State of Climate Adaptation

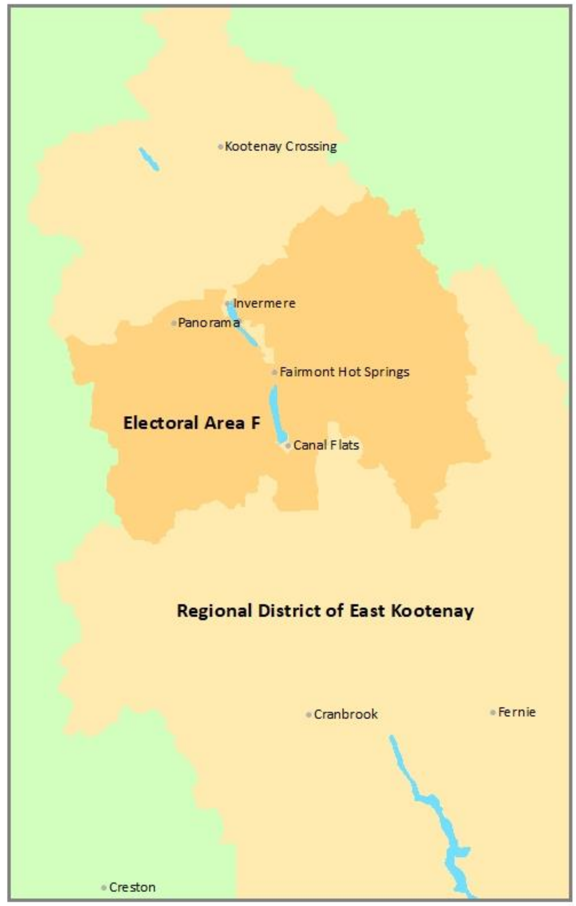
Regional District of East Kootenay Area F - 2017

CONTENTS

INTRODUCTION

Purpose

Welcome to the Regional District of East Kootenay Area F's 2017 baseline report for the State of Climate Adaptation and Resilience in the Basin (SoCARB) indicator suite. The SoCARB indicator suite measures community progress on climate adaptation across five climate impact pathways: extreme weather and emergency preparedness, wildfire, water supply, flooding and agriculture. SoCARB indicators were designed to provide data and insights relating to climate change, including local environmental impacts and community impacts (e.g., economic impacts), as well as information to help build adaptive capacity and track local actions.



This report summarizes the results of an analysis of SoCARB indicators for Area F, and has been prepared as part of a two-year Columbia Basin Rural Development Institute (RDI) pilot project to test and refine the SoCARB indicator suite in communities across the Columbia Basin-Boundary region.

Climate-related events like flooding, drought and higher temperatures can be critical events for communities. Flooding poses a risk to water infrastructure and contributes to turbidity in surface sources; drought has implications for water supply, local food production and increasing wildfire risk; higher temperatures can impact vulnerable populations, including the elderly, socially isolated, chronically ill and infants.

The information presented in this report is intended to highlight trends and impacts related to the local climate and surrounding environment, and to inform local planning and decision-making. This includes changes in indicators outside of the Regional District's jurisdiction such as glacier extent and wildfire starts, recognizing that a better understanding of trends associated with these indicators can help the community prepare for current and future changes. For other indicators, like per capita water consumption, local governments are better positioned to identify and track where their actions could increase community climate resilience.

Not all 58 SoCARB indicators are reported here. Indicators that Area F has not identified as a priority, as well as all indicators from SoCARB's Community Resilience Index (see page 2), have been excluded.

Report Highlights

- Area F's climate is changing, with data showing trends toward higher average annual and seasonal temperatures. There is also a trend toward higher spring precipitation and more extreme heat days. Trends for other climate variables (e.g., extreme precipitation) are not yet clear in the datasets from stations in and around Area F.
- Climate change is becoming evident through changes in environmental conditions. For example, the glaciers in Area F are becoming smaller, the spring snowpack is declining, and the amount of heat energy available for crop growth is on the rise. Several environmental impact indicators lack sufficient data to infer trends, suggesting important focal points for efforts to enhance climate adaptation monitoring, planning and action.
- The RDEK has taken important steps to adapt to changes that have already happened in Area F, and to prepare for future changes. These actions are primarily related to emergency preparedness (with a recently-updated emergency management plan), community water supply (with the introduction of multi-barrier treatment) and efforts to better understand the risk of debris flows in local creeks. Opportunities exist to further Area F's readiness to adapt, which include exploring additional opportunities to reduce interface fire risk, updating floodplain mapping, and promoting community-based efforts to adapt (e.g., through programs aimed at enhancing personal emergency preparedness and local food production).
- While some datasets are not lengthy or complete enough to evaluate trends in Area F's adaptation, the analyses conducted for this project provide a valuable baseline assessment against which future progress can be compared.

Methods

The State of Climate Adaptation and Resilience in the Basin indicator suite was developed in 2015 by a team of climate change professionals. The full suite groups indicators into two instruments:

1) A set of five thematic pathways (wildfire, water supply, agriculture, flooding, and extreme weather) that, through 58 indicators, measure climate change, climate change impacts, and climate change adaptation; and
2) a Community Resilience Index that uses an additional 20 indicators to provide insights on socio-economic conditions in the community that contribute to its capacity to adapt.

The Water Supply pathway (Figure 1) illustrates how SoCARB conceptualizes the relationships between categories of indicators. Climate changes have direct and indirect impacts on communities. Indirect impacts are experienced through environmental impacts. Impacts can be addressed through adaptation actions and capacity building, and the results of such efforts improve adaptation outcomes.

For this report, Regional District personnel identified 48 indicators that reflect local priorities. Community Resilience Index indicators were not assessed as part of this report; however, most are addressed in the RDI's annual State of the Basin reports. This report includes an introductory Climate section, which presents climate change indicators common to all five pathways, followed by pathway-specific sections following the same structure as Figure 1.

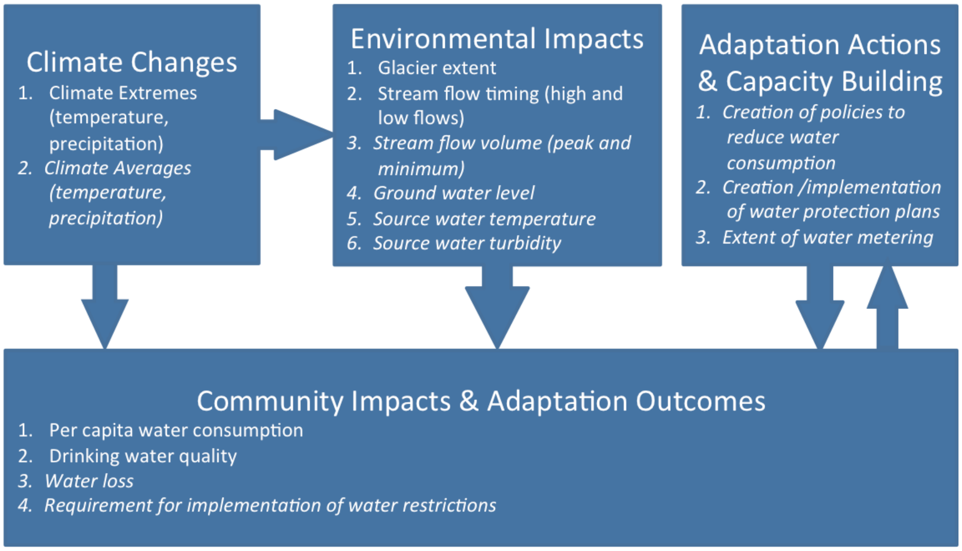


Figure 1: Water Supply pathway from the SoCARB indicator suite

This report is accompanied by full datasets along with detailed information related to the data source, analysis method, and reporting for every indicator in this report. These files allow for more detailed analysis of indicators of interest and support ongoing tracking of climate adaptation progress.

Notes to the Reader

The indicators and their related data sets range from simple to complex. Additional detail on any of the datasets or analytical methods is available from the RDI (cbrdi@selkirk.ca). Understanding the data and its limitations is important for many reasons. The points below are general notes to keep in mind while reviewing the report.

- **Climate trends are complex**. It is difficult to look at climate trends over the short or medium term because there are other factors beyond climate change that can influence trends. Basin climate experts were consulted when analysing and interpreting data for this report.
- **Use of proxy data**. For some indicators, there is no local data source. Where feasible and appropriate, proxy (or stand-in) data sources were used. For example, the closest long-term Environment Canada weather stations to Area F are in Cranbrook and Golden. For this reason, climate data have been modeled for Fairmont Hot Springs, a central community in Area F. More details are provided in the body of the report.
- **Confounding factors**. An indicator can be influenced by several factors, making it difficult to distinguish the cause of a change. For example, trends in water consumption may be influenced by water conservation initiatives, but other factors (e.g., anomalous weather) should also be considered.
- **No obvious trend**. Some data may show no obvious trend. However, this data still has value as i) a trend may eventually emerge, and ii) the information can still help inform decision making.

CLIMATE

Four climate change indicators are common to most pathways: climate averages and extremes for both temperature and precipitation. They are presented first since changes in temperature and precipitation are key drivers of both environmental and community impacts. These indicators all use two datasets—both of which are discussed for comparative purposes. Adjusted and Homogenized Canadian Climate Data (AHCCD) from Environment Canada provides long-term (since the early 1900s) observed data for Cranbrook and Golden. ERA-Interim Reanalysis data from the European Centre for Medium-Range Weather Forecasts provides shorter-term (since 1979) modeled data for Fairmont Hot Springs[i]. To provide regional context, results of a composite analysis of average temperature and precipitation from AHCCD data available for four stations in the Central Canadian Columbia Basin are also discussed[ii].

The Overall Picture

Both annual and seasonal average temperatures are rising in Area F, with winter warming at a faster rate than other seasons. This could have negative implications for snow-related tourism, local ecosystems and infrastructure. Annual precipitation is also increasing, but the trend is not consistent across seasons. The trend toward higher average precipitation in the spring could have implications for flood risk, erosion and debris slides. While other climate change studies have predicted more extreme precipitation and temperature trends for the Columbia Basin, those trends are not clearly apparent in historical data for Area F.

Average annual and seasonal temperatures are increasing

Various analyses of climate data for Area F show increasing temperatures over time. Annually, the Fairmont, Golden, Cranbrook and Central Columbia Basin datasets all show statistically significant (reliable) increasing trends ranging in magnitude from 1.4 to 3.0 degrees Celsius per century (Table 1, Figure 2). Modeled data show that Fairmont temperatures have averaged 5.2°C since 1979 and ranged from a low of 3.6 degrees in 1996 to a high of 6.5 degrees in 1998. Average seasonal temperatures have also generally increased in Golden, Cranbrook and the Central Basin. Winter temperatures have increased at the highest rate, with trends calculated at 3.2, 2.5 and 2.6 degrees per century, respectively, from these datasets (Table 1).

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[i] Data and analyses were provided by Charles Cuell and Climate Resilience Consulting. It is important to note that modeled trends based on the ERA-Interim dataset encompass only 37 years of data. Relatively speaking, this is a short record for climate trends. Short climate records are vulnerable to inordinate influence by natural fluctuations ("oscillations") in the climate cycle. For this reason, trends based on ERA-Interim data should be viewed and used with consideration of these limitations.

[ii] This analysis was provided by Dr. Mel Reasoner and Columbia Basin Trust

	Annual	Winter	Spring	Summer	Fall
Fairmont (since 1979)	3.0ºC/century	not available			
Golden (since 1902)	1.9	3.2	1.5	2.1	*0.6*
Cranbrook (since 1909)	1.8	2.5	1.6	1.8	1.1
Central Columbia Basin (since 1915)	1.4	2.6	not available	1.0	not available

Table 1: Annual and seasonal average temperature trends for Fairmont, Golden, Cranbrook and the Central Columbia Basin, in degrees Celsius per century. Results that are not statistically significant (reliable) are in italics.

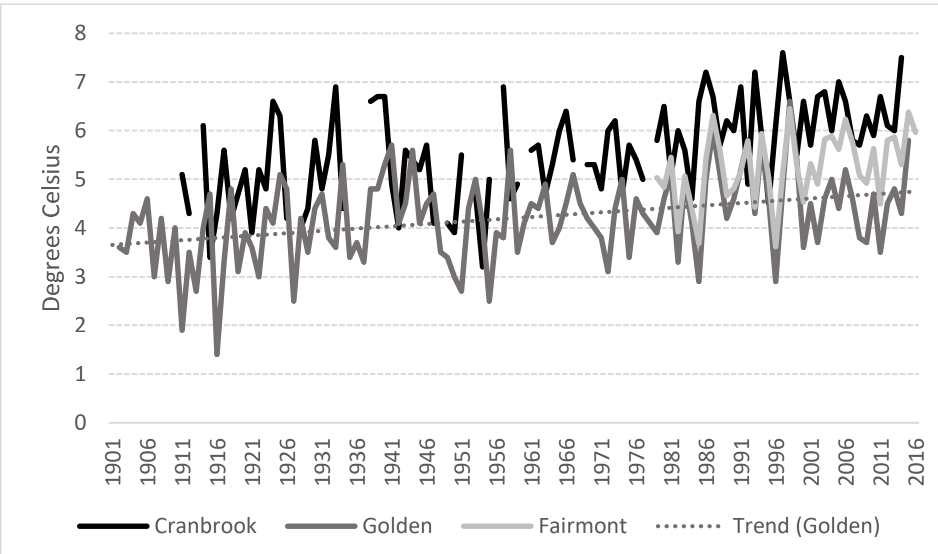

Figure 2: Average annual temperature for Cranbrook, Golden, and Fairmont

Precipitation trends vary with the seasons

Trends for average precipitation in Area F are not as clear as those for average temperature (Figure 3, Table 2). Annually, modeled precipitation data for Fairmont show that total precipitation ranged between 259 and 499 mm per year from 1979 to 2016 and averaged 361 mm. While this dataset shows a slight increasing trend, it is not statistically significant. Trends for the Cranbrook and Central Basin datasets are statistically significant and show total annual precipitation increasing at rates of 130 and 17 mm per century, respectively.

	Annual	Winter	Spring	Summer	Fall
Fairmont (since 1979)	*4 mm/century*	not available			
Golden (since 1908)	*50*	*-11*	29	35	23
Cranbrook (since 1901)	130	*-15*	60	43	*21*
Central Columbia Basin (since 1915)	17	-156	31	-91	63

Table 2: Annual and seasonal total precipitation trends for Fairmont, Golden, Kootenay National Park West Gate, Cranbrook and the Central Columbia Basin, in millimetres per century. Results that are not statistically significant (reliable) are in italics.

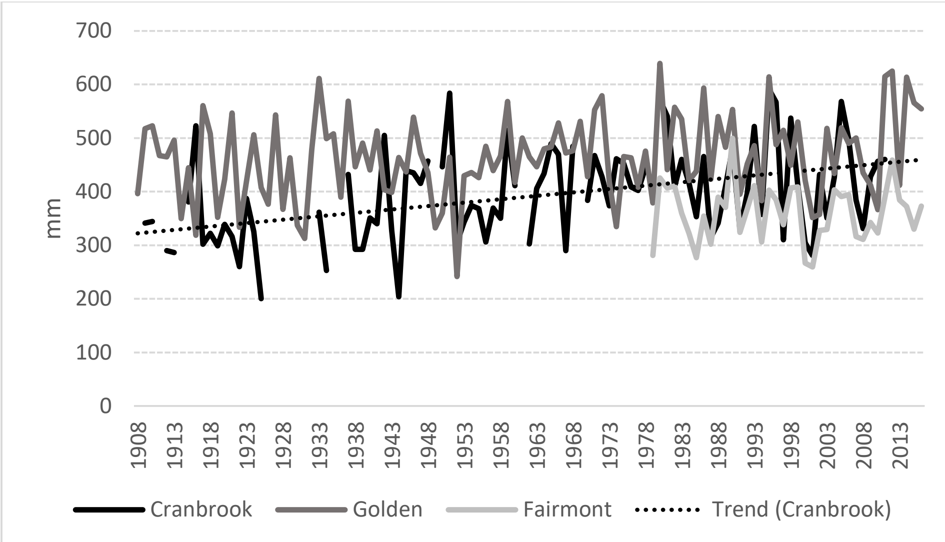

Figure 3: Total annual precipitation for Cranbrook, Golden and Fairmont

Seasonally, the Golden, Cranbrook and Central Basin datasets all show statistically significant increasing trends for the spring. All datasets also show increasing trends for the fall and decreasing trends for the winter, but not all of these trends are statistically significant. Trends for the summer season are mixed. Seasonal values were not calculated from the modelled Fairmont data.

Unclear trend in frequency of hot days

The extreme temperature indicator measures the percentage of days where the temperature exceeds the 90th percentile for the baseline period (1961-1990). While the Cranbrook data shows a statistically significant rate of increase of about 0.05% per year (approximately 16 days per century), neither the Golden nor Fairmont datasets show a statistically significant trend. All three stations tend to experience between 35 and 40 ‘hot days’ per year.

Unclear trend in amount of precipitation falling during heavy rainfalls

The extreme precipitation indicator measures the annual sum of daily precipitation exceeding the 95th percentile for the baseline period (1961-1990) and can be described as the amount of rain that falls during very heavy rainfall days. The trend in extreme precipitation for Golden shows a statistically significant decrease of 63.1 mm per century since 1909, but Fairmont and Cranbrook’s records do not show statistically significant trends. Fairmont generally sees less precipitation falling during extreme events than Cranbrook or Golden do. An average of 61 mm of Fairmont’s 361 mm of annual rainfall fell during extreme events over the period 1979-2016.

EXTREME WEATHER AND EMERGENCY PREPAREDNESS

Extreme weather events, such as extreme snowfall, windstorms and heat, can have significant impacts on communities, both positive and negative. Future projections suggest an increase in some extreme weather events, such as warm days, extreme warm days, and extreme wet days. Communities can prepare for extreme weather events with adaptations such as emergency preparedness plans, backup power sources and home emergency preparedness kits.

The Overall Picture

Area F is seeing a higher number of extreme heat days than in the past. Other indicators of extreme weather in Area F, however, are either lacking long-term datasets or not yet showing the trends that have been identified at larger scales. The RDEK's up-to-date Emergency Preparedness Plan will help mitigate the impacts of extreme weather events on residents and businesses. The number of Area F residents with emergency preparedness kits is low, suggesting an opportunity for the RDEK to support personal emergency preparedness in the region.

Climate Changes

As discussed in the Climate section, weather stations in and around Area F have seen increases in annual and seasonal average temperatures and increased annual precipitation. Trends are unclear for the frequency of hot days and amount of rain falling on heavy rainfall days. Additional climate indicators related to the Extreme Weather pathway are discussed below.

More extreme heat days

Temperature data for Cranbrook (since 1909), Golden (since 1910) and Fairmont (since 1979) shows a clear upward trend in frequency of days over 30°C, increasing at a rate of 9, 10 and 20 days per century, respectively (Figure 4). Between 1979 and 1996, Fairmont saw an average of 11 extreme heat days annually. This increased to an average of 17 extreme heat days per year from 1997 to 2016. Heat waves and heat extremes have negative health impacts on vulnerable populations including the elderly, socially isolated, chronically ill, and infants.

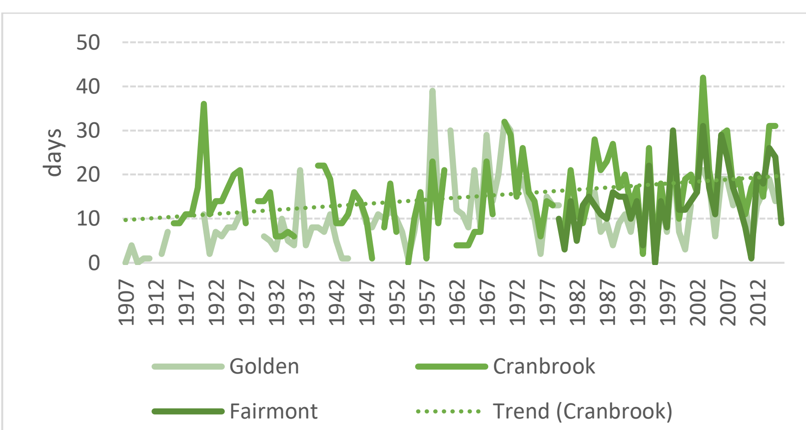

Figure 4: Extreme heat days (above 30°C) in Golden, Cranbrook and Fairmont

Insufficient snowfall data

No long-term, quality-controlled snowfall data was available for Area F. While Cranbrook data has limited comparative value for Area F, it shows a decline in extreme snowfall days from 1909 through to 2009. Extreme snowfall days are defined as those receiving 15 cm or more over 24 hours. Cranbrook's annual maximum 1-day snowfall is decreasing by 11 cm per century.

Monitoring strong wind events

Wind storms can damage infrastructure, bring down power lines and cause power outages. A strong wind event is defined as a day with winds of 70 km/h or more of sustained wind and/or gusts to 90 km/h or more. Wind data has been collected in Canal Flats since 1997, but the record is inconsistent and too short to identify a trend in strong wind events. From 2011 to 2016, there were 9 days with gusts of 90 km/h or more at the Canal Flats station.

No trend for maximum 1-day rainfall

Heavy rainfall is a major cause of flooding of creeks and rivers, and can cause stormwater management issues, erosion and debris slides. A warming climate increases the risk of extreme rainfall events. Modeled data for Fairmont since 1979 shows an annual average maximum 1-day rainfall of 14.4 mm, which is lower than the average for both Golden and Cranbrook. None of the three datasets show a statistically significant trend over their period of record.

Adaptation Actions and Capacity Building

Emergency Preparedness Plan in place

The RDEK has an emergency plan that was updated in 2016. Of the important plan components included in our survey, most are already complete (Table 3). Though MOUs with other agencies involved in emergency response are not formally in place, the RDEK's role as a coordinating agency during past periods of emergency response has resulted in development of working relationships with relevant organizations.

Table 3: Emergency preparedness plan components in RDEK

	Included in Emergency Preparedness Plan?			
Component	Yes	In Progress	No	N/A
Hazard risk assessment	☑	☐	☐	☐
Emergency procedures[1]	☑	☐	☐	☐
Municipal business continuity plan[2]	☐	☑	☐	☐
Community evacuation plan[3]	☑	☐	☐	☐
Public communication plan[4]	☑	☐	☐	☐
Designated emergency response centre	☑	☐	☐	☐
Emergency program coordinator	☑	☐	☐	☐
Designated emergency response team	☑	☐	☐	☐
Identified emergency roles and responsibilities	☑	☐	☐	☐
Action list for each type of hazard	☑	☐	☐	☐

Designated emergency/reception shelter[5]	☐	☐	☐	☑
Plan for shelter stocking	☐	☐	☐	☑
Training and emergency exercise plan for response personnel	☑	☐	☐	☐
Contact list for all response personnel	☑	☐	☐	☐
Fan-out call list	☐	☑	☐	☐
MOUs with any agencies helping in response (e.g. neighbouring municipalities, school board, local service groups)[6]	☐	☐	☑	☐

1: Separate document

2: Work with businesses and institutions to encourage Business Continuity Planning in major economic enterprises.

3: Separate document

4: EOC has Information Officer position to manage this, method of alerting public depends on situation

5: Subregional Emergency Social Services directors are responsible for identifying reception sites and planning

6: MOUs for mutual emergency aid are typically created between communities and are not seen as relevant to RDEK's emergency preparedness for Area F.

Essential backup power in place

The RDEK has backup power sources for all of its fire halls and owns a large diesel generator, which can be moved by trailer. All RDEK-owned and -operated water systems in Area F have reservoirs with adequate storage of treated water to ensure service to residents over an extended power outage; therefore, backup power is not required to maintain delivery of water. Backup power is also in place for the RDEK's central Emergency Operations Centre.

Few residents have complete emergency preparedness kits

A voluntary resident survey conducted by the RDEK and RDI in November and December of 2017 shows considerable opportunity for improvement in emergency preparedness among residents. Of 174 respondents, only 26% had a 72-hour emergency kit. Of those who had a kit, only one of 16 standard emergency kit items was identified by all respondents: flashlight and batteries. 98% had a first aid kit, and 96% had a manual can opener and candles and matches/lighters (Table 4). Future surveys will help the RDEK track personal emergency preparedness over time.

Table 4: percentage of respondents from Area F with emergency kits indicating the presence of important items in their kit

Item	% Yes
Drinking water (2-3 litres of water per person and pets per day, for 3 days)	91%
Foods that will not spoil (minimum 3-day supply)	93%
Manual can opener	96%
Flashlight and batteries	100%
Candles and matches/lighter	96%
Battery-powered or wind-up radio	39%
Cash in smaller bills and change	78%
First aid kit	98%
Special items such as prescription medications, infant formula or equipment for people with disabilities	59%

Extra keys that you might need (e.g. for your car, house, safe deposit box)	67%
A copy of your emergency plan including contact numbers (e.g. for out-of-town family)	35%
Copies of relevant identification papers (e.g. licenses, birth certificates, care cards)	57%
Insurance policy information	65%

Community Impacts and Adaptation Outcomes

No weather-related highway closure in past decade

Since 2006, there have been no highway closures in Area F directly related to weather. Ongoing tracking of this dataset will allow for evaluation of trends.

Provincial emergency assistance data precludes area-specific analysis

Monitoring emergency assistance funding issued by the province can provide some measure of the economic impact of disaster and associated recovery over time. The RDEK's current records for these types of payments begin in 2011 and are not delineated by electoral area. Therefore, it was not possible to analyse this indicator for Area F.

WATER SUPPLY

Projected changes to the climate could influence both the supply of and demand for fresh water for human use. Shifts in temperature and precipitation could change the amount of water stored in the snowpack and the timing of surface water availability in the spring. The water supply pathway focuses on the quality and quantity of water available for consumptive use and adaptation actions that help to conserve and protect the water supply. The RDEK currently owns and operates 4 water systems in Area F: Windermere (482 connections), Rushmere (34 connections), Timber Ridge (346 connections) and Holland Creek (374 connections). The RDEK systems are the focus of this report; however, select data from two of the nine privately operated water systems in Area F (Fairmont Hot Springs Resort with 500 connections and Columbia Ridge with 154 connections) is included here to help the RDEK understand the adaptation context for systems managed by private or community-based water user groups.

The Overall Picture

While the trend toward a wetter spring and summer in Area F may have positive implications for water supply, the warming trend and decline of glacial extent may have the opposite effect. Regional research suggests changes to the climate could alter stream flow timing and reduce the volume or quality of water available for human use, especially in late summer and early fall. The short-term datasets available for Area F source watersheds preclude an assessment of whether this regional trend exists locally. Area F water systems demonstrate some of the challenges common to rural utilities including high rates of water loss and inadequate levels of filtration or treatment. However, the RDEK and some private and community-owned systems are taking action to address these challenges by implementing actions that will improve resilience to anticipated climate changes, including water demand reduction policies/practices and improvements to water treatment infrastructure.

Climate Changes

As discussed in the Climate section, average annual and seasonal temperatures are increasing, and precipitation is increasing both annually and in the spring and summer. Historic weather datasets for stations in and around Area F are not showing trends in extreme temperatures or precipitation.

Environmental Impacts

Glacier extent is decreasing

Glacier extent in the Canadian Columbia Basin declined by 20 per cent from 1985 to 2005, and has declined further since then. A decline in glacier extent and glacial meltwater has implications for reduced summer stream flow and higher summer water temperatures in the many Area F water bodies that receive glacial flow. Figure 5 shows how the extent of the Toby Glacier changed over the 20 years leading up to 2005.

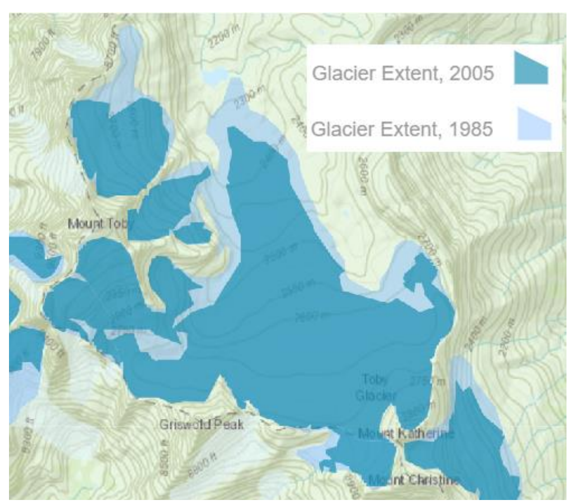

Figure 5: 1985 and 2005 extent of Toby Glacier

Limited stream flow timing data shows no trend

Stream flow timing is sensitive to climate change, especially in snowmelt-dominated river systems such as those in the Canadian Columbia Basin. Studies generally discuss a trend toward earlier peak flows, which results in a longer period of low flows. Low summer stream flows mean less water is available for human use at the time of year when it is typically in highest demand. Low flows also result in higher water temperatures, which presents challenges for both ecosystems and water quality. While a trend toward earlier peak flows is present in the western Rockies of the U.S., the same changes have not yet been detected widely by streamflow monitoring in the Canadian Columbia Basin.

No long-term, active stream flow monitoring sites exist in Area F. The nearest record is for the Kootenay River at Kootenay Crossing. No statistically significant trend can be observed from this record regarding streamflow timing. Since 1939, the average date of annual maximum discharge has been June 8, and the date of late summer minimum discharge has been September 22. Since streamflow is highly complex and can vary significantly with the size, slope and aspect of the watershed in question, the Kootenay River dataset has limited comparative value for smaller Area F streams. Stewardship groups such as the Lake Windermere Ambassadors and Columbia Lake Stewardship Society have begun monitoring streams within Area F and are now gathering water quantity data for select water bodies. While these records are currently too short to identify trends, the data may be useful in the future to observe changes in local stream flow timing.

Stream flow volume data precludes trend analysis

Maximum daily discharge can be an indicator of flood risk, whereas minimum daily discharge can be an indicator of water supply constraints. The record for Kootenay Crossing shows decreasing late summer minimum flow volumes (Figure 6), but the trend is not statistically significant. Annual maximum daily discharge for Kootenay Crossing ranged from 18 to 53 m^3/s between 1939 and 2016. Over the same time period, late summer minimum daily discharge for Kootenay Crossing ranged from 0.93 to 4.3m^3/s.

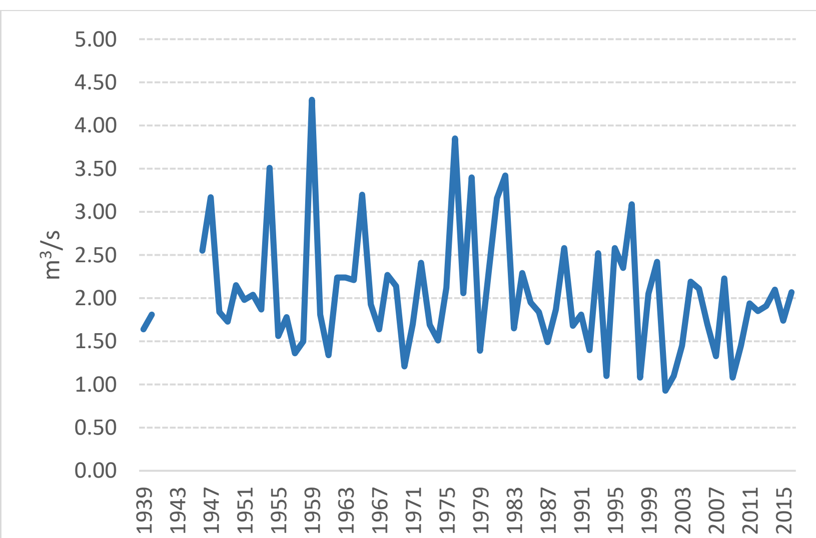

Figure 6: Late summer minimum daily discharge for the Kootenay River at Kootenay Crossing

Limited groundwater data

Some community water supplies in Area F rely on groundwater sources. Groundwater sources have not been as well monitored as surface sources. Living Lakes Canada began monitoring groundwater in Invermere in 2013. Since then, the average monthly water level has fluctuated between 808 and 810 metres above sea level. While these records are currently too short to identify trends, this data collection will be useful in the future to observe groundwater level conditions.

Source water temperature data collection initiated by stewardship groups

Temperature can be an important determinant of water quality. Reflecting the importance of Lake Windermere and Columbia Lake as key drinking water sources for Area F, the Lake Windermere Ambassadors and Columbia Lake Stewardship Society are monitoring water quality in these sources. With few exceptions, Lake Windermere temperature samples (since 2006) have consistently been below the Water Quality Objectives set by the Ministry of Environment for Lake Windermere. However, these guidelines reflect the needs of aquatic life rather than human use. Lake Windermere temperature results regularly exceed 15°C—the aesthetic objective set by Health Canada for drinking water sources. The Columbia Lake Stewardship Society has monitored Columbia Lake during the open water season since 2014, using the same objectives as the Lake Windermere Ambassadors. Though these records are too short to infer trends, future monitoring will help Area F communities better understand these two important water sources.

Baseline established for source water turbidity

Higher turbidity associated with snowmelt and high stream volumes during spring freshet may result in boil water notices or water quality advisories. Both the Lake Windermere Ambassadors and the Columbia Lake Stewardship Society collect turbidity information, comparing their results to objectives set for recreational water quality and protecting aquatic life. Records for Lake Windermere will be published online in spring 2018. The Columbia Lake Stewardship Society began collecting turbidity information in 2014. Since then, turbidity levels in Columbia Lake have ranged from a low of 0.6 NTU in June 2015 to a high of 2.7 NTU in April 2016. Results from the RDEK's water quality testing on the Windermere system can also be used to evaluate source water turbidity since there is currently no filtration on that system. Since 2014, approximately 65% of samples have measured under 1 NTU and 100% have measured under 5 NTU. This data will be useful for setting a baseline against which future measurements of source water turbidity can be compared.

Adaptation Actions and Capacity Building

Policies to reduce water consumption vary by utility

The RDEK has integrated a broad range of water conservation measures into its policies for drinking water systems it owns and operates in Area F. For example, in Windermere, universal water metering and volumetric billing are in place, and a full suite of actions to address water system leakage have been implemented (Table 5). Of note, adoption and enforcement of a watering restriction bylaw have not been implemented.

Table 5: Implementation of policies to reduce water consumption in Windermere

	Level of Implementation			
Policy/Practice	Full	Moderate	Minimal	None
Universal water metering	☑	☐	☐	☐
Public education and outreach on water conservation	☐	☑	☐	☐
Public education and outreach on water consumption trends	☐	☐	☑	☐
Water meter data analysis	☑	☐	☐	☐
Consumer billing by amount of water used (volumetric)	☑	☐	☐	☐
Implementation of water utility rates sufficient to cover capital and operating costs of water system	☑	☐	☐	☐
Water conservation outcome requirements for developers	☐	☐	☐	☑
Water conservation targets	☐	☐	☑	☐
Stage 1 through 4 watering restriction bylaw	☐	☐	☐	☑
Enforcement of watering restriction bylaw	☐	☐	☐	☑
Drought management plan	☐	☐	☐	☑
Actions to address water system leaks:				
Targeted leak repair	☑	☐	☐	☐
Water operator training	☑	☐	☐	☐
Replacement of aging mains	☑	☐	☐	☐
Addressing private service line leakage	☑	☐	☐	☐
Pressure management solutions	☑	☐	☐	☐
Solicitation of community input	☑	☐	☐	☐

Area F has a number of private and community-run water utilities with up to 500 connections. Several of the larger private water systems in Area F were contacted to gain insights on how these systems are preparing for climate change. Both respondents are actively addressing water system leakage and are also taking steps to reduce water use through public education and outreach, water conservation outcome requirements for developers, and watering restrictions.

Opportunity to consider climate change in water protection plans

Of the six water systems analysed in Area F, only the Fairmont Hot Springs Resort water system has a water protection plan that identifies potential effects of projected climate changes on the water supply and watershed. The Fairmont Hot Springs Resort system also identifies potential measures to undertake to adapt to projected climate changes. The RDEK notes that, though water planning documents do not expressly address climate change, potential shifts in water supply are considered in water-related decision-making. Staff also note that, due to water storage requirements related to fire-fighting, most systems have ample storage that far exceeds drinking water needs.

Some water loss detection practices in place

Implementation of water loss detection practices varies by utility in Area F. The Windermere Water System has implemented water metering, but implementation of other practices has been moderate or minimal (Table 7). RDEK staff share the opinion of many rural water operators that, while leaks can account for significant percentage of loss in small systems, the economic costs of finding and fixing these leaks often outweigh the anticipated benefits, as the actual volumes of water loss are low.

Table 6: Implementation of water loss detection practices in Windermere

	Level of Implementation			
	Full	Moderate	Minimal	None
District water meters	☑	☐	☐	☐
Residential water meters	☑	☐	☐	☐
Night flow analysis	☐	☑	☐	☐
Water loss audits	☐	☑	☐	☐
Acoustic leak detection	☐	☐	☑	☐
Leak noise correlation testing	☐	☐	☑	☐

Community Impacts and Adaptation Outcomes

Per capita water consumption heavily influenced by seasonal population change

This indicator measures water use attributable to user demand and system water loss. Due to the prevalence of vacation homes in Area F, both RDEK-run and private systems show a substantial difference in summer vs. winter consumption; as a result, a typical analysis of per capita water use over the course of a year may provide limited insight. For example, on the Windermere system, third quarter water use is typically six to eight times greater than first quarter water use (Figure 7). Assuming a summer population of 1200, third quarter per capita daily water use on the Windermere system has averaged 625 litres since 2011. Rates of water use were highest in 2014 and lowest in 2011.

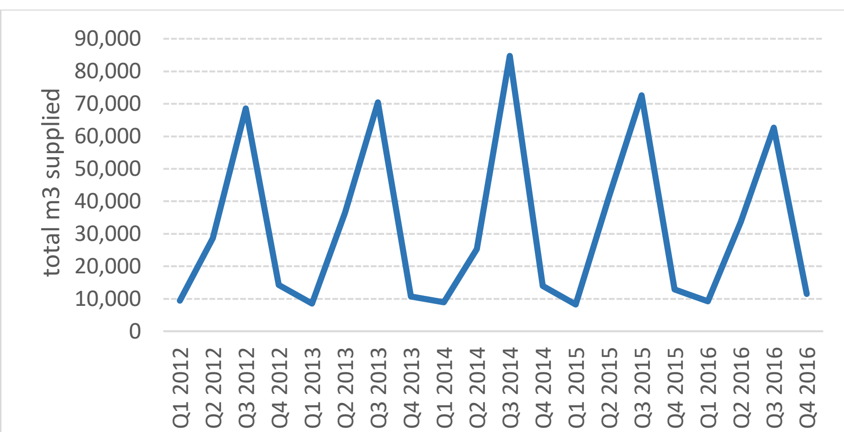

Figure 7: Seasonal fluctuation in water use on the Windermere water system

Drinking water quality improving with system upgrades

Water utilities are required to notify residents of high turbidity and/or the presence of pathogens in drinking water. The frequency of notices could increase with climate change due to potential changes in water quality associated with rising temperatures or more rapid runoff. At least 13 water systems supply Area F residents. Records show that 7 of these systems have experienced a water quality advisory or boil water notice since 2005. Some systems experience annual notices associated with turbidity due to spring runoff, which is common for stream-sourced water systems in the Columbia Basin. Others have been under a long-term notice due to ongoing detection of pathogens. Due to the variability in reasons for implementation of a water quality notice, it is not possible to link trends in this data to climate change. However, the number of advisories that have been issued in Area F points to a more general issue related to historically insufficient filtration or treatment of surface water sources. Robust, multi-barrier treatment systems can help communities reduce their vulnerability to source water quality problems that may accompany climate change. In recent years, many Area F systems have been improved in response to water quality issues. For example, in 2010, the Timber Ridge water system was upgraded, ending a Water Quality Advisory which had been active since 2006. In 2015, the RDEK approved Community Works Funds to upgrade the Fairmont Hot Springs Utility to a groundwater system and merge it with other nearby systems, providing several communities with safer drinking water and reducing annual increases in turbidity associated with spring runoff. In 2017, a referendum was passed that will allow the RDEK to undertake improvements to the Windermere Community Water System, which has been under Water Quality Advisory since 2006, and amalgamate with other nearby systems. Finally, Corix Utilities has announced that the community of Panorama's water system will be changed to a groundwater source which could mitigate seasonal issues related to turbidity.

No enforcement of restrictions to conserve water

Watering restriction bylaws provide a tool for utilities to reduce their vulnerability to water supply challenges, and by tracking the need to implement these restrictions, water operators can better understand how climate change is affecting supply and demand. The Regional District has implemented designated watering hours for its watering systems, including "No Watering Fridays" in the Columbia Valley to allow reservoirs to replenish. These restrictions are not enforced by bylaw. The Fairmont Hot Springs Resort system has developed a stage 1 through 4 watering restriction bylaw, but data on discretionary implementation of restrictions was not available.

High rates of water loss are typical of Basin communities

The RDEK-run systems in Area F experienced an average of 30-38% leakage in 2017 and while leakage has declined over time on the Rushmore system, there is no trend for the others. Fairmont estimates that 40% of its supplied water is lost to leakage. Columbia Ridge operators do not track ongoing water loss in the system. The Columbia Basin Water Smart Summary Report states that leakage within most systems in the Columbia Basin is 30-40%, and that this is typical of aging systems in developed nations, and particularly small rural systems.

FLOODING

Projected climate changes, including more intense rainstorms and warmer, wetter winters, indicate a potential for higher flood risk. Flooding affects communities through damage to homes and infrastructure, and negative impacts on water quality. Certain areas in Area F are prone to flooding or debris flows. In some cases, flooding occurs gradually, allowing impacts to be somewhat mitigated with proper planning. In other cases, such as those resulting from severe storms, flooding occurs rapidly, requiring the rapid implementation of emergency measures by the community.

The Overall Picture

While Area F is not yet witnessing the trends toward more extreme precipitation that some studies have predicted for our region, a trend toward higher average spring and summer precipitation may drive more rapid snow melt, increasing flood risk. This risk may be partially mitigated by a declining trend in spring snowpack. Area F experienced a major debris flow event in 2012 which was followed by the implementation of flood protection works and updates to hazard mapping for local creeks. Floodplain maps are out of date, however, and the existence of many Area F dwellings within floodplain boundaries suggests that a more accurate understanding of this risk could positively inform and guide adaptation efforts.

Climate Changes

As discussed in the Climate and Extreme Weather sections, trends toward more extreme rainfall have not been confirmed through an analysis of historic climate data for stations in and around Area F. An analysis of average precipitation data shows rising annual and spring precipitation.

Freeze-thaw cycle not showing a trend

The frequency of freeze/thaw cycles is an important parameter for engineering design in cold regions. The modeled ERA data for Fairmont covers 1979 to 2016 and shows no statistically significant trend. The annual number of days identified as experiencing a freeze/thaw cycle ranged from a minimum of 106 days in 2016 to a maximum of 152 days in 1984.

Environmental Impacts

As discussed in the Water Supply section, available streamflow data precludes an assessment of local trends in timing or volume of flow. One additional environmental impact indicator from the Flooding Pathway is covered below.

Spring snowpack on the decline

Snowpack data provides an indication of the amount of snow available to contribute to water supplies and flooding. Rates of change in April 1st snow water equivalent (SWE) show a statistically significant decline of approximately 46 mm per century at Sinclair Pass (in Area F at 1374 m elevation) since 1938 (Figure 8). Sinclair Pass April 1 SWE has averaged 125 mm during this period. While data for the Floe Lake site (north of Area F at 2987 m elevation) also shows declining April 1 SWE, this trend is not statistically significant.

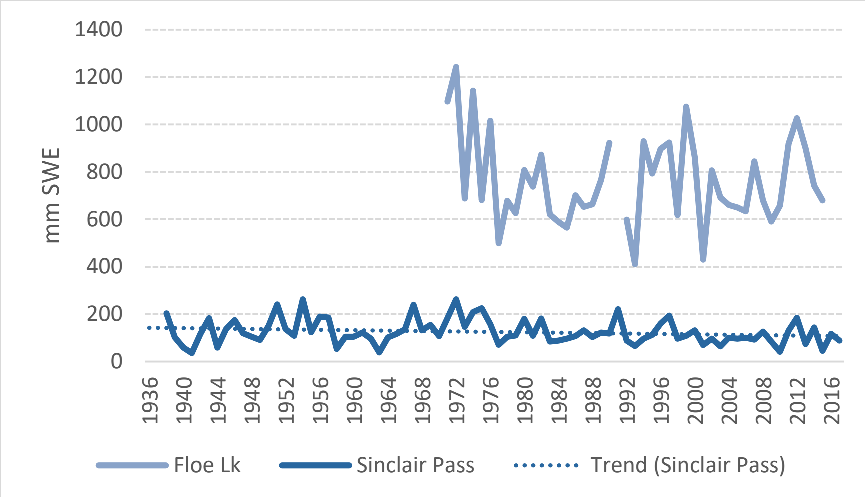

Figure 8: April 1st snowpack at Sinclair Pass and Floe Lake

Adaptation Actions and Capacity Building

As discussed in the Extreme Weather section, the RDEK has an Emergency Preparedness Plan in place with several established components and others in development.

Floodplain mapping out of date

The BC government completed floodplain mapping in the 1980s. The RDEK has converted these maps to digital files, but the mapping has not been updated. Floodplain mapping for Area F identifies both floodplains (low lying areas at risk of rising waters) and flood hazard areas (alluvial fans and areas at risk of debris torrents). The RDEK commissioned updated debris flow hazard assessments for Fairmont, Windermere and Coldspring creeks in 2012, 2013 and 2015 respectively. These assessments include updated debris flow hazard mapping and considerations for projected climate changes.

No data available on flood protection expenditures

Information on spending related to flood protection infrastructure provides some measure of a local government's efforts to improve their resilience to climate change. RDEK staff identified expenditures in 2014-2016 that were undertaken following debris flow events on Fairmont Creek in 2012 and 2013. The work has involved widening the creek channel, installing debris barriers, upsizing a culvert, and installing a rain gage and early warning system. The total value of these works is approximately $1.9 million. No other information on flood expenditures was available.

Community Impacts and Adaptation Outcomes

Provincial emergency assistance data precludes area-specific analysis

As discussed in the Extreme Weather section, the RDEK's current records for emergency funding received from higher levels of government are not delineated by area and therefore preclude analysis of this indicator specific to Area F.

Many Area F dwellings lie in the floodplain

Using civic address points as a proxy for dwellings, 195 dwellings exist within the identified floodplain in Area F, and 468 dwellings exist within flood hazard areas. There are also small areas zoned as residential or residential development within identified floodplain and flood hazard areas. Updated floodplain mapping will permit a more accurate assessment of flood risk to properties and help the RDEK understand whether new development policies are needed to support community resilience to flooding.

One flood-related highway closure on record

Since the provincial government began recording highway event data in 2006, the only flood-related highway closure in Area F was associated with the 2012 debris flow in Fairmont. The closure lasted approximately 2.5 hours.

AGRICULTURE

Climate has a significant, but complex, impact on food growing activities, with some projected climate changes expected to increase productivity and others reducing it. Climate change also has the potential to negatively affect food production in other parts of the world, which means that locally produced food and local food self-sufficiency could become important climate adaptations in coming years. The Agriculture Pathway tracks the climate-related viability of food production, the impact of climate change on agricultural activity, and the degree to which farmers and backyard growers are prepared to deal with climate change.

The Overall Picture

A trend toward higher temperatures is influencing the growing climate in the region, with Cranbrook and Golden experiencing more growing degree days than in the past. Notably, however, higher temperatures have not been accompanied by a significant change in the length of the growing season. Continued monitoring of drought levels will help planners understand how a trend toward higher precipitation levels is affecting agricultural viability and local food production. While the number of Area F residents engaged in backyard gardening shows local enthusiasm for food self-sufficiency, the declining amount of land being farmed reflects common economic challenges that must be addressed in order to reinvigorate small-scale agricultural production in this region.

Climate Changes

As discussed in the Climate and Extreme Weather sections, average annual and seasonal temperatures are increasing, as is annual and spring/summer precipitation. While Area F has not seen a trend in extreme precipitation or the frequency of hot days, the number of extreme heat days is on the rise.

Environmental Impacts

Drought Index tracking begins in 2010

The BC drought index is comprised of four core indicators: Basin snow indices; seasonal volume runoff forecast; 30-day percent of average precipitation; and 7-day average streamflow. While this data set is too short to infer any kind of trend, these initial years will contribute to creating a baseline against which future conditions can be assessed. Area F includes portions of the Upper Columbia Basin and East Kootenay Basin. Since 2011, these basins have experienced an average of 34 and 33 ‘dry’ or ‘very dry’ days, respectively. In 2017, the Upper Columbia Basin experienced 70 dry days and no very dry days, and the East Kootenay Basin experienced 42 dry days and 28 very dry days.

Length of the growing season remains unchanged

A longer growing season[iii] allows for greater diversity of crops (especially crops requiring longer days to maturity), greater flexibility in early planting avoiding late summer drought, and more time for plant

[iii] For the purposes of this report, growing season is defined as the number of days annually between the first and last five consecutive days with a mean temperature of 5°C.

growth. Some communities in the Columbia Basin are experiencing a longer growing season[iv]; however, datasets for Golden (1907-2015), Cranbrook (1913-2015) and Fairmont (1979-2016) do not show a statistically significant trend in growing season length. Fairmont's modeled dataset shows an average growing season length of 191 days, peaking at 228 days in 2015 and dropping as low as 146 days in 1982.

Growing degree days are increasing

Growing degree days[v] describe the amount of heat energy that is available for plant growth, providing better insight on how plants are affected by temperatures than straight temperature data. Growing degree days for Cranbrook (1909-2015) and Golden (1907-2015) have been increasing by about 238 and 297 degree days per century, respectively (Figure 9). Modeled Fairmont data was not available for this indicator.

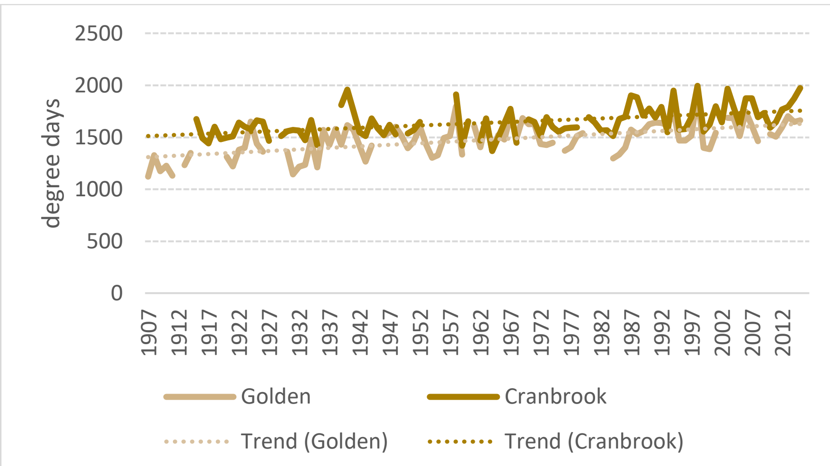

Figure 9: Growing degree days in Golden and Cranbrook

Consecutive dry days average 21 per year

There is no statistically significant trend evident in the annual maximum number of consecutive dry days for the Golden (since 1907), Cranbrook (since 1909) or Fairmont (since 1979) datasets. Over the period of record, Fairmont shows an average of 21 consecutive dry days per year with a high of 37 in 1998 and a low of 9 in 2016.

More than 40 documented species of invasive plants

Warming trends associated with climate change can create a more hospitable environment for invasive plants. Invasive plants can challenge agricultural production by outcompeting native or cultivated plants. Some invasive species (e.g., Hoary alyssum) are also toxic to livestock. Two invasive plant inventories were available for Area F, but neither represents a comprehensive survey of the entire land base. The provincial government's Invasive Alien Plant Program has recorded a total of 0.59 km^2 in Area F that is

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[iv] See: http://www.cbrdi.ca/wp-content/uploads/TA_GrowingSeason.pdf

[v] For the purposes of this report, growing degree days was calculated by multiplying the number of days that the mean daily temperature exceeds 5 C (average base temperature at which plant growth starts) by the number of degrees above that threshold. Studies often use different definitions of growing degree days; therefore, caution should be exercised when comparing these results to other research.

occupied by invasive plants, with the most widespread documented species of invasive plants being leafy spurge, perennial pepperweed and spotted knapweed. The RDEK's invasive plant dataset shows 7.5 km^2 of land occupied by invasive plants in Area F, with the most widespread documented species being diffuse knapweed, spotted knapweed and perennial sow thistle. Leafy spurge, classified as a top priority by the East Kootenay Invasive Plant Council, began appearing in the Columbia Valley in the 1960s. Most of the leafy spurge present in BC is found in the Columbia Valley area. Caution should be exercised when comparing these findings to updated datasets in future years. As current inventories are incomplete, trends may be indicative of a change in survey extent rather than a change in the prevalence of each species.

Adaptation Actions and Capacity Building

Approximately 1000 ha being irrigated

The necessity to irrigate cultivated land is anticipated to increase with the warming and drying trends associated with climate change. Two sources of agricultural information are available for Area F. The Census of Agriculture, completed most recently in 2016 by Statistics Canada, reports that 868 hectares are currently irrigated in the East Kootenay F Census Consolidated Subdivision. This figure is roughly unchanged from 2011, when 871 hectares were irrigated. The RDEK's Agricultural Land Use Inventory for the Columbia Valley Region was completed in 2011 and provides property-level agricultural data. This inventory found 1153 hectares of irrigated land in Areas F and G combined.

Many residents grow some of their own food

The community food production indicator tracks the number of people in the community who grow at least some of their own food, giving a sense of local self-sufficiency and food security. In November and December 2017, an online survey was distributed to Area F residents to gather information on the degree to which residents engage in 'backyard' food production. Of 174 survey respondents, 49% reported that they grow or raise some of their own food. Of these respondents, the vast majority grow less than 10% of their own food. 8 respondents raise livestock (primarily chickens), 49 grow fruit trees, and 6 keep bees. The most commonly grown crops include lettuce (30 respondents), herbs (30 respondents) and potatoes (20 respondents). The area under cultivation varied widely (Table 7). A detailed analysis of survey responses in available in the datasets that accompany this report.

Table 7: Area under cultivation (excluding orchards and berry patches) by growers in Area F

Area	# of respondents
Less than 15 square feet	9
15 to 30 square feet	13
30 to 50 square feet	9
50 to 100 square feet	15
100 to 200 square feet	13
200 to 300 square feet	9
More than 300 square feet	20

Community Impacts and Adaptation Outcomes

Less area being farmed

The annual number of hectares being farmed gives some indication of agricultural viability and the amount of food being produced in an area. Based on an analysis of aerial imagery and a 'windshield' survey of agricultural properties in Areas F and G, the Columbia Valley Agricultural Land Use Inventory found that 2724 hectares of land were farmed in 2011 (not including natural pasture or rangeland). The 2016 Census of Agriculture reported 13,700 hectares of total farm area (including rangeland leased from governments) in Area F, down 12% from five years prior. The trend towards less area being farmed is also present at regional, provincial and national scales, although the East Kootenay and Area F saw a greater decrease than the rest of the province.

Net agricultural productivity up from 5 years ago

The agricultural productivity indicator measures an area's ratio of agricultural inputs to outputs with outputs measured in market value. It provides an indication of agricultural viability in a region, which could be affected by shifting climatic conditions. Both gross and net farm productivity increased between the 2011 and 2016 agricultural censuses. However, reflecting the relatively minor contribution that agriculture makes to the Area F economy, farm productivity values for Area F and the RDEK are significantly lower than those for BC and Canada (Table 9).

Table 8: Agricultural productivity ($/ha) in Canada, BC, the RDEK and Area F

Geography	Gross Farm Productivity ($Receipts/ha)		Net Farm Productivity (($Receipts-$Expenses)/ha)	
	2016	2011	2016	2011
Canada	$1,079.94	$787.84	$185.39	$136.87
BC	$1,439.79	$1,124.27	$219.92	$120.70
East Kootenay	$287.96	$181.14	$47.71	-$6.70
East Kootenay F	$235.27	$134.98	$23.14	$14.67

WILDFIRE

Wildfire can cause serious damage to community infrastructure, water supplies and human health. It is projected that climate change may increase the length of the wildfire season and the annual area burned by wildfire due to warmer, drier summers. The Wildfire Pathway tracks fire risks and impacts on communities as well as adaptation actions being undertaken by communities. Area F is situated in the Invermere Fire Zone, which falls within the boundaries of BC's Southeast Fire Centre.

The Overall Picture

Wildfires are becoming more frequent at regional and national scales and studies generally suggest that this trend, along with a trend to more area burned, will continue. Local-scale data relating to wildfire frequency and size does not show reliable trends but provides a baseline for future assessments. The active wildfire season experienced in 2017 highlights the social and economic impacts of fire due to a lengthy fire ban, evacuation alert and road closure. Though interface fires have not historically been a frequent occurrence in Area F, some communities are taking steps to prepare for an anticipated increase in fire risk through implementation of FireSmart principles in their neighbourhoods. The limited amount of land in Area F that has been treated for interface fire fuel management reflects the challenging policy environment surrounding this issue in British Columbia.

Climate Changes

Longest period of high fire danger on record in 2017

The BC Wildfire Service establishes wildfire danger ratings using the Canadian Forest Fire Danger Rating System. The number of days in the high and extreme danger classes provides an indication of how weather and water availability are influencing fire risk. For 1999 to 2017, overall fire risk for the three fire weather stations in Area F (Toby Hub, White River and Palliser) was highest in August with an average of 9.5 days in the month rated as 'high' and 2.3 rated as 'extreme.' 2017 saw the longest period of high fire danger on record (Figure 10). Conditions at Toby Hub are drier than the other two stations, with an average of 50 days per year in high or extreme danger classes at that station, 24 at Palliser and 18 at White River. The short record for this data precludes evaluation of temporal trends.

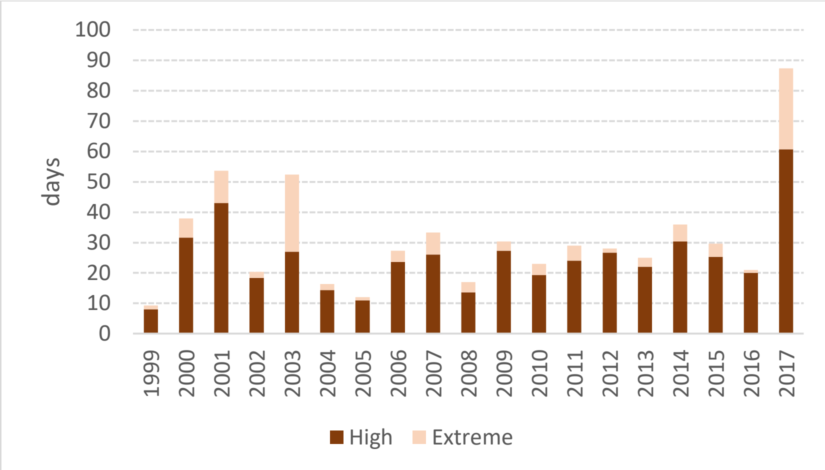

Figure 10: Number of days per year in high and extreme danger classes (average of Toby Hub, Palliser and White River stations)

Environmental Impacts

Air quality declines in active fire years

The air quality indicator reports concentrations of fine particulate matter ($PM_{2.5}$) in the air and is strongly influenced by wildfire. High $PM_{2.5}$ concentrations can have significant impacts on human health. There is currently no air quality monitoring station in Area F and the nearest stations (Cranbrook and Golden) are too far away to provide valuable insight. However, a comparison of Castlegar data from 2017 (a year with a relatively active wildfire season) and 2016 (a year with less wildfire activity) clearly shows how air quality in our mountainous region is influenced by smoke from wildfires (Figure 11).

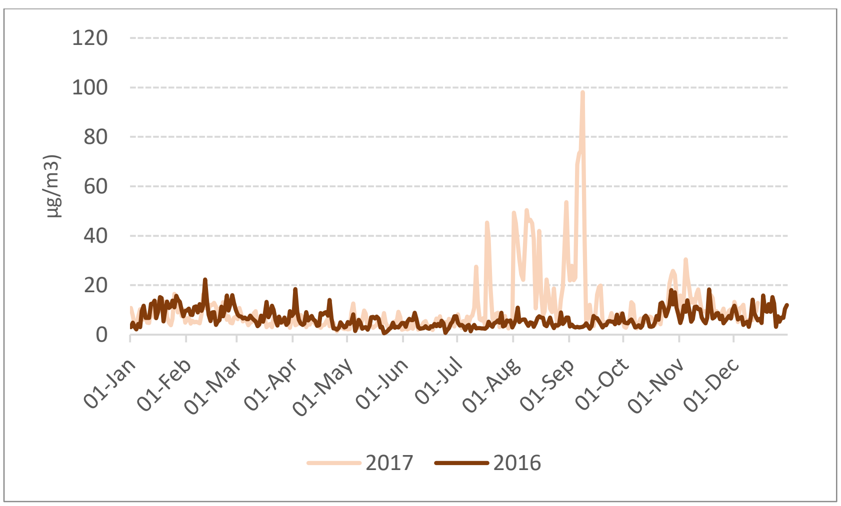

Figure 11: Daily average $PM_{2.5}$ readings at Castlegar Zinio Park in 2016 and 2017

Increasing number of wildfires at regional scale

This indicator tracks the total number of human-caused and lightning-caused wildfire starts per year. Though national-scale data points to increasing frequency of wildfires, since the mid-1900s, there is no statistically significant trend in the number of wildfires started annually in the Invermere Fire Zone or

Area F. However, the small geographic scale of this dataset may be preventing effective evaluation of trends. An upward trend is apparent in the number of fires in the Southeast Fire Centre region that have been mapped by the BC Wildfire Service, indicating that they grew to at least 1 ha in size (Figure 12).

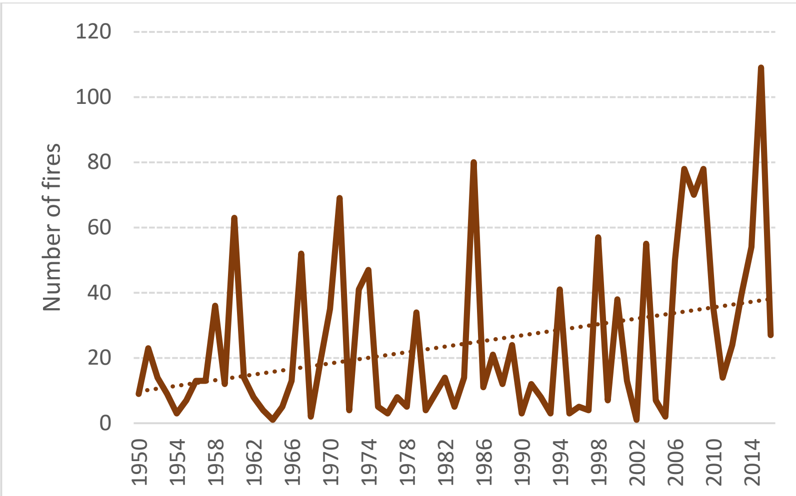

Figure 12: Fires > 1 ha in the Southeast Fire Centre region, 1950-2016

The ratio of fires caused by humans vs. lightning can be influenced by both climate and public awareness. For Area F fires, this ratio is consistent with that for the Southeast Fire Centre—about two thirds are lightning caused. The Southeast Fire Centre is seeing a decline in human-caused fires over time, which may help temper the increased fire risk that could accompany climate change.

On average, there are 20 fires per year in Area F.

No trend in area burned annually

This indicator provides a direct measure of how much fire is occurring on a specific landscape. Since the onset of provincial wildfire suppression efforts in the mid-20th century, no trend can be observed in the annual area burned in Area F, the Invermere Fire Zone, or the Southeast Fire Centre region. The Invermere Fire Zone experienced significant wildfire years in 1985, 2003 and 2017. A total of 329,325 hectares have burned between 1919 and 2017 in the Invermere Fire Zone, equivalent to 25% of the zone’s total area. Area F sees an average of about 1300 hectares burned annually, but 2017 was the most significant fire year since 1919, with 31,646 hectares burned.

Adaptation Actions and Capacity Building

Limited interface fire fuel treatments in Area F

Interface fire risk reduction involves assessing and treating high-risk areas to reduce wildfire risk. The Regional District has not completed any fuel reduction treatments in Area F, but the communities of Rushmere, Timber Ridge and Fairmont have undertaken small projects. The Community Wildfire Protection Plan written for Areas F and G in 2011 recommends interface fire risk reduction activities and identifies priority areas. However, the RDEK has been reluctant to implement these recommendations due to questions over where responsibility should lie for managing wildfire risk on crown land.

Communities achieving FireSmart recognition

This indicator reports on the number of neighbourhoods recognized through Fire Smart Canada's Community Recognition Program, providing a measure of citizen involvement in reducing the risk of wildfire to their homes. The RDEK does not currently administer a FireSmart program, but some communities have completed the process. The communities of Rushmere and Aquisknuk achieved FireSmart Community Recognition in 2015 and 2016 respectively, and both have maintained this status for 2017. In 2016, the BC Wildfire Service and Windermere Fire Department held a FireSmart Community Champion Workshop to educate residents and demonstrate leadership in community wildfire protection.

Community Impacts and Adaptation Outcomes

Frequency of interface fires averages less than one per year

This indicator measures the annual number of wildfires that come within 2 km of address points. Since 1950, Area F has experienced 29 interface fires, with five occurring in 2008 and 3 in 2017 (Figure 13). On average, this equates to less than one interface fire per year. There is no trend evident in this dataset. More interface fires have been caused by people than lightning in Area F. Increased fire prevention education may therefore be beneficial.

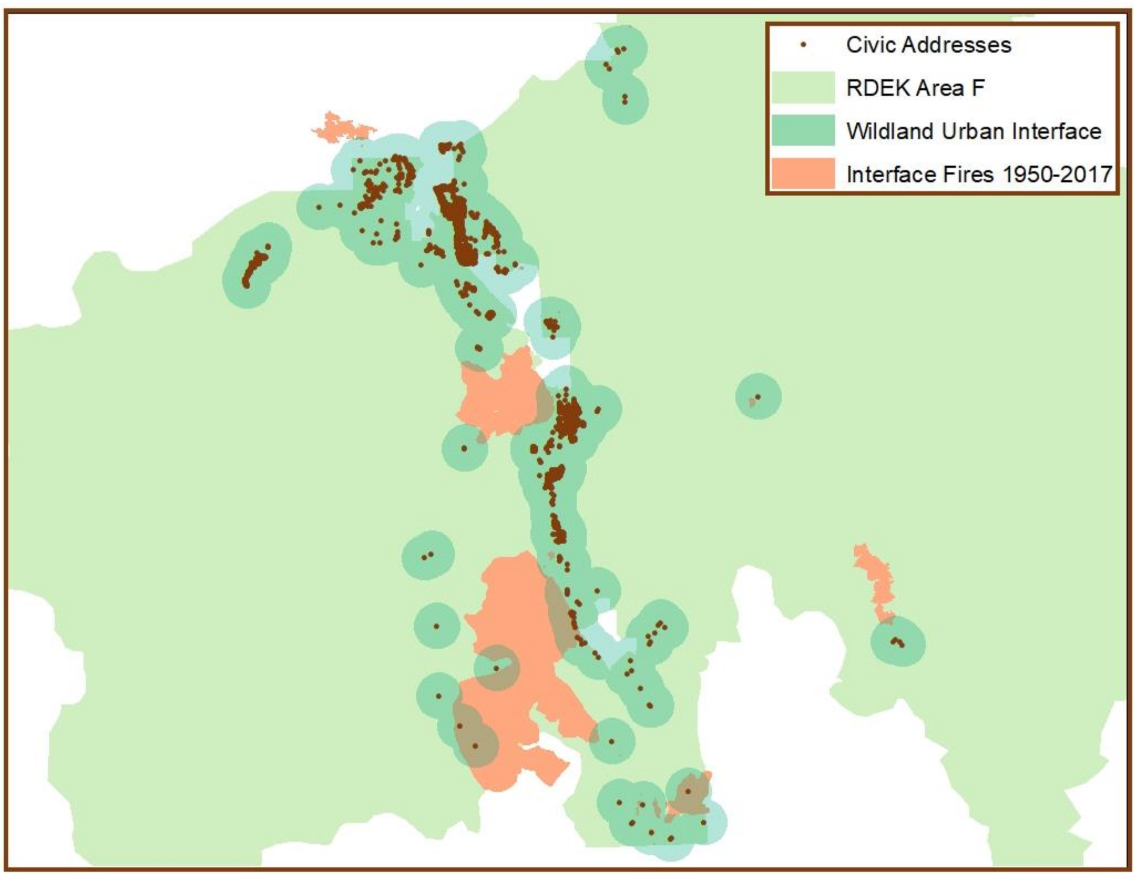

Figure 13: Interface fires in Area F since 1950

Cost of fire suppression averaging $1.25m per year

The average annual cost of fire suppression in the Invermere Fire Zone from 2006-2015 was $1.25 million, peaking at $4.53 million in 2007 and falling as low as $86,706 in 2011. Costs of fire suppression will vary from year to year and be significantly influenced by prevailing weather conditions. There is no discernible trend over the period of record.

2017 sees fire-related highway events and evacuation alert

In July 2017, a wildfire in the area between Canal Flats and Skookumchuck caused the issuance of an evacuation alert for the Island Pond area (at the south end of Area F) and reduction of Highway 93/95 to single lane alternating traffic. This was the first wildfire-caused highway event on record for Area F. It is not possible to assess historic evacuation orders/alerts due to a lack of tracking of this information by the RDEK.

Annual days under campfire ban is highly variable

This indicator tracks the number of days annually for which the BC Wildfire Service has issued a campfire ban for the Southeast Fire Centre. It provides a measure of the social cost of the increasing wildfire risk that is projected to accompany climate change. Since 2000, there have been 6 years with campfire bans. 2017 saw the lengthiest fire ban, at 77 days. Long term tracking of this indicator is necessary to establish a trend.

NEXT STEPS

Action Areas

Assessment results indicate that the RDEK has initiated important steps to improve its adaptive capacity. Five areas for further consideration are evident in the data:

- **Wildfire risk reduction**. Area F's Community Wildfire Protection Plan identifies several potential measures to reduce interface fire risk and establishes priority fuel treatment areas. A reluctance to assume responsibility for the management of wildfire risk on crown land has prevented the RDEK from undertaking fuel treatments to date. By continuing its ongoing conversations with other agencies and private land owners, the RDEK may be able to advance creative solutions to this issue. The type of public engagement and education around wildfire risk that is already being led by RDEK fire departments will help Area F residents advance their own contributions to risk reduction in the wildland urban interface.
- **Personal emergency preparedness**. Encouraging emergency preparedness among residents would help foster resilience to the types of extreme weather that are expected to increase with climate change. Local governments have an important role to play in personal emergency preparedness as they are often the 'front line' for residents when disaster strikes. The RDEK has hosted an Emergency Preparedness Fair in the Columbia Valley in the past. Similar initiatives could help increase the percentage of Area F residents with a 72-hour emergency preparedness kit, which currently stands at 26%.
- **Local food production.** A declining amount of land being farmed combined with low levels of agricultural productivity suggest that there is a substantial opportunity to introduce policies or programs that improve the economic viability of agriculture in Area F. Local food self-sufficiency can be an important contributor to the resilience of a community, and the high number of Area F residents engaged in backyard food growing suggests good support for the types of agricultural initiatives the RDEK is already involved with (e.g., Regional Agricultural Plan, Kootenay Boundary Farm Advisors program).
- **Floodplain mapping**. The RDEK's floodplain maps have not been updated since they were developed in the 1980s, and assessment of debris flow hazard on specific creeks have been undertaken on a reactionary as opposed to anticipatory basis. Outdated floodplain maps are a common problem faced by BC local governments, and there is growing concern that development decisions are being made based on outdated information. Shifts in climate variables are some of many factors influencing changes to flood risk. The BC Real Estate Association's Floodplain Maps Action Plan identifies actions to support local governments to undertake floodplain mapping projects and includes a funding guidebook for this type of work.
- **Air quality**. Area F currently lacks access to air quality data. In the absence of a continuous monitoring station with rigorous data quality control, other communities have considered operation of cost-effective air quality monitoring equipment to gather data on select variables on a seasonal basis. By exploring this opportunity with relevant government agencies, the RDEK may be able to better understand the potential impact of wildfires on human health.

Future Assessments

Though some SoCARB indicators will be monitored on an annual basis, it is recommended that the next full assessment be conducted in five years (2022). A recommended update cycle is included with the documentation provided for specific indicators. Many SoCARB indicators are also tracked as part of the State of the Basin initiative, which means substantial data may be available through the RDI.

ACKNOWLEDGEMENTS

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