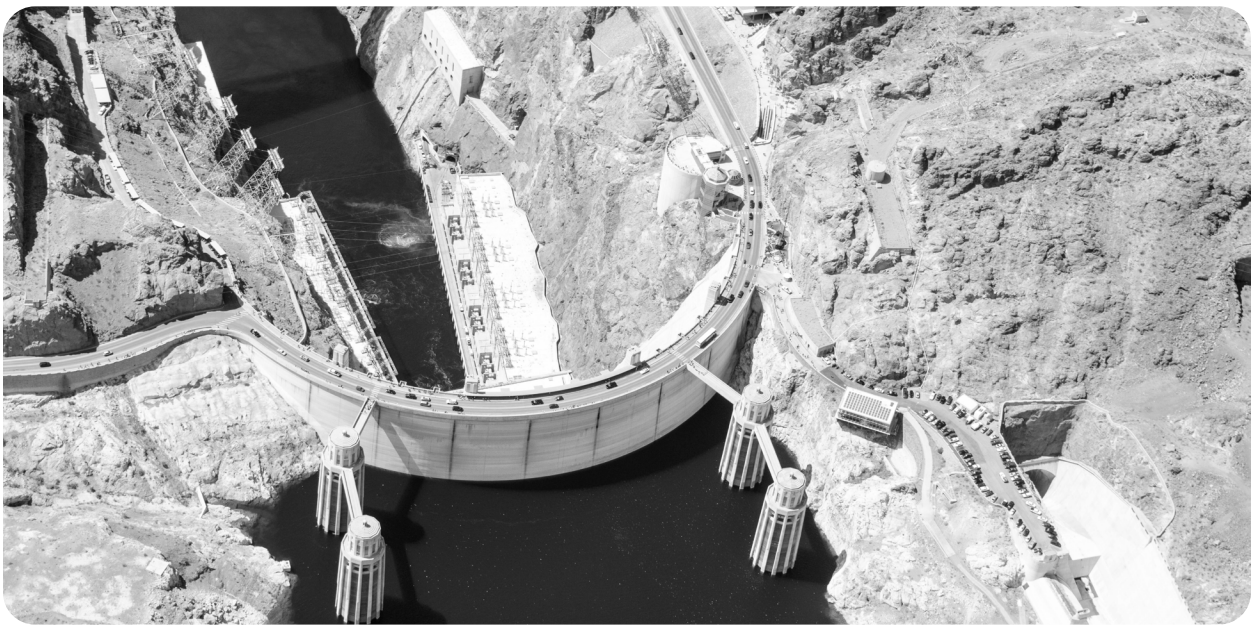
Student Handout: Hydroelectric Damming Case Study

WHAT ARE HYDROELECTRIC DAMS?

Hydro dams are a great source for renewable energy in regions where water is plentiful. They use the force of running water to generate energy through dams across rivers. Hydropower is a replacement for harmful fossil fuels that contribute to climate change, positively impacting the health of the planet. Hydro dams do not release pollutants into the air, meaning the air around them remains clean to breathe.

However, hydro damming has significant environmental impacts on local ecosystems. Hydro damming blocks fish migrations, traps sediments upstream that are important to downstream ecosystems, and keeps Indigenous peoples from accessing some of their traditional fishing areas.



Areal Image of a Hydroelectic Dam
Photo Credit: Cédric Dhaenens

DID YOU KNOW?

The **Tracking Change** research project identified that fish in the area around Nonacho Lake are considered 'ruined' due to the impacts of the **Talston River Hydroelectric Project.** The flooding that occurred as a result of that project led to changes in **mercury** levels in fish as well as other changes in the quality of fish tissue such that people no longer consider them good to eat. This is consistent with other environmental impacts when dams are built on free-flowing water, including **changes in temperature, chemical composition, and dissolved oxygen levels.**

KEY DEFINITIONS:

ENVIRONMENTAL HEALTH: The concept of "environmental health" focuses on the interrelationships between people and their environments. It includes all abiotic and biotic factors that are needed to sustain life. The "environment" part of the term includes both the natural environment and spaces made by humans.

MERCURY: Mercury is a naturally occurring element that is toxic to humans, causing serious health problems. People are mainly exposed to mercury by eating fish that contain mercury. It is released into the ecosystems via permafrost melts due to climate change. Mercury also enters ecosystems through burning of coal. It also enters water systems after it has been used in mines to extract metals like gold, and through the building of dams. When dams are built and land is flooded, microbes convert naturally occurring mercury in soils into toxic methylmercury. Fish are exposed to mercury through the water. Mercury levels get higher and higher in organisms that are further up the food chain. So, mercury levels are higher in larger fish, which eat lots of smaller fish, and they may become even higher in humans who rely on fish for food.

HYDROELECTRIC DEVELOPMENT: Hydroelectric engery, or hydroelectric power, is a form of energy that harnesses the power of water in motion - through a hydroelectric dam on a river, or a waterfall - to create electricity.

MIGRATION: Seasonal movement of animals, fish, humans, etc. from one region to another.

QUESTIONS TO CONSIDER

Below are some statements from Elders, land users, and community members about some of the concerns they have about the impacts of hydroelectric dams on the environment. Information about hydroelectric dam processes is also included. As you read the case study, consider the following questions:

1. What are some possible toxins associated with hydroelectric development?
2. How might toxins bioaccumulate within the watershed or ecosystem?
3. What are some potential environmental health issues associated with hydroelectric damming (consider abiotic and biotic factors)?
4. What aquatic management concerns exist regarding this development? What stakeholders are involved in aquatic management? What factors do these stakeholders consider and prioritize when making decisions about hydroelectric dams?
5. How do communities benefit from the development in long and short terms?

INDIGENOUS KNOWLEDGE ABOUT HYDROELECTRIC DAMMING

Hydroelectric dams have some major implications on traditional fishing practices and livelihood of Indingoeus people, below are some quotes from Indigneous people about the impacts caused by the hydroelectric dams built in the river basin:

There's private property all along the banks from Hudson Hope to Fort St John so unless you own a boat, there's not many spots to fish from the banks. We are banned from the best fishing spots by Hydro anyway. They built a fence and put up signs and they have security. - Thomas Hale, Saulteau First Nation fisher, Treaty 8 Association of BC, p. 64, 2016-2017 Report

The fish in the area around Nonacho Lake are considered "ruined" due to the impacts of the Talston River Hydro Electric Project. The flooding that occurred as a result of that project led to changes in mercury levels in fish as well as other changes in the quality of fish tissue such that people no longer consider them good to eat. - Lutsel k'e portion of the 2016-2017 Tracking Change Report, p. 49

Whatever happens up here, Peace River, directly impacts us at home. There is a deep fear. One, BC Hydro did their own environmental assessment on Site C [Dam], how is that legal? Two, they are turning away nations saying there will be no impacts to rights and interests. When they first built the Bennett Dam, there were deep impacts, changes to water levels and quality. The Peace River is such an important river. Water is life, we can't eat money. We don't do anything at Beaver First Nation for money—we do things in a forward-thinking way. Money comes and goes, but the land is there forever. We have a hard time trying to understand land ownership. We don't own the land, we never owned the land. There is no such thing as land ownership, the land owns you. We have to shift our own thinking, we have to think about our children. I know our issues aren't going to be fixed by me or anyone else at this table – it's going to be our kids.

Water is number one. We came here to support anything and everything that T8TA (Treaty 8 Tribal Association) would like to do to support water. We have a real fear of water quality, water shortage. We have to do everything we can. You don't have to be a leader to speak your mind. We need everybody to stand up. If we teach our kids that that drop of water is the most important thing on the planet, they will grow up respecting it." – Chief Trevor Mercredi, Treaty 8 Mackenzie All Chiefs Water Gathering Initiative, p. 40 2017-2018 Report

Fish Parasites found in a fish from Łutselk´e
Photo Credit: Łutselk´e Dene First Nation provided by LauraJane Michel

Fish with a lesion on the lefthand side
Photo Credit: Łutselk´e Dene First Nation provided by LauraJane Michel

HYDROELECTRIC DAMMING PROCESSES

Hydroelectric dam construction (Adapted from: https://sciencing.com/what-are-hydroelectric-dams-made-out-of-13661668.html)

Dams are constructed to stop the flow of water, and this creates a reservoir behind the dam. Energy is built up behind the dam and is then used to generate electricity by harnessing the flowing water. As water falls through the dam it turns a turbine which spins electric generators. Hydroelectric dams are constructed with great care- they need to be strong!

- **Earth**: Ground material is used to create a base for the dam, which sits in the river and blocks the flow of water. Operators try to use easily available material like rock and dirt to keep the cost down, while also creating a strong foundation to build the rest of the dam.
- **Concrete**: Next, concrete is poured around the layer of earth material to provide shape, structure, and strength to the dam. Workers use concrete in a near liquid form which is effective for making specific shapes. It is also useful because it hardens and holds its strength!
- **Steel:** This is the final part of hydroelectric dam construction. Whereas concrete is strong in terms of compression, it is not very strong with twisting or pulling. Steel rebar is put into the concrete to add additional strength. Without the steel, the water pushing against the dam could break the concrete.

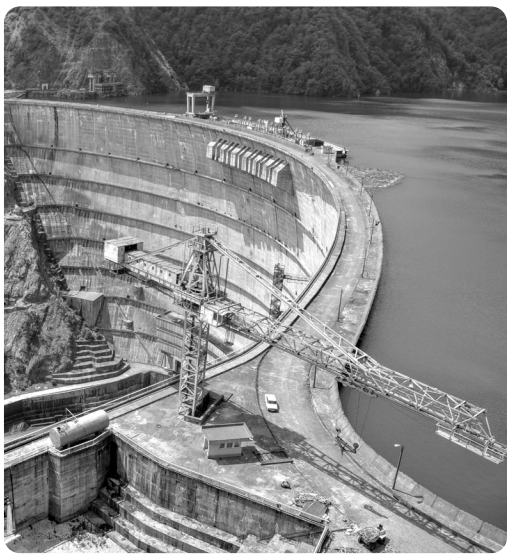
FACTS ABOUT HYDROELECTRIC DAMS IN CANADA:

The largest hydroelectric dam in Canada is the Robert-Bourassa hydroelectric generating station. It is location on La Grade River in Northern Quebec and is 162 meters high and 2,835 meters wide!

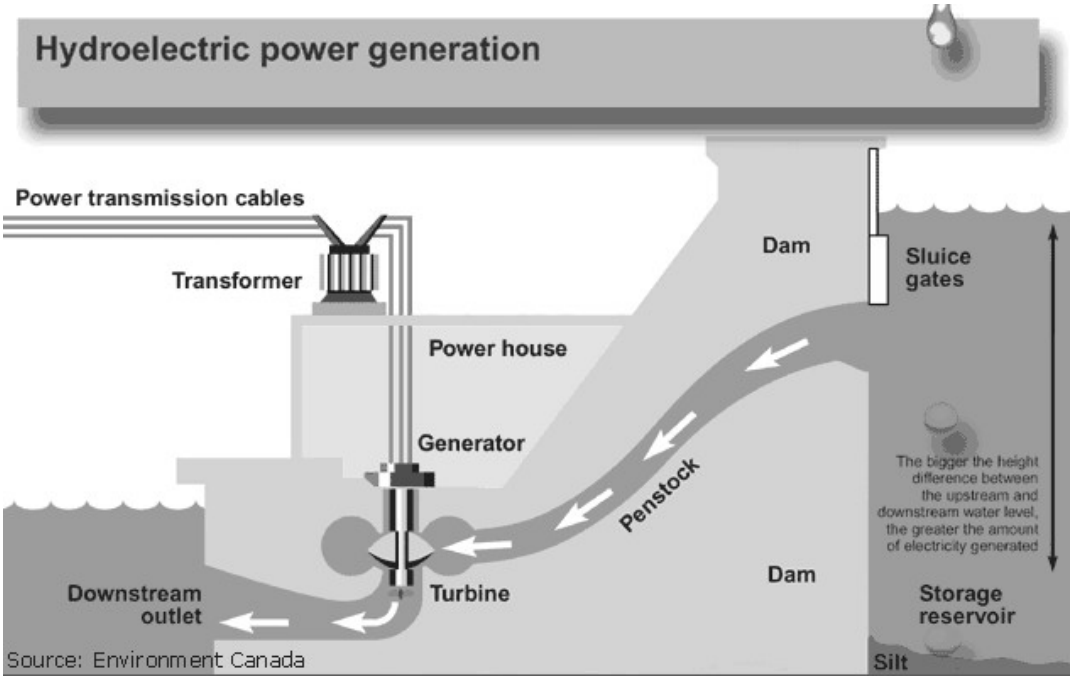
According to the Canadian Dam Association, there are over 15,000 dams in Canada, of which 1,157 are categorized as “large” dams (CDA, 2019).

Hydroelectric dam usage in Canada has resulted in Canada producing 60% of its power from its waterways (Kirby, 2015).

Over the next twenty years, it is estimated that Canada will spend $55 to $70 billion on new hydro projects (Kirby, 2015).



High water levels on one side of a hydro electric dam
Photo Credit: Alex Bagirov



Hydroelectric power generation process
Photo Credit: Environment Canada

HYDROELECTRIC DAM OPERATION

Adapted from: https://www.usgs.gov/special-topic/water-science-school/science/hydroelectric-power-how-it-works?qt-science_center_objects=0#qt-science_center_objects

Hydroelectric dams create electricity by using a source of energy, in this case water, to turn a propeller-like turbine. This turbine turns a metal shaft in an electricity generator, which creates electricity that you can use to power your refrigerator or charge your cell phone. Coal-fired power plants operate the same way, except they use steam to turn the turbine blades.

Dam operators tend to build hydroelectric plants on a large river with a drop in elevation. This is because the dam will be able to store a lot of water behind it and there will be a lot of energy built up to turn the turbine. Gravity causes the water to fall through the penstock and move the turbine at the end of the dam. A shaft connected to the turbine turns the electricity generator and creates power. Power lines carry the electricity from the generator to homes, buildings, and industrial site.

ENVIRONMENTAL IMPACTS

One of the main motivations behind hydroelectric power is that it is cleaner than many conventional energy sources- it is a great way to reduce Canada's greenhouse gas emissions! On average, hydropower emits 35 times less GHGs than natural gas and approximately 70 times less emissions than coal generation (Hydro Quebec, 2020). However, recent studies have also found that the decaying vegetation caused by hydroelectric dams also cause greenhouse gas emissions, further contributing to climate change. The environmental benefits of hydroelectric development is complicated. Unfortunately, there are still negative environmental impacts that result from hydroelectric development that must be considered. The dam blocks fish migrations which can separate fish spawning areas from rearing habitats. Sediment can also get trapped behind the dam, which is an issue because this material is needed to maintain the habitat downstream. One of the greatest environmental impacts of hydroelectric dams is the alteration in the water's natural flow. Aquatic ecosystems rely on the natural timing and quantities of water. Dams disrupt these natural rhythms and can result in flooding in irregular areas and low levels or non-existent water in other areas.

ECONOMIC CONSIDERATIONS

Hydroelectric dams make up 60.2% of Canada's electricity generation. Globally, Canada is the second largest producer of hydroelectric power and sells some of it's supply to the United States. The amount of hydroelectricity produced in each province differs significantly (Natural Resources Canada, 2019):

- Manitoba: 96.8%
- Quebec: 95.0%
- Newfoundland and Labrador: 93.7%
- Yukon: 92.2%
- British Columbia: 90.5%
- Northwest Territories: 38.5%
- Ontario: 25.9%
- New Brunswick: 19.6%
- Saskatchewan: 13.7%
- Nova Scotia: 8.8%
- Alberta: 2.5%

In the Northwest Territories, electricity rates that people pay to power their homes depend on how the electricity is generated in the community (Northwest Territories Power Corporation, 2014a). Communities that rely on diesel or natural gas are called "thermal communities" and they pay a higher rate for electricity than communities that are connected to hydroelectric plants. There are three hydro dams in the Northwest Territories: Snare Hydro System, Bluefish Hydro, and Taltson Hydro (Northwest Territories Power Corporation, 2014b).