Regional District of Bulkley-Nechako

HRVA Electoral Area 'E' Committee Backgrounder

ELECTORAL AREA ‘E’ HAZARD IDENTIFICATION

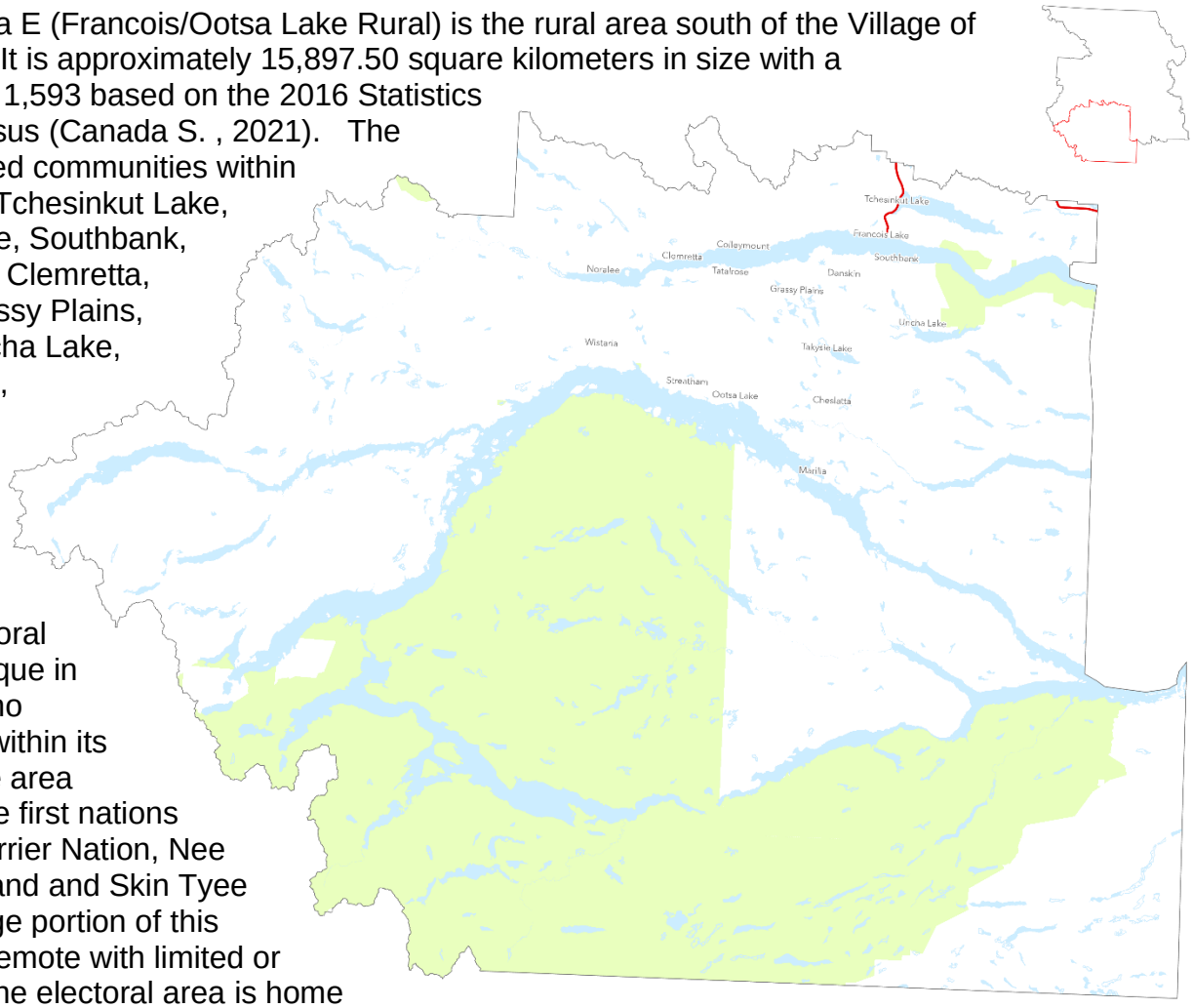
FEBRUARY 2022

“Know the Risks, Make a Plan, Be Prepared”

CHAPTER 2: ELECTORAL AREA ‘E’ HAZARD IDENTIFICATION

Electoral Area ‘E’ Geographic Setting

Electoral Area E (Francois/Ootsa Lake Rural) is the rural area south of the Village of Burns Lake. It is approximately 15,897.50 square kilometers in size with a population of 1,593 based on the 2016 Statistics Canada Census (Canada S. , 2021). The unincorporated communities within the area are Tchesinkut Lake, Francois Lake, Southbank, Colleymount, Clemretta, Noralee, Grassy Plains, Danskin, Uncha Lake, Takysie Lake, Tatalrose, Wistaria, Streatham, Ootsa Lake, Cheslatta, Marilla. Electoral Area E is unique in that there is no municipality within its borders. The area includes three first nations Cheslatta Carrier Nation, Nee Tahi Buhn Band and Skin Tyee Nation. A large portion of this vast area is remote with limited or no access. The electoral area is home to multiple provincial parks and protected areas that include Entiako Park, Entiako Protected Area, and Tweedsmuir Park.



The Cheslatta Carrier Nation office is based at Southbank, on the south shore of francois lake, 23 km south of burns lake. Cheslatta Carrier has a membership of 383 people both on-reserve and off reserve according to the Aboriginal Affairs and Northern Development Canada website (as of September 2016). Residents live on 17 reserves scattered over a vast area known as the ‘southside’ (Nation, 2021). Prior to 1952, the people of the Cheslatta Carrier Nation lived for centuries on the shores of Cheslatta and Murray lakes. The Cheslatta Carrier Nation owns several businesses including the Pondosy Bay Resort, Cheslatta Marine Services, Cheslatta Logging and others which provide employment for members and revenues to support the nation.

The Skin Tyee Nation has a membership of 182 people both on-reserve and off reserve according to the Aboriginal Affairs and Northern Development Canada website (as of September 2016). The main community and band office of the Skin Tyee Nation are located at Uncha Lake on the Skins Lake 16B reserve on the Southbank. The Skin Tyee Nation has one reserve, Tatla’t East 2, within the Plan area, which is located at the west end of Francois Lake. There are two dwellings on this 56.1-hectare reserve.

Nee Tahi Buhn is the name for Francois Lake, and means, "it fills at one end and empties at the other." In 1984 the Omineca Band split into the Broman Lake and Nee-Tahi-Buhn bands. Nee Tahi Buhn Band is an independent band with the most populated reserve being Uncha Lake 13A. The band has a membership of 144 people both on-reserve and off reserve according to the Aboriginal Affairs and Northern Development Canada website (as of September 2016). Nee Tahi Band has five reserve areas including Eastern Island 13, Francois Lake 7, Isaac 8, Omineca 1, and Uncha Lake 13A.

The forestry, agriculture and tourism sectors are the major industries in the area. The Francois Lake Forester, owned and operated by Waterbridge Equipment Ltd., is a free ferry that is the connector for the southside of Francois Lake. Capable of transporting up to eight loaded logging trucks, the Forester is a key infrastructure component in Electoral Area E. The north shore community of Francois Lake is an agricultural community with acres of hay land and several cattle ranches.

Hazards for Electoral Area 'E'

The first step in the HRVA process was to identify the possible hazards that will need to be analyzed in the study area. The list below is an adaptation of hazards identified in the BC Emergency Management Regulation and a reflection of the HRVA Committees Selection of Hazards as discussed. Climate change is recognized as having impacts on the frequency and intensity of many hazards and may also cause new hazards to emerge. This list will guide the HRVA analysis moving forward. The objective moving forward will be to prioritize the mostly likely hazards and consider historic experiences and future likelihood when scoring the frequency, severity, and consequence of each specific hazard.

Emergency ManagementBC

Regional District Bulkley Nechako HRVA 2022

HRVA Hazard List

Community: Electoral Area E **Date: 14-February-2022**

This hazard list is an adaptation of hazards identified within the BC Emergency Management Regulation

Atmospheric

- ☑ 1. Air Quality ↗
- ☑ 2. Extreme Heat ↗
- ☑ 3. Extreme Cold ↗
- ☑ 4. Fog ↗
- ☑ 5. Freezing Rain or Drizzle ↗
- ☑ 6. Space Weather ↗
- ☐ 7. Hail ↗
- ☐ 8. Hurricane/Typhoon/High Wind Event ↗
- ☑ 9. Lightning ↗
- ☑ 10. Snowstorms and Blizzards ↗
- ☐ 11. Tornado ↗

Disease & Epidemic

- ☑ 12. Animal Disease ↗
- ☑ 13. Human Disease (Includes Pandemic/Epidemic) ↗
- ☑ 14. Plant Disease and Pest Infestation ↗
- ☑ 15. Public Health Crisis

Fire

- ☑ 16. Structure Fire
- ☑ 17. Wildfire ↗

Geological

- ☐ 18. Avalanche ↗
- ☑ 19. Landslide/Debris Flow ↗
- ☐ 20. Land Subsidence (and Sinkholes) ↗
- ☐ 21. Submarine Slides

Seismic

- ☑ 22. Earthquake
- ☐ 23. Liquefaction
- ☐ 24. Tsunami (Telegenic and Terrestrial)

Volcanic

- ☐ 25. Ash Fall
- ☐ 26. Volcanic Flow (Pyroclastic, Lava, Lahars)

Hazardous Materials and Explosions

- ☑ 27. Explosions
- ☑ 28. Hazardous Materials Spill
- ☑ 29. Mine Incident
- ☐ 30. Nuclear Incident
- ☑ 31. Oil or Gas Pipeline Spill
- ☐ 32. Space Debris

Hydrological

- ☑ 33. Drought ↗
- ☐ 34. Seiche ↗
- ☑ 35. Storm Surge ↗

Flooding

- ☑ 36. Lake, River, and Stream Flooding ↗
- ☐ 37. Coastal Flooding ↗
- ☐ 38. Storm Water Flooding (urban, local, pluvial) ↗
- ☐ 39. Flash Flooding ↗

Infrastructure Failure

- ☑ 40. Dam and Spillways Failure ↗
- ☐ 41. Dike Failure ↗
- ☑ 42. Structure Failure ↗

Interruptions to Critical Services

- ☑ 43. Electrical Outage ↗
- ☑ 44. Food Source Interruption (supply chain, or community food stores) ↗
- ☑ 45. Telecommunications Interruption ↗
- ☑ 46. Transportation Route Interruption ↗
- ☑ 47. Wastewater Interruption ↗
- ☑ 48. Water Service Interruption (Includes shortage and contamination) ↗
- ☑ 49. Fuel Source Interruption ↗

Security

- ☑ 50. Cyber Security Threat
- ☐ 51. National Security Threat
- ☑ 52. Public Disturbance
- ☐ 53. Major Planned Event

Transportation

- ☑ 54. Aircraft Incident
- ☑ 55. Marine Vehicle Incident
- ☑ 56. Motor Vehicle Incident
- ☑ 57. Rail Incident

Note: Climate change is recognized as having impacts on the frequency and intensity of many hazards and may also cause new hazards to emerge. Those hazards identified as being impacted by changing climatic conditions are indicated with a "↗".

Electoral Area 'E' Hazard History

Electoral Area 'E' has experienced several events that have impacted residents of the region. The regularity of the event happening determines the risk factor which will be used in the Hazard, Risk, and Vulnerability Analysis.

There are several well-known hazards in Electoral Area 'E' including wildfire, flooding, and severe weather. Many of these hazards are high risk and are a priority to all communities within the Regional District of Bulkley-Nechako. However, given this areas rural and remote setting, the hazards create higher risks for residents in this region.

Appendix 1, Historic Hazard Data, provides the details on recorded events in Electoral Area 'E'. The highest recurring event types and severity of impact in this area are:

- Wildfires;
- Flash Flooding; and
- Severe Weather.

The Regional District HRVA 2003 Hazard, Risk, and Vulnerability Analysis Priority Matrix identifies the following hazards:

FREQUENCY	Very Low	Low	High	Very High	
6			Fire – industrial (18)	Fire- interface & Wildfire, Flood (24)	**Frequent or very likely**
5	Avalanche (5)		Dangerous goods spill, Epidemic- human, Explosion transportation accident – Road (15)	Severe Weather (20)	**Moderate or likely**
4		Critical Facility Failure, Infrastructure Failure (8)	Transportation accident – Air, Rail (12)	Earthquake (16)	**Occasional, slight chance**
3		Epidemic – Animal (6)	Landslide, debris flow (9)		**Unlikely, Improbable**
2			Terrorism (6)		**Highly unlikely (rare event)**
1		Dam Failure, Mine Accident (2)		Volcano Eruption (4)	**Very Rare event**
	1	**2**	**3**	**4**	

SEVERITY

Risk index # is the Frequency x Severity.

The following First Nation community emergency plans from 2010 each indicated the highest probability risks listed in order as follows:

Nee Tahi Buhn Band	**Skin Tyee Nation**
Flood, Flash Flood, Seiche, tidal Surge	Landslide
Fire	Flashflood
Snow, Ice, Hail, Sleet, Avalanche, Blizzard	Fire
Windstorm, tropical cyclone, hurricane, tornado, waterspout, dust/sandstorm	Snow
Disease that impacts humans and animals	Windstorm
Water control structure/dam/levee failure	Heatwave
telecommunications	Pandemic
Energy/power /utility failure	Transportation Accident
	Energy Power Failure

Cheslatta Carrier Nation 2010 Emergency Plan dose select hazard probability from a list of all hazards. However, these were not summarized in a list of highest probability risk items in the plan.

The above plans may have been updated by the First Nations communities; however, the Regional District does not have copies of these updated plans to date.

Defining Hazard Considerations for Electoral Area ‘E’

This section provides definitions from the HRVA Hazard Reference Guide 2021 Province of British Columbia, and additional hazard research. These definitions and related information can help to inform the HRVA advisory committee in scoring the likelihood and consequence of the hazards identified in this process.

The hazards are grouped in to three categories: Natural Hazards; Human-Caused Hazards; and Diseases, Pest Infestations & Epidemics. Hazards defined in this section are based on historical events that may have impacted Area ‘E’ and were included in the Hazard, Risk, and Vulnerability Analysis Priority Matrix’s from the Regional District HRVA 2003. This backgrounder has also been updated with input and further research resulting from the Hazard Identification workshop on February 3rd, 2022. The top priority hazards identified by RDBN staff include:

Wildfire

Severe Weather

Known hazards are also identified on a map of electoral area ‘E’ and can be found in Appendix 2 of this chapter. Additional hazard definitions and information can be found in the provinces HRVA Companion Guide 2021.

If you have information on known hazards, resources or details on resiliency strategies related to the hazards listed below, please include these as notes and pass them on to the Regional District HRVA Coordinator for inclusion in the analysis.

Indigenous Traditional Knowledge

Long before European explorers and traders arrived in the late 1700s, Indigenous people in BC told stories and practiced traditions to share important knowledge about natural hazards. By repeating these stories, Indigenous people passed on valuable information about how to prepare for and survive disasters across time and across generations. (Prepare BC Emergency Management BC, 2019)

Those holding traditional knowledge can assist in understanding the nature of local hazards, suggest appropriate risk reduction and response mechanisms, and even give options for recovery based on past experiences. They can also help us recognize and respect the long history and rich traditions of First Nations communities on this land. (Munsaka, 2018) The Regional District recognizes the importance of learning from traditional knowledge and is looking to continually strengthen and develop relationships in the hopes that this knowledge can assist and inform future emergency planning and preparedness planning.

Summary of Climate Patterns

The information below has been summarized from the *Climate Patterns, Trends, and Projections for the Omineca, Skeena, and Northeast Natural Resource Regions, British Columbia - Technical Report 097,* 2016. (Foord, 2016)

Baseline climate of the Skeena Natural Resource District

Seasonal/Annual	Precipitation (mm)	Mean Temperature (°C)	Maximum Temperature (°C)	Minimum Temperature (°C)
Nadina District				
Winter	203.7	-7.9	8.0	-31.9
Spring	104.9	2.3	22.6	-21.6
Summer	141.1	12.5	29.4	-1.2
Fall	206.3	3.4	23.1	-17.6
Annual	652.0	2.6	29.6	-33.6

Skeena Natural Resource Region Climate Trends

The Skeena Natural Resource Region, which includes the Nadina District, has become warmer and wetter over the last century. Mean annual precipitation has increased 5.2%. Most significantly, summer precipitation has increased by more than 10%. The largest increases in precipitation have occurred in the Skeena (southern) portion of the Skeena−Stikine District. Mean annual temperature has increased in the region by 0.2°C. Seasonally, mean winter temperatures have increased the most throughout the region, by about 0.7°C. Winter precipitation has declined only int the Nadina District (by 19.5%). The Skeena (southern) portion of the Skeena−Stikine District has experienced large increases in precipitation resulting likely in moderate increases in temperature. Summers, overall, are getting warmer in the region. Fall maximum temperatures have declined significantly in the Nadina District (-1.6C).

Skeena Natural Resource Region Climate Projections

Climate projections for the northern regions and districts were made for 2055 (2041–2070). Mean annual temperature in the Skeena Natural Resource Region is projected to increase by 3.1°C, with minimum temperatures increasing more than maximum temperatures. Mean annual precipitation for the Nadina District is projected to increase by 5%. Increases will likely be as rainfall because precipitation as snow is projected to decrease by about 35%. Precipitation is projected to increase the most in the fall. The number of growing degree-days will increase, and the number of frost-free days will increase. The greatest increase in the number of frost-free days is projected to occur in the spring.

A Note about Climate Change:

Climate change impacts both the frequency and intensity of many hazards. It may also cause new hazards to emerge. In this HRVA methodology, climate change is not indicated as a separate hazard; however, those hazards identified as being impacted by climate change are indicated with a special symbol. e.g. Drought (BC E. M., 2021)

Natural Hazards

Wildfire

An unplanned fire - including unauthorized human-caused fires - occurring on forest or range lands, burning forest vegetation, grass, brush, scrub, peat lands, or a prescribed fire set under regulation which spreads beyond the area authorized for burning.

The wildland urban interface (WUI) is any area where combustible forest fuel is found adjacent to homes, farm structures or other outbuildings. This may occur at the interface, where development and forest fuel (vegetation) meet at a well-defined boundary, or in the intermix, where development and forest fuel intermingle with no clearly defined boundary. **(Service B. W., 2021)**

- Forest fires are an integral part of the ecosystems of the Lakes TSA and stand replacing fires are frequent. Lodgepole pine is a fire-adapted species and is well suited to prompt re-establishment after fires. Fires provide nutrient cycling, complexity, resiliency, and biological legacies within the ecosystem. between 1933 and 2009, fires in the Lakes TSA burned an average of about 400 hectares per year and rarely did they exceed 1000 hectares in size. In the past decade, the average has increased tenfold to about 42 000 hectares per year. In 2010, about 28 000 hectares were burned by the Binta Lake fire; in 2014 the Chelaslie River and China Nose fires burned about 92 000 hectares and in 2018, a total of eight large wildfires impacted 209 000 hectares within the total geographic boundary of the Lakes TSA. (Forest Analysis and Inventory Branch Ministry of Forests, April 2019)
- There are 44 addresses in Electoral Area 'E' in a High Wildfire Urban Interface risk area and 435 addresses in a medium Risk Wildfire Urban Interface risk area.
- The Wildland-Urban Interface (WUI) occurs where homes, structures, and critical infrastructure are found adjacent to or intermixed with combustible vegetated lands. Historically in BC, the WUI was created by buffering an area, using geographic information systems, where structure density is greater than 6 structures/km² by 2 km. The 2 km buffered area was originally designed to represent a reasonable distance that embers from a wildfire can travel to ignite a structure.
- Wildfires rank among the threats of highest concern for the entire Electoral Area which is predominantly forested land. Generally, from May to October of each year, this area faces a serious threat from wildland fires.
- Southside is the foothills of the coastal mountains and Tweedsmuir Park – this rain shadow puts the region at even higher risk for forest fires.
- In February 2016 the provincial government awarded a community forest licence to the 6 first nations and 2 local governments – Chinook Community Forest. Chinook Community Forest is undergoing a Wildfire Mitigation Planning process, in part to address the ongoing threat to the land-base and our communities. In 2021, the Crown Land Wildfire Risk Reduction Tactical Plan for the southside of Francois Lake identified priority fuel management treatment units around Southbank and Danskin. These areas were identified as high priority for wildfire risk reduction treatment based on stand characteristics, prevailing winds, local topography, and proximity to structures and community.
- The Burns Lake Community Forest has developed a Landscape Fire Management Plan and highlights the overall risk rating of the tenure area is considered high. (Blackwell, 2019) This community forest includes areas in Electoral Area 'E'.

- There was a total of 111 fire starts with an average of 11 fires per year, within and around the Village of Burns Lake for the period from 2007 – 2016. (Capling, 2019) Although this stat is not representative of Electoral Area 'E' three is some similarities.
- When wildfires get going, there is poor communication or reach past Grassy Plains and creates several challenges. Information is difficult to share.
- The Regional District of Bulkley Nechako operates a FireSmart program that is a federal, provincial, and community-based program that encourages the public to take simple, scientifically proven steps to increase wildfire resiliency. In 2021 the RDBN FireSmart educator conducted 27 home assessments in Electoral Area 'E' to help residents better understand and apply these practices on their properties and homes. These assessments came with funding for mitigation work.
- In 2018 there were cascading events that caused interruption of first response resources. BCEHS was not available during the fires, at times they were posted in the evacuation zones for shifts. Highlights a need to continue to build communications between BCEHS and the RDBN.

Notable fires

- In 2018 2,117 fires consumed 1,354,284 ha of land in BC, which surpassed the previous record of 2017 of approximately 1.2 million ha. 66 evacuation orders were issued, affecting 2,211 properties. Total provincial suppression cost reached $615 million. Approximately half of the area burned was south and east of the Village.
- That summer of 2018, the RDBN mobilized its emergency management structure for over 72 days in response to 15 major fires which resulted in 64 evacuation orders and alerts with 1,544 dwellings under evacuation order, affecting approximately 3,475 people and requiring the relocation of over 3,000 livestock. Eight dwellings and over 45 other structures were lost and a declaration of state of local emergency was in place from August 1 to September 20. (Inc., 2019) The Babine Complex consisted of the following fires:
  - Nadina Lake: 86,767 ha; 40 km southwest of Burns Lake; discovered July 31; lightning-caused; prompted Evacuation Orders and Alerts
  - Verdun Mountain: 47,610 ha; 10 km southwest of Grassy Plains, 40 km south of Burns Lake; discovered July 12; lightning-caused; prompted Evacuation Orders and Alerts
  - Chelaslie Arm: 9,253 ha; 85 km southeast of Burns Lake; discovered August 6; lightning-caused; prompted Evacuation Orders and Alerts
- Additional Fires of note included:
  - 2010 **Binta Lake Wildfire**, south of Burns Lake, grew from 7,000 hectares to about 35,000 hectares in a 12-hour period due to dry conditions and strong winds. At its final size of 40,000 hectares (400 square kilometres) this was the single largest blaze of 2010 and resulted in evacuation orders and alerts.[1]
  - 2013 The **Eutsuk Lake wildfire** in Tweedsmuir North Provincial Park was the largest fire of the season, burning an estimated 3600 hectares. It resulted in an evacuation alert for nearby wilderness properties.

[1] Major Historical Wildfires. Retrieved on March 9, 2021 from: https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/major-historical-wildfires
and https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary

- 2014 **Chelaslie River Wildfire**, 7 kilometres south of the Chelaslie River burned an area of 133,098 hectares (1,331 square kilometres), including sections of Entiako Provincial Park. This fire resulted in several evacuation alerts and orders.

➢ Additional wildfire accounts can be found in Appendix 1.

Related Hazards: Air Quality / Extreme Heat / Lightning / Structure Fire / Explosions / Drought / Structure Failure / Electrical Outage / Telecommunications Interruption / Transportation Route Interruption / Water Service Interruption.

Flooding: Lakes, Rivers, and Stream

Flooding is the overflow of natural drainage channels, natural shorelines and/or human-made facsimiles leading to partial or complete inundation from the overflow of inland or tidal waters, and/or the accumulation or runoff of surface waters from any source. **(BC E. M., 2021)**

➢ Electoral Area 'E' has in its boundary a large portion of the Nechako Reservoir, including Natakuz Lake, Whitesail Lake and Tahtsa Lake. The impoundment of water in the Nechako Reservoir and the resultant diversion and spillway releases have altered the hydrology of the Nechako River system and watershed since 1952, when the Kenney Dam was completed. These lakes are all impacted by season flooding and the control of water levels by Rio Tinto Alcan.
➢ In the Electoral Area 'E' rivers are not an issue; however, low lying areas near smaller streams and the many large Lake adjacent can be subject to localized flooding during the spring freshet or during periods of heavy rain events.
➢ Known flooding sites in Electoral Area 'E' include Flooding around Francois lake can impact 350 houses, flooding on Ootsa Lake impacts farmers (fencing) and flooding On Chelatta Lake impacts ancient burial grounds.
➢ Flooding in the area has impacted the road networks and other infrastructure including
    - Road washouts at Takysie and Wisteria in the last couple years;
    - East Tchesinkut Lake Road has had a couple large washouts in the past few years;
    - Transfer station at Takysie Lake, there was road erosion because the culvert was undersized and caused damage. Date unknown.
➢ There is one Ministry of Environment hydrometric data monitoring stations in Electoral Area 'E' that monitors the Nechako Reservoir at Skins Lake Spillway 08JA023. However, there are very few years reported.

Notable floods in Electoral Area 'E' include:

➢ Additional flood accounts can be found in Appendix 1.

Related Hazards: Hurricane/Typhoon/High Wind Event / Landslide/Debris Flow / Storm Water Flooding / Flash Flooding / Dam and Spillways Failure / Dike Failure.

Area E Weather Hazards

Climate Norm's	
Ootsa L Skins L Spillway 1981-2010[2]	**Wistaria 1981-2010[3]**
Annual Rainfall 264.1 mm Annual Snowfall 152.9 mm Average Temperature, January -7.7 C Average Temperature, July 13.7 C Average Frost-free Days 99 days Maximum Temperature 34 C (May 29, 1983) Minimum Temperature -42.2 C (Jan. 25, 1972)	Annual Rainfall 275.2 mm Annual Snowfall 157.3 mm Average Temperature, January -7.9 C Average Temperature, July 13.5 C Maximum Temperature 36.1 C (July 16, 1941) Minimum Temperature -43.9 C (Jan. 24, 1950)
Takysie Lake 1981-2010[4]	
Annual Rainfall 342.1 mm Annual Snowfall 217.0 mm Average Temperature, January -9.1 C Average Temperature, July 12.2 C Maximum Temperature 32.5 C (Aug 15, 1991) Minimum Temperature -45 C (Dec 29, 1996) Average Frost-free Days 43 days	

- In Area 'E', has three\ Environment Canada station that monitored Climate Normal from 1981 – 2010 being Ootsa L Skins L Spillway, Wistaria, and Takysie Lake.
- According to Environment Canada Takysie Lake station, the minimum extreme temperature recorded was -45 degrees Celsius and occurred on December 29th, 1996. On average, there were less than 4.4 days in a year where the temperature reaches below -30 degrees Celsius. (Canada G. o., Climate Normals & Averages, 2021)
- Atmospheric River effects can be seen throughout the region. An **atmospheric river, or AR**, is a large, narrow stream of water vapour that travels through the sky. It can stretch to 1,000 miles (1,600 kilometres) long and more than 400 miles (640 km) wide, and on average, carries an amount of water equivalent to 25 Mississippi Rivers. As the rivers cross from the ocean to the land — particularly to mountainous regions like the B.C. coast — the vapour condenses into precipitation, sometimes dumping a month's worth of rain or snow in a matter of days. Less-intense ARs are essential to many continents' water supply by bringing a whole lot of it from the warmer tropical oceans. But the bigger and more intense they get, the more dangerous they can be, triggering landslides and flooding resulting in tens to hundreds of millions of dollars in damage or more. The warmer the air is, the more water vapour an AR can carry. As the atmosphere's average temperature rises, then, an atmospheric river can grow — and when it makes landfall, it can release more rain or snow than in years past. (Linch, 2021)
- Environment and Climate Change Canada is working to create a new warning system that would act as a Canadian version of AR warnings. This system is predicted to be publicly ready in the fall of 2022. (Linch, 2021)

Comments and questions for consideration and further research:

- Are there any up-to-date climatic patterns? 2021 was like -40 and plus 40.

[2] (Canada G. o., Climate Normals & Averages, 2021)
[3] (Canada E. , Climate Normal 1981-2010 - Wistaria, Climate ID 1088970, 1981-2010)
[4] (Canada G. o., Climate Normals & Averages, 2021)

Snowstorms and Blizzards

Meteorological disturbance giving rise to a heavy fall of snow, often accompanied by strong winds. Snowstorm and blizzards impact upon transportation, powerlines and communications infrastructure, and agriculture. **(BC E. M., 2021)**

- Snowfall is a common occurrence in the winter months for the entire Area E. Although it is rarely heavy enough to pose a significant risk, severe snow events cause power failures. This was experienced with the severe snow event of 1996 and Oct. 2006.

Notable Storm events in Electoral Area 'E' can be found in Appendix 1.

Related Hazards: Extreme Cold / Freezing Rain or Drizzle / Avalanche / Structure Failure / Electrical Outage / Food Source Interruption / Telecommunications Interruption / Transportation Route Interruption / Fuel Source Interruption / Aircraft Incident / Motor Vehicle Incident.

Extreme Heat

Heat waves can be characterized by temperatures significantly above the mean for an extended period, or by a combination of high temperatures with high humidity and a lack of air motion. Heat waves impact upon the very young, the elderly and those with cardiovascular conditions. Heat waves also impact upon agriculture. **(BC E. M., 2021)**

Notable Heatwaves in the Electoral Area 'E' include:

- The last week in June 2021 brought about unprecedent heat in British Columbia and across western Canada. With forecasts stating it was the warmest stretch since records have been kept (In many instances 100+ years) ((MSC), 2021). With CBC reporting 486 sudden deaths over a five-day period from June 25th – 30th, 2021 195% increase over the approximately 165 deaths that would normally occur in the province over a five-day period. (Service B. C., 2021)

Related Hazards: Lightning / Animal Disease / Human Disease / Plant Disease and Pest Infestation / Public Health Crisis / Structure Fire / Wildfire / Drought / Food Source Interruption / Water Service Interruption.

Lightning

Generally, all the various forms of visible electrical discharge that are produced by thunderstorms; often seen as a bright flash of light in the sky. Lightning impacts air transportation, powerlines and communications infrastructure and causes forest fires. (BC E. M., 2021)

- Lightning occurs virtually year-round in the Pacific coastal region. The average date of the beginning of lightning season in Western Canada (1999-2018) for British Columbia - Interior – North and high mountain ranges is June 1st. The Average date of the end of the lightning season in Western Canada (1999-2018) is between October 1st and November 1st. (Canada G. o., Lightning Statistics, 2016)
- The Canadian Lightning Detection Network (CLDN) was established in 1998 and consists of over 80 lightning sensors distributed across Canada. (Canada G. o., Lightning, 2016)
- Some quick facts regarding forest fires from Natural Resources Canada, Forest fires started by lightning, represent 45 per cent of all fires and 81 per cent of the total area

burned in Canada, and occur in remote locations and often in multiple clusters. (Canada G. o., Lightning Statistics, 2016)

- There is no total ground to cloud lighting strike data for locations in Electoral Area 'E'. (Canada G. o., Lightning Statistics, 2016) Historical Lightning strike data is included in Appendix 2 – Hazard Maps.

Related Hazards: Hail / Wildfire / Storm Water Flooding / Flash Flooding / Electrical Outage / Telecommunications Interruption.

Space Weather

A disturbance or fluctuation in the earth's magnetic field, associated with solar flares. The impact may include disruption of electrical grids, communications systems, navigation equipment, and satellite operations. Resource operations including surveying, drilling, and pipelines may also be negatively affected. (BC E. M., 2021)

- The source of space weather is the Sun. The Sun is a million times larger than Earth and so distant that its light takes eight minutes to reach us. When violent solar phenomena occur, they create space weather effects on Earth, which can pose a hazard for human activities. (Government of Canada, 2021)
- Effects from solar activity include (but are not limited to) geomagnetically induced currents in power systems and pipelines, azimuthal errors in directional drilling, disruptions to HF radio communication and GPS navigation, and failure or mis operation of satellites:
  - Magnetic disturbances induce electric currents in long conductors such as power lines and pipelines causing power system outages or interfere with pipeline corrosion systems.
  - Magnetic disturbances directly affect operations that use the magnetic field, such as magnetic surveys, directional drilling, or compass use.
  - Radio waves used for satellite communications or GPS navigation are affected.
  - Effects on satellites including radiation damage, memory upsets, phantom commands, surface charging and internal charging. (Government of Canada, 2021)

Related Hazards: Cyber Security Threat / Telecommunications Interruption / Electrical Outage / Transportation Route Interruption.

Drought

Drought is a recurrent feature of climate involving a deficiency of precipitation over an extended period, resulting in a water shortage for activities, communities, or aquatic ecosystems. In BC, combinations of insufficient snow accumulation, hot and dry weather, or a delay in rainfall may cause drought. (BC E. M., 2021)

- Drought can lead to reduced water availability for household and business use. Lower stream flows may cause warmer river temperatures, affecting fish and other aquatic life. Low stream flows can also affect the growth of agricultural crops and limit the water available for irrigation. Low flows and extended periods of low precipitation can also have impacts on groundwater levels. Aquifers – particularly those at shallow depths - may develop a lower water table due to drought in any given year and from previous drought seasons, as there may not be enough water to recharge the aquifer. If natural water sources or adequate storage are not available

in a community, it may also lead to insufficient supplies for firefighting. (Econics, May 2021)

Notable regional incidents involving drought:

- Due to relatively normal to high snowpacks in the spring, early forecasts did not flag a drought risk for 2018. However, a heat wave in late spring rapidly depleted snowpacks and caused freshet flooding earlier than normal. That, and the lack of precipitation from July to November, created extensive dry conditions across lots of the province.
- In 2018, the Northwest, Upper Fraser West, Upper Fraser East, and Nechako regions reached Level 2 to Level 3 drought ratings, meaning these areas were very dry. (BC Agriculture & Food Climate Action Initiative, 2019)

Related Hazards: Extreme Heat / Lightning / Animal Disease / Human Disease / Plant Disease and Pest Infestation / Public Health Crisis / Wildfire / Food Source Interruption / Water Service Interruption.

Air Quality

Solids, liquids, or gases which, if discharged into the air, may result in statutory air pollution. (BC E. M., 2021)

- Communities in this region experience air quality episodes due to elevated particulate concentrations at various times throughout the year. Particulate matter is a concern for human health and from an aesthetic point of view. Burns Lake has an air quality monitoring station that provides an Air Quality Health Index (AQHI), hourly air quality readings, and related health messages. The AQHI reports on the health risks posed by a mixture of pollutants, including particulate matter ($PM_{2.5}$[5]), ground-level ozone (O^3), and nitrogen dioxide (NO^2). (BC A. Q., 2021) These readings illustrate the level of health risks with a number and advice on minimizing health risks from air pollutants.
- The most significant air pollutant in the Bulkley Valley Lakes District (BVLD), including Electoral Area 'E' is fine particulate matter, $PM_{2.5}$, from open burning, industrial sources, wood burning appliances, backyard burning, transportation road dust and vehicle emissions. A study conducted by Elliot and Copes (2011) has estimated that between 16 to 74 deaths each year are attributable to fine particulate matter concentrations in Northern and Interior Health Regions alone. (Zirnhelt, June 21, 2021)
- In Canada, wildfires can significantly increase air pollution levels of fine particulate matter ($PM_{2.5}$) posing the greatest human health risk (Canada H. , 2021).
- Elevated $PM_{2.5}$ typically occur in the autumn and winter months when dispersion is poor and many different emission sources (industry, space heating, open burning) are active. (Zirnhelt, June 21, 2021)
- BC Ambulance on the Southside was monitoring COPD patient's lung conditions just last year, 2021, during the Chief Loui Fire.
- Air quality from Smoke is a big concern.

[5] $PM_{2.5}$ Particulate matter with a diameter of less than 2.5 micrometers (µm). One micrometer is one millionth of a metre. PM2.5 is included in fine particulate and is a subset of PM10 (when measuring PM10, it includes PM2.5). PM2.5 is typically associated with combustion sources (smoke) and is more closely related to adverse health effects than larger particles.

- There are no air quality monitoring station in Electoral Area 'E'.

Notable Air quality data outside Electoral Area 'E' includes:

- The Province of BC does not operate any active Air Quality Monitoring station in this region. The Burns Lake Fire Centre and the Burns Lake Sheraton East. (Columbia P. o., Air Quality Data BC, 2021) are the closest monitoring stations.
- There are no Purple Air Quality Monitoring stations in this region, but the closest is in Burns Lake.

Related Hazards: Human Disease / Public Health Crisis / Structure Fire / Wildfire / Ash Fall / Explosions / Hazardous Materials Spill / Oil or Gas Pipeline Spill.

Fog

A cloud based at the earth's surface, consisting of tiny water droplets, or under very cold conditions, ice crystals or ice fog. It is generally found in calm or low wind conditions. Under foggy conditions, visibility is reduced to less than 1 kilometre. (BC E. M., 2021)

- Fog is a concern in the fall in Electoral Area 'E'. Can cause motor vehicle incidents.
- Generally, the interior is foggier in the fall and winter months prior to the large lakes and reservoir freezing.

Related Hazards: Extreme Cold / Freezing Rain or Drizzle / Transportation Route Interruption / Aircraft Incident / Marine Vehicle Incident / Motor Vehicle Incident.

Hurricane / Typhoon / High Wind Event

Hurricanes are tropical cyclones with maximum sustained surface winds of at least 64 knots (118 km/h). Hurricanes are known as typhoons in the western Pacific, very severe cyclonic storms in the North Indian Ocean, and severe tropical cyclones in Australia. There are five classes of hurricane intensity as outlined by the Saffir-Simpson Scale. (BC E. M., 2021)

- Wind is becoming more and more of an issue especially taking out power lines and falling across the roads, account of extreme wind events are anecdotally reported as happening very frequently.

Related Hazards: Hail / Lightning / Snowstorms and Blizzards / Tornado / Landslide/Debris Flow / Explosions / Hazardous Materials Spill / Seiche / Storm Surge / Lake, River, and Stream Flooding / Coastal Flooding / Storm Water Flooding / Flash Flooding / Dam and Spillways Failure / Dike Failure / Structure Failure / Electrical Outage / Food Source Interruption / Telecommunications Interruption / Transportation Route Interruption / Wastewater Interruption / Water Service Interruption / Fuel Source Interruption / Aircraft Incident / Marine Vehicle Incident / Motor Vehicle Incident / Rail Incident

Freezing Rain or Drizzle

Rain that freezes on impact to form a coating of clear ice (glaze) on the ground and on exposed objects. (BC E. M., 2021)

- Anecdotal stories of freezing r every year – there is a need for good warning systems to avoid mass casualty car accidents.

Related Hazards: Extreme Cold / Fog / Hail / Snowstorms and Blizzards / Electrical Outage / Telecommunications Interruption / Transportation Route Interruption / Aircraft Incident / Motor Vehicle Incident.

Landslide/Debris Flow

Debris avalanches and debris flows.
Debris avalanches are extremely rapid debris flows of mud, rock, brush, trees, and other debris propelled by torrential rains.
Debris flows are a form of rapid mass down-slope movement of a slurry of loose soils, rocks, and organic matter. (BC E. M., 2021)

- Slope stability and landslide hazards have been identified along Highway 35 near the ferry landing and in the Colleymount Road area. Given that building inspection is not provided as a service in this area, the building permit approval process cannot be used to ensure that development occurs in a safe manner. Therefore, where there is evidence of slope stability and landslide hazard, residents are encouraged to retain the services of a qualified geotechnical engineer prior to development on their lands to ensure the safety of any new construction. (Nechako, RDBN Area B and E Official Community Plan, 2021)
- Reports of a Chicken Creek slide, possibly because one side burnt and created soil instability.
- Increase in slide risk because of forest fires.

Comments and questions for consideration and further research:

- How is MOTI Addressing sluffing and slides affecting culverts and roads?

Related Hazards: Avalanche / Land Subsidence / Submarine Slides / Tsunami / Seiche / Lake, River, and Stream Flooding / Flash Flooding / Structure Failure / Electrical Outage / Telecommunications Interruption / Transportation Route Interruption.

Radon

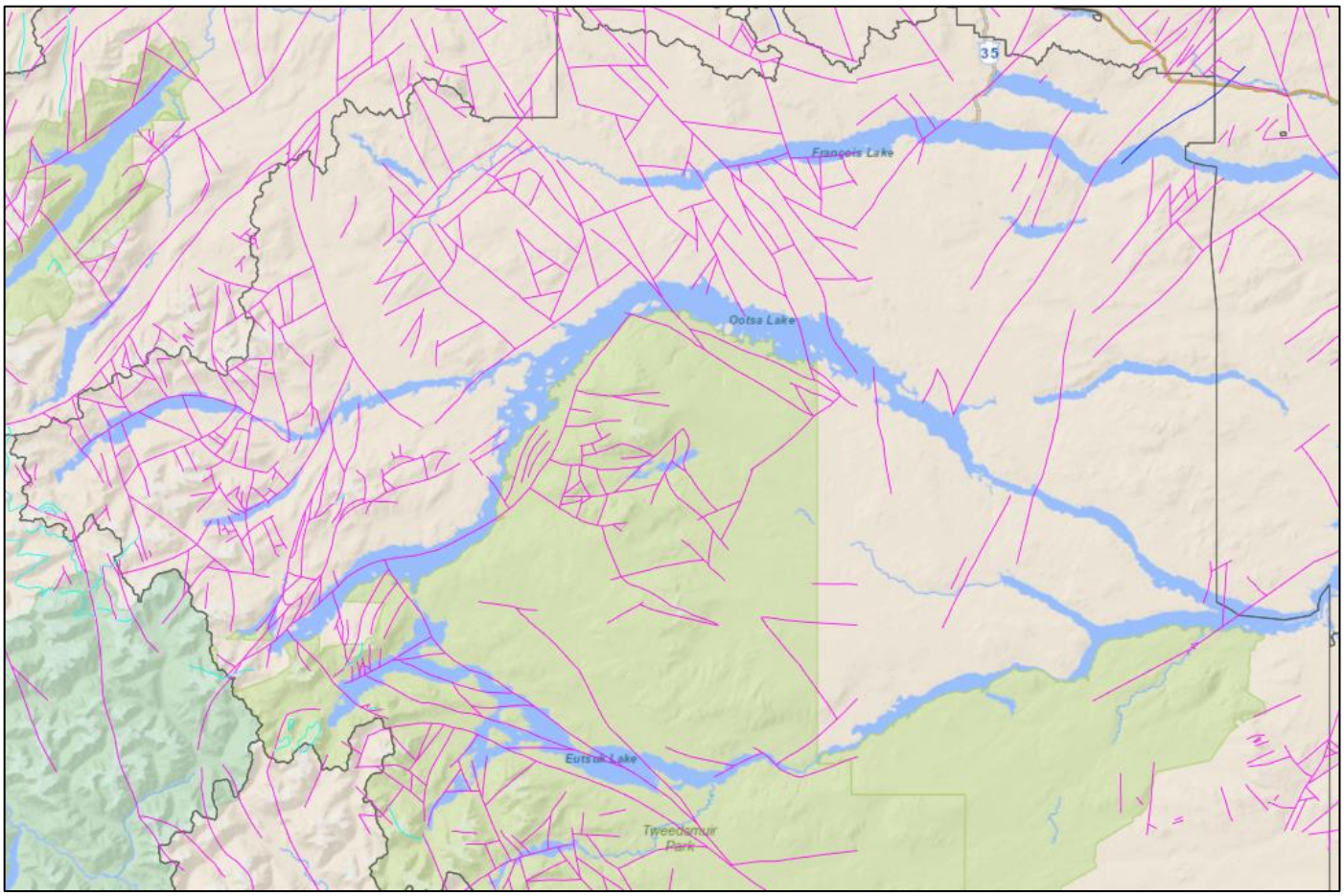
Radon is an invisible, odorless gas that can seep into your home through cracks in floors, walls and foundations. Radon comes from the natural breakdown of uranium in soil, rock and water. Radon is the second leading cause of lung cancer in Canada. As radon breaks down it forms radioactive particles that can get lodged into your lung tissue as you breathe. (Association, 2021)

- RDBN redirects inquires on Radon to the BC Lung association Radon Awareness Program.
- Due to geological factors, some areas in British Columbia have naturally higher surface levels of radon than others. Many of these areas are in the Interior and Northern parts of the province. However, indoor radon accumulation can vary widely from building to building, even in the same neighborhood. Even if you live in an area with generally lower levels of radon, it is still recommended to test your home for radon. BC Centre for disease control has an interactive map displays indoor radon levels recorded in homes across BC. In the Northern BC region, it is estimated that 18% of homes tested are in the medium range for radon levels and 4% of homes tested are in the high range for radon levels. Health Canada recommends testing every home for radon because levels can vary widely from house to house, even in the same neighborhood.

Earthquake

An earthquake is defined as the shaking of the ground due to movement along a fault rupture. When a large magnitude earthquake occurs, energy traveling in seismic waves may cause damage to structures, trigger landslides, liquefaction, or other geologic hazards and, in certain circumstances, generate tsunamis. Impacts from earthquakes can be widespread and severe. (BC E. M., 2021)

- The Regional District's risk for seismic activity is considered medium to low (Canada G. S., 2015).
- In Electoral Area 'E,' there is no record of earthquakes. (Natural Resources Canada, 2021)
- Regional District residents would experience minimal physical impact; however, there could be a significant event that could impact the delivery of goods and services, depending on the location of the epicentre and the impact on major transportation routes from the east and the south.
- Colleymount residents felt tremors from the 2012 earthquake out of region.
- Francois Lake is on a fault line.
- A map showing faults lines within Electoral Area 'E' reveals that many faults do exist. Most faults in the regional district are of the Strike-Slip (pink) variety. *See map below– source: Imap BC, retrieve Nov 2nd, 2021.*



- The five most significant earthquakes in BC occurred in 1700, 1946, 1949, 1970 and 2012. They ranged in magnitude from 7.3 (1946) to 9.0 (1700).

Related Hazards: Structure Fire / Avalanche / Landslide/Debris Flow / Land Subsidence / Submarine Slides / Liquefaction / Tsunami / Explosions / Hazardous Materials Spill / Mine Incident / Oil or Gas Pipeline Spill / Seiche / Dam and Spillways Failure / Dike Failure / Structure Failure / Electrical Outage / Food Source Interruption / Telecommunications Interruption / Transportation Route Interruption / Wastewater Interruption / Water Service Interruption / Fuel Source Interruption / Marine Vehicle Incident / Motor Vehicle Incident / Rail Incident.

Cyanobacteria Algae Bloom

Cyanobacteria (also known as **blue-green algae**) are naturally occurring microscopic bacteria that are common to freshwater ecosystems across B.C. Cyanobacteria blooms are of particular concern as there are several species capable of producing toxins that can be harmful to humans, domestic animals, and livestock. They can produce potent liver toxins, neurotoxins, as well as skin irritants. However, not all cyanobacteria are toxic, and even toxic species do not always produce toxins. (Environment, 2021)

- Blue-green algae are not true algae but are more properly photosynthetic bacteria and can also be called cyanobacteria. They are commonly found in lakes, ponds, and wetlands. Blooms are unsightly, and blue-green algal blooms may be toxic if ingested by wildlife, livestock, or humans. When conditions are favourable (most often during hot, calm weather), algae increase dramatically, becoming easy to see. This condition is generally called a ***bloom***.
- There are two types of toxins produced by strains of blue-green algae:
  - ***Neurotoxins*** affect the nervous and respiratory systems and can cause muscle tremors, stupor, staggering, rapid paralysis, respiratory failure and — often within 30 minutes — death. Most frequently, animals are found dead close to the lake or pond.
  - ***Hepato-toxins*** affect the liver and cause a slow death, up to 36 hours or longer after drinking water contaminated with toxic strains of blue-green algae. The animals appear ill, may show jaundice (yellowing of the mucous membranes or the white of the eye), photosensitization (swelling and fluid under the skin, which may peel, especially in the unpigmented areas), or severe scouring. (Environment, 2021)
- Alge blooms in lakes are another concerns and hazard. Takysie Lake a few years ago, Tatla Rose Lake, in 2021 present on the shores of Francios Lake. – due to an increase cattle producing fecal bacteria in the waters.

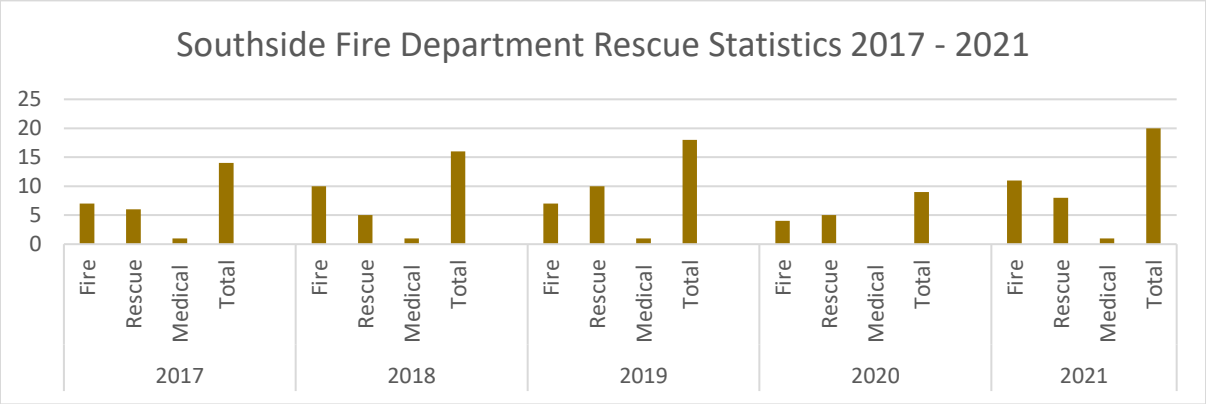
Related Hazards: Animal Disease / Human Disease / Plant Disease and Pest Infestation / Public Health Crisis / Water Service Interruption.

Human Caused Hazards

Structural Fire

Urban fires are fires that occur in a residential, commercial, or industrial community. Rural and urban fires occur on a frequent basis in many parts of the province, and of provincial concern are the fires that cause many deaths and injuries, those that are beyond the ability of the local resources to respond or those that cause severe economic losses. For interface fires, see wildfires. (BC E. M., 2021)

- The Southside Rural Fire Protection Area service is provided by Southside Volunteer Fire Department. The Southside Volunteer Fire Department is operated by a local society; the Regional District provides annual funding to support operations and capital purchases.
- Below is a chart outlining the number of Call outs that the Southside Rural Fire department responded to over the last 5 years:



- Notable Structural Fires in Electoral Area 'E':
  - Ferry Dock on Southside was contained;
  - Lost house in Southbank in the winter; and,
  - 2021 house fire in height of summer – Chinook Emergency Response ensured resources were there.
- Colleymount and Techsinkut don't have a volunteer fire department and lost a house 4 years ago on Tchesinkut Lake Road and a home on Colleymount had a roof fire and luckily the owner and neighbours acted fast.

Related Hazards: Air Quality / Lightning / Wildfire / Explosions / Structure Failure / Electrical Outage / Telecommunications Interruption / Water Service Interruption.

Oil or Gas Pipeline Spill

Pipeline and gas well leaks and explosions occur when natural gas or gasoline pipelines, valves, or components rupture, by accident, by mechanical failure or corrosion. Gas leaks can also be caused by natural hazards such as earthquakes or landslides. (BC E. M., 2021)

- TransCanada Coastal GasLink Project is a pipeline currently under construction the Electoral Area 'E' boundary:
  - Approximately 670 kilometres (416 miles), the Coastal GasLink pipeline project will safely deliver natural gas across northern B.C. After Coastal GasLink delivers the natural gas from northeastern B.C. to the LNG Canada facility in Kitimat,

B.C., LNG Canada will prepare it for export to global markets by converting the gas to a liquefied state – also known as LNG. (Coastal GasLink, 2021)
    - Section 6 of the Coastal GasLink pipeline runs 85 km in length South of Burns Lake to Houston. This section of the pipeline route is 100% cleared, 76.9% graded, and 30.8% installed. Currently, there are 386 workers at 7-mile Lodge. (Coastal GasLink, 2021)
    - The proposed pipeline will be underground except at valve sites and compressor stations. The pipeline proposed to be monitored 24 hours a day, 365 days a year. With satellite technology, sensors within the pipeline send data every five seconds to our state-of-the-art control centre. If low gas pressure is detected, the valves on the affected section close automatically and are evaluated by our team of highly trained professionals, assessing the next steps. (Coastal GasLink, 2021)
    - Coastal GasLink has prepared a comprehensive Emergency Response Plan that outlines procedures to protect the public, emergency responders, property, and the environment in the unlikely event of an emergency.
- There are dangers from the rupture of this pipeline from incidents such as earthquakes and landslides anywhere along the entire line. An interruption of gas supply could have serious economic consequences to industry dependent on natural gas for their day-by-day operations. An interruption of gas supply during winter conditions would have even more serious consequences to heating systems.
- Potential for more pipelines to Kitimat, discussion on Chevron LNG and Enbridge.
- Potential risk where CGL crosses Bald Hill Rd and Highway 37.
- Concern that Tchesinkut Lake is downhill from the pipeline and concerns about explosive risk vs water contamination risk, both are a concern. Tchesinkut Lake is heavily populated, and this risk could be linked to wildfires.

Comments and questions for consideration and further research:

- Do residents draw their water from Tchesinkut Lake or in ground wells?

Related Hazards: Animal Disease / Human Disease / Plant Disease and Pest Infestation / Public Health Crisis / Explosions / Hazardous Materials Spill / Fuel Source Interruption.

Dam and Spillways Failure

A breach in the foundations, abutments, or spillways of a dam, which results in a sudden, rapid, and uncontrolled release of the impounded water. (BC E. M., 2021)

Nechako Reservoir

The Nechako River was dammed at its source on the eastern edge of the Kitimat Ranges in the early 1950s to provide power to the Alcan aluminum smelter in Kitimat that Australian company Rio Tinto now owns. The hydroelectric reservoir was formed by constructing the Kenney Dam on the Nechako River and nine smaller dams that inundated a chain of lakes and rivers. The Nechako Reservoir finished filling in 1957 and is 233 km long, with a water surface of 910 km². (Rio Tinto, 2021)

Three emergency scenarios are associated with the Nechako reservoir that could threaten downstream communities, these include:

- **A breach of Kenney Dam** consists of a failure of the dam, or its foundations or abutments accompanied by a large or rapidly increasing uncontrolled flow of water from the reservoir. This is the most severe emergency involving the Nechako

Reservoir and will result in extensive downstream flooding. (Rio Tinto, November 2020) The Kenney Dam is located in the southern area of Electoral Area D. The Rio Tinto Kenney dams have a dam failure consequence of extreme and a failure probability rating being small. (Staff, 2009)

- **A Saddle Dam breach** consists of a failure of one of the nine saddle dams, the Skins Lake spillway, or their foundations or abutments accompanied by a large or rapidly increasing uncontrolled flow of water from the reservoir. This is the second most serious emergency involving the Nechako Reservoir. A saddle dam breach may result in extensive downstream flooding. (Rio Tinto, November 2020) The Skins Lake spillway is located in Electoral Area E adjacent to Oosta Lake. The Rio Tinto Cut off Creek Saddle #1, #2, and #3 dams have a dams failure consequence of high and a failure probability rating being small. Dam failure probability of small means that the risk level is of no concern and includes regular audit programs to identify any changes to the operation. (Staff, 2009)
- **"An extreme flood release** is defined as a Skins Lake Spillway discharge at or near the Probable Maximum Flood (PMF) of 1653 m3/s. The PMF results from the combination of a severe hydrometeorological event followed – or preceded - by a second extreme event. The PMF flood is estimated to produce a peak daily inflow to the Nechako Reservoir between 3566 m3/s. The Nechako Reservoir is capable of temporarily storing the major portion of these inflows. However, the PMF would require very large releases from Skins Lake Spillway of up to a maximum of approximately 1653 m3/s. These releases would be necessary to prevent excessively high-water levels, which could cause breaching of the dams. The PMF would also be accompanied by a substantial rise in reservoir level, which would cause flooding around the shoreline. It is anticipated that snowpack and/or weather conditions, together with monitoring of reservoir levels, would provide a minimum of several days warning of the need to make very large releases." (Rio Tinto, November 2020)

Rio Tinto provides inundation maps that provide information about possible flood arrival times and water levels for threatened downstream communities. The maps are based on computer model simulations. The inundation maps concerning Electoral Area E include Skins Lake Spillway map sheet 1-5.

Rio Tinto makes available inundation maps from 2015. Maps 1-5 illustrate the extent of flooding of the worst-case scenario of Kenney Dam Breach and Skins Lake Spillway Breach under two scenarios Probable Maximum Flood Breach Scenario and Fair-Weather Breach Scenario.

Mine Projects with Tailing Ponds and Dams in Area 'E'

- Tailing Storage Facilities, including mining dams, in British Columbia are regulated under Part 10 of the Health, Safety and Reclamation Code for Mines in British Columbia (the Code), as established under the Mines Act. These facilities require annual inspections commonly called Dam Safety Inspection that report on risk data. This data is available to the public on the BC Mine Information website.
- Huckleberry Mine is located in Electoral Area 'E' at the west end of Ootsa Lake directly South of Sweeney Lake. Operations ceased in August 2016, and the mine remains on care and maintenance status. The COVID-19 pandemic has impacted the mine restart timeline. (Ltd., 2021)

- The Huckleberry Mine has three tailings management facilities. Currently only the TMF-2 Dam and the Orica Saddle Dam retain tailings. Following the guidelines from the Canadian Dam Association, Dam Safety Guidelines (CDA 2013, 2014, 2019), East Pit Pug Dam (EPPD), TMF-2 dams, and TMF-3 dams are all classified as High consequence structures. Inundation studies associated with overtopping and piping failure modes were conducted in 2009 for TMF-2 and EPPD (AMEC 2009) and in 2014 for TMF-3 (BGC 2014c). The studies considered several potential failure scenarios and the resulting impacts on the downstream environment. (Ltd., 2021)
- Excess site contact water that satisfies water quality criteria for discharge is pumped from the EZP West Cell to Tahtsa Reach, where the pipeline outlets into the Tahtsa Reach Outfall diffuser (TRO). During the care and maintenance period, discharge through the TRO is utilized on an as-required basis. When actively discharging to Tahtsa Reach, the water is monitored daily by HML for flow rate, volume, and pH. The Mines permit (PE 14483) stipulates that 5.0 Mm3 per year of water can be discharged to Tahtsa Reach, with a maximum daily discharge rate of 20,000 m3, and that any site water that meets discharge criteria. (Ltd., 2021)

Other Types of Dams

- The Dam Safety Regulation under the Water Sustainability Act, objective is to mitigate loss of life and damage to property and the environment from a dam breach by requiring dam owners to inspect their own dams, undertake proper maintenance on them, and ensure that these dams meet ongoing engineering standards. The dam administered under this regulation are associated with dams that store or divert fresh water from a stream or aquifer or both. These dams are inspected annually and assigned a failure consequence and risk rating according to the Dam Safety Regulations of BC. [6]
- In Area E there are 36 dams regulated under the Dam Safety Regulations, five of which have a failure consequence of significant, two high, two very high and three extreme. The dams classified as high, very high and extreme are all operated by Rio Tino Alcan. The dams rated as significant are all private dams, two of which are owned by Ducks unlimited and have a failure probability rating being moderate. Meaning that the risk level is stable and that the regular owner inspect plus monitors operation under peak loading/rehab hazardous conditions. May request submission of Annual Inspection Report, OMS, or early DSR. May audit an increased frequency. of no concern and includes regular audit programs to identify any changes to operation. (Staff, 2009) The general guidelines that apply to theses five dams state that the dams may have uncorrected design, construction, structural and/or operational deficiencies that could potentially lead to uncontrolled reservoir release. Owner exhibits reluctance to undertake and report on annual inspection or is incapable of doing so and design and operation lacks redundancy, e.g., no back-up power for electrical gates. (Staff, 2009)
- If a dam has a failure consequence of significant or higher than the owner is required to provide a record containing information for the use of the local emergency authorities for the dam for the purpose of preparing local emergency plans under the *Emergency Program Act.*
- One dam at Tatalrose Lake on the Salake property 7km past Grassy Plains.

[6] Michael Trudell, Senior Dam Safety Officer.

- One dam at Totem Pole Lake that feeds into Tatalrose and could cause culvert failure on east Pickle Road and affect other roads in the area.

Comments and questions for consideration and further research:

- Are there inundation maps or studies on the tailing's dams from Huckleberry mines as the mine is in maintenance and care? How would these affect Electoral Area E?
- Ducks unlimited dam – question if they are being maintained?
- Potential for other private dams that might affect roads and infrastructure in the area. Can we survey landowners to determine where other unregistered dams might be?

Related Hazards: Hurricane/Typhoon/High Wind Event / Landslide/Debris Flow / Earthquake / Mine Incident / Storm Water Flooding / Flash Flooding / Dike Failure / Structure Failure / Electrical Outage / Water Service Interruption.

Electrical Outage

A deficit, interruption or failure of electricity or power systems, services, supplies, or resources. Power outages occur on a regular basis, however, they become a concern when the power outage is for a significant amount of time, when the temperatures are very low, or critical infrastructure, persons, livestock, or businesses are affected. (BC E. M., 2021)

- Power outages occur on a regular basis, however, they become a concern when the power outage is for a significant amount of time, when the temperatures are very low, or critical infrastructure, persons, livestock, or businesses are affected.
- Historical electrical outage events in Area 'E' are documented in association with other hazards accounts and can be found in Appendix 1.
- 2006 winter storm caused power failures for over 3 weeks.
- 2018 Wildfires resulted in the power being out for 60 days + from the end of July to September. No one reported it and assumed someone else reported it.
- The Hydro Power Supply lines run under the lake in maybe three separate lines. Electrical system and lines are aging and not up to modern standards.
- 3 phase power was installed to the south side but was never energized.
- When power is out on the south side, kids are sent home because they can not flush the toilets.
- 3 Nations water distribution system goes out when the power goes out. There are no backups, and this water system supplies many people in the area.
- SSHWC has a generator (quality not aware), but not at the Grassy School.

Related Hazards: Space Weather / Lightning / Telecommunications Interruption.

Explosions

An explosion affecting a residential or non-residential area, resulting in partial or total destruction of the structure and/or bodily injury, smoke inhalation or death. (BC E. M., 2021)

- There are dangers from the rupture of this pipeline from incidents such as earthquakes and landslides anywhere along the entire line. An interruption of gas supply could have serious economic consequences to small business dependent on natural gas for their day-by-day operations. An interruption of gas supply during

winter conditions would have even more serious consequences to heating systems in homes.
- Service stations, bulk fuel facilities, natural gas pipelines, and propane storage facilities are areas in the village that could propose a threat of explosion and/or fire.

Food Source Interruption

Food shortages occur when the population of a community undergoes a severe shortage of food. A severe shortage of food can lead to starvation, illness and, in extreme cases, death. (BC E. M., 2021)

- Statistics Canada provides data on the primary types of locations where BC residents buy their food. If residents in the region are representative of BC, they would be expected to buy 87% of their grocery shopping from supermarkets and other grocery stores. The remaining 13% is purchased from convenience and speciality stores. (Strategies, March 2021) Much of the food in the stores is shipped in through the major highway transportation corridors that are susceptible to external hazards and emergencies that can lead to food source interruptions in this region.
- Agriculture in Electoral Area 'E' is predominantly beef, hay, and multiple animal farms. (Strategies, March 2021).
- The cost of locally grown and produced food remains high within the region.
- The average family in the Northern Health region spends $1038 a month on groceries (BC Centre for Disease Control Provincial Health Services Authority, 2018). According to the RDBN food economic and hub assessment Electoral Area E residents spend approximately $8,695 a year per household, being 14% of the median household income in 2015. (Strategies, March 2021)
- Canada's Food Price Report 2021, which forecasts an overall food price increase of between 3% and 5% this year. (Dalhousie University | University of Guelph | University of Saskatchewan | University of British Columbia, 2021)
- Wildlife populations and food supply of indigenous communities is being heavily impacted.
- Food bank services is provided through the LINK every Wednesday to the Southside. The community paramedics then deliver to those who can not leave their homes.
- RDBN "Connecting Consumers and Producers" is a marketing project that promotes local food producers and provides resources to consumers that support eating locally produced food all year round.

Notable Incidents involving food source interruptions:

- COVID-19 Pandemic (Started 2020) exasperated food insecurity for Canadian who already had food security and affordability issues. Locally, the 2020 COVID-19 Pandemic prompted transportation delays and crisis in availability of food at the grocery stores following the March 2020 provincial lockdowns. The grocery stores implemented purchase limits and store shelves were empty. "Food bank numbers in the local area increased by 22% at the start of COVID-19 and again increased now that government COVID subsidies have stopped." (Smithers Salvation Army Food Bank Coordinator, 2021)
- Big Bar Landslide, BC (2019) caused a decline in salmon fisheries affecting FN food supplies.

- The 2016 ice storms in the Lower Mainland prompted an inevitable crisis — highways were closed, and food trucks couldn't make it up here. We were having a food system breakdown.
- Floods in Abbotsford in 2021 caused food shortages in the stores.

Related Hazards: Extreme Heat / Extreme Cold / Snowstorms and Blizzards / Animal Disease / Landslide/Debris Flow / Plant Disease and Pest Infestation / Public Health Crisis / Drought.

Transportation Route Interruptions

An interruption or failure of transportation infrastructure or systems. This can include road, rail, or waterway damage, transportation delays due to weather and/or infrastructure failure. Transportation Route Interruptions are probable during disaster events. (BC E. M., 2021)

- Primary Roads in the area include Highway 35 – N Francois Highway that connects these communities to Highway 16. Secondary Arterial Roads connected to Highway include Colleymount Rd, Partington Rd, Deeder Rd, Francois Lake Rd E, Walker Rd, Palmer Rd, Keefes Landing Rd, Uncha Lake Rd, and many others on the Southside.
- All residents south of Nechako Reservoir heading north rely on the use of a ferry to cross the Nechako Reservoir.

Related Hazards: Snowstorms and Blizzards / Wildfire / Avalanche / Landslide/Debris Flow / Earthquake / Liquefaction / Tsunami / Lake, River, and Stream Flooding / Aircraft Incident / Marine Vehicle Incident / Motor Vehicle Incident / Rail Incident.

Telecommunications Interruptions

The unavailability of services provided by the communications infrastructure resulting in significant inconvenience or an emergency event caused by human error, equipment malfunction or breakdown. (BC E. M., 2021)

- In the 2020 rain fall and subsequent slides and again in 2021 November floods in the lower mainland the local cell service was disrupted for long periods of time.
- The Amateur Radio Club in Burns Lake has members living throughout the Lakes District and has their own communications network. As well, most logging companies and their trucks have 2-way truck to truck radio communication capabilities.
- The Chinook Emergency Response Society (CERS) led cell service signage project for the spotty coverage on the Southside in 2020. Users can download the interactive google map and use it offline to find cellular service or signs for cellular service. As per the map, cell service signs are present at Northside ferry terminal, Southside ferry terminal, Grassy Plains, Chicken Creek FSR, Braun FSR, Km. 39 on the Ootsa Nadina Rd., Windy Point Pullout and Km. 15 Binta South. Maps for cellular service of the area can be found at two places – Skins Lake Spillway Campground and Francoise Lake Forester. (Ketkar, 2020)
- Poor communication infrastructure.

- Telus land lines – aging infrastructure that is not reliable. Reports that the lines are from the 1960's and when there are repairs needed old equipment is salvaged rather than replaced with modern infrastructure.

Comments and questions for consideration and further research:

- What is the percentage of people who still have landlines?
- Is Amateur radio a resource on the South side? Are there members who are part of the PG club who can operate radios in an emergency?

Related Hazards: Freezing Rain or Drizzle / Space Weather / Hurricane/Typhoon/High Wind Event / Lightning / Snowstorms and Blizzards / Tornado / Landslide/Debris Flow / Earthquake / Electrical Outage.

Wastewater Interruptions

A deficit, interruption or failure of wastewater or sewer systems, services, supplies, or resources resulting in significant inconvenience or an emergency event. (BC E. M., 2021)

Related Hazards: Hurricane/Typhoon/High Wind Event / Animal Disease / Human Disease / Public Health Crisis / Earthquake / Water Service Interruption.

Fuel Source Interruptions

A deficit, interruption, or failure of fuel systems, services, supplies or resources. This can include pipeline damage, transportation delays due to weather and/or shipping infrastructure damage, or general shortages due to market supply problems, or panic fuel hoarding during emergencies. Fuel Source Interruptions are probable during disaster events. (BC E. M., 2021)

- The majority of fuel is transported from Alberta via Trans Mountain Pipeline and railway. Prince George is the distribution centre, where fuel is then trucked to its destination. There is a refinery in Prince George that refines gasoline, diesel, propane butane and heavy oil.
- There are two gas stations in electoral area E Grassy Plains Racetrack Gas Esso and Takysie Lake Resort.
- Many ranchers, loggers, and CCN have bulk fuel.

Related Hazards: Hurricane/Typhoon/High Wind Event / Snowstorms and Blizzards / Wildfire / Landslide/Debris Flow / Earthquake / Oil or Gas Pipeline Spill / Transportation Route Interruption / Rail Incident.

Aircraft Incident

An incident involving one or more aircraft that results in damage, bodily injury, or death. (BC E. M., 2021)

- While the closest commercial airport is in Smithers 145 km to the west of Burns Lake, and 226 km to the east of Prince George, Burns Lake does have an airport approximately 20 km to the northwest of the village along Highway # 16 with a 5000 ft paved runway. This airport serves the municipality and surrounding area with access by private and chartered aircraft. Air transport is also an essential form of evacuating

critically ill people to larger medical centres. Closure of this facility for any length of time would create an inconvenience to local small aircraft and businesses using this facility for their charter flights. Lack of emergency medivac flights would cause a serious health risk to the population.

- The Smithers Airport is the only airport within the Regional District of Bulkley-Nechako with scheduled air service. Air carriers include Air Canada, Northern Thunderbird Air, and Central Mountain Air.
- In addition to the risk of aircraft damage and injury to passengers, an aircraft crash may have other effects on residents. A wildfire may be started by an aircraft crash, causing damage to property and resources, and possible evacuation of residents.
- There is an airstrip and sea plane Base at Moose Lake Lodge and two closed airstrips in Electoral Area 'E' one at Marilla and a second at Tetachuck Lake.

Related Hazards: Fog / Snowstorms and Blizzards / Ash Fall / Explosions / Hazardous Materials Spill / Structure Failure / Transportation Route Interruption.

Motor Vehicle Incident

An incident involving a truck, car, bus, farm vehicle, or any other motor- or person-powered vehicle that results in damage, bodily injury, or death. (BC E. M., 2021)

- Highway 35 North Francois Hwy runs south through the region, Ending at the Francois Lake Ferry. This route contributes to the risk of motor vehicle crashes in the area, with the majority being reported along Highway 35.
- According to the Insurance Corporation of British Columbia North Central Crashes 2016 to 2020, there were 5 reported casualty crashes[7] in Francois Lake, 1 in Noralee, 1 in Grassy Plains, and 4 in Southbank. (ICBC, 2020)

Related Hazards: Fog / Freezing Rain or Drizzle / Snowstorms and Blizzards / Explosions / Hazardous Materials Spill / Transportation Route Interruption.

Cyber Security Threat

A circumstance or event with the potential to interrupt or adversely impact organizational operations, assets, or individuals (including mission, functions, image, or reputation). Cyber Threats occur through information systems via unauthorized access, destruction, disclosure, modification of information, and/or denial of service. Also, the potential for a threat-source to successfully exploit a particular information system vulnerability. (BC E. M., 2021)

- Cyber security is a big threat for government and businesses for business continuity.
- Increase in phone, Facebook, dating apps, and email scams affecting seniors and vulnerable populations. Limited statistics affecting the local community however recent news reports state that "British Columbians reported $3.5 million in losses to cryptocurrency investment scams in the first eight months of 2021" (Samanski-Langille, 2021).

Related Hazards: Telecommunications Interruption / National Security Threat.

[7] "Casualty Crash" (ICBC collision data) motor vehicle crashes resulting in an injury or fatality.

Disease, Pest Infestations & Epidemics

Plant Disease and Pest Infestation

Plant diseases include invasive pests including insects and mites, and plant pathogens including fungi, bacteria and viruses' impact upon crops, forests, and urban environments. New introductions and/or widespread outbreaks could have severe economic and environmental consequences. **(BC E. M., 2021)**

- With climate change, shifts in the distribution, lifecycles, and prevalence of agricultural pests (insects, diseases, weeds, and invasive species) are anticipated. Increasing average annual temperatures (in particular winter minimum temperatures) combined with shifting precipitation patterns are already magnifying pest impacts, pest management complexity and associated costs of production.
- The region has been significantly impacted by Mountain Pine Beetle (MPB) outbreaks, in part due to increased winter survival rates. Modelling of changes to bio geoclimatic zones (BGC zones) how that the Interior Douglas Fir zone will spread northward and increase in area, while the Sub-Boreal Spruce zone will decrease dramatically. While this modeling was completed with a forestry lens, agricultural pests associated with these ecosystems would be expected to shift along with the BGC zones. (BC Agriculture & Food Climate Action Initiative, 2019)
- Within the total geographic boundary of the Lakes TSA, the MPB outbreak began in the late 1990's and the peak in mortality occurred in 2005. It is currently estimated that about 76 percent of the mature pine volume – or 49 percent of the commercially available volume – was killed by the mountain pine beetle. As of 2018, dead pine continued to account for half of the total harvest in the Lakes TSA. (Forest Analysis and Inventory Branch Ministry of Forests, April 2019)
- Since 2005, the Regional District of Bulkley-Nechako has partnered with the Northwest Invasive Plant Council (NWIPC) to address invasive plant species spread within the region. The NWIPC coordinates the invasive plant response based on priority areas and species and on funding availability through their network of partners. Specifically, funds contributed from the RDBN go toward a number of programs including local education and signage on invasive plants and invasive plant monitoring and treatment at RDBN owned and administered properties. In addition, the NWIPC administers the Private Landowner Rebate program that offers rebates to land owners that use contractors to treat for invasive plants on their property.
- The Northwest Invasive Plant Council (NWIPC) is currently targeting 60 invasive plants for management, as per the NWIPC 2020 Target Plant List. The list of species is reviewed, updated, and approved by the membership every spring at the annual general meeting. The Lakes District IPMA Plant list for 2020 identified species listed in electoral area B and E.
- Invasive plant species up and down rail lines and highways taking over farm fields – Knapp weed, hock weeds. This results in spraying along Creeks and rivers causing harm to the environment.
- Agriculture producers can also experience challenges due to pests, including grasshoppers, aphids, cutworms and more. Some resources and information are linked below to help with identification, monitoring and management of pests in gardens and crops. Grasshopper Monitoring and Control in BC ; Pesticides and Pest Management - Province of BC

Related Hazards: Animal Disease / Human Disease / Public Health Crisis / Drought / Food Source Interruption.

Animal Disease

Precipitation in the form of lumps of ice mainly associated with thunderstorms. Hail ranges in size from that of a small pea to the size of cherries, but has been observed as large as grapefruit. Hail in Canada occurs most frequently during the summer when thunderstorm activity is at its peak.. (BC E. M., 2021)

Related Hazards: Human Disease / Plant Disease and Pest Infestation / Public Health Crisis / Food Source Interruption.

Human Disease (Including Pandemic and Epidemic)

Diseases that are caused by pathogenic microorganisms and are spread directly, or indirectly, from one person to another. Diseases can impact public health, cause death, have economic implications, and result in mass casualty response. These include epidemics such as meningitis, pandemic flu, hepatitis, E. coli, and other communicable diseases.

A pandemic is the worldwide spread of a new disease. The total number of people who get severely ill can vary. However, the impact or severity tends to be higher in pandemics in part because of the much larger number of people in the population who lack pre-existing immunity to the new virus. (BC E. M., 2021)

Notable Pandemic Incidents in BC:

- COVID-19 Pandemic (2020)
- Ebola (2013-16
- H1N1 Flu Pandemic (2009)
- SARS Outbreak (2003)
- The lands in BC have been populated by the ancestors of First Nations since time immemorial. Epidemics spread through First Nations communities in advance of explorers. Some researchers have suggested epidemics reached the Northwest Coast as early as the 1500s, believing the well-known epidemics from the Caribbean and Central America may have spread to the Pacific Coast through native trade networks and social contact. Some of the recorded epidemics in the Interior were known to have originated on the prairies during the historic period (early 1800s). The introduction of infectious diseases from Europe and Asia into the Northwest Coast and adjacent areas, and an increase in the severity of warfare, had devastating effects on the people. Smallpox, influenza, measles, and whooping cough were recorded epidemics, with smallpox particularly recurring with devastating effects in the native population. The 1918-19 influenza pandemic was the last major epidemic to seriously affect First Nations and marked the end of the epidemic cycles that had begun over 150 years previously. In some cases, entire villages were significantly reduced in single disease events, with mortality rates ranging from 50% to 90% of the population. (First Nations Health Council, 2011)
- History of Pandemics: **https://www.visualcapitalist.com/history-of-pandemics-deadliest/**

Related Hazards: Animal Disease / Plant Disease and Pest Infestation / Public Health Crisis.

Public Health Crisis

A localized or regional event that poses or causes a significant threat to the health of human populations. The event may be declared as a Public Health Emergency if the event meets at least two of the following criteria:

- a regional event that could have a serious impact on public health;
- a regional event that is unusual or unexpected;
- there is a significant risk of the spread of an infectious agent or a hazardous agent; and
- there is a significant risk of travel or trade restrictions because of the regional event.

An example of a Public Health Crisis is the contamination of a communities drinking-water supply by a hazardous material. If the event is regional in nature and poses a serious impact to public health, it may be declared a Public Health Emergency. (BC E. M., 2021)

- Overdose B.C.`s Public Health Emergency Progress Update on B.C.`s Response to the Overdose Crisis reported that on April 14, 2016, B.C.'s provincial health officer declared a public health emergency under the Public Health Act. In July 2017, the Ministry of Mental Health and Addictions was established, in part, to work in partnership to develop an immediate response to the overdose emergency. (Columbia B. , 2021)
- Preliminary data in 2021 has found that fentanyl or its analogues have been detected in 85% of all illicit drug toxicity deaths. In 2020, fentanyl or its analogues have been detected in 86% of deaths. (Service C. , 2021) In the Northern Interior[8] the Illicit drug toxicity deaths between 2011-2021 have increased and are reported as follows:

2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021[9]
8	12	8	11	15	24	35	63	34	84	56

- By Health Authority (HA), in 2021, the highest rates were in Vancouver Coastal Health (46 deaths per 100,000 individuals) and Northern Health (45 per 100,000). Overall, the rate in BC is 39 deaths per 100,000 individuals in 2021.
- The 2019 Taking the Pulse of the Population An Update on the Health of British Columbian identifies positive Mental Health as a public health challenge and a provincial goal. Collecting public health statistics as indicators to monitor this complex public health crisis. Under Section 66 of the Public Health Act, the Provincial Health Officer (PHO) has the authority and responsibility to monitor the health of the population in BC, and to provide independent advice on public health issues and the need for legislation, policies, and practices respecting those issues.
- Across Northern health and the province there are challenges in providing and maintaining levels of service in many remote and rural communities. The challenges include the difficulty of recruiting and retaining doctors and nurses, creating tight staffing levels across the province, and the ability for these professionals to offer a comprehensive level of service that address physical to mental health services in rural areas.

Related Hazards: Air Quality / Extreme Heat / Extreme Cold / Animal Disease / Human Disease / Plant Disease and Pest Infestation / Explosions / Hazardous Materials Spill / Structure Failure / Electrical Outage / Food Source Interruption / Telecommunications Interruption / Transportation Route Interruption / Wastewater Interruption / Water Service Interruption / Fuel Source Interruption.

[8] Electoral Area E is in the Northern Interior Health Service Delivery Area.
[9] https://www2.gov.bc.ca/assets/gov/birth-adoption-death-marriage-and-divorce/deaths/coroners-service/statistical/illicit-drug.pdf

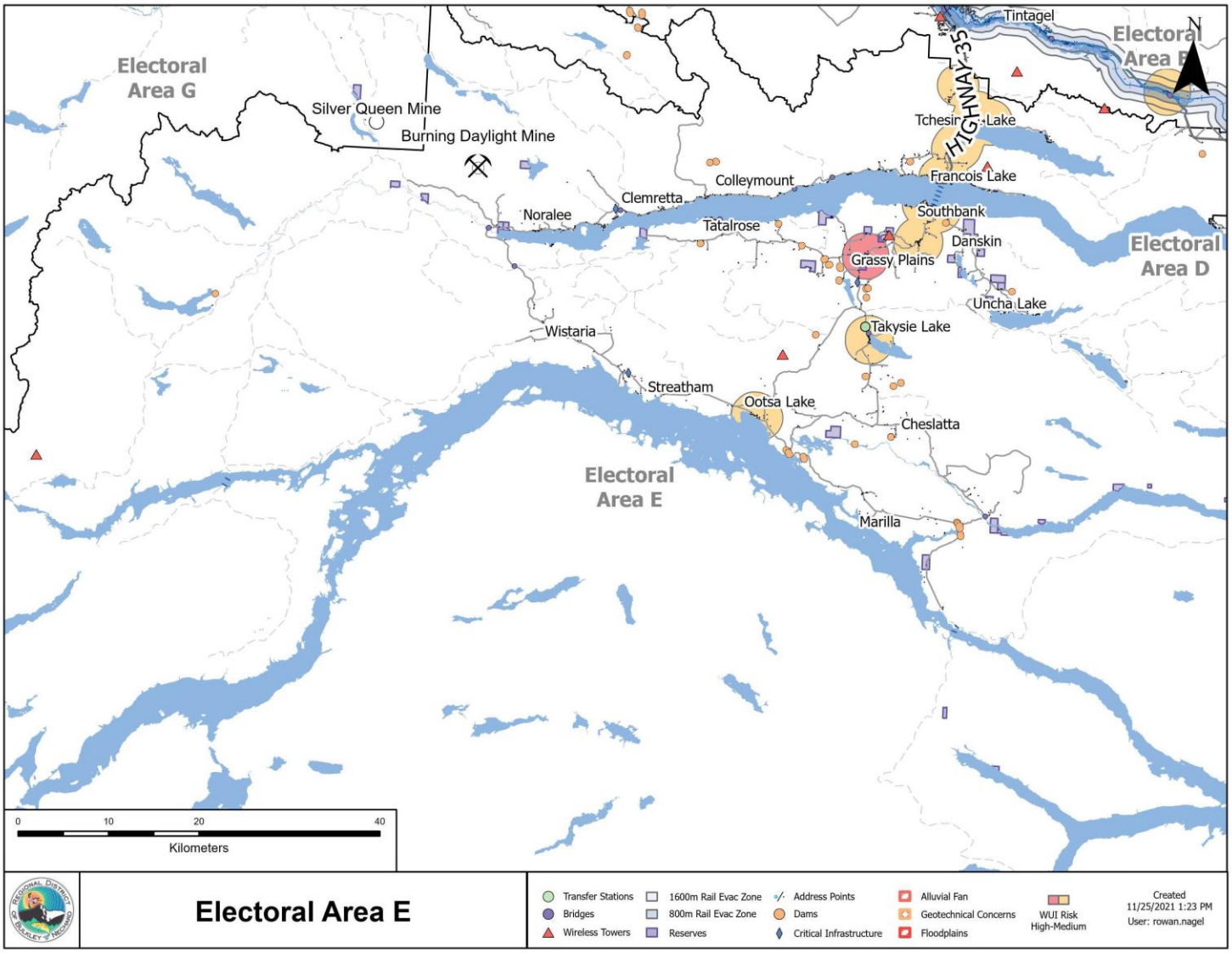
APPENDIX 1 – ELECTORAL AREA 'E' HISTORIC HAZARD EVENTS

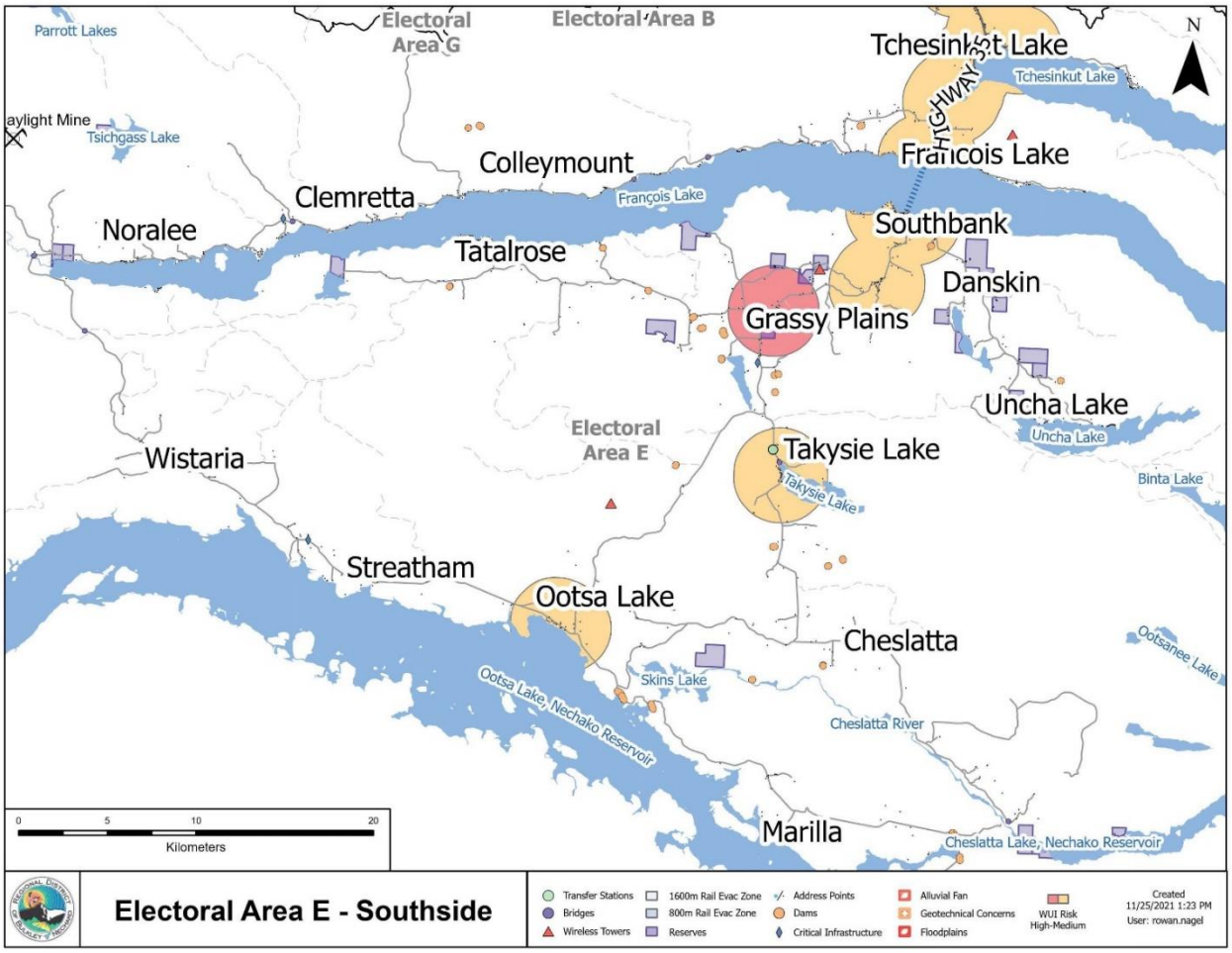
Year	Event Type	Severity	Cause	Impact Effect	Description
1995	Severe Weather	moderate	Heavy Snow	Residential and Industrial damage	In the rural Burns Lake area, at least eight Quonsets, arch-shaped corrugated steel structures, and four other buildings including the 1947-vintage gas station at Grassy Plains collapsed.
1996	Severe Weather	moderate	Roof Collapse	Residential and industrial damage	In the Francois Lake-Ootsa Lake area, unusually heavy snow combined with poor design in some cases caused the roofs of at least seven buildings to collapse. Between January 13 and 14, five structures (hay barns), one shop and one of undetermined nature came down. Building inspector Wainwright came close to issuing a snow advisory, however, mild temperatures and heavy rain swept through the area reducing the snow load issues.
2004	Wildfire - EOC Activation	low	Lightning Caused		10313 Hectares but under control by July 3rd.
2004	Wildfire - EOC Activation	low	Lightning Caused		500 Hectares
2004	Wildfire - EOC Activation	low	Lightning Caused		300+ Hectares. Nanika and Kidprice Park Closed.
2004	Wildfire - EOC Activation	low	Lightning Caused		2900 hectares. Were observed only and allowed to burn as was in park
2004	Wildfire - EOC Activation	moderate	Wildfire		150 Hectares
2006	Electrical Outage	Low	Severe Weather	Transportation	On October 28, a massive snowstorm that hit northern British Columbia dumped 2.5-3 ft. (75-90 cm) of wet snow in some areas. It was a result of a combination of two weather systems, a warm Pacific and a large cold front, colliding. The Smithers airport set a 24-hour October record of 62 cm of snow. *1) Early on October 28, the 244-km section of Highway 16 between Moricetown-Fraser Lake was temporarily closed, to be reopened the next day. The early season snowstorm left an estimated 15,000 BC Hydro customers in northwestern British Columbia without power. Affected communities included: Mackenzie, Prince George, Vanderhoof, Fort St. James, Fraser Lake, Burns Lake, Takla Landing, Houston, Telkwa, Smithers and Hazelton. Three transmission lines were down and due to impassable roads crews in some areas were relying on helicopters to access problem areas.

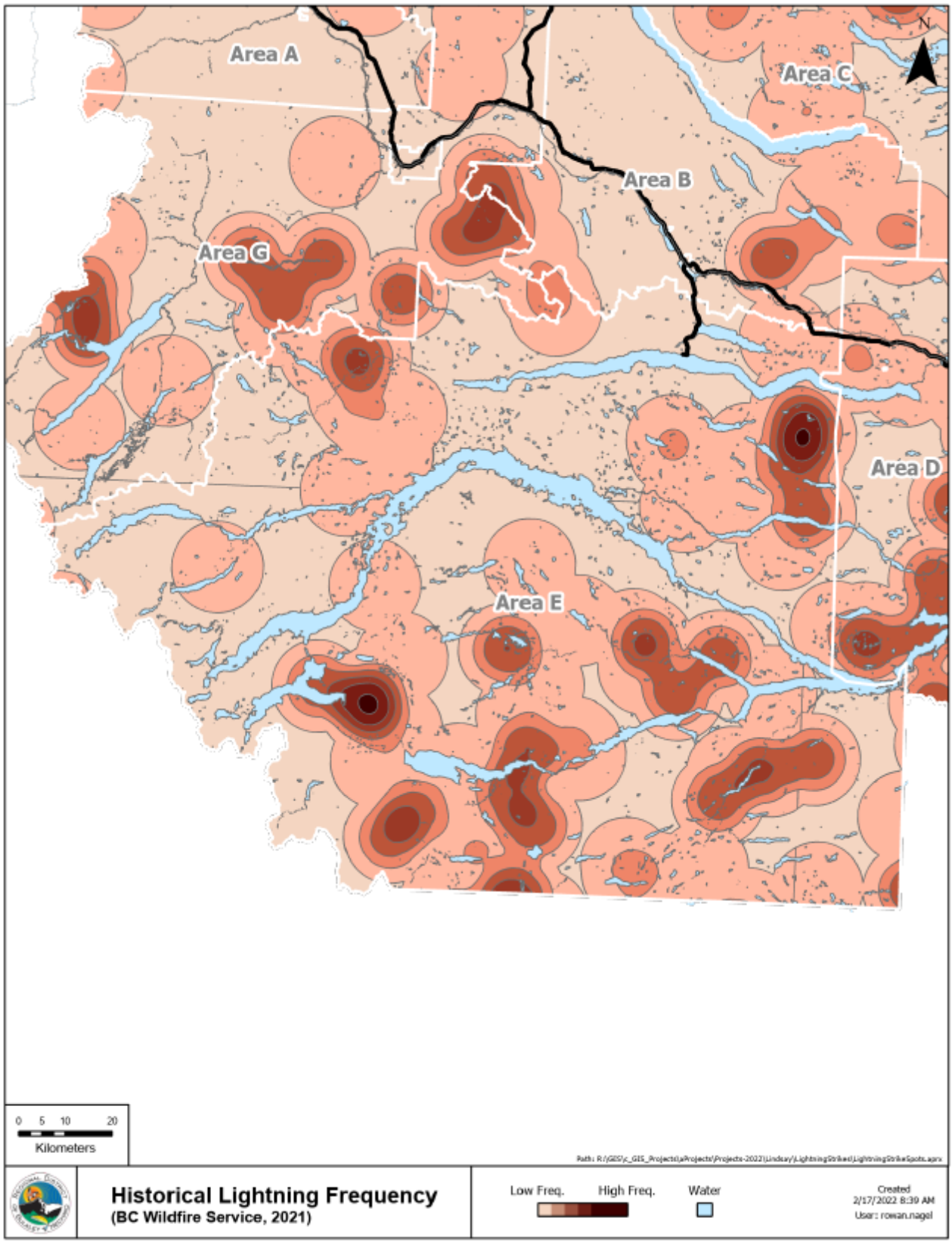
Year	Event Type	Severity	Cause	Impact Effect	Description
					On October 30, an estimated 2,500 customers were still without power. On November 2, six days after the storm, about 200 households in about 10 communities near Burns Lake were still without power. Most of these were unlikely to get service back for several more days. The area most heavily affected was the south shore of Francois Lake, about 25 km south of Burns Lake. Large trees coated with ice hampered repair efforts. BC Hydro representative Elisha Moreno said, "There was about a metre-and–a-half of wet snow; then it froze."
2007	Flooding	high	Spring Run Off	Transportation, Residential damage and evacuation	An evacuation alert was also put in place for residences along Francois Lake and included approximately 350 homes.
2009	Wildfire - EOC Activation	high	Interface Fire	Transportation, Residential Evacuation	August 2, 2009 , the Regional District of Bulkley-Nechako issued an evacuation order for persons residing in the area from the eastside of Morice Lake to the west side of Parrott Lake, North from Aspen Recreational Area to the Southside of Nadina, west of Morice River Forest Service Road and North of Morice River. The Regional District of Bulkley-Nechako has evacuated 5 homes in the area and put 127 homes on one hour evacuation alert. Evacuation Order rescinded Aug 11.
2010	Wildfire - EOC Activation	high	Wildfire	Transportation, Residential Evacuation	Evacuation Order issued Aug 15, Order expanded Aug 17, and Alert put in place for 10km surrounding evacuation order area. Alert area expanded Aug 19, Order expanded Aug. 19. The evacuation alert rescinded Aug 24. Order area was downgraded to alert on Aug 24-rescinded Aug 30.
2010	Wildfire - EOC Activation	high	Wildfire	Transportation, Residential Evacuation	Evacuation Order Issued Aug 16, order rescinded Aug 22.
2010	Wildfire - EOC Activation	high	Interface Fire	Residential Evacuation	68 Homes in the Evacuation Order, 400 in Evacuation Alert area. Reception Centres in Burns lake and Fraser Lake. 5 Roads blocked off - Uncha Lake & Binta Lake, Nithi Rd., Holy Cross FSR, Lily Lake Rd, Kenny Dam Rd. Rescinded Order August 24. 40,000 hectares (400 square kilometres)
2010	Wildfire - EOC Activation	high	Interface Fire	Residential Evacuation	92 Homes in Evacuation Order, 123 in Evacuation Alert area. Reception Centres opened in Houston and Burns Lake 4 Roads block off to the public-Carroll Rd., West Francois FSR, Roses Rd, and Morice River Rd. Rescinded Order Aug 24.
2012	Wildfire - EOC Activation	low	Wildfire	Forest Fire	6,120.0 hectares Monitored and allowed to burn

Year	Event Type	Severity	Cause	Impact Effect	Description
2013	Wildfire - EOC Activation	low	Wildfire	Recreational incl Lodge Evacuation	Grew to 3600 hectares and came within 6 km of Tetachuk Lodge. Evacuation Order was issued for Tetachuk Lake area. Smoke drifted into Region causing discomfort to residents.
2013	Wildfire - EOC Activation	low	Wildfire		The Eutsuk Lake wildfire in Tweedsmuir North Provincial Park was the largest fire of the season, burning an estimated 3600 hectares. It resulted in an evacuation alert for nearby wilderness properties.
2013	Fuel Spill in Ootsa		Barge Sink	fuel spil in Ootsa Lake	
2014	Wildfire - EOC Activation	high	Wildfire	Residential Evacuation	Chelaslie River Wildfire, 7 kilometres south of the Chelaslie River burned an area of 133,098 hectares (1,331 square kilometres), including sections of Entiako Provincal Park. This fire resulted in several evacuation alerts and orders.
2014	Cyanobacteria Outbreak	moderate		Economic/ Environmental	Takysie Lake Blue Green Algae Bloom Ø Reported to RDBN on September 18, 2014. Ø Six cows were lost from the Ulmer's Ranch. Ø Northern Health to be attending at Takysie Lake September 18, 2014 to test and look at situation. Ø DJM contacted Kelly at SEDA – 9-18-14. Ø DJM contacted Takysie Lake Resort – 9-8-14.
2017	Wildfire		Wildfire		TAKYSIE LAKE FIRE (R10659) June 8, 2017
2018	Wildfire - EOC Activation		Wildfire	Residential Evacuation	Nadina Lake: 86,767 ha; 40 km southwest of Burns Lake; discovered July 31; lightning-caused; prompted Evacuation Orders and Alerts
2018	Wildfire - EOC Activation		Wildfire	Residential Evacuation	Verdun Mountain: 47,610 ha; 10 km southwest of Grassy Plains, 40 km south of Burns Lake; discovered July 12; lightning-caused; prompted Evacuation Orders and Alerts
2018	Wildfire - EOC Activation		Wildfire	Residential Evacuation	Chelaslie Arm: 9,253 ha; 85 km southeast of Burns Lake; discovered August 6; lightning-caused; prompted Evacuation Orders and Alerts
2018	Wildfire - EOC Activation		Wildfire	Residential Evacuation	Island Lake: 21,381 ha; adjacent to Island Lake; discovered August 1; lightning-caused; prompted Evacuation Orders and Alerts
2020	Pandemic	moderate	Pandemic	Social economic	COVID-19 Pandemic, Business shut down and restrictions on gatherings and inter-community travel.
2021	Wildfire - EOC Activation	moderate	Wildfire	Residential Evacuation	Chief Louis Lake R11562 burnt 20,750 Ha started on July 7, 2021

APPENDIX 2 – ELECTORAL AREA ‘E’ KNOWN HAZARDS MAP




Parrott Lakes
Electoral Area G
Electoral Area B
Tchesinkut Lake
Tchesinkut Lake
HIGHWAY 16
aylight Mine
Tsichgass Lake
Colleymount
François Lake
François Lake
Clemretta
Noralee
Tatalrose
Southbank
Danskin
Grassy Plains
Uncha Lake
Uncha Lake
Electoral Area E
Takysie Lake
Takysie Lake
Binta Lake
Wistaria
Streatham
Ootsa Lake
Cheslatta
Ootsanee Lake
Skins Lake
Ootsa Lake, Nechako Reservoir
Cheslatta River
Marilla
Cheslatta Lake, Nechako Reservoir
N
0 5 10 20
Kilometers
Electoral Area E - Southside
Transfer Stations
Bridges
Wireless Towers
1600m Rail Evac Zone
800m Rail Evac Zone
Reserves
Address Points
Dams
Critical Infrastructure
Alluvial Fan
Geotechnical Concerns
Floodplains
WUI Risk
High-Medium
Created
11/25/2021 1:23 PM
User: rowan.nagel


Area A
Area B
Area C
Area D
Area E
Area G
N
0 5 10 20
Kilometers
Historical Lightning Frequency
(BC Wildfire Service, 2021)
Low Freq.
High Freq.
Water
Created
2/17/2022 8:39 AM
User: rowan.nagel

WORKS CITED

BC Agriculture & Food Climate Action Initiative. (2019). *Regional Adaptation Strategies: Bulkley-Nechako & Fraser-Fort George.* Bulkley-Nechako: BC Agriculture & Food Climate Action Initiative. Retrieved from https://climateagriculturebc.ca/app/uploads/RegionalStrategies-BNFFG.pdf

BC Centre for Disease Control Provincial Health Services Authority. (2018). *Food Costing in BC 2017.* Vancouver: BC Centre for Disease Control. Retrieved from http://www.bccdc.ca/pop-public-health/Documents/food-costing-BC-2017.pdf

BC, E. M. (2021, winter). *BC Government HRVA Guides and Tools for Local Government.* (W. 2. 2.1 edition, Ed.) Retrieved from HRVA Hazard Reference Guide: https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/local-government/hrva/guides/hrva_hazard_reference_guide.pdf

Blackwell, B. A. (2019). *Burns Lake Community Forest Landscape Fire Managment Plan.* North Vancouver: Burns Lake Community Forest. Retrieved from https://blcomfor.com/wp-content/uploads/2019/05/Burns-Lake-LFMP_14May2019_FINAL.pdf

Canada, E. (1981-2010). *Climate Normal 1981-2010 - Wistaria, Climate ID 1088970.* Retrieved June 7, 2021, from Environmnet Canada Climate Normals: https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnProx&txtRadius=200&selCity=&selPark=&optProxType=custom&txtCentralLatDeg=54&txtCentralLatMin=14&txtCentralLatSec=00&txtCentralLongDeg=125&txtCentralLongMin=46&txtCentralL

Canada, G. o. (2016, June 21). *Lightning*. Retrieved from Canadian Lightning Detection Network: https://www.canada.ca/en/environment-climate-change/services/lightning/canadian-detection-network.html

Canada, G. o. (2016, June 16). *Lightning Statistics*. Retrieved from Map of Canada’s lightning hotspots: https://www.canada.ca/en/environment-climate-change/services/lightning/statistics/maps-hotspots.html

Canada, G. o. (2016, June 16). *Lightning Statistics*. Retrieved from Map of Canada’s lightning hotspots: https://www.canada.ca/en/environment-climate-change/services/lightning/statistics/activity-canadian-cities.html#wb-auto-4

Canada, G. o. (2021, 12 21). *Climate Normals & Averages.* Retrieved from Canadian Climate Normals 1981 - 2010 Station Data - Ootsa L Skins L Spillway Climate ID10085835: https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnProx&txtRadius=200&selCity=&selPark=&optProxType=custom&txtCentralLatDeg=54&txtCentralLatMin=14&txtCentralLatSec=00&txtCentralLongDeg=125&txtCentralLongMin=46&txtCentralL

Canada, G. o. (2021, 12 21). *Climate Normals & Averages.* Retrieved from Canadian Climate Normals 1981-2010 Station Data - Takysie Lake 1087974: https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchT

ype=stnProx&txtRadius=200&selCity=&selPark=&optProxType=custom&txtCentralLatDeg=54&txtCentralLatMin=14&txtCentralLatSec=00&txtCentralLongDeg=125&txtCentralLongMin=46&txtCentralL

Canada, G. S. (2015). *Seismic Hazard Map of British Columbia.* Retrieved from earthquake canada: https://earthquakescanada.nrcan.gc.ca/hazard-alea/simphaz-en.php#BC

Canada, H. (2021, June 10). *Wildfire smoke 101: Wildfire smoke and your health*. Retrieved july 14, 2021, from Health canada wildfire smoke health: https://www.canada.ca/en/health-canada/services/publications/healthy-living/wildfire-smoke-health.html

Canada, S. (2021, 12 09). *2017. Bulkley-Nechako E, RDA* . Retrieved from Census Profile. 2016 Census.: https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E

Capling, S. M. (2019). *Village of Burns Lake Community Wildfire Protection Plan Update.* Burns Lake: Village of Burns Lake.

Coastal GasLink. (2021, October 29). *Construction Update.* Retrieved from Coastal GasLink: https://www.coastalgaslink.com/siteassets/pdfs/construction/updates/Coastal-GasLink-Construction-Update-October-29-2021.pdf

Coastal GasLink. (2021, September 22). *Safety Operations Coastal GasLink*. Retrieved from Coastal GasLink: https://www.coastalgaslink.com/sustainability/safety/

Columbia, B. (2021, July 19). *Office of the Provinical Health Officer*. Retrieved from Current Health Topics: https://www2.gov.bc.ca/gov/content/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/current-health-topics

Columbia, P. o. (2021, 07 15). *Air Quality Data BC*. Retrieved from Current Air Quality Data: https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-quality/current-air-quality-data#S

Columbia, P. o. (2021, July 26). *British Columbia Drought Information Portal*. Retrieved from Historic Drought Portal: https://www.arcgis.com/apps/MapSeries/index.html?appid=838d533d8062411c820eef50b08f7ebc

Dalhousie University | University of Guelph | University of Saskatchewan | University of British Columbia. (2021). *Canada's Food Price Report 11th Edition.* Saskatoon: DALHOUSIE UNIVERSITY. Retrieved from https://cdn.dal.ca/content/dam/dalhousie/pdf/sites/agri-food/Food%20Price%20Report%202021%20-%20EN%20(December%208).pdf

Econics. (May 2021). *British Columbia Drought and Water Scarcity Response Plan.* Victoria: MInistry of Environment and Climate Change Strategy Interagency Drought Working Group. Retrieved from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/drought-info/drought_response_plan_final.pdf

First Nations Health Council. (2011). *Implementing the Vision: BC First Nations Health Governance.* West Vancouver: First Nations Health Council. Retrieved from https://www.fnha.ca/Documents/FNHC_Health_Governance_Book.pdf

Foord, v. (2016). *Climate patterns, trends, and projections for the Omineca, Skeena, and Northeast Natural Resource Regions, British Columbia.* Forest, Lands, and NR Operations. Retrieved from https://www.for.gov.bc.ca/hfd/pubs/tr.htm

Government of Canada. (2021, 12 06). *Space Weather Canada*. Retrieved from Learning About Space Weather: https://www.spaceweather.gc.ca/info-gen/index-en.php

ICBC. (2020, May 20). *ICBC Reported Crashes*. (C. i. Licence., Editor) Retrieved from Search Southside Casuality Crashed Only.: https://public.tableau.com/app/profile/icbc/viz/ICBCReportedCrashes/ICBCReportedCrashes

Inc., E. M. (2019). *Review of the Regional District of Bulkley-Nechako Emergency Operations Centre Response to the 2018 Wildfires.* Burns Lake: Regional District of Bulkley-Nechako.

Ketkar, P. (2020, 09 16). A cell coverage map is now available along with signage indicating places where cellular coverage can be found on the Southside. (Cheslatta Carrier Nation Facebook photo). Burns lake, BC, Canada. Retrieved from https://www.todayinbc.com/news/cell-service-signage-coverage-maps-now-available-for-north-and-south-side-of-francoise-lake/

Linch, L. (2021, November 18). What are atmospheric rivers, and how are they affecting the B.C. floods? Vancouver, BC, Canada. Retrieved from https://www.cbc.ca/radio/whatonearth/what-are-atmospheric-rivers-and-how-are-they-affecting-the-b-c-floods-1.6253763

ltd., N. h. (2019). *BC Dike Consequence Classification Study.* Victoria: MInistry of Forests, Lands, Natural Resource Operations and Rural Development. Retrieved from Dike Consequence Classification: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/integrated-flood-hazard-mgmt/dike_consequence_classification_study_2019.pdf

Munsaka, E. D. (2018). *The contribution of indigenous knowledge to disaster risk reduction activities in Zimbabwe: A big call to practitioners.* South Africa: Jamba - Journal of Disaster Risk Studies. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6014067/

Nation, C. C. (2021, 12 20). *About*. Retrieved from Cheslatta Carrier Nation : https://www.cheslatta.com/the-nation

Natural Resources Canada. (2021, 04 06). *EarthQuakes Canada*. Retrieved from Search the EarthQuake Database: https://earthquakescanada.nrcan.gc.ca/stndon/NEDB-BNDS/bulletin-en.php?display=1&endtime=2021-09-28T23%3A59%3A59&eventtype=L&latitude=54.508&limit=4001&longitude=-124.196&maxdepth=1000&maxlatitude=90&maxlongitude=180&maxmagnitude=10&maxradius=4.5045045045

NAVCAN. (2021, June 27). *Government of Canada Historical Data*. Retrieved from Hourly Data Report For June 27, 2021 - Burns Lake:

https://climate.weather.gc.ca/climate_data/daily_data_e.html?StationID=574&timeframe=2&StartYear=1840&EndYear=2021&Day=14&Year=2021&Month=6#

Nechako, R. D. (2021, July 21). *Agriculture*. Retrieved from Connecting Consumers and Producers: https://www.rdbn.bc.ca/departments/agriculture/connecting-consumers-and-producers

Nechako, R. D. (2021, 12 21). *RDBN Area B and E Official Community Plan.* Retrieved from Planning : https://www.rdbn.bc.ca/application/files/5616/0314/7458/Area_B_E_OCP_Schedule_A_Bylaw_1785.pdf

Patrick Ferguson, R. (2021, May 3). Wildfire Risk Reduction Officer, Skeena Stikine District, Ministry of Forests, Lands and Natural Resource Operations. *Bulkley Valley Wildfire Risk Reduction Public*. Hazelton, BC, Canada.

Prepare BC Emergency Management BC. (2019, January 01). *Get Ready Guide Education Material.* Retrieved from Master of Disaster Get Ready Guide: https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/master-of-disaster/learning-materials/mod_learning_work_book.pdf

PREPARED BY DALHOUSIE UNIVERSITY | UNIVERSITY OF GUELPH | UNIVERSITY OF SASKATCHEWAN | UNIVERSITY OF BRITISH COLUMBIA. (2021). *Canada's Food Price Report 11th Edition.* Saskatoon: DALHOUSIE UNIVERSITY. Retrieved from https://cdn.dal.ca/content/dam/dalhousie/pdf/sites/agri-food/Food%20Price%20Report%202021%20-%20EN%20(December%208).pdf

Rio Tinto. (2021, October 27). *Nechako Reservoir*. Retrieved from Operations, Canada, BC Works, Nechako Reservoir: https://www.riotinto.com/en/operations/canada/bc-works/nechako-reservoir

Rio Tinto. (November 2020). *Nechako Reservior Dam Emergency Plan (DEP).* Kitimat/Kenamo: Rio Tinto. Retrieved October 23, 2021, from https://ehq-production-canada.s3.ca-central-1.amazonaws.com/463468586768ac25ca4d60fccc695c34843793cc/original/1607030837/930-001_Nechako_Dam_Emergency_Procedure.pdf_e1848c0ca58eec8a1bb633dc6c26b8c0?X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAIBJ

Samanski-Langille, J. (2021, Nov 3). British Columbians reported $3.5 million in losses to cryptocurrency investment scams in the first eight months of 2021. Smithers, BC, Canada. Retrieved from https://www.interior-news.com/news/british-columbians-have-lost-3-5m-to-cryptocurrency-scams-so-far-in-2021/

Service, B. C. (2021, June 30). *Province of BC*. Retrieved from Chief coroner’s updated statement on public safety during heat wave: https://archive.news.gov.bc.ca/releases/news_releases_2020-2024/2021PSSG0045-001280.htm

Service, B. W. (2021). *About the BC WIldfire Service*. Retrieved from Wildfire Glossary: https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/glossary

Service, C. (2021, August 31). *Statistical Reports on Deaths in British Columbia.* Retrieved from BC Coroners Service: https://www2.gov.bc.ca/assets/gov/birth-adoption-death-marriage-and-divorce/deaths/coroners-service/statistical/illicit-drug-type.pdf

Staff, D. S. (2009, september 1). *Dam Safety Audit Program.* Retrieved August 2021, from Dam Safety policy legislation: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/water-use/dam-safety/policy-legislation/dam_safety_audit_program-2013-amendment.pdf

Strategies, U. F. (March 2021). *RDBN Food Economy Assessment and Food Hub Feasibility Study.* Burns Lake: RDBN. Retrieved from https://www.rdbn.bc.ca/application/files/1316/2455/2474/V3-

Village of Burns Lake. (2020). *Emergency Preparedness Plan Village of Burns Lake 2020.* Burns Lake: Village of Burns Lake.

Village of Fraser Lake. (2015 2020). *Village of Fraser Lake Emergency Preparedness Plan.* Fraser Lake: Village of Fraser Lake.

Zirnhelt, N. (June 21, 2021). *BVLD Airshed Managment Plan: A Community Action Plan for Clean Air.* Cariboo Environmental Quality Consulting. Smithers: Bulkley Valley Lakes District Airshed Managment Society. Retrieved from https://cleanairplan.ca/cleanairplan2012.pdf