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## Contamination in the Upper Columbia: Smelting and Its Impact to the Environment and Human Health

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# Contamination in the Upper Columbia

Smelting and Its Impact to the Environment and Human Health

Brenden Murphy

Storymap link: <https://arcg.is/OT15bz>

## Acknowledgement

I took an environmental studies capstone course Spring Quarter of 2021 called ENV5 417 - SMOCS, which stands for Science, Management, and Outreach of Contaminated Sites. This course is partially grant funded by Washington State Department of Ecology (Ecology). Student groups in this course typically choose a contaminated site in Washington to study, and propose a research project or a communication piece centered around the site. These sites are called MTCA sites, which stands for Model Toxics Control Act, which is Washington state's cleanup law. Our group decided to create and present a communication piece about contamination in the Upper Columbia River basin. I presented this research project and communication piece as my Honors Capstone final project.

I would like to thank my other two group members Olivia Hobson and Nick Baca for their effort and support on this research and communication project throughout the quarter. I would also like to thank all the sources we spoke to this quarter who helped us grasp an understanding of this complex, multifaceted region. Thank you to Sandra Trecanni, John Roland, and the folks at Ecology, Monica Tonel at the EPA, Jeff Johnson with the Department of Interior, Jamie Paparich, Andrew Child, Jim Regis, Kate Darby, and Shawn Behling.

## Overview

At first, this project consisted of performing a profile of a smaller-scale metal smelter located in Northport, WA on the banks of the Columbia River. This would include the historical context of the smelter, the environmental contamination that occurred, and the cleanup of this old smelter location. Shortly after initial research, we stumbled upon a much greater environmental concern in the area, encompassing Northport and spanning the whole Upper Columbia River Basin. Another smelter located just 20 miles north of Northport, has been the cause of a century of pollution in the river.

A communication piece in the form of an ESRI StoryMap was created to present the findings of our research. A StoryMap is an interactive online website that includes spatial maps and other multi-media facets. A significant part of this project involves portraying the extent and magnitude of the pollution from these smelters. This is where mapping technology and visuals lends itself to effectively communicating the data.

The following information has been distilled from a culmination of scouring websites of different organizations and government agencies, reading scientific literature on the

environmental impacts of smelting, looking over court documents, and conducting interviews with scholars, historians, scientists, site managers, and community members.

This report, along with our Storymap, will explain some of the historical aspects, environmental cleanup, and impacts these smelters had on the Upper Columbia River Basin. Trying to express the sheer amount of information and research that is needed to cover the scope of this geographic area and timeline, a source said, “It’s like trying to etch the bible onto a grain of rice”. With that, here is the culmination of ten weeks of research on the Upper Columbia River Basin.

## **The Upper Columbia: A River of Industry**

Tucked away in the eastern corner of Washington State is a mineral rich playground carved by one of the Pacific Northwest’s mightiest rivers. The Columbia River sprouts out of the Canadian Rockies where sturgeon, steelhead and salmon travel through man-made dams and reservoirs to spawn. The Upper Columbia River Basin stretches from present day Grand Coulee towards the Canadian border and encompasses the surrounding forests, hills, and valleys.

In the 1800s, towns began to form along the river, born from mining booms and sustained with the expanding railroad businesses. When gold was found along the banks of the Upper Columbia, wealth-hungry prospectors flooded the region. By 1890, copper, gold and silver were being pulled from the hills at a dizzying speed. The railroad grew to accommodate the growing volume of raw materials needing to be moved, connecting the small mining towns between Spokane, Washington, and southern British Columbia with a network of tracks. But to extract these precious metals from the rock they were trapped in, large smelting operations were needed. And with that, the smelting industry in the Upper Columbia River Basin was born.

## **A Proud Mining Town**

Northport, Washington, is a small, rural town in the eastern shadow of the North Cascades. With a population of 300, the community sits nestled on the shore of the Upper Columbia River, quietly going about daily life while the river flows beside it. The town today is a relic of its past self, when the population was ever growing, the economy was steadily increasing, and smoke from the local smelter filled the air.

Northport was a mining town, with a history full of booms and busts, that played a large part in lead ore production for the World War I war effort. When the railroad arrived in 1892, it positioned Northport as an ideal mining export town, and a mining district was quickly established. Copper, gold, and silver ore was drilled, carted, and blasted from the surrounding Red Mountain mines.

The town bustled. Schools, grocers, and banks were built, saloons were frequented, balls were held at dance halls, and at Cline’s Dance Hall, a *Northport News* article from 1897 wrote about how, “ladies of easy virtue” were entertaining the “horny handed prospector and miner.”

The railroad proximity and bustling life of Northport provided a perfect location for a new smelter, and in 1898, the LeRoi Smelter opened for business. It grew from 200 employees to 600 in a matter of two years.

At its peak, the smelter processed 500 tons of ore per day. The ore, mined from the nearby mountainsides, contained gold, silver and copper. To extract the precious metals, entrapped and oxidized in its rock encasings, the ore was blasted in a furnace with chemical agents. The pure metal, freed and melted, oozed out of the furnace and cooled, becoming a valuable lump of refined metal, while the ore's impurities and leftover chemicals, called slag, were collected and disposed of.

Some of the waste slag, a sandy concoction of limestone, ash and hazardous chemicals like lead, arsenic, and zinc, was recycled into bricks used in the smelter and surrounding town's construction. More of it was disposed of in collection areas on the smelter site; it was inevitable that some would be released into the nearby Columbia River.

Through the early 1900's, the LeRoi Smelter provided the lifeblood for the town of Northport. But the boom of LeRoi's first period of activity was ended by a bust in 1909, when it could not outcompete the larger smelter in Trail, British Columbia, 20 miles upstream.

The LeRoi smelter stopped smelting, which led to an economic depression for Northport. The population dwindled to 300 and the local bank became insolvent.

World War I brought the smelter booming back to life, having been purchased and renovated in 1915 to treat lead ore, when great deposits of the metal were found nearby. When the US joined the war effort in April of 1917, the LeRoi smelter and the valuable war resource it was producing was fenced and guarded.

According to Jim Regis, the director and founder of the Northport Historical Society, the smelter was an indicator of the economic conditions of Northport.

"When the smelter was going, the town was prosperous," Regis said. "When the smelter wasn't going, the town declined."

Despite its importance to the war effort, the end of the war brought the end of the LeRoi Smelter. It was closed and dismantled in 1921, leaving memories of a bygone era and a legacy of heavy metals contamination.

## **The LeRoi Smelter Cleanup**

In 1993, concerns about the legacy of LeRoi's contamination at the smelter site and in Northport led to an EPA inspection. Concerning concentrations of heavy metals, including arsenic, copper, and lead, were found in the soil. The Washington State Department of Ecology listed the site on Washington's Hazardous Sites list in 1995, and the EPA's cleanup began in 2001, according to Monica Tonel, the EPA LeRoi site coordinator.

Through a public records request from the Washington State Department of Ecology (Ecology), non-digitized soil sampling data was secured and used to create an interactive map of the sampling sites and the levels of contamination. Geographic Information Systems (GIS) software, ArcGIS Pro, can be used to create and portray this spatial data which can then be loaded into the StoryMap. This was done by referencing other maps and tracing the boundaries to create the layer in the software, termed georeferencing. Another tool called geocoding was used to generate the points where residential and public land sampling took place. This technique created points for each address that was listed on the soil sampling data. Along with this, we could attribute the metal concentrations determined from the lab tests to their respective addresses. Some of the soil sampling data had GPS coordinates instead of addresses and the GIS software was used to convert the coordinates to point data as well. From here, calculations were used to determine which metals exceeded state-determined threshold concentrations.

Ecology sets the state-wide contamination limits for ecological and human health. When the EPA tests the soil for contamination, if readings come back high, certain cleanup strategies, like exposure reduction or soil removal, may be called for. In Northport, almost 150 sites were sampled, and hundreds of cubic yards of soil from 29 residential properties was removed for heavy metals contamination, Tonel said.

Lead and arsenic exposure were a concern, especially for young children, so yards and gardens at the local school and family homes were prioritized. An 11-acre consolidation area for the removed, contaminated soil was made at the excavated historical smelter site. In total, almost 20,000 cubic yards of soil was removed and quarantined under an eight-millimeter polyethylene cap before it was buried under layers of gravel, soil, and plant material, according to EPA reports. The fresh material was topped with a collection of trees and shrubs, hiding the disturbed earth and protecting what lay beneath it.

The equivalent of 1,650 dump trucks of soil were removed in the cleanup process.

Almost 20 years later, the cap is still intact, according to Ecology Site Manager Sandra Trecanni. Ecology continues to watch and monitor the site, and the EPA continues to test soils for concerned residents, with the most recent testing happening in spring of 2020, Tonel said.

While the LeRoi Smelter left a footprint of heavy metals contamination in the local Northport area, there was a larger, more formidable source of pollution just three miles upstream. For more than a century, Teck released an assortment of toxic substances into the environment, contaminating both the air and waterways and inspiring milestone legal battles that are still being fought decades later.

## **The Teck Smelter**

Just a few miles north of the US-Canadian border above eastern Washington, sitting on the edge of the Columbia River, resides one of the most prominent smelting operations in North America.

Dwarfing the size and output of LeRoi, Teck is one of the world's largest smelting and refining complexes for zinc and lead.

Teck produces hundreds of thousands of tonnes of copper and zinc each year, millions of tonnes of coal, provides ten thousand jobs, and generates billions of dollars in revenue each year, according to their quarterly reports.

But with decades of production comes decades of pollution, and with the intense heating, extraction and refining processes comes enormous amounts of waste. Teck has been releasing this waste into the Columbia River for over a century.

It is estimated that 13 million tons of slag have been discharged directly into the Columbia River between the 1890s and 1994, averaging over 100 tons every day, according to court documents. Additionally, the smelting process generates other chemical and metal waste, including arsenic, cadmium, lead, and mercury. Although the smelter exists on Canadian soil, the Columbia River flows directly into the United States, making Teck a serious transboundary waterway polluter, said Jeff Johnson, the Upper Columbia River Project Manager for the Department of the Interior.

"It's a Canadian source, but it's messing up things on US soil," Johnson said.

The Upper Columbia riverbed is made up of tiger stripes, Johnson said. The naturally occurring sediment weaves together with the black slag waste, and some banks and beaches of the river are made up entirely of smelter slag.

In addition to slag waste dumped into the river, Teck pumped hundreds of tons of aerial emissions into the atmosphere every day. From 1916 through the 1940s, Teck espoused 100 to 700 tons of sulfur dioxide into the air per day, according to court documents.

In the 1920s, farmers downstream started to complain about the emissions, blaming their sick cattle and withering crops on the poor air quality, according to the historical society. In 1931, the International Joint Commission, an organization created in 1912 to help Canada and the US resolve conflicts over transboundary waterways, recommended Canada pay the US \$350,000 in damages and required Teck to install devices to reduce Sulphur Dioxide emissions.

The aerial emissions did not stop there. From 1958 to 2002, the Teck smelter produced more than 11,000 tons of aerial emissions, including 7,359 tons of lead, 302 tons of arsenic and 3,053 tons of zinc, according to court materials. These emissions wafted south through the atmosphere and deposited themselves up to 90 miles away from their smelter roots, according to Andrew Child, a freshwater aquatic ecologist at the University of Idaho involved in the Teck litigation.

While LeRoi and Teck are two smelters located in the same region with similar operating history, it is not accurate to compare the two on a similar scale, especially when looking at their environmental impact, Child said.

“It's like if I ran like a coal power plant, and you were standing outside smoking a cigarette, and I said that you were polluting the air because you're burning stuff,” Child said. “Like, sure, you're polluting the air, but I'm running a coal power plant right next to you.”

Part of Child's research was tracing where these metals came from. Lead isotopes have unique characteristics, not unlike human fingerprints, that help identify their source and where they were smelted. Lead from Teck has a unique print, different from lead smelted at LeRoi and different from lead smelted around the world. Researchers like Child were able to identify those unique lead isotopes in each contaminated lake and trace them back to Teck.

The culprit was overwhelmingly Teck, Child said.

## **Smelting's Environmental Impact**

Despite advances in technology and a long list of regulations to limit emissions, smelting is still a pollution-heavy industry that creates many hazardous by-products. Heavy metals can accumulate and permeate in areas through slag deposition and air transportation. Because of the Upper Columbia River Basin's rich mining and smelting history, these heavy metals are prolific throughout the region.

Throughout the past century, the Teck Smelter, and to a lesser extent, the LeRoi Smelter, emitted slag and air pollution that blanketed sediments around the region, according to Ecology.

An Ecology soil sampling study found that in a 15 to 20 mile radius of the Teck Smelter study area, lead, zinc, arsenic, cadmium, mercury and sulfur dioxide were found in the first three inches of the soil due to air emissions. This study also found that the levels of these metals were more “pronounced” near the Columbia River Valley.

The landscape surrounding the Teck Smelter is also scattered with other chemicals, like PCBs and organochlorine pesticides, that are known to build up in these areas and affect fish species. Metals that entered the Columbia River and other waterways directly were spread along the banks of the river and created toxic sediment environments. Small aquatic insects, like amphipods and midges, struggle to thrive in their blanket of chemicals.

Where slag was present, mortality rates of these species increased by 80% and the total amphipod population decreased by 94%, according to an Ecology study. In addition to spreading downstream, traces of heavy metals were also found in lakes and ponds in the Upper Columbia Basin more than 90 miles away from the Teck Smelter, according to Child.

According to a study Child published in 2018, the heavy metals Teck pumped into the air were blown downstream and left in the lakes and ponds of eastern Washington. Small aquatic insects, called zooplankton, flush the lake water through their bodies while they filter feed, and Child found that those heavy metals are being flushed through their bodies at the same time. While his research did not focus on the effect of these metals, it did prove the metals are bioavailable in the system, Child said.

“Some of these lakes have grossly high amounts of heavy metals,” Child said. “If they were land not covered by water, like farmland, they would need immediate remediation. This is dangerous levels of metals in the soil.”

As the EPA continues to study the region and understand which cleanup strategies will be most effective, part of the problem is understanding what affect the contaminants have on the surrounding ecosystem. The pollution is there, and it is available for ecological use, Child said. But while the effect is still largely unknown, there are some communities speaking out.

## **The Northport Project**

The Northport Project, founded in 2008, is an environmental health advocacy group and awareness program for the people of Northport, Washington. It was created to inform and voice the concerns about the impacts of the Teck’s pollution in the Upper Columbia River Basin. Two health surveys were conducted for citizens of Northport, one in 1991 and one in 2011. The Northport Project involved the Citizens for a Clean Columbia (CCC) and an outside health expert for the 2011 survey. Both surveys revealed that residents of the Northport area suffered from similar health effects of similar autoimmune diseases. The Northport Project attributes the health clusters to the chronic exposure of metal pollution from the Teck Smelter.

In the beginning, it was difficult to get the community on board, said Jaime Papparich, the Northport Project founder and longtime Northport resident. Teck is such an important economic source for the region, it’s difficult to step against them, Papparich said.

“There has definitely been a struggle with people. You know, [Teck] provides their income,” Papparich said. “It provides a lot for the community and the communities a few miles from us. It’s a hard fight.”

At the time of the first survey in 1991, approximately .001% of the US population suffered from Ulcerative Colitis and Crohn's disease, a chronic inflammatory condition of the gastrointestinal tract. At that same time, 5% of the Northport population had been diagnosed.

These health clusters caught the attention of Dr. Joshua Korzenik, one of the nation’s leading experts in inflammatory bowel disease (IBD) research and director of Brigham and Women's Hospital (BWH) Crohn’s and Colitis Center. Dr. Korzenik and his team helped conduct the 2011 study, and are currently working on publishing an in-depth epidemiological case-control study from surveys taken in 2016-2017.

In addition, of the 500 respondents from the 2011 survey, 36% reported thyroid or endocrine disorders, compared to the 6% of the general population that is affected by the same disorders.

Papparich emphasized that the long-term goal is helping the future generation of Northport residents.



“Our community members are willing to say, ‘We know we won't be fixed, but we are willing to step forward and show our health concerns and our health issues to try to save the future generations’,” Paparich said.

Despite the statistical trend, proving an epidemiological link is incredibly difficult, Trecanni, the Ecology site manager, said. Without knowing every detail of an individual's lifestyle and possible exposure paths, placing blame is incredibly difficult, given all of the other chemicals and contaminants the modern world exposes humans to.

Paparich understands the complex facets of epidemiological studies, she said. In working with the EPA and Ecology, she has gotten used to fighting for her voice to be heard amidst eye-rolls. Something is not right in Northport, and Paparich is determined to prove it.

“It's easy to say there was no relation, but once you're part of it, once you're in it, it is so hard to say there's not,” Paparich said.

## **The Litigation**

Throughout the years, Teck denied responsibility for the slag and pollution waste in the Upper Columbia Region, claiming that because they were a Canadian source, they were not responsible for US environmental cleanup laws. Landmark litigation in the 30s and early 2000s have changed that story, but challenges remain when it comes to cleaning up a river of slag.

In 1999, the Confederated Tribes of the Colville Reservation, consisting of 12 Bands of tribes who have lived in the Upper Columbia River Basin since Time Immemorial, petitioned the federal government to investigate the legacy of contamination left by the smelting industry.

The initial investigation began in 2001 as a partnership between the tribe and the EPA. The investigation found evidence of heavy metals contamination throughout the Upper Columbia River. In 2003, the EPA administered Teck to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Upper Columbia on the grounds of CERCLA, or the Comprehensive Environmental Response, Compensation, and Liability Act. Teck refused, arguing that because it discharged its waste on Canadian soil, it was not liable for US environmental cleanup law.

In 2004, the Confederated Tribes of the Colville Reservation filed a civil lawsuit against Teck. The contamination from upstream affects the tribe's treaty-granted rights to hunt, fish and gather on the lands they have always lived on.

While the lawsuit was pending appeal, the EPA and Teck reached a settlement agreement: Teck would help fund and conduct a RI/FS, but was not liable for any cleanup under CERCLA. The Tribes pushed back against this, filing another suit in 2008 alleging Teck's responsibility for the contamination in the Upper Columbia. In 2009, the Tribes contracted an environmental consultant to conduct water and sediment sampling. The results of these tests conclusively proved Teck's responsibility.

Throughout the case, Teck's defenses shifted. Originally, they argued that their Canadian status exempted them from US cleanup law, and went on to deny the presence of their pollution entirely. One month before the trial, however, they admitted to dumping 9.97 million tons of slag into the Columbia, which they classified as a waste facility.

The fight was not over though. To prove liability under CERCLA, there needs to be evidence that the polluter knew their waste had the potential to cause injury. At one point, Teck's Manager for Environmental Health and Safety testified in court that he "did not know the fate of slag released from Trail operations."

Finally, a landmark ruling finalized in 2012 ruled on the side of the tribes: Teck was responsible for environmental contamination in the US, and was responsible, under US law, to clean it up. A large part of the ruling came down to the fact that the ore Teck smelts comes from the US, weakening Teck's claim of being an entirely Canadian company, Child said.

## **What's Next**

Teck was found reliable under CERCLA law and have since been cooperating with the EPA and the tribes to work on cleanup investigations. They have provided millions of dollars in funds for the investigation and remediation efforts.

The litigation has gone on, with the most recent ruling being the first defeat the tribes have experienced in the courtroom so far. In 2016, the Supreme Court decided Teck was not responsible or liable for cleanup and damages for air emissions in the United States.

The EPA's Human Health Risk Assessment Draft was released in 2020, a part of the RI/FS. The RI/FS determines the extent of contamination, the ecological effects, and the possible human health effects. The RI/FS will be completed in a handful of years, Jeff Johnson said, and after that, those cleanup strategies will begin.

## **Final Thoughts**

Ultimately, the Columbia will never be restored to the state it was before mining and smelting. With a century of pollution and the sheer magnitude and extent of contamination, it is not possible to remove every grain of slag and reverse the ecological damage that has occurred, Child said.

"There has to be, at some point, compromise by both sides to realize that this is never going to be a perfect scenario," Child said. "There's too much damage now, there's too much legacy pollution, to think that we could get back to pristine upper Columbia. It's just not going to happen."

Successful cleanups are possible though, and the LeRoi Smelter site is an example of this. Contaminated soil was removed from people's homes and schools and confined to an area where it is not able to harm any organism. At the Upper Columbia and Lake Roosevelt site, the ongoing

cleanup effort is a project that has spanned multiple decades and numerous agencies, and continues to provide a picture of what the future may look like for the Upper Columbia River.

It is important to realize that Teck is a significant facility for our economy, providing valuable resources for our numerous technologies, as well as economic support for the region it employs, Child said. It provides the materials that we need for our phones, laptops, and cars. We are driving that economy, and it's a delicate balance, Child said. Striking a compromise is the only way progress can continue.

“Whatever Teck does in that balance will always look like they're just being this monster,” Child said. “And to attack anyone that tells them they need more regulation is viewed as this combatant enemy.”

Ongoing collaboration and cooperation between Teck and the many stakeholders downstream is essential to ensure the long term health of the Upper Columbia watershed. Teck has improved in the past 20 years; slag is no longer being deposited into the Columbia at a rate of 100 tons per day and aerial emissions have improved dramatically. But ongoing recognition of Teck's responsibility and a comprehensive, communicative cleanup effort will be necessary to protect the environment, improve human health and restore the Upper Columbia to a river of industry, cleaned up.

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