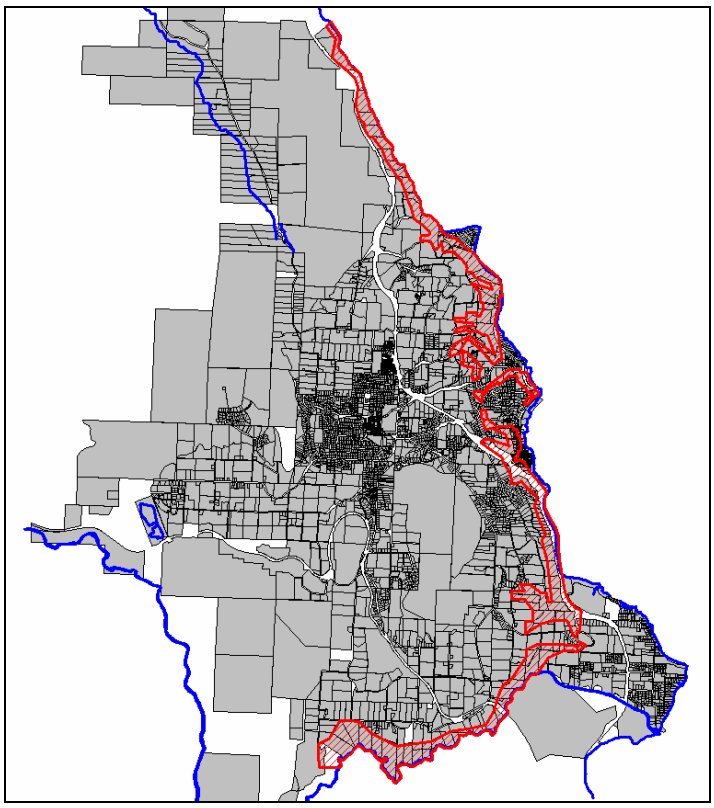


Figure 4 Silt bluff high hazard areas. The area in red shows the silt bluff high hazard areas as identified in the Municipal Act and the Official Community Plan (1996).

In addition to these landslide events, there area also two perpetual slides (a slow downward slope movement). Both are in the area of the Summerland Golf and Country Club. One is on the silt bluffs below the Club and has been releasing a substantial amount of sediment into the Trout Creek, contributing to the changes in Trout Creek's environment and resulting in the loss of useable fish habitat in the lower few kilometres of the creek (Ashley et al. 1998). The other is below the golf course on Mountain Avenue. No major structures are at risk, however this could have a negative impact on the golf course itself.

The risk of a landslide to the District of Summerland is *moderate*.

6.2.3 Seismic Event

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.

According to the National Building Code 1990, the District of Summerland is located in seismic zone 2 of six possible zones (zone 6 being the most extreme). Zones three through six 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 (for more information, see http://www.pgc.nrcan.gc.ca/seismo/eqhaz/seishaz.htm).

The District of Summerland is not 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.

The majority of the structures are of wood frame and low level (Palmer 2005). 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.

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

The risk from a seismic event for the District of Summerland is *low*.

6.2.4 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 pyrocastic 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. 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 southern BC (Provincial Emergency Program 2005a).

The risk of volcanic ash fallout to the District of Summerland is *low*.

6.2.5 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 a very costly, especially when shifts in land cause damage to property and lives. Subsidence usually occurs slowly over a large area.

Several areas of the District of Summerland are either on or below silt bluffs. These bluffs are subject to subsidence and are designated as high hazard areas under section 945(4)(b) of the Municipal Act. Any development within these areas are at risk of subsidence.

The risk of subsidence to the District of Summerland is *moderate*.

6.3 HYDROLOGICAL

6.3.1 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 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, often of a local nature.

According to Neilsen et al (2001), climate change is likely to have a negative effect on the water supply in the Okanagan region for the foreseeable future. This coupled with the increased competition for water from domestic, commercial, and agricultural users, suggests that drought events will become more common.

The District of Summerland is an area yielding many orchard and vine-ripened fruits, and is rivalled only by Kelowna in fruit production and processing in the Okanagan. The Okanagan Basin has the lowest per capita availability of water in Canada, and agriculture draws upon 75% of the total usage (Neilsen 2004). In recent years, discussion has taken place regarding the possible effects of global warming on available water and irrigation. Warmer temperatures are likely to increase the demand on irrigation, and lower levels of snow and rainfall are predicted. Earlier spring freshets and earlier recessions are also discussed as potential impacts as a result of irrigation demand. Finally, increases in domestic demand due to population growth will contribute to the future pressures on water resources in the District. This may leave minimal water for usage and storage.

Recent years have seen the water storage use period being set prior to July 1st, in addition to lower than average levels of precipitation (Bennest 2005). The possibility of drought condition occurrence may increase, which will not only directly affect the economy, but may also force changes in the agricultural species makeup of the region in the long term. With increased CO_2 levels and higher temperatures, plant response to high-temperature stress, below ground processes and nutrient allocation are variables that may change for a negative overall effect on the agricultural environment.

In the District of Summerland, this was most recently felt in the summer of 2003 which was one of British Columbia's driest summers in recent memory (Zacharias 2003). Summerland's water supply was low enough for the Province of British Columbia to extended a State of Emergency to the District due to water shortage (Canadian Press 2003a).

The District has three main water sources. The Trout Creek System satisfies about 90 percent of the District's water demand, the Garnet Valley System provides about 10 percent, and the Summerland Rodeo Grounds Water System supplies water to only three clients from a ground well. The District also has a water license on Okanagan Lake which

can provide water to the Lower Town holding tank. This source is used as a backup because an online chlorination system is not currently connected; a portable chlorinator would need to be borrowed from one of the other systems in an emergency situation. The District also has two emergency wells (Palmer 2005). Specific vulnerabilities in the water system include the dams which may be susceptible to failure, the open reservoirs which are susceptible to both natural and intentional contamination and the absence of backup power for some of the District's water pumps.

It should be noted that most fish and flora will not be permanently affected from droughts, though extreme cases may have more lasting impacts (Matthews and marsh Matthews, 2003).

Due to its widespread nature and impact on the agricultural industry, drinking water supplies, and fire flow requirements, the risk of drought to the District of Summerland is *moderate*.

6.3.2 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.

The District of Summerland is susceptible to erosion along the silt bluffs, along the creeks within the District, and along the shorelines of Lake Okanagan. The silt bluffs pose the greatest hazard to structures within the District and to transportation routes to and from the District. A number of points along Highway 97 are at risk of being cut-off from a land slide resulting from instability caused by erosion of the bluffs. Erosion of the beaches along Lake Okanagan may cause damage to the beaches. Sedimentation may occur along Trout Creek and can have a detrimental effect on its fish populations.

The risk of erosion and sedimentation to the District of Summerland is *moderate*.

6.3.3 Flooding

Local 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 see local flooding when water inflow surpasses the pumps' capacity. In addition, storm drains, drainage ditches, or natural drainage channels can become blocked by sediment, debris or ice and cause local flooding. Excessive rainfall is the basic cause behind most river floods, leading to inundation of low-lying river floodplain areas. Flooding can also be caused by dam failure, large waves on Okanagan Lake and on a local level by ruptured water mains. Low-lying areas are the most commonly affected by flooding.

Figure 5 shows the 200-year flood plain of Trout Creek. A 200-year flood plain indicates that the area within the flood plain will flood at least once every 200 years, on average.

Due to its infrequency and the confined nature of the impact area, the risk of flooding is considered *moderate*.

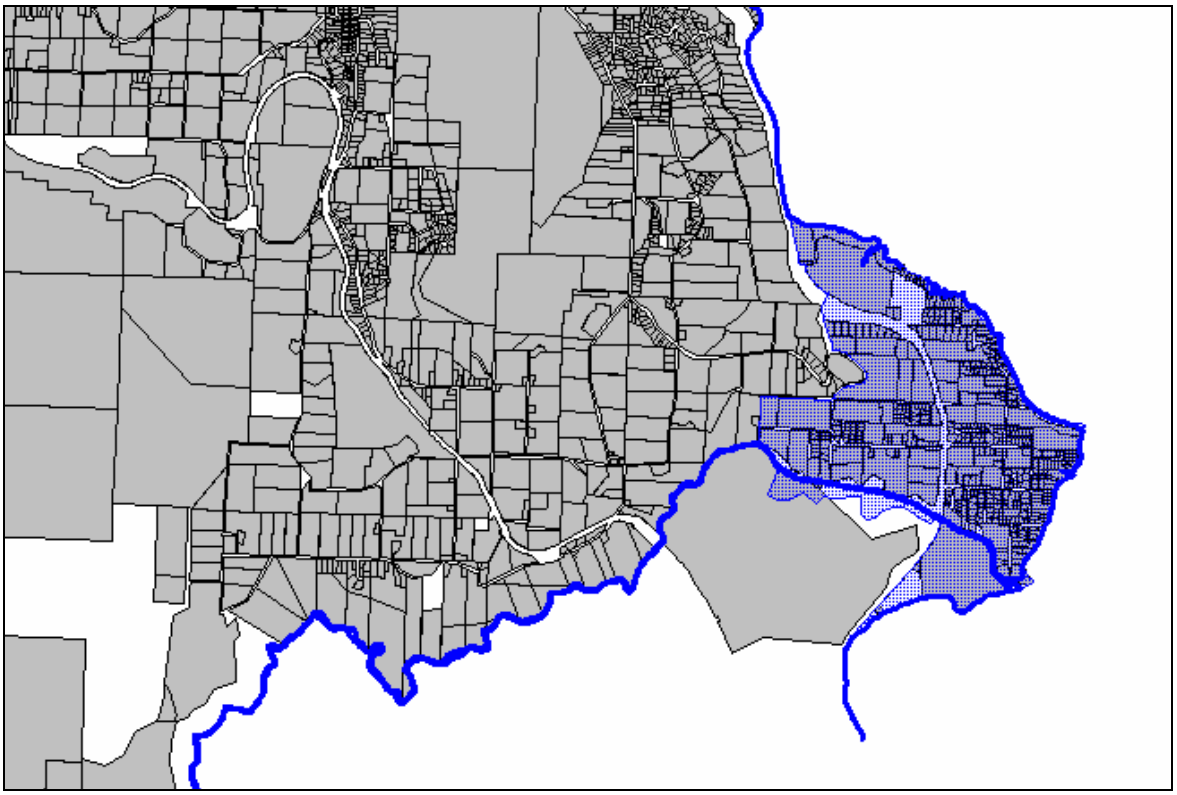


Figure 5 Trout Creek flood plain. The area shown in blue indicates the 200-year flood plain of Trout Creek while the grey polygons indicate property parcels within the District of Summerland.

6.3.4 Ice Jams

Ice jams result from the accumulation of ice fragments that build up and restrict the flow of water by causing a temporary obstruction. Jams form during freeze-up as well as break-up periods, but break-up jams typically have the greater potential as they are associated with ice thaws and melting.

Ice jams are a concern in the District of Summerland, especially along Eneas Creek (Miskiman 2005; Noble 2005) where ice can freeze from the creek bed up causing flooding. As a mitigation measure, the District has crews clear the ice on a daily basis during the winter months (District of Summerland 2005b).

The risk of ice jams to the District of Summerland is *moderate*.

6.3.5 Freshets

During the Canadian winter, most of the precipitation is simply stored as snow or ice on the ground. During the spring melt, huge quantities of water are released, which explains our heavy spring runoff and flooding. This is called *freshet* (Environment Canada 2005b). These floods generally occur in the spring but will also occur during sudden winter thaws.

According to the Camp Creek monitoring station (located where Camp Creek feeds into Trout Creek) the mean monthly discharge peaks in May (Figure 6). This suggests that the peak flow in Trout Creek will take place at approximately the same time. it is likely that freshet floods would take place at this time.

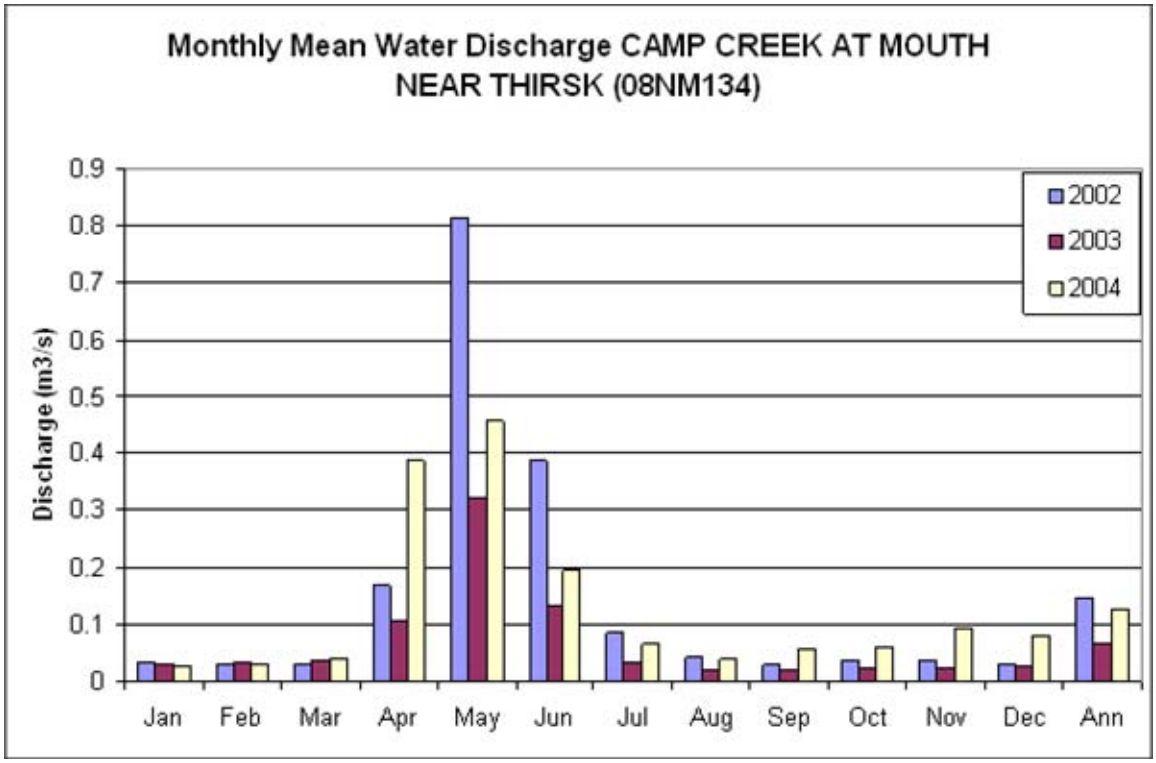


Figure 6 Historic discharge levels for Okanagan River at Penticton (Environment Canada 2005b)

Snowmelt runoff floods are the most common type of flooding in Canada. Due to the District's dike system and the infrequency of freshet floods in the District, the risk of freshets is considered *moderate*.

6.3.6 Local Terrestrial Tsunami

Tsunamis are large wave events generated by large surface impacts, or when the floor of a water body suddenly moves and displaces the water above it. Although usually associated with earthquakes, tsunamis also can be triggered by many other types of phenomenon, including submarine or terrestrial slides, submarine and terrestrial volcanic eruptions, explosions and even bolide (e.g. asteroid, meteor, comet) impacts.

The District of Summerland is most at risk from local terrestrial tsunamis caused by terrestrial or submarine slides. These are usually caused by slope failure though can also be the result of an earthquake-induced landslide. Such an event occurred on 28 February 1880 when 27 acres of farmland located on the north side of the Fraser River in Maple Ridge slid into the Fraser River causing a wave 12 metres high (Anderson and Gow 2003). If a slide were to occur on Lake Okanagan, the District of Summerland's shoreline and adjacent low-lying property would be at risk from flooding and damage from the waves.

The District can also be affected by a tsunami-like phenomena called a *seiche*. *Seiches* are oscillations in enclosed bodies of water resulting from seismic waves. Osoyoos Lake rose about a third of a metre along its shoreline from *seiches* following the Alaskan quake of 1964 (Anderson and Gow 2003). Anderson and Gow also report that a megathrust earthquake along the Cascadia subduction zone could cause *seiches* throughout British Columbia.

Due to the infrequency of such an event and the limited area of potential impact, the risk of a local terrestrial tsunami 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 was destroyed. The total cost of the Firestorm was estimated to be $700 million (Filmon 2004).

According to the British Columbia Biogeoclimatic Ecosystem Classification (see http://www.for.gov.bc.ca/hre/becweb/), the District of Summerland falls in zones BG (Bunchgrass) and PP (Ponderosa Pine). The BG classification applies to the lower elevations where bluebunch wheatgrass is the dominant species on undisturbed sites and big sagegrass is also common. Ponderosa pine and Douglas fir occasionally occur in draws and on coarser textured soils, although the harsh climate restricts their growth.

The PP zone applies to the higher elevations in and around the District. PP is the warmest and driest of all forest zones in BC. Due to the hot and dry characteristics of this zone, groundfires are common and are important for creating and maintaining widely-spaced pine stands with a bunchgrass understorey. Douglas fir also occurs on the colder and moister sites. Due to the hot and dry characteristics of these two zones, the District of Summerland can expect forest fires and WUI fires within and around the District, especially in wilderness areas used for recreation.

A number of pests affect trees in the District of Summarland area resulting in tree mortality which contributes to the fuel load and increases the intensity of wildland fires. The Western Pine Beetle (WPB) and the Mountain Pine Beetle (MPB) are both present in the area (See Section 6.5.4). The increased tree mortality as a result of the beetles creates additional fuel which can increase the intensity of wildfires thus heightening their risk. Current models

project that the MPB epidemic will increase in the Summerland area in the coming years (Ministry of Forests and Range, 2005d). If this occurs, the risk associated with the increased tree mortality will also rise.

In 2004, the SFD responded to 17 campfire fires and 14 grass/bush/forest fires. Between January 1, 2005 and November 30, 2005, the SFD responded to 10 campfire fires and 12 grass/bush/forest fires (District of Summerland Fire Department 2005).

Due to the frequency and widespread impact of forest fires and WUI fires, their risk to the District of Summerland is *high*. **However, the lack of auxiliary power at the District's pumping stations may result in a loss of water for fire fighting in the event of a power outage resulting in increased risk.**

6.4.2 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 in every municipality and have the capacity to spread quickly to adjoining structures. Generally, local agencies are able to control fires without relying on external resources or support, but occasionally an event becomes so severe that managing it requires the assistance of neighbouring jurisdictions. Predicting the frequency of urban fires is difficult, as most outbreaks tend to be random accidents. Estimating a community's ability to respond based on available resources and the existence of mutual aid agreements is a much more efficient way of calculating the risk of structural fire.

The SFD responded to 29 dollar loss fires in 2004 and 18 dollar loss fires in 2005. The SFD has mutual aid agreements with the City of Penticton and the District of Peachland, and a number of other communities (including Naramata, Kaledan, Town of Oliver, Town of Osoyoos, Town of Princeton, and the Hedley Improvement District) through an agreement with the Regional District of Okanagan-Similkameen.

Due to the District's response capabilities, the risk of structure fires to the District of Summerland is *moderate*. **However, it should be noted that the lack of auxiliary power at the District's pumping stations may result in a loss of water for fire fighting in the event of a power outage resulting in an increased risk.**

6.5 DIESEASES, EPIDEMICS, PANDEMICS

6.5.1 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. Many outbreaks were associated with ingestion of chlorinated but unfiltered surface water.

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.

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 a thousand people were infected.

Tampering with public water supplies has recently surfaced in BC with incidents reported at Ladysmith and Kaslo.

The District of Summerland has a number of open reservoirs which are susceptible to both intentional and accidental contamination. These facilities are listed in section 3.3.1 and are monitored according to standards outlined in the federal Guidelines for Canadian Drinking Water Quality (GCDWQ). **It should be noted, however, that during times of spring freshet water quality may not meet GCDWQ standards at the Trout Creek reservoir** (District of Summerland, 2004b). At the time of writing, no historical occurrences of water contamination have been reported in the District.

The risk of water supply contamination to the District of Summerland is *moderate*.

6.5.2 Pandemics

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 many municipal employees may also become infected and be unable to work, contingency plans should be made to operate with a reduced workforce. Due to the widespread nature of pandemics, neighbouring communities may not be able to provide assistance. Due to the District of Summerland's location, the disease may be detected in cities higher up on the urban hierarchy (i.e. Vancouver, Calgary) before it arrives in the District. This may provide some advanced warning to the District; however, with today's transportation networks and the mobility of today's population this should not be relied upon, especially during times of high tourism.

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 District; therefore, the risk of a pandemic to the District is considered *high*.

6.5.3 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 November 12, 2005 (Public Health Agency of Canada 2005b). 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).

Each disease, bacteria or virus has a different vector and aetiology, which complicates group classification and risk ranking. 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), this risk of animal disease is *moderate.*

6.5.4 Plant Diseases and Pest Infestations

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.

Forest defoliators are pests of particular interest in the Okanagan Shuswap Forest District. Butterflies and moths (Lepidoptera) are considered to be the most destructive of these forest defoliators as the larvae, or caterpillars, feed on the foliage of trees and plants. Forests of any age class may be attacked. Two lepidopterans are particularly important defoliators of coniferous forests: western spruce budworm (*Choristoneura occidentalis*) and Douglas-fir tussock moth (*Orgyia pseudotsugata*) (Ministry of Forests and Range 2005b).

Both the Western Pine Beetle *Dendroctonus brevicomis* (WPB) and the Mountain Pine Beetle *Dendroctonus ponderosae* (MPB) are significant concerns in the Okanagan-Shuswap Forest District (Natural Resources Canada 2005b).The WPB attacks mostly old or diseased ponderosa pine trees of 15 cm diameter or more. It is most damaging in California, but is found as far north as Southern British Columbia, including in the Okanagan Valley. The WPB's range is shown in Figure 7.

Figure 7 Range of the Western Pine Beetle (USDAFS, 2006)

The current MPB outbreak is considered at epidemic proportions in British Columbia. Ministry of Forests and Range surveys have detected seven million hectares (an area about the size of New Brunswick) of pine-beetle affected trees in 2004 in British Columbia. Trace amounts of attack were found over about two million hectares. The other five million hectares showed light to severe levels of attack. The District of Summerland itself is within the "suppression" zone of the Okanagan Shuswap Forest District, with areas of forest rated as medium to high susceptibility to Mountain Pine Beetle attack (Figure 8). The Ministry of Forests' British Columbia's Mountain Pine Beetle Action Plan for 2005-2010 provides a

framework to guide all provincial ministries and agencies, and to assist communities, First Nations and other stakeholders in understanding and carrying out measures for mitigating impacts of the epidemic. Models suggest that the MPB epidemic will become increasingly severe in the Okanagan Valley in future years (Ministry of Forests and Range, 2005d).

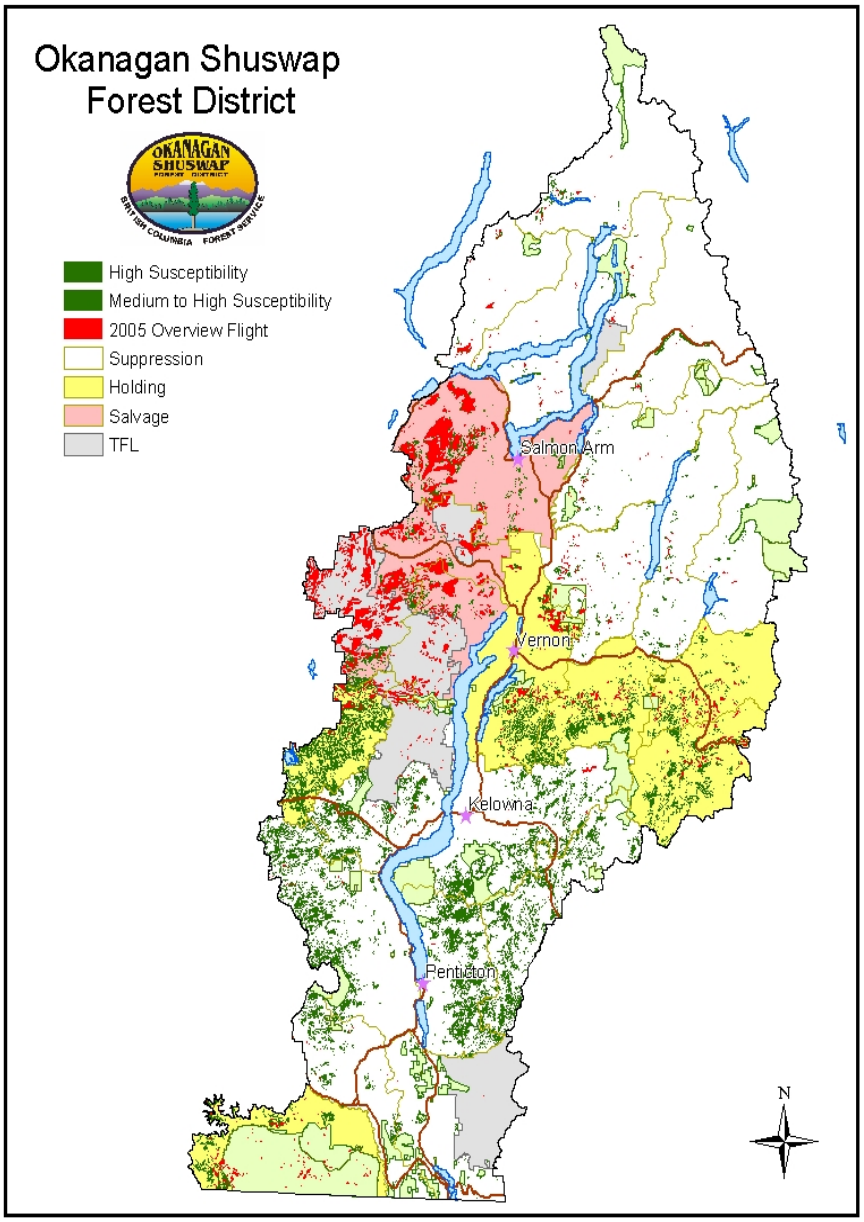


Figure 8 Okanagan Shuswap Forest District MPB Strategy (Source: Ministry of Forests and Range 2005c)

In addition to considerations of forest health, tree fruit production in and around the District of Summerland is vulnerable to a wide range of diseases including: Apple Scab, Anthracnose and Perennial Canker of Apple, Apple Leaf Drop (Necrotic Leaf Blotch, Golden Leaf Drop), Bacterial Canker of Stone Fruits, Blister Spot, Brown Rot of Stone Fruits, Botrytis Rots of Pome and Stone Fruit, Bull's Eye Rot of Apple and Pear, Calcium

deficiency (bitter pit), Coprinus Rot, Coryneum Blight (Shot Hole), Crown Gall, Root Gall and Hairy Root, Crown Rot, Cytospora Canker (Leucostoma Canker), European Canker (Nectria Canker), Fire Blight of Apple and Pear, Little Cherry Virus in British Columbia, Powdery Mildew - Tree Fruit, Mucor Rot, Peach Leaf Curl, Apple Replant Problem, Rhizopus Rot of Peach, Verticillium Wilt of Stone Fruits, Virus and Virus-Like Diseases of Tree Fruit, **as well as pests including**: Ambrosia Beetles, Tree Fruit Aphids, Apple Curculio, Apple Leaf Midge, Eyespotted Bud Moth, Caterpillars (Apple-and-Thorn Skeletonizer, Red-humped, Yellow-necked, Tent and Fall Webworm), Cherry Fruitworm, Codling Moth, Cutworms, Earwigs, Western Cherry Fruit Fly, Green Fruitworms, White Apple Leafhopper, Tentiform Leafminer, Leafrollers, Lygus Bugs, Apple Mealybug, Mites, Mullein Bug (Campylomma), Peach Tree Borer, Peach Twig Borer, Pear Psylla, Pear Slug (Pear Sawfly), Scale Insects, Shothole Borer, Bruce Spanworm, and Western Flower Thrips (Ministry of Agriculture and Lands 2005).

Due to the combination of the WPB and MPB threat and the potential impact of pest or disease on the local agricultural industry, the risk of pest infestations and plant diseases 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 District of Summerland residents. A wildfire may be started by an aircraft crash, causing damage to property and resources, and possible evacuation of residents.

While there are no airports within the District of Summerland, the District is under the flight path for aeroplanes approaching the Penticton Airport and under a major east-west flight corridor. This increases the likelihood of aircraft crashes impacting the District directly and requiring direct response from the District's emergency services. For example, on August 20th, 1999, two aircraft collided and crashed in the City of Penticton resulting in the deaths of all five occupants; no other injuries occurred on the ground.

Due to the flight path over and near the District combined with the localized nature of aircraft accidents and the non-existence of an airport within the District, the risk of aircraft accidents is *moderate*.

6.6.2 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 breach. A dam failure 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.

Past dam failures within British Columbia have caused fatalities and property damage. The May 1995 failure of a 6-metre high earth-filled irrigation dam in the Caribou region caused approximately $500 000 in damage. The release killed more than 40 head of cattle, destroyed a 1.5 km section of public road, and dumped tons of debris into the Quesnell River. The ranch owners escaped injury.

The District of Summerland has 10 earthen and one concrete arch water storage dams in and around the District (Associated Engineering 2005), most of which are low-consequence dams; even if they were to fail, the impact to the District would be minimal (Palmer 2005). However, the **Thirsk Lake Dam** is considered a **high consequence** dam (Land and Water British Columbia Inc 2004a) and is the largest owned by the District. It is currently undergoing reconstruction as the reservoir is expanded (Associated Engineering 2005). Additionally, **Canyon Creek Dam** and **Garnet Valley Dam** are also considered **high consequence** dams. If these dams were to fail, the consequences would be more severe.

According to the Downstream Consequence Classification Guide (Land and Water British Columbia Inc. 2004) the consequences for high consequence dams include some potential for multiple loss of life involving residents, and public working, travelling and or recreating in the inundation area. Estimated fatalities are less than 100. Economic losses would affect infrastructure, and public and commercial facilities in and beyond the inundation area. Losses typically include the destruction of or extensive damage to concentrated commercial land uses, highways, railways, power lines, pipelines and other utilities. Scattered residences may be destroyed or severely damaged. Estimated direct and indirect (interruption of service) costs could exceed $1 million. Environmental and cultural losses include deterioration of nationally or provincially important fisheries habitat (including water quality), wildlife habitat, rare and/or endangered species, unique landscapes or sites of cultural significance. Feasibility and practicality of restoration and/or compensation is high.

The risk of a dam failure to the District of Summerland is considered *low*.

6.6.3 Recreational Boating Accident

Marine accidents include collisions, groundings, striking, explosions and fires, structural failures, as well as accidental spills of petroleum products or chemicals, loss of cargo and human death or injury. Marine accidents can have local or widespread environmental and economic impacts.

Okanagan Lake supports primarily recreational boating activity, and several recreational boating facilities are located along the District's shoreline. The overall likelihood of a marine accident occurring on the lake within the District is low. The City of Penticton to the south and the District of Peachland to the north have response capacity for marine accidents on Okanagan Lake. Therefore the risk of recreational boating accidents to the District of Summerland is considered *low*.

6.6.4 Motor Vehicle Crash

Motor vehicle crashes can result in a request for site support activities when they involve large numbers of people. Most occurrences result in property damage that requires 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 hazardous materials spills, that may require evacuation and sheltering efforts.

According to the Insurance Corporation of British Columbia 2003 Traffic Collision Statistics Report, there were 20 traffic collisions and 34 victims, with a total of 2 fatalities within the District of Summerland in 2003 (the most recent year currently reported).

While the frequency of motor vehicle crashes is high, most incidents are minor and involve a relatively small number of people. Their risk to the District of Summerland is *low*.

6.7 EXPLOSIONS AND LEAKS

6.7.1 Explosion/Gas 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 in section 6.8 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.

At 7:30am on June 17, 2002, a Summerland underground natural gas line was hit by lightning causing leakage and eventually a massive explosion. The explosion destroyed a home and killed its two residents. The blast was strong enough to knock pictures off the walls of houses up to a kilometre away (Canadian Press 2002).

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.

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

6.8 HAZARDOUS MATERIALS ACCIDENT

6.8.1 Hazardous Materials Accident

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, 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 SFD has only limited means to deal with small hazardous materials accidents and has responded to two spills in 2004 and two spills between Jan 1 and Nov 30, 2005.

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

6.9 OTHER HAZARDS

6.9.1 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 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, snow storms, 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 District of Summerland 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 take place during a time of power outage, some of the District's critical facilities would be impacted. A number of water pumps and the District's Emergency Operations Centre do not have backup power.

While the risk of a short power outage may be low, the risk will increase with the length of the outage. Therefore, the risk of a power outage is considered *moderate*.

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. As stated earlier in this report, activation of the EOC will be limited due to lack of a backup power supply and a number of water pumps in the District will not function due to lack of backup power. This will result in a loss of water for fire fighting purposes in addition to the loss of domestic water supply to households and businesses.

6.9.2 Riots

A riot is a violent disorder, specifically a disturbance of the public peace by a group of persons with either a common or random intent to destroy property, assault persons or otherwise disturb the peace. The most likely form of civil disobedience is likely to come from labour unrest, strikes or environmental protests.

The frequency of such an event in the District of Summerland is low, however nearby municipalities such as Penticton have experienced riots. In 1991, hundreds of people, mostly teenagers, rioted through the streets of Penticton (Vancouver Sun 1993). In 1986 a riot broke out at the Kelowna Regatta with 90 RCMP officers on the scene resulting in the arrest of a 22-year-old Summerland man among others (Vancouver Sun 1987).

Teenagers often hold parties and create bonfires in the wildlands within and surrounding the District. These parties have the potential to escalate into riot-like events. In addition, transient orchard labourers have also been known to cause civil unrest in the area.

The risk of riots to the District of Summerland is *low*.

6.9.3 Structural Collapse

Structural collapse may be caused by engineering or 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 incidences of structural collapse in the District.

The risk of structural collapse to the District is *low*.

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