OUR RELATIONSHIP WITH WATER in the OKANAGAN

Explorations in Outdoor Education to Support the B.C. Curriculum

THE OKANAGAN WATERSHED AND CLIMATE

OKANAGAN waterwise

One valley. One water.

Acknowledgments

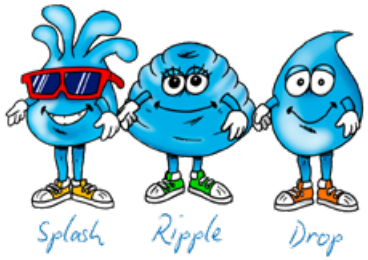
The Okanagan Basin Water Board (OBWB) and its Okanagan WaterWise program wish to thank the *Syilx* Knowledge Keepers who guided, evaluated, and shared knowledge in the *Syilx* (Okanagan) Indigenous Knowledge and Perspectives part of this guide: **Jordan Coble, cucuasquet (Pamela Barnes), Angela Paolera, Delphine Derickson, Sʔímlaʔxʷ (Michele Johnson)**. Thank you also to the authors and creators of the resources cited in this guide.

Thank you also to **Desiree Marshall-Peer** and **Jennifer Laminger** for their valuable input and review of this chapter. Project management, writing and editing was contributed by **Corinne Jackson**. Graphic design by **Karen Christensen**.

This project was made possible with funding from the Okanagan Basin Water Board-Okanagan WaterWise, the Real Estate Foundation of BC, Environment and Climate Change Canada, and support from the Okanagan Collaborative Conservation Program (OCCP).

Publication Data

Our Relationship with Water in the Okanagan: Okanagan Watershed and Climate. Okanagan Basin Water Board-Okanagan WaterWise 2021.



The *Okanagan Watershed and Climate Module* investigates the Okanagan basin and how climate in the area affects the water cycle. Inherent to the Okanagan is the *Syilx* idea of respect for the spirit of water and the interconnectedness of all things. This is related to the concept of conservation and protection of water quality. Activities in this module address the changes being seen in the Okanagan, and beyond, due to climate change, how this affects the water cycle, as well as erosion and water quality.

TABLE OF CONTENTS

Activities

THE OKANAGAN WATERSHED AND CLIMATE

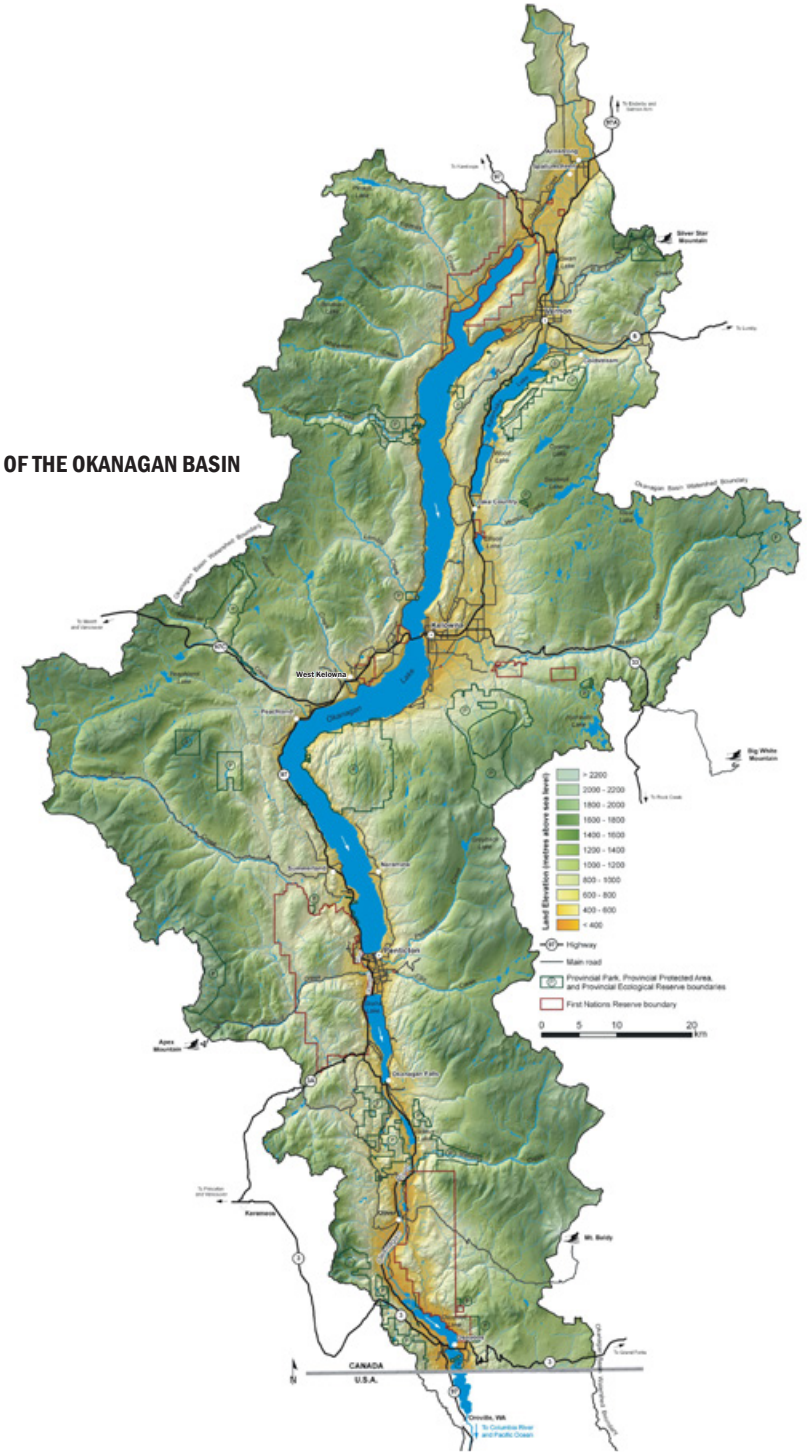
The Okanagan watershed, or basin, is a narrow strip that spans from Armstrong in the north to Osoyoos in the south and includes six mainstem (i.e. valley bottom) lakes – Okanagan, Kalamalka, Wood, Skaha, Vaseux and Osoyoos – and the surrounding mountains.[1]

A river basin or watershed is high at its edges and low in the centre where the waters flow. The Okanagan Basin includes all the land that feeds water to our big lakes. Armstrong, Vernon, Kelowna, Penticton, Osoyoos, and all the other communities in between all lie within the Okanagan Basin.

The Okanagan Basin is almost 200 km in length and 8,000 km^2 in area.

The Okanagan Basin is a semi-arid watershed, and requires management of the water to meet all the needs of the communities. These needs include water for agriculture, domestic use, industry, commercial and institutional use, as well as water to meet the needs of fish and the broader ecosystem. The Okanagan Basin Water Board (OBWB) was established in 1970 as a collaboration of the three Okanagan regional districts (North Okanagan, Central, and Okanagan-Similkameen) to provide leadership on valley-wide water issues, including water management.

MAP OF THE OKANAGAN BASIN



1 https://www.obwb.ca/wsd/about/state-of-the-basin

Where does water from the Okanagan Basin go?

The waters of the Okanagan flow south, crossing the Canada-United States border at Osoyoos Lake and carry on to join the Okanogan River, then joins the Columbia River, running past the city of Portland, to the Pacific Ocean.[2]

Watch the video, "A River Film," available at https://www.youtube.com/watch?v=P6IzkUhDpC0&list=PLg7XjOZTdpR07eeIO3jxbfE6WOMi7b4f_.

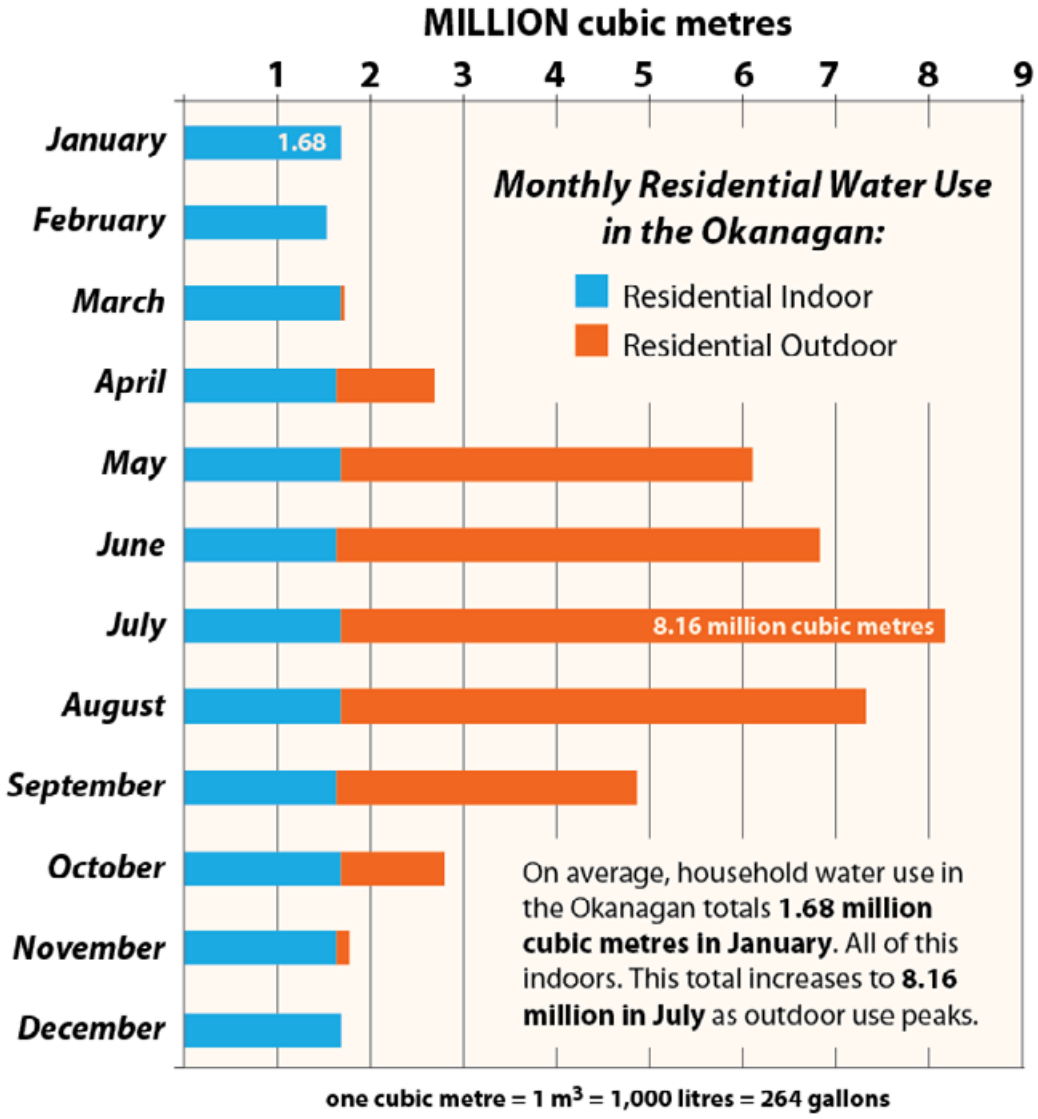
This award-winning short documentary showcases the Okanagan/Okanogan rivershed. Breathtaking film footage provides a spectacular look at the Okanagan River and Osoyoos Lake. Visit the sites and meet the residents. Learn about the complex relationships between people, fish, upland species, and this watershed, regulated by the International Joint Commission (IJC), a bi-national organization established to protect the interests of all for a clean, sustainable water supply. The film was developed in partnership with the OBWB and its Okanagan WaterWise outreach and education program, the IJC, and the Washington State Department of Ecology.

State of the Basin:

- The Okanagan Basin is semi-arid, with strong variability between wet and dry years.
- The Okanagan Basin is Canada's most water-stressed region. There is less water available per person in the Okanagan than anywhere else in Canada.[3]
- Many Okanagan streams are now fully "allocated" for water use. This means the Province of B.C. can no longer issue water licences without causing water shortages. Allowing any more would impact each licencee's ability to withdraw the amount of water they are licenced to withdraw. In some cases, streams are "over allocated" meaning that too much water is already being withdrawn and is impacting water availability for fish and other ecosystem needs.
- In some cases, new users are applying for groundwater licences instead. Groundwater and surface water are connected. When we withdraw from one, we withdraw from the other, and in certain circumstances this can cause conflicts between surface and groundwater use.

2 A River Film is an award-winning short documentary developed by the OBWB-OkWaterWise and several partners and looks at the complex relationships between people, fish, upland species, and how the waters are managed to protect the interests of all for a clean, sustainable supply. The full film and various shorts (focusing on the First Nations fishery, water for agriculture, and more) is available at https://www.youtube.com/playlist?list=PLg7XjOZTdpR07eeIO3jxbfE6WOMi7b4f_.

3 https://www150.statcan.gc.ca/n1/en/pub/16-201-x/16-201-x2003000-eng.pdf?st=t-mnyM0d (Source: Statistics Canada, Human Activity and the Environment: Annual Statistics 2003. Catalogue no. 16-201-XIE, p. 8.)

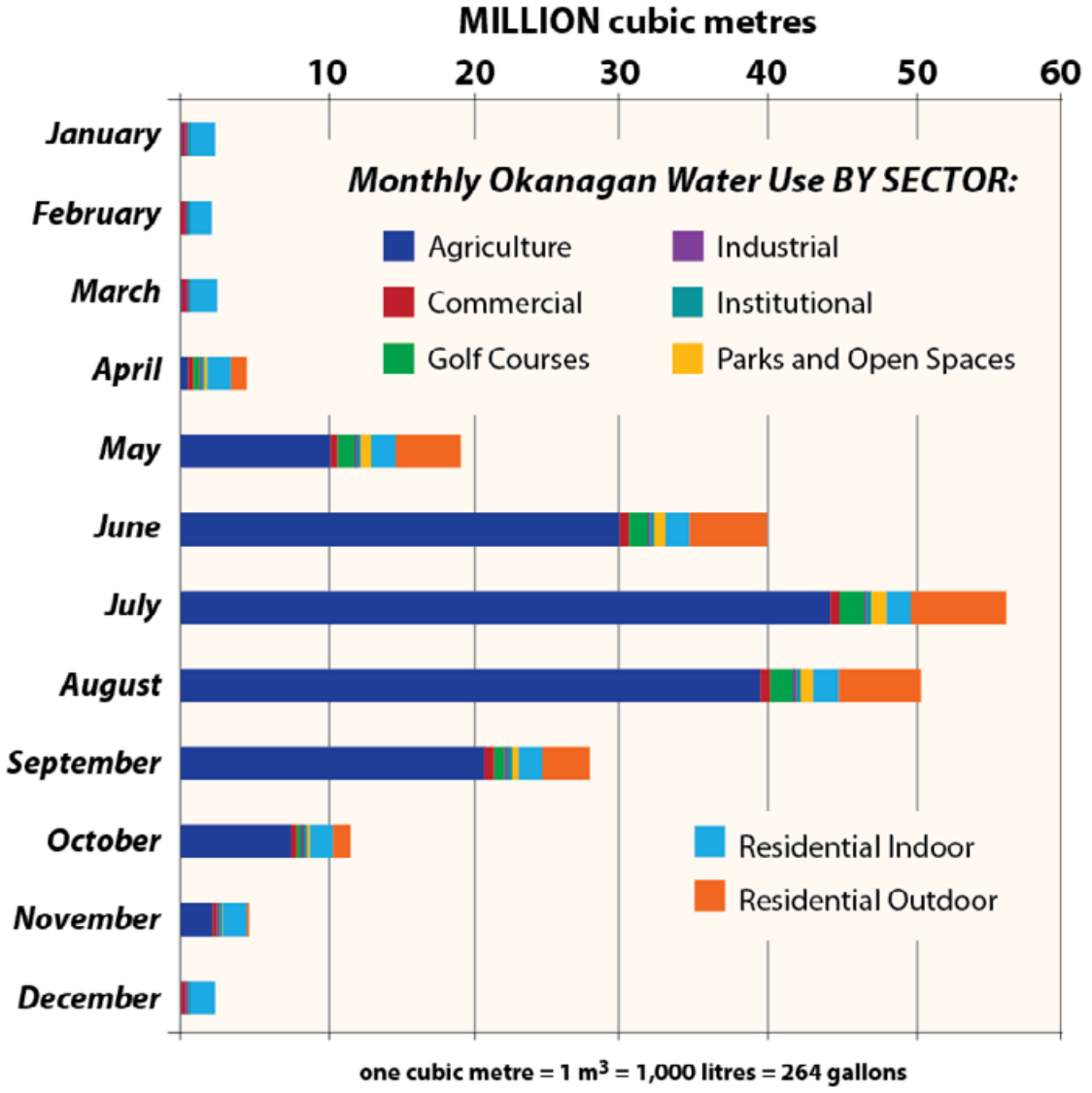


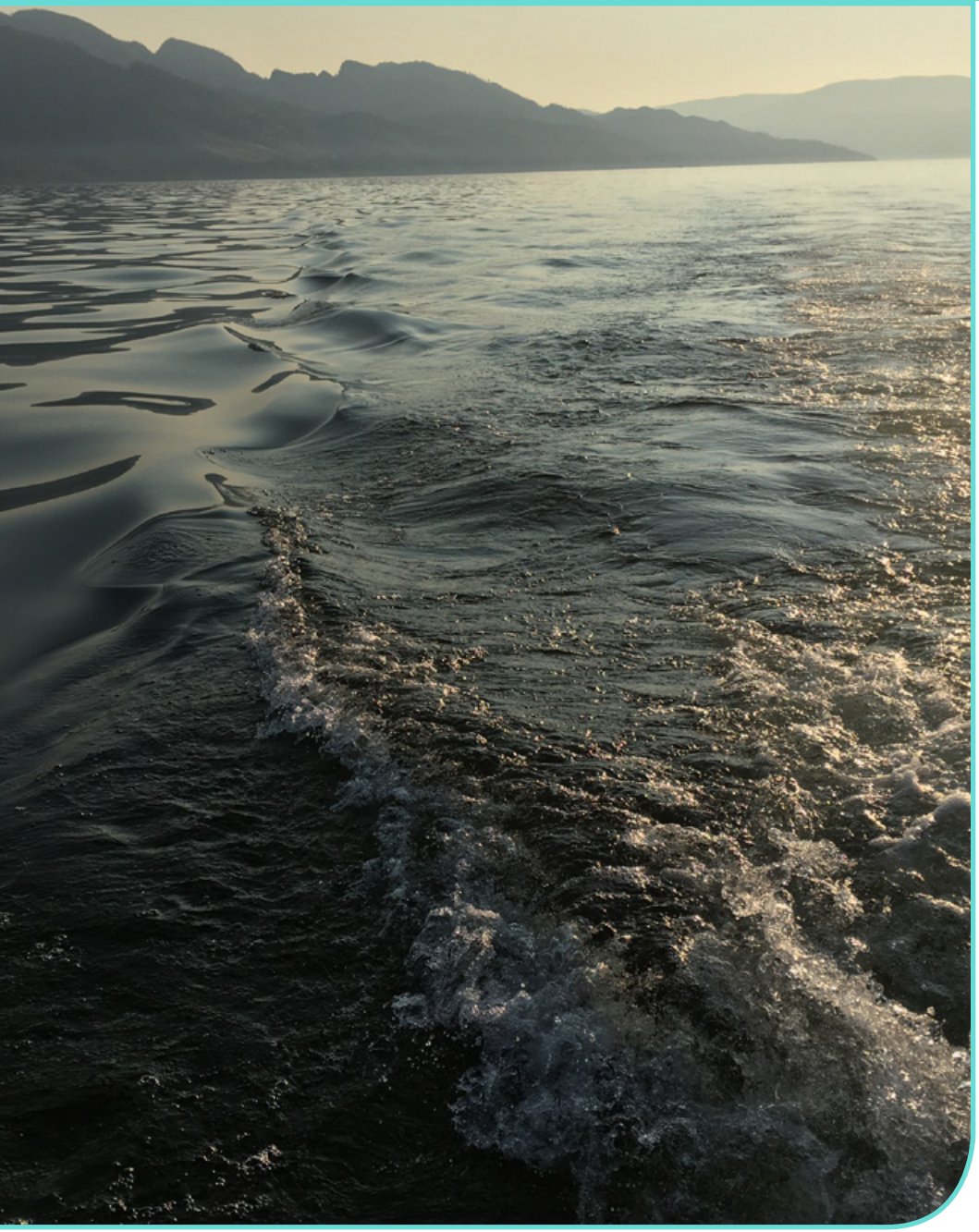
- Increasing water licence requests put pressure on the water systems and availability, underscoring the need for a valley-wide approach to water management.
- In 2010, the OBWB released its Okanagan Water Supply and Demand Study.[4] At the time it was considered the most comprehensive study of its kind in Canada. The study was conducted recognizing high water use in the valley, a variable water supply, and the impact population growth and climate change could have on water supply and demand and the sustainability of aquatic ecosystems.
- Between 2015 and 2018, with water meter data now available in several Okanagan communities, the OBWB updated some of the research. It compiled and studied water meter data from communities in the North, South and Central Okanagan and determined that the average Okanagan household uses 1,032 litres of water each day.
- The figure of 1,032 L/day is an annual average for all Okanagan households. The study shows that the average home uses 391 litres indoors/day, and 641 litres outdoors per day (mostly in summer). As the chart on the left shows, residential outdoor water use

4 https://www.obwb.ca/wsd/ and https://www.obwb.ca/wsd/wp-content/uploads/2011/02/339_2011_summary_report.pdf

starts to spike in April when we turn on the taps for our lawns and gardens and continues into October. Some people even water in November.

- The research also shows which sectors use what amount of water, and when. Agriculture accounts for the largest use of water. And, as one might expect, the greatest amount of water is used April to October, due to crop irrigation. While water use by some sectors remains stable throughout the year (e.g. commercial), other sectors use more mid-spring to mid-fall to meet outdoor watering needs (e.g. golf courses, parks, and agriculture).
- Learn more about where the Okanagan's water comes from on the Okanagan WaterWise website at https://okwaterwise.ca/prog_one-valley-one-water.html, and for information on how the water is managed and which sectors use how much and when at https://okwaterwise.ca/learn-go.html.





THE IMPACT OF INCREASING AVERAGE GLOBAL TEMPERATURES AND CLIMATE CHANGE

"Climate Projections for the Okanagan,"[5] a report prepared for the three Okanagan regional districts in partnership with the OBWB and others, looks at projected changes in the valley for the 2050s and 2080s. According to scientific modeling, the Okanagan is expected to experience warmer temperatures year-round, hotter and drier summers, longer growing seasons, warmer winter temperatures, increased precipitation in all seasons except summer, and seasons may shift.

The report lays the groundwork for everyone to respond and act in a meaningful way to help mitigate the potential challenges we face in the years ahead.

What do you think will happen when the temperature in the atmosphere rises? What are the possible effects of this increase in temperature?

Even slight increases in average global temperatures can have huge effects. If the climate of an area changes, the people who live there may no longer be able to grow the crops they depend on for survival. Or, they may have to adapt and grow different crops. Many human societies depend on specific crops for food, clothing, and trade.

5 http://www.rdno.ca/docs/200104_OK_ClimateReport_Final.pdf

IMAGES FROM "CLIMATE PROJECTIONS FOR THE OKANAGAN" REPORT

How do you think a change in the climate could impact animals?

As climates change, so do the habitats that living things rely on for food, water, shelter, and protection from predators. Plants and animals are adapted to live in a particular kind of climate so if the climate changes, they may no longer be able to survive in the places where they usually live.

Can you think of an animal in the Okanagan Basin that is susceptible to changes in climate?

Monarch butterflies in the Okanagan overwinter along the Coast of California. Researchers have found that in addition to tree removal, the severe drought and wildfires in California may be impacting the survival of the tree groves where the butterflies spend the winter months.

Early spring freshet and greater water turbulence can scour salmon eggs from the gravel in creeks, rivers, and along shorelines. Also, salmon require cool water. Lower summer streamflows on snowmelt-dominated creeks can result in warmer water temperatures, causing problems for fish returning to spawn in the fall.

What could be the impact of climate change on *Syilx* culture?

The *Syilx* people are a salmon people. Salmon is a major food source - it is the source of *Syilx* ceremonies, laws and stories, and is one of the Four Food Chiefs. The loss of salmon in the past has shown that this results in not only a loss of a food source, but also a loss of trade source, knowledge (about how to fish), and relationships (the ability to spend time fishing with family and/or friends, or sharing the catch). Learn more about the importance of salmon to the *Syilx* people.[6]

6 Okanagan Nation Alliance, https://www.syilx.org/fisheries/

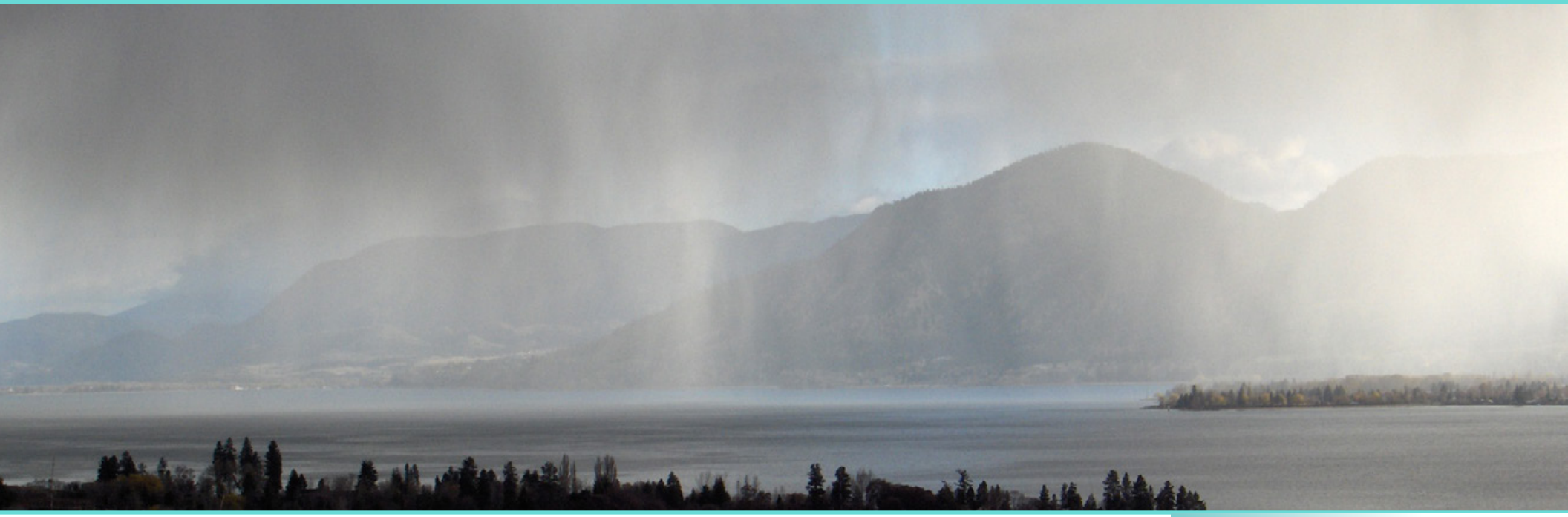


PHOTO COURTESY ZOE KIRK

Changes in Precipitation

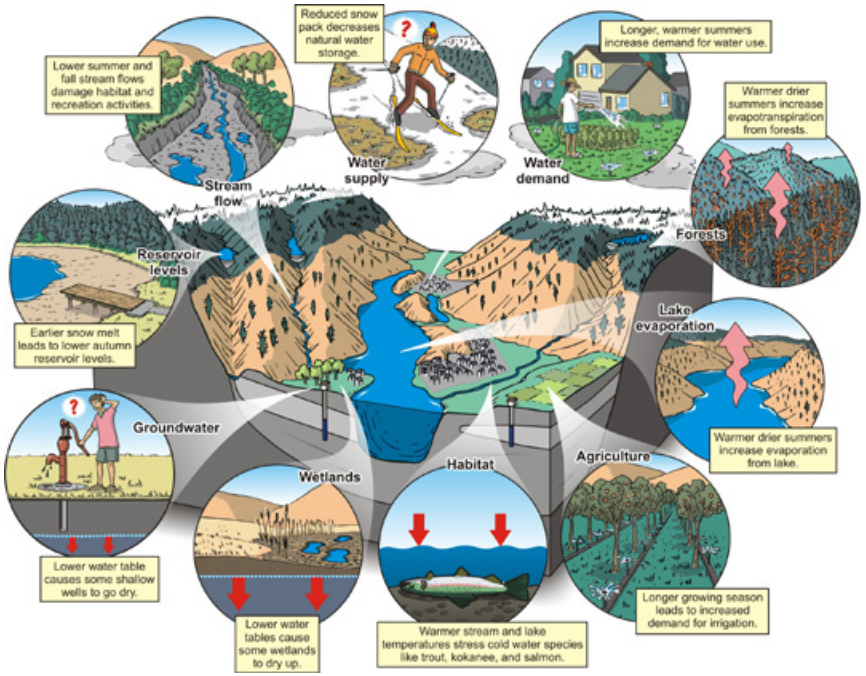
Over the course of the 20th century, precipitation increased in eastern parts of North and South America, northern Europe, and northern and central Asia. However, it has decreased in parts of Africa, the Mediterranean, and southern Asia. The Okanagan has also seen the impacts of climate change. In the last few years, the Okanagan has experienced periods of flooding, drought and fire all within a few weeks of each other. Scientific research indicates that these extreme weather events will become more common in our valley.[7]

What kinds of changes might happen in the Okanagan if the amount of precipitation changes significantly?

- changes in rainfall patterns could lead to alternating periods of drought and flooding events with extreme weather events/intense storms
- drought conditions (higher air temperatures and less water, including in the creeks) could change the temperature of our creeks and rivers, which in turn effects the fish and other aquatic life

7 https://www.makewaterwork.ca/our-water-story/

- temperature changes in freshwater systems might lead to algal blooms[8] in the lakes. Harmful algae usually bloom during the warm summer season or when water temperatures are warmer than usual. Warmer water due to climate change might favour harmful algae in several ways:
  - Toxic blue-green algae prefer warmer water.
  - Warmer temperatures prevent water from mixing, allowing algae to grow thicker and faster.
  - Warmer water is easier for small organisms to move through and allows algae to float to the surface faster.
  - Algal blooms absorb sunlight, making water even warmer and promoting more blooms.
  - Algae need carbon dioxide to survive. Higher levels of carbon dioxide in the air and water can lead to rapid growth of algae, especially toxic blue-green algae that can float to the surface of the water.
- Extreme rainfall events could lead to increased erosion.



OKANAGAN BASIN WATERSCAPE POSTER - CLIMATE CHANGE IMPACTS

Changes in Precipitation information sources:
http://nationalgeographic.org/encyclopedia/greenhouse-effect/
https://www.epa.gov/nutrientpollution/climate-change-and-harmful-algal-blooms
http://www.omafra.gov.on.ca/english/engineer/facts/12-053.htm

8 https://www.obwb.ca/bga/

Erosion

Erosion is the process by which soil and rock are removed from the Earth's surface by wind or water flow, and then transported and deposited in other locations.

One of the most obvious ways erosion affects waterways is the deterioration of the shoreline. Factors like wind and rain can cause the erosion of the land at the edge of a creek, river or lake, and high water volume also impacts the health of the shore.

Another way erosion affects waterways is in the sediment that ends up in the water. Gravity does its job, and dirt and other particles in a body of water sink to the bottom. Increased erosion near a creek, river or lake can cause an increase of sediment in the waterbody, which can be problematic in several ways:

- A large amount of sediment can cause a creek or river to 'rise' in height (as it fills from the bottom, and the sediment displaces the water) which might make the river more prone to flooding outside its previous banks.
- Sediment often contains pollutants and disease-causing micro-organisms, and the increase of pollutants in a waterway has negative consequences on the health of both plant and animal living there.
- Excess sediment in the water causes issues with regards to fish and fish habitat.

Erosion information source:
https://creeklife.com/blog/river-erosion-what-it-is-how-it-happens/

EROSION CAUSED BY HIGH WATER LEVELS AND WAVE ACTION ALONG OKANAGAN RAIL TRAIL, SPRING 2020
PHOTO COURTESY RDNO

ROAD EROSION IN LAKE COUNTRY DUE TO OKANAGAN LAKE FLOODING IN 2017
PHOTO COURTESY DISTRICT OF LAKE COUNTRY

SYILX PERSPECTIVES

siwɬkʷ (water)[9]

According to the ***Syilx*** people, ***siwɬkʷ*** (water) is sacred[10]. It is a living, sacred relative that provides life. It is not a resource to be owned or exploited.

Syilx people see themselves as borrowing the land and water from future generations which is different than the western concept of ownership. This Indigenous world-view impacts the way land and water is cared for and the way decisions are made. When something is borrowed the best care possible is expected from the borrower. When something is owned, that care is at the discretion of the owner, sometimes maximizing short-term benefits to the detriment of the item or even destruction.

One of the most important insights into *Syilx* perspectives and world view comes from the word ***siwɬkʷ*** (water). The first part of the word refers to the way humans drink (e.g. from cupped hands or a vessel) and the second part refers to the sound animals make as they drink (i.e. lapping). This word represents the idea that both humans and animals have an equal right to the water.

Humans are a part of the environment not apart from the environment. Every living thing is interconnected...a part of the ecosystem.

9 https://www.syilx.org/natural-resources/water
10 https://syilx.org/water-declaration

Water as a humble spirit

Watch the video, The ***sukna?qín̓x*** (Okanagan) is Beautiful, found at:
https://www.youtube.com/watch?v=xuRjeRXAWbo

The *Syilx* people have identified the paths of water and its inherent nature as a sustainer of life. The video points out how water is interconnected and integral to the Okanagan Valley. The ***Syilx*** people honour the waters that give life to them as well as the land.

In the classroom, use this video to identify how water flows in the Okanagan watershed. Look at the video from a wholistic outlook to incorporate the local Indigenous people's worldview and perspective.

NX̌AʔX̌ʔITKʷ **SCULPTURE, LOCATED AT WESTBANK FIRST NATION, 1900 QUAIL LANE, BY ARTIST SMOKER MARCHAND.**[12]
PHOTO COURTESY VISITWESTSIDE.COM

ṅx̌aʔx̌ʔitkʷ (in-ha-ha-itk-hoo)[11] The Sacred Being of the Water

This word means sacred being of the water:
x̌aʔx̌ʔ (sacred) and *itkʷ* for water.

ṅx̌aʔx̌ʔitkʷ was misappropriated by early European settlers and renamed "Ogopogo" and described as a monster. It later was commodified, represented in toys, books, and other items for sale.

ṅx̌aʔx̌ʔitkʷ reminds us that the lake does not belong to us. It is the home of *ṅx̌aʔx̌ʔitkʷ*. Whenever we go to the lake we should show the same respect as we do when we enter someone else's home. This is a different way of understanding that everything is not just here for human use and cannot be owned.

When going to the lake for a ceremony, *Syilx* people may offer a gift to show respect just like we might bring a gift when we visit someone's home. *Syilx* may not make an offering on a day at the beach, but feel that we should always be conscious of the respect in our hearts and minds for the water, as visitors to the home of *ṅx̌aʔx̌ʔitkʷ.*

11 ***ṅx̌aʔx̌ʔitkʷ*** pronunciation: https://www.firstvoices.com/explore/FV/sections/Data/nsyilxc%C9%99n/nsyilxc%C9%99n/Syilx/learn/words/98976e54-b0b4-45b3-b9a2-97861937b140
12 http://www.wfn.ca/docs/public-art-heritage-brochure.pdf

siya? **(SASKATOON) BERRIES**

Climate Change Impacts on "Indicators"

An important part of Traditional Ecological Knowledge is the understanding of the complex relationship between the seasonal timing of events and the life cycles of plants and animals. Changes in species act as indicators, or signals, for other life cycle events or natural phenomenon. (Scientists call them phenological indicators, and this key knowledge is called "traditional phenological knowledge.") Environmental events are linked together in memory. For example, sunflowers blooming is linked to the time of coyote puppies. The time when the ***siya?*** (Saskatoon) bushes[13] are blooming tells the people when Rainbow Trout are starting to come up Mission Creek.

Climate change is already starting to have a big effect on lifecycles and the environment. However, not everything is affected in the same way.

What happens if the ***siya?*** (Saskatoon) bloom earlier or later than the fish appear? What happens if less precipitation falls at a certain time of year? These events start to become mismatched and no longer coincide. This affects the passing on of traditional knowledge which relies on a certain sequence of events.

But there is also the impact on - even threatening of - species due to climate change. For example, certain native bees depend on specific native plants. If the plants are not blooming at critical times in the life-cycle of the bee, both species can be put at risk.

13 ***siya?*** pronunciation: https://www.firstvoices.com/explore/FV/sections/Data/nsyilxc%C9%99n/nsyilxc%C9%99n/Syilx/learn/words?page=1&pageSize=10&searchTerm=siya?&searchStyle=match&searchByTitle=true&searchByDefinitions=true&searchPartOfSpeech=Any&searchByTranslations=false

Activity:

Where Does the Water Go?

Grades: K-3

K 1 2 3 4 5 6 7 8 9 10 11 12

BC Curriculum Core Competency:

Communication

Science:

Living things have features that help them survive in their environment.

Curricular Competencies:

- Demonstrate curiosity and a sense of wonder about the world
- Observe objects and events in familiar contexts
- Ask simple questions about familiar objects and events
- Discuss observations
- Communicate observations and ideas using oral or written language, drawing, or role-play
- Collect simple data

Materials:

- Large, clear glass jar or vase
- Two chopstick, dowels, or thick skewers
- Clear packing tape
- Plant pot that has a smaller diameter than the opening in the jar/vase and has drainage openings in the bottom
- Clump of dug up soil and plants; for example, a spade's worth of grass or weeds, including the soil
- Water in 250 mL or larger pourable measuring cup
- Chart paper to record results

WATER IN:	WATER OUT:	DIFFERENCE:
100ML		

What to do:

- Take the plant pot and turn it over. Tape the two chopsticks into an X on the bottom of the pot using the clear packing tape. Do not block the drainage holes in the pot. Loosely fill the pot with grasses/weeds and soil. Using the chopsticks as supports, place the pot on top of the glass jar or vase.
- Prior to the experiment, talk with students about their observations on rainy days.
  - Where does the rain go when it hits the ground?
  - What makes a puddle?
  - Where does the water from puddles go?
  - What happens when rain lands on plants and soil?
- Discuss. Record observations as a list on chart paper. When students raise other questions about rainfall, list them on a different chart paper and display prominently.
- Show the students that there is 100 mL of water in the measuring cup. Tell students that you are going to have a volunteer pour 100 mL of water into the pot.
  - Have students predict:
  - What will happen if I pour water into the plant pot?
  - What will the water look like when it drains through?
  - How long will it take the water to drain through?
  - Will the water that drains through equal the same amount as was poured in?
- You may wish to make a video of this experiment.
- Proceed to pour the water into the pot. Observe what happens.
- After the water has finished draining, remove the pot and pour the water from the bottom of the jar into the measuring cup.
  - How much was collected? Record on the chart paper.
- Repeat the process with greater volumes of water, having students predict how much water will drain through. Remember, saturated soil will give different results. This is worth discussing, too. Have the students touch the soil and develop vocabulary to describe the textures: moist, soggy, saturated, damp, sodden, water-logged, squelchy.
- Help students to develop understanding that precipitation is absorbed by the plants, grasses, soils, and sand. This rainwater becomes “groundwater.”

Activity:

Building a Watershed Model

Grades: 4-12

K 1 2 3 4 5 6 7 8 9 10 11 12

BC Curriculum Core Competency:

Thinking

Science:

The biosphere, geosphere, hydrosphere, and atmosphere are interconnected, as matter cycles and energy flows through them.

Curricular Competencies:

- Demonstrate curiosity and a sense of wonder about the world
- Discuss observations
- Communicate observations and ideas using oral or written language, drawing, or role-play
- Collect simple data
- Make observations aimed at identifying their own questions about the natural world
- Observe, measure, and record data (qualitative and quantitative), using equipment, including digital technologies, with accuracy and precision
- Suggest improvements to their investigation method

Materials:

- Large sheets of strong plastic (4m x 2m)
- Assortment of rocks, sticks, crumpled paper, crushed cans
- Water source (hose or buckets of water)
- Golf tees
- Spray bottle
- Sponge
- Blackline Master (BLM) 1 and 2

What to do:

- Divide students into groups of 3-4.
- Give each group a sheet of plastic, a plastic pail and a handful of golf tees.
- In the schoolyard (preferably in an area close to a water source and with a slope) have each group collect rocks, sticks, crumpled paper etc. ... (this can be collected before the class by the students).

- Have students arrange the objects to create an uneven landscape. The tall objects will become the mountains, shorter objects may become lakes, hills, etc. Cover the objects with the plastic sheet and tack down the outside edges with golf tees.
- Gently mould the plastic around the objects.
- Ask students to predict what will happen when it 'rains' on their model.
- Using the spray bottle, have the students spray water, starting at the top of the landscape.
- Continue raining until streams, rivers and lakes begin to form.
- Ask students to think about what other habitats are found in the Okanagan Basin. If they can see hills around them, ask them to look for areas where the water drains down the slope - is the vegetation different? (e.g. in grasslands, the natural drainage can often be spotted because of the shrubs and trees that live there).
- Have students choose a site in the watershed to build their homes, school, farms, industry, etc. What happens when it rains? Are the homes and schools safe from flooding? How do farms access water?
- Students could demonstrate the impact of a resource extraction industry on the watershed (e.g., students 'plant a forest' by placing a large flat sponge for the forest - it will soak up water like soil and vegetation). What happens if you remove the forest (sponge)? Or demonstrate water from a tailings pond at a mine site overflowing (e.g. could use food colouring diluted in water to represent water from the tailings pond).
- Have students experiment with their river by rearranging the landforms, building dams and changing the rate of water flow. For example: have students take water away from their 'river/creek' for irrigation by making 'canals.'
- Have students write down or draw their observations. Consider video-taping the building of the watersheds and the 'rain' event.

STARTING TO BUILD A WATERSHED

ADDING VEGETATION TO HOLD WATER

ADDING WATER TO WATERSHED

INTRODUCING HUMANS & ANIMALS TO WATERSHED

INTRODUCING POLLUTANTS TO WATERSHED

ILLUSTRATING POLLUTANTS

Discussion:

Distribute BLM 1 and 2 (consider providing these questions to students before they begin building the model; students to provide the answers after they have completed the building of the model)

- Where is the source or headwater of the lake?
- Where does the water flow?
- Why does it follow that path?
- Where does the water pool?
- What things on the landscape determine the watershed or basin?
- What determines the boundaries of the watershed?
- Who might use your watershed and how? Explain where you located your houses, farms, etc. Why did you decide this?
- How might point-source pollution (from a single source) or nonpoint-source pollution (from many places all at once) enter the watershed? (e.g. factories can be a source of point-source pollution. Rainwater washing dog waste, fertilizer from lawns, or oil leaked from car engines can be sources of nonpoint-source pollution.)
- Where do most of the people in the Okanagan Basin live (in the valley bottom? on the hillsides?). Where are most of the farms located in the Okanagan Basin?
- Where do you think most of the animals live in the watershed? Do you think that has changed since humans started to build their homes and businesses here?
- What are other things that we do in our watershed (e.g. recreation - skiing, boating)?
- How can nature or people change a watershed?
- Can you think of ways that climate change could change the watershed?

Extension:

- Have students reflect on the connection between their watershed and climate change. Where did they choose to locate their houses, farms etc.? Is there a way they could redesign their watershed to reduce greenhouse gas (GHG) emissions? On the flip side, have students imagine how climate change might impact the watershed. Have students re-build their model to reflect these changes.
- Have students videotape the ‘before’ and ‘after’ watersheds. The videos can be watched by the class (could also be evaluated by the class).

BLACKLINE MASTER: WATERSHEDS

What is a watershed?

If you are standing on ground right now, just look down. You're standing, and everyone is standing, in a watershed. A watershed is the area of land where all of the water that falls in it, and drains off it, goes to a common outlet. Watersheds can be as small as a footprint or large enough to encompass all the land that drains water into a river that eventually drains into the ocean.

A watershed can consist of surface water (e.g., lakes, streams, wetlands) and all the underlying groundwater. Larger watersheds contain many smaller watersheds. It all depends on the outflow point; all of the land that drains water to the outflow point is the watershed for that outflow location.

A river basin, or watershed, is high at its edges and low in its centre, where the water flows.

What watershed do you live in?

The Okanagan Basin includes all the land that feeds water to our big lakes. Vernon, Kelowna, Penticton, and Osoyoos, all lie within the Okanagan Basin.

The Okanagan River drains the lakes and flows south across the Canada/U.S. border into the Columbia River, which flows past the city of Portland into the Pacific Ocean.

How can you tell one watershed from the next?

The divide between watersheds is the ridge or point on land at which water flows in two different directions. For example, falling rain might land and flow down two different sides of a mountain, dividing into distinct watersheds on either side.

Watersheds can be different sizes. We can describe specific watersheds in our communities, but in reality, they are connected. If we trace the way water flows, we see that one watershed drains into another, forming a nested system.

Why are watersheds important?

Watersheds are important because the streamflow and the water quality of a river are affected by things, human-induced or not, happening in the land area "above" the river-outflow point.

Healthy watersheds are important to all life on Earth. They are the source of our drinking water, and the water needed by other animals and plants in the watershed. And they supply the water needed on farmer's fields to grow our food. Every watershed is different, shaped by variations in geology, weather, ecology and human activity. The more we understand about our watersheds, the better chance we have of sustaining a clean and healthy water supply.

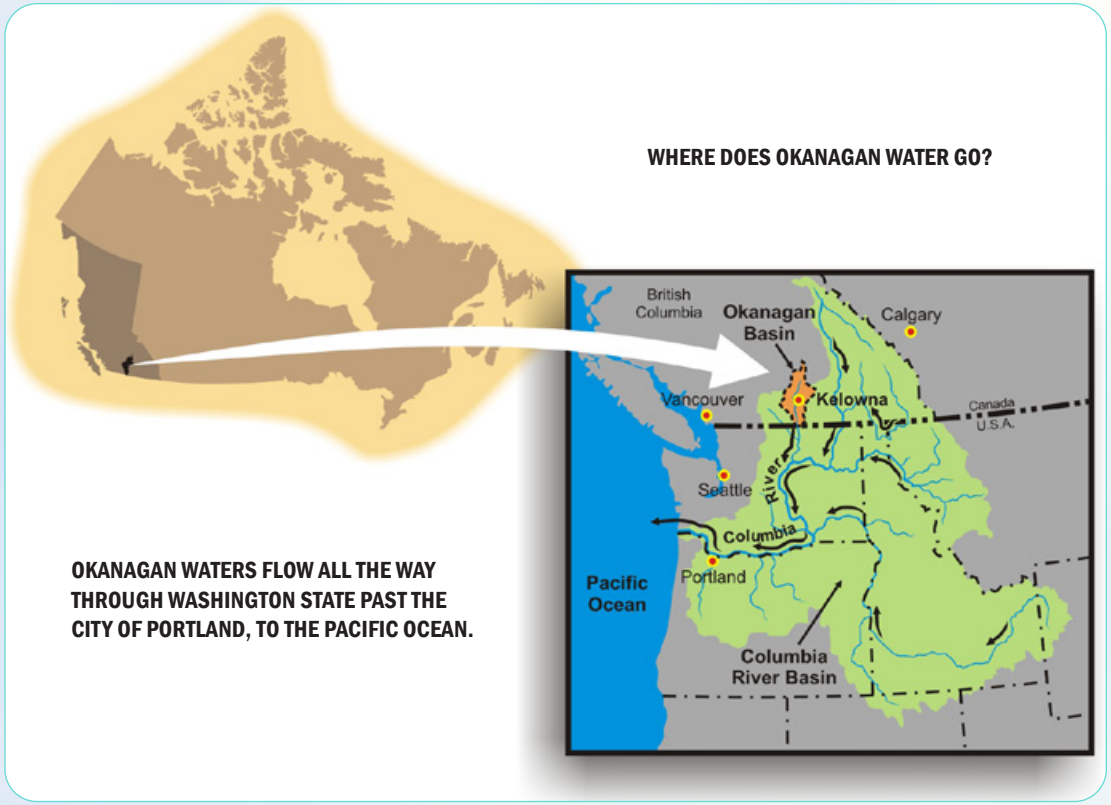
BLACKLINE MASTER 2: OKANAGAN BASIN

From: http://www.soks.ca/okanaganwaterscapeteachersguide/index.html

What is the Okanagan Basin?

Background Information

A river basin or watershed is high at its edges and low in the centre where the waters flow. The Okanagan Basin includes all the land that feeds water to our big lakes and the Okanagan River. Highland streams from east and west flow into the valley, and the waters flow south down the valley through the chain of lakes to feed into the Columbia River System. The Okanagan Valley is a trough that extends from Armstrong in the north to Osoyoos Lake in the south. The valley is the part of the basin we know best, but it is just a small part of the overall basin. The Okanagan Basin and valley continues south across the international border into Washington State.



Activity:

Soil Erosion Experiment

Adapted from: http://www.lifeisagarden.co.za/soil-erosion-experiment/#.U3uAtVhdVmc

Grades: 4-12

K 1 2 3 4 5 6 7 8 9 10 11 12

BC Curriculum Core Competency:

Thinking

Science:

The biosphere, geosphere, hydrosphere, and atmosphere are interconnected, as matter cycles and energy flows through them.

Learning Intention:

Students set up an experiment to investigate the effect of water erosion in three different scenarios - bare soil, soil covered in mulch, soil with growing plants.

This experiment can lead students to think about the connections between erosion and water quality. From there, students can consider the impacts of climate change on water quality: more extreme rainfall events, increased erosion, reduced water quality.

Curricular Competencies:

- Demonstrate curiosity and a sense of wonder about the world
- Discuss observations
- Communicate observations and ideas using oral or written language, drawing, or role-play
- Collect simple data
- Make observations aimed at identifying their own questions about the natural world
- Observe, measure, and record data (qualitative and quantitative), using equipment, including digital technologies, with accuracy and precision
- Suggest improvements to their investigation method

Materials:

- 2 L soft drink bottles (6 per group of students)
- Plywood (approximately 1 piece 30 cm x 30 cm in size per group)
- Wood glue
- Scissors
- Utility knife
- String
- Garden Soil
- 4 Seedling Plants
- Mulch (wood chips, dead leaves, sticks)
- Water

What to do:

- Using a permanent marker, have students mark a rectangular hole along the side of three of the bottles approximately 7 cm x 25 cm. Cut the hole out of each.
- Glue the bottles to the wood. Be sure that the necks of the three bottles stick out over the edge of the board.
- Fill the three bottles with garden soil, firmly pressing in the soil, leaving some room to add mulch and plants.
- Cover the top of the soil in the second bottle with mulch.
- Plant seedlings in the third bottle tightly together. Be sure to press down the soil firmly.
- Cut the other 3 bottles horizontally in half. Keep the bottom half.
- Make two small holes on either side of the bottle near the cut.
- Cut three pieces of string (~25cm long) and insert each end into the holes. Tie a knot on the ends to secure them. This forms a 'bucket' to collect the water.
- Hang the 'buckets' over the necks of each of the three bottles on the board.
- Slowly pour equal amounts of water into each of the bottles. Pour the water in at the end furthest from the neck of the bottle.
- Have students predict what will happen over time when water is poured in each of the bottles. Do they think that the water running out into the buckets will look the same in each case? Why?
- Have students water their bottles every day over a period of two weeks and record what they see in the buckets.

GLUING BOTTLES TO WOOD

ADDING SOIL TO BOTTLES

HANGING BUCKETS TO CATCH WATER

POURING WATER INTO SOIL

DEEP CREEK AT O'KEEFE RANCH IN VERNON, BEFORE HABITAT RESTORATION, JUNE 2018.

AFTER RESTORATION, OCTOBER 2020. NOTICE THE WATER COLOUR.

Discussion:

- What did you observe in your collection buckets? Was the colour of the water the same in each? What made the difference in colour? Why do you think there was more soil in the first bottle compared to the other two?
- Do you think that soil runoff (erosion) is a problem? Why?
- Think of, or visit, a nearby creek or river. Are there trees or plants along its edge? What do you think would happen if that vegetation was removed?
- What are some of the ways that a creek or river can be impacted by erosion?
- Discuss what animals live in the creek or drink from the creek. What is the impact of clean vs. polluted water on these animals?
- Many creeks are either drinking water sources, or drain into drinking water sources. Why is it important to keep this water clean?
- Many have seen creeks in the valley bottom. Have you ever noticed a creek up in the hills, or the "backcountry?" What do you think happens to the creek water when there is a fire, vegetation is lost, and then it rains?
- How might climate change impact rates of erosion?

Extension:

- Have students go for a walk around their school grounds. Can they find any examples of erosion? Can they think of things that could be done to reduce the erosion?

Activity:

AfterMath

adapted from: http://sierraclub.bc.ca/wp-content/uploads/2015/08/climate-change-learning-resource.pdf

Grades: 8-12

K 1 2 3 4 5 6 7 8 9 10 11 12

BC Curriculum Core Competency:

Thinking

Science:

The biosphere, geosphere, hydrosphere, and atmosphere are interconnected, as matter cycles and energy flows through them.

Curricular Competencies:

- Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal interest
- Seek and analyze patterns, trends, and connections in data, including describing relationships between variables (dependent and independent) and identifying inconsistencies
- Collect data
- Formulate multiple hypotheses and predict multiple outcomes
- Observe, measure, and record data (qualitative and quantitative), using equipment, including digital technologies, with accuracy and precision
- Suggest improvements to their investigation method

Materials:

- Catalogues of household items
- Classified ads for real estate and advertisements for new and used automobiles
- Paper and pencils
- About 300 small pieces of scrap paper (1cm square) in a bag
- A collection of local, provincial and national newspapers and magazines with water-related disaster stories (e.g., flood, drought, hailstorm, ice storm).

What to do:

- Generate a list of water-related weather events. Discuss the role of each event from an ecological perspective. What determines whether a natural event like a flood or drought is a disaster? Who makes that determination?

- Ask students to think of their own bedrooms. Imagine that their rooms are on the first floor of their homes. A flood occurs in their community. The water is rising in their rooms. It is now a foot deep. Tell students that the water will not recede for two to three days. How will their personal possessions be affected? (The longer water remains in a house, the greater the likelihood of structural damage.)
- Rescue workers tell students that they can take five items with them. Which personal possessions would they select? Have students discuss the "value" of these possessions. Do these items reflect an emotional or an economic worth?
- Inform students that they will be part of a flood simulation and will calculate the economic losses of the aftermath. Have students arrange their chairs or desks in rows to form a grid.
- Assign each student to a square on the grid. Tell students that the square represents their home and property. Have students determine "property values" for their squares.
- Distribute catalogues, magazines and newspapers with ads for houses and automobiles. Tell each student to clip pictures of a house and two cars. Have them select furnishings and appliances for their home. Students should record all items and associated costs and determine the value of their assets.
    - Ask students to stand at their desks. Give a bag of paper squares to one student.
- Inform the student that when you say "Now", he or she should move diagonally from the upper right-hand corner of the grid to the lower left-hand corner. The student will weave among the desks and toss handfuls of paper over his or her head and from side to side.
    - After the student has reached the lower left-hand corner of the grid, ask all students to be seated. Ask students to gather as many pieces of paper (representing flood damage) as they can without leaving their seats.
- Tell students that warm early spring temperatures have prompted the onset of freshet with a quick snowmelt. This is followed by extreme rains and creeks are overflowing their banks. Land variations and differences in elevation affect the amount of flooding along the creek's length.
    - Tell the students that they will now calculate the value of the loss of property. Each piece of paper collected represents a $1,000 loss from floodwater damage.
- Have students determine their individual losses by comparing the value of the flood damage with the value of their assets.
    - Draw the grid on the board. Write the economic loss for each student in the squares on the grid. Have students connect areas of similar property loss.
- Have students compare property losses to their locations on the grid. Discuss how people living in heavily damaged areas would feel compared to those who missed the worst of the damage.
- Ask students to think about other weather-related events that happened recently in the Okanagan Basin that led to property damage (e.g. the Okanagan has experienced forest fires in interface areas that have been made more severe after periods of low precipitation and extreme heat; drought; landslides after an extremely heavy rain event, etc.).
- Ask students to consider how climate change might lead to more 'disasters' (events that have a significant social, environmental and/or economic impact).
- What can communities do to reduce the chances of such disasters?
- Ask students which they think is more economical:
    - Government invests money towards things that reduce greenhouse gas emissions (e.g. public transit) OR
    - Government pays for helping repair damage and compensates people for their loss of property each time a weather-related disaster occurs.

Activity:

“Beyond Climate”—Film Discussion

Grades: 7-12

K 1 2 3 4 5 6 7 8 9 10 11 12

BC Curriculum Core Competency:

Communication and Thinking

Science:

Humans can play a role in stewardship and restoration of ecosystems.

English Language Arts:

Exploring stories helps us understand ourselves and make connections to others and the world.

Socials:

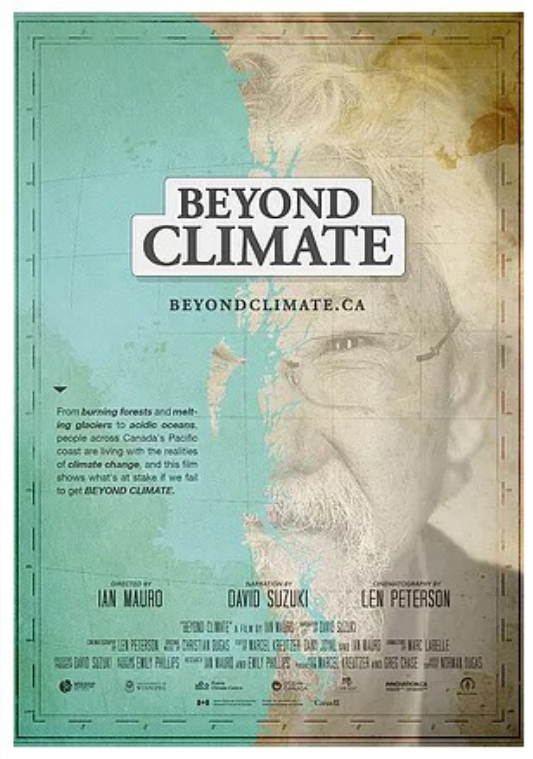
Human activities cause changes in the global climate system.

Activity Summary:

Beyond Climate is a timely, touching and hopeful documentary that looks at how climate change is already affecting us here in the Okanagan and around B.C., and how we can effect change. Find the Beyond Climate film here: https://www.beyondclimate.ca/

Students will watch “Beyond Climate” to learn about how climate change is affecting British Columbia, including the Okanagan, and the steps we can take to change it.

Following the film, students will engage in a discussion about what they learned in the film and how they can respond to climate change.



Curricular Competencies:

- Demonstrate an understanding and appreciation of evidence (quantitative and qualitative)
- Transfer and apply learning to new situations
- Generate and introduce new or refined ideas when problem solving
- Communicate ideas, findings, and solutions to problems, using scientific language, representations, and digital technologies as appropriate
- Synthesize ideas from a variety of sources to build understanding
- Respectfully exchange ideas and viewpoints from diverse perspectives to build shared understandings and extend thinking
- Express and support an opinion with evidence

Materials:

- *Beyond Climate* film

Time required:

- Film length: 48 minutes
- Discussion: 30 minutes – 1 hour (at instructor's discretion)

What to do:

- Watch the Beyond Climate film as a class. Encourage students to take notes as they view the film. Notes can include information, facts, and inquiry questions raised by the film's content.
- Following the film, engage in a discussion with the class. Below are some suggested prompts for discussion:
  - Why would Ian Mauro, the director of the film, title the movie Beyond Climate?
  - The film states that B.C. is a hotspot to see and experience how global warming is affecting local ecosystems and communities. What are some of the changes that you have seen in the Okanagan over your lifetime?

    Consider inviting people who have lived in the Okanagan over the past several decades (e.g. parents, grandparents, *Syilx* Knowledge Keepers) about the changes they've seen and the impact to the watershed and climate.
  - The film uses Vancouver as an example of a "green city." What steps can our communities in the Okanagan take to become more "green?"
  - The film calls climate change "the paramount issue of our time." Do you agree, or disagree? Tell us why.
  - What can you do to engage your school, family or neighbourhood to participate in solutions to the challenges we are facing?
- Write a letter to the editor of your local newspaper or your City Council telling them why climate change solutions and protecting water are important or how your community can become "greener."
- Organize a garbage clean-up in a wetland, beach, or creek in your neighbourhood
- Plant a tree that is indigenous and/or WaterWise to the Okanagan Valley. [1]
- Create a song, poem, or video to raise awareness about an environmental issue in your community that you are passionate about.

MAKE CURRICULAR CONNECTIONS

Write a letter to the editor of your local newspaper or your City Council telling them why climate change solutions and protecting water are important or how your community can become "greener."

1 www.MakeWaterWork.ca/plants

Activity:

Explore a Wetland

Grades: K-12

K 1 2 3 4 5 6 7 8 9 10 11 12

BC Curriculum Core Competency:

Communication and Thinking

Science:

Human practices can affect the sustainability of ecosystems.

Background:

Wetlands, once considered a nuisance and a waste of valuable land, are an important part of our valley, providing many benefits for people and our planet.

A wetland is an area where the land is wet or flooded for at least part of the year. Wetlands include marshes, bogs, fens, swamps and areas of shallow open water. At one time, wetlands and riparian areas covered a large portion of our valley bottom. But during the last few decades, as we channeled water ways in an effort to control flooding, and as the Okanagan's population has swelled, we have filled in these areas with homes and other buildings. Today, more than 85% of our wetlands and natural riparian areas have disappeared and remaining areas are at risk of loss.

MAKE CURRICULAR CONNECTIONS

Help a habitat in need of garbage clean-up in your area such as the wetland you've visited, or a beach, creek, or wetland. Document it in photos or video.

Today, we understand the importance of wetlands. They act like giant sponges during storms, soaking up extra storm water which prevents flooding. They also act as "carbon sinks," absorbing carbon and giving off oxygen and are a critical tool in fighting climate change.

Of course, they are also home to a diverse ecosystem with many rare and endangered plant and animal species. Many people also enjoy visiting wetlands, listening to the singing of red-winged blackbirds, hoping to spot a majestic Great Blue heron, or a frog or Painted Turtle.

Also, check out some of the wetlands featured at OkanaganWetlands.ca. Find text in English, French, as well as *nsyilxcən*, the language of the *Syilx* people who are the original inhabitants of the Okanagan.

Curricular Competencies:

- Demonstrate curiosity about the natural world
- Identify questions about familiar objects and events that can be investigated scientifically
- Collect simple data
- Experience and interpret the local environment
- Analyze cause-and-effect relationships
- Use knowledge of scientific concepts to draw conclusion that are consistent with evidence

Materials:

- Notebooks to take notes or drawings of observations
- Weather appropriate clothing
- Packed snack/lunch and water
- Optional: camera for photos and videos

ROTARY MARSH/BRANDT'S CREEK, KELOWNA

Time required:

- Half day to full day field trip (dependent on travel time)

What to do:

- Find a wetland in your neighborhood and plan a visit. Use the map here (https://okwaterwise.ca/waterwise-in-the-community.html) to help.
- Review the important role of wetlands in the environment.
- On the wetland visit, encourage students to:
  - Observe and record the different components of the ecosystem
  - Consider what are the roles and relationships in a wetland ecosystem? How do these contribute to biodiversity? Why is diversity important to a sustainable ecosystem?
  - Watch for animals, plants, and insects
  - How do healthy wetlands influence the well-being of humans?
  - Consider how human action affects the wetland
  - Consider how climate change could impact the wetland

Help a habitat in need of garbage clean-up in your area such as the wetland you've visited, or a beach, creek, or wetland. Document it in photos or video.

- Find old photos of your Okanagan community through the local museum. Notice the creeks, wetlands, floodplain. How have things changed? Discuss why it changed (e.g. for housing, agriculture, flooding). Is co-existence between wetlands and people possible? Understanding the importance of wetlands, is restoration possible?

Activity:

Green City Leaders —Mock Public Hearing

Grades: 7-12

K 1 2 3 4 5 6 7 8 9 10 11 12

BC Curriculum Core Competency:

Communication and Thinking

Science:

Energy is conserved, and its transformation can affect living things and the environment.

English Language Arts:

Questioning what we hear, read, and view contributes to our ability to be educated and engaged citizens.

Curricular Competencies:

- Demonstrate an understanding and appreciation of evidence (quantitative and qualitative)
- Transfer and apply learning to new situations
- Generate and introduce new or refined ideas when problem solving
- Communicate ideas, findings, and solutions to problems, using scientific language, representations, and digital technologies as appropriate
- Synthesize ideas from a variety of sources to build understanding
- Respectfully exchange ideas and viewpoints from diverse perspectives to build shared understandings and extend thinking
- Express and support an opinion with evidence

Materials:

- Large line drawing of the earth on roll paper (see below)

Time required:

- 2-3 class periods (approximately 2-3 hours)

What to do:

1. Break students into two groups.
2. Provide students with the following scenario:

Imagine that your local government has organized a public meeting so that members of the community can tell their City Council how they feel about a proposed development.

The proposal is to build a subdivision of townhouses and small homes. These homes will be affordable for many people. The town is in need of this kind of housing because it is currently hard for people to find affordable places to live.

About the development:

- The development is considered 'high density,' which means there will be many units (homes) built on the one piece of land.
- The proposed subdivision will be located next to a creek that runs through the city.
- The subdivision will be built on land that is currently a forested area and that supports a large variety of wildlife.
- One part of the land is steeply sloped.
- The development is far away from the centre of town.
- A new road system will also need to be built so that people that live in the subdivision can drive into town to work, to get groceries, run other errands, etc.

PHOTO CREDIT N.Y. TIMES

3. Explain to the students that one group will come up with a presentation for their City Council that is in support of the proposal, while the second group will be opposed to the proposal.

After students have made their pro/con presentations, tell them:

- The Mayor understands that there are both positive and negative things about the development; however, as the City is hoping to win an award this year for being the 'greenest' city in the province, the Mayor wants to improve this development proposal.
- The Mayor has decided to create a citizen's committee - made up of the two groups who presented at the public meeting. The Committee has been tasked with suggesting ways that the development can be improved/changed so that it does not have as high an impact on the environment (e.g. habitat loss, impacts on the creek, Green House Gas- GHG- emissions).

4. Have students (i.e. the Committee) brainstorm ideas about possible improvements to the development.

Do the students think that, even with the improvements, the City should accept the proposal and approve the development?

Activity:

Our Actions Matter—Reducing Greenhouse Gases Class Poster

adapted from: http://sierraclub.bc.ca/wp-content/uploads/2015/08/climate-change-learning-resource.pdf

Grades: K-6

K 1 2 3 4 5 6 7 8 9 10 11 12

BC Curriculum Core Competency:

Communication and Thinking

Science:

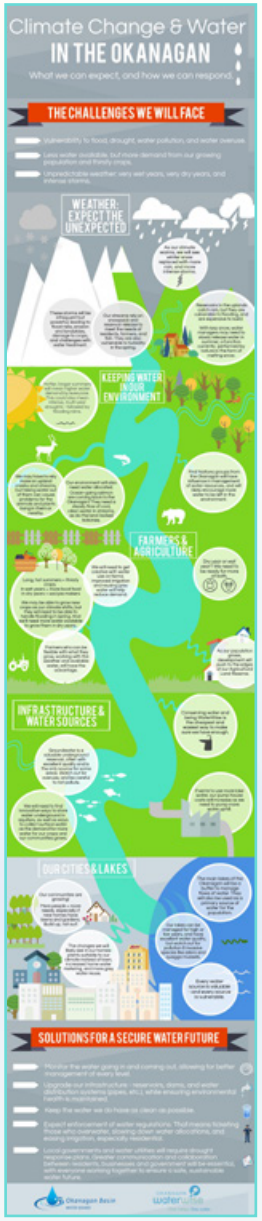
All living things sense and respond to their environment.

English Language Arts:

Using language in creative and playful ways helps us understand how language works.

Curricular Competencies:

- Demonstrate an understanding and appreciation of evidence (quantitative and qualitative)
- Transfer and apply learning to new situations
- Generate and introduce new or refined ideas when problem solving
- Communicate ideas, findings, and solutions to problems, using scientific language, representations, and digital technologies as appropriate
- Synthesize ideas from a variety of sources to build understanding
- Respectfully exchange ideas and viewpoints from diverse perspectives to build shared understandings and extend thinking
- Express and support an opinion with evidence



Materials:

- Okanagan WaterWise Climate Infographic[1]
- Teacher Background
- poster size pieces of paper
- art supplies

Time required:

- 50 minutes

1 https://okwaterwise.ca/waterwise-for-educators.html

What to do:

- Review the teacher background material (https://okwaterwise.ca/challenge/2019/2019_okww_challenge_public_info.pdf) to learn about the Earth's atmosphere, greenhouse gases, effects of climate change, and ways that everyone can reduce their carbon footprint.
- Review the "Climate Change & Water in the Okanagan" (https://okwaterwise.ca/resources/2018/obwb_climate_infographic.pdf) infographic.[2]
- Brainstorm with students ways we can help reduce greenhouse gases and the impact of these gases on our planet.
- Provide each student with a piece of paper and instruct students to use their knowledge of climate change and the watershed of the Okanagan to create a poster/image. This poster should communicate their thinking and understanding of the information.
- Circulate, support, and listen as students explore ideas for their images and drawings.
- When complete, have students discuss their posters with the class. Finally, collaborate to create a class poster to display.

MAKE CURRICULAR CONNECTIONS

How are you a Climate Hero?

Students' presentations could include a video, a song, a photo essay, etc.

Students could also do a collage by cutting pictures from magazines, newspapers, etc. Encourage creativity!

2 https://okwaterwise.ca/resources.html

GLOSSARY

Aquatic

With reference to water.

Aquifer

An underground formation that stores groundwater.

Basin (Watershed)

Land area from which water drains towards a common point.

Bathymetry

The measurement of the depth of bodies of water.

Bedrock

Rock at or near the Earth's surface that is solid and relatively unweathered.

Ecosystem

A system in which populations of species group together into communities and interact with each other and the abiotic environment.

Erosion

The process by which soil and rock are removed from the Earth's surface by wind or water flow, and then transported and deposited in other locations.

Evaporation

The process by which water changes from a liquid to atmospheric water vapour – an essential part of the water cycle.

Evapotranspiration

The combined processes of evaporation and transpiration.

Groundwater

Water existing below the ground surface in aquifers.

Habitat

The area or natural environment in which an organism or population normally lives.

Naturalized Flow

Flows that would have existed without human use or management.

Nodes

Locations at which surface water properties are reported, such as the mouths of tributaries.

Nonpoint-source pollution

Pollution from many places all at once (e.g. rainwater washing animal waste, fertilizer from lawns, or oil leaked from car engines into a watershed).

Offstream Use

Water withdrawn or diverted from a ground- or surface-water source for use.

Outfall

The place where a sewer, drain or stream discharges.

Point-source pollution

Pollution from a single source (e.g. discharge from a factory into a watershed).

Reservoir

A large natural, or artificial, lake used to store water. (Okanagan Lake is a natural reservoir and is the primary source of water for most Okanagan residents, but there are also several smaller natural and human-created lakes used to supply water.)

Surface Flows

Open channel flow, or the gravity-driven flow of water above the ground.

Surface Water

Water that flows in streams and rivers, and exists in natural lakes, wetlands, and in reservoirs.

Topography

The relief exhibited by a surface.

Transpiration

Loss of water vapour from plants.

Unconsolidated Aquifer

An aquifer that exists in an unconsolidated deposit.

Water Demand

Water use that is determined using an estimation approach, such as a model.

Water Licence

A licence issued by the B.C. government to store water, or to withdraw water from a surface water source for a particular purpose.

Water Use

Volume or rate of water diverted or withdrawn from a water body (e.g. a stream, lake, or groundwater aquifer) for use by humans on the land surface. Actual water use is determined through direct measurement. Water demand is an estimate of actual water use.

Water Use Area

An area of the land surface which obtains water from a common location or locations.

Watershed (Basin)

Land area from which water drains towards a common point.

OUR RELATIONSHIP WITH WATER in the OKANAGAN

OKANAGAN waterwise

One valley. One water.