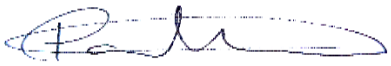
Final Report

City of Coquitlam

Climate Adaptation Strategic Plan

October 2020

PREPARED BY



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EXECUTIVE SUMMARY

The City of Coquitlam has developed this Climate Adaptation Strategic Plan to better understand how to cope with climate change and extreme weather impacts on infrastructure, services and the community.

With help from a Federation of Canadian Municipalities (FCM) *Municipalities for Climate Innovation Program* grant, this Plan evaluates potential climate change risks to the City's infrastructure and services and recommends adaptive actions to build resilience. Once adopted by the Coquitlam City Council, these strategies will help provide the framework for new policies, practices and plans.

The City has begun to adapt to climate change through initiatives such as:

- Developed integrated watershed management plans for urban watersheds to protect watershed health;
- Adopted rainwater management guidelines which require all new developments to capture and control runoff in a way that mimics the hydrology of natural watersheds;
- Implemented drinking water conservation measures and applied seasonal watering restrictions, to ensure sufficient water availability as the summers become longer, hotter and drier;
- Revised policy of development in coastal floodplains to account for projected sea level rise of 1.0 m by the year 2100; and
- Incorporated climate change impacts into emergency response planning.

An Adaptation Plan is a long-term strategy that enables communities to deal with the impacts, risks and opportunities posed by climate change.

Adaptation plans tend to have greater local impacts, shorter implementation times, and more concentrated effects.

Coquitlam is projected to see increased average temperatures throughout the year, with the greatest increase in summer. This will include more heat waves, higher temperatures on the hottest day of the year, earlier snowmelt and milder winters. Precipitation is projected to increase during winter, fall, and spring, but decrease during the summer, possibly causing longer drought conditions. Projections indicate more heavy precipitation days, more intense storm events, greater risk of flooding, and sea level rise, which will impact nearby rivers.

This Plan identified climate risks by examining the City's exposure to climate impacts using the latest available models and projection data, and comparing it to information about Coquitlam's drainage systems, drinking water, energy, buildings, transportation, parks, natural areas, business, agriculture, and residents' health and safety. Taking into consideration historical records and City staff knowledge, each component's vulnerability was assessed and compared with the likelihood of a climate event happening to inform future risk. Risks were ranked from Very Low to Very High, and adaptation options were considered for significant risks (those Moderate or greater).

Timebound strategic actions have been recommended to mitigate high climate risks with the greatest community impact and risks that pose medium to low impacts which will affect resident wellbeing.

These strategic actions are listed, with action owners, under seven climate risk events: Drought, Wildfires, Heat Waves, Seasonal Water Shortages, Inland Flooding, Coastal Flooding, and Storm Events.

This Plan is intended as a strategic starting point for the City of Coquitlam to continue building resilience against the impact of changing weather patterns and long-term climate change.

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1. WHY WE NEED AN ADAPTATION PLAN

Canada's climate is changing and is projected to warm at approximately double the global average. Recent global action to reduce GHG emissions resulted in the historic signing of the 2015 Paris Agreement which saw 196 countries agree to undertake ambitious efforts to keep average global temperature increase well below 2°C compared with pre-industrial levels. This means that we will have to adapt our communities, our homes, businesses and our behaviours to reduce the impacts that these changes will bring.

Mitigation measures are actions that reduce emissions such as reducing the number of cars on the road, increasing forested area and electrifying power sources.

Adaptation is managing and minimizing the risks of climate change impacts through actions such as flood protections, infrastructure upgrades, and emergency management plans.

We are already witnessing the local impacts of a changing climate. Since 1950, British Columbia (BC) has experienced average temperature increases of 1.5°C and we now receive 30% more precipitation. More recently, the prolonged cold snap of 2017 highlighted the challenges related to winter salt and sand management required to ensure safe winter roads in Coquitlam, and the 2017-18 fire seasons were some of the most severe on record, placing increasing demands on our emergency services and causing damage to our sensitive ecosystems. In 2019, BC broke 17 temperature records, increasing pressure on our water supplies and energy demands.

The impacts of climate change are not discrete. Vulnerable communities are more exposed to change and less able to adapt. Today, we have already begun to witness the impacts of climate change, with 2019 seeing numerous broken records for heat, water supply, and energy demand. The consequences of climate change are here, visible and expensive.

The costs associated with these events are spiralling. In Canada, compensation provided through the Disaster Financial Assistance Arrangements (DFAA) between 2009 to 2015 was greater than the past 39 fiscal years combined, whilst costs associated with repairing, replacing and rebuilding our communities exceed those covered by insurance. Meanwhile, against this backdrop, Coquitlam's population is projected to increase by more than half in the next 25 years, placing additional pressure on the City's services, businesses and communities.

Taking action now will reduce risks and save money. Today, cities across the world are developing plans and strategies to reduce their GHG emissions and to adapt to the impacts of extreme weather and long-term climate change. While implementing measures to mitigate our emissions remains a priority, adaptation to climate change is now essential to reduce impacts and future costs. Some estimates project that for every dollar spent on adaptation measures, three dollars are saved on emergency response, cleanup, and rebuilding[1]. However, adapting to a new reality can be challenging without knowing where to begin. Where should we focus our efforts and community investments? What can we control and what are our greatest risks? This report attempts to address these questions.

[1] Read more here: https://www.fema.gov/natural-hazard-mitigation-saves-2017-interim-report

The City of Coquitlam is preparing for these challenges. The City of Coquitlam plays a major role in the Metro Vancouver area, providing homes, jobs, tourism and an abundance of natural beauty and amenities. As a local government, the City is already taking action, and is going further to implement plans to adapt service delivery and public infrastructure for a future that may look very different than today. This requires a flexible, proactive and collaborative approach, drawing on the knowledge, relationships, and leadership of the City's businesses and communities.

To be resilient to future climate change and to build a healthy and sustainable Coquitlam, **the City has created this Climate Adaptation Strategic Plan based on adaptation, resilience, equity, and educating citizens**. This Plan will reduce the City's vulnerabilities to climate change. It describes how our climate will change, what the impacts will be, and the actions we can take to reduce risks and take advantage of the opportunities associated with our changing climate. In tandem with the City's GHG Reduction Strategy, this Plan supports Coquitlam's growth towards an adaptable and resilient future which will benefit everyone, now and in the future.

2. WE ARE TAKING ACTION

The City of Coquitlam is already taking action, through mitigation efforts to reduce GHG emissions, and adaptation actions to reduce current or anticipated future climate change impacts.

Mitigation and adaptation are not mutually exclusive and often complement each other. For example, planting trees in urban areas can reduce the effects of heatwaves whilst also absorbing carbon dioxide (contributing to GHG reduction targets) and improving air quality. The City has already taken important steps to reduce its GHG emissions, including setting targets to reduce corporate and City emissions.

Whilst Coquitlam has committed to several mitigation actions over the past decade, the City has also taken steps to adapt to climate change, including:

- Developed policies under City's Official Community Plan to support creating compact urban areas;
- Developed integrated watershed management plans for urban watersheds to protect watershed health;
- Adopted rainwater management guidelines which require all new developments to capture and control runoff in a way that mimics the hydrology of natural watersheds;
- Implemented drinking water conservation measures and applied seasonal watering restrictions, to ensure sufficient water availability as the summers become longer, hotter and drier;
- Revised policy of development in coastal floodplains to account for projected sea level rise of 1.0 m by the year 2100;
- Incorporated climate change impacts into emergency response planning;
- Required street trees as part of all new developments and brought Tree Management Bylaw to protect trees from removal; and
- Required fire hazard mitigation plan under Interface Wildlife Risk Management Development permits.

The City has begun to incorporate adaptation principles into its decision-making. Every day municipal operations will need support from all citizens as we move forward to meet the challenges of a changing climate.

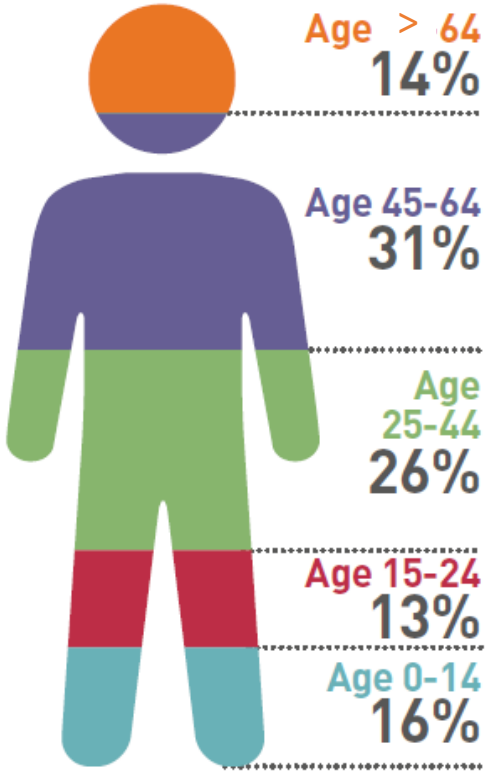
Climate change is a unique challenge without precedent, but if we understand the impacts and associated risks, we can take action to increase the resilience of our City.

3. THE CITY NOW

Every community is different, having unique vulnerabilities and capacity to adapt. Demographics, geography, quality of life and prosperity all contribute to how the City will adapt to a changing climate. Coquitlam is located along the Fraser River, approximately 20 km from Vancouver's city centre. It is well connected to other communities within Metro Vancouver with a variety of major transportation options. From 0 to 1,000 m above sea level, the City contains both hillside and riverfront developments. The City enjoys a temperate coastal climate with warm and dry summers and wet and cool winters. Due to its proximity to mountain slopes, precipitation is especially heavier than some other Metro Vancouver communities. One third of its land is dedicated to recreation and nature areas, bringing a high quality of life for its residents; it allows people to remain close to economic activities, without jeopardizing access to nature and leisure facilities. The population of Coquitlam is dynamic and multi-cultural, due to its large immigrant population.

The City of Coquitlam is ambitious. Its vision is to be a community of neighbourhoods within a vibrant city where people choose to live, learn, work and play. To sustain Coquitlam's high quality of life for current and future generations, municipal agencies serve the public interest through leadership, innovation and a focus on community priorities and strengths.

The City of Coquitlam is growing. Coquitlam is the sixth-largest city in BC with a population of nearly 150,000. With population projections indicating an additional 100,000 people by 2046, the City plays an important role in the future development of the Metro Vancouver area. However, such a high projected growth rate will put additional pressure on City services and infrastructure, which will need to be adapted to future climate and demographic conditions.



This Climate Adaptation Strategic Plan will ensure that these adaptation strategies come with strong actions, so that Coquitlam grows towards an adaptable and resilient future for everyone.

4. COQUITLAM'S FUTURE CLIMATE

Globally, climate change will result in a long-term rise in the Earth's average temperature. On a local scale, impacts will vary and include shifts in temperature, precipitation, wind, and other weather patterns, including extreme weather events. Broadly speaking, the local projections are divided into two different 'scenarios': **active scenario** and **passive scenario**. The active scenario is modelled assuming that there is a significant decrease in global GHG emissions, while the passive scenario assumes a 'business-as-usual' approach with few decreases. Often, though not always, greater changes in climate are projected for the passive scenario. Given the current state of global climate negotiations, the passive scenario remains the more likely at this stage.

PASSIVE **ACTIVE**

Both scenarios highlight a similar evolution for most of the climate indicators described below. This is due to the slow response time of the climate system to GHG emissions. However, as climate change continues, scenarios differ from around the year 2050 onwards, highlighting the importance of implementing rapid and efficient adaptation measures and detailed planning processes. Future climate conditions have been projected for two timelines: the 2050s and 2080s to represent planning horizons into the near and far future.

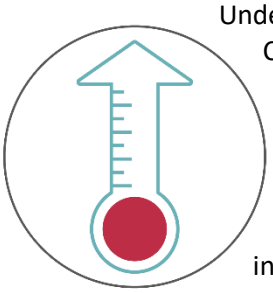
Under both scenarios, the City of Coquitlam is projected to experience an increase in average temperature and a change in the distribution of precipitation patterns, with more rain (or snow) falling during the winter, spring, and fall seasons, and a decrease during summer. Extreme events such as heat waves, days with very heavy and prolonged precipitation (i.e. very rainy/snowy days) and flood events are likely to occur more frequently and often to be more severe.

WEATHER OR CLIMATE?

Weather refers to the short-term changes in the atmosphere while *climate* describes long-term trends in weather. For example, when someone says, "It is cold today", they are referring to weather, but if they say, "Coquitlam has warm winters", they are referring to climate.

2019 Flooding Over Cedar Drive

4.1 TEMPERATURE



Under both active and passive scenarios, temperatures in Coquitlam are projected to increase. By 2050, under a passive scenario, the City could see a mean increase of 1.8°C, with that number rising to 3.5°C by the 2080s. This trend is most prevalent in the summer, which is projected to see an increase in mean temperature of 4.2°C by 2080s, though an increase in all seasons is expected. The hottest day of the year, currently averaged at 29.5°C (usually in August), may increase by as much as 2.2°C by 2050 and 4.9°C by 2080.

Projections also show increases in variables related to temperature such as **cooling-degree-days**, **hottest day**, **icing days**, and **freeze-thaw cycles** with decreases **in heating-degree-days** and **snow-based precipitation**. Increased temperatures may have chain reaction effects such as earlier and more severe snowmelts, migration of pest species northward, and shifts in local flora and fauna.

Table 1 Temperature Climate Data for Coquitlam

Climate Change Variable	Today	2050s		2080s	
		CO_2	CO_2	CO_2	CO_2
Mean temperature	10.6°C	+1.4°C	+ 1.8°C	+2.6	+3.5
Hottest day of the year	29.5°C	+1.9°C	+2.2°C	+3.3°C	+4.9°C
Mean summer temperature	15.4°C	1.8°C	+2.1°C	2.8°C	+4.2°C
Cooling-degree-days	71 days (low lands) 42 (NE[2] sector)	x2 more	x3 more	x3 more	x5 more
Icing days (below 0°C)	3.2 days (low lands) 29 (NE sector)	x2 less	x2 less	x2 less	x3 less
Heating degree-days	4,170 days	-12%	-15%	-20%	-30%
Freeze-thaw cycles	17 (low lands) 68 (NE sector)	x2 less	x2 less	x4 less	x4 less

Cooling-degree-days: The total number of degrees (averaged per day) that are over 18°C in a year. This is a measure of how much energy will be required to cool down a building. The more cooling degree-days there are, the more energy is needed. For example, if the temperature on Monday is 22°C, that will increase the number of cooling degree-days by 3.

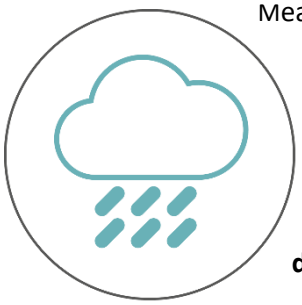
Heating-degree-days: The total number of degrees (average per day) that are under 18°C in a year. This is a measure of how much heating energy will be required to warm a building. The more heating-degree days there are, the more energy is needed. For example, if the average temperature on Tuesday is 17°C, that will increase the number of heating-degree days by 1.

Icing days: The number of days that the temperature does not rise above freezing. This is a good measure of the severity of a winter season.

Freeze-thaw cycles: The process of water freezing and thawing multiple times during a winter season. This is a problem when water slips into a material, such as a pipe or a road, and then freezes and expands, causing cracking. A frustrating example are potholes, which expand during the winter due to this effect.

[2] NE= Northeastern

4.2 PRECIPITATION



Mean precipitation in Coquitlam is projected to increase under both active and passive scenarios towards 2050 and 2080, with the greatest mean increase around +6% in the passive scenario. In general, precipitation patterns show a wider variability than temperature. Fall, winter, and spring show projected increases by 2080. Summer, however, is projected to see a significant decrease in precipitation, ranging from -6% in 2050 to -10% in 2080, under the passive scenario. Annually, there is a projected increase of five extra **very rainy days** and an increase in **max 1-day precipitation** of +14% by 2080.

Table 2 Precipitation Climate Data for Coquitlam

Climate Change Variable	Today	2050s		2080s	
		CO_2	CO_2	CO_2	CO_2
Mean precipitation*	1740mm	+4%	+2%	+5%	+6%
Mean summer precipitation*	201mm	-8%	-6%	-12%	-10%
Mean winter precipitation*	666mm	+5%	+5%	+5%	+12%
Very rainy/snowy days (>20mm)	35 days	+2 days	+2 days	+4 days	+5 days
Max 1-day precipitation*	62mm	+7%	+7%	+9%	+14%

*Precipitation refers to hail, rain, sleet and snow.

4.3 SEA LEVEL RISE

Melting polar ice caps and thermal expansion of water caused by increased global temperatures are projected to increase sea level by 30 cm by 2050, and 80 cm by 2080, under a passive scenario. Some studies also project an increase of at least 1 m by the end of the century. This may lead to flooding of coastal land, property, roads, and water and energy systems, since sea level rise is likely to reach locations like Coquitlam that are upstream on the Fraser river.

4.4 STORM EVENTS

The changes in precipitation patterns will lead to extreme rain/snow events that are more intense and more frequent. Under a passive scenario, the number of very rainy/snowy days is projected to increase from 35 to 40 per year, contributing to increased risk of river and creek flooding which is likely to overwhelm the current storm water systems and cause damage to property, infrastructure and the environment.

Although projections for snow exhibit a strong decrease by the end of the century, major storms are very likely to continue occurring, with a slight increase in frequency and intensity in the coming decades. This poses a threat to Coquitlam's Northeastern population which is located at a higher elevation and may be more isolated from services and transit, as well as to the City, which may require increased maintenance efforts and budget.

5. METHODOLOGY

This Plan's approach to conduct the exposure and risk assessment of the City's assets aligns with the ISO 31000 Risk Management Standard, an international standard that provides guidelines on managing risks faced by organizations. To establish the context, climate change trends and climate risk events were identified; for each climate risk event, key impacts were identified and analyzed to assess their likelihood of occurrence and their severity. Each impact's level of risk was then calculated. Finally, we've identified a set of actions to help adapt to the risks, aligned with the City's Strategic Goals.

5.1 HIGH-LEVEL CLIMATE EXPOSURE ASSESSMENT

Given the climate conditions the City of Coquitlam is experiencing (and will experience in the coming decades), seven climate risk events have been identified as representative of the main challenges that the City will face in a future with climate change. The seven climate risk events were reviewed and refined with City representatives to highlight key sectors and activities to consider in order to prepare for future climate challenges. The climate risk events in this Plan are **Droughts**, **Wildfires**, **Heat Waves**, **Seasonal Water Shortages**, **Coastal Flooding, Inland Flooding**, and **Storm Events**.

The likelihood of each climate risk event occurring in the future (2050- and 2080-time horizons) was assessed through the analysis of regional climate projections and scientific literature[3]. The likelihood is the probability score of the climate risk event (ranked "Very Low" to "Very High"). Each probability score is defined in Appendix D (Matrices); see Figure 3 for likelihood, severity and risk definitions.

5.2 LIKELIHOOD OF SPECIFIC IMPACTS

Each climate risk event is likely to affect the City's assets, services and/or population in a specific way. Key impacts identified for each climate risk event are representative of how the City will be exposed.

Impacts have been defined and confirmed through interviews with representatives of several City departments (Engineering and Public Works, Parks, Recreation and Culture, Planning and Development, Civic Lands and Facilities, and Fire and Rescue). The likelihood of key impacts occurring is linked to the likelihood of the corresponding climate risk event, and the vulnerability of the exposed service.

Vulnerability refers to the likelihood of a given service to suffer from a specific impact. It is a function of its sensitivity to the climate risk event and its capacity to adapt to impacts with a minimum cost.

Vulnerability is the degree to which a service is able or unable to cope with an impact.

Sensitivity is the degree to which a service is affected by an impact.

Adaptive capacity is the collection of forces that influence the ability of a service to adapt to an impact.

[3] Refer to Appendix B for detailed of referenced resources.

The likelihood of an impact is the combination of the likelihood of the climate risk event occurring and the service vulnerability (Figure 1).

The vulnerability assessment and the scoring of each impact's likelihood have been conducted in collaboration with City representatives.

Figure 1 Determinants of likelihood of impacts

Given the sensitivity and adaptive capacity, vulnerability is ranked as seen in Figure 2. Ideally, an impact would have a low **sensitivity** (the system is not very sensitive to climate) and a high **adaptive capacity** (the system has a high ability to adapt to those conditions). That would indicate the system had a low vulnerability to climate and was less likely to be at risk.

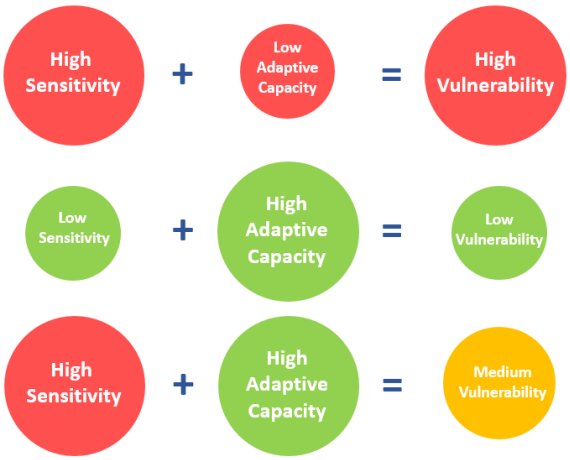


Figure 2 Vulnerability ranking

5.3 SEVERITY OF SPECIFIC IMPACTS

Following the likelihood assessment of impacts, the second step of the climate risk assessment is to evaluate severity. The City of Coquitlam considered how the impacts would affect three main components:

- **People** – includes health and safety issues, social aspects, reputation, quality of service, and governance;
- **Economy** – includes cost of restoration, potential for litigation, and the economy; and
- **Environment** – focuses on physical harms to surrounding ecosystems.

The severity of each impact was assessed using a scale from "Very Low" to "Very High". Factors are detailed in Appendix D (Matrix 2). The global severity score is represented by the greatest score assessed among the three components, using a precautionary approach.

5.4 RISK ASSESSMENT

Risk is the product of likelihood and the severity of impact. **Likelihood** is the probability of the projected impact occurring whilst **Severity** is the estimated effects of an impact (Figure 3).

Figure 3 Definition of Risk

Severity and likelihood are combined to obtain a risk rating on the following scale:

		Likelihood of Impact				
		Very Low	*Low*	*Moderate*	*High*	*Very High*
Severity of Impact	*Very Low*	Low	Low	Low	Moderate	Moderate
	Low	Low	Low	Moderate	Moderate	Moderate
	Moderate	Low	Moderate	Moderate	Moderate	High
	High	Moderate	Moderate	Moderate	High	High
	Very High	Moderate	Moderate	High	High	High

5.5 EVALUATION OF ADAPTATION OPTIONS

Interviews and discussions were held with City staff across various departments to identify the main concerns regarding climate risks and the actions already undertaken by the different departments. These interviews informed a gap analysis which defined a list of actions to reduce risks from the main impacts. Actions were considered based on a review of previous literature, professional knowledge and judgement, and in consultation with City staff.

A timeline, implementation method, and responsible party have been identified for the implementation of each action in collaboration with City representatives. See Section 7 for further details.

6. CLIMATE RISK EVENTS

6.1 WHAT IS A CLIMATE RISK EVENT?

Temperature and precipitation are **climate parameters** and are measurable properties that influence the climate system.

Climate risk events are potentially hazardous atmospheric phenomena. For example, precipitation is not in itself necessarily harmful, but a flood is. The main climate impacts considered in the development of this Plan are shown below.

The image to the right is of the water levels during the historic 1948 Coquitlam flood, when several dikes failed due to the unusual combination of warm weather and heavy snowpack.

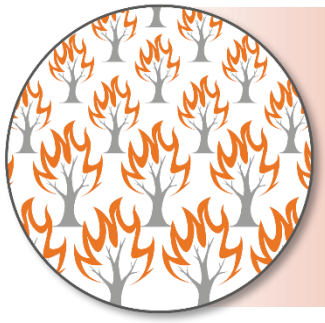
Historic 1948 Flood, TriCity News

6.2 CLIMATE RISK EVENTS

The City of Coquitlam's seven climate risk events are described below.

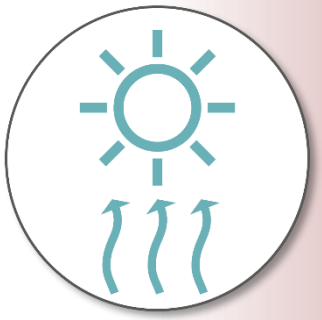
DROUGHTS

The changes in precipitation patterns will cause a moderate increase in winter precipitation, and a decrease in summer precipitation. Long periods without precipitation are likely in summer. The effect of climate change will be a lengthening of these dry summer periods. In the recent past, the longest average dry period has been 21 days. By the end of the century, dry periods may last 29 days if no adaptation measures are implemented. This, coupled with a reduction of winter snow pack, will lead to new challenges for the City's water supply and may have regional impacts on food supply.



WILDFIRES

Increased summer temperatures and drought conditions are very likely to exacerbate the impacts of wildfires; their occurrence may double by the end of the century. Croplands will be more exposed and interactions between wildfires and urban infrastructure will increase, especially in the City's newly-developed North East section.



HEAT WAVES

Global temperature rise will cause a major increase in the frequency, duration and intensity of heat waves affecting Coquitlam. Rare heat wave events will become common, with the hottest day of the year reaching 35°C on average by the end of the century. This will expose the most vulnerable populations to health issues, strain health systems, increase water and energy consumption, and may pose a threat to the normal infrastructure operations, such as overheating of mechanical components.

DRINKING WATER SHORTAGES

Summer drought conditions coupled with a massive reduction of local mountain snowpack in winter and spring will affect drinking water quality and availability. Snowpack is the main source of drinking water for Metro Vancouver. By the end of the century, the snowpack will have reduced by 84%, and dry periods will last for more than four weeks (compared to the current three weeks). The City may have to work with Metro Vancouver on alternative drinking water sources and explore opportunities to develop local drinking water sources such as groundwater wells.

COASTAL FLOODING

With rising temperatures and changes in precipitation regimes, sea level will rise by 30 cm by 2050. By the end of the century, this rise may reach 80 cm, but can be maintained at 50 cm if adaptation measures are implemented. Rising sea levels endanger coastal lands, properties, roads, and water and energy systems, since sea level rise is likely to reach locations that are upstream on the Fraser river.

INLAND FLOODING

The changes in precipitation patterns will lead to extreme rain/snow events that are more intense and more frequent. Under the passive scenario, the number of very rainy/snowy days will increase from 35 to 41 per year. The risk of river and creek flooding is likely to increase, overwhelming existing stormwater systems, and causing damage to property, infrastructure and the environment.

STORM EVENTS

Although projections for snow exhibit a strong decrease by the end of the century, the number of and frequency of major storms are likely to increase. This poses a threat to Coquitlam's Northeastern population which may be isolated from services and transit, and to the City which may require increased maintenance efforts and budget.

7. CLIMATE ADAPTATION STRATEGIC PLAN

Having identified the most significant climate change risks that the City of Coquitlam will experience, we must act to reduce the impacts on our people, the economy, and the environment. This Plan has been developed using a set of guiding principles and with a specific scope in mind, including time limits, geographic scale and jurisdiction. Our priority actions support the City's vision of a vibrant community where people choose to live, learn, work and play. Actions are high-level strategies organized by climate risk events and will guide the development of implementation plans.

7.1 PRINCIPLES

- **Adaptation and Resilience.** The Plan is focused on creating an adaptive and resilient City that can survive and thrive in future conditions, regardless of what the future might bring.
- **Equity.** The City has presented actions that consider potential impacts to vulnerable populations from future climate conditions.
- **Educating on Citizen Action.** The Plan considers the people of Coquitlam to be an integral part of adapting to a changing climate.

7.2 SCOPE

- **Time.** The climate parameters used have been projected to the 2080s to support long-term planning. Adaptation actions are presented in the short (<5 years), medium (5-15 years) and long term (>15 years) to correspond with typical planning cycles. It is recommended that this Plan be updated every 5 years to coincide with Coquitlam planning updates.
- **Geography.** Coquitlam's diverse geography includes rivers, forests, mountains, and rural areas which have all been considered at a high level within this assessment.
- **Jurisdiction.** The City recognizes that there are some aspects of daily life that are out of its control, such as the drinking water supply, which is a Metro Vancouver responsibility. Where this is the case, collaborative actions have been identified with required bodies.

For each climate risk event, the City has identified climate impacts relevant for their assets, infrastructure and population. Risk levels have been identified for the 2080-time horizon, and follow the color code to the right:

High (A)

Moderate (B)

Low (C)

DROUGHTS

During its driest season, Coquitlam currently sees on average 21 consecutive days with less than 1 mm of precipitation. Under a passive scenario, that number is projected to increase to 26 days by the 2050s and 29 days by the 2080s. In addition to depleting water sources and placing strain on agricultural production, long periods of drought increase the risk of forest fires by drying out local vegetation, therefore providing a source of flammable material. During periods of drought the City currently enforces drinking water use restrictions and regulations relative to the risk level[4]. Increased drought periods in the future may require tighter regulation and monitoring to ensure a stable, sustainable, and adequate source of drinking water in the future.

Impact		Risk Level	Action Needed	Timeline	Implement Mode	Lead Department for Action
1	Wildlife habitat loss and ecosystem degradation	B	Build compact communities to reduce sprawl and environmental impacts	Short	Part of day-to-day business	**Planning & Development**
2			Continue requirement of rainwater management measures for all new development to protect the health of watersheds (e.g. capture and control urban runoff to mimic the natural hydrology of the watershed)	Short	Part of day-to-day business	**Engineering & Public Works**, Planning & Development, Parks, Recreation & Culture, and Civic Lands & Facilities
3			Monitor the health of natural ecosystems (e.g. stream flows, stream water quality, urban tree canopy)	Short to Medium	Part of day-to-day business	**Engineering & Public Works** and Parks, Recreation & Culture
4			Assess the health of natural ecosystems and impacts from changing climate and take corrective restorative actions as needed (e.g. lower effective	Short to Medium	Part of day-to-day business	**Parks, Recreation & Culture** and Engineering & Public Works

[4] Read more about water conservation on the City's website: https://www.coquitlam.ca

			impervious cover in urban watersheds and replace climate-sensitive trees in parks)			
5	Stress on drinking water supply and distribution system from higher peak demands	B	Enhance drinking water conservation measures	Short	Project	**Engineering & Public Works**
6			Improve supply in collaboration with Metro Vancouver	Medium	Part of day-to-day business	**Engineering & Public Works**
7	Impact on food supply	B	Promote onsite (tower/podium) and offsite (in parks) community and home gardens	Short to Medium	Project	**Parks, Recreation & Culture**

WILDFIRES

Since 1919, nearly 21,000 km^2 of forested land has been burned in Coquitlam due to wildfires. Urbanization and improvements in fire-fighting technology have greatly reduced this value, with no reported large forest fires occurring in the past few decades. However, growing development in the forested north eastern part of the City coupled with a projected doubling of forest fires in this region by 2080 indicates that increased wildfires may become a risk.

Impact		Risk Level	Action Needed	Timeline	Implement Mode	Lead Department for Action
1	Air quality concerns	A	Plan and implement clean air shelters to protect vulnerable communities from reduced air quality	Short	Project	**Civic Land & Facilities** and Parks, Recreation & Culture
2	Wildfire and interface fire damages to properties	A	Plan and implement emergency response for interface fires	Short	Part of day-to-day business	**Fire & Rescue and Emergency Management**
3			Promote the use of fire-resistant building materials for construction of residential housing in fire prone areas	Short	Part of day-to-day business	**Planning & Development** and Fire & Rescue
4			Collaborate closely with the insurance sector	Medium to Long	Part of day-to-day business or Project	**Legal and Risk Management**
5	Properties more exposed to forest interface wildfires	B	Explore the possibility creating a buffer zone to limit the expansion of wildfires	Short to medium	Part of day-to-day business	**Planning & Development** and Fire & Rescue
6	Loss of forest ecosystems and tree canopy	B	Work with relevant authorities to explore forest management practices to reduce risk of forest fire (e.g. selective tree harvest to reduce fuel)	Medium	Part of day-to-day business	**Parks, Recreation & Culture**

HEAT WAVES

An increase in both average and extreme summer temperatures is projected to increase the amount and duration of heat waves in Coquitlam. Heat waves often impact the most vulnerable members of society including the elderly, young children, those with pre-existing medical conditions, the homeless, and those of a lower socio-economic standing. Continuous extended heat increases an individual's risk of heat stress, heat stroke, dehydration, and death as well as the need for a cooling environment.

Impact		Risk Level	Action Needed	Timeline	Implement Mode	Lead Department for Action
1	Health risks (due to reduced air quality and extreme heat)	A	Work with Fraser Health Authority and Metro Vancouver on educating the public on health risks related to climate change (e.g. heat waves and poor air quality)	Short to Medium	Project	**Emergency Management** and Corporate Communications
2			Explore measures to protect vulnerable communities from heat waves (e.g. cooling stations and/or shelters)	Medium	Project	**Civic Lands & Facilities** and Parks, Recreation & Culture
3			Introduce policies to reduce the urban heat island effect (e.g. enhance urban tree canopy)	Short	Part of day-to-day business	**Parks, Recreation & Culture** and Planning & Development
4	Increased occupational health costs and construction delays	A	Develop measures so that City staff follow health recommendations regarding access to water, appropriate clothing, and taking sufficient breaks in shaded areas	Short	Part of day-to-day business	**Human Resources**
5	Increased energy requirements for cooling	B	Strengthen building bylaws to improve resiliency to climate change (e.g. energy efficiency and building durability)	Medium	Part of day-to-day business	**Planning & Development**

	Impact	Risk Level	Action Needed	Timeline	Implement Mode	Lead Department for Action
6	Damage to transportation infrastructure	B	Incorporate climate change considerations into design criteria, lifecycle planning and maintenance of transportation infrastructure	Medium	Part of day-to-day business	**Engineering & Public Works**

DRINKING WATER SHORTAGES

The City's drinking water sources are the Capilano, Seymour, and Coquitlam watersheds, which are susceptible to increased temperatures and decreased precipitation. Projections indicate that by the year 2050, under a passive scenario, the current mountain snowpack will decrease by 54%, and up to 84% by 2080. The City currently enforces drinking water use restrictions and regulations during the summer months, and encourages citizens to reduce their water use through the promotion of water conservation tools and programs, such as rain barrels and water wise kits.

Impact		Risk Level	Action Needed	Timeline	Implement Mode	Lead Department for Action
1	Impact on drinking water supply	A	In collaboration with Metro Vancouver, develop new regional drinking water supply sources when required	Long	Metro Vancouver	**Engineering & Public Works**
2			Explore local sources of drinking water (e.g. groundwater wells)	Long	Project	**Engineering & Public Works**
3			Promote drinking water conservation options (e.g. reducing lawn irrigation, efficient and less water-dependent appliances, enhancing leak detection and repair)	Short	Part of day-to-day business	**Engineering & Public Works**
4			Monitor the regulatory use of greywater in new housing developments, industrial and civic facilities	Medium	Part of day-to-day business	**Planning & Development**
5	Demand on agriculture irrigation greater than supply	B	Promote the purchase and the production of local produce (e.g. support local businesses)	Short to Medium	Part of day-to-day business	**Planning & Development**
6			Encourage and provide information on crop alternatives with lower irrigation requirements to home gardeners	Medium	Part of day-to-day business	**Planning & Development** and Engineering & Public Works

COASTAL FLOODING

Sea level is projected to increase globally by 30 cm by 2050 and 80 cm by 2080, with some models showing a rise of at least 1 m by the end of the century. While Coquitlam is not directly on the coast, it is located directly above the Fraser River, which will be impacted by rising sea levels as well as changes in freshet melt. A study conducted for the Lower Mainland estimated that the flood scenarios for the year 2100 could result in losses estimated from $24.7 to $32.7 billion, and property impacts would include health care facilities on Riverview lands in Coquitlam[5].

Impact		Risk Level	Action Needed	Timeline	Implement Mode	Lead Department for Action
1	Increased flooding of property along the Fraser river	A	Develop flood protection plans and capital works to reflect sea level rise (e.g. dikes, raising flood construction levels and impacts to agricultural crops)	Short	Project	**Engineering & Public Works**
2	Loss of land directly due to sea level rise	B	Explore long range strategies to manage land use in coastal floodplains in partnership with Fraser Basin Council, Province of BC, and Metro Vancouver municipalities	Long	Project in partnership with FBC	**Planning & Development**
3			Prioritize the protection of areas adjacent to the rivers by increasing no-build setbacks and flood construction levels	Medium	Part of day-to-day business	**Planning & Development**
4	Increased salinity of irrigation water and soils near the riverside	B	Promote irrigation with rainwater (reduction in irrigation with drinking water)	Medium	Part of day-to-day business	**Engineering & Public Works**

[5] Read more about the 2016 Lower Mainland Flood Management Strategy here: https://www.fraserbasin.bc.ca/_Library/Water_Flood_Strategy/FBC_LMFMS_Phase_1_Report_Web_May_2016.pdf

INLAND FLOODING

Projected increases in the intensity of precipitation, the amount of precipitation, and shifts in seasonal temperature and snow melt will result in increased frequency of inland flooding. In addition to posing a health and safety risk and disrupting daily services, flooding is one of the most significant costs associated with climate change. Basement flooding is typically the worst culprit, according to a 2019 study by the University of Waterloo using data from the Insurance Bureau of Canada[6].

Impact		Risk Level	Action Needed	Timeline	Implement Mode	Lead Department for Action
1	Property flooding from higher rainfall runoff	A	Assess and upgrade sewer system capacities (storm and sanitary), including green infrastructure	Short to Medium	Part of day-to-day business	**Engineering & Public Works**
2			Revise sewer system (including green infrastructure) design criteria to include allowance for climate change factors (e.g. utilizing intensity-duration-frequency curves based on projected climate data)	Short	Part of day-to-day business	**Engineering & Public Works**
3	Flooding of transportation routes including roads and pedestrian routes (e.g. trails and sidewalks)	B	Develop route contingency plans for high-risk areas, long term flood-retrofit plans for major routes, and citizen communication plans	Short to Long	Part of day-to-day business and project	**Engineering & Public Works** and Parks, Recreation & Culture
4	Coquitlam dam breach	B	Review and update emergency response with coordination between the Province and BC Hydro	Short to Medium	Project	**Emergency Management**

[6] Read more here: https://www.insurancebusinessmag.com/ca/news/flood/report-basement-flooding-is-the-top-climate-change-cost-in-canada-165200.aspx

5	Flooding from Fraser River freshet	B	Review and update emergency response and protection plans.	Short to Medium	Project	**Emergency Management**
6			Establish land use criteria in flood prone areas	Short to Medium	Part of day-to-day business	**Planning & Development**
7	Habitat loss and ecosystem degradation from higher runoff and stream flows	B	Monitor the health of natural ecosystems	Short to Medium	Part of day-to-day business	**Engineering & Public Works**
8			Assess the health of natural ecosystems and impacts from changing climate and take corrective restorative actions as needed (e.g. replace climate-sensitive trees in parks)	Short to Medium	Part of day-to-day business	**Parks, Recreation & Culture**
9	Increased risk of landslides	B	Strengthen policy regarding the development on steep slopes to account for future climate change	Medium	Part of day-to-day business	**Engineering & Public Works** and Planning & Development
10	Impact on outdoor recreation/ community events	C	Plan/schedule events around inclement weather	Short to Medium	Part of day-to-day business	**Parks, Recreation & Culture**
11			Review indoor event capacity	Short to Medium	Part of day-to-day business	**Civic Land & Facilities** and Parks, Recreation & Culture

STORM EVENTS

Globally and locally, storms are projected to increase in both frequency and intensity by the end of the century, with a projected increase in the intensity and amount of precipitation. Increased storms pose risks to operations and human health and safety through flooding, potential power loss, high winds, poor visibility and large amounts of snow.

Impact		Risk Level	Action Needed	Timeline	Implement Mode	Lead Department for Action
1	Increase in duration and frequency of power outages	A	Ensure availability of alternate power (e.g. generators) at all strategic civic facility locations	Short	Part of day-to-day business	**Civic Land & Facilities** and Parks, Recreation & Culture
2			In collaboration with BC Hydro, develop an emergency plan to manage response during the event, and prioritize response for business community	Short	BC Hydro	**Emergency Management** and Fire & Rescue
3			In collaboration with BC Hydro, develop an emergency management plan for prolonged community wide power outages	Short	BC Hydro	**Emergency Management**
4	Impact of abnormal snowstorm	B	Review and update plan for road safety impacts due to challenges in material and resources (e.g. salt for road de-icing)	Short to Medium	Part of day-to-day business	**Engineering & Public Works**
5			Consider expanding feasible public works services from satellite works yard in Northeast Coquitlam	Medium	Project	**Engineering & Public Works** and Parks, Recreation & Culture

6	Adapted buildings for changing snow loads and wind speed	B	Explore retrofit options of existing City buildings and construction of new buildings following the National Building Code	Short	Project	**Civic Lands & Facilities**
7	Increase in the number of safety incidents due to debris from storm events	B	Raise awareness for the danger of outdoor activity during massive storm events to increase preparedness	Short to Medium	Part of day-to-day business	**Corporate Communications**
8			Ensure that debris is removed as soon at storm completion	Short	Part of day-to-day business	**Engineering & Public Works** and Parks, Recreation & Culture
9	Disruption of transportation services	C	Work closely with the public transit and private mobility companies to facilitate the transportation of City residents.	Medium	Part of day-to-day business	**Engineering & Public Works**
10	Damage to transportation infrastructure	B	Incorporate climate change considerations into design criteria, lifecycle planning and maintenance of transportation infrastructure	Medium	Part of day-to-day business	**Engineering & Public Works**

8. HOW WILL WE MEASURE SUCCESS?

To understand how the City is making progress over time, we need to consider current and future actions, continually review assumptions and lessons learned along the way, and update the Plan as our knowledge improves.

The questions below will be helpful in gauging the Plan's success:

- Did we reduce climate change impacts to our planned level?
- Has the consideration of climate change been mainstreamed into everyday decision-making?
- Did actions increase the Plan's targeted adaptation capacity of infrastructure, social systems, and natural systems?
- Are the different stakeholders engaged in the Plan's implementation?

The success of adaptation actions is to be measured through performance evaluation. Some typical success indicators are given below:

Climate Risk Event	**What can be Measured?**
Droughts and Seasonal Drinking Water Shortage	Number of kilometres of pipes with detected and repaired leaks
Wildfires	Monitoring the replacement rate of park vegetation resources
	Number of homes with fire resistant materials in wildfire-prone areas
Heat Waves	Number of urban trees reducing heat island effect
Coastal and Inland Flooding	Number of kilometers of drainage pipes and ditches lacking capacity
Storm Events	Number of days taken to clean debris after storm events
Cross-Cutting	Existence of publicly-accessible and City-specific information on extreme weather events

APPENDIX A: GLOSSARY OF TERMS

Active Scenario (Representative Concentration Pathway or RCP4.5): A more committed scenario in which immediate action is taken to reduce global GHG emissions, with the aim of limiting the global temperature increase to approximately +2°C (above pre-industrial levels) and meeting the historic 2015 Paris Agreement. GHG emissions would continue to increase in the next few decades but would decrease from approximately 2030 onwards. Mitigation measures consist of, among other things, the implementation of new energy production technologies and innovations in geological carbon capture and storage that allow us to rapidly move to a low carbon economy.

Adaptation: The process of changing human decisions, activities, behaviours, and thinking to reduce or avoid the negative impacts of observed or expected climate change or take advantage of any benefits. Adaptation can range from changes to human behaviour, the natural environment, or the built environment.

Adaptive Capacity: A system's ability to adjust to climate change and avoid or reduce damages while taking advantage of opportunities.

Cooling-Degree-Days: The total number of degrees (averaged per day) that are over 18°C in a year. This is a measure of how much energy will be required to cool down a building. The more cooling degree-days there are, the more energy is needed.

Climate: Patterns of variability in atmospheric conditions in a given region over a long period of time, often decades or longer. This contrasts with *weather* which describes current atmospheric conditions (i.e. it's raining or windy).

Climate Change: Any significant long-term change in the expected patterns of average weather of a region over a significant time period.

Climate Impact: One of the consequences of a climate risk event on a service, an asset or a sector of the City.

Climate Parameter: A measurable property that influences the climate system. The main parameters are temperature, precipitation, wind and humidity.

Climate Risk Event: A potentially hazardous atmospheric phenomenon. A natural or human-induced physical climate event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources.

Drought: A climate risk event characterized by exceptionally dry and warm weather conditions. In most definitions, the severity of a drought is assessed by the number of consecutive days without precipitation.

Exposure: Presence of people, livelihoods, assets, services, resources or infrastructure in place in a specific region that could be adversely affected by climate change.

Freeze-Thaw Cycles: The process of water freezing and thawing multiple times during a winter season. This is a problem when water slips into a material, such as a pipe or a road, and then freezes and expands, causing cracking.

Freshet: A spring thaw resulting from snow and ice melt in rivers located in the upper part of North America.

Heating-Degree-Days: The total number of degrees (average per day) that are under 18°C in a year. This is a measure of how much heating energy will be required to warm a building. The more heating-degree days there are, the more energy is needed.

Heat Wave: A period of excessively hot weather, which may be accompanied by high humidity, especially in oceanic climate countries. While definitions vary, a heat wave is usually measured relative to the usual weather in the area and relative to normal temperatures for the season. In this Plan, a heat wave is considered as a period of at least 3 days reaching temperatures above 30°C.

Icing Days: The number of days that the temperature does not rise above freezing. This is a good measure of the severity of a winter season.

Likelihood: The state of a phenomenon being likely, namely its probability to occur. In this Plan, likelihood can be assessed for an impact or a climate risk event. Both definitions are linked through the vulnerability.

Max 1-Day Precipitation: The maximum amount of rain or snow that can be accumulated in a 24h-period once a year. This is an indicator of extreme precipitation and may be the cause of inland flooding.

Mitigation: Efforts to reduce the amount of greenhouse gas emissions in the atmosphere.

Passive Scenario (Representative Concentration Pathway or RCP8.5)**:** A passive or business-as-usual scenario in which there are no significant global efforts to reduce GHG emissions, and the world continues much as it does today. Under this scenario, the global temperature increase is projected to reach +4°C by the end of the century compared to the pre-industrial period, and to continue rising after 2100. The targets set in Paris in 2015 would not be reached, having major consequences on society, infrastructure and ecosystems both in Canada and worldwide.

Representative Concentration Pathway (RCP): A greenhouse gas concentration trajectory adopted by the Intergovernmental Panel on Climate Change (IPCC) for its Fifth Assessment Report (AR5) in 2014. Four pathways have been selected for climate modeling and research, which describe different climate futures, all of which are considered possible depending on how much greenhouse gases are emitted in the years to come.

Resilience: The ability of a system to absorb disturbances while maintaining the same basic structure and ways of functioning.

Risk: A measure of the expected outcome of an uncertain event, which is estimated by combining an event's likelihood and expected consequences or severity.

Risk Rating: The assessment of the level of risk through a pre-defined scale.

Scenario: A plausible representation of future climate that has been constructed for explicit use in investigating the potential impacts of climate change.

Sea Level Rise: Due to warmer temperatures, sea ice and glaciers are melting, and the water of the ocean swells by a phenomenon named “thermal expansion”. These two factors lead to an increase in sea level rise. Sea level rise is on of the major issues exacerbated by climate change.

Sensitivity: The degree to which a system is affected by climatic conditions or a specific climate change impact.

Sustainability: A notion that means meeting our own needs without compromising the ability of future generations to meet theirs. In addition to natural resources, social and economic resources are essential. Sustainability is not just environmentalism, but also social equity and economic development.

Very Rainy Days: A day when the precipitation amounts exceed 20 mm in 24 hours.

Vulnerability: The degree to which a service or an asset can cope with a given climate change impact. It is a function of its exposure, its sensitivity and its adaptive capacity.

Weather: The short term, day-to day conditions of the atmosphere.

APPENDIX B: LIST OF REFERENCES

The sources below were used in developing this Plan.

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APPENDIX C: RISK MATRICES

Matrix 1 Estimates for Likelihood of Events

Probability Range	1- Very Low	2- Low	3- Moderate	4- High	5- Very High
Significant Single Event	Not likely to occur in period	Likely to occur once between 30 and 50 years	Likely to occur once between 10 and 30 years	Likely to occur at least once a decade	Likely to occur once or more annually
Ongoing/ Cumulative Occurrence	Not likely to become critical/ beneficial in period	Likely to become critical/ beneficial in 30-50 years	Likely to become critical/ beneficial in 10-30 years	Likely to become critical/ beneficial in a decade	Will become critical/ beneficial in several years

Matrix 2 Assessment of the Severity of Consequences

Factor	**People**					**Environment**	**Financial**		
Degree	Health and Safety	Social	Reputation	Quality of Service	Governance	Physical	Cost of Restoration	Legal/Litigation	Economy
1- Very Low	First aid	No tangible impact on society	Localised temporary impact on public opinion	No tangible impact to services	No changes to management required	No adverse effects on natural environment. Localised to point source. No recovery required	Little financial loss or increase in operating expenses	No litigation and/or legal action	No effect on the broader economy
2- Low	Minor injury, medical treatment with/or restricted work.	Localised, temporary social impacts.	Localised, short term impact on public opinion.	Localized or temporary disruption to services.	General concern raised by regulators requiring response action.	Minimal effects on the natural environment. Localised within site boundaries. Recovery measurable within 1 month of impact.	Additional operational costs. Financial loss small, <10% of turnover.	Minimal individual legal action.	Minor effect on the broader economy due to disruption of service provided by the asset.
3 - Moderate	Serious injury or lost work.	Localised, long term social impacts.	Local, long term impact on public opinion with adverse local media coverage.	Localized long-term disruption to services.	Investigation by regulators Changes to management actions required.	Some damage to the environment including local ecosystems. Some remedial action may be required.	Moderate financial loss, 10-50% of turnover.	Multiple claims and/or litigations.	High impact on the local economy with some effect on the wider economy.

						Recovery in 1 year.			
4- High	Major or multiple injuries, permanent injury or disability.	Failure to protect poor or vulnerable groups. National, long term social impacts.	National, short term impact on public opinion; negative national media coverage.	Failure to provide services with long-term region-wide impacts.	Notices issued by regulators for corrective actions. Changes required in management. Senior management responsibility questionable.	Significant effect on the environment and local ecosystems. Remedial action likely to be required. Recovery longer than 1 year. Failure to comply with environmental regulations / consents.	Major financial loss, 50-90% of turnover.	Major litigation and/or legal action by multiple claimants.	Serious effect on the local economy spreading to the wider economy.
5- Very High	Single or multiple fatalities.	Loss of social license to operate. Community protests.	National, long term impact with potential to affect stability of Government.	Permanent disruption and/or termination of services.	Major policy shifts. Change to legislative requirements. Full change of management control.	Very significant loss to the environment. May include localised loss of species, habitats or ecosystems. Extensive remedial action essential to prevent further degradation. Restoration likely to be required. Recovery longer than 1 year. Limited prospect of full recovery.	Extreme financial loss >90% of turnover.	Class action legal action.	Major effect on the local, regional and state economies.

Coquitlam