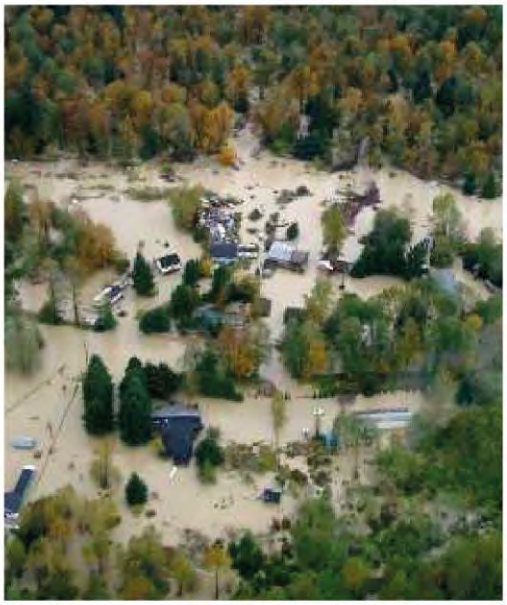
SQUAMISH EMERGENCY PROGRAM

SEP

SQUAMISH

HARDWIRED *for* ADVENTURE

Community Risk Assessment



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Key Definitions

Emergency	A present or imminent event that requires prompt coordination of actions concerning persons or property to protect the health, safety or welfare of people, or to limit damage to property or the environment.
Hazard	A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.
Resilience	Resilience is the capacity of a system, community or society exposed to hazards to adapt to disturbances resulting from hazards by persevering, recuperating or changing to reach and maintain an acceptable level of functioning. Resilient capacity is built through a process of empowering citizens, responders, organizations, communities, governments, systems and society to share the responsibility to keep hazards from becoming disasters.
Risk	The combination of the likelihood and the consequence of a specified hazard being realized; refers to the vulnerability, proximity or exposure to hazards, which affects the likelihood of adverse impact.
Vulnerability	The conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards. It is a measure of how well prepared and equipped a community is to minimize the impact of or cope with hazards.

Community Risk Assessment - Draft

Hazards, Vulnerabilities, and Risk in the
District of Squamish
2015

Introduction

Hazards and vulnerabilities are important community elements to understand in preparing emergency response, business continuity, and recovery plans. The Community Risk Assessment is an opportunity for the Senior Leadership and key staff members to identify hazards, risks and vulnerabilities. The Community Risk Assessment is a fundamental building block towards establishing plans and strategies that effectively protect the people and assets of Squamish.

The purpose of a Community Risk Assessment is to guide practical steps in preparedness, response, recovery and mitigation that reduce both the likelihood of emergencies and the consequences when disaster cannot be avoided. Risk information also informs community residents, business owners, and institution managers of the hazards to expect and how best to prepare for them.

The Squamish Emergency Program (SEP) intends for this report to identify the community risks and priorities. This will be the foundation to the development of the Comprehensive Emergency Management Plan. The Emergency Program Coordinator will ensure this Community Risk Assessment is updated at least every five years.

A variety of sources and knowledgeable persons contributed information to this Community Risk Assessment including Fire Department, Development Services, Engineering Services and Public Works Department and other municipal staff. In addition external agencies such as the Royal Canadian Mounted Police (RCMP), Ministry of Health, Search and Rescue (SAR) and BC Ambulance Service (BCAS) provided information on context and hazards at the local level.

Legal Requirements for Assessing Risk

As a local authority under the *British Columbia Local Authority Emergency Management Regulation (1995)*, 2(a) The District of Squamish is required to reflect in plans:

> *The potential emergencies and disasters that could affect all or any part of the jurisdictional area for which the local authority has responsibility, and…*
>
> *…The local authority's assessment of the relative risk of occurrence and the potential impact on people and property of the emergencies or disasters.*

SECTION ONE

The Community

History

The Squamish First Nations have occupied the area for at least 5,000 years with settlements throughout the Squamish and Cheakamus Valleys, and around Howe Sound. Originally, settlements were often seasonal as native fishermen and hunters followed the food sources.

The first permanent settlers of European descent began arriving around 1888 with the completion of the transcontinental Canadian Pacific Railway. By the early 20th century, forestry was the primary economic driver. Until the original Sea to Sky Highway was constructed in 1958, the only access to Squamish was by boat. Today, Squamish has a deep sea port, railway, local airport and major arterial highway as transportation options (District of Squamish, 2014). In 1964, shortly after the completion of the highway, Squamish incorporated, consolidating governance, infrastructure services, and land use planning activities under a single authority (Journeay, 2011).

In the 1990's, growth in the resource sector began to decline. This decline coupled with the rise of Whistler as a year round tourism destination, has significantly shifted Squamish's economic base. Today, the economy of Squamish is primarily driven by the recreation and tourism sector and its increased popularity as a bedroom community for Vancouver commuters.

Geographical Setting

Squamish is oriented in a north/south direction, stretching 26 kilometres along Highway 99 and extending 12.5 kilometres east to west at its widest point. The total land area of the District of Squamish is 11,730 hectares (29,000 acres). At Howe Sound, Squamish is at sea level and the terrain within the District boundaries rises to elevations of over 900 metres.

Squamish is set in a geographically complex and beautiful natural environment at the north end of Howe Sound, a fjord of the Pacific Ocean, and surrounded by rugged coastal mountains rising to elevations of more than 2500m. The natural beauty and convenience factors that make Squamish increasingly attractive as a place to live, work and play also increase the potential for hazard impacts.

Within the District of Squamish there is extensive floodplain area from five (5) rivers with mountainous watersheds (Squamish, Mamquam, Cheakamus, Stawamus and Cheekye). The response of the District's major watersheds to rain, snowmelt and rain-on-snow conditions varies based on their size and elevation. Smaller, lower-elevation watersheds produce more rain-driven floods, while snowmelt plays a more significant role for larger, higher-elevation watersheds.

Severe floods impacting Squamish are typically the result of snowmelt or intense, prolonged rainfall or a combination of the two processes. Most flooding events have occurred in the October to December period when there may be a thin snowpack, and the temperature is warm enough that precipitation falls as rain throughout the watersheds.

The Mt. Garibaldi complex located just northwest of the District boundary is a quaternary volcanic rising to 2670m. Due to the Mt. Garibaldi's steep topography and geological features, the Cheekye River, which originates from its slopes, poses a significant debris flow risk and has formed the Cheekye Alluvial Fan below about 600m that stretches from its current confluence with the Cheakamus River southward to Brackendale.

Geographical Implications

The geographic location and access to transportation determine the nature of settlement in Squamish and, to some degree, the hazards in the community. The people of Squamish have exposure to the second highest number of hazards in the province.

Bordered by sea and with one arterial road in and out of the District, severe road, rail, and marine transportation accidents are among the man-made hazard concerns. Floods, landslides, and interface fires are among the primary natural hazard concerns.

The Squamish River watershed is the largest watershed within the Strait of Georgia region and supports a great abundance of flora and fauna. In addition, the Squamish Estuary is a highly productive and valuable ecosystem. It provides wintering, migration, feeding and breeding for many species.

Climate

Squamish has a temperate coastal climate with mild, wet winters and warm, dry summers. During the winter, precipitation can fall for extended periods of time. Squamish experiences over 180 days of precipitation per year, totaling over 2300 mm. The most intense periods of rain occur between October and January, which also presents the time of year when the flood hazard is most prominent.

During the winter months it is common for cold polar air to be funneled westward down the valley towards Howe Sounds. Arctic outflow winds can cause a dangerous wind chill factor, dropping temperatures well below freezing for multiple days at a time.

Periods of snowfall are common between December and February. The quality of the snow is typically heavy, and tends to melt quickly due to the temperate climate. Larger quantities of snow accumulate in the local mountains and present a flood hazard between April and June during the spring runoff.

Water levels along BC's coast are affected by offshore ocean-scale processes in the Pacific Ocean basin including atmospheric pressure, wind and ocean currents. Together, these conditions can result in a 'storm surge' whereby the ocean rises higher than its predicted level. Coastal floods typically occur when external storm surges combine with the highest tides of the year during the winter storm season. Storm surge has been measured as high as 1m in the Squamish region.

The warm, dry summer months present increased risk for interface wildfires, and drought.

Implications of Climate Change

In an area greatly influenced by the interaction of geography and climate, climate change will continue to present risk management challenges to Squamish.

Flooding potential is likely to be exacerbated by rising sea levels, increased frequency of storm events, coastal storm surges and changes in patterns of precipitation. Increased ocean temperatures and acidification may pose new environmental health risks.

Community Profile

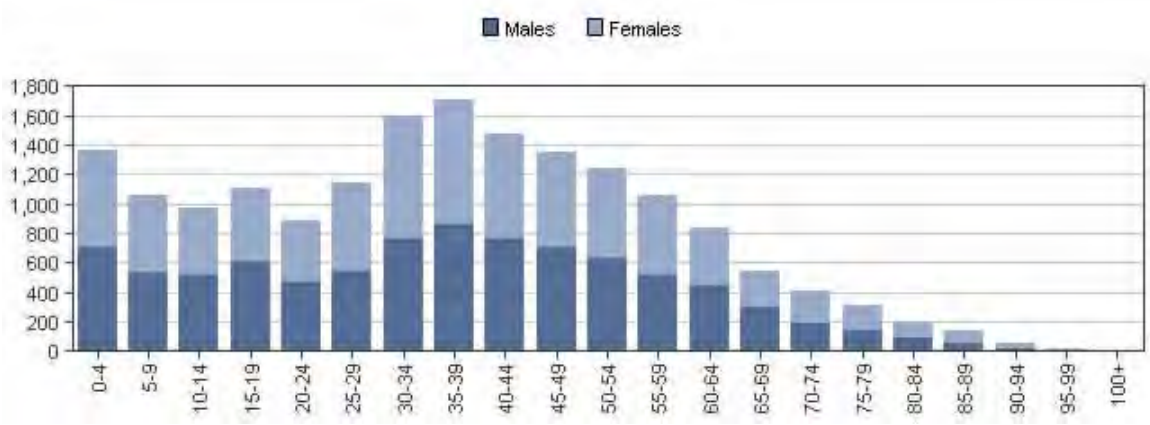
Halfway between downtown Vancouver and Whistler, Squamish acts as the gateway community for the transportation of goods and services to rural communities to the North (Journeay, 2011). Under an hour from Vancouver, Squamish is also a weekend adventure playground for thousands of city visitors and increasingly, a residential choice within moderate commuting distance of Vancouver. It is estimated that almost one third of the working population commutes to either Vancouver or Whistler for employment.

Demographics

According to the 2011 census, the population of Squamish was 17,479, representing a change of 14.6% since 2006 compared with a provincial growth rate of 7%. This positions Squamish as one of the fastest growing communities in the province with slightly more males (51%) than females (49%). Seven percent of the Squamish population has an aboriginal background, slightly higher than the provincial average (Statistics Canada, 2011).

Age

In 2011 the median age was reported to be 36.8 with almost 60% of the population under 40. The age distribution, shown is Figure 2, indicates that Squamish does not have a very old population with only 1,645 residents over the age of 65. Squamish's youth population (under the age of 14), however, represents 18% of the total population base and grew by 8% between 2006 and 2011. This indicates that there are lots of young families in Squamish who may require special assistance during specific events.



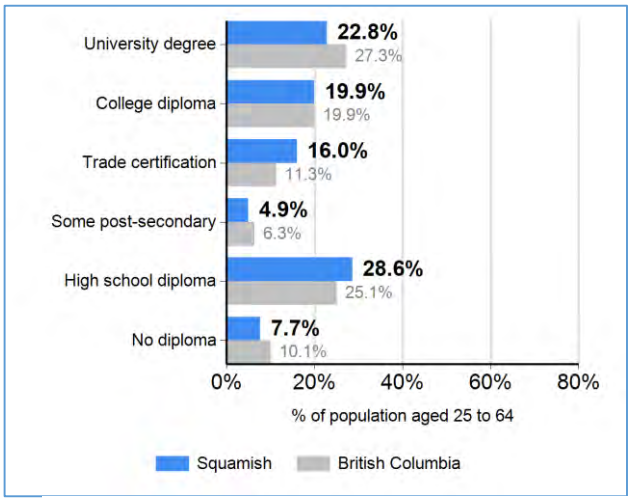
Squamish- Population by five-year age groups and sex (Stats Canada, 2011)

Education and Income

The median annual household income in Squamish is $72,751, which is above the provincial median at $60,333 (Statistics Canada, 2013). Approximately 12% of Squamish individuals are considered to be low-income, which is 4% below the BC average of 16% (Provincial Health Services Authority, 2013).

Language

English continues to be the dominant language spoken by Squamish residents. According to the 2011 census, 81% of the residents reported English as their mother tongue. Other languages of note include Punjabi (6.9%), French (2.8%), German (1.8%) and Tagalog (1.1%) (Statistics Canada, 2013).



Highest Level of Education (Stats Canada, 2011)

Land Use

Neighbourhoods

The primary industrial-commercial zones and residential neighbourhoods are extremely spread out, covering a large area. The total land area of Squamish is 105.59 square kilometres with a population density of 165.5 persons per square kilometre (Statistics Canada, 2011). Highway 99, running north-south, bisects the community into the more industrial developments to the west and residential neighbourhoods to the east.

Implications of Neighbourhood

Due to their placement at differing elevations and in relation to different watersheds, neighbourhoods have differential exposure to flood hazard.

There is new housing stock in flood prone areas and future development proposals for areas exposed to multiple hazards.

The layout of neighbourhoods and connector roads, constrained by geography, means that parts of Squamish may become isolated from assistance and services if a connecting road or bridge river crossing is washed out or blocked.

Garibaldi Estates, Garibaldi Highlands, Brackendale, and Downtown/Dentville. In total, Squamish is comprised of 14 distinct neighbourhood nodes, a downtown commercial core along the waterfront, and several industrial areas scattered throughout the district.

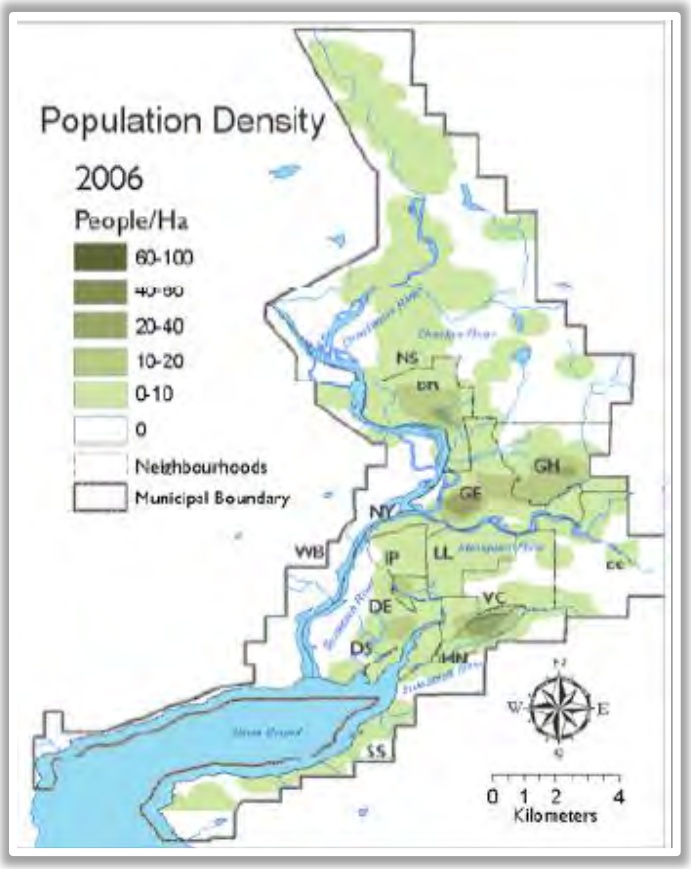
Implications of Transient Populations

In addition to residents, others may be present in Squamish on a transient basis during an emergency, such as workers, tourists and recreational visitors, and motorists travelling along Highway 99.

Major community events are becoming more frequent and increasing in scale. The Squamish Valley Music Festival is forecast to attract 35,000 people to Squamish in 2015, presenting unique risk management challenges for the community.

The primary industrial-commercial core extends northward from the downtown waterfront area along Howe Sound and the Blind Channel, along the Squamish River to its confluence with the Mamquam River. A second industrial node includes the airport and electrical power facilities located at the north end of the community (Journeay, 2011).

Residential neighbourhoods primarily surround the industrial-commercial core, and are largely separated from one another. The densest residential neighbourhoods include Hospital Hill, Valleycliffe,



Disaster Resilience by Design. Journeay, 2011

Neighbourhood Key:

BR Brackendale
DC Downtown Core
IP Industrial Park
NS North Squamish
GE Garibaldi Estates
GH Garibaldi Highlands
HH Hospital Hill/Northridge
DE Dentville
LL Loggers Lane
ES Eastern Squamish
SS South Squamish
VC Vallycliffe
WB West Bank

Critical Infrastructure

Key infrastructure statistics for the District of Squamish

Water	Sanitary	WWTP	Roads	Drainage	Flood	Parks
122 km water main 24 million litres/day capacity	105 km sewer main 18 lift stations	21 million litres/day capacity	137 km paved road 5 major bridges	31 km storm sewer 72 km ditches	19 km dykes 4 dyke pump stations	244 ha parkland 387 km trails

(Source: Public Works Asset Management Plan, 2010)

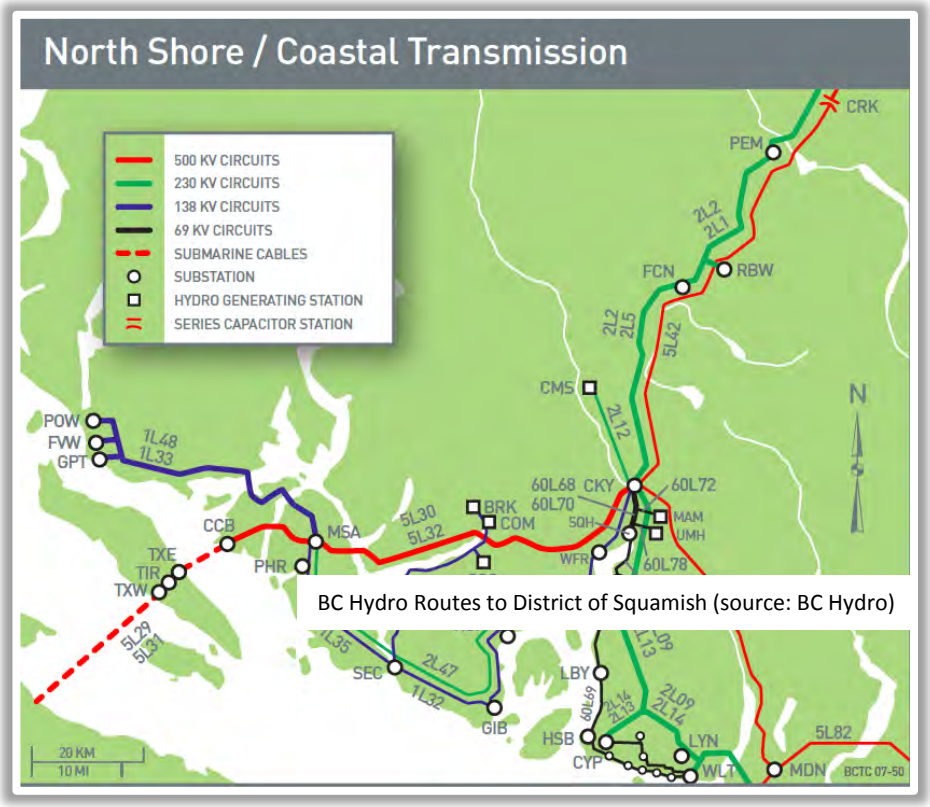
Significant disruption or loss involving critical infrastructure will have debilitating effects on a community or organization. The ability to recover from such a disruption or loss is key to overall recovery, and depends on a coordinated and comprehensive effort to assess impact, prioritize infrastructure restoration, and initiate rebuilding processes.

"Critical Infrastructure includes municipal road, water and waste facilities, an extensive levee system, natural gas pipelines, electrical transmission facilities, and major port, rail and highway facilities that provide essential transportation services between urban and rural centres in southwest British Columbia" (Journeay, 2011).

Electrical Power Systems

BC Hydro provides the electrical power service for the District of Squamish, with two substations, one located at Squamish Valley Road (Cheekye) and the other at the corner of Pemberton Avenue and Loggers Lane (Squamish). Additionally there is a DOS-owned transmission line on the Mamquam FSR for Powerhouse Springs. There is also a privately owned (IPP) powerhouse at Powerhouse Springs, which may be a potential avenue for emergency supply if an appropriate negotiated agreement were entered into.

Critical power users in Squamish include the hospital, RCMP, waste water treatment plant, Powerhouse Springs, sanitary lift stations, the Judd/Harris/Dryden storm pump stations, grocery stores, telecommunications companies, the DOS-wide Supervisory Control and Data Acquisition (SCADA) network for monitoring and alarm system for drainage and pumping stations.



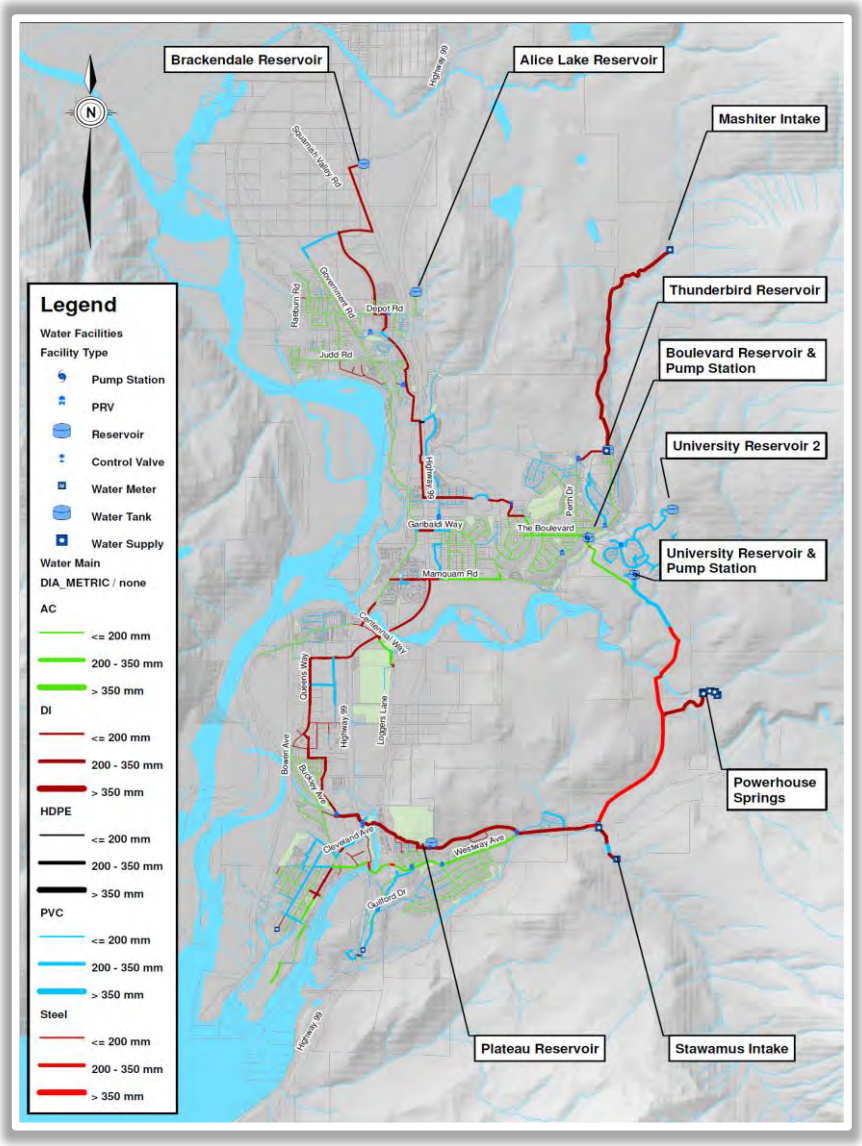
BC Hydro Routes to District of Squamish (source: BC Hydro)

A number of key organizations and facilities in Squamish have backup generators, including City Hall, the RCMP, both Fire Halls, the Brennan Park Leisure Centre, and some water and waste water system infrastructure. However, power interruption is still a concern, especially at the waste water treatment plant, sanitary lift stations, water system and storm pump houses because loss of water and sewer service affects business continuity, may cause sanitary sewer overflows and/or WWTP bypass discharge, creating negative environmental impacts. Loss of fire protection is also a consideration if water delivery systems are interrupted by power failure, rendering fire hydrants inoperable.

Water Systems

The potable water supply for the District of Squamish is located at three points, the primary Powerhouse Springs, secondary Stawamus Surface Intake and tertiary Mashiter Creek Intake. The District manages seven reservoirs: Plateau, Lower University, Upper University, Boulevard, Thunderbird, Alice Lake and Crumpit Woods. The District is responsible for water distribution in all areas of Squamish, except parts of Raven/Finch and Fernwood Road up north by Cheekye and on the west side of the Cheakamus Bridge. The Woodfibre site is also independent.

Bacterial water quality samples are collected weekly from nine locations across the District. Chemical and physical water quality parameters are sampled twice per year at Powerhouse Springs. There are potential health concerns related to water service interruption and loss of fire protection is a major concern because without water fire hydrants are also out of service. The water supply infrastructure has areas of system vulnerability, notably the primary transmission lines at river crossings or areas where the watermain is hung from bridges, i.e., Powerhouse, Stawamus, Mashiter, Highway99, Government Road, Smoke Bluffs primary water supply for Stawamus zone, secondary supply main from Valleycliffe and the feedermain on Ring Creek that ties into lower university pump station. The Judd/Harris/Dryden pump stations have no onsite standby generators. There is one trailer mounted generator for these stations and this generator can only run one station at a time.



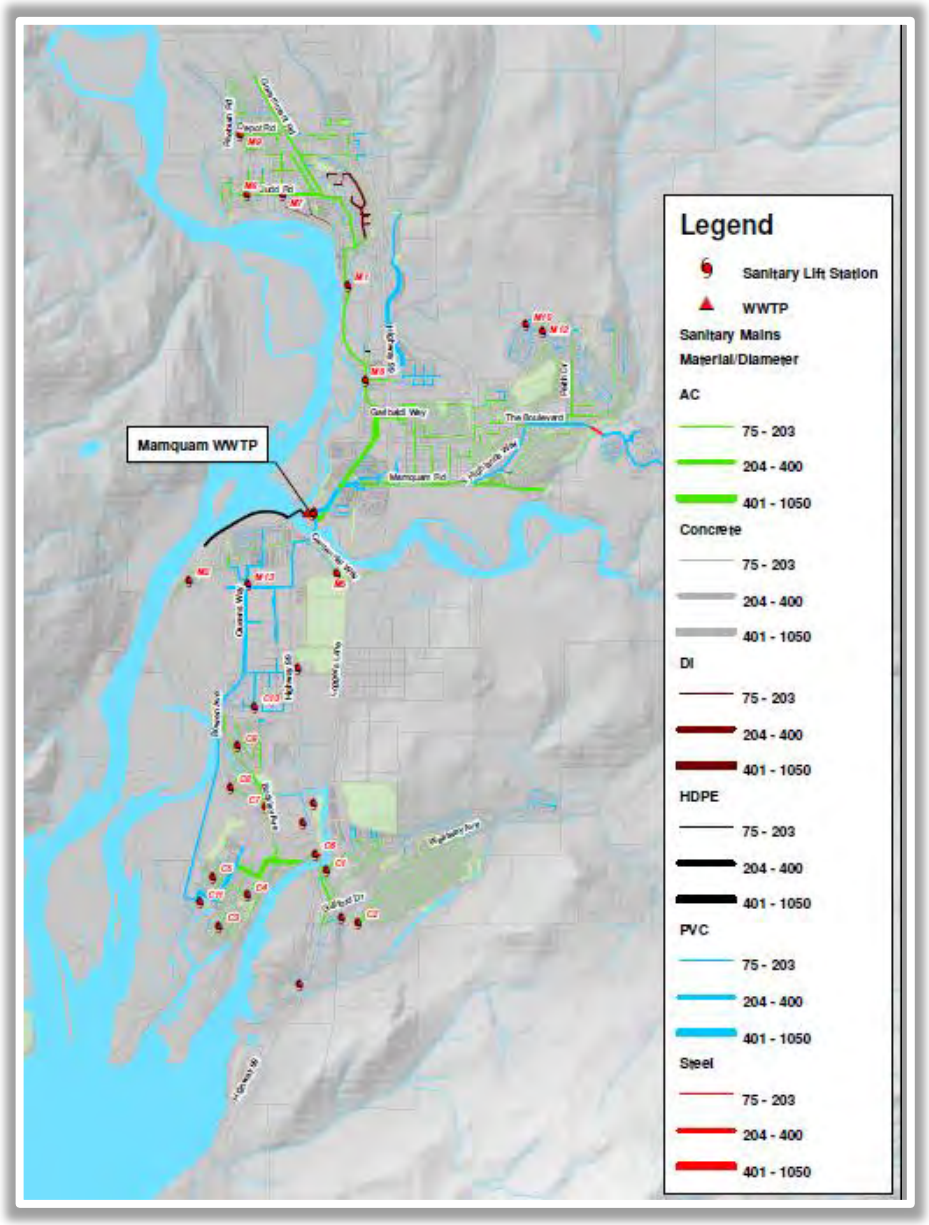
DOS Water Facilities (Public Works Asset Management Plan, 2010)

Widespread contamination is possible if a major main break occurs (e.g. in the event of an earthquake) or if serious cross connection occurs. As part of mitigating these risks, the Water Supply Emergency Response Plan is updated annually.

Waste Water Systems

The District's waste water treatment plant is located at 39909 Government Road and treats sewage plus landfill leachate. The waste water collection system consists of gravity mains, force mains and sanitary pump stations. Four lift stations have dedicated back-up generators and there are also two portable generators that can be used to run lift stations in the event of an emergency. The District has 420 catch basins and 442 manholes.

There are significant aspects of system vulnerability, including older infrastructure not designed for seismic resistance, 105kms of pipes, averaging 30 years old which are subject to earthquake liquefaction in compressible soils, 25 lift stations and force mains, plus considerable infrastructure located in the flood plain, below the water line and hence constantly under water. An interruption to the waste water systems would trigger public health concerns and environmental impacts, for example sewer overflow and/or waste water treatment bypass discharge.



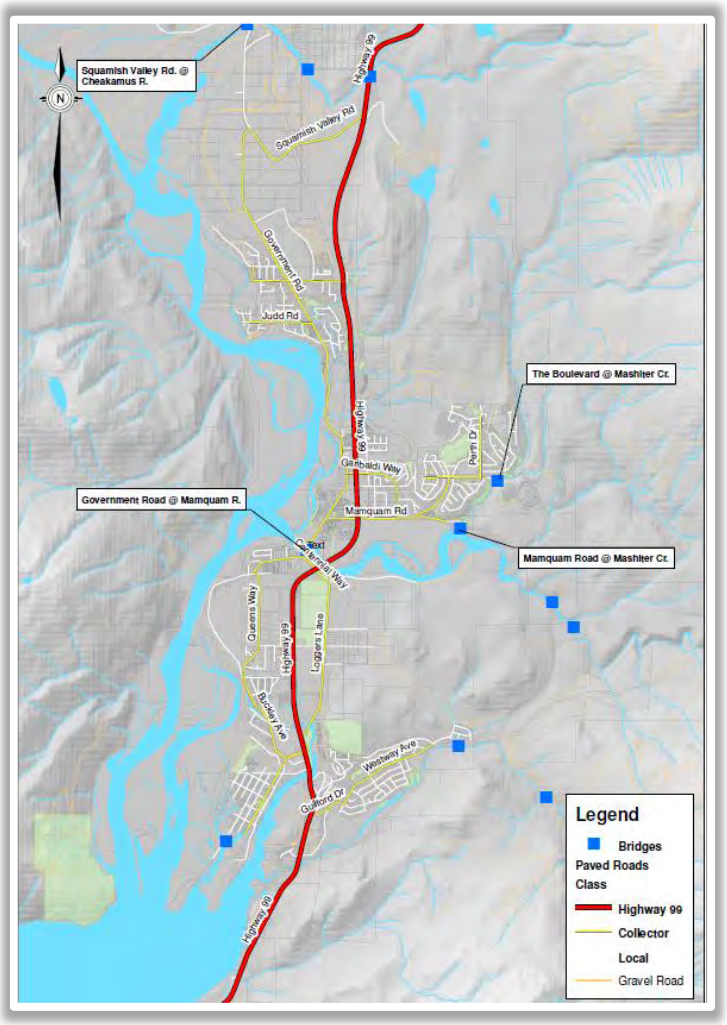
Sanitary System Assets (Public Works Asset Management Plan, 2010)

Road Transportation

Major transportation infrastructure in Squamish consists of provincially maintained, Highway 99 (Sea to Sky Highway), while the District is responsible for maintaining five key bridges, 137km of paved roads and 82km of gravel roads. Other major arterials running parallel to Highway 99 include Government Road and Loggers Lane. Road maintenance services provided by the District include snow clearing, vegetation management, shouldering, pothole repair, road replacement, salting, street sweeping, sidewalk and bus shelter maintenance, grading gravel roads, road culvert repair and replacement.

Due to the narrow characteristics of the valley there are many smaller connectors branching off, east and west, from the major north-south arteries. There are nine highway bridges crossing all of the major river systems (Journeay, 2011) and these, along with low-lying road areas that flood repeatedly, are of particular concern because roading infrastructure failure at these points can effectively cut off parts of the District from assistance, and prevent crews accessing critical infrastructure to complete monitoring, maintenance and repairs.

On Friday afternoons during the summer, Squamish can experience upwards of 21,000 vehicles driving through to Whistler. This represents the busiest time of year and the busiest time of day for major arterial roadways (Creative Transportation Solutions, 2009).



Road System Assets (Public Works Asset Management Plan, 2010)

Road Transportation Considerations

It is estimated that 30% of Squamish population commutes for work either south to Vancouver, or north to Whistler.

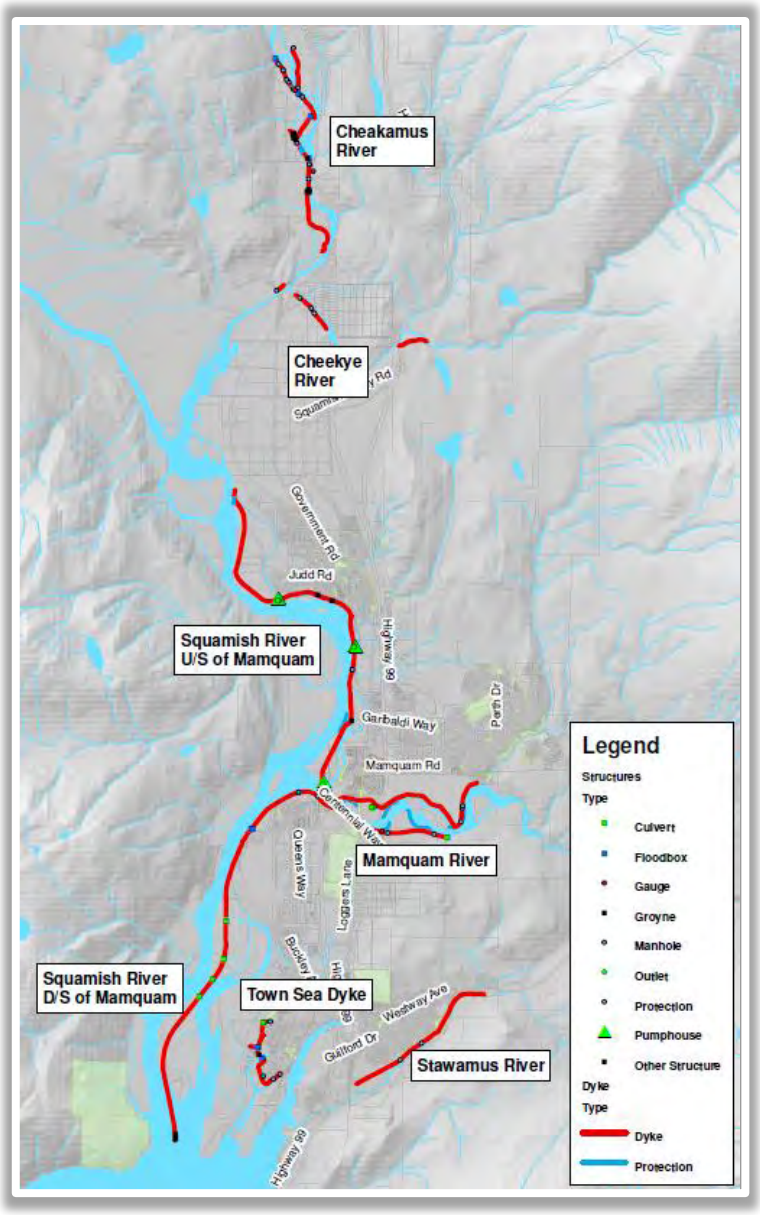
Due to the limited points of entry and egress, any emergency event, for example a major landslide or motor vehicle accident, that results in the closure of Highway 99 could present community isolation concerns.

Flood Protection Assets

Squamish has a history of flooding, with areas of the District repeatedly and severely inundated since settlement was established. High functioning flood protection assets are vital to mitigate flood effects. The District currently maintains 19km of dikes with a dike volume of 670,000 cubic metres, 4 pump stations, 9 floodboxes and 50 gates.

The 2010 District of Squamish Public Works Asset Management Plan recommended a number of dike repairs and upgrades, plus recommendations for other key flood protection infrastructure including an electrical upgrade at Harris Slough pump station, replacement of a leaking floodbox at Whittaker Slough, repair of 250m of riprap on the Stawamus River and installation of a water level monitoring station at Fergie's Bridge.

As Squamish is anticipated to roughly double in population by 2030, effective flood protection design is a fundamental aspect of sustainable residential and commercial growth.



Flood Protection Assets (Public Works Asset Management Plan, 2010)

Marine Transportation

There are three ferry docking facilities located in the Sea-to-Sky corridor (Horseshoe Bay, Porteau Cove and Darrell Bay). Horseshoe Bay is an active Lower Mainland terminal that is currently providing daily service to Vancouver Island and the Sunshine Coast.

The Porteau Cove dock is located within the 50-hectare Porteau Cove Provincial Park that includes campsites, a railway, a pebble beach and an artificial reef for diving.

The Darrell Bay ferry docking facility is located near Shannon Falls near Squamish. The Darrel Bay ferry originally provided access to a pulp mill in Woodfibre but ferry service stopped when the mill closed. In 2010 the Darrell Bay dock was rehabilitated to enable emergency service if required. *The Ministry of Transportation and Infrastructure Highway No.99 Emergency Ferry Service Plan: Sea to Sky Segment* outlines how this ferry terminal can be used during emergency.

Squamish Terminal, located at 37500 Third Avenue, is a deep-water, break-bulk terminal that contains two berths, three warehouses and specialized handling equipment. This terminal is an intermodal transportation infrastructure (including rail, ocean and truck). In the event of a major emergency Squamish Terminals may be used to transport materials to and from the Lower Mainland.

Air Transportation

The Squamish Airport is a general aviation airport with a 2,400 ft (732 m) runway located about 8 km from downtown Squamish. It is used for charter services, private aircraft, flying clubs, and other commercial activities. At present there is no regularly scheduled air service at the Squamish Airport.

Squamish Municipal Airport is an uncontrolled aerodrome. The airport is equipped with an asphalt runway and there is one taxiway and one apron. There are numerous private commercial helipads. Noise abatement arrivals and departures are in effect throughout the year.

Community Services and Special Occupancies

Vulnerable Populations

Vulnerable populations are those groups identified to be at greatest risk and in need of particular safeguarding during an emergency event. Within Squamish the vulnerable populations at highest risk include people living with disabilities, the seriously ill, the very young (<5 years of age), and seniors living alone or in care facilities. Neighborhoods of high concern include those with a high proportion or single parent families, First Nation communities, low-income families, and English as a second language speaking families. A further vulnerable population includes pets, livestock, and wildlife that would likely be stranded during an emergency event.

Health Care Facilities

Squamish is serviced by Vancouver Coastal Health (VCH). VCH is responsible for providing all publically funded health services and executes the duties of the Drinking Water Officer, which regulates the potable water supply activities within Squamish and the implementation of health related emergency response.

Implications of Health Care Facilities

Health care facilities must be functional during major emergencies and after disasters to provide emergency care and ongoing public health services. Inpatient facilities will require additional support if impacted by an event.

Squamish General Hospital is located at 38140 Behrner Drive, has 21 inpatient beds, seven emergency room stretchers, two labor and delivery rooms, and two operating rooms. It provides a variety of medical care including general surgery, emergency care, and laboratory services.

Other health care facilities include several small medical clinics.

Mental Health

Squamish Mental Health and Addictions serves Britannia Beach, Furry Creek, and Squamish, providing services and support to adults (19 years +) and older adults with mental health and/or addiction issues. Services include assessment, treatment planning, case management, urgent response services, psychiatric consultation, individual and group counseling, referrals to employment and education support, and referrals to other resources such as detox and treatment centres. The facility also provides education services for community groups and events, free and confidential needle exchange service for injection drugs, condoms and smoking equipment for crack cocaine users.

Potential support that could be provided by Squamish Mental Health and Addictions in an emergency situation includes a variety of staff including nurses. However, response during an emergency situation would be coordinated by the VCH Emergency Operation Centre (EOC). Staff would be deployed based on direction received from the VCH EOC and VCH EOC Coordinator. The VCH EOC has personnel dedicated to respond to the District of Squamish EOC to relay information and requests for personnel and resources. Nurses specialize in mental health & addiction services, however all have had basic medical/surgical training during their nursing education.

Additionally, it may be possible to provide some space to help treat those requiring less urgent care.

Schools in Squamish

There are six elementary schools, a French school, a French immersion program, a junior high school and a high school in proximity to major neighborhood nodes. Independent preschools and schools offer Montessori and Waldorf-inspired education, and Squamish is home to two universities - Quest University Canada and Capilano University, Squamish Campus.

Responsibility for emergency preparedness and response at schools rests with the School District 48 Board. School District 48 (Sea to Sky) has shipping containers with emergency supplies and equipment at each school as well as an Emergency Plan detailing the roles and responsibilities of staff.

Seniors

There are two assisted living facilities, Hilltop House and Shannon Falls Retirement Residence. Hilltop House, located directly beside the hospital, has 110 beds available. The Shannon Falls Residence, located in the downtown area, has 75 beds available and offers both independent and assisted living accommodations.

The Squamish Seniors Centre is located on 1201 Village Green Way. The Senior Centre is operated by the District and provides recreational activities for all ages.

Response Capabilities

Police

Municipal policing is provided by the Royal Canadian Mounted Police Squamish Municipal Detachment located at 1000 Finch Drive. As a result of an area-wide amalgamation in 2006, the Squamish RCMP Detachment falls under the umbrella of the Sea-to-Sky Regional RCMP Services. The RCMP Detachments along the Sea to Sky corridor are commanded by one Officer-In-Charge and supported by a leadership team of senior staff in each jurisdiction. Squamish RCMP provides the people of Squamish with a 24/7 police service consisting of four General Duty Watches, and complemented with a Plainclothes Unit, Municipal Traffic Services and a Community Policing Unit. The Detachment has access to additional resources and/or equipment if required from neighboring Detachments in the corridor (Whistler RCMP, Pemberton RCMP & Tribal Police).

Squamish RCMP is also able to rely on the assistance of additional support services and Integrated Teams at the District (Metro Vancouver) and Divisional (Provincial) level. Such teams would include, are not be limited to, Integrated Traffic Units, Dive Teams, Marine Sections, and others.

Ambulance Services

Emergency ambulance services are offered through the British Columbia Ambulance Service (BCAS). Station 222 is located at 38929 Production Way and all ambulance personnel are dispatched through a regional dispatch centre in Vancouver. There are always two staffed ambulances 24/7. This station has four full time staff and about 26 part time staff. In total 21 ambulance staff live in Squamish. In 2014 BCAS responded to 3600 calls.

This station also has one multi casualty/disaster response ambulance that can be dispatched to large scale events. This ambulance is not used to transport patients but is used instead as a command post. There is also a spare ambulance and a second spare ambulance for the winter months. These are primarily used when regular cars go in for service or at shift change.

The BCAS station provides service to the area from Porteau Cove to the Cullton Creek Bridge on Highway 99. There are also two ambulances staffed 24/7 in Lions Bay, and Whistler.

Fire Department

Squamish Fire Rescue provides fire prevention and protection services to the community through a combination of career and volunteer members. As of 2015, the department included 50 volunteers and seven career personnel on staff, including the Fire Chief, Deputy Chief, Fire Captain and four firefighters that oversee public education, inspections and equipment repair. The main fire hall is located at 40439 Tantalus Road.

The Squamish Fire Department responds to emergency incidents, such as structure fires, motor vehicle accidents and requests for assistance from the BC Ambulance Service and the RCMP. The department provides fire protection services to a 100km square area within the District of Squamish. In 2014 the department responded to 728 calls, 233 of which were medical. Squamish Fire has a mutual aid agreement with Whistler.

Volunteer Response Capabilities

Search and Rescue (SAR)

Squamish SAR provides the technical and emergency medical skills required to reach, treat and remove injured or distressed people from the backcountry. As of 2015, Squamish SAR has 60 volunteers. In 2014 the team responded to approximately 80 calls making them one of the busiest SAR teams in the Province.

SAR maintains several highly specialized teams with the technical skills and expertise required to complete highly complex rescues, including Helicopter External Transport Systems, technical rope, swift water and mountain rescue.

Squamish SAR's primary response area is imposing. Extending from Porteau Cove (Deeks Lake) to the southern boundary of Whistler (Daisy Lake) including the popular climbing areas of Stawamus Chief Provincial Park, Murrin Provincial Park, Cheakamus Canyon, Sky Pilot and the Tantalus mountain range. The team also responds to the heavily used Garibaldi Provincial Park and Squamish Valley.

Royal Canadian Marine SAR (RCMSAR)

RCMSAR Station 04 is located at the Squamish Yacht Club. The team has 21 dedicated volunteers and two rescue vessels including Titan T-Top (main response vessel) and a Tornado (secondary training vessel). This team responds to approximately 12 calls a year.

Emergency Social Service/ Red Cross

The District has signed a service agreement with Red Cross to provide Level 1 Emergency Social Services (ESS) support to the Community of Squamish. This team has approximately 18 volunteers who are

trained to provide short-term assistance to people who are forced to evacuate their homes due to an emergency.

Any emergency that affects 25 or more people will be coordinated through the District of Squamish. In an emergency where people are evacuated, a reception centre will be established at the Brennan Park Community Centre.

Victim Services

The Squamish Victim Services team is positioned within the RCMP umbrella and operates out of the RCMP office. Victim Services works with the RCMP to provide emotional support, information and referrals to victims of crime and trauma. Staff and volunteers provide emotional support in person and over the phone to victims, witnesses and their family members. Although they do not provide counseling, they can make appropriate referrals to counseling services in the community. One full-time staff member coordinates the volunteers.

Emergency Response Partners

Squamish Nation

Squamish Nation members are descendants of the Coast Salish Aboriginal people who have lived in this area since before recorded time. Total area of Squamish Nation Traditional Territory is 6,921km^2 (~692,100 hectares). The Nation's population is scattered among nine communities stretching from North Vancouver to the northern area of Howe Sound. Over 60% of the more than 3,600 Squamish Nation members live on-reserve and membership is determined by guidelines set out in the Squamish Nation Membership Code.

Squamish Nation Council provides support and services to its members including family services, education, employment and training, housing and health services.

Squamish Lillooet Regional District

The Squamish-Lillooet Regional District (SLRD) is a local government federation consisting of four member municipalities (District of Lillooet, Village of Pemberton, Resort Municipality of Whistler, District of Squamish) and four unincorporated rural Electoral Areas (A, B, C, D). The SLRD is found within the traditional territories of both the Squamish and St'at'imc Nations.

Headquartered in Pemberton, which is the approximate geographic centre of the region, the SLRD delivers a range of local, sub-regional and regional services to approximately 38,000 residents. The SLRD Emergency Management Program provides emergency management services to SLRD residents in the four Electoral Areas, and partners closely with member municipalities including Squamish. In addition to the Emergency Management Program, the SLRD funds and/or operates select Emergency Services in the region including:

- 9-1-1 Services
- Diking and Drainage in Electoral Area D
- Fire and Rescue Services
- Wildfire Fuel Management Program

Economy

Squamish has experienced considerable socio-economic shifts in recent years. Once dominated by resource-based industries, Squamish is now leveraging its enviable recreational assets and quality of life amenities to help diversify its local economy. Supported by these assets, Squamish is attracting new residents and employers and has established itself as a relatively fast growing (in comparison to the province as a whole, and regional averages), yet affordable (in comparison to Metro Vancouver) community where public services (health, education, social services), tourism, education and construction have emerged as important components of a relatively diverse local economy.

The decline of resource-based industries combined with significant residential development (and residential development pressure) has resulted in large areas of industrial employment lands being re-designated and rezoned. The District of Squamish has developed an Employment Lands Strategy to help ensure that sufficient employment lands are available to meet a range of potential future needs through 2031.

The 2011 – 2015 Outline for Economic Activities document (District of Squamish) proposes three phases of economic development activities, each building on the work of the previous phase, and each predicated on the approach that 80% of effort should be directed towards business retention, maintenance, and reaction to inquiries. The focus is leveraging what is already working in Squamish, rather than looking outside of Squamish for a new economic engine.
The proposed three phases – “looking inward”, “connecting inward to outward”, and “looking outward” – recognize the irreplaceable value of Squamish’s existing businesses, and the importance of working with existing businesses. It is assumed that the activities in each phase will continue as subsequent phases are launched, and that the 80% focus on retention, maintenance, and reaction to inquiries will be maintained even after launching phase three.

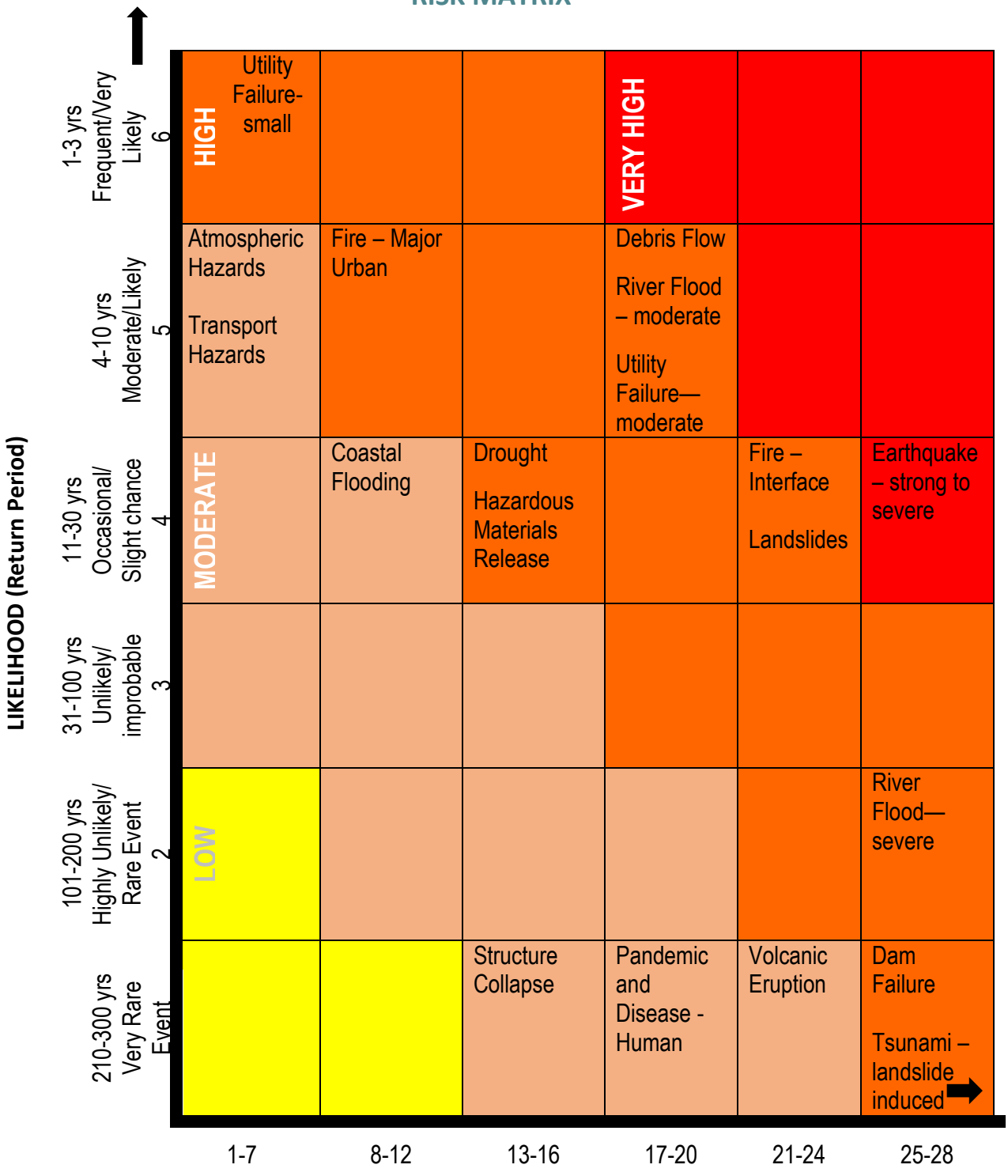
Priorities

During a workshop attended by over 30 District of Squamish managers, key staff and first responder agencies, the following actions were most cited in response to the question: What should be done about risks to the community from identified hazards?

- Develop Comprehensive Emergency Management Plan (CEMP) as required by the EPA
- Develop comprehensive Municipal business continuity plan
    - Succession planning of staff
    - Backup IT systems established
- Develop comprehensive evacuation plans for multiple hazards, and multi-hazard impact scenarios
- Test emergency planning through exercises including: inter-agency desk-top simulations, funcutional and community-wide exercises
- Develop emergency communication plans – for the community, across volunteer organisations and inter-agency. Test emergency communications regularly.
- Strengthen neighbouring district mutual aid agreements, develop integrated systems and plans
- Community education planning and partnerships to increase two-way emergency planning and response knowledge, preparedness and self-rescue capabilities
- Maintain flood protection infrastructure to high standard and improve where possible
- Prioritize upgrades of ageing critical infrastructure where risk of impact is high and consequences are severe - lobby provincial and federal government for funding
- Stronger hazard/risk direction in Official Community Planning (OCP) so that it directs land use planning and growth management with hazard impacts in mind.
- Develop Emergency Reserves/Contingency - funds and supplies - lobby for provincial/federal assistance as Squamish is an unusually high multi-hazard impact risk location

For more information on specific hazards and a full list of suggested risk reduction actions, refer to section two of this report, Hazards Affecting Squamish A-Z.

RISK MATRIX



District of Squamish Risk Matrix. The risk increases from low to very high in the direction of the arrow, from bottom-left to top-right. The low hazards are infrequent and have a relatively low impact while the very high hazards are frequent and have a very high impact.

SECTION TWO

Index of Hazards Affecting Squamish

Hazard	Risk Level
Atmospheric Hazards	Moderate
Dam Failure	Low
Debris Flow	High
Drought	Low-Moderate
Flood – moderate to major	Moderate-High
Earthquake – strong to severe	Low-Moderate
Fire – Major Urban	Moderate
Fire - Interface	Low
Hazardous Materials Release	Moderate-High
Landslides	Moderate
Pandemic and Disease – Human	Moderate
Structure Collapse	Low
Transport Hazards – Road, Rail, Marine, Air	Low-Moderate
Tsunami – Landslide induced	Low*
Utility Failure	Moderate
Volcanic Eruption	Low

Atmospheric Hazards

Risk: Moderate

Description

Atmospheric hazards may cause a variety of impacts depending on the weather type. Extreme weather events can lead to long-term economic repercussions. Damage from atmospheric hazards may range from temporary power and utility outages, to more severe damage causing long-term economic repercussions, such as the collapse of structures, or serious damage to roadways and power transmission facilities. Atmospheric conditions include: fog, hail, heavy rain, high winds, ice storms, lightening, temperature extremes, and heavy snowfall.

Squamish is particularly susceptible to heavy rain and high wind events and extreme temperature events may become more common as the climate changes. With climate change, Atmospheric Rivers (Pineapple Express) are predicted to double in duration and frequency, causing increases in overland flooding such as sewer back-ups and nuisance flooding. There are no definitive predictions on what will happen to wind; precipitation will increase except in the summer and heat wave events could increase mortality in vulnerable populations such as the very young and very old.

Past Events

1999 B.C. Southwest: Windstorm forced cancellation of many ferry sailings, closing of major highways, and power outages to 50,000 customers. Half a dozen waterfront homes were flooded, some destroyed by large waves. Estimated $1M damages, 3 fatalities.

1991 Greater Vancouver area Snowstorm: 52cm of snow in Vancouver, disrupted transit lines and electricity to remote areas such as Bowen Island for days at a time. The City's road repair expenditures were increased by over $1M, as freezing and melting of ice and snow caused severe damage and potholing to local roads. In addition, the snow removal expenditures for the City of Vancouver were $1 million over budget.

1990 Vancouver Harbour Fog: Two ships collided in the fog, releasing 40 tonnes of marine diesel oil into the harbour.

1936 Cross-Canada: A heat wave affected all ten Provinces in July 1936. Over a two-week period, up to five hundred people were estimated to have died in B.C.

Hazard Areas

Whole of Community.

Vulnerabilities

- Severe storm events may lead to debris fall or snow related closures along the Sea-to-Sky Highway, isolating part or all of Squamish
- Some critical infrastructure may be affected by weather including sewage treatment, power supply and telephone lines, leading to secondary hazards from health impacts and communication impacts
- Increases in mold from more warm and wet conditions would also present a secondary health hazard.

Risk Management

- Facilitate business continuity planning to mitigate potential economic losses and civic disruption. ***Who: Core Leadership Team, Economic Development and Emergency Program.***
- Facilitate citizen and business preparedness for prolonged power outage. ***Who: Operations and Business groups.***
- Prepare plans for emergency care of highway travelers stranded in Squamish due to road closures from severe weather. ***Who: Emergency Program in partnership with Ministry of Transportation.***

Dam Failure

Risk: Moderate

Description

Catastrophic dam failures are rare, but can cause immense damage and loss of life when they occur. Failures are often attributed to poor design and severe weather events which cause water levels to exceed the maximum capacity of the dam.

Located just south of Whistler, the Daisy Lake Dam, on the Cheakamus River, presents a catastrophic dam failure hazard to Squamish. Before flowing into Howe Sound, The Cheakamus River connects with the Squamish River which passes directly through the community of Squamish. BC Hydro monitors and controls flow levels from the Daisy Lake Dam.

Past Events

1995-present, Cleveland Dam leak: A massive engineering project that will cost up to $25 million is required to fix a growing leak at Cleveland Dam that poses an increasing risk to people living downstream near the Capilano River. Regional water district officials stress there is no immediate danger of the dam failing and people should not be alarmed, but the Capilano reservoir, a major source of drinking water for Greater Vancouver, could be shut down for up to four years as the leak is addressed (Pearce, 2011).

1989 Britannia Beach: The Parklane Dam, just eight kilometres east of Britannia Beach, was in imminent danger of collapse. Britannia, built on an alluvial plain, and subject to floods in the past, was at substantial risk from this dam built at 4,800 feet up in the mountains.

On May 26, the town was evacuated while a hole was blown into the side of the dam to relieve the pressure and lower the water level. The dam was in such poor condition (the steel reinforcement indicated in the plans proved non-existent) that the rafters came apart and there was a partial dam collapse. This collapse caused such a rush of water, that a huge debris torrent was created. One footbridge and one other older bridge succumbed to the debris torrent, the others and the residences were left undamaged.

Hazard Areas

The lowest lying areas are more vulnerable to any emergency release or dam failure scenario, but inundation areas and depth of inundation are dependent on the nature of the hazard event – e.g. an emergency release due to storm/flood scenario compared to a release due to a severe earthquake event. BC Hydro has mapped eight inundation scenarios to assist emergency planning.

Vulnerabilities

The majority of residential, municipal and business infrastructure will be impacted.

Risk Management

- Develop and rehearse comprehensive evacuation plans, including vulnerable populations. ***Who: Emergency Program and Operations.***
- Continue coordination and communication with BC Hydro to ensure knowledge of dam status remains current. ***Who: Emergency Program, Engineering and Operations.***
- Consult BC Hydro to develop an early warning notification system and more streamlined communication system to the public. ***Who: Emergency Program.***

Debris Flow

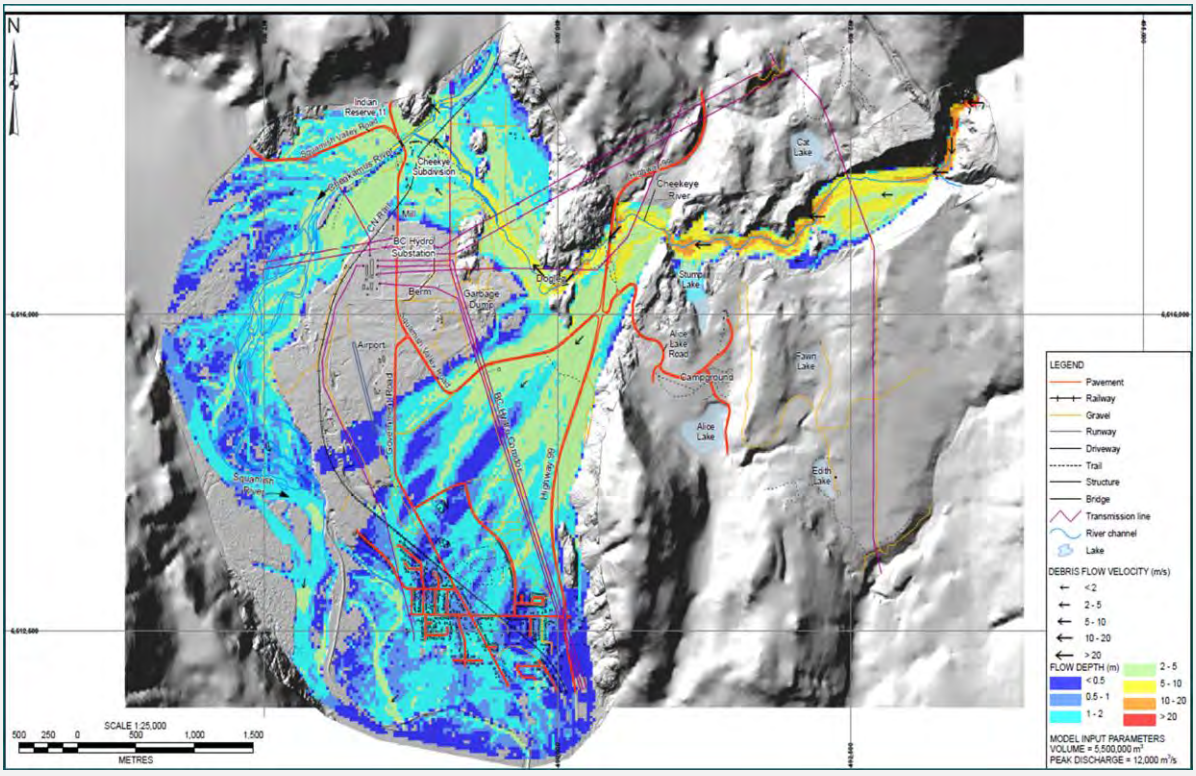
Risk: High

Description

Debris flows are very fast-moving, liquefied landslides that carry soil and other debris including boulders, and vegetation. Debris flows are most often triggered during periods of intensive rainfall resulting in high soil saturation levels but can also be triggered by rockfall or avalanche on unstable slopes. Known debris flow hazards within Squamish include the Cheekye Fan and Stawamus River.

Concave slopes like gullies and ravines are particularly susceptible to debris flows because they tend to concentrate surface water runoff and accumulate surface water and loose soil. Debris flows can be the result of natural factors and man-made interventions (SLRD, 2015). BCG Engineering reports that due to the impacts of climate change, both the frequency and magnitude of debris flow events on the Cheekye Fan are expected to increase.

Hazard Areas



Source: District of Squamish

Debris Flow

Risk: High

Vulnerabilities

- Anticipated population growth – new residential development is proposed within the Cheekye Fan which has the potential to increase Squamish's vulnerability to debris flow hazard
- IRs, Brackendale, residents at confluence, BC Hydro substation, Highway 99, two schools
- Most scenarios also show the debris flow running down the highway as the path of least resistance. This means the highway will be closed for many days impacting transportation to/from north of Squamish.
- The debris flow could cause a dam outburst flood on the Cheakamus River causing flooding as a secondary hazard.

Risk Management

- Stronger hazard/risk direction in the OCP so that it directs land use planning and growth management with hazard impacts in mind – to avoid direct damages and avoid prohibitive mitigation costs to safeguard future communities if development in high hazard areas is permitted. ***Who: Development Services.***
- Establish comprehensive evacuation plans for multiple hazards, and multi-hazard impact scenarios, including hazard monitoring and alert systems. ***Who: Emergency Program and Development Services.***
- Implementation of engineered structural mitigation. ***Who: Development Services and Engineering.***

Past Events

2013 Canmore, Cougar Creek: debris flow/flood event caused tens of millions of dollars in damages, severed road and rail lines and mitigating against future events of this nature (assessed as high risk) will cost $40 million.

Over the past 10,000 years events ranging in magnitude but up to a volume of 5 million m³ have occurred on the Cheekye Fan. In the past century several moderate debris flows have occurred up to 100,000 m³ causing moderate damage (bridge washouts, property damage, bank erosion).

TransCanada Highway following the Cougar Creek, Canmore debris flood event. (Source: Ben Gadd, 2013. via thetyee.ca)

Scars formed by debris flow in Ventura, greater Los Angeles during the winter of 1983. The photograph was taken within several months of the debris flows occurring.

Source: D.M. Morton, R.M. Alvarez, and R.H. Campbell. "Preliminary Soil-Slip Susceptibility Maps, Southwestern California" (Open-File Report OF 03-17 USGS 2003)

Drought

Risk: Low-Moderate

Description

Drought is a recurrent feature of climate involving a deficiency of precipitation over an extended period of time, resulting in a water shortage. Drought may be caused by combinations of insufficient snow accumulation, hot and dry weather or a delay in rainfall.

The DOS Water Conservation plan explains that "although the effects of climate change cannot be predicted accurately, the District is likely to experience variations in weather resulting in both flooding and drought conditions…If the Mamquam glacier retreats, flow may reduce in the Manquam River, and subsequent recharge to the aquifer may drop as well. This, combined with less rain in the summer could impact available capacity of the aquifer to supply the District." (DOS Water Conservation Plan 2015)

Past Events

2002 Drought Whistler: had its driest October ever. Pacific Coast water managers continue to worry as the last three years have been among the nine driest over 55 years of records, with some 15% less precipitation

1984 Drought Western Canada: also affecting British Columbia, caused estimated losses of over $1 billion and affected 10,000 farms.

Hazard Areas

Whole of Community. Those with private wells or other water sources may be affected differently.

Risk Management

- Implement the 2014 Source Water Protection Plan and schedule progress reviews. ***Who: Operations and Engineering***
- Implement the 2015 – Water Conservation Plan and schedule progress reviews. ***Who: Operations and Engineering***
- Implement the 2015 – Master Water Plan and schedule progress reviews. ***Who: Operations and Engineering***
- Ongoing – Staff water conservation initiatives. ***Who: Operations and Facilities***

Vulnerabilities

- Population growth and the resulting strain on the age and condition of water distribution system components
- Culture of high water consumption
- Residents using private surface and/or shallow well sources may be more vulnerable to changes in the water table.
- Drought conditions in surrounding landscape increase the wildfire hazard and the resulting risk to DOS.
- Greater impact on vulnerable populations such as very young, elderly and chronically ill.

Flood: Moderate-Major

Risk: Moderate-High

Description

Flood events can range in scale from minor to major. Minor events often present little threat to the public with minimal or no property damage. Major events can cause extensive damage or destruction to critical infrastructure, while presenting a high degree of danger to the public.

Floods can be either slow or fast rising, generally developing over days or weeks. The geography of Squamish combines four of the five most commonly flooded land types, i.e., river floodplains, basins and valleys affected by flash flooding, land below water-retention structures (dams), and low lying coastal and inland shorelines.

Past Events

October 2014: Minor Flood Event
2003: Major Flood: Extreme Weather Event; damages: $30 M; evacuated to shelter: 360 people
1984: Major Flood: Debris Flow / Riverine Flooding; damages: $1.9M
1980: Major Flood: Debris Flow / Riverine Flooding; damages: $313K; Homes Destroyed/Damaged: 200
1908-1958: Seven major floods resulting in wide spread inundation in the downtown

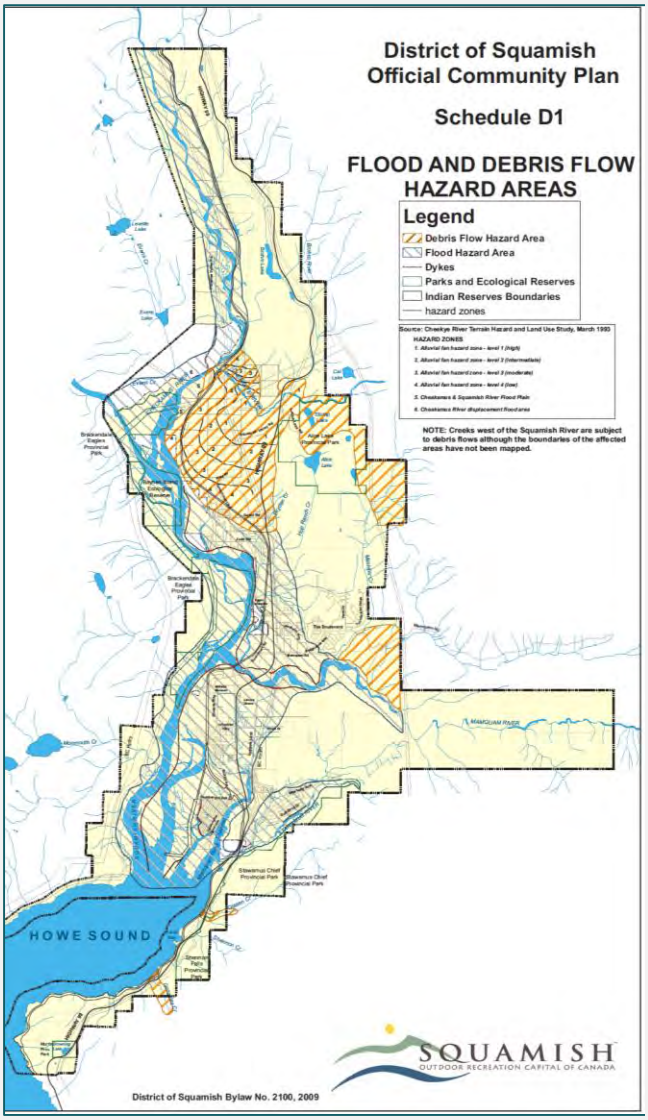
Vulnerabilities

- As of 2011 the areas of potential inundation encompassed 3,235 residential buildings, nearly 60% of the total building stock (Journeay, 2011).
- Older homes built prior to flood construction levels and homes located in low-lying areas will experience the greatest impact and damage.

Risk Management

- Develop comprehensive evacuation plan including vulnerable populations. ***Who: Emergency Program.***
- Strengthen OCP in relation to land use planning aligned with flood area to reduce direct damage. ***Who: Development Services and Engineering.***
- Maintain flood protection infrastructure to a high standard and improve where possible as per the 2015 Flood Hazard Mitigation Plan. ***Who: Engineering and Operations.***

Hazard Areas



Earthquake – strong to severe

Risk: Low-Moderate

Description

Earthquakes may be described as "sudden movements of earth, caused by an abrupt release of strains that have accumulated over time along fault lines" (Coppola, 2011). Notably, many secondary hazards are triggered by earthquakes including landslides, rockslides, avalanches, and multiple utility failures from downed lines and collapsed pipes. Damage to buildings generally begins to occur at magnitude six while an earthquake above magnitude seven may be a major disaster if it occurred near a populated area. Although a low probability, if an earthquake were to occur, much of Squamish's infrastructure would be at risk for structural damage. Ground shaking, liquefaction, and earthquake-triggered landslides represent the most significant earthquake related threats to Squamish (Journeay, 2011).

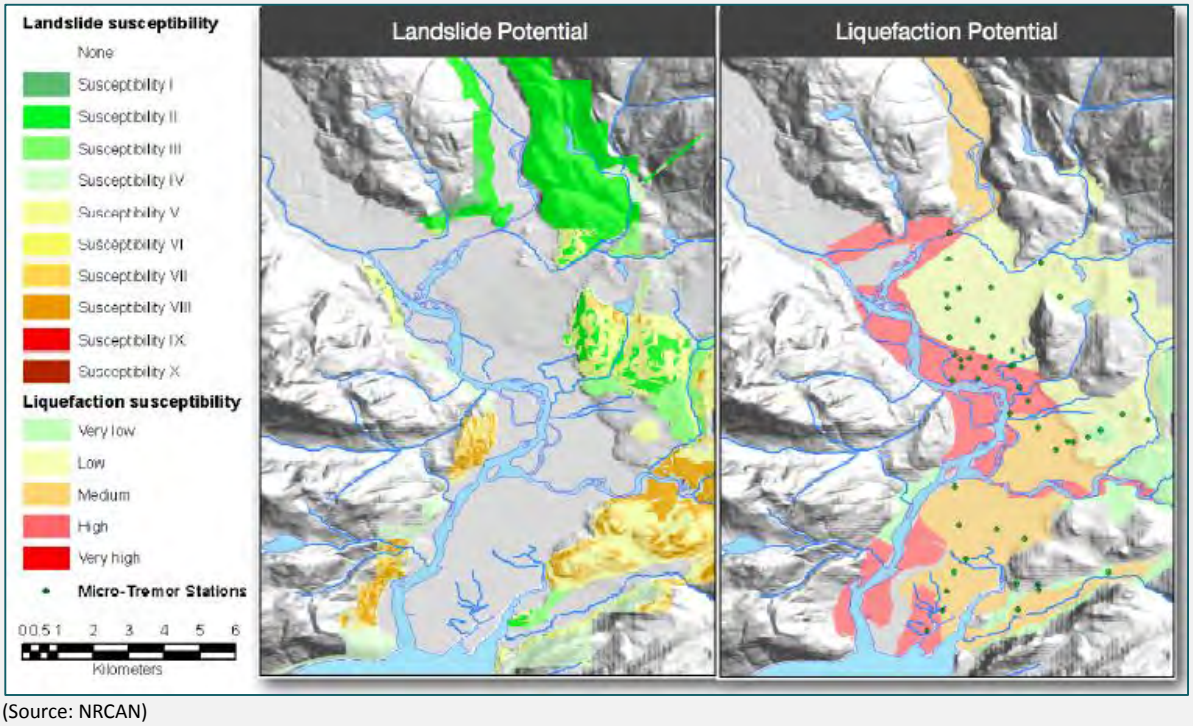
Mega-thrust earthquake:"This type of quake occurs, on average, every 500 to 600 years, but the intervals between events have been as short as100 to 300 years. Scientists have estimated that there is about a **12% chance** of a similar magnitude quake in the next 50 years" (Auditor General of British Columbia, May 2014).

Shallow-focus earthquake: Shallow-focus earthquakes occur within the earth's crust along fractures, generally at depths less than 35 kilometres. This class affects a smaller area than a deep earthquake of the same magnitude, but the shaking is usually more intense and aftershocks more numerous. The probability of a shallow crustal earthquake causing considerable damage in British Columbia has been estimated at **approximately 12%** in the next 50 years. To better understand these quakes, more information is needed about where the active faults are. (Auditor General of British Columbia, May 2014).

Deep sub-crustal earthquake: can occur as deep as 80km within the North American Plate, on which Squamish rests. Scientists estimate the frequency of deep sub-crustal earthquakes at **about 60%** in the next 50

Hazard Areas

Map showing the permanent ground deformation potential for earthquake-triggered landslides and liquefaction in the District Municipality of Squamish (Natural Resources Canada)



(Source: NRCAN)

Earthquake – strong to severe

Risk: Low-Moderate

Vulnerabilities

- All development on flood plain land is vulnerable to liquefaction in the event of a shallow-focus seismic event.
- Substantial commuter population risks being isolated from home and family if earthquake closes Highway 99 on either side of DOS.
- Older building stock, including the Fire Hall and other public service infrastructure, are not earthquake resistant without strengthening work.
- There are limited reception centre options for evacuated people, including potentially high numbers of tourists/visitors.

Risk Management

- Establish comprehensive evacuation plans for multiple hazards, and multi-hazard impact scenarios. ***Who: Emergency Program with collaboration from all Departments.***
- Develop comprehensive Municipal business continuity plan, -i.e. how DOS would continue to operate under hazard impact conditions. ***Who: Emergency Program and Economic Development.***
- Community education planning and partnerships to increase two-way emergency planning and response knowledge, preparedness and self-rescue capabilities. ***Who: Emergency Program and Fire Rescue.***
- Develop and test alternative EOC location to build system redundancy for responding to hazard events. ***Who: Emergency Program, Fire Rescue and Facilities.***
- Prioritize upgrades of ageing critical infrastructure and emergency response buildings where risk on impact is high and consequences severe. Lobby provincial and federal government for funding. ***Who: Engineering, Development Services, and Facilities.***

Past Events

2012 Haida Gwaii: initial 7.7 Mw earthquake occurred in the Haida Gwaii region with numerous aftershocks of M3 to 5 after the main quake. It was felt across much of north-central BC, including Haida Gwaii, Prince Rupert, Quesnel, and Houston. There were no reports of damage.

2010 Christchurch, New Zealand: initial 7.1 magnitude shallow focus earthquake, located on a previously unknown fault line, generated 42 aftershocks of magnitude 5.0 or greater including the most damaging magnitude 6.3 aftershock which killed 185 people and caused an estimated $30B damage Nearly 8,000 houses were red zoned (which prohibits rebuilding) in suburbs built on floodplain land.

1975-present: "Seismic activity has been recorded since 1975 and over this time there have been 17 small earthquakes (M2.0 – M4.6) within a 50km radius of Squamish. The largest of these would have been felt but none have posed a direct threat" Natural Resources Canada).

Vehicle partially buried in liquefied ground after Christchurch, New Zealand 2011 earthquake. Source: AAP via www.news.com.au

Fire – Major Urban

Risk: Moderate

Description

Major urban fires can be ignited by a number of causes including faulty electrical wiring, improper use of smoking materials, and arson. Although severe fires are becoming less frequent, fire in a residential, commercial, institutional, or industrial building could result in catastrophic impacts. This is of particular concern among high-density occupancies, such as schools and apartment buildings (Smart Risk Control, 2014).

Damage to residential units can render occupants homeless for weeks or more, and in need of immediate care and shelter. Commercial and industrial buildings carry the risk of toxic smoke from urban fires.

Hazard Areas

Multi-Unit residential areas with no sprinkler systems (Edgewater Arms/Manor; Tantalus Manor; Strathmore Lodge). Dentville area has several multi-units. These are low income housing.

Vulnerabilities

Elderly/ mobility challenged people in low income multi residential housing.

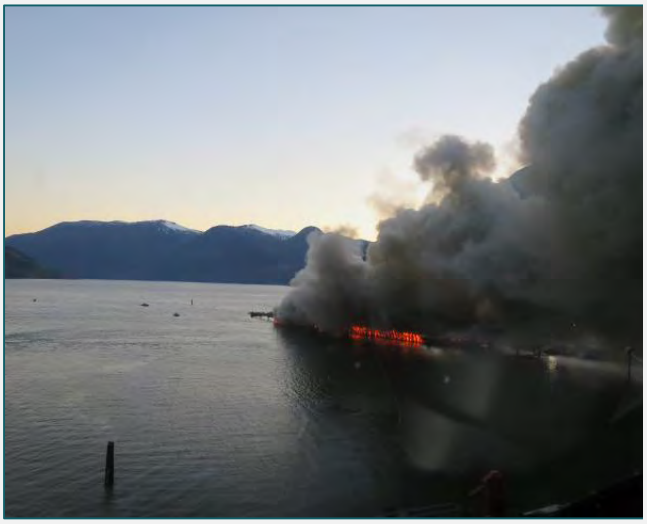
Risk Management

- Establish comprehensive emergency plans for multiple hazards, and multi-hazard impact scenarios. ***Who: Emergency Program***
- Maintain Pre-fire Plans. ***Who: Fire Rescue***
- Design and conduct public education campaign for at risk areas. ***Who: Fire Rescue***
- Expansion of full time fire department staffing to allow for quicker fire suppression. ***Who: Core Leadership Team, Fire Rescue***

Past Events

2015 Squamish Terminals: Creosote timbers caught fire under the pier. Approximately 45 firefighters fought the smouldering fire for 4 operational periods. Mutual aid from Whistler and Vancouver Fire Departments were brought in. Residents of Squamish were initially advised to stay indoors and close their windows and doors.

2010 Phoenix Fire: The call out for the fire came in the early morning hours so the response was no crew on shift. On arrival there was an eight unit attached townhouse structure 75 % involved.
The entire townhouse complex, eight units and several vehicles were lost.



Wharf burning during Squamish Terminals fire, 2015.

Fire - Interface

Risk: Moderate

Description

Wildfires burning in urban areas are referred to as interface fires and can be devastating when they encroach on human settlements and critical infrastructure. Wildland fires primarily occur during hot, dry weather when forest fuel sources are particularly susceptible to lightning strikes and human carelessness. Squamish has many forested areas in and around the Municipality, heightening the potential risk posed by an interface fire.

Interface fires can result in significant economic and environmental costs, including the cost of suppression, damage to public and private infrastructure and property, and costs associated with disruption of local businesses (Natural Resources Canada, 2008).

Changes in climate may result in a drier landscape, creating a higher fire risk.

NB: Some of the most successful interface fire mitigation has been achieved under OCP designated DPAs – Wildfire Hazard Areas with guidelines established for protection of development from wildfire hazardous conditions. Examples of viable interface fire legislation are City of Kimberley, City of Langford, and Regional District Central Okanagan.

Past Events

1986 Hospital Hill Interface: A forest fire broke out on the cliffs above Mamquam Blind Channel and threatened several homes. A tanker was brought in to drop fire retardant on the blaze. Several homes were evacuated.

1957 Major fire: started north of Squamish, destroying much forest on both sides of the river. Stopped near site of "Old Salt Shed" on the highway, 3 miles south of Old Garibaldi Village.

Vulnerabilities

Dependent on hazard areas.

Interface fire threatens nearby homes.
Source: www.firetrax.us

Hazard Areas

Any area that backs onto interface forest such as Thunderbird Ridge, Garbaildi Highlands, Brackendale (near Farmer Institute)

Risk Management

- Establish comprehensive emergency plans for multiple hazards, and multi-hazard impact scenarios. ***Who: Emergency Program.***
- Implement Fire Smart public education activities. ***Who: Fire Rescue.***
- Conduct Seasonal Readiness workshops for DOS staff. ***Who: Emergency Program and Fire Rescue.***
- Conduct and maintain Wildfire and fire department joint training and cooperation**.** ***Who: Fire Rescue and BC Wildfire Service.***
- Develop wildfire risk assessment and wildfire mitigation actions with assistance from Forests, Lands and Natural Resource Operations (FLNRO). ***Who: Fire Rescue.***
- Develop evacuation plans for interface fires, including processes that identify at-risk residences. ***Who: Emergency Program and Fire Rescue.***
- Adapt the DOS OCP to identify and require Interface Fire mitigation measures in high hazard areas**.** ***Who: Development Services.***
- Prepare plans in coordination with Vancouver Coastal Health for air quality monitoring for particulates in order to determine when to issue a public advisory or to order an evacuation, and when residents would be allowed to return. ***Who: Emergency Program.***

Hazardous Materials Release

Risk: Moderate-High

Description

Hazardous materials processing and storage accidents are common. Most HAZMAT events occur during road or rail transportation. Accidents at industrial sites occur from natural disasters, fire, human error, infrastructure deterioration and failure, accidents and intentional damage. The success of safety standards and procedures for containment rely on the degree of enforcement and a level of environmental control.

"Major gas distribution line breaks are becoming more of a risk as intra- and intercity systems are established" (Coppola, 2011). These pipes, containing highly pressurized and flammable gas, are vulnerable to a range of natural and man-made influences that could ultimately result in their failure." Special expertise is required to respond to a gas pipeline break and significant populations can be at risk of injury and death from fire and environmental pollution. In addition to current residential supply line, Squamish is the proposed site for a new gas pipeline, compressor station, Liquefied Natural Gas (LNG) processing facility and associated large tanker movements from the processing site.

Hazard Areas

Transportation routes, gas pipelines and industrial users/storers of large quantities and/or highly toxic hazardous materials.

Note: *DOS has written confirmation from CN Rail stating that no dangerous goods are transported in the Sea-to-Sky corridor.*

Risk Management

- Develop HAZMAT response plan: potentially a regional plan for the benefit of all neighbouring communities. ***Who: Emergency Program***
- Coordinate with HAZMAT response agency to understand roles, and jurisdiction for identifying spilled substances, and practice together using ICS. ***Who: Emergency Program and Fire Rescue.***
- Develop knowledge of what industry-related hazardous materials are stored in Squamish, and where they are located in order to understand any commercial/residential proximity risks, including any potential interface of hazardous substances with water systems. ***Who: Emergency Program, Fire Rescue, and Operations***.
- Work with schools on evacuation and shelter-in-place plans in case of HAZMAT release on the highway or from a nearby fixed facility. ***Who: Emergency Program.***

Vulnerabilities

The geography of Squamish necessarily constrains development areas, resulting in industry, transportation routes and residential developments that are not far removed from each other.

Past Events

2015 Wharf fire at Squamish Terminals: ignited creosote pilings and generated clouds of noxious smoke that blanketed Squamish. A Shelter-In-Place order was declared overnight and lifted the following morning. Creosote is a probable human carcinogen with a range of other health effects. Creosote can move through the soil to groundwater and once there, can take many years to break down.

2006 Squamish Harbour Marine Oil Spill: A ship, the Westwood Anette became damaged while leaving port, resulting in 29,000 litres of bunker oil spilled in Squamish Harbour, causing substantial environmental damage within the Squamish Estuary and land areas within the Squamish Harbour.

2005 CN Rail derailment in Squamish: Nine cars derailed, spilling 40,000 litres of Sodium Hydroxide (caustic soda) in the Cheakamus River and Squamish River systems, "more than 500,000 adult and young salmon, steelhead, trout, lamprey and other species died of suffocation from skin burns and gill haemorrhaging. Birds and animals that rely on the Cheakamus salmon for food were also affected by the spill." (Ministry of Environment).

Landslides

Risk: Moderate

Description

Landslides include a range of downhill earth movements, including slope failures, and rock falls. Landslides can be extremely destructive and are caused by a number of pre-existing and contributing factors including heavy rainfall or rapid snowmelt, erosion, poor construction practices, freezing and thawing, earthquakes and volcanic eruptions (SLRD, 2015).

Due to the mountainous topography and high levels of annual rainfall, Squamish and the surrounding area are highly susceptible to landslide events. Landslide events are common along the steep valley walls and have resulted in significant alterations to river grades over the past several hundred years. Climate change is projected to increase landslides as an indirect impact of more and heavier rain.

Hazard Areas

Much of the District is at risk of smaller events, with particularly high hazard in areas such as the Cheakamus Fan.

Risk Management

- Stronger hazard/risk direction in OCP so that it directs land use planning and growth management with hazard impacts in mind. ***Who: Development Services***
- Establish comprehensive evacuation plans for multiple hazards, and multi-hazard impact scenarios. ***Who: Emergency Program***
- Develop business continuity plan. ***Who: Core Leadership Team and Emergency Program.***

Past Events

1996 Landslide: A medium-size rock slide, involving 60,000 cubic meters of material, closed Highway 99 between Squamish and Whistler for several days while clean up took place. Failure occurred in plutonic rock and was controlled by a steep fault surface.

1921 Britannia Beach Landslide: A 20-metre high wall of water crashed through Britannia Beach. A fill had failed after six days of heavy rain. The community was devastated. Thirty-seven lay dead. Almost half the 110 homes were gone -- flattened or swept out to sea. Thirty-five families were left homeless. An island of dislodged houses stood as a bizarre sentinel to the disaster.

1906 – present: The Vancouver to Squamish highway has been affected by 14 major debris torrents since 1906. Twelve lives have been lost and 11 bridges, 4 homes and numerous structures have been damaged or destroyed. Not one of these 14 slide events was larger than 20 000 cubic metres.

Vulnerabilities

- Anticipated population growth – the location and density of new residential development to accommodate such growth
- Multiple developed areas near steep slopes
- Aging infrastructure unable to withstand landslide impacts
- Hospital Hill area, including the actual hospital
- Landslide may create earth dams which then create flooding as secondary hazard.

Pandemic & Disease - Human

Risk: Moderate

Description

Human diseases include a large array of parasitic, bacterial, and viral agents that can cause illness and death. A great variety of events can lead to disease outbreaks and epidemics among Squamish residents and visitors. The most notable disasters associated with human diseases include respiratory viruses, such as high-mortality influenza.

A pandemic is a worldwide outbreak of a specific disease which affects a large proportion of the population and spreads rapidly. Squamish falls within a Vancouver Coastal Health, Health Services Delivery Area. Vancouver Coastal Health is responsible for developing, maintaining, and implementing the pandemic response plan for the Sea to Sky Corridor (VCH, 2014).

In a large-scale and sudden human disease outbreak, such as pandemic influenza, health care services may be unable to deal with the large number of expected patients.

Past Events

2002/03 Greater Vancouver: Hepatitis outbreak was linked to food sold at Capers markets. At least 8 Capers patrons were infected and 6,447 Capers customers received anti-Hepatitis vaccine.

1918/19 British Columbia: The "Spanish Flu" rapidly spread across Canada along the railway lines, arriving in Vancouver in October 1918. A second wave came in 1919. 4,400 fatalities.

Source: Scientific Computing World 08/09/2007

Hazard Areas

Whole of District, but dependant on the nature of the disease, where it enters the community and how quickly an outbreak is discovered and contained.

Vulnerabilities

- Specific populations including the elderly, very young, those already ill and those who are homeless
- People congregated at large scale events such as the Squamish Valley Music Festival
- Proximity to Vancouver with international airport and commuter population increases the risk of disease being spread from city to Squamish.

Risk Management

- Work with health authorities to develop local response protocols.
  Who: Emergency Program

Structure Collapse

Risk: Low

Description

Structure collapse is a general term that refers to any failure of integrity in a designed building, walkway, or other community infrastructure. Structure collapse may be caused by engineering or construction problems, metal fatigue, severe weather events, 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 support infrastructure, such as gas lines, electricity, water, sewer, and telephone lines. Factors that may contribute to structure collapse include building age, design, time of year, use levels, and seismic activity.

Erosion is also a reason for building collapse. Squamish buildings are mostly wood frame and small and nearby floods and slides have the potential to destabilize houses even though they are not directly affected by these events.

Past Events

1988 Vancouver: As the cruise ship Noordam was preparing to leave for Alaska, a 45 tonne mobile gangway collapsed. One shoreworker was killed and three others were seriously injured.

1958 Structural Collapse – Bridge: 18 people killed when, during construction of the Second Narrows Bridge (Ironworkers Memorial Bridge), suddenly the fifth span's front end drooped downwards and plunged into the water. 59 workers were on the bridge at the time.

Hazard Areas

Public, industrial and commercial buildings and structures, especially after strong storm, seismic or flood events.

Vulnerabilities

Older building stock vulnerable to being flood, erosion or earthquake weakened.

Risk Management

- Ensure Squamish Search and Rescue (SAR) and Fire Department are Light Urban SAR (LUSAR) trained, to enhance response capabilities in isolated structure collapse, and in earthquake scenario. ***Who: Emergency Program, Fire Rescue and SAR.***
- Assess risk of structure collapse of older high-capacity buildings (300+ people). ***Who: Engineering.***

Transport Hazards- Road, Rail, Marine, Air

Risk: Low-Moderate

Description

Marine accidents present a potential hazard in Howe Sound. Factors that may contribute to the risk of marine accidents include congestion and conflicts between multiple users, inexperience, intoxication and hazardous weather. Collision, grounding and mechanical failure involving water craft can put passengers and crew members at risk. Squamish has an active deep water port, marina, and timber rafting operation, which accommodate a wide range of watercraft.

Road transportation to and from the District is available by Highway 99 only. A major disaster or road accident may cut-off access and egress to and from Squamish to the south or the north or both. This makes Squamish especially vulnerable to certain hazards as access to safe evacuation routes, food, energy and fuel could be limited for an extended period.

Railway transportation runs through Squamish on the B.C. Rail Line and is used for both tourism and commodity transportation. Hazardous materials are not carried as freight but a derailment and fuel spillage remain a hazard.

Past Events

2015 Marine oil spill off English Bay, Vancouver: Upwards of 2,300 litres of highly toxic bunker C fuel oil were accidently released into the surrounding waters from the grain carrier MV Marathassa (Canadian Coast Guard), washing up on beaches and sinking to the ocean floor with unknown longer term effects. The exact extent of the contamination is not yet known and Fisheries and Oceans Canada issued a closure for harvesting of all shellfish and groundfish species in affected areas.

Risk Management

- Maintain mutual aid agreements with first responder agencies. ***Who: Emergency Program and Fire Rescue.***
- Maintain response coordination communication and agreements with Coastguard. ***Who: Emergency Program.***
- Work with Vancouver Coastal Health on conducting a Squamish mass-casualty scenario exercise. ***Who: Emergency Program.***

2005 CN Rail derailment in Squamish

Hazard Areas

Distribution of transportation system infrastructure and related facilities.

(Source: NRCAN)

Vulnerabilities

- Single access road in and out of Squamish
- Population is concentrated in condensed areas
- Downtown area is exposed to marine related events.

Tsunami – Landslide Induced

Risk: Low

Description

A tsunami is a natural hazard consisting of a series of long, surge-like waves generated when a large volume of ocean water is rapidly displaced. Tsunamis are known for their capacity to violently flood coastlines, causing devastating property damage, injuries and loss of life.

Most tsunamis are caused by major subduction zone earthquakes, where there is significant displacement of the ocean floor. Such tsunamis produce the most extensive inundation area, i.e., the area subjected to flooding.Coastal and underwater landslides, and volcanic eruptions, can occasionally cause tsunami too. As some landslides and eruptions are not associated with shaking, evacuation should be carried out if the ocean suddenly recedes or if there is roaring like a jet engine from the ocean.

*Note that while a tsunami may not be very likely, the impact areas is about the same as that for climate change-induced sea level rise and resulting higher storm surges.

Past Events

1964 Port Alberni: The strongest North American earthquake of the century, measuring 8.5 on the Richter scale, struck off Anchorage, Alaska, sending a tsunami travelling at over 700 kilometres an hour hurtling toward the BC coast. The 4.3 metre wave destroyed houses and flooded basements in Hot Springs Cove and Bamfield on the coast of Vancouver Island before travelling up Alberni Inlet and flooding Port Alberni. Luckily, no one was killed, but damages caused by the wave totalled over $8 million.

Hazard Areas

Potentially unstable coastal slopes rising from Howe Sound opposite populated areas, especially downtown Squamish.

Risk Management

- Develop comprehensive Municipal business continuity plans ***Who: Deputy CAO and Emergency Program.***
- Liaise with DOS staff who have responsibility for investigating long term impacts from climate change and sea level rise, in order to influence the OCP rules. ***Who: Emergency program, Development Services and Engineering.***
- Investigate whether municipal infrastructure can be hardened against impact from tsunami, storm surge and/or sea-level rise. ***Who: Engineering and Development Services.***

Vulnerabilities

- Steep coastal slopes opposite developed downtown area.
- Critical infrastructure located in the downtown area.

Utility Failure

Risk: Moderate

Description

Critical systems of utilities that serve the public, namely, power, water, sewer systems, telecommunications and computer network failures affecting these systems, public health services, traffic systems and other government-related functions.

Power failure: Caused by a breakdown in the power generation and/or distribution grid, or by an accident or disaster that damages the grid. Extended power outages can quickly turn into public health emergencies when life safety systems begin to fail. Without power, people can find themselves unable to travel, work, buy necessary supplies, heat or cool their homes or communicate with each other. **Critical effects** of power outage or water/sewerage system failure include loss of drinking water and sewer service, direct business interruption and wider economic losses, loss of fire protection and sanitary sewer overflows and/or WWTP bypass causing environmental impact.

Drinking water and sewage system failure: these occur usually as a result of natural hazards and/or failure of aging infrastructure, and include water contamination, service stoppage and environmental damage. “Humans rely upon a steady supply of useable water for basic survival, industry and agriculture, and an interruption of as little as a day can result in disaster” (Coppola, 2011).

The District drinking water supply source is separate from the township and there is a low risk of source contamination unless subject to a significant natural hazard impact such as earthquake.

Sewer System Failure: As with potable water, most of Squamish depends on sewer systems. Prolonged

Hazard Areas

Critical utility infrastructure distribution and related facilities.

(Source: NRCAN)

Past Events

2012 Hurricane Sandy: caused power outage in New York that had particular effects on thousands of people in hospitals and high-rise elder care residential facilities that did not have backup power generation.

2003 power outage: struck 50 million people in Canada and the USA resulting in over $6 billion in economic losses and affected water supplies, transportation systems, communication systems and food supplies.

2000 Walkerton, Ontario: The water supply was found to be contaminated with E.coli intestinal bacteria after a heavy rain storm on May 12 washed cattle manure into a town well, according to evidence submitted at a judicial inquiry examining what happened. A faulty chlorinating system in the well failed to kill the bacteria, In a town of 5,000, 2,300 people were sickened and seven people died. The township relied on bottled drinking water only for six months and was under a boil-

Utility Failure

Vulnerabilities

- All DOS pump stations are of concern if power fails however some have generator backup available.
- Climate changes may exacerbate existing risk from aging infrastructure, due to drying and cracking soils, increased soil saturation with increased rainfall, or fluctuating extremes between these states.
- Hospital and medical clinic emergency back-up arrangements for power, water and sanitation may be insufficient.

Hydro sub-station fire.
Source: www.smartgridnews.com

Source: forensic-analysis.com

Risk: Moderate

Risk Management

- Implement the recommendations of the 2014 Well Protection Study by Piteau Associates, (geotechnical and hydrogeological consultants). ***Who: Engineering and Operations.***
- Develop comprehensive Municipal business continuity plan. ***Who: Core Leadership Team and Emergency Program.***
- Survey the resources of local critical infrastructure, such as hospitals, to understand the availability of generators, fuel supplies and availability of ports to connect supplementary generators. ***Who: Emergency Program***
- Acquire, stock and distribute emergency response shipping containers for key locations including schools. ***Who: Emergency program***
- Investigate alternatives to current reliance on power for water pumping to alleviate risk of loss of fire protection. ***Who: Fire Rescue and Operations.***
- Pursue an agreement for emergency access to electrical power from the privately owned powerhouse at Power House Springs. ***Who: Operations.***

Volcanic Eruption

Risk: Low

Description

"Volcanic eruptions in Canada are a rare event. Though infrequent, volcanoes can be catastrophic enough to warrant serious attention (Institute for Catastrophic Loss Reduction, 2010)". A volcano is a vent in the crust of the Earth's surface through which molten rock (magma) is extruded onto the surface of the earth as lava and volcanic debris flows, and also into the Earth's atmosphere as volcanic gases and rock fragments. The District of Squamish sits within the Garibaldi Volcanic belt, part of the Pacific Ring of Fire. (Hickson, Mulder & Stasiuk, 2004). The Garibaldi Volcanic belt includes Mt. Garibaldi, Mt. Price, Black Tusk, Mt. Meager, Mt. Cayley, Mt. Fee and Mt. Silverthrone.

Volcanoes are one of the few hazards that typically exhibit clear precursor activity. (Hickson, Mulder & Stasiuk, 2004). Should a volcano erupt in the Squamish area, this precursor activity would give the District time to plan an emergency response, limiting the amount of injury and loss of life. However, an erupting volcano threatens infrastructure such as highways, roads, and railways. Ash can pollute water supplies and collapse buildings, especially when it falls wet. Airborne ash clouds can adversely affect aircraft corridors and the routing of flights. Heavy ash fall may reduce sunlight, causing a sudden demand and possibly brownouts of electrical power. Ash can clog water systems, sewage plants, and all kinds of machinery, cause roofs to collapse and electrical short circuits. Fine ash is extremely slippery, hampering driving and walking. Ash can also damage the lungs of small infants, elderly, and those having respiratory problems (Institute for Catastrophic Loss Reduction, 2010)

Hazard Areas

Whole of district plus transportation access routes.

Vulnerabilities

- Air quality impact will affect all, but especially vulnerable populations
- Lack of long term evacuation options
- Squamish is a potential long-term recipient community for those displaced from areas such as Pemberton.

Risk Management

- Establish comprehensive evacuation plans and protocols for multiple hazards, and multi-hazard impact scenarios. *Who: Emergency program.*
- Work with Vancouver Coastal Health to prepare plans for air quality monitoring for particulates in order to determine when to issue a public advisory or to order an evacuation, and when residents would be allowed to return. *Who: Emergency Program.*

Past Events

1980 Eruption of Mount St. Helens: deposited ash in southern B.C.

2350 before present, Eruption of Mt. Meager: eruption is the youngest explosive eruption in Canada. It was similar to that of Mt. St. Helens in 1980. Th e explosive phase of Mt. Meager's eruption generated an ash plume that covered most of southern B.C. and extended into southern Alberta and its pyroclastic flows extended down the Lillooet River a distance of 7 km. (Geological Survey of Canada, 2005).

Mt Cabulco in Chile erupts without warning, April 2015, 4000 evacuated. (Source: BBC)

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