What Happens After The Mine?

A critique of approaches to the design, remediation, and perpetual care of post-extraction landscapes in Canada

by
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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Mining produces enormous amounts of waste, often toxic, that requires containment, record keeping, and monitoring in perpetuity to ensure it does not harm the surrounding ecosystem. Post-extraction landscapes in Canada receive inadequate remediation and care. Current mine closure regulations and remediation practices focus on short term, technical toxin mitigation strategies on site and ignore the diverse impacts of mining on surrounding communities and non-human species. The push for a global transition to renewable energy paradoxically requires an unprecedented increase in mining for minerals used in wind turbines, solar panels, and batteries. The Government of Canada is taking the opportunity to capitalize on this global demand for its natural resources by exploring, developing, and opening new mines. In doing so, it is consequently creating new permanent waste sites each year, adding to thousands of existing abandoned mines not yet remediated.

Leaning on post-extractivist literature, this thesis analyzes a range of approaches to reclamation and remediation of post-mining landscapes through three themes: (1) *perpetuity* – acknowledging the deep time extraction processes rely upon and the endurance of toxins, critiquing the short-term thinking of the mining industry, and advocating for long-term planning of care practices; (2) *communities* – recognizing that negative impacts of extraction on humans and nature are interconnected, reflecting on the colonial history of mining, and arguing that remediation must include social healing; (3) *ecosystems* – exploring the limits of property and profit driven practices, and recognizing the importance of multi-species, watershed scale remediation and care.

Part 1 examines government regulations and the mining industry's mine closure and reclamation practices. Part 2 considers the role of architects and landscape architects in the design of post-extraction sites, by reviewing projects and identifying stakeholder motivations and values. Part 3 discusses post-extractivist frameworks which advocate for a more holistic remediation and explores theory on concept of *perpetual care*, through the themes of *perpetuity*, *communities*, and *ecosystems*. Part 4 studies two community initiatives, which demonstrate aspects of perpetual care. These case studies gather and synthesize a range of existing documents, including technical assessment and remediation reports, community member testimonies, and socio-ecological data. Writing and drawings contrast the mining industry's perspective and values with community perpetual care. Finally, the thesis reflects on the mining industry, government, designer, and community's approaches to post-extraction sites, and considers the potential role of designers in mine reclamation. It argues that the themes of *perpetuity*, *communities*, and *ecosystems* are overlooked and need to be addressed for successful design, remediation, and perpetual care of post-extraction landscapes.

Acknowledgements

I am the granddaughter of four immigrants, who found refuge in North America after fleeing from their occupied homeland, Latvia, during World War 2. Canada and the United States provided my grandparents with safety and allowed them to sustain their language and culture. Growing up in Canada, I had the opportunity to establish roots in my Latvian culture, but I increasingly understand the privilege I had in being able to do so. This has not been the case for the many Indigenous nations which have lived on and cared for this land for generations upon generations.

I acknowledge that the land I've called home during my graduate studies is on the traditional territory of many nations, including the Mississaugas of the Credit, the Anishinaabeg, the Chippewa, the Haudenosaunee, and the Huron-Wendat. I also acknowledge that the University of Waterloo's School of Architecture is situated on the Haldimand Tract, land granted to the Haudenosaunee of the Six Nations of the Grand River in the Haldimand Treaty of 1784. The Haldimand Tract and surrounding area is the traditional territory of the Attawandaron, Anishinaabeg, and Haudenosaunee.

I recognize that in Canada, mineral extraction has been and is linked to the dispossession of Indigenous traditional territories, the environmental destruction of land and waters that sustain livelihoods, and negative impacts on community health and culture. Remediation of post-extraction sites should not only work to repair environmental damage. It should also support community healing from cumulative and intergenerational impacts.

I also recognize that Indigenous nations have been caretakers of this land and water for thousands of years. This sustainable stewardship is increasingly necessary as extraction processes create permanent waste sites that need to be cared for in perpetuity. We must support these practices.

Starting and completing my graduate studies online came with its difficulties, but I am grateful to those who continuously inspired and motivated me throughout the process.

To Jane Mah Hutton, my supervisor, thank you for the care you take in your work. I am grateful for your consistent support, guidance, and thoughtful comments from day one of my research. Our conversations helped clarify questions but also left me with new ones, and always made me reconsider my bias and opinions. Thank you for encouraging me to find motivation in my detachment from this research topic and not view it as a roadblock.

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To my Monday Motivation crew, Natalie and Shaina, I am thankful to have gone through these graduate studies with you both. Our meetings gave me a sense of normalcy in this weird online grad school world, and your friendship and encouragement kept me moving forward.

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Table of Contents

List of Figures

Introduction

Intent

In *What Happens After The Mine?: A critique of approaches to the design, remediation, and perpetual care of post-extraction landscapes in Canada,* I explore a range of stakeholder perspectives on Canadian post-extraction sites. I study a sampling of government regulations, mining industry practices, designers' projects, and community-led initiatives. Analyzing varying approaches through three themes (perpetuity, communities, and ecosystems), I identify both successful and inadequate aspects of each example.

The following is my positioning on the three themes:

(1) *Perpetuity* – I acknowledge the deep time extraction processes rely upon and the endurance of toxins, I critique the short-term thinking of the mining industry, and I advocate for long-term planning of care practices.

(2) *Communities* – I recognize that negative impacts of extraction on humans and nature are interconnected, I reflect on the colonial history of mining, and I argue that remediation must include support for social healing.

(3) *Ecosystems* – I explore the limits of property and profit driven practices, and I recognize the importance of multi-species, watershed scale remediation and care.

Throughout my analysis, I use these three themes to develop an understanding of post-extraction landscapes, as well as assess stakeholder motivations, values, and practices. I lean on post-extractivist literature that amplifies these elements, which are overlooked by government policy and industry standards.

I acknowledge that although I cover a range of approaches to reclamation and remediation of Canadian post-extraction landscapes, there are limits to my research and this thesis document. I recognize that my perspective and this project cannot offer a complete picture of issues around post-extraction sites.

Summary

In Part 1, **Context and Problem**, I introduce the reader to post-extraction sites in Canada, and the nation's role as a financial hub in the planetary mine. I describe the growing demand for minerals, fueled in part by the global transition to renewable energy, which requires an unprecedented increase in extraction of minerals used in wind turbines, solar panels, and batteries. I then acknowledge that mining produces enormous amounts of waste, often toxic, that requires forever containment, record keeping, and monitoring to ensure it does not harm the surrounding ecosystem. Finally, I investigate current mine closure regulations and reclamation practices, concluding that post-extraction landscapes in Canada receive inadequate remediation and perpetual care. Part 1 outlines why further research on alternative approaches to mine remediation and care is important.

In Part 2, **The Art, Architecture, and Design of Mine Afterlives**, I explore how the landscape architecture profession has participated in the design of mine afterlives. I follow two parallel trajectories of mine reclamation work, which are both closely tied to the mining industry. First, I discuss the early involvement of landscape architects as part of an interdisciplinary team within the mining industry, from the 1960s to 1980s in the United States. Second, I examine mine reclamation projects, which are centered on art and design, from 1970s land artists' earthworks in the United States to more recent projects by landscape architects Martha Schwartz and Charles Jencks. In the third section, I discuss a more recent project, in which a landscape architect focused mine reclamation around water and the broader ecosystem. Part 2 describes benefits and limits of artist, architect, and other designer involvement in the design of post-extraction landscapes.

In Part 3, **Literature Review: Perpetual Care**, I acknowledge the need to look to communities, researchers, and writers for alternative and more holistic approaches to remediation. First, I outline the concept of *care*, which has been gaining attention across industries and is increasingly discussed in relation to the natural world. I then investigate the more specific concept of *perpetual care*, which is used by the post-extractivism community to describe an approach to mine monitoring and maintenance programs after formal remediation. Finally, I dive deeper into theory on the three concepts of *perpetuity*, *community*, and *ecosystems*. In *Perpetuity*, I explore Marcia Bjornerud's geological understanding of deep time and Sebastian Ureta's work on proactive vs. reactive care. In *Community*, I review Jennifer Wenzel's concept of overburden as more than dirt, theory on the human/nature dualism, and discussions on the impacts of colonialism within mining. In *Ecosystems*, I examine Kathryn Yusoff's writing on property and theory related

to watershed thinking, including Sibyl Diver's use of the term watershed to describe a potential structure of perpetual care. Part 3 gathers theory that challenges current extractive perspectives and offers alternative ways of understanding and viewing post-extraction sites.

In Part 4, **Case Studies: Community Perpetual Care**, I study two community initiatives that demonstrate aspects of perpetual care. These case studies gather and synthesize a range of existing documents, including technical assessment and remediation reports, community member testimonies, and socio-ecological data. Writing and drawings contrast the mining industry's motivations and values with community perpetual care.

1) The Tsolum River community is located near the former Mt. Washington Copper Mine on Vancouver Island, BC. This mine demonstrates the consequences of conflicting ownership and watershed boundaries. The Tsolum River suffered from acid rock drainage from the mining waste, but it became a central character in the repair of the post-extraction landscape. Established relationships between the community and river sparked organizing and cleanup, and these connections will continue to fuel monitoring and care in the future.

2) The Dél̨ı̨nę First Nation is located near several former mines adjacent to lake Sahtú, also known as Great Bear Lake, NWT. These mines demonstrate the negative impacts of colonialism on the land, lake, and Dél̨ı̨nę First Nation, whose ancestors have lived there for thousands of years. The Dél̨ı̨nę suffered but fought to regain governance over the lake and were ultimately successful by establishing a biosphere reserve. The lake was the site of damage but is also the powerful freshwater source that motivates the community to protect it from further development in the future.

Part 4 provides two examples of community-led initiatives that demonstrate sustainable and successful structures of perpetual care, as well as experiments with drawing contrasting stakeholder approaches to these sites.

In the final section, **Reflection**, I compare and connect the mining industry, government, designer, and community's approaches to post-extraction sites, and I consider the potential role of an architect or designer in mine reclamation. I argue that the three themes of Perpetuity, Communities, and Ecosystems are overlooked in post-extraction landscapes, and that they need to be addressed for successful design, remediation, and perpetual care. I also reflect on my drawing methodology throughout the project and conclude with my key takeaways for designers.

1 Context and Problem

The Planetary Mine, and Canada's Role Within It

This thesis focuses on post-extraction landscapes within Canada, but these sites cannot be disconnected from their global network. Mine impacts extend far beyond pits to include material processing facilities, urban centers of accumulation, transportation systems, and capital circulation. Over the past few decades, the mine has become a planetary phenomenon. The term *planetary mine* was first introduced by geographer Mazen Labban, who emphasizes mining's relationship to urbanization, stating that

> "In a general sense, all mining is urban insofar as urban areas initiate processes of extraction and are the intended sites of accumulation of the products of mines, as well as sites of control over financial flows, regulatory mechanisms and production and circulation networks that constitute extractive industry."[1]

The planetary mine is an increasingly important theoretic framework as supply chains are divided into more steps across the entire globe. The framework resists the detachment that is easily felt living in a city, faraway from mine sites and processing facilities. It clarifies the impact that urban centers have on more distant sites of extraction. An understanding of the planetary mine is necessary in moving towards accountability and change.

Communities are raising awareness of human rights struggles and environmental impacts of mining across various stages of material extraction, processing, and manufacturing. Environmental costs include the loss of critical biodiverse ecosystems and the toxic contamination of water sources. Human rights issues encompass the lack of consultation with local communities, the violence towards land defenders, and the exploitation of workers within the extraction industry.[2] The Global Atlas of Environmental Justice is an example of a project that collects and catalogues these stories. The maps bring attention to community struggles otherwise invisible to those further away. They act as a facilitator in the anti-extractivism community. Projects like these are also necessary because conscious consumers do not often have access to a comprehensive understanding of a product's supply chain, making it difficult to understand the true global impact of a product or material.

Architecture scholarship and design school studios have been increasingly interested in urbanization, studying the spaces and processes that design projects rely on but feel disconnected from. For example, the Urban Theory Lab, now based at the University of Chicago (founded by urban theorist Neil Brenner at Harvard's Graduate School of Design), is "deeply interested in the power of concepts to advance our understanding of contemporary urban transformations."[3] Through theory, methods, and cartographies, the lab exposes the interconnected nature of urbanization, erasing urban/rural binaries that exist within design thinking.

The "Extraction" exhibition at the 2016 Venice Architecture Biennale, led by landscape architect Pierre Bélanger, and the book *Extraction Empire: Undermining the Systems, States, and Scales of Canada's Global Resource Empire, 2017—1217*, edited by Bélanger, are examples that relate more directly to

1 Mazen Labban, "Deterritorializing Extraction: Bioaccumulation and the Planetary Mine," *Annals of the Association of American Geographers* 104, no.3 (May 2014): 564, https://www.jstor.org/stable/24537757.

2 Leah Temper, Daniela del Bene, and Joan Martinez-Alier, "Mapping the frontiers and front lines of global environmental justice: the EJAtlas," *Journal of Political Ecology* 22 (2015): 255-278. https://doi.org/10.2458/v22i1.21108.

3 Neil Brenner, quoted in Sarah Steimer, "Data-spheres project from the Urban Theory Lab highlights the planetary reach of urbanization," The University of Chicago, last modified June 16, 2021, https://socialsciences.uchicago.edu/news/data-spheres-project-urban-theory-lab-highlights-planetary-reach-urbanization.

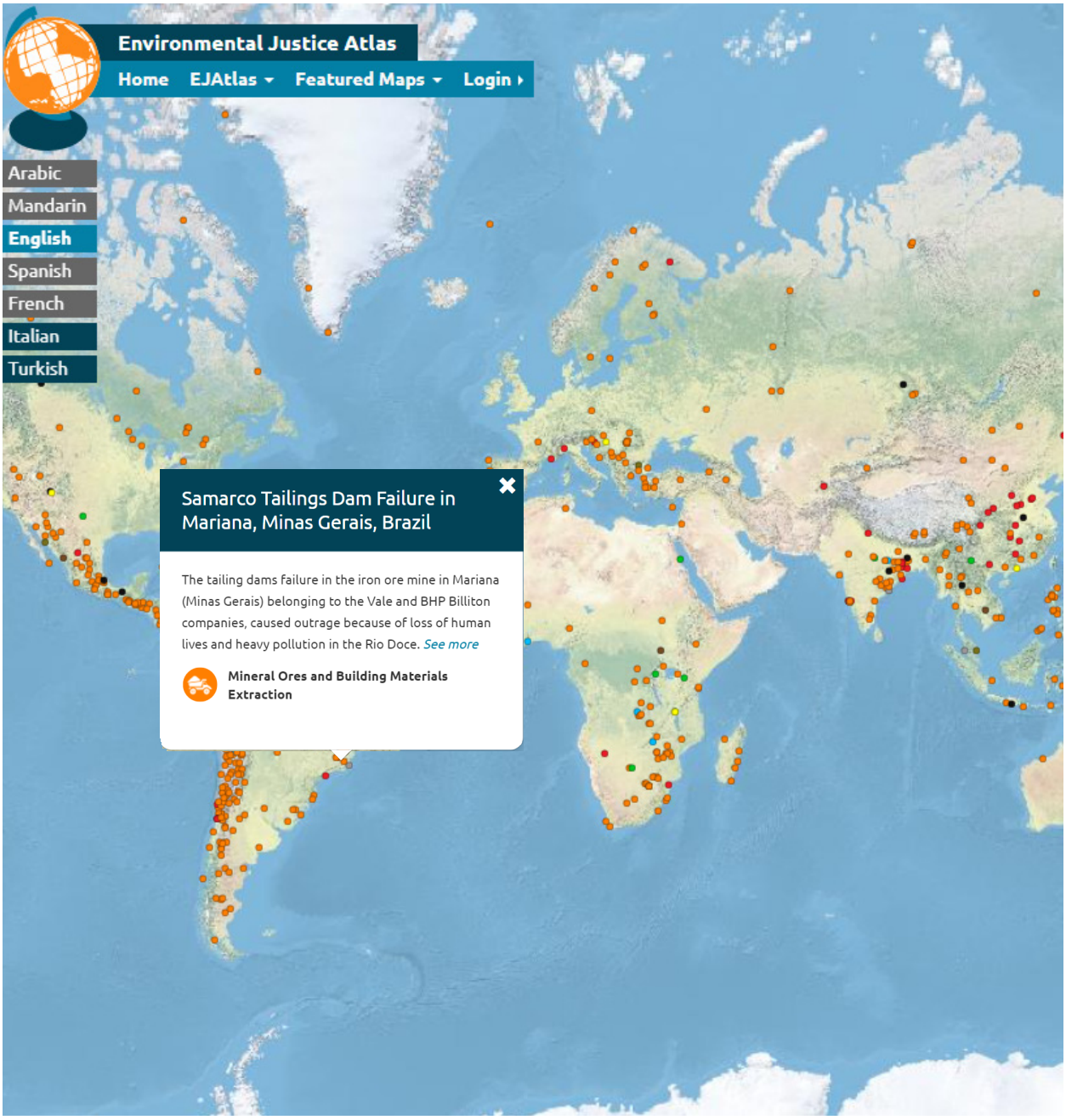


Fig. 1.1 A screenshot of the Global Atlas of Environmental Justice. Each marker on this map represents an environmental justice issue related to "mineral ore exploration" or "mineral processing." (Source: EJatlas, 2022. The Global Atlas of Environmental Justice. www.ejatlas.org)

mining in Canada. Both projects discuss Canada's long extractive history and continual reliance on territories of extraction all over the globe. Book contributors include architects, planners, landscape architects, and designers.

A third example is The University of Waterloo School of Architecture's 2020/2021 "What is Solidarity?" online speaker series' event titled "Anti-Extractivism," organized by Jane Hutton. The conversation assessed the architect's role in material flows and the consequent social and ecological costs of design, in discussion with mining community activist Joan Kuyek and political geographer Martin Arboleda. With a planetary understanding of urbanization, designers hold a greater responsibility to sites of extraction, their surrounding communities, and all other parts of the global system (and planetary mine) they are operating within.

In his book, *The Planetary Mine: Territories of Extraction under Late* Capitalism, Martin Arboleda uses and expands on Labban's concept of the *planetary mine*, emphasizing that "the immanent dynamics that underpin the spaces of extraction of late capitalism are global in content and national only in form."[4] Arboleda notes the danger in focusing on the nation state in studies of extraction, as it fragments an interconnected system and potentially "pits the workers and communities of 'resource-rich' countries against those of the manufacturing centers, when in fact they all share increasingly common conditions of existence."[5] Still, as a nation, Canada has a unique role in the *planetary mine*.

Canada has always been a resource nation. Winona Laduke writes, "Some of the first incursions onto Anishinaabeg land were to secure access to iron and copper deposits."[6] The first European settlers were drawn to this land because of its minerals and Canada continues to rely on the extraction of them to this day. The mineral sector is considered "a pillar of the national economy."[7] In 2017, the sector employed 634,000 people, contributed $97 billion to Canada's GDP, and accounted for 19% of Canada's exports.[8] Natural Resources Canada is the government sector which develops policy, programs, and these statistics in relation to minerals and mining. Its title itself reveals the Government of Canada's motivations. As political scientist James C. Scott writes, the "utilitarian discourse replaces the term 'nature' with the term 'natural resources,' focusing on those aspects of nature that can be appropriated for human use."[9] The Government of Canada continues to view its land and subsurface minerals as commodities.

There are currently 200 operating mines in Canada,[10] but the nation's impact on the global supply chain is not limited to exports of minerals extracted within its borders. More than half of the planet's mines are Canadian operated and two thirds of mining companies are based in Canada.[11] Toronto is an important financial center within the *planetary mine,* as these companies are consequently listed on the Toronto Stock Exchange. The Government of Canada has and continues to work closely with the Mining Lobby to attract mining companies and investors by establishing advantageous tax regimes.[12] Alan Deneault writes that in Canada, "investing in a mining company is tax-free just as a charity donation."[13]

4 Martin Arboleda, *Planetary Mine: Territories of Extraction Under Late Capitalism* (New York: Verso, 2020), 26.

5 Arboleda, *Planetary Mine*, 5.

6 Winona Laduke, *All Our Relations: Native Struggles for Land and Life* (Chicago, Illinois: Haymarket Books, 2015), 117.

7 "Minerals Sector Employment," Natural Resources Canada, last modified February 8, 2019, https://www.nrcan.gc.ca/science-data/science-research/earth-sciences/earth-sciences-resources/earth-sciences-federal-programs/minerals-sector-employment/16739.

8 "10 Key Facts on Canada's Mineral Sector," Natural Resources Canada, August 2018, https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/minerals-metals/pdf/mms-smm/10_Key_Facts_on_Canadas_Mineral_Sector_EN.pdf.

9 James C. Scott, *Seeing Like a State: How Certain Schemes to improve the Human Condition Have Failed* (New Haven and London: Yale University Press, 1998), 13.

10 Natural Resources Canada, "10 Key Facts on Canada's Mineral Sector."

11 Pierre Bélanger, ed., *Extraction Empire 2017-1217* (Altona: MIT Press Ltd, 2018), 6-7.

12 Alan Deneault, "At the Financial Heart of the World Mining Industry," in *Extraction Empire 2017-1217,* ed. Pierre Bélanger (Altona: MIT Press Ltd, 2018), 79.

13 Deneault, "At the Financial Heart of the World Mining Industry," 80.

Fig. 1.2 10 Key Facts on Canada's Minerals Sector. (Source: Natural Resources Canada. This reproduction is a copy of an official work that is published by the Government of Canada. This reproduction has not been produced in affiliation with, or with the endorsement of the Government of Canada.)

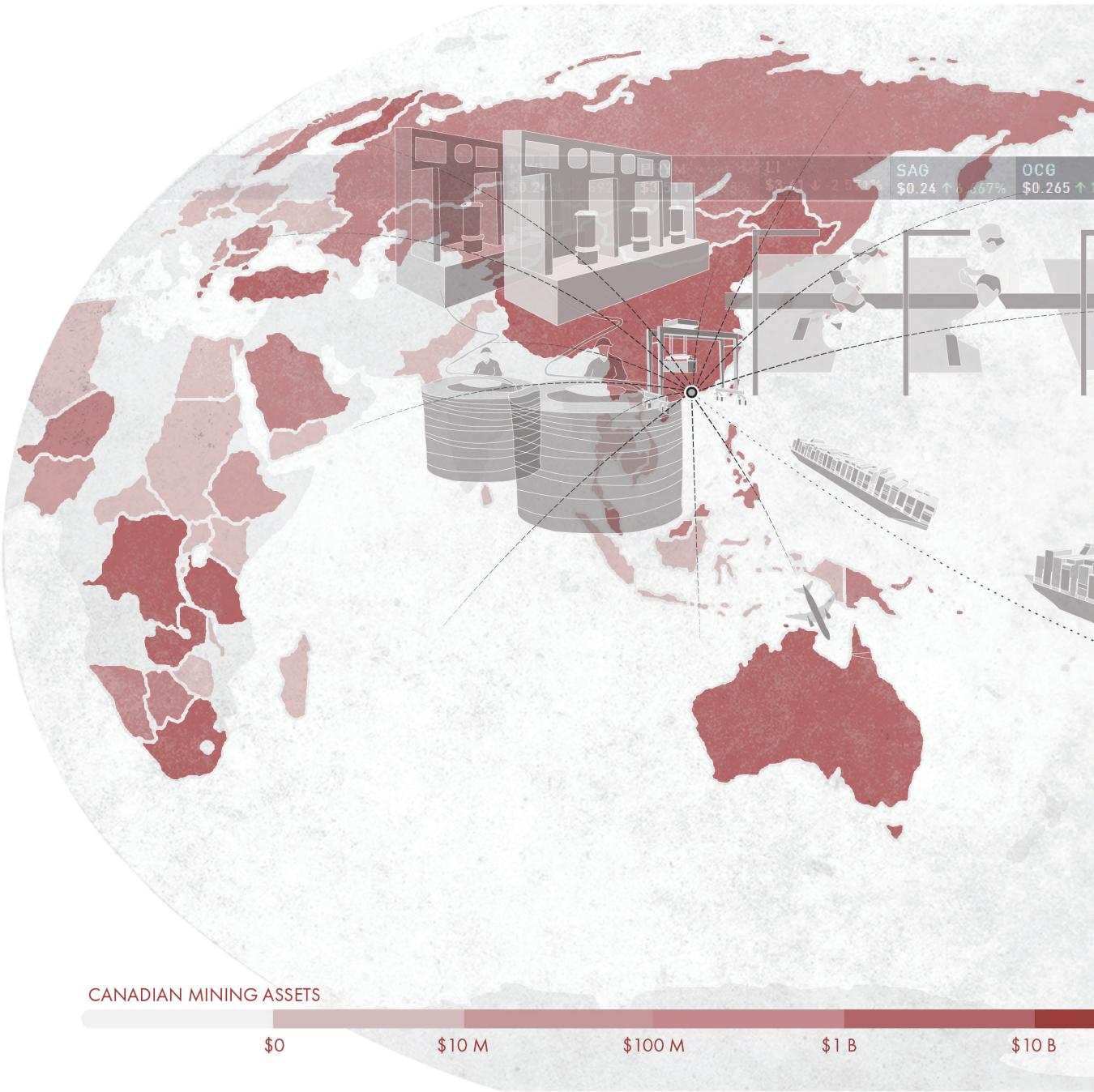


Fig. 1.3 The planetary mine, and Canada's role within it. The drawing overlays Martin Arboleda's description of the material tracting of copper (the interconnected nature of its extraction in Chile, processing in China, and distribution worldwide), Canada's global mining assets, and the Toronto Stock Exchange as a global financial hub for the extractive industry. Drawing by author.


MXR
$0.24 -7.692%
PRYM
$3.51 3.235%
ZEN
$3.47 2.663%
NOU
$8.90 -0.891%
CBR
$0.38 1.333%
AUN
$0.315 3.279%
TSX

Toronto is also home to the annual conference held by The Prospectors & Developers Association of Canada (PDAC), "the leading voice of the mineral exploration and development community."[14] Beyond Extraction (BE), a group of researchers, writers, artists, and activists that critique the practice of extraction, work in opposition to PDAC. BE describes that by hosting PDAC, "Toronto reveals itself as the extractive capital of the world, the veritable 'belly of the beast,' whose tentacles reach far across time and space wreaking havoc in communities and ecologies around the world."[15] The collective counters PDAC's conference with one of their own – the Beyond Extraction Counter Conference, which reveals the power of PDAC and discusses projects that intervene with the negative impacts of the mineral industry.

Figure 1.3 draws the planetary mine and Canada's role within it by overlaying Arboleda's material tracing of copper (the interconnected nature of its extraction in Chile, processing in China, and distribution worldwide), Canada's global mining assets, and Beyond Extraction's descriptions of Toronto as a global financial hub for the extractive industry.

Renewable Energy and the Growing Demand for Minerals

Martin Arboleda notes a dramatic increase in mineral extraction and production during the past few decades. The robotization and computerization of labor processes mark a sharp jump in demand for minerals, called a "fourth machine age."[16] The goal to globally transition to a renewable energy run economy will only further increase mineral demand. Specifically, lithium, copper, graphite, cobalt, nickel, and rare earth minerals will be in high demand.[17]

With the awareness of high global carbon emissions and dangers of climate change have come plans for transitioning to a low-carbon economy. There is no one silver bullet to approach lowering and reversing carbon emissions. A combination of many solutions is necessary. Project Drawdown, a non-profit organization which aims to help lower global emissions, has compiled a catalog of climate solutions. A number of these solutions, which have become a key part of Canadian and US governments' plans, include the production of renewable energy and clean technology systems.

In the architecture industry, there has been a parallel push for carbon reduction in the built environment. The Canada Green Building Council advocates for continuous changes in government building codes and encourages developments to meet goals set out by certifications such as the Zero Carbon Building Standard, LEED green building rating system, and WELL Building Standard. Certifications include efforts to reduce both the embodied and operational energies, and reward on site renewable energy sources.

Governments and industries are turning to solar photovoltaics, advanced batteries, and wind turbines among other so-called green technology to lower carbon emissions. Without a dramatic change in energy consumption, the transition to clean energy sources relies on an unprecedented acceleration in demand for minerals.[18] Although the energy transition supports the

14 "ABOUT PDAC," Prospectors and Developers Association of Canada, Accessed March 14, 2022, https://www.pdac.ca/about-pdac.

15 "What is PDAC?," Beyond Extraction: a collective, Accessed March 14, 2022, https://www.beyondextraction.ca/becc.

16 Arboleda, *Planetary Mine*, 4.

17 Yannick Deniau, Viviana Herrera Vargas, and Mariana Walter, "Mapping community resistance to the impacts and discourses of mining for the energy transition in the Americas (2nd ed.)," EJAtlas and Mining Watch Canada, November 23, 2021, https://miningwatch.ca/sites/default/files/2022-03-04_report_in_english_ejatlas-mwc.pdf.

18 Mining Watch Canada, "International Conference: Turning Down the Heat: Can We Mine Our Way Out of the Climate Crisis?," Published November 2020, 6, miningwatch.ca/turning-down-the-heat.

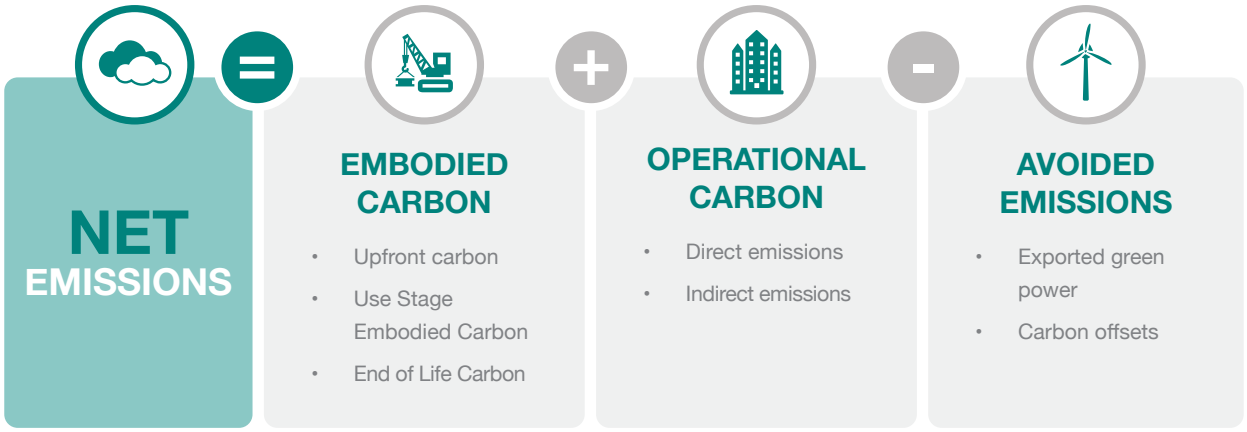


Fig. 1.4 The compents of calculating Zero Carbon Balance for a building. Renewable energy is taken into consideration in both Operational Carbon and Avoided Emissions categories. (Source: Zero Carbon Building Design Standard Version 2, July 2021, Canada Green Building Council.)

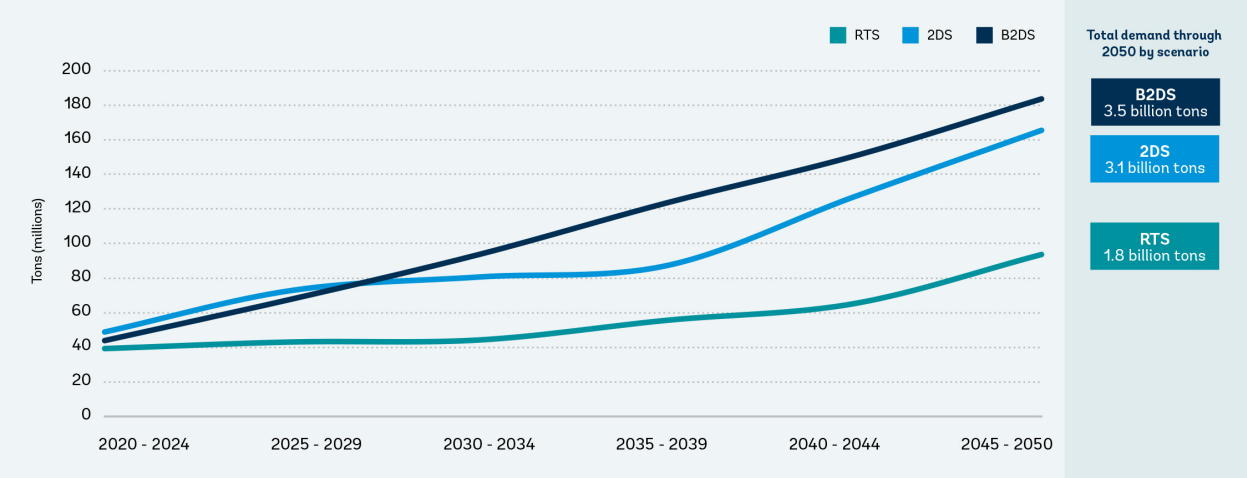


Fig. 1.5 Projected annual average demand of minerals based on three scenarios. RTS is a reference technology scenario, 2DS is a scenario limiting global warming to two degrees, and B2DS is a beyond two degrees scenario. (Source: Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition, 2020, World Bank Group.)

elimination of coal mines, notorious for their environmental destruction, it relies on production of alternate extraction sites. Both the Government of Canada and PDAC profit from this current shift in the rebranding of mining's narrative from something dirty to something necessary for a clean/green future. Canada, which has always been a resource nation, now has a reasoned excuse to expand its extractive industry. The government states that "Canada is primed to capitalize on the rising global demand for critical minerals, driven in large part by their role in the transition to a low-carbon and digitized economy."[19] In 2021, the Government of Canada released a list of *critical minerals* required for this transition, along with maps that illustrate exploration sites for solar panel minerals across the country. PDAC also supports the status quo growth in demand for minerals.[20] It references the term *critical minerals* in its 2021 annual convention's "Canada day session" titled "Canada's critical minerals for the global clean energy transition."[21]

The transition to renewable energy sources is paradoxical because there are permanent, negative social and ecological impacts from the development of extraction sites. The Government of Canada and PDAC do acknowledge some consequences of mining and the need for more sustainable practices within the industry, but this is largely overshadowed by discussions on *critical minerals* necessary for clean energy technology. Natural Resources Canada describes lithium, copper, graphite, cobalt, nickel, and rare earth minerals as *crtitical* and argue that in turn, their extraction sites are *critical* to the economy and climate change mitigation. However, some of these sites overlap with *critical* landscapes for carbon sequestration. One example is the future mining developments in Ontario's Ring of Fire, including the proposed Eagle's Nest nickel mine. This project is associated with the green transition as nickel is a key mineral input for advanced batteries. Ontario's Ring of Fire, however, is located within concentrated and intact peatlands. Peatlands are important carbon sequestration ecosystems and when disturbed, release large quantities of carbon into the atmosphere, contributing to the advance of climate change. Canada contains 25% of the world's peatlands and a large portion of these are found in Ontario.[22] Future developments in Ontario's Ring of Fire threaten *critical* intact peatlands.

Minerals contribute to green technology (such as solar panels and wind turbines) that can replace non-renewable energy sources, but their extraction results in the destruction of habitats and the production of massive amounts of overburden and toxic waste. The mining industry and Canada rely on the narrative that mineral extraction is key to the clean energy transition. With it they can continue business as usual.

Canadian registered mining companies operate worldwide. As a result, Canadian companies are globally causing harm to biodiversity, water, and community livelihoods. There is a vast range of negative consequences across the spectrum of operations in the *planetary mine,* including labor issues, processing and transportation emissions, and community health impacts. In contrary to the mining industry's propaganda on the green transition, The EJAtlas's "Mapping the mining impacts of the energy transition in the Americas" proves it to be unsustainable and unjust.[23] The map includes stories

19 "Critical minerals," Natural Resources Canada, last modified March 29, 2021, https://www.nrcan.gc.ca/our-natural-resources/minerals-mining/critical-minerals/23414.

20 Beyond Extraction: a collective, "What is PDAC?"

21 Prospectors and Developers Association of Canada, "Convention Program," February 22, 2021, https://www.pdac.ca/docs/default-source/conventions/2021-convention/pdac_2021_convention_program.pdf?sfvrsn=869f629f_2.

22 Lorna I Harris et al., "The essential carbon service provided by northern peatlands," *Frontiers in Ecology and the Environment* (2021), https://doi.org/10.1002/fee.2437.

23 Deniau, Herrera, and Walter, "Mapping community resistance."

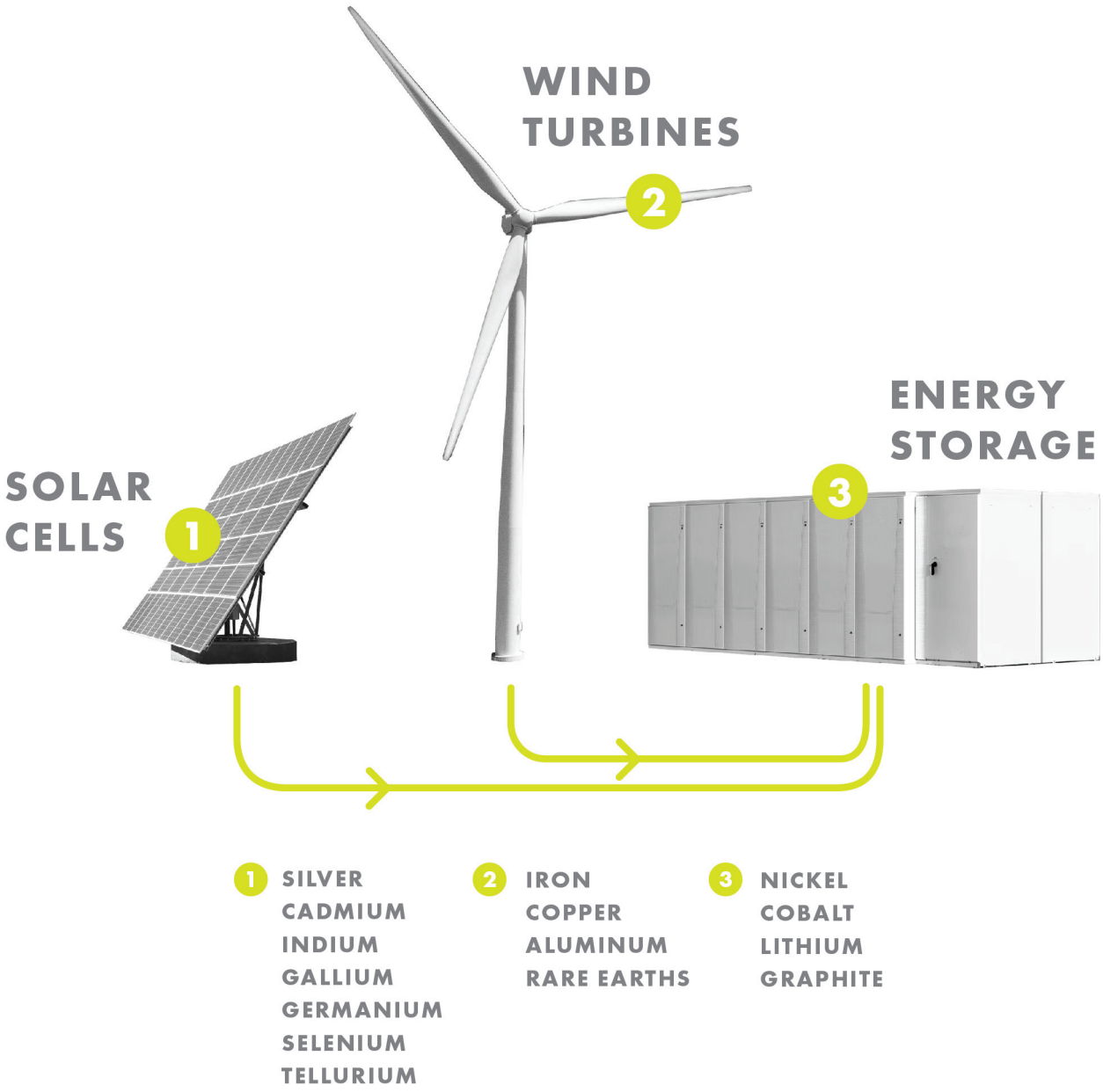


Fig. 1.6 Minerals required for clean energy applications. Drawing by author. (Data from "Enabling Clean Energy Applications" Information Bulletin, March 2017, Natural Resources Canada.)

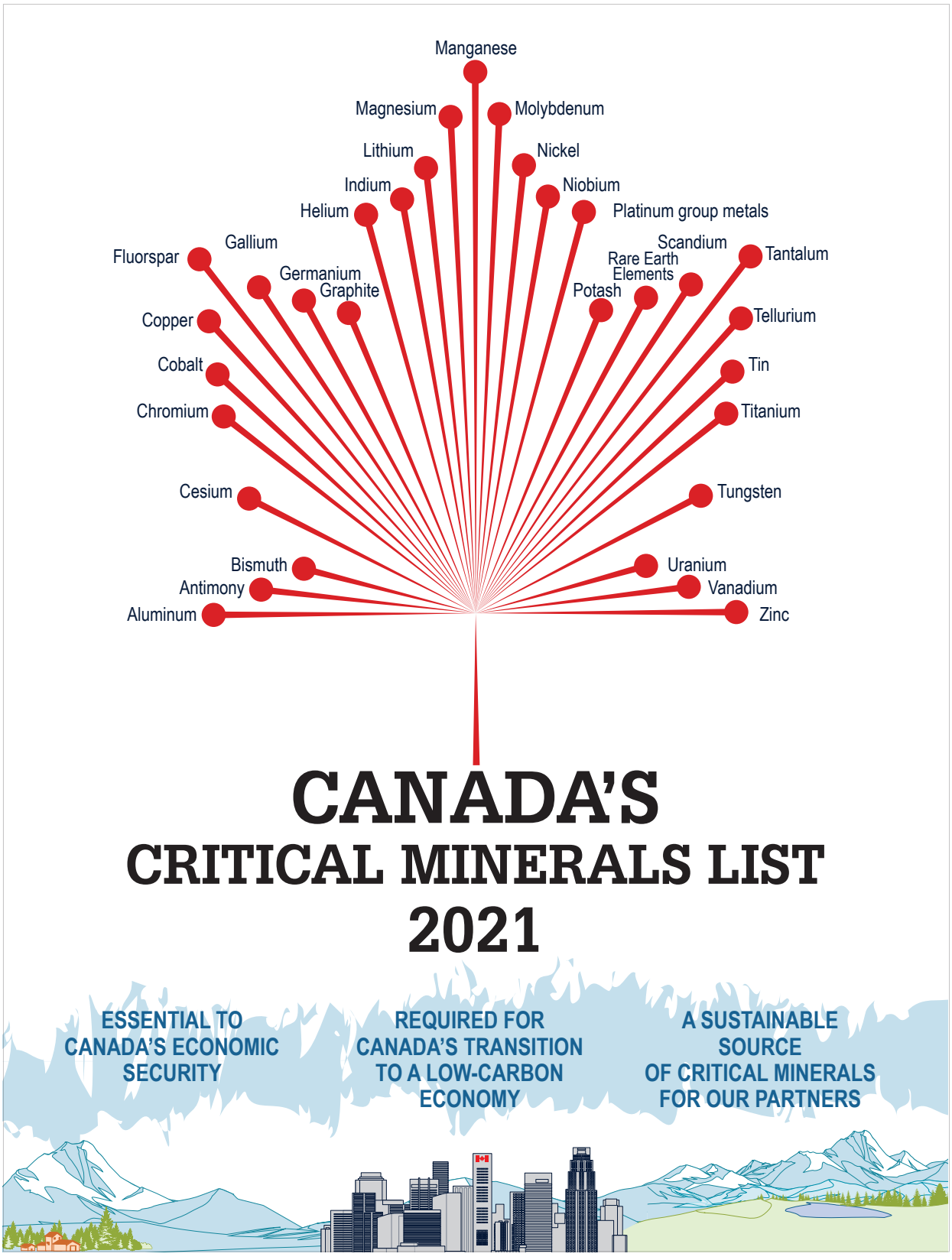


Fig. 1.7 Canada's Critical Minerals List. (Source: Canada's Critical Minerals List 2021, Natural Resources Canada. This reproduction is a copy of an official work that is published by the Government of Canada. This reproduction has not been produced in affiliation with, or with the endorsement of the Government of Canada.)

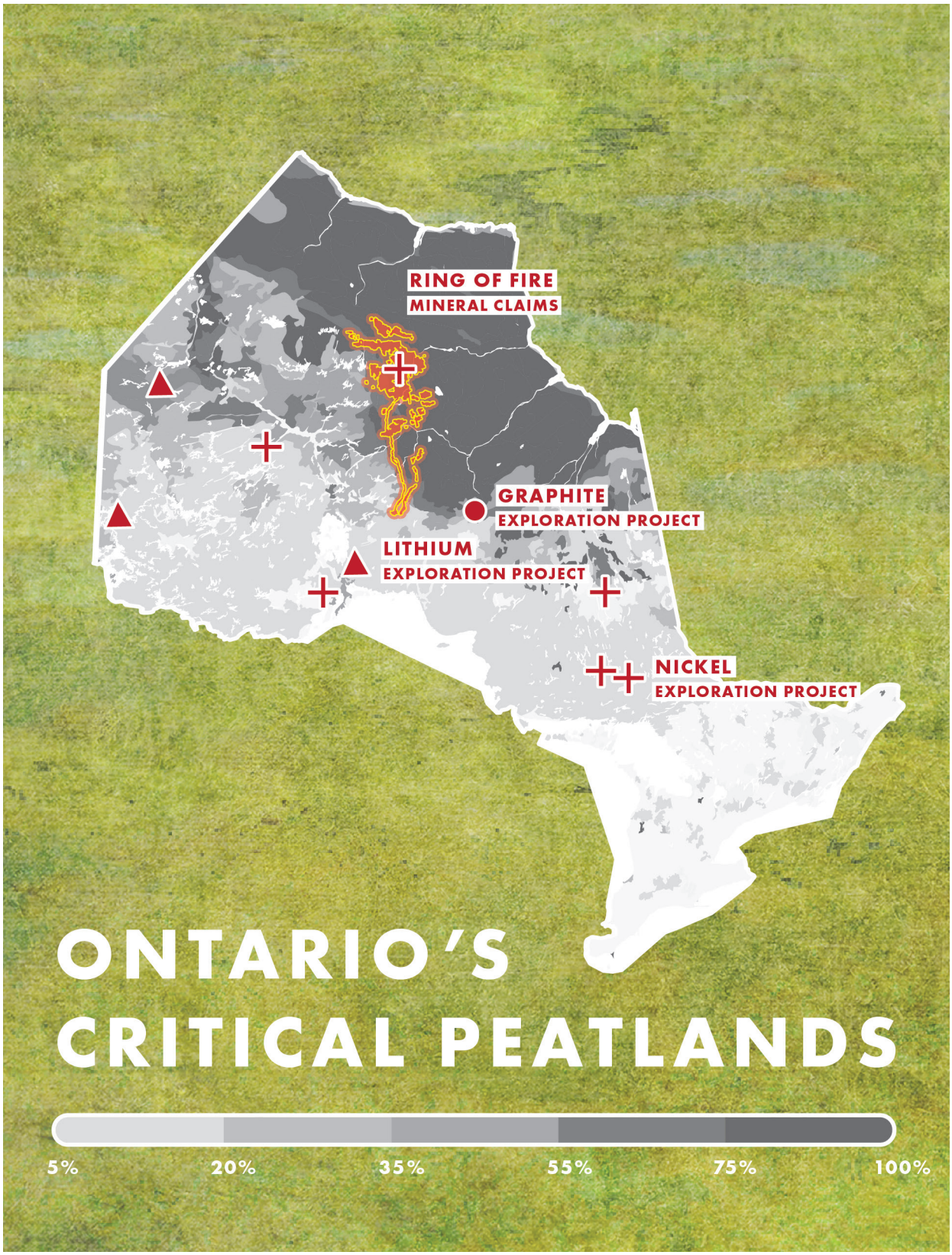


Fig. 1.8 Ontario's Critical Peatlands. Mineral Exploration Projects associated with Canda's Critical Minerals List are overlayed, revealing the conflict between the two. This poster counters the Natural Resources Canada poster on the left page. Drawing by author.

from communities in both North and South America, and it highlights issues which differ by continent and country.

MiningWatch Canada also addresses this paradox in their 2020 report titled "Turning Down The Heat: Can We Mine Our Way Out of the Climate Crisis?" Ultimately, the organization identifies the need for a decrease in consumption and de-growth of primary mineral demand. It encourages greater mineral efficiency and recycling, recommending the halt of mining for luxury projects, and advocates for systematic changes within urban developments and transportation systems.[24] MiningWatch Canada also identifies that mine sites that are deemed necessary must "prioritize environmental protection and prevent perpetual & intergenerational impacts (water, air, land, health)," acknowledge the perpetuity of the toxic waste from these sites, and plan to provide necessary financial assurance and care.[25] The Environmental Justice Atlas project similarly argues that a just energy transition must not "further entrench the same extractivist practices that have caused the climate emergency in the first place."[26]

As mining regulations and negative impacts vary across the globe, this thesis chooses to focus on mines and their adjacent local communities within Canada. Whereas the drawing of the *planetary mine* follows the mineral supply chain during operations, the remaining portion of this project examines what happens after the mine, after operations have ceased. Additionally, to limit the scope of this thesis, the remaining sections focus on coal, metal, and non-metal mines; and exclude sand, gravel, and stone quarries from discussions (Canada currently has 6500 operating sand, gravel, and stone quarries in comparison to 200 mines).[27]

24 Mining Watch Canada, "Turning Down the Heat," 4.

25 Mining Watch Canada, "Turning Down the Heat," 14.

26 Deniau, Herrera, and Walter, "Mapping community resistance," 6.

27 "Minerals and the economy," Natural Resources Canada, last modified February 3, 2022, https://www.nrcan.gc.ca/our-natural-resources/minerals-mining/minerals-metals-facts/minerals-and-the-economy/20529.

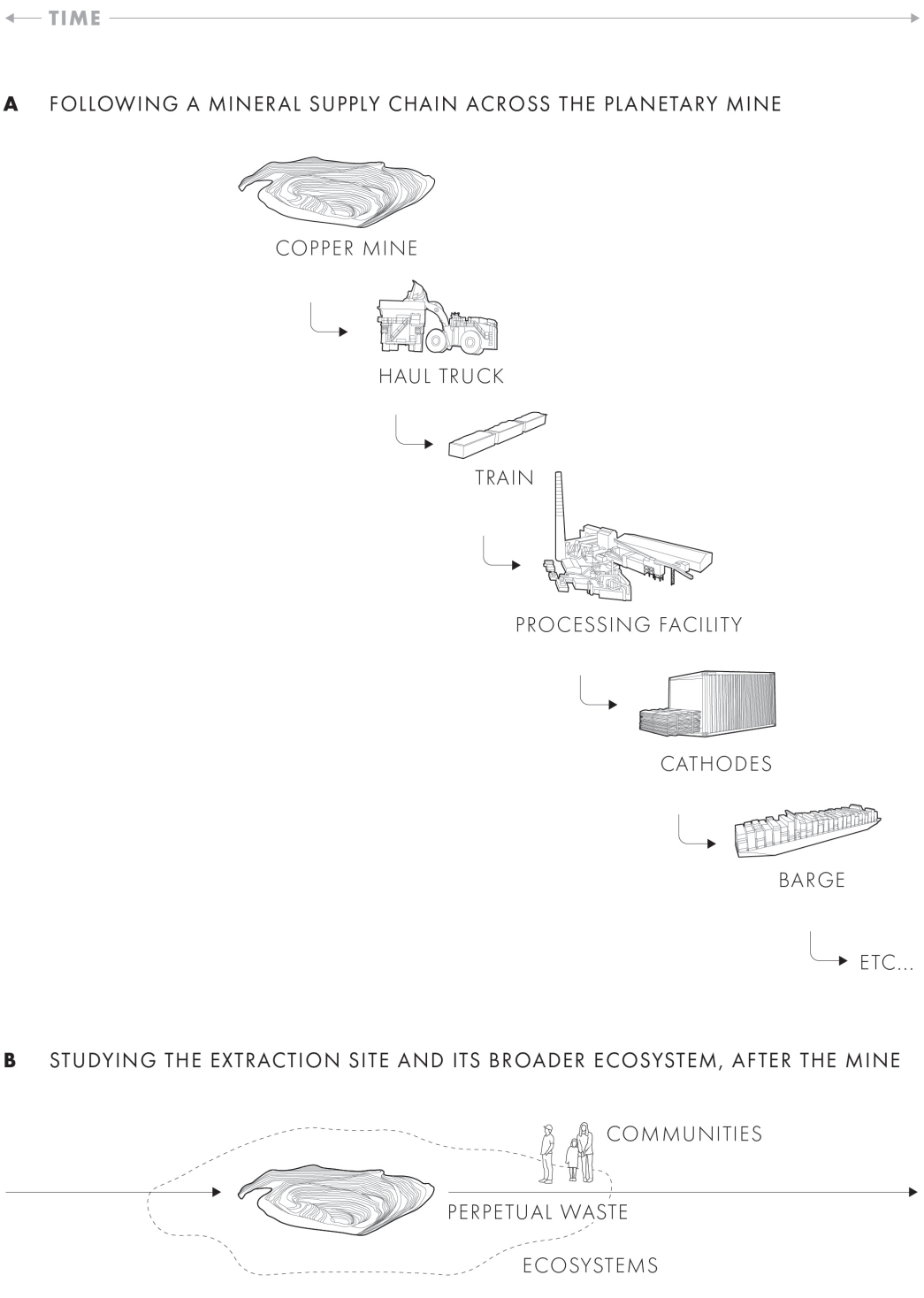


Fig. 1.9 Path A follows minerals as they are extracted, transported, processed, etc. Path B studies the extraction site and the surrounding ecosystem both before and after mining operations have ceased. Path B illustrates the subject matter of the remaining portion of this thesis. Drawing by author.

The Problem of Mine Afterlives

A mine is not only an extraction site for minerals that are transformed into productive materials. It is a site of negative consequences, which this thesis examines through three themes: *perpetuity* – it is a perpetual waste site because of massive amounts of overburden removed and toxic byproducts produced; *communities* – it is a damaged home to nearby human and non-human species; and *ecosystems* – its boundaries are ever-expanding when waste is not contained and flows through watersheds.

Mining is often viewed as an industry of valuable minerals, but as Joan Kuyek, community organizer and activist, states, "mining is a waste management industry."[28] Only a fraction of ore is processed and considered to be of value in the end. For example, a deposit typically only needs to contain 1% copper, 0.1% silver, or 2% nickel to make it economically viable.[29] A large portion of extracted rock is discarded as overburden or as tailings in the processing stage. (The Government of Canada defines tailings as "the waste material, which may or may not be mixed with water, that remains after processing ore, ore concentrate or mined materials to extract marketable components such as metals, minerals or bitumen."[30]) In one year in Canada, 25 megatons of citizen, municipal, and industrial waste are created.[31] In comparison, mining produces 800+ megatons of waste.[32] Still, it is categorized as an extractive industry, instead of a waste management industry. Mining waste is often toxic, which means it requires remediation and care in *perpetuity* – containment, record keeping, and monitoring for the foreseeable future – to ensure it does not harm the surrounding ecosystem.

If mining overburden and waste is not adequately contained within rock dumps and tailings ponds, toxic minerals can flow according to their own agency, past a mine site's boundaries. When waste rock is exposed to rain or water, it can produce acid rock drainage, which can kill life in rivers, expanding a mine's impact to include larger watersheds and *ecosystems*. Nearby developments associated with mining can also negatively impact ecosystems. For example, the removal of gravel from the Tsolum River's beds for nearby industry resulted in long-term damage to salmon spawning grounds (discussed further in Part 4.1).

Mineral extraction does not only damage habitats of plant and animal species but can negatively impact nearby *communities*. Ecological damage directly affects the health of food and water sources, and therefore the health of the communities. Many abandoned mines in Canada are located near or on the homes of Indigenous nations that were dispossessed of their land. Impacts on these communities vary from site to site. For example, the Eldorado mine at Port Radium, NWT employed individuals in unsafe and exploitative working conditions, damaging their long-term health and community relations (discussed further in Part 4.2). Mining projects resulted in negative cumulative impacts that communities are still dealing with years and decades after nearby mines are no longer in operation.

Mine closure and rehabilitation regulations and practices do exist but are and/or have been inadequate in addressing the themes of *perpetuity*, *communities*,

28 Joan Kuyek, *Unearthing Justice: How To Protect Your Community From the Mining Industry* (Toronto: Between the Lines, 2019), 10.

29 Steven Earle, Physical Geology – 2nd Edition (BCcampus, 2019).

30 "Tailings and waste rock: guide to reporting," Government of Canada, last modified April 3, 2020, https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/publications/guidance-reporting-tailings-waste-rock.html.

31 Mining Watch Canada, "Turning Down the Heat," 6.

32 Mining Watch Canada, "Turning Down the Heat," 6.

and *ecosystems*. This thesis builds upon geographers Arn Keeling, Caitlynn Beckett, and Miranda Monosky's critiques of mine closure and remediation. Generally, they assert that current practices are based on technical, short-term fixes, and argue for a more comprehensive remediation that addresses perpetuity, social injustices, and broader ecological damage. This thesis also advocates for *perpetual care*, a concept introduced by Joan Kuyek, which addresses *perpetuity, communities*, and *ecosystems*. *Perpetual care* is further explored in Part 3, but first the background context of regulations and practices is reviewed. The following section examines how the legal landscape has changed, from the lack of regulations and abandonment of mines to the legislation that increasingly protects ecosystems but still has shortcomings.

Closure and Rehabilitation - Current Regulations

The Minerals and Metals Policy of the Government of Canada states that Canada's provinces and territories have jurisdiction over mining operations within their boundaries.[33] The federal government does, however, regulate mining North of 60° and uranium mining (*Uranium and Thorium Mining Regulations)*. It is also involved with issues related to the *Fisheries Act* and the *Canadian Environmental Assessment Act* where necessary. The federal government policy that regulates extraction sites post-operations is titled *Mine Reclamation.* Mine reclamation is considered "the last phase of a mineral development cycle" [34] and "seeks to rehabilitate a mine site to a viable, and wherever practicable, self-sustaining, ecosystem that is compatible with a healthy environment and other human activities."[35]

Although the phrase self-sustaining implies an end to human intervention, many post-extraction sites will never become completely self-sustaining and safe. They should therefore require some form of monitoring and care forever. *Mine closure* is another term often used with or in the place of the term *mine reclamation*. Various government organizations admit that the *closure* process can often extend for years or decades. Still, the word *closure* frames post-extraction practices as something to complete, as opposed to an "ongoing process of trust building, reconciliation, and perpetual care for humans, animals and environments alike," which Keeling and Beckett suggest it should be. [36]

As provinces are responsible for the regulation of mining in Canada, terminology for this concept slightly varies around the country, and the extents of regulations regarding it vary more. As Joan Kuyek concludes that Quebec has the most stringent guidelines and British Columbia the least,[37] I review these two jurisdictions more closely.

British Columbia requires mining companies to submit and receive approval for a *reclamation program* prior to starting mining operations. It also states that mining companies must submit a security, which the province would return upon satisfactory reclamation. The *Mines Act* leaves the acceptable amount up to the Chief Inspector of Mines' discretion.[38] The BC Mining Law Reform Network, however, has observed that the Chief Inspector "has regularly chosen

33 "The Minerals and Metals Policy of the Government of Canada," Natural Resources Canada, last modified November 14, 2017, https://www.nrcan.gc.ca/science-data/science-research/earth-sciences/earth-sciences-resources/earth-sciences-federal-programs/minerals-and-metals-policy-government-canada/8690.

34 Natural Resources Canada, "Exploration and Mining Guide for Aboriginal Communities," 2013, https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/mineralsmetals/files/pdf/abor-auto/mining-guide-eng.pdf.

35 Minister of Public Works and Government Services Canada, "Mine Reclamation," in "The Minerals and Metals Policy of the Government of Canada," 1996, 14. https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/minerals-metals/pdf/mms-smm/poli-poli/pdf/mmp-eng.pdf.

36 Caitlynn Beckett and Arn Keeling, "Rethinking remediation: mine reclamation, environmental justice, and relations of care," *Local Environment* 24, no. 3 (2019): 217.

37 Kuyek, *Unearthing Justice*, 184.

38 "Mines Act," Government of British Columbia, last modified February 16, 2022, https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96293_01#section10.1.

Fig. 1.10 Mining pit at an operating iron ore mine near Fermont, Quebec. Image by author.

Fig. 1.11 Tailings pond at an operating iron ore mine near Fermont, Quebec. Image by author.

to require that companies provide security for only parts of the projected cleanup costs," increasing government and taxpayer liability.[39] In the *Health, Safety and Reclamation Code for Mines in British Columbia*, reclamation is defined as a program of environmental protection and reclamation "to an end land use approved by the chief permitting officer that considers previous and potential uses."[40] The BC Auditor General found that the Ministry of Energy and Mines' guidelines for inspection of reclamation and closed mines are vague.[41] Generic language that suggests inspection should happen "from time to time" [42] detracts from the necessity of these practices and makes it difficult to evaluate and enforce adequate reclamation practices.

Quebec, on the other hand, is known for more rigorous regulations. To acquire a mining lease, mining companies must have a "rehabilitation and restoration plan", also referred to as a "closure plan," approved by Quebec's *Ministère de l'Énergie et des Ressources Naturelles*.[43] Companies are required to provide a detailed estimate of rehabilitation and restoration costs, as well as an aligned financial guarantee. This financial guarantee is required to be paid upfront in full, an incentive for companies to carry out mining operations as responsibly as possible.[44] Quebec's mine reclamation goals are:

- "eliminating unacceptable risks to public health and safety;
- limiting the production and spread of contaminants that may damage the receiving environment, and attempting to eliminate all forms of long-term care and maintenance;
- reclaim[ing] the site to a visually acceptable standard;
- rehabilitat[ing] the infrastructure area to be compatible with future use."[45]

Mine closure regulations in both provinces are limited to physical aspects of public safety and containment – removing infrastructure above ground, stabilizing mining pit walls and tailing pond dams – and exclude some of the broader impacts on the ecosystem and nearby communities. Again, although Quebec admits long-term care and maintenance may be necessary, it aims to avoid this when possible.

Regulations are one part of the problem, but the closure and rehabilitation plans that are created and approved are another. For example, revegetation is considered mandatory in the *Guidelines for Preparing Mine Closure Plans in Quebec*, but a clause states that "if all or part of the mine site cannot be revegetated, the proponent must prove why revegetation is impossible and how the site will nevertheless attain a satisfactory condition."[46] A 2015 iron ore mine feasibility study in sub-arctic Quebec does not include revegetation in its closure plan. It states that "artificial re-vegetation is not technically feasible, nor adapted to sub-arctic conditions,"[47] and is therefore excluded from the plan. Yes, revegetation in the sub-arctic requires hardy native species, which are harder to acquire in the north, but so many of Canada's mines are located in sub-arctic or arctic conditions. Can this one-line excuse in a closure plan be enough to release the mining company from revegetation responsibilities?

Regarding *communities*, Monosky and Keeling write about the exclusion of Indigenous voices in the planning for mine afterlives. The geographers

39 BC Mining Law Reform, "Closure, Reclamation, & Abandoned Mines," May 2019, https://reformbcmining.ca/wp-content/uploads/2019/05/BC-MLR-Closure-Reclamation-Abandoned-Mines.pdf.

40 British Columbia Ministry of Energy, Mines and Low Carbon Innovation, "Part 10: Permitting, Reclamation, and Closure," in "Health, Safety and Reclamation Code for Mines in British Columbia," revised April 2021, 92, https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/health-and-safety/code-review/health_safety_and_reclamation_code_apr2021.pdf.

41 Carol Bellringer, "An audit of compliance and enforcement of the mining sector," Auditor General of British Columbia, May 2016, 47. https://www.bcauditor.com/sites/default/files/publications/reports/OAGBC%20Mining%20Report%20FINAL.pdf.

42 Bellringer, "An audit of compliance," 47.

43 "Mine Reclamation," Quebec Ministère de l'Énergie et des Ressources naturelles, accessed February 2022, https://mern.gouv.qc.ca/en/mines/mining-reclamation/.

44 BC First Nations Energy and Mining Council, "Using financial assurance to reduce the risk of mine non-remediation: Considerations for British Columbia and Indigenous governments," November 2019, 5, http://fnemc.ca/wp-content/uploads/2015/07/Using-financial-assurance-to-reduce-the-risk-of-mine-non-remediation.pdf.

45 Quebec Ministère de l'Énergie et des Ressources naturelles, "Mine Reclamation."

46 Quebec Ministère de l'Énergie et des Ressources naturelles, "Guidelines for Preparing Mine Closure Plans in Quebec," November 2017, https://mern.gouv.qc.ca/english/mines/reclamation/documents/guidelines-mine-closure.pdf.

47 R. W. Risto et al., "Lac Otelnuk Project Feasibility Study – NI 43-101 Technical Report," Lac Otelnuk Mining, 2015.

CLOSURE PLAN

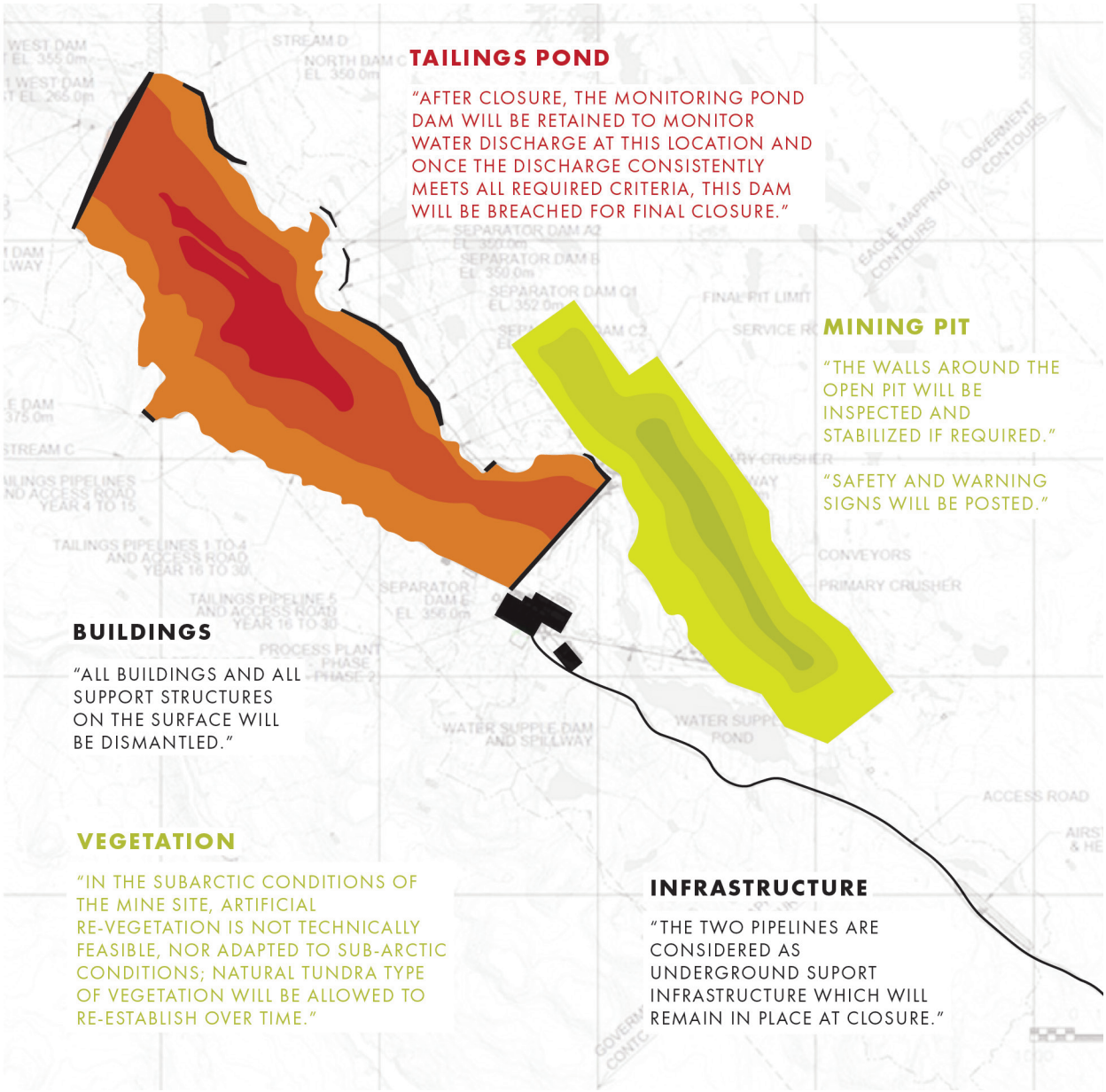


Fig. 1.12 Analysis of the Lac Otelnuk mine's closure plan. Drawing by author. (Quotes: Lac Otelnuk Project Feasibility Study - Technical Report, Lac Otelnuk Mining, 2015.)

analyzed ten closure plans in Canada, referring to the many Indigenous territories that Canada's mines are located within. Although closure planning is required at early stages of a mine's development, Monosky and Keeling found that engagement with Indigenous communities is often only vaguely mentioned in these plans. They suggest that this is a result of both gaps in public policy and the implementation in industry practices.[48] Regarding *ecosystems*, Beckett and Keeling examine the "spatial challenges of waste containment and stabilization, which requires continual monitoring, and re-evaluation as waste moves and changes."[49] Mine closure and rehabilitation practices often focus on mitigating waste production within property boundaries and don't necessarily clean up long-term damage that exists beyond the site. Regarding *perpetuity*, Monosky and Keeling describe closure planning as prioritizing "short-term technical fixes over longer-term socio-economic, cultural, and ecological considerations" and they observe that the mining industry regularly lacks the motivation to close and remediate mines beyond the inadequate minimum regulations.[50]

Mines closed to satisfy regulations can still pose a risk to nearby communities and ecosystems. Tailings dams, for example, still need long-term maintenance and care. A tailings dam is an engineered structure which is designed to contain tailings (mine waste) within a limited area. Canada has had a sizeable number of substantial tailings dam failures in the last few decades.[51] The Mount Polley copper and gold mine, located in south-central British Columbia, had a devastating failure in 2014. The tailings dam, which contained a four square kilometer pond of mining waste, breached due to an engineering failure.[52] The waste consequently spread to contaminate various water sources and habitats. The Mount Polley mine, which was still in operation at the time, is an example where existing monitoring and maintenance structures were inadequate, considering that the failure resulted in profound damage. All closed mines should require a long-term continual system of care.

When looking at the future of mining, there is some innovation in technological mine closure and reclamation strategies in Canada and regulations are constantly being updated. But it is not enough, and as Canada continues to produce these permanent waste landscapes, their closure, reclamation, and care practices need to reflect all perpetual environmental, social, and economic costs.

Legacy Sites

The mining industry uses the term "legacy site" to describe mines for which there is no viable closed state. The term has different connotations depending on the stakeholder describing it. Steven Woolfenden, Director of Environment for Iamgold describes "managing some legacy sites that are 30, 40, 50 years old and there is no end to that management – it will be in perpetuity."[53] Although these sites may never be fully cleaned up, they are continuously maintained to some extent. On the other hand, MiningWatch Canada defines legacy sites as "those inactive sites for which a private owner still exists, but which has not been reclaimed and risks becoming abandoned."[54] The emphasis here is put on the fact that the site is not safe and secure.

48 Miranda Monosky and Arn Keeling, "Planning for social and community-engaged closure: A comparison of mine closure plans from Canada's territorial and provincial North," *Journal of Environmental Management* 227 (2021): 2.

49 Beckett and Keeling. "Rethinking remediation," 220.

50 Monosky and Keeling, "Planning for social and community-engaged closure," 1.

51 Kuyek, *Unearthing Justice*, 52.

52 "News and Information on the Mount Polley Mine Disaster," *The Narwhal*, accessed February 14, 2022, https://thenarwhal.ca/topics/mount-polley-mine-disaster/.

53 Alisha Hiyate, "Why mine closure matters and why it gets ignored," *Canadian Mining Journal,* last modified January 1, 2018, https://www.canadianminingjournal.com/features/mine-closure-matters-gets-ignored/.

54 "Finally! New National Inventory for Orphaned and Abandoned Mine Sites," Mining Watch Canada, last modified May 10, 2017, https://miningwatch.ca/news/2017/5/10/finally-new-national-inventory-orphaned-and-abandoned-mine-sites.

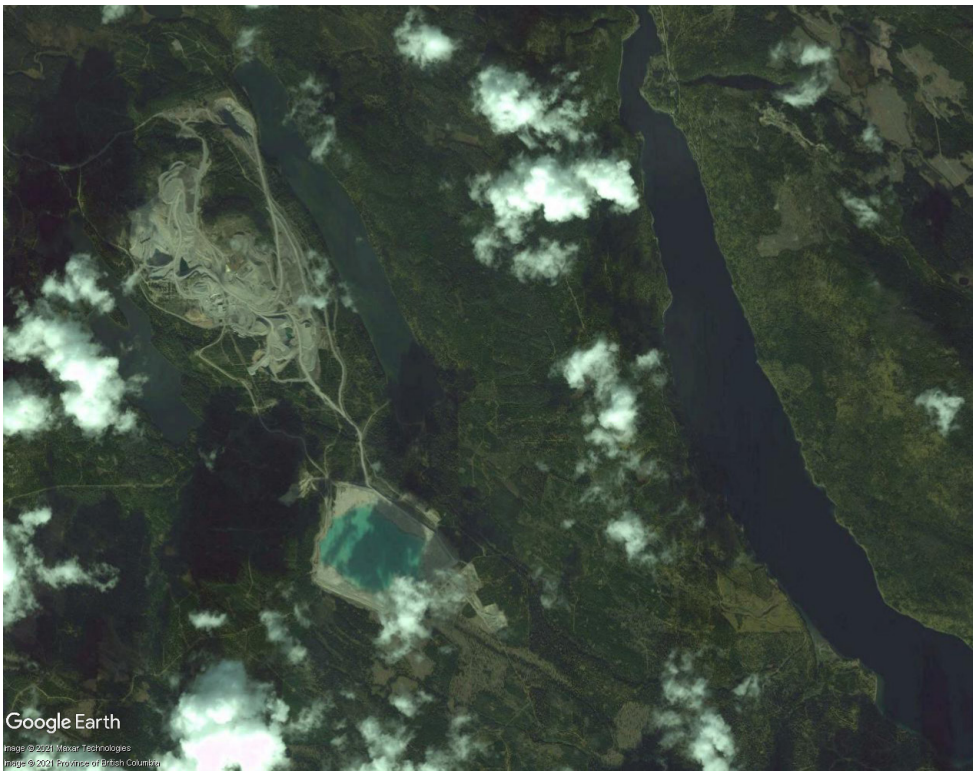


Fig. 1.13 Mount Polley Copper Mine before its tailings dam failure, on October 8, 2011. (Source: Map Data: Google, Maxar Technologies, Province of British Columbia 2021.)

Fig. 1.14 Mount Polley Copper Mine after its tailings dam failure, on August 4, 2014. (Source: Map Data: Google, Maxar Technologies 2021. Annotations by author.)

Abandoned Mines

Across the board, mine closure and reclamation is a relatively new concept and consequentially, there are few examples of closed mines which pose no risk to the surrounding environment and community. In British Columbia, the first ecological reclamation requirements came into effect in 1969, were repealed in 1977, and introduced again in 1990. In 1994, the province introduced regulations which required mining companies to submit some financial security for reclamation practices. In Quebec, the first examples of government-led remediation were in 1990.[55] Ken Bocking, principal in the mine waste division at Golder Associates, explains that until mine closure and reclamation regulations were implemented, "mines would live out their useful life and then many of the operators just walked away."[56]

Canada is not only a resource nation; it is also a nation of contaminated sites. As the Government of Canada boasts its 200 active mines,[57] it does not advertise its 10,139 abandoned mines,[58] which continue to endanger or pose risks to their surrounding ecosystems. Thousands of abandoned mines in Canada, "those mines for which the owner cannot be found or for which the owner is financially unable or unwilling to carry out cleanup,"[59] have yet to be remediated. The typical abandoned mine continues to disrupt habitats on site, endanger freshwater sources in a larger area, and negatively impact the nearby communities.

The Tulsequah Chief mine is an example of an abandoned mine in British Columbia, located near the Alaska border. The mine was operated between 1947 and 1957, after which it was abandoned by Teck-Comico.[60] From 1987 to 2015, the ownership changed multiple times and various exploration and development took place, but the mine never went into production again. After 60 years of abandonment, cadmium, copper, lead, and zinc levels in the Tulsequah River water remain dangerous to the health of the ecosystem and animals that inhabit it.[61] The nearby Taku River Tlingit First Nation operates fisheries on the Taku and would potentially expand to the Tulsequah valley, but current toxin levels post unacceptable risks to those using the site for extended periods of time.[62] Without remediation and perpetual care, the site remains unsafe. The two case studies discussed in Part 4, Mt. Washington Copper Mine and Port Radium Mine, are also examples of abandoned mines.

NOAMI, the *National Orphaned/Abandoned Mines Initiative*, was formed in 2002. The Government of Canada currently uses the term *abandoned mine*, but it is interesting to note the formerly used term *orphaned mine.* The term *orphan* is usually used to describe a child deprived of its parents. *Orphaned mine* then implies a similar relationship between a mine and its operating company. This adds weight to a mining company's desertion of its role as caretaker and not just an owner of a site.

NOAMI was funded by provincial and federal governments and reported to Canada's Mine Ministers. The NOAMI working group was dedicated to studying Canada's large number of abandoned mine sites. It created a national inventory of abandoned mines in Canada, classifying them by their minerals, location, and level of risk.

55 "30 Years of Mine Site Reclamation: A Clear Look at the Past," Quebec Ministère de l'Énergie et des Ressources naturelles, accessed March 14, 2022, https://mern.gouv.qc.ca/en/quebec-mines/program-2021/30-years-mine-site-reclamation-clear-look-past/.

56 Hiyate, "Why mine closure matters."

57 Natural Resources Canada, "Minerals Sector Employment."

58 W O. Mackasey, "ABANDONED MINES IN CANADA," February 17, 2000, 14, https://miningwatch.ca/sites/default/files/mackasey_abandoned_mines.pdf.

59 "About NOAMI," National Orphaned/Abandoned Mines Initiative, accessed November 17, 2020, http://www.abandoned-mines.org/en/.

60 "Closure and Reclamation Plan for the Tulsequah Chief Mine Site, Near Atlin, British Columbia," British Columbia Ministry of Energy, Mines and Petroleum Resources, last modified April 14, 2020, 950, https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-permitting-and-compliance/tulsequah/remediation_plan_tulsequah_chief_mine_site_for_distribution.pdf.

61 British Columbia Ministry of Energy, Mines and Petroleum Resources, "Closure and Reclamation Plan," 973.

62 British Columbia Ministry of Energy, Mines and Petroleum Resources, "Closure and Reclamation Plan," 973.

The government of Canada has further begun to acknowledge that thousands of abandoned mines exist, and there are now both federal and provincial funded initiatives working to remediate sites. On the federal level, the *Northern Abandoned Mine Reclamation Program* works to remediate "the [eight] largest and highest-risk abandoned mines in the Yukon and the Northwest Territories" over the next 15 years and plans for ongoing care and monitoring afterwards.[63] Smaller sites can be considered under the Canada's *Federal Contaminated Sites Action Plan* or provincial programs, each with varying approaches to abandoned mine futures.

PDAC, on the other hand, acknowledges abandoned mines when talking about the potential for re-exploration of sites for further development.[64] As valuable ore bodies become less abundant and mining technology becomes more developed, it is becoming profitable for mining companies to re-mine waste rock at former inactive mine sites.[65] This puts abandoned mine landscapes at risk for further damage, unless re-development in sites would come with responsibility for their cleanup and care.

Mines, abandoned and closed, continue to pose risk after operations are ceased. This section has presented stakeholders that argue that current mine closure and reclamation regulations and practices are inadequate. Canada and the mining industry need to work towards a more holistic reclamation of post-extraction sites and acknowledge the necessity for perpetual care.

Fig. 1.15 The abandoned Tulsequah Chief Mine. Acid mine drainage flows to contaminated the larger watershed. (Source: Colin Arisman / The Narwhal, 2020.) (Image removed for UW space upload.)

63 "The Northern Abandoned Mine Reclamation Program," Crown-Indigenous Relations and Northern Affairs Canada, last modified August 19, 2019, https://www.canada.ca/en/crown-indigenous-relations-northern-affairs/news/2019/08/the-northern-abandoned-mine-reclamation-program.html.

64 "Abandoned Surface And Old Underground Mine Workings," Prospectors & Developers Association of Canada, accessed December 2021, https://www.pdac.ca/priorities/responsible-exploration/e3-plus/toolkits/health-and-safety/abandoned-surface.

65 Arboleda, *Planetary Mine*, 4.

2 The Art, Architecture, and Design of Mine Afterlives

The Role of Landscape Architects in Mine Reclamation

Mine afterlives are designed by interdisciplinary teams. Traditionally, engineers and environmental scientists working for the mining industry are at the core, as practices focus on technical environmental fixes. Although the landscape architecture profession has had limited involvement in the reclamation of post-extraction sites over the last half century, there are landscape architects that believe that their role in the mining industry is still overlooked. They argue that their potential to think about these sites creatively is not fully recognized. There are reasons why landscape architects' roles are still limited, Belinda Arbogast, a chemist and physical scientist with a Master of Landscape Architecture, writes:

> "One of the main challenges to developing creative science-based designs for mining reclamation is the lack of interaction between scientists and engineers, who have traditionally dominated the mining field, and design professionals, who may feel that incorporating aspects of science and statistics interferes with the creative process."[1]

By definition, landscape architects are supposed to have a broad knowledge of the planning and design of the environment, rather than a deep understanding of specifics. This range in thinking allows them to be strong coordinators between specialists, bringing together different areas of expertise. T. Allan Comp writes, in the design of mine reclamation landscape architects should be seen

> "not as solitary visionaries, but as participants; not as some ultimately mystical or magical intervention, but offering an important, critical perspective; not as an arbitrator, but as a coworker, one among many disciplines equally necessary to the recovery and revitalization of a region and its peoples."[2]

The main argument for landscape architects to be involved in the design of post-extraction sites is that they understand the necessity for both ecological and social aspects of reclamation and remediation. Baida, Slingerland, and Wilson write that "their balancing act between quantitative technical (science, engineering) and qualitative (land-use, socio-cultural) knowledge-based approaches allows for holistic systems design of multifaceted sites, including post-mining environments."[3] As a nature/culture divide is often discussed in relation to the extraction industry, landscape architects could be instrumental in responding to this problem. As landscape architects understand the ties between ecological and social aspects, they have the tools to think about humans' place within nature and how to repair the relationship "lost through the reductive procedures of resource extraction."[4]

The following sections explore how landscape architecture and other designer professions have been drawn to and participated in the design of mine afterlives. All discussed projects are analyzed through the three analytic themes of this thesis: *perpetuity*, *communities*, and *ecosystems*. As mine afterlives are an interdisciplinary problem, it is interesting to explore both the benefits and limits of designer involvement in post-extraction landscapes.

1 Belinda Arbogast, "Interrogating a landscape design agenda in the scientifically based mining world," in *Designing the Reclaimed Landscape*, edited by Alan Berger (New York: Taylor & Francis, 2008), 52.

2 T. Allan Comp, "Science, art, and environmental reclamation: three projects and a few thoughts," in *Designing the Reclaimed Landscape*, edited by Alan Berger (New York: Taylor & Francis, 2008), 75.

3 M. Baida, N. Slingerland, and G.W. Wilson, "The great divide between mine closure goals and outcomes, and potential solutions," University of the Witwatersrand, October 2014.

4 Rod Barnett, "Gold and the gift: theory and design in a mine-reclamation project," in *Designing the Reclaimed Landscape*, edited by Alan Berger (New York: Taylor & Francis, 2008), 34.

Landscape Architects within the Mining Industry: 1950s to 1980s United States

The signing of the *Surface Mining Control and Reclamation Act* by president Carter in 1977 marked the point in the United States' history when mine reclamation became a mandatory and regular practice. The government recognized the negative impacts of extraction on the environment and proposed reclamation strategies to restore land and water resources degraded by coal mining.[5] The act established a program and funds for this work. In the 1980s, the U.S. Department of Interior's Office of Surface Mining started to employ landscape architects for the Abandoned Mined Lands Program, created as part of the *Surface Mining Control and Reclamation Act*.[6]

The landscape architecture profession, however, already had limited involvement in the design of mine afterlives a few decades prior. Kenneth L. Schellie is one example. Schellie is called a "landscape architectural reclamation pioneer"[7] by fellow American landscape architects Anthony M. Bauer and Jon Burley. He was already practicing mine reclamation design in 1948, when he first started working as a consultant for the National Sand and Gravel Association.[8] Schellie "promoted the idea of surface mining as just a transitional land-use, the concept of simultaneous excavation and rehabilitation, the importance of mining operations to create land for post-mining land uses."[9] He worked closely with the mining industry, argued that mine reclamation would increase both profits and mining efficiency, and authored publications on his approach to this work.[10] Schellie also worked at the University of Illinois in the 1960s and 1970s, encouraging and training landscape architects in mine reclamation design.[11]

In the 1980s, mine reclamation was mandatory and the involvement of landscape architects in their design became more regular. Anthony M. Bauer was, however, concerned that mine reclamation was becoming too focused on repairing disturbed landscapes.[12] Bauer's outlook was similar to Schellie's, and he stated that landscape architects "need to look at the mining operation as being a creative part of shaping a new environment, and need to become involved in this process right from the outset" of the mining process.[13] Sue Massie, a landscape architect working with the Illinois Abandoned Mined Land Department, also in the 1980s, was hesitant to accept this viewpoint, arguing that all land should not be looked at as moldable and that "there's a lot of concern that, in mining, huge areas of land are being disturbed, never to return to the types of land use that are needed in that area."[14] Massie was concerned that the ecological restoration and remediation did not always align with motivations to use the mining process to create new landscapes for future profitable development. These two opinions show some of the variation in landscape architects' views of the extraction industry at the time.

The reclamation projects of West Virginia's abandoned coal mines demonstrate typical ways landscape architects were involved in the 1980s United States. Architects were both employed directly by government agencies related to mine reclamation and hired as consultants as part of a design team.[15] In West Virginia, future land use proposals included "(1) wildlife and forest development through revegetation, (2) recreation development, and (3) the

5 "Surface Mining Control and Reclamation Act of 1977," United States Congress, last modified December 9, 2021, https://www.govinfo.gov/content/pkg/COMPS-1574/pdf/COMPS-1574.pdf.

6 Jeff L. Nelsen and Jeffrey D. Robertson, "Abandoned Mines: West Virginia's Reclamation," *Landscape Architecture Magazine* 75, no. 3 (May/June 1985).

7 J. Burley and A. Bauer, "Kenneth L. Schellie, A Landscape Architectural Reclamation Pioneer," *Journal of the American Society of Mining and Reclamation*, January 2000.

8 Burley and Bauer, "Kenneth L. Schellier."

9 Burley and Bauer, "Kenneth L. Schellier."

10 Burley and Bauer, "Kenneth L. Schellier."

11 Dr. Jon Byan Burley and Lee R. Skabelund, "Reclamation and Restoration Professional Interest Group: A Brief History," American Society of Landscape Architects, August 21, 2004, https://www.asla.org/uploadedFiles/CMS/PPNs/Landing_Pages/Eco_PIGroup_History_Aug21_2004.pdf.

12 Anthony Bauer et al., "Design for Reclamation," *Landscape Architecture Magazine*, June 1989.

13 Anthony Bauer et al., "Design for Reclamation."

14 Anthony Bauer et al., "Design for Reclamation."

15 Nelsen and Robertson, "Abandoned Mines: West Virginia's Reclamation," 50.

development of flat land for potential future housing."[16] These uses reflect the range of thoughts discussed by Bauer and Massie earlier. Landscape architects were desired for their combined aesthetic and environmental thinking, as they worked with engineers and agronomists, who had the technical knowledge required. They were specifically involved in the design of landform configurations and revegetation planting schemes. In Minden, West Virginia's reclamation, native trees and shrub species were planted on slopes to unify the former mine site with natural areas nearby and herbaceous vegetation was chosen for flat areas that were due to become a housing development in the future.

Revegetation has been a larger topic of discussion within the landscape architecture discipline in relation to the mining industry. More recently, traditional landscape architecture strategies in revegetation have been critiqued and new, more appropriate models for post-extraction sites have been considered. In 2008, Peter del Tredici writes that a shift to valuing an ecosystem's function

> "requires abandoning the age-old practice of assigning individual plants to fixed locations in a planting plan and replacing it with mixed plantings of trees, shrubs, and herbaceous perennials. Adopting this change in planting strategy is difficult for some landscape architects, because it means giving up a measure of control over the planting design to the plants themselves."[17]

Whereas aesthetics are harder to control with this mode of thinking, the strategy relies on the ecosystem creating an optimal environment for things like water use, carbon sequestration, etc. – some plants will live and some will die.[18] Also, although the goal with revegetation is often for a reclaimed area to become self-sufficient, Del Tredici notes that his

> "approach to reclamation requires an acknowledgment - early on in the design process - of the need for ongoing maintenance at all constructed landscapes, regardless of scale. All too often the concept of sustainability is misinterpreted to mean self-sustaining, a fantasy that is false in ecology as it is in horticulture."[19]

With this he suggests that perpetual care needs to be acknowledged in the design of post-extraction sites, even for elements such as revegetation.

In terms of perpetual care, the reclamation of West Virginia's coal mines does not mention ongoing maintenance of the site, so it is unclear if the team considered the reclamation as a final, self-sustaining design. The project did, however, start to think about the landscape beyond the abandoned mine boundaries. Although reclamation practices such as revegetation and landform configurations are limited to the site, the West Virginia reclamation team also analyzed the acid mine drainage in the larger watershed and worked to develop systems of drainage control. This is a successful acknowledgement of the broader negative impacts of extraction on the ecosystem. Also, projects that had "greater community impact" were selected and future land use was

16 Nelsen and Robertson, "Abandoned Mines: West Virginia's Reclamation," 50.

17 Peter Del Tredici, "Disturbance ecology and symbiosis in mine-reclamation design," in *Designing the Reclaimed Landscape*, edited by Alan Berger (New York: Taylor & Francis, 2008), 23.

18 Del Tredici, "Disturbance ecology," 23.

19 Del Tredici, "Disturbance ecology," 20.

Fig. 2.1 Mine reclamation at Minden, West Virginia. (Source: West Virginia Division of Natural Resources.)

evaluated based on benefits to the landowner and community.[20] Still, no consultation or participation is outlined and it does not state who has priority – the landowner or the community.

American Earthworks as Land Reclamation: 1970s United States

Earthworks created by land artists in the 1970s in the United States are examples of mine reclamation projects centered on art. When legislation regarding mine reclamation requirements came into play, American land artists such as Robert Smithson and Robert Morris vied for opportunities to participate in these projects. The new state legislation in the early 1970s and the *Surface Mining Control and Reclamation Act* in 1977 opened up a new set of potential projects for earthwork artists,[21] like it had for landscape architects. Not only were land reclamation projects an opportunity for land artists to create large-scale artworks on site, but their work could be sponsored by Abandoned Mined Lands Reclamation Councils across the country. As Robert Morris said, "Art functioning as land reclamation has a potential sponsorship in millions of dollars and a possible location over hundreds of thousands of acres throughout the country." [22]

When proposing their work to the mining industry, artists argued that land art would transform the perception of the damaged landscapes in a cost-effective way. Smithson explained how

> "an investment in art would be advantageous in terms of both their tax obligations and their wider reputation, indeed, that Earth Art would increase the value of their land: 'Waste land is thus converted into something practical and necessary, as well as becoming good to look at.'"[23]

Smithson was interested in designing interventions to highlight elements of abandoned mines and tailing ponds, while leaving much of the sites as they were. He was interested in maintaining the industrial nature of a site rather than concealing its exploitative past. He viewed land reclamation projects as an opportunity to explore and change the relationship between humans and landscape in real life. Although not a landscape architect himself, Smithson was interested in the discipline and inspired by Frederick Law Olmsted. He viewed Olmsted's landscape architecture as a successful model of this: "A park can no longer be seen as 'a thing-in-itself,' but rather as a process of ongoing relationships existing in a physical region – the park becomes a 'thing-for-us.'"[24]

Bingham Copper Mining Pit Reclamation Project is an example of Smithson's proposed projects for mine reclamation, drawn in 1973. The Bingham mine is one of the world's most productive copper mines. It began operating in 1906, continued to operate when Smithson was drawings his proposal, and is still in operation today. In his drawing, Smithson explores ideas of scale, time, nature, and culture. These themes can be read in Thomas Dreher's description of the *Bingham Copper Mining Pit Reclamation Project*:

> "Four dams comprised of circular segments were to lead into a center consisting only of water. With this liquid

20 Nelsen and Robertson, "Abandoned Mines: West Virginia's Reclamation," 50.

21 Thomas Dreher, "Robert Smithson: Land Reclamation and the Sublime," *Arte Factum* 9, no. 45 (October-November 1992): 26.

22 Robert Morris, "Notes on Art as/and Land Reclamation," *October* 12 (Spring 1980): 98.

23 Philip Ursprung, *Robert Smithson, and the Limits to Art* (University of California Press, 2013), 211.

24 Ursprung, *Robert Smithson*, 214.

Fig. 2.2 Johnson Pit #30 in King County, WA, completed by Robert Morris in 1979. (Source: Jon Roanhaus, 2021.)

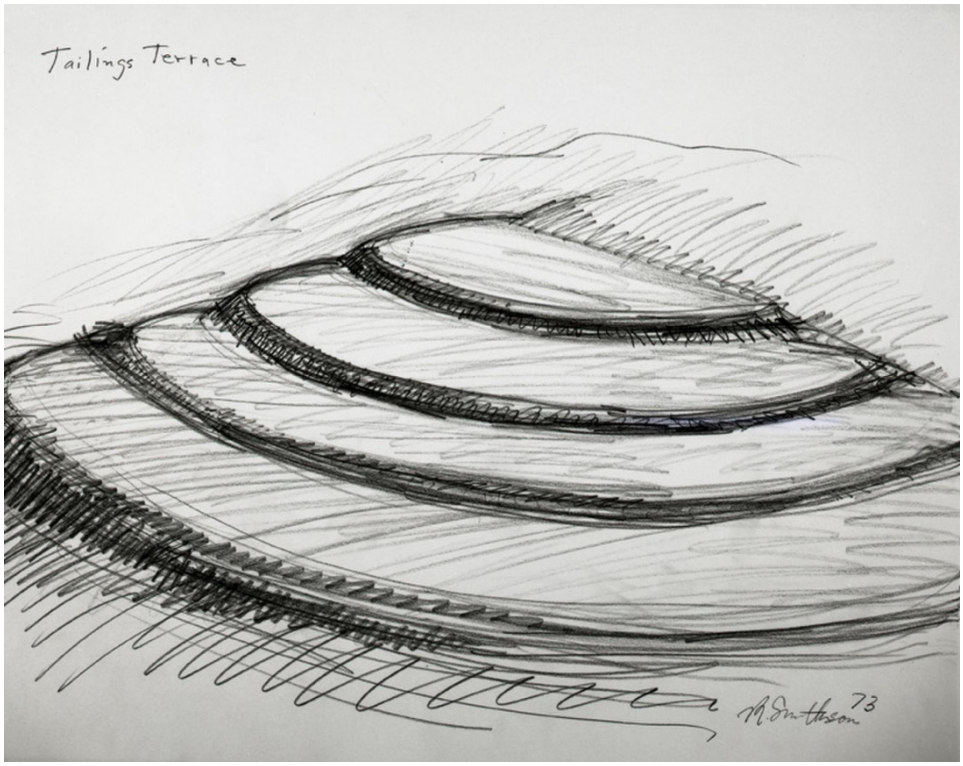


Fig. 2.3 Robert Smithson, *Tailings Terrace* (1973)
Graphite and charcoal on paper
30 x 35 in. (76.2 x 88.9 cm)

> center between curved dams, the mining terraces would have appeared as the outer rings of an inwardly (counter-clockwise) or outwardly (clockwise) rotating whirlpool."[25]

The project speaks to the past by leaving the mining pit as a large industrial void on display, revealing the exploitation of nature. Looking to the future, Smithson often worked with the concept of entropy, allowing his land art to interact with the surrounding site and transform over time. Although it is not clear if he had similar intent for this specific earthwork, the concept of entropy could be dangerous for a site with mining waste. Interestingly, many of Smithson's land art projects have been maintained and cared for in their original form as he became a renowned artist. Although this was not Smithson's original intention, it shows how design can bring value and attract attention and care in the long-term.

Smithson's concept includes humans not only as viewers, but as participants within the landscape. He draws dams that humans could potentially walk upon. Smithson was interested in this on-the-ground interaction, rather than limiting audience's views to above or outside the earthwork. However, he draws from the point of view of a universal man, rather than a particular nearby community. Lucy Lippard, writer and activist, writes how "land art tends to be site-specific but not overtly place-specific. Local geology, history, and identity are secondary, if acknowledged at all. Local residents are considered primarily in their roles as workers and incidental audiences."[26] Smithson thought of the human more generally in this case, to convey the massive scale of the mineral extraction.

Although Smithson's drawing was limited in scale to the mining pit, he was theoretically connecting to areas further away. The spiral dams in the *Bingham Copper Mining Pit Reclamation Project* draws one's eyes outwards, suggesting a larger, ever-expanding boundary. Lippard described that earthwork projects "surrender scale to the adjacent spaces, while drawing their emotional power from distance – distance from people, from environmental issues, and even from places."[27] The environmental remediation of Smithson's proposed earthworks is meager, but the project is successful in amplifying the scale of exploitation of the site.

Although Smithson has built projects within other types of industrial sites, this proposed mine reclamation earthwork was never approved and constructed. For one, the Bingham copper mine continued operations for decades. Also, the mining companies associated with these sites were not interested in financing projects that would exhibit their exploitative past. Instead, they were interested in converting land for other functional uses such as recreation, tourism, or farming.[28] Sponsors had great impact on what types of mine reclamation projects were built.

As Lippard notes, most of the famous land artists of this time were white men, as it was "rare for women artists to raise the thousands of dollars it takes to create such monumental works."[29] Robert Morris and Michael Heizer are two other famous land artists that worked with earthworks as land reclamation in the United States in the 1970s. They both have built mine reclamation

25 Dreher, "Robert Smithson," 26.

26 Lucy Lippard, *Undermining: A Wild Ride Through Land Use, Politics, and Art in the Changing West* (The New Press, 2014), 82.

27 Lippard, *Undermining*, 82.

28 Dreher, "Robert Smithson," 26.

29 Lippard, *Undermining*, 81.

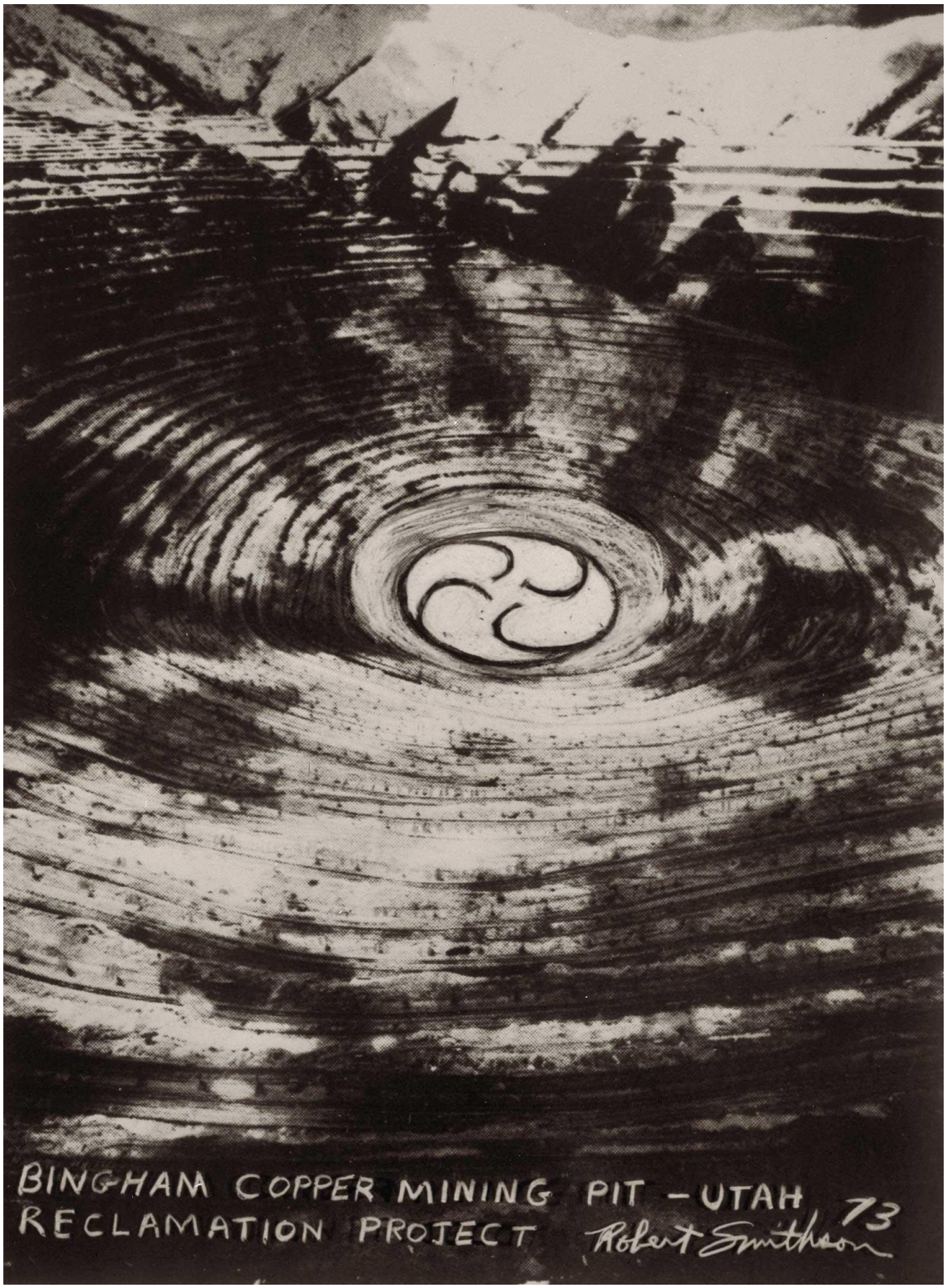


Fig. 2.4 Robert Smithson, *Bingham Canyon Copper Mine, Utah, USA* (1973)
Photostat, clear plastic overlay, grease pencil, and tape
18 1/2 x 13 1/2 in. (47 x 34.3 cm)
Collection: The Metropolitan Museum of Art, Pat and John Rosenwald Gift

projects that demonstrate their two different approaches. Robert Morris was particularly interested in the environmental impact of earthworks. He believed the art "would hinder further damage caused by the nonregenerative exploitation of nature."[30] Michael Heizer, on the other hand, was interested in historical aspects of a site.

A popular example of Heizer's work is *Effigy Tumuli Sculptures*, constructed in 1985 on land devasted by coal mining in the 1930s. The project is located near Ottawa, Illinois. State environmental agencies called for the property owner, the Ottawa Silica Company, to reclaim the site, as toxic overburden was contaminating water, and affecting the nearby Illinois River's health.[31] Heizer was hired and paid by this company, and the Illinois' Abandoned Mined Land Reclamation Council contributed around one million dollars to the construction of the project.[32] Heizer viewed his work as art, and not land reclamation, even though his projects were sponsored for mine land reclamation purposes.[33]

Effigy Tumuli Sculptures is composed of a series of sculptures, which depict five different animals. Heizer states he was trying to reactivate the Native American tradition of mound building, to speak to the site's historic past. [34] It is not said whether he consulted with (or learned from) the nearby Indigenous communities or was generalizing the various earthen mounds found across the country.

The designed mounds became part of a public sculpture park. They have, however, been criticized because these shapes can only be understood in their entirety from an airplane. Additionally, "many of Ottawa's 20,000 locals saw the sculpture park as an elitist tax dodge and 'corporate folly,'" and complained about the lack of consultation or public participation in the development of the project.[35]

Currently, there is some ongoing maintenance and care for the site, as the land was donated to the state of Illinois and became designated as Buffalo Rock State Park. The constructed project today appears natural and wildlife is once again inhabiting the site. The animal forms seem to have slowly dissolved into their surrounding landscape. Although Heizer viewed his work as art and not land reclamation, the environmental remediation seems to be more effective than community oriented aspirations.

Lippard, like Heizer, was interested in Aboriginal earthworks such as rock art and earth mounds. Lippard, however, was motivated by the subtle influence of this art, in contrast to the imposing character of American land artists' work. Lippard writes,

> "Where contemporary land art demands all the attention, rock art quietly absorbs us into its place, even when we understand very little about the messages we are getting… And of course it is easier to identify with the people who were once relatively peaceful stewards of that particular landscape than with today's property owner."[36]

30 Dreher, "Robert Smithson," 27.

31 Erika Doss, "Public Art Chronicles: Michael Heizer's Effigy Tumuli," *Public Art Dialogue* 1:2 (2011): 242.

32 Doss, "Public Art Chronicles," 242.

33 Dreher, "Robert Smithson," 26.

34 Doss, "Public Art Chronicles," 243.

35 Doss, "Public Art Chronicles," 243.

36 Lippard, *Undermining*, 91.

Fig. 2.5 Effigy Tumuli by Michael Heizer in 2017. (Source: Google Earth, 2017.)


Fig. 2.6 Effigy Tumuli Trail from a visitor's perspective in 2010. (Source: henskechristine, Flickr.)

The Ottawa Silica Company originally offered the project to artist Isamu Noguchi, a critically acclaimed American sculptor, and only afterwards to Heizer. This is indicative of what the company was looking for – a well-known and celebrated artist that would improve its public image. Although regulatory bodies began requiring the cleanup of sites at this time, mining companies could use necessary reclamation as an opportunity to improve their reputations.

Landscape Architects and Earthworks

Martha Schwartz's *MacLeods Tailings* (completed in 1998 in Geraldton, Canada) and Charles Jencks and Mark Simmons' *Northumberlandia* (completed in 2012 in northern England, United Kingdom) are two examples of more contemporary earthworks. Both were designed by landscape architects and constructed as mine reclamation. Although these projects are not part of the earthworks conceptual art movement in the United States in the 1960s and 1970s, they are created by similar practices of shaping of land. Additionally, Schwartz refers to the *MacLeods Tailings* as earthworks.

Martha Schwartz was hired by Barrick Gold Corporation to design *MacLeods Tailings*, located near a closed gold mine in Geraldton, Ontario. After mine operations halted, the site was left covered in 14 million tons of tailings. Barrick Gold's vision was to reconfigure the existing tailings, which were considered an eyesore, into a more aesthetically sound design.[37] The motivation behind this project was to increase tourism and with it the town's economy. The tailings were located just off the trans-Canada highway and the first thing one saw when driving into the town. The company did not want the public to be reminded of the negative environmental impacts of the extraction industry and mining waste. The mining company hired Schwartz as she was already a world-renowned landscape architect at the time. In addition to being a landscape architect, Schwartz has a background in art. During her undergraduate degree in fine arts, she was inspired by land artists, noting influence from Robert Smithson and Michael Heizer.[38]

In *MacLeods Tailings*, Schwartz shaped the tailings into a series of mounds that meander through the site. She aimed to create a "dynamic roadway edge and a landmark gateway to the town," which would attract tourists to further interact with the site through a set of trails for pedestrians, mountain bikers, snowmobiles, and more. [39] Although the primary objective was to create a "cultural artifact" [40] that would monumentalize the town's industrial history, Schwartz's design strategy took into consideration the toxins on the site.

The movement of tailings was limited as they contained higher levels of arsenic near the bottom and the site was designed to maintain storm water drainage.[41] Similar to the earthworks projects discussed earlier, the *MacLeods Tailings* focuses on the reclamation of one piece of the afterlife of a mine, as opposed to the broader area and people. The project honors the local miners by monumentalizing the site. The citizens of Geraldton were consulted about the design,[42] but it is unclear if and how the nearby Long Lake #58 and Ginoogaming First Nations were included.

37 "Facelift for the future," Canada Mining Journal, last modified January 1, 2001, https://www.canadianmining-journal.com/featured-article/facelift-for-the-future/.

38 Heidi Kost Gross, "An Interview with Martha Schwartz," New England Landscape Design & History Association, Winter 1999, https://www.neldha.org/perspectives-menu/design/231-an-interview-with-martha-schwartz.

39 "McLeod Tailings, Geraldton, Canada," Martha Schwartz Partners, Accessed March 14, 2022, https://msp.world/mcleod-tailings-geraldton-canada/.

40 Martha Schwartz Partners, "McLeod Tailings."

41 Martha Schwartz Partners, "McLeod Tailings."

42 Canada Mining Journal, "Facelift for the future."

Fig. 2.7 MacLeods Tailings, Martha Schwarz, 1998. (Source: Martha Schwartz Partners.)

Fig. 2.8 MacLeods Tailings, Martha Schwarz, 1998. (Source: Martha Schwartz Partners.)

The vegetation was designed to require no water maintenance and the topography designed to safely drain stormwater. There is a cap located within the tailings pile, but it is unclear what its longevity is and what maintenance it requires. The Discover Geraldton Interpretive Centre located on one of the mounds suggests there was some consistent attention and use of the site. With recent news of the site undergoing construction to become part of a mining pit for the Greenstone Gold Mine, [43] however, it is unclear on whether the mining company's initial intent was for the earthworks to be a permanent reclamation of the site or a temporary band-aid and reputation boost. It is once again undergoing transformation, from a reclaimed part of a mine's afterlife to an operating mine. The *MacLeods Tailings* will be excavated and moved – this time to a new "engineered tailings management facility for permanent storage."[44] The plan for the new mine describes a 20 year closure phase, which includes the refilling of the open pit and revegetation test plot studies. A blanket statement assures that ongoing monitoring and maintenance will be continued until the project meets Ontario's acceptable regulatory criteria.[45]

A second, more recent, earthworks project is *Northumberlandia*, designed by artist Charles Jencks and landscape architect Mark Simmons, completed in 2012. The earthworks are located within an opencast coal mining region in northern England, UK. The 300m long form depicting a reclining female figure was sculpted from millions of tonnes of overburden transported to the site.[46] Like Schwartz's project, *Northumberlandia*'s goal was to create a public open space that would attract tourists to the area and boost the local economy. Unlike Schwartz's project, which was designed after the mine, the proposal for these earthworks were part of a larger mining scheme to create a new opencast coal mine in the area – the company's hope was to gain approval by balancing the negative environmental impacts elsewhere with this positive asset for the community.[47] Similar to the *MacLeod* Tailings, the goal was to aesthetically sculpt waste materials to invert the public's image of waste from destructive to beautiful. The mining company aimed to improve its public image to continue business as usual. The site is regarded as a success by many, with over 100,000 visitors in the first year.[48] In terms of boundaries of reclamation, *Northumberlandia* focuses on the overburden material, but does not reclaim waste on site like Schwartz's project. Instead, it moves the waste to a new site. The project team does, however, view the site-specific design as a social reclamation for the broader community to "enhance the local landscape in the long-term."[49] The design raises the question: who is the reclamation for and who does it ignore?

Caitlyn Beckett calls out the contentious nature of shaping earthworks to look like the forms of a reclining woman's body in a lecture on mine closure and remediation, noting the overlooked gender context of women and mineral extraction.[50] A communications manager associated with *Northumberlandia* described that "part of the rationale behind the design was to create something that the local community and visitors could connect with. 'People naturally associate with human features.'"[51] In Canada, however, resource extraction projects have correlated to the increased violence against Indigenous women and girls. Specifically, the transient and temporary workforces, often referred

43 "Project Update," Equinox Gold: The Premier Americas Gold Producer, December 14, 2021, https://www.greenstonegoldmines.com/upload/documents/newsletters/project-update-presentation_20211214_web.pdf.

44 "HARDROCK PROJECT: Final Environmental Impact Statement/ Environmental Assessment Summary," Greenstone Gold Mines, August 2017, https://www.greenstonegoldmines.com/upload/documents/final-eis-ea-2020/_final-eis-ea-_hardrock-_summary_amended.pdf.

45 Greenstone Gold Mines,"HARDROCK PROJECT."

46 M. Baida, N, Slingerland, and G.W. Wilson, "The great divide between mine closure goals and outcomes, and potential solutions," Univerisity of the Witwatersrand (2014).

47 Baida, Slingerland, and Wilson, "The great divide."

48 Baida, Slingerland, and Wilson, "The great divide."

49 Baida, Slingerland, and Wilson, "The great divide."

50 Caitlynn Beckett, "Caring For and Living With Abandoned Mines in Northern Canada" (presentation, Beyond Extraction Open House, Toronto, Canada, March 16, 2021.

51 "How we did it – Building public art into mine site planning," Planning Resource: Independent intelligence for planning professionals, April 4, 2014, https://www.planningresource.co.uk/article/1288697/-building-public-art-mine-site-planning.

Fig. 2.9 Northumberlandia from above. (Source: Cianfranco Mirizzi, 2015, Flickr.)

Fig. 2.10 Northumberlandia from a visitor's perspective. (Source: Cianfranco Mirizzi, 2015, Flickr.)

to as "man camps," comprised of mostly non-Indigenous, well paid, young men are responsible for this increase in harassment and violence.[52] Also, as the Final Report of the National Inquiry Into Missing and Murdered Indigenous Women and Girls states, "Indigenous women face significant barriers to participating in the extraction industry due to work environments that are often hypermasculine and hypersexualized."[53] As women have been hypersexualized in the extraction industry, a holistic remediation or reclamation should attempt to repair this relationship, rather than further it in reclamation earthworks such as *Northumberlandia*.

As designers are hired by the mining industry, their projects tend to reflect the companies' visions. The industry aims to repair relationships between humans and mines in order to minimize negative public judgement. It does so, however, with power. These reclamation projects intend to reclaim landscapes aesthetically and culturally but do so by referring to a universal idea of man rather than the local communities most harmed by the extraction industry.

Both projects monumentalize the industrial nature of the sites in some way. Schwartz's *MacLeod Tailings* attempts to create something beautiful from an area once considered a wasteland, and it celebrates the former industrial economy. Charles Jencks and Mark Simmons' *Northumberlandia* attempts to attract visitors to the site through interventions limited to a specific portion of a mine's afterlife—the tailings—and improve the public image of the extractive industry.

Landscape Architects and Watershed Reclamation

The following project is an example of a landscape architect involved in a more holistic and far reaching mine reclamation project. First, it addresses the need for ongoing care and maintenance. Second, it views the designer as only one of many team members and involves local residents. Third, it is structured around a watershed, as opposed to the mine site, and therefore addresses a range of negative environmental impacts on the broader area.

In 1995, D.I.R.T. Studio, led by landscape architect Julie Bargmann, became involved in the design of *Vintondale AMD&ART Reclamation Park*, for which construction was completed in 2004. This project was focused around the watershed. *Vintondale AMD&ART Reclamation Park* is located in a region of old coal mines in Pennsylvania and was funded by the Environmental Protection Agency as a pilot remediation program for the Superfund Redevelopment Initiative.[54] Acid mine drainage (AMD), toxicity created when water interacts with minerals left exposed from mining operations, threatened the health of the surrounding watershed. Although AMD was one of the biggest issues of the site, Allan Comp, a historian who worked within the interdisciplinary team on the Vintondale project stated, "It is clear that restoring watersheds and communities contaminated by AMD, or reclaiming any other environmentally damaged area in which communities have a stake, needs more than a technical fix."[55] Similarly, Bargmann spoke to the importance of looking at both the site's ecological and social contexts and histories:

52 "Reclaiming Power and Place: The Final Report of the National Inquiry into Missing and Murdered Indigenous Women and Girls, Volume 1a," National Inquiry into Missing and Murdered Indigenous Women and Girls, 2019, 593. https://www.mmiwg-ffada.ca/wp-content/uploads/2019/06/Final_Report_Vol_1a-1.pdf.

53 "Reclaiming Power and Place: The Final Report of the National Inquiry into Missing and Murdered Indigenous Women and Girls, Volume 1a," National Inquiry into Missing and Murdered Indigenous Women and Girls (2019), 593. https://www.mmiwg-ffada.ca/wp-content/uploads/2019/06/Final_Report_Vol_1a-1.pdf.

54 Susan Hines, "Julie Bargmann Unexpurgated," *Landscape Architecture Magazine* 97, no. 10 (October 2007): 133.

55 T. Allan Comp, "Science, art, and environmental reclamation: three projects and a few thoughts," in Alan Berger, *Designing the Reclaimed Landscape* (New York: Taylor & Francis, 2008), 75.

Fig. 2.11 People walking on the face of the Northumberlandia sculpture. (Source: Glen Bowman, 2012, Flickr.)

Fig. 2.12 Neighbours planting at the Vintondale Reclamation Park. (Source: Stacy Levy, artist.)

> "I've been to Superfund site meetings where the landscape architects did their palette and their images but didn't present any pictures of the existing site to the community. How presumptuous is that? To totally ignore the landscape and not give people the choice to value this landscape they worked on for a century, the one that shaped their lives."[56]

The designed project follows this ideology and looks beyond the boundaries of the mining pits, to the impacted watershed and community involved. The park has three types of landscapes which reflect themes of watershed and community health. First, the treatment garden with ponds passively filters the water, and adjacent vegetation visualizes the steps of the filtration process.[57] Second, the *Emergent History Wetlands* are the final level of water filtration but also resemble an area that remembers the industrial nature of the site, with forms that relate to past mining buildings. [58] Finally, the *Community Uplands* create a site for local recreation.[59]

D.I.R.T. Studio's Vintondale project is a positive example of a landscape architect starting to address important aspects of reclamation and perpetual care: *perpetuity*, *communities*, and *ecosystems*.

Contemporary Design Studios Studying Post-Extraction Landscapes

This section has discussed examples by artists and landscape architects, but designers in other disciplines have also been involved in reimagining post-extraction landscapes. To give an idea of some of the various perspectives, the following are three examples of university design studios (in architecture, planning, and landscape architecture) that each tackle the topic of mine afterlives in some way:

1) "Cold Urbanism," 3B design studio by Lola Sheppard, 2017, School of Architecture, University of Waterloo: I was a student in this design studio, which studied sub-arctic mining towns and raised important questions about the social and environmental implications of mining in northern Canada. We were tasked with master planning a permanent mining town to replace a proposed temporary fly-in-fly-out camp for a new iron ore mine in Quebec. The town was meant to stay functioning after the closure of the nearby mine. At the time, my partner and I designed a compact town structured around a tailings dam. We reasoned designing a permanent town by arguing that it could support the many more planned mines along the Labrador trough. With a greater understanding of mine closure, remediation, and perpetual care, I would probably design a different project today. However, when reflecting on the studio, I've thought about how a permanent community could provide the tailings pond and closed mine with a greater degree of perpetual care than if all residents moved away.

2) "How to Live With Stones: Landscape & Planning Beyond Closure (Sardinia, Italy)," Planning Studio by Christopher Alton, 2019, School of Urban and Regional Planning, Ryerson University: This planning studio studied the Santu Miali gold mine in Sardinia as it was undergoing closure

56 Susan Hines, "Julie Bargmann Unexpurgated," *Landscape Architecture Magazine* 97, no. 10 (October 2007): 135.

57 Julie Bargmann and Stacy Levy, "Testing the Waters," *Landscape journal* 17, Special Issue (1998): 40.

58 Bargmann and Levy, "Testing the Waters," 41.

59 Bargmann and Levy, "Testing the Waters," 41.

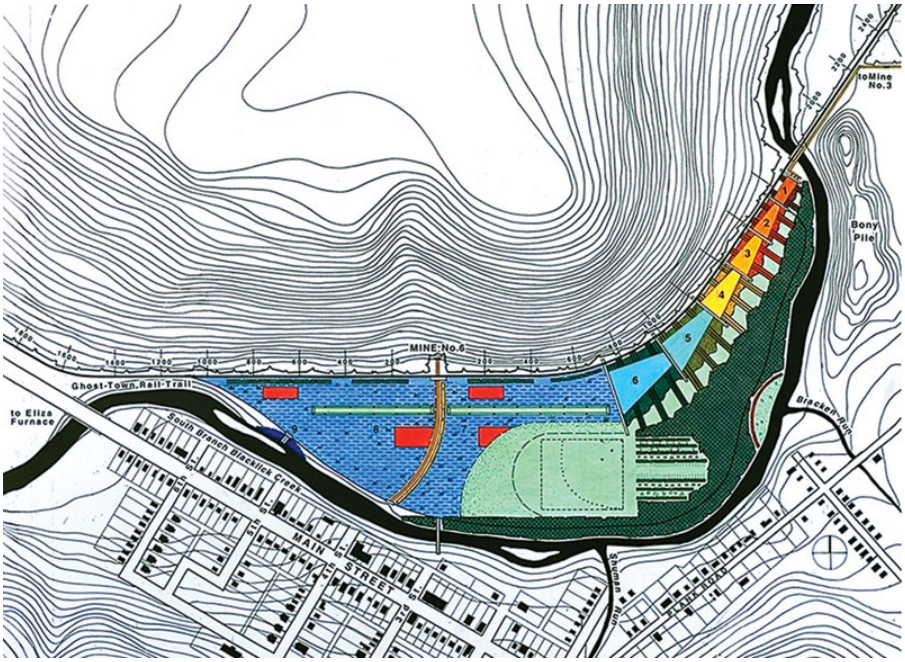


Fig. 2.13 Vintondale Reclamation Park site plan. (Source: Julie Bargmann, DIRT Studio.)

Fig. 2.14 Vintondale Reclamation Park site plan excavation overview. (Source: Julie Bargmann, DIRT Studio.)

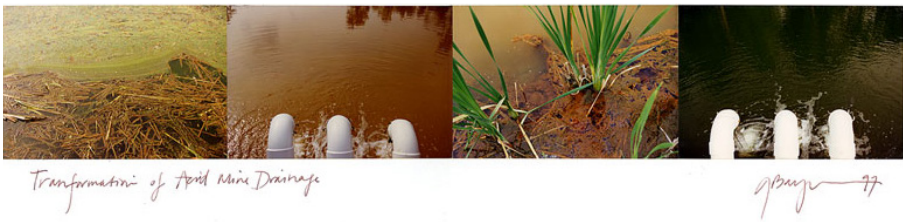


Fig. 2.15 Vintondale Reclamation Park treatment process. (Source: Julie Bargmann, DIRT Studio.)

and remediation. Alton states that the studio looked to "understand how the methods of planner and landscape designers encounter the stories and everyday lives of those affected by mining and ask how data – both qualitative and quantitative – may inform a strategy for a mine's afterlife."[60] This studio examined both the local and global scales. It aimed to build a deeper understanding of the local community and its knowledge, as well as the mine's connection to global financial systems and institutions.

3) "Tar Creek Remade: Environmental Legacy, Toxic Terrain and Re-Imagining the Future in the Tri-State Mining Area, Ottawa County, Oklahoma, USA," Landscape architecture studio by Niall Kirkwood, 2021, Graduate School of Design, Harvard University: This design studio studied an area distressed by former lead and zinc mining. The area is a U.S. Superfund site, which means it is considered one of the nation's most contaminated landscapes. The studio asked students to propose designs that considered both the contaminated and toxic materials of the site, as well as the local community. As they worked on their proposals, students were in conversation with local Quapaw Nation tribal advisors, environmental groups that studied the Tar Creek, and environmental scientists.[61] This landscape studio frames the project around the Tar Creek rather than the specific mine sites and considers the long term care and maintenance that will be required. Students had varying ideas for how this could take place, one student proposing to use "the collapsed ground as remediation ponds – monitored over the long term through robotics."[62] Like D.I.R.T. Studio's reclamation park project, the reclamation proposed in this studio was based around a watershed. It considered systems of perpetual care, co-operated with local community groups, and designed around the broader ecosystem.

60 Christopher Alton, "How To Live With Stones: Landscape & Planning Beyond Closure (Sardinia, Italy)," Course Outline, School of Urban and Regional Planning, Ryerson University, Fall 2019.

61 Alex Anderson, "Tar Creek Remade: Taking on 120 years of environmental injustice at an Oklahoma Superfund site," Harvard University Graduate School of Design, last modified June 15, 2021, https://www.gsd.harvard.edu/2021/06/tar-creek-remade-taking-on-120-years-of-environmental-injustice-at-an-oklahoma-superfund-site/.

62 Anderson, "Tar Creek Remade."

3 Literature Review: Perpetual Care

Care

With an understanding of status quo mine reclamation and designer involvement, it is important to look to communities, researchers, and writers for alternative and more holistic approaches to remediation.

The broad concept of care has been gaining attention over the past few years. The COVID pandemic brought awareness to the term along with the increasing acknowledgment of the essential work of healthcare, childcare, and elder care. As a result, care is being discussed across several industries, as well as in relation to the natural world.[1] People are recognizing that care work is low carbon work. The Leap, a disbanded environmental and social justice organization, writes in their manifesto that "caring for one another and caring for the planet could be the economy's fastest growing sector."[2] The Green New Deal, a United States congressional proposal for fighting climate change while simultaneously creating new infrastructural jobs, reflects this idea. Environmental historian and geographer Jason W. Moore refers to the Green New Deal as a model of care, but he also notes it is problematic because it focuses on growth in renewable energy industries, and therefore the extractive industry.[3]

The Leap, along with many others, addresses the need for systematic changes that work towards a mindset of care. Xiye Bastida, a climate activist, says, "We need to have a whole cultural shift, where it becomes our culture to take care of the Earth, and in order to make this shift, we need storytelling about how the Earth takes care of us and how we can take care of her."[4] Bastida explains how that the current dominate world view is one of extraction, where culture controls nature. There are, however, many Indigenous nations who have for thousands of years viewed culture as interconnected with nature and themselves as caretakers of land and waters.[5] Dr. Andrew Judge, an Anishinaabe teacher who specializes in Indigenous knowledge and land-based learning, explains there is an Anishinaabe word for living sustainably – *Minobimaatisiiwin*, which means a good way of life.[6] Dr. Judge emphasizes that *Minobimaatisiiwin* is not theory on how to live sustainably but is the act of actually doing it. Care of nature has always been a part of Indigenous culture. Ironically, a similar phrase of "good life" is used in Bernice Fisher and Joan Tronto's 1990 essay titled "Toward a Feminist Theory of Caring," where they write that "caring has virtually no place in the description of 'the good life' that provides a focus for Western philosophy, despite the fact that caring permeates our experience."[7] Whereas in the Anishinaabe concept of *Minobimaatisiiwin* care is valued as a part of the good life, Fisher and Tronto suggest there is a lack of this perspective in Western philosophy.

Fisher and Tronto argue for a new understanding of care, defining it as

> "a species activity that includes everything that we do to maintain, continue and repair our 'world' so that we can live in it as well as possible. That world includes our bodies, ourselves and our environment, all of which we seek to interweave in a complete, life-sustaining web."[8]

1 The Care Collective, *The Care Manifesto* (London: Verso Books, 2020).

2 "Background," The Leap, accessed March 14, 2022, https://theleap.org/our-work/care-work/.

3 Jason W. Moore, "CAPITALISM, CLIMATE, AND GEOHISTORICAL CRISES: Jason W. Moore in conversation with Nikos Katsikis" (presentation, Architecture of Territory ETH Zurich, Zurich, Switzerland, February 25, 2019. https://www.youtube.com/watch?v=k-CQt9sYpDSs.

4 Xiye Bastida, "Calling In," in *All We Can Save: truth, courage, and solutions for the climate crisis,* ed. Ayana Elizabeth Johnson and Katharine K. Wilkinson (New York: One World, 2020), 4.

5 M. Sharon Jeannotte, "Caretakers of the Earth: integrating Canadian Aboriginal perspectives on culture and sustainability into local plans," *International Journal of Cultural Policy* 23, no.2 (2017), 199.

6 Dr. Andrew Judge, "Trees and Spring Teachings," (online lecture, University of Waterloo, Cambridge, June 8, 2021).

7 Berenice Fisher and Joan Tronto, "Toward a Feminist Theory of Caring," in *Circles of Care: Work and Identity in Women's Lives,* ed. Emily K. Abel and Margaret K. Nelson (Albany, SUNY Press, 1990), 35.

8 Fisher Tronto, "Toward a Feminist Theory of Caring," 40.

Fig. 3.1 Care work is low-carbon work. (Source: Screenshot at 5:56 of "A Message From the Future With Alexandria Ocasio-Cortez" video, illustrated by Molly Crabapple. The Intercept, 2019.)

Fig. 3.2 Indigenous communities have generational knowledge on healing the land. (Source: Screenshot at 5:35 of "A Message From the Future With Alexandria Ocasio-Cortez" video, illustrated by Molly Crabapple. The Intercept, 2019.)

Max Liboiron writes about the concept of care within the science & technology studies. Similarly, they speak of an "active engagement" and "obligation to maintain relations."[9] Fisher, Tronto, and Liboiron all use words like "maintain" and "continue" which reflect the ongoing nature of care. Care work often has no end and is necessary in perpetuity.

The terms care and repair are often used together, connecting the concept of care not only to maintaining sustainable ways of being, but also to healing damaged landscapes and relationships. Naomi Klein, author and social activist, further speaks of care and repair in relation to Canada's extractive past and present history:

> "There is a grand story to be told here about the duty to repair—to repair our relationship with the earth and with one another, to heal the deep wounds dating back to the founding of the country. Because while it is true that climate change is a crisis produced by an excess of greenhouse gases in the atmosphere, it is also, in a more profound sense, a crisis produced by an extractive mindset—a way of viewing both the natural world and the majority of its inhabitants as resources to use up and then discard. I call it the 'gig and dig' economy and firmly believe that we will not emerge from this crisis without a shift in worldview, a transformation from 'gig and dig' to an ethos of care and repair."[10]

In this statement, Klein addresses communities and ecosystems that have both been extracted from. She speaks of the repair of broken relationships, as well as devastated physical environments, and refers to the long historical context which must be addressed.

Like in many sectors, the concept of care has recently gained interest in geography.[11] With this has come the increased discussion of the term *perpetual care*, which connects the concept of care with post-extraction sites.

Perpetual Care

The post-extractivism community speaks about the concept of care in relation to the mining sector. Specifically, the term *perpetual care* describes a practice that invests deeply in stewardship of post-extraction landscapes. It encompasses both logical steps as well as less tangible ideas. Joan Kuyek describes *perpetual care* as a new problem in "The Theory and Practice of Perpetual Care of Contaminated Sites" in 2011. Kuyek states that current mine maintenance and care practices focus on the next 50 or 100 years, instead of the thousands of years that need to be planned for when dealing with enduring toxic waste.

Over the last decade, the term *perpetual care* has been used by others adjacent to Kuyek, often in relation to Canada's largest and most dangerous abandoned mine site, the Giant Mine. In "Principles of Perpetual Care: The Giant Mine, Yellowknife, Northwest Territories," environmental lawyer Carolyn Raffensperger proposes "five rules of caring for contaminated sites forever:

9 Max Liboiron, "Care and Solidarity Are Conditions for Interventionist Research," *Engaging Science, Technology, and Society* 2 (2016), 68.

10 Naomi Klein, "Care and Repair: Left Politics in the Age of Climate Change," *Dissent Magazine,* Winter 2020, https://www.dissentmagazine.org/article/care-and-repair-left-politics-in-the-age-of-climate-change.

11 Karin Schwiter and Jennifer Steiner, "Geographies of care work: The commodification of care, digital care futures and alternative caring visions," *Geography Compass* 14, no.12 (2020).

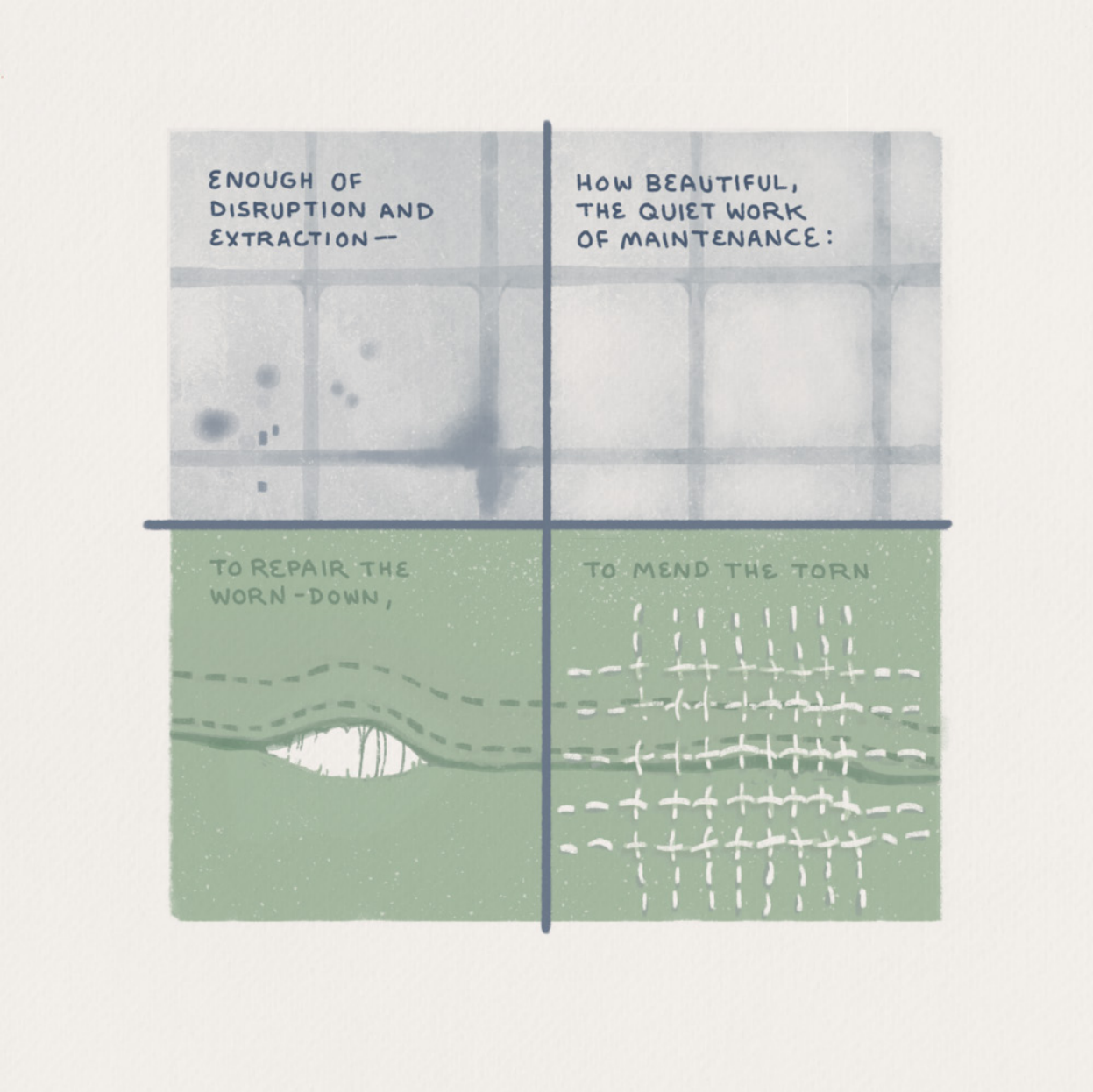


Fig. 3.3 "Enough of disruption and extraction" by cartoonist + illustrator Madeleine Jubilee Saito. (Source: Madeleine Jubilee Saito, 30 days of comics / 2019 : on climate crisis.)

1. Responsibility to future generations
2. Protection of 'the Commons'
3. Free, prior, and informed participation and consent
4. Precautionary Principle
5. Nature as guide"[12]

These five principles speak to the temporal dimension of waste, the communities that need to be addressed, and the larger ecosystems and watersheds mines exist within. Raffensperger also outlines more specifically what practices follow these principles:

1. "Information, warning, and memory systems;
2. Monitoring;
3. Technology;
4. Financial mechanisms; and
5. Restoration."[13]

A large aspect of perpetual care is ensuring resources, be they financial or natural, to sustainably continue life. Raffensperger states that "since it is impossible to leave adequate resources to care for sites in perpetuity, sites requiring perpetual care should not be created in the first place."

Planning for perpetual care is a complicated problem that involves unknowns. The lack of successful examples, however, means this topic requires more research and development. Although advances in science and technology might allow for permanent fixes, it cannot be assumed that these sites will ever be completely self-sustaining. Giant Mine is an example of such a site.

Giant Mine's site contains 237,000 tons of arsenic trioxide dust, a byproduct from former gold mining.[14] If not contained forever, arsenic trioxide has the potential to contaminate the local waters and could devastate the health of human communities in addition to wildlife in the nearby ecosystem. Giant Mine is one of the eight sites the *Northern Abandoned Mine Reclamation Program*, mentioned previously, is working to remediate.

The government has proposed a perpetual care approach that outlines a plan for the next 100 years but acknowledges that this is only an interim solution, as the arsenic poses a much longer threat. Social justice advocate Kevin O'Reilly explains that the environmental assessment board and communities are hesitant to accept the proposal as it would leave responsibility of creating a permanent solution to future generations.[15]

Where perpetual care plans are being discussed, they still largely focus on technical aspects of waste containment. In recent years, Beckett and Keeling have written and spoken about the term perpetual care, as seen in a key text this thesis relies on, "Rethinking remediation: mine reclamation, environmental justice, and relations of care." Beckett and Keeling advocate for a perpetual care that encompasses historical, political, and social dimensions in addition to the ecological one more commonly discussed. They argue that perpetual care and maintenance should exist in addition to a more active remediation that can be completed, and that one should not replace the other.[16] While industry terms of closure and rehabilitation speak to more technical solutions,

12 Carolyn Raffensperger, "Principles of Perpetual Care: The Giant Mine, Yellowknife, Northwest Territories," prepared for Alternatives North, December 2011.

13 Carolyn Raffensperger. "Principles of Perpetual Care."

14 John Sandlos, Arn Keeling, and Kevin O'Reilly, "Communicating Danger: A Community Primer on Communicating the Arsenic Hazards at Yellowknife's Giant Mine to Future Generations," September 2014, 3, http://www.toxiclegacies.com/wordpress/wp-content/uploads/Comm_Future_Gen_YK_Report_Sep-2014-FINAL.pdf.

15 Kevin O'Reilly, "Liability, Legacy, and Perpetual Care: Government Ownership and Management of the Giant Mine, 1999-2015," in *Mining and communities in Northern Canada: history, politics, and memory,* ed. Arn Keeling and John Sandlos (Canada: Univeristy of Calgary Press, 2015), 363.

16 Beckett and Keeling, "Rethinking remediation," 223.

the term perpetual care refers to less physical "ideas of concern, responsibility, and even love for the environment and the social relations that sustain healthy ecosystems."[17]

T. Allan Comp similarly writes about a typical technical approach to care:

> "We as a society decide what we care - and do not care - about at any given time. We define problems as those issues we now care about, and we immediately set about measuring that problem and the potential of its fix, somehow leaping from a culturally defined problem to a scientifically defined fix. While all this measurement, this 'science,' is necessary, it is not sufficient to fully address the real landscape in which we live."[18]

Innovation in technical aspects of waste remediation and containment is necessary, but so is the shift from thinking about perpetual care of post-extraction sites as a technical problem to one less measurable, one with ongoing practices.

As it is not a technical mining term, *perpetual care* does not have legal requirements. It has mostly been used within the post-extractivism community, with an exception being the government in relation to a perpetual care plan at the Giant Mine. The terms *perpetual* and *care* do not appear in PDAC's conference program. On the other hand, Beyond Extraction's last counter-conference focused specifically on both the before and afterlives of extraction, and included a talk by Caitlynn Beckett on "Caring For and Living With Abandoned Mines in Northern Canada."[19]

There are several authors that speak of the concept of long-term stewardship, care, and healing using similar words. Their thoughts are included within the next section, which reviews theory related to three overlooked themes of mine afterlives: *perpetuity*, *communities*, and *ecosystems*.

1. Perpetuity

Understanding Deep Time

Deep time describes the long timescales over which natural forces and processes shape the earth. Minerals extracted in just a few years or decades were formed millions or billions of years ago. The exploration, development, and operations of a mine are just a blip in time. These processes, however, leave long term impacts on the earth, which are comparable in scale to those created naturally over deep time. Once safely contained beneath the earth's crust, extracted minerals exposed to air and water can create toxic substances. These toxic substances exist beyond the timeline of mine operations, often in perpetuity.

The arsenic trioxide dust at Giant Mine in an example of the enduring nature of toxins. An even more extreme timescale can be seen at uranium mines. Lippard explores the complexity of former uranium mine care: "The puzzle that no one has solved concerning nuclear waste is how to mark its deposits

17 Beckett and Keeling, "Rethinking remediation," 223.

18 Comp, "Science, art, and environmental reclamation." 63.

19 Beckett, "Caring For and Living With Abandoned Mines in Northern Canada."

in a manner lasting for the thousands of years that constitute the half-life of radioactivity. This is the so-called Forever Problem."[20] Other less dire toxic minerals such as copper still pose serious risks for ecosystems. If not contained, they will continuously spread.

An uncanny balance in timescales is seen when comparing the relative short-term thinking of the mining industry to the deep time of mineral formation and perpetual care of post-extraction sites. Perhaps a more comprehensive understanding of deep time could contribute to more robust perpetual care practices.

Timefulness

Marcia Bjornerud, professor of geology, writes about the concept of deep time and introduces the term *timefulness*. Bjornerud writes how "most humans, including those in affluent and technically advanced countries, have no sense of temporal proportion – the *durations* of the great chapters in earth's history, the rates of change during previous intervals of environmental instability, the *intrinsic timescales* of 'natural capital' like groundwater systems."[21] These large timescales are hard to comprehend, which results in a lack of assigned value to natural systems and processes. Bjornerud argues that geologists, on the other hand, have this deeper understanding of Earth's history, and can offer a perspective that will help others think in a long-term, multi-generational way.[22]

Bjornerud's thinking applies both to the development of new mines and the care existing post-extraction sites. In terms of new mines, an understanding of deep time would consider the stability of existing ecosystems. It would compare their current value with both the value of potential minerals and habitat destruction that comes along with it. In terms of post-extraction sites, addressing deep time would mean taking full responsibility for the care of landscapes for future generations. If extraction companies rely on millions or billions of years of mineral formation, they should ensure they will care for the site for the same time into the future.

Reactive vs. Proactive Care

As care is ongoing process and not something that can be completed, it should be proactive, not reactive. Sebastian Ureta, a researcher in science and technology studies, discusses the concept of reactive vs. proactive care in relation to the tailings' management at a copper mine in Chile. Ureta describes repair to be the more traditional, reactive care and maintenance to be the modern, proactive care that is found in successful waste management systems.[23] Care of the copper mine tailings includes both repair and maintenance, but Ureta explains that there has been a shift in emphasis towards maintenance, which entails more regular and consistent practices. This shift includes diverting tailings through an alternative canal once a month to inspect the other canal. This practice is seen as unnecessary by some employees but helps mitigate potential messes.[24] On a daily basis, this care practice is more time consuming, but it can prevent damage and minimize repair work in the long term.

20 Lippard, *Undermining*, 119.

21 Marcia Bjornerud, *Timefulness: How Thinking Like a Geologist Can Help Save the World* (Princeton: Princeton University Press, 2018), 7.

22 Bjornerud, *Timefulness*, 14.

23 Sebastian Ureta, "Caring for waste: Handling tailings in a Chilean copper mine," *Environment and Planning A* 48, no.8 (2016), 1539.

24 Ureta, "Caring for waste," 1540.

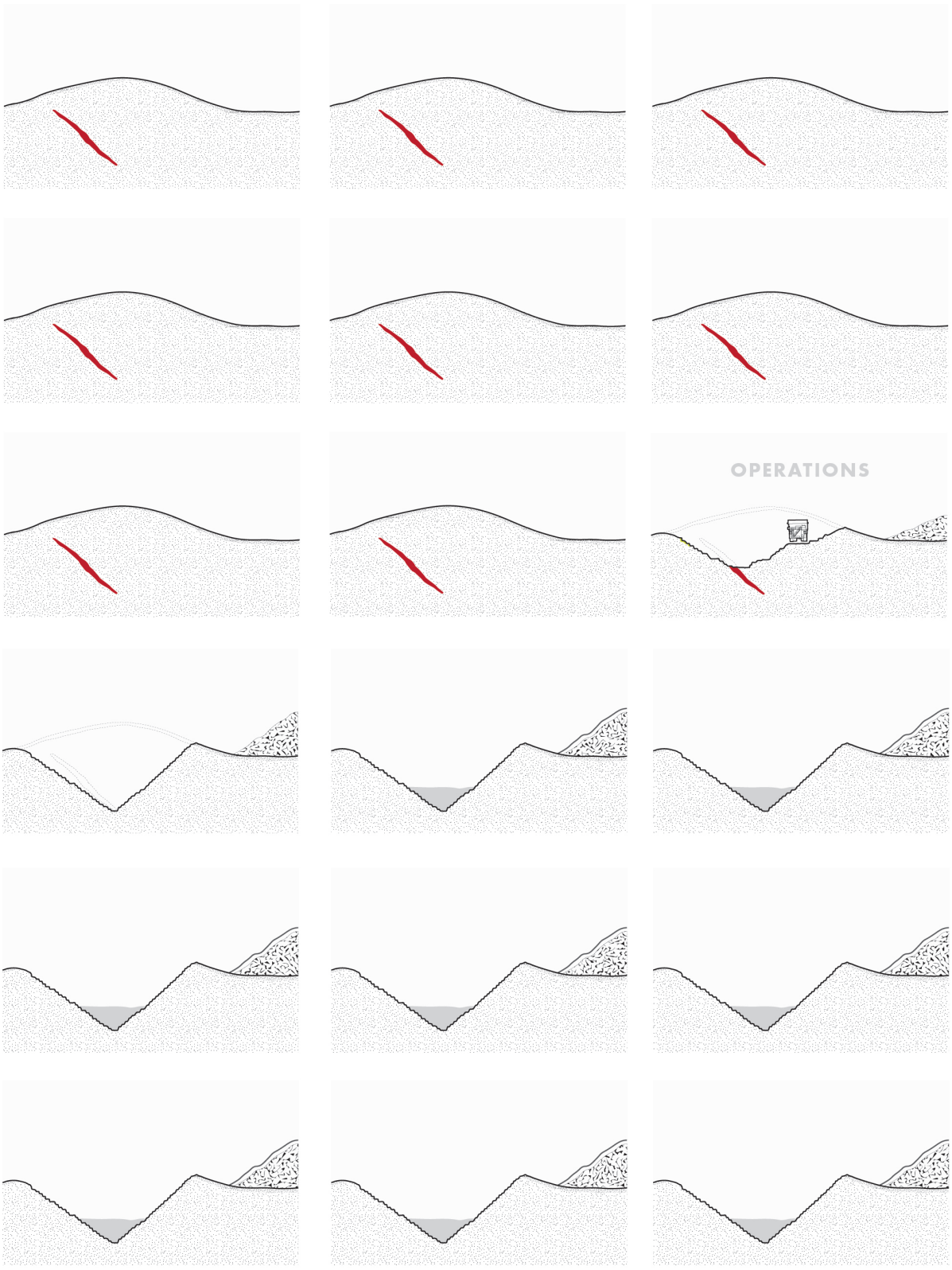


Fig. 3.4 Mine operations are exploration, development, and operations of a mine are just a blip in deep time but have large impacts on landscapes. Drawing by author.

The proactive care Ureta describes refers to Cristina Grasseni's concept of "skilled vision."[25] Skilled vision is a less formal learned perception that workers develop from maintaining and caring for a place over time.[26] It is only through familiarity and regular interactions that workers can identify issues proactively. Therefore, a consistent workforce is important in caring for sites in perpetuity.

2. Communities

Human/Nature Dualism

The extractive industry operates on the assumption that humans dominate nature. By separating the two, which in reality are interconnected, a hierarchy of value is established:

> "When dualisms become 'value dualisms'—distinctions that elevate one side of the dualism and diminish the other, as is the case with familiar dualisms such as nature/culture, gay/straight, black/white, female/male, animal/human—they also provide the conceptual bases for exploitative and oppressive practices."[27]

Nature, including subsurface minerals, is then judged on its usefulness to humans. It is looked at as something to profit from. The human/nature dualism is reflected in what Jason W. Moore calls "cheap nature." But while some considered themselves as elevated above nature, they considered other humans as part of this cheap nature, something to profit from. As Moore describes,

> "Capitalism was built on excluding most humans from Humanity – indigenous peoples, enslaved Africans, nearly all women, and even many white-skinned men (Slavs, Jews, the Irish)…They were regarded as part of Nature, along with trees and soils and rivers – and treated accordingly."[28]

In the case of the mining industry in Canada, Indigenous nations were excluded from Humanity, as they were dispossessed from their land, exploited for labor in unsafe working conditions, and overburdened by the negative effects of nearby mining.

In the reclamation and perpetual care of post-extraction sites, it is important to repair the human/nature divide where it exists. By acknowledging the interconnectedness of humans and nature, people are less likely to exploit land and its minerals. It is also important to put effort and care into repairing relationships with communities that were treated as cheap nature in the development and operations of mines.

Overburden as More Than Dirt

Jennifer Wenzel, author of essays on environmental and energy humanities, uses the concept of overburden to further describe this treatment of communities. Whereas the mining industry defines overburden as the

25 Cristina Grasseni, "Skilled visions: Toward an ecology of visual inscriptions," in *Made to Be Seen: Perspectives on the History of Visual Anthropology,* ed. Marcus Banks and Jay Ruby (The University of Chicago Press: 2011), 19.

26 Ureta, "Caring for waste," 1540.

27 Trish O'Flynn, Hilary Geoghegan, Alison Dyke, and Annearieke de Bruin, "Attending to nature: Understanding care and caring relations in forest management in the UK," *Journal of Rural Studies* 86 (August 2021), 34.

28 Jason W. Moore, "The Rise of Cheap Nature," in *Anthropocene or Capitalocene?* (PM Press), 78-115.

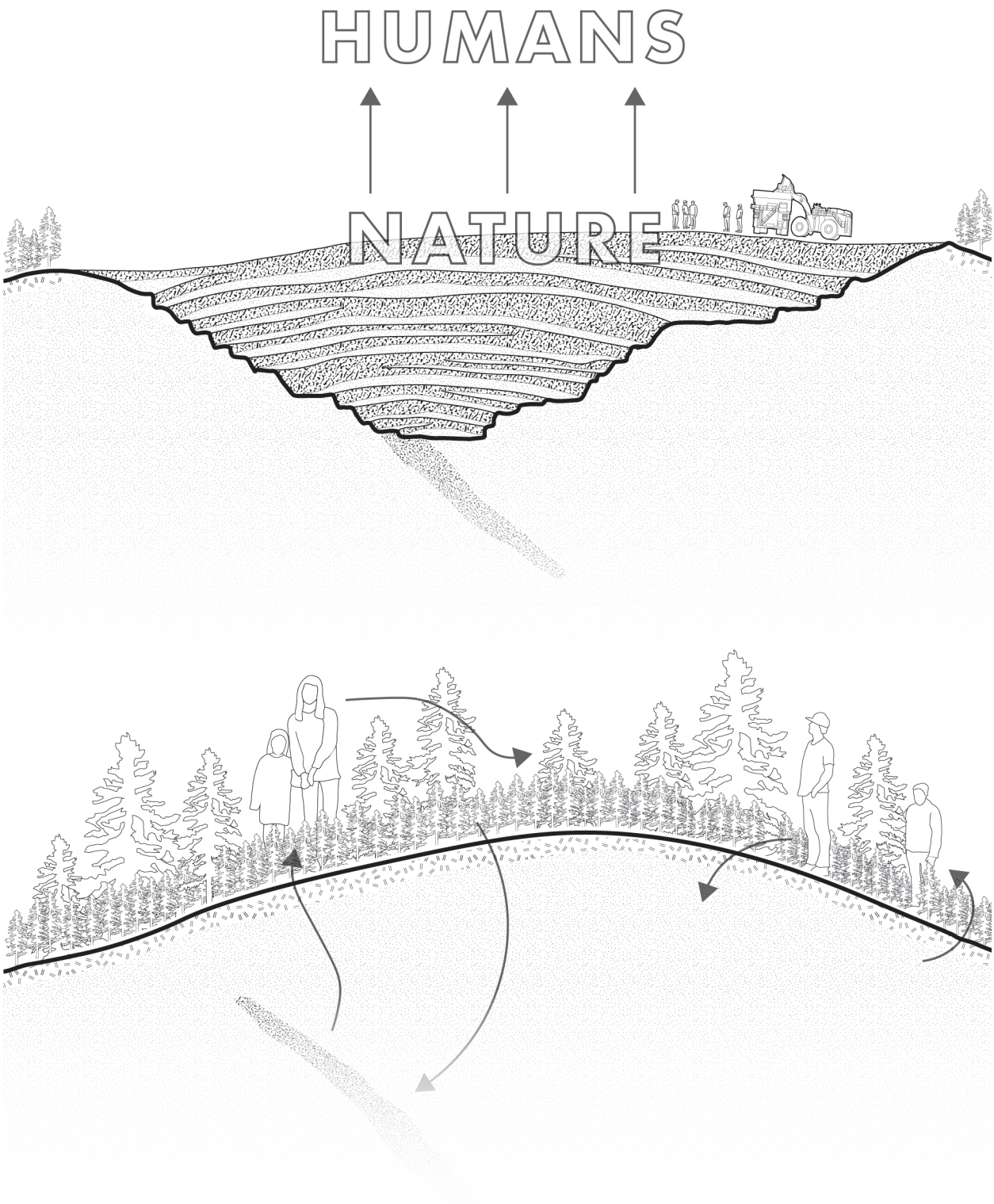


Fig. 3.5 Human/nature divide diagrams. Drawing by author.

physical rock and dirt removed to reach desired minerals, Wenzel argues for a much broader definition of overburden. She suggests that the concept of overburden should include "the everything-else that stands in the way of resource extraction,"[29] human communities as well as non-human species and their habitats. Limited remediation and care practices reflect the mining industry's narrow view of mining landscapes, which Jennifer Wenzel calls the extracting eye, "X-ray vision whose image renders negative everything but profit."[30] Overburden is part of this "negative everything."

Kathryn Yusoff and Joan Kuyek use the concept of overburden in a slightly varied way. Instead of including the communities as mining industry's overburden, the two refer to the overburden laid on communities by the extraction industry. In "Mine as Paradigm." Yusoff suggests that

> "two subjective-earth states might be distinguished: 1) those given by extraction (white man's overburden) and 2) those continuously exposed by extraction processes, such that they are subject to the weight of the overburden (which makes digging yourself out of a hole and hitting rock bottom a constant threat, not to mention the collapse of the earth itself).[31]

Kuyek refers to the overburden put on community health in the essay "Overburden: understanding the impacts of mineral extraction on women's health in mining communities." She discusses the increase of respiratory disease, as well as lung and stomach cancer in mining towns. Additionally, she reflects on the impact on mental health and the violence towards women in nearby communities.[32] Kuyek observed that often these communities do not know of all the risks and impacts, the overburden being placed on them.

Consistent in all these ideas are the unjust impacts on human communities in the production and maintenance of extraction sites. Wenzel argues that communities were viewed as overburden, as something disposable. Yusoff and Kuyek describe the unmanageable overburden that the mining industry forces onto communities. By redefining the term, these authors are raising awareness to often-neglected aspects of overburden. As closure, reclamation, and perpetual care practices address physical overburden, they should also address communities.

Remediating Colonialism

Caitlynn Beckett writes that remediation and reclamation are framed as ways to fix damage but can be quite extractive processes in themselves.[33] Environmental remediation and planning does not address the colonial history of extraction, and technical remediation practices can allow "responsible parties to cleanse themselves of social responsibility."[34] Instead, remediation should focus on repairing damaged connections and building trust.

Sarah M. Gordon, an academic studying folklore and a contributor for the Abandoned Mines Project, similarly states that "to address and heal from the impacts of the mine is to address and heal from the impacts of colonialism

29 Jennifer Wenzel, "Afterword: Improvement and Overburden," *Postmodern Culture* 26, no. 2 (Jan 2016), 4.

30 Wenzel, "Improvement and Overburden," 5.

31 Kathryn Yusoff, "Mine as Paradigm," *e-flux Architecture*, June 2021, https://www.e-flux.com/architecture/survivance/381867/mine-as-paradigm/.

32 Joan Kuyek, "Overburdened: understanding the impacts of mineral extraction on women's health in mining communities," *Canadian Woman Sutdies* 23, no.1 (2004), 121-123.

33 Beckett, "Caring For and Living With Abandoned Mines in Northern Canada."

34 Beckett and Keeling, "Rethinking remediation," 222.

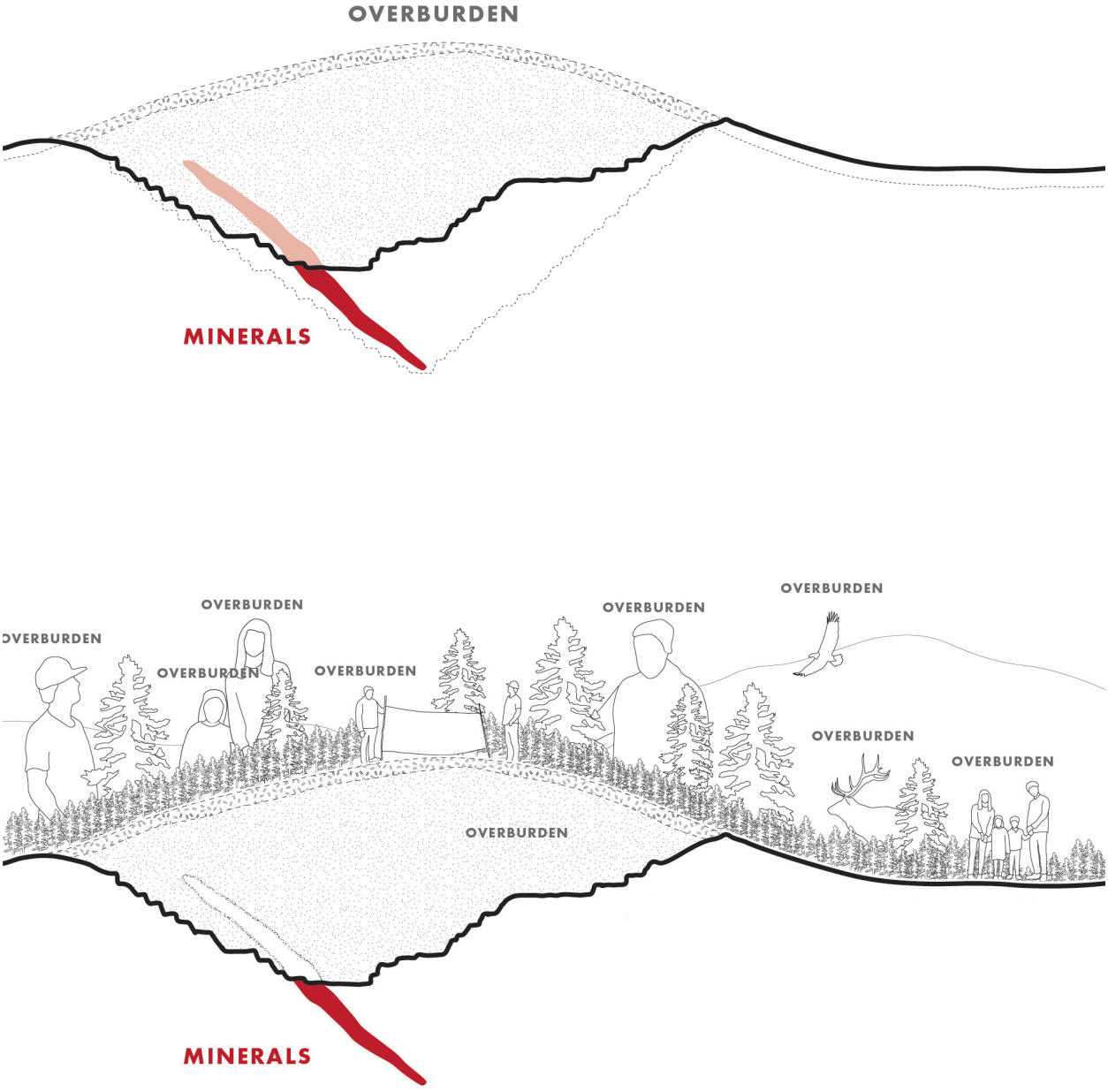


Fig. 3.6 Overburden - two definitions. Drawing by author.

more broadly."[35] Remediation of relationships is not as easily enforced and measurable as technical environmental fixes, but it is a necessary part of reclamation and perpetual care.

3. Ecosystems

Property and Ownership

The first European settlers, drawn to this land because of its natural resources, claimed ownership of minerals through creating land grants (which certain Indigenous groups have called grabs), as well as establishing property and mining claim boundaries. As James C. Scott writes,

> "The history of property in this sense has meant the inexorable incorporation of what were once thought of as free gifts of nature: forests, game, wasteland, prairie, subsurface minerals, water and watercourses, air rights, breathable air, and even genetic sequences, into a property regime."[36]

Property always excludes something or someone. Additionally, it draws invisible boundaries which divide larger ecosystems and watersheds. Although profits are limited to property lines, disturbed minerals are not. As Beckett and Keeling describe, once the earth is rearranged and certain minerals are extracted, the leftover "geochemical matter has different kinds of porosity and promiscuity. Under certain conditions, it mixes and makes new amalgams. It aggregates, often in toxic ways when it is unearthed or segregated from prior relations."[37] Minerals start to cross over the arbitrary orthogonal mineral claims and property lines, and organically flow through watersheds. In some cases, First Nations have been boxed in by mining claims, putting them at risk from consequences of the extraction process. Figure 3.7 shows six screenshots from the Yellowhead's Mine Sweeper Map, which overlays Ontario and Quebec mining claims (red blocks) with First Nations (green circles).[38] These images show a few of many cases where First Nations are surrounded or right next to current mining claims.

Although current regulations require environmental assessment beyond strict boundaries, the mining industry does not need to own all land they will damage. Beckett and Keeling argue that "remediation might not entirely clean up a site and often does not extend beyond certain arbitrary boundaries such as mining leases or territorial boundaries, disregarding the ability of waste to flow and change."[39] As waste often flows through watersheds, their boundaries are important to mine afterlives.

Water Rights

Granting water legal personhood is one way to move past property thinking. In the past decade, globally, there have been several rivers or other water bodies that have been granted legal personhood and associated human rights. Canada has recently recognized the rights of the Magpie River in Quebec. Abigail Hutchison writes that "society's values dictate what is given legal

35 Sarah M. Gordon, "Narratives Unearthed, or, How an Abandoned Mine Doesn't Really Abandon You," in *Mining and communities in Northern Canada: history, politics, and memory*, ed. Arn Keeling and John Sandlos (Canada: Univeristy of Calgary Press, 2015), 80.

36 Scott, *Seeing Like a State*, 39.

37 Yusoff, "Mine as Paradigm."

38 "Mine Sweeper Map," Yellowhead Institute, accessed March 14, 2022, https://redpaper.yellowheadinstitute.org/mine-sweeper-map.

39 Beckett and Keeling, "Rethinking remediation," 220.

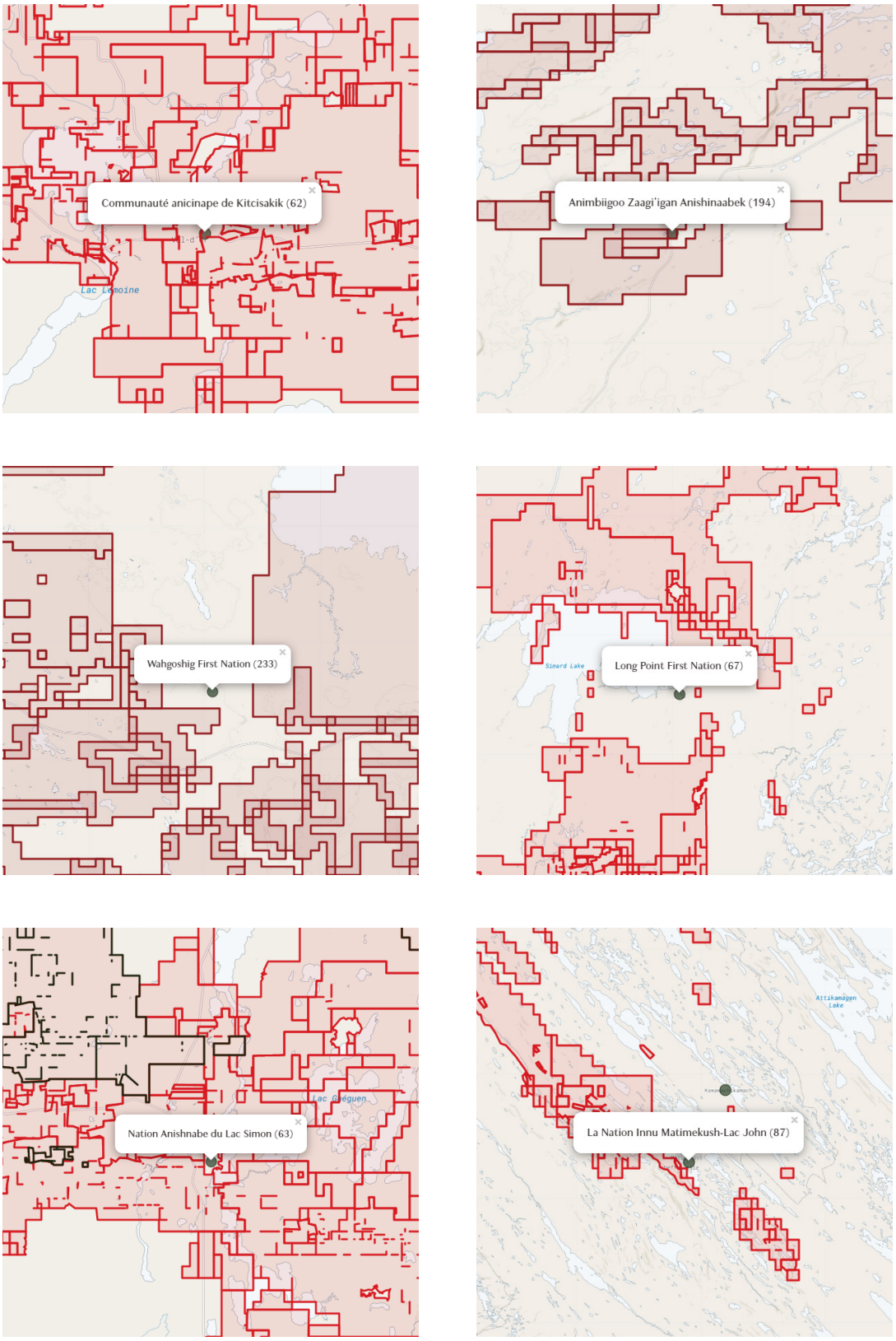


Fig. 3.7 Screenshots from Yellowhead Institute's Mine Sweeper Map. The map overlays mining claims with First Nations. (Source: Mine Sweeper Map, 2020, Collaboration between the Yellowhead Institute, PlanLab, and BadMath.)

personhood status and what is seen as property."[40] Hutchison explains how the definition of a legal person has always been set by law, citing the example that slaves were once considered property before they were considered legal persons.[41] When rivers and larger watersheds are viewed as property or as cheap nature for human use, their rights are ignored, extending the boundaries of negative impacts of mine afterlives.

Watershed Thinking

There are various groups and individuals that advocate for governance based around watersheds. Many Indigenous groups have defined their traditional territories by watersheds for thousands of years and view their role as being caretakers of the land and water, rather than owners. In British Columbia, there is a lot of discussion "on shifting water governance away from a centralized single authority towards an approach that is watershed-based, collaborative, and involves First Nations as central to decision-making processes".[42] Communities like the Dél̨ı̨ne First Nation in the NWT and the Tsolum River community in BC have organized around watersheds to set up structures of perpetual care near abandoned mine sites (as discussed later in this thesis).

On the larger scale, the International Joint Commission is a bi-national organization that works across Canada/United State borders and was created because the two nations "recognized that each country is affected by the other's actions in lake and river systems along the border."[43] It cooperates with more local watershed boards to approve and reject projects that may affect water, as well as investigate and recommend solutions for existing issues. Both countries have invested interest in this organization, which means its actions overall benefit both. This kind of organization is more difficult on the smaller scale, where waste flows in only one direction.

John Wesley Powell, a geographer, had a bioregional vision of organizing all governance by watersheds, and balancing residents' interests to ensure shared stewardship.[44] The vision took away power from corporations traditionally controlling water and instead gave it to nearby landowners.

All of these examples show how watersheds can be more than a physical region. Sibyl Diver, an environmental scientist, uses the watershed concept to describe a potential structure of perpetual care:

> "'Watershed,' which is often defined as all the land area that drains into a receiving water body, is now also used in the daily speech of some watershed group members to signify the group itself. Thus, "Watershed" is referred to both as a place and the group of people working to protect that place."[45]

A watershed can be an organizing structure through which to address broader environmental and social impacts of post-extraction sites.

40 Abigail Hutchison, "The Whanganui River as Legal Person," *Alternative Law Journal (Gaunt)* 39, no. 3 (2014), 179.

41 Hutchison, "The Whanganui River," 180.

42 Rosie Simms, Leila Harris, Nadia Joe, and Karen Bakker, "Navigating the tensions in collaborative watershed governance: Water governance and Indigenous communities in British Columbia, Canada," *Geoforum* 73 (2016), 6-16.

43 "Role of the IJC," International Joint Commission, accessed March 14, 2022, https://www.ijc.org/en/who/role.

44 John Wesley Powell, *Seeing things whole: the essential John Wesley Powell* (Washington, D.C.: Island Press/Shearwater Books, 2004).

45 Sibyl Diver, Mehana Vaughan, Merrill Baker-Medard, and Heather Lukacs, "Recognizing 'reciprocal relations' to restore community access to land and water," *International Journal of the Commons* 13, no.1 (2019), 400-429.

Fig. 3.8 Canada national and provincial borders overlayed on its watershed drainage basin areas. Drawing by author.

4 Case Studies: Community Perpetual Care

The Two Communities

The Tsolum River and Délıŋę communities are located near abandoned mines in Canada. Both communities were vital in advocating for remediation of nearby mine sites and have established community-led caretaking initiatives. These practices illustrate a type of perpetual care, which addresses the perpetuity of toxic waste, social aspects of remediation, and the well-being of the broader ecosystem. They focus on mending the local landscape, rather than developing the post-extraction site for economic and recreational use. As both communities have a long history of stewardship and a deep connection to their watersheds, they demonstrate sustainable aspects of perpetual care.

In the following section, I explore the motivations and values held by those extracting minerals, as well as by those repairing and caring for their landscapes. As with projects examined earlier in this thesis, I analyze both case studies through the three themes of *perpetuity*, *communities*, and *ecosystems*. By studying the extended history and broader context of these abandoned mines, I identify aspects in which these projects and practices embody a broader remediation and perpetual care.

Drawing Methodology

In addition to my written analysis, I've created sets of posters that go along with the writing. I chose to map these post-extraction landscapes to gain a deeper understanding of these sites over space and time. I first looked at the types of maps used to illustrate extraction processes. Mine developers primarily use plan and section drawings to map desired elements and design excavation sites.[1] Additionally, mine lease maps simplify land into organized squares. Bioregional planner Doug Aberley writes about the dangerous power maps can have when they

> "divide whole local, regional and continental environments into the absurdity of squared efficiency. They aid in attaching legitimacy to a reductionist control that strips contact with the web of life from the experience of a place."[2]

I wanted to highlight some of these elements excluded by these extractive maps. I ultimately did so by creating pairs of drawings that illustrate two contrasting perspectives of the same piece of landscape. They are both based in cartography so that the viewer can make spatial comparisons.

In each pair, one map traces extractive elements to amplify the destruction they bring. These extractive maps are inspired by Jennifer Wenzel's description of the mining industry's x-ray vision for minerals (described in Part 3). They are dark and highlight the focus of the industry – minerals, property, and profits. Aberley describes my approach: "Imagine if map-borne information

1 Alan Berger, "Representation and Reclaiming: Cartographies, Mappings, and Images of Altered American Western Landscapes," *Landscape Journal* 21, no. 1 (2002): 12.

2 Doug Aberley, "The Lure of Mapping: An Introduction," in *Boundaries of Home: Mappings for Local Empowerment*, edited by Doug Aberley (Philadelphia: New Society Publishers, 1993), 2.

generated for exploitation of land and life is redirected to an equally proficient quest for social justice and integration of human cultures with place."[3]

The second map draws elements of the ecosystem ignored in the first. Gene Marshall writes about all of the mapped districts, from nations to postal codes, that were created for "human supervision of nature and other humans," and how "if we shift our overall imagination from controlling nature to cooperating with nature, other modes of drawing our geographical districts emerge."[4] The second map draws these alternate geographical districts. Whereas the first map shows and property lines, the second map illustrates watershed boundaries.

Side by side the maps contrast extraction with community resistance and care of landscapes. I hope these posters encourage viewers to think critically about what is included in excluded in each. As Alan Berger writes,

> "Speculative mappings are more subjective than cartographies in that their primary role is not to accurately measure the landscape but to envision what may need further investigation. Unlike cartographies, mappings do not lead one through a singular reading of the landscape."[5]

I think of these maps as a first effort to visualize and question various perspectives of post-extraction landscapes, rather than accurately depict reality.

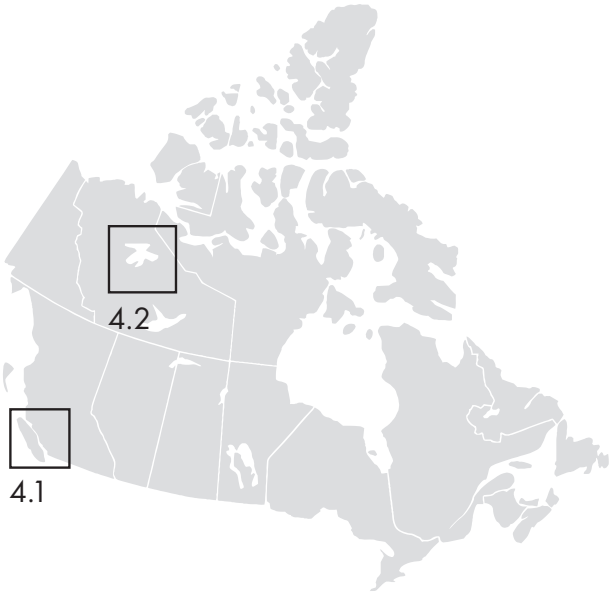


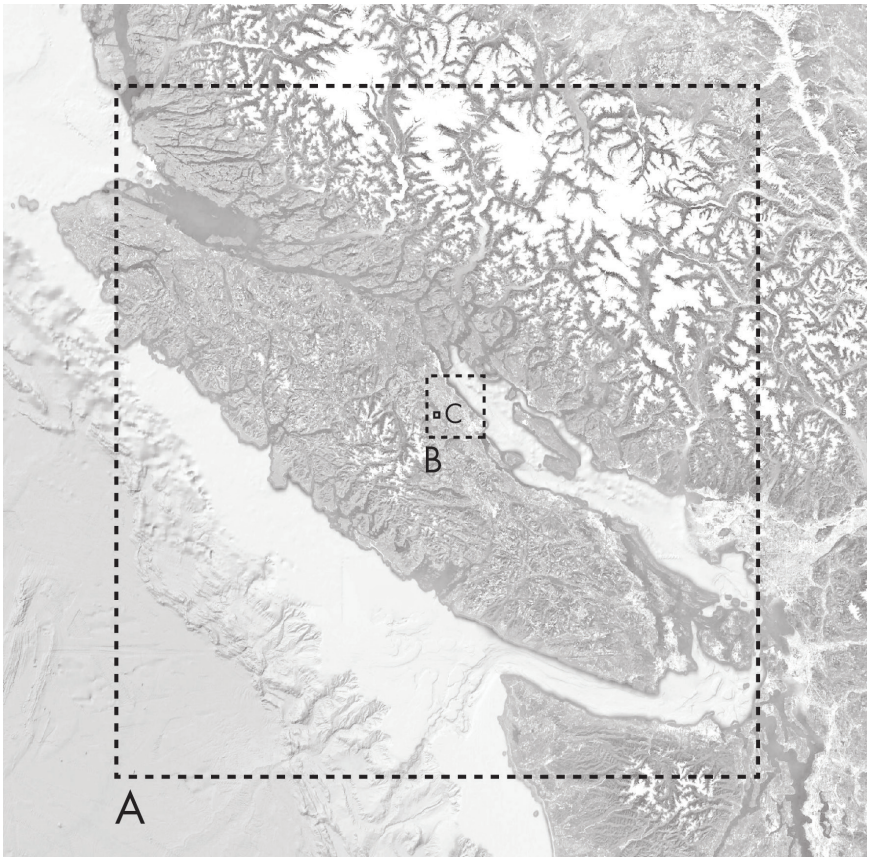
Fig. 4.1 Case study locations. Drawing by author.

3 Aberley, "The Lure of Mapping: An Introduction," 6.

4 Gene Marshall, "Step One: Mapping the Biosphere," in *Boundaries of Home: Mappings for Local Empowerment*, edited by Doug Aberley (Philadelphia: New Society Publishers, 1993), 52.

5 Berger, "Representation and Reclaiming," 18.

4.1 Mt. Washington Copper Mine // Tsolum River



A - Scale of Vancouver Island

B - Scale of the Tsolum River watershed

C - Scale of the Mt. Washington copper mine site

- 0 Base map (included for context)

- 1 Drawing minerals, extraction, and profits

- 2 Drawing ecosystems, communities, and care

Fig. 4.2 Context map illustrating the three drawing scales. Drawing by author.

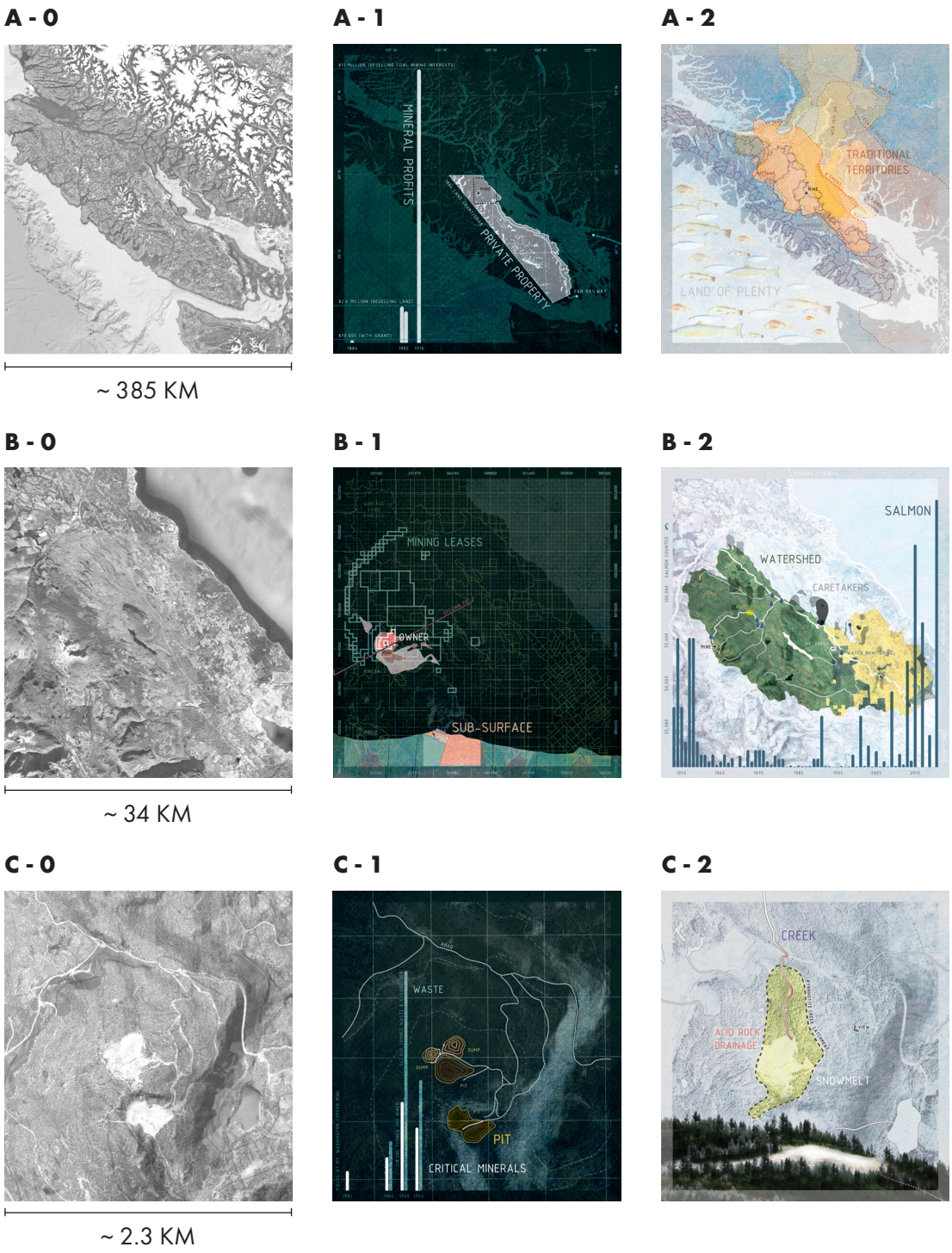


Fig. 4.3 Drawing matrix/legend. Drawing by author.

Mt. Washington Copper Mine: Extraction

In the 1940s, various groups began to explore, map, and stake mineral deposits at Mt. Washington. In 1956, the Mt. Washington Copper Company Limited was formed, and in 1961, the company joined Noranda in creating Qualicum Mines, which subsequently began to develop the site. [6] The Esquimalt and Nanaimo Railway Company Limited owned the base metals on the site prior to this time, but the Qualicum Mines formed an agreement with the E&N Railway to mine and process ore at Mt. Washington. [7] Pre-production mining began in 1961.

Full operation of the mine began in 1964 by Mt. Washington Milling Company, a subsidiary of Mt. Washington Copper and Consolidated Woodgreen Mines Ltd. (renamed Cumberland Mining Ltd.).[8] Ore was extracted from Mt. Washington and milled to produce copper, silver, and gold. At the time, copper was widely used for building wiring and plumbing.

In the short duration of mine operations, 3,443 tonnes of copper were produced, further circulated, and transformed into productive materials. This copper was less than 1% of the ore mined and an even smaller fraction of all the overburden removed and waste created. In the production of these 3,443 tonnes of copper,

375,800 tonnes of ore were mined,

815,400 tonnes of waste / overburden were removed.[9]

Just three years after beginning operations, on April 3, 1967, Mt. Washington Milling Co. was placed in receivership because of poor copper recovery.[10]

Initially, the property and minerals were still owned by the parent companies. Over the next decade, various others optioned the property and carried out exploration work, after which the property and claims were sold in 1982.[11]

Fig. 4.4 Copper produced in comparison to ore mined. Drawing by author.

6 Jacques Houle and Paul D. Gray, "Geological Technical Assessment Report on the Mt. Washington Property," Bluerock Resources Ltd., 2008, 13-15, https://aris.empr.gov.bc.ca/ArisReports/30010.PDF.

7 Houle and Gray, "Geological Technical Assessment Report," 15.

8 Houle and Gray, "Geological Technical Assessment Report," 16.

9 Houle and Gray, "Geological Technical Assessment Report," 16-18.

10 Houle and Gray, "Geological Technical Assessment Report," 18.

11 Houle and Gray, "Geological Technical Assessment Report," 16-18.

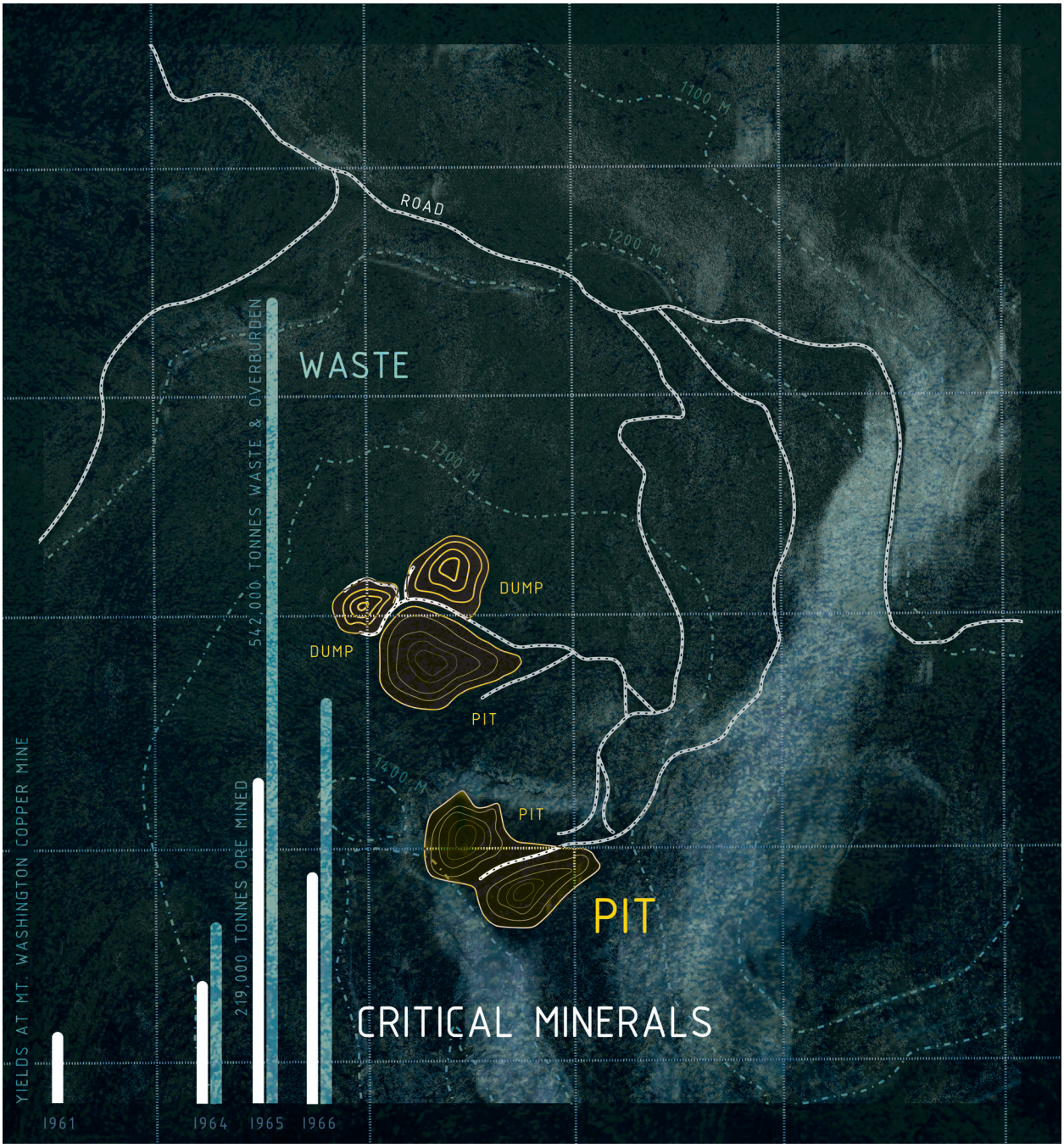


Fig. 4.5 The Mt. Washington copper mine site, from the start of operations in 1963 onwards. The drawing illustrates the x-ray vision of the mining industry. This perspective largely ignores lakes and rivers, and it focuses on extractive processes, including building mining roads, pits, and dumps. The overlaid mineral lease grid illustrates the perspective that land and subsurface minerals are commodities to simplify, divide, and earn profits from. The bar graph on the bottom axis shows ore mined (white) and waste and overburden removed (teal), revealing the difference between productive ore mined and waste produced. Drawing by author.

Mt. Washington Copper Mine: Waste

The Government of British Columbia did not require reclamation or security money at the time the mine was placed in receivership. Although the mining company created dumps for the waste rock, they did not ensure that the dumps were isolated from nearby water channels. After operations at Mt. Washington copper mine stopped, leftover mining waste rock produced acid rock drainage when exposed to air, rain, and snowmelt.[12] The toxic runoff ran into the Pyrrhotite Creek located just north of the former mine and further into the larger Tsolum River. The acid rock drainage killed a lot of life in the river, including previously prospering salmon populations.[13]

By considering Jennifer Wenzel's concept of overburden as "the everything-else that stands in the way of resource extraction"[14] at this site, I understand that the overburden at Mt. Washington Copper Mine included more than the technical 815,400 tons listed in reports. The following sections look beyond the three years of mine operations to examine the history of the site and what/who else was deemed discardable.

Overburden and waste were not only classified through the act of extraction and dumping, but also through the restructuring of land ownership boundaries in its colonial past.

12 Houle and Gray, "Geological Technical Assessment Report," 43.

13 Tsolum River Restoration Society, "Tsolum River Recovery Plan: Tsolum River Watershed," August 2016, iii.

14 Wenzel, "Improvement and Overburden," 4.

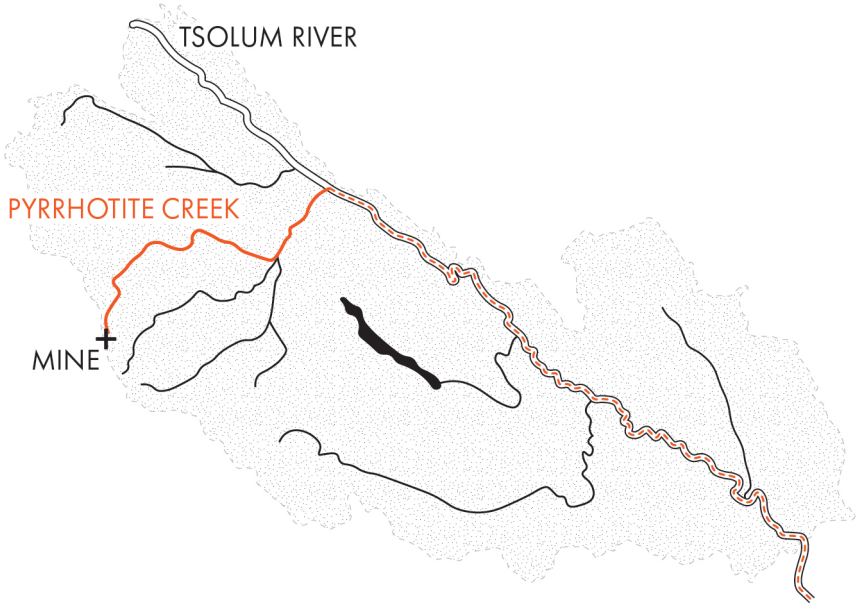


Fig. 4.6 Context map illustrating Pyrrhotite Creek and Tsolum River. Drawing by author.

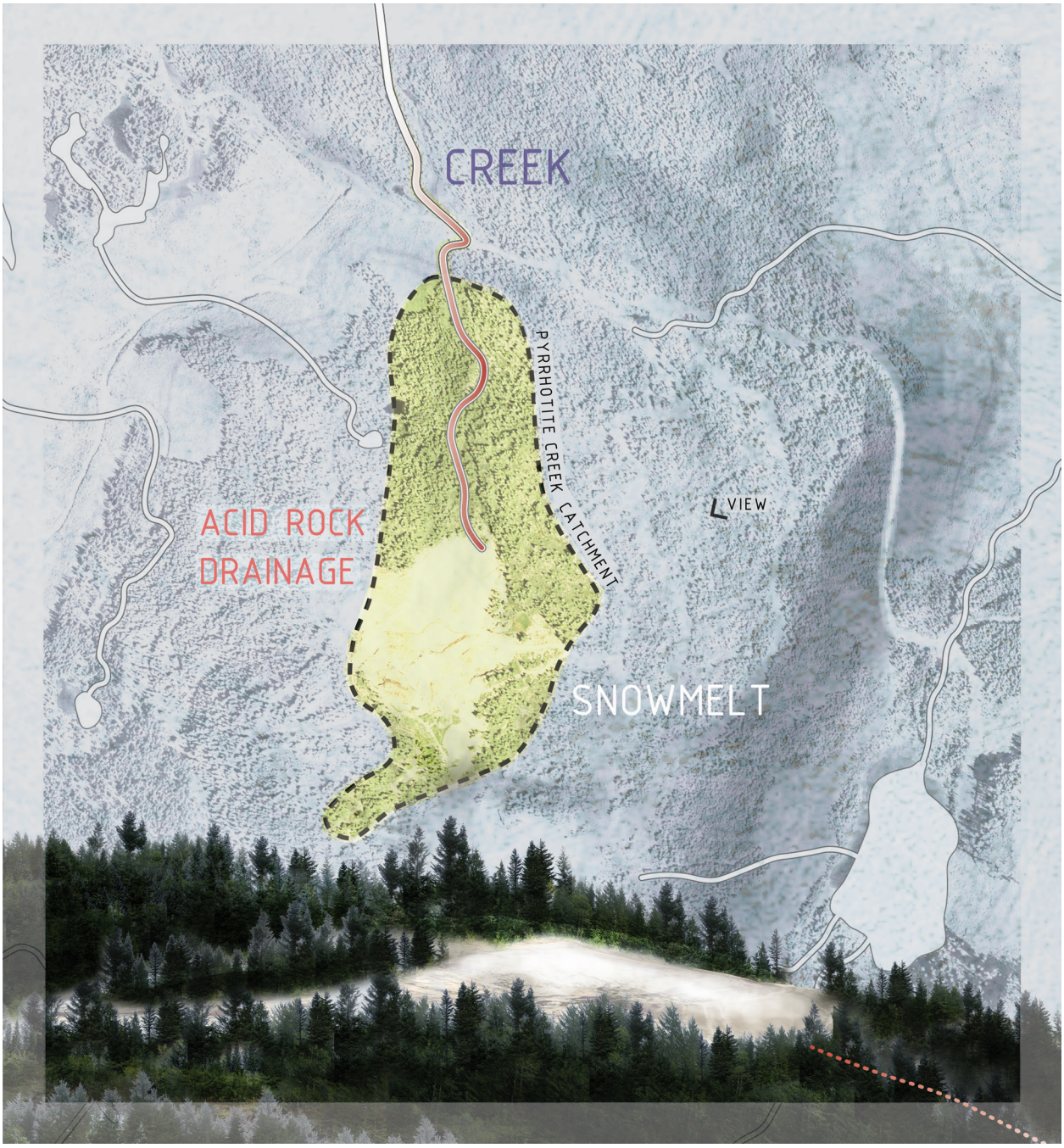


Fig. 4.7 The Mt. Washington copper mine site, after abandonment. Fig 4.7 maps the same footprint as Fig. 4.5 but focuses on the ecosystem. As snowmelt interacts with the waste rock, acid rock drainage is produced. Since mine dumps are located within the Pyrrhotite Creek catchment area, toxins drained into the creek and the larger watershed beyond the site. While Figure 4.5 illustrates the pits and dumps as contained areas, Figure 4.7 shows how mine impacts go beyond the site's boundaries. Drawing by author.

Fig. 4.8 Stones containing copper. (Source: Taylor Roades / The Narwhal.) (Image removed for UW space upload.)

Fig. 4.9 The white streaks on the rock show where salts are created (due to exposed copper ore). (Source: Taylor Roades / The Narwhal.) (Image removed for UW space upload.)

Context: K'ómoks as Caretakers

15 "K'ómoks First Nation," K'ómoks First Nation, accessed March 14, 2022, https://www.komoks.ca.

16 K'ómoks First Nation, "K'ómoks First Nation."

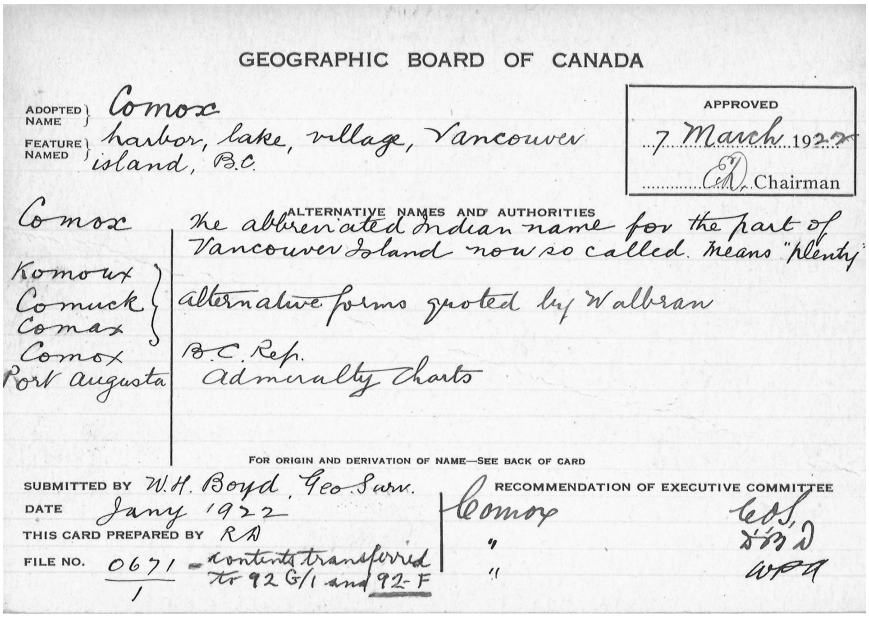
17 "Maps," K'ómoks First Nation, accessed March 19, 2021, https://www.komoks.ca/maps.

Before the extraction of the copper ore at Mt. Washington, the site's land and surrounding waters were cared for. The mine site is located within Tsolum River watershed, part of the unceded traditional territory of the K'ómoks First Nation, the traditional keepers of this land.[15] This region has been home to various Indigenous peoples for over ten thousand years, including ancestors of the K'ómoks.

The K'ómoks First Nation, refers to its people as "care takers of the 'land of plenty' since time immemorial."[16] The 'land of plenty' refers to the abundance of various types of fish, animals, and berries that sustained their livelihood. Their traditional territory is defined in terms of watersheds:

> "The K'ómoks First Nation (KFN) traditional territory is the eastern portion of Vancouver Island from the Salmon River **watershed** in the north to the Englishman River **watershed** in the south."[17]

As the K'ómoks cared for the water, the water in turn supported its people.


GEOGRAPHIC BOARD OF CANADA

ADOPTED NAME } Comox
FEATURE NAMED } harbor, lake, village, Vancouver island, B.C.

APPROVED
7 March 1927
Chairman

ALTERNATIVE NAMES AND AUTHORITIES

Comox — the abbreviated Indian name for the part of Vancouver Island now so called. means "Plenty"

Komoux, Comuck, Comax, Comox, Port Augusta — alternative forms quoted by Walbran

B.C. Rep.
Admiralty Charts

FOR ORIGIN AND DERIVATION OF NAME—SEE BACK OF CARD

SUBMITTED BY W.H. Boyd, Geo. Surv.
DATE Jany 1922
THIS CARD PREPARED BY RA
FILE NO. 0671/1 — contents transferred to 92 G/1 and 92-F

RECOMMENDATION OF EXECUTIVE COMMITTEE
Comox
"
"

Fig. 4.10 Mt. Washington is located in the Comox Valley and the Tsolum River flows into the Comox Harbour. The name "Comox" was adopted from the K'ómoks people for its meaning of "plenty." (Source: "Stories from the Land: Indigenous Place Names in Canada," Geographical Names Board of Canada, Natural Resources Canada.)

Fig. 4.11 The traditional territories of various Indigenous First Nations, which had called the area of the mine site home for thousands of years. Many of these territory boundaries are defined by watersheds. K'ómoks First Nation describes its people as caretakers of the land of plenty, which includes the fish, plants, and animals that sustain their livelihood. Drawing by author.

Context: The 1884 Land Grant

Vancouver Island was claimed as a British territory in 1846. The gold rush from the mid-1850s to 1860s brought many settlers and by 1871 the island was part of the Dominion of Canada. When the province of British Columbia joined Confederation, the BC government wanted to ensure that Vancouver Island would become a part of the rail system that was being built across Canada.[18] Therefore, in 1884, Parliament in Ottawa made a deal with coal baron Robert Dunsmuir and the E&N railway. This deal granted the baron and his company approximately one fifth of Vancouver Island in exchange for building a railroad from Courtenay to Victoria.[19] Canada refers to this as a grant, but the Hul'qumi'num Treaty Group refers to it as a land grab, as it expropriates a large portion of many Indigenous traditional territories, the land grant was completed without acknowledgement of First Nation rights, and did not compensate them in any way. [20] The Indigenous groups living on the land were considered overburden to the profit made from the railroad and future mineral extraction.

The 1884 land grab defined a shift in the way the land was thought about – from the K'ómoks' view of one to take care of, to the settlers' view of one to own and enclose within a property. Each defined boundaries, which reflect these varying relationships. While the K'ómoks use watersheds to explain the extents of their traditional territory, the 1884 grant defined a set of straight lines, cutting through all (including watersheds) in its way:

> "…all that piece or parcel of land situated on Vancouver Island … [b]ounded on the South by a **straight line** drawn from the head of Saanich Inlet to Muir Creek on the Strait of Fuca; On the West by a **straight line** drawn from Muir Creek aforesaid to Crown Mountain; On the North by **a straight line** drawn from Crown Mountain to Seymour Narrows; and On the East by the Coast line of Vancouver Island to the point of commencement."[21]

This grab is significant to the Mt. Washington site as the baron with it took rights to "all coal, oil, ores, stones, clay, marble, slate, mines, minerals, and substances whatsoever."[22] The copper underneath Mt. Washington became privately owned and everything in its way was dismissed. Within just a decade or two the land was further subdivided again and again. Subsurface rights were sold separately from surface rights. Dunsmuir and the E & N Railway continued to profit.

Currently, Mt. Washington's mineral rights are held by one entity and the surface rights by another, a privately managed forest company.[23] The boundaries do not align with one another.

18 "History of the E & N Railway," Panel by the City of Courtenay Heritage Advisory Commission, 2017, https://www.courtenay.ca/assets/Community/Heritage/2018-EandN-Train-24x36-web.pdf.

19 Robert Morales, Brian David Thom, and Brian Egan, "The Great Land Grab: Colonialism and the Esquimalt & Nanaimo Railway Land Grant in Hul'qumi'num Territory," Hul'qumi'num Treaty Group, 2007, 12.

20 Morales, Thom, and Egan, "The Great Land Grab," 13.

21 Morales, Thom, and Egan, "The Great Land Grab," 12.

22 Morales, Thom, and Egan, "The Great Land Grab," 12.

23 Andrew Findlay, "Three Years of Mining, 40 Years of Taxpayer Clean up for River Downstream of Vancouver Island Copper Mine," *The Narwhal*, accessed October 20, 2020, https://thenarwhal.ca/three-years-of-mining-40-years-of-taxpayer-clean-up-for-river-downstream-of-vancouver-island-copper-mine/.

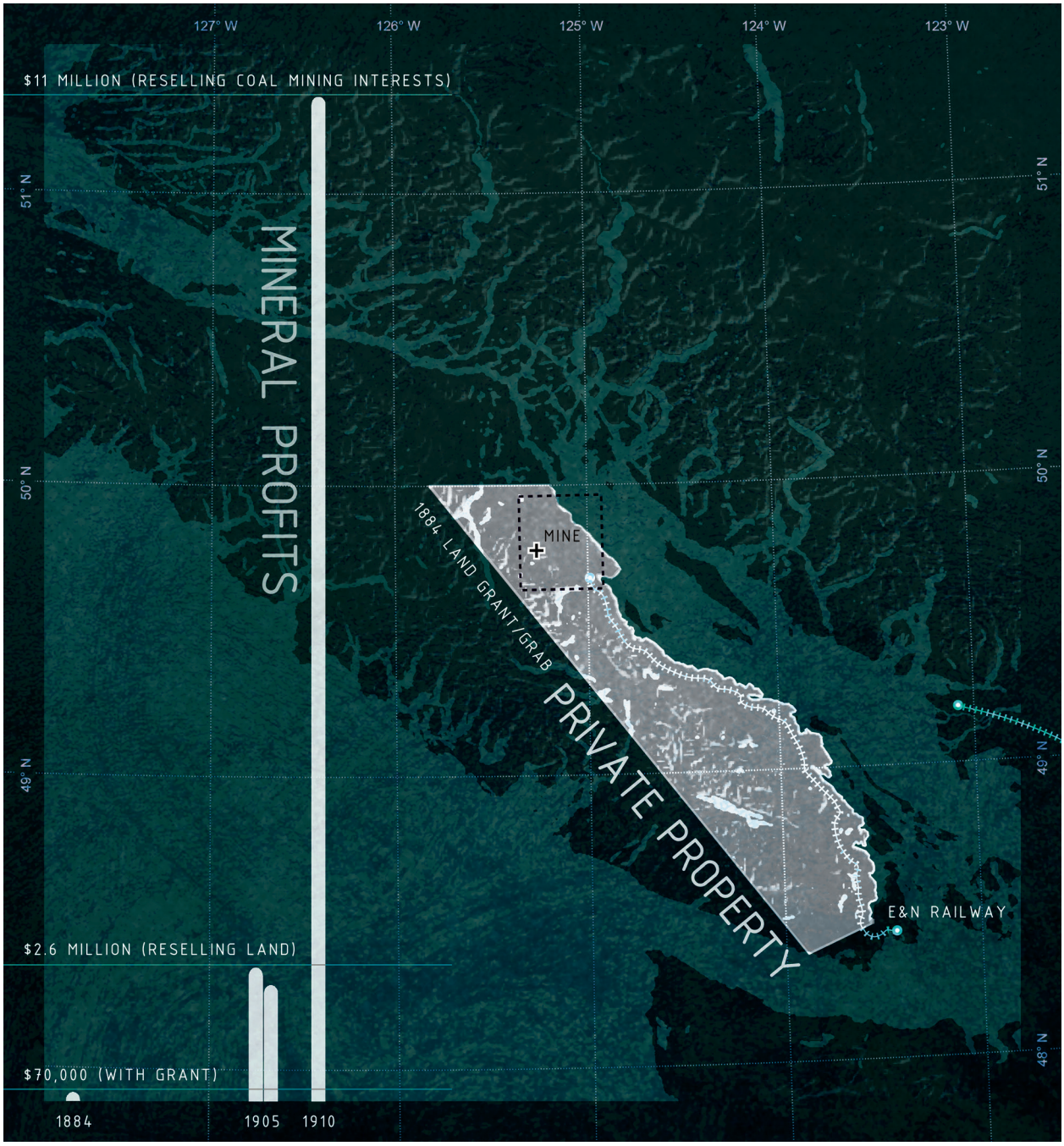


Fig. 4.12 The 1884 land grant, which converted a fifth of Vancouver Island to private property. This drawing maps the same footprint as Fig. 4.11 but illustrates a constrasting perspective on human relationships to land. The land grant was defined by "straight lines" that cut through everything in its way, including watersheds. It granted ownership of land that included both surface and subsurface rights. Land and mining interests were viewed as commodities and resold for further profits. Figures 4.11 and 4.12 illustrate the way land is described, contrasting ownership and straight boundaries with caretaking and watersheds.

After the Mine: Initial Advocacy and Organizing

As discussed earlier, the waste rock at Mt. Washington Copper Mine was not contained and acid rock drainage contaminated water on the site. Although the mining property enclosed a small area around the mine, the water that flowed beyond these invisible boundaries brought the toxic copper to the much larger Tsolum River watershed. The Tsolum River had already suffered from other industry, specifically logging and the removal of gravel from river beds. Damaged gravel beds and weakened banks accelerated the decline of salmon and made their recovery difficult.[24]

Salmon disappeared from the Tsolum River, part of the "land of plenty," just years after operations at the Mt. Washington copper mine.[25] Even though it was more than a decade later, the lack of salmon brought attention to the mine's destruction. Wayne Wright, current president of the Tsolum River Restoration Society, wrote,

> "Although the community was aware of the decline of fish in the river, it was not until 1982, when after operating for four years with very low returns, the headquarters creek hatchery released 2.5 million pink fry into the Tsolum river and none returned, that the seriousness of the problem was discovered. Subsequent water monitoring in 1983 revealed high copper levels originating from the mine."[26]

Community members were motivated to advocate for the Tsolum River's health. This was largely driven by fishermen that had a well-established connection to salmon and river. In particular, the Comox Valley Chapter of the Steelhead Society began writing letters to the government and advocating for the river.[27]

Remediation: Mine Site

The BC government was liable for the environmental destruction at Mt. Washington since there were no reclamation regulations at the time of abandonment. After initial community advocacy, in the late 1980s the Ministry of Energy, Mines and Petroleum Resources (MEMPR) paid $1.5 million for the installation of a glacial till waste cap at the mine site, which years later was deemed unsuccessful in containing toxins.[28]

Meanwhile, community members continued to organize. Advocating for the river was the common interest. The Tsolum River Task Force (TRTF) was formed in 1997 after a workshop titled "Healing the Tsolum" was organized by the Comox Valley Watershed Assembly, an existing group that met and discussed watershed issues in the broader area.[29] The TRTF was able to secure funding from the Department of Fisheries and Oceans that same year, however the funding supported water monitoring and assessment projects, not the remediation of the mine site.[30] The Tsolum River Restoration Society (TRRS) was formed in 1998, as the TRTF was having difficulty moving forward since "Provincial/Federal orphaned minesite remediation had become a legal issue" and agencies and industry were no longer openly co-operating with the community.[31]

24 Tsolum River Restoration Society, "Tsolum River Recovery Plan."

25 "Fish Stocks from 1953 to 2017," Tsolum River Restoration Society, accessed March 14, 2022, http://www.tsolumriver.org/fish-stocks.html.

26 Wayne White and Peter Healey, "Mount Washington Mine Remediation Project," Tsolum River Restoration Society, 2007, 5, https://open.library.ubc.ca/media/download/pdf/59367/1.0042592/1.

27 White and Healey, "Mount Washington Mine Remediation Project, 6.

28 White and Healey, "Mount Washington Mine Remediation Project, 6.

29 "Goals and History," Tsolum River Restoration Society, accessed February 23, 2022, http://www.tsolumriver.org/goals-and-history.html.

30 Kathy Campbell, "State of the Tsolum River: A comprehensive report on work completed by the Tsolum River Task Force," Tsolum River Restoration Society, April 1997-March 1999, http://www.tsolumriver.org/uploads/4/0/5/7/4057952/state_of_the_tsolum_river.pdf.

31 Tsolum River Restoration Society, "Goals and History."

In 2001 the TRRS decided that a better point source control was needed at the mine site.[32] Two years later, the TRRS created a partnership with the mining industry, government organizations, and the Pacific Salmon Foundation that worked to divert Pyrrhotite Creek through nearby wetlands, in hopes of lowering copper levels in the Tsolum River. [33] Although this strategy did improve water quality, it was a short-term solution that only dealt with the waste once it had travelled beyond the mining site boundaries. It would only help for a limited number of years but was an encouraging success. The partnership grew to include the MEMPR, who had funded the first unsuccessful waste cap, the Mining Association of BC, Natural Resources Canada, and Breakwater Resources.[34]

A large part of the ultimate remediation of Mt. Washington copper mine was the installation of a bituminous membrane cap on the site in 2009, which was planned by the partnership.[35] The cap was successful in artificially repairing the broken surface-subsurface relationships on site and protecting waste rock from the elements. Salmon returned to the river.

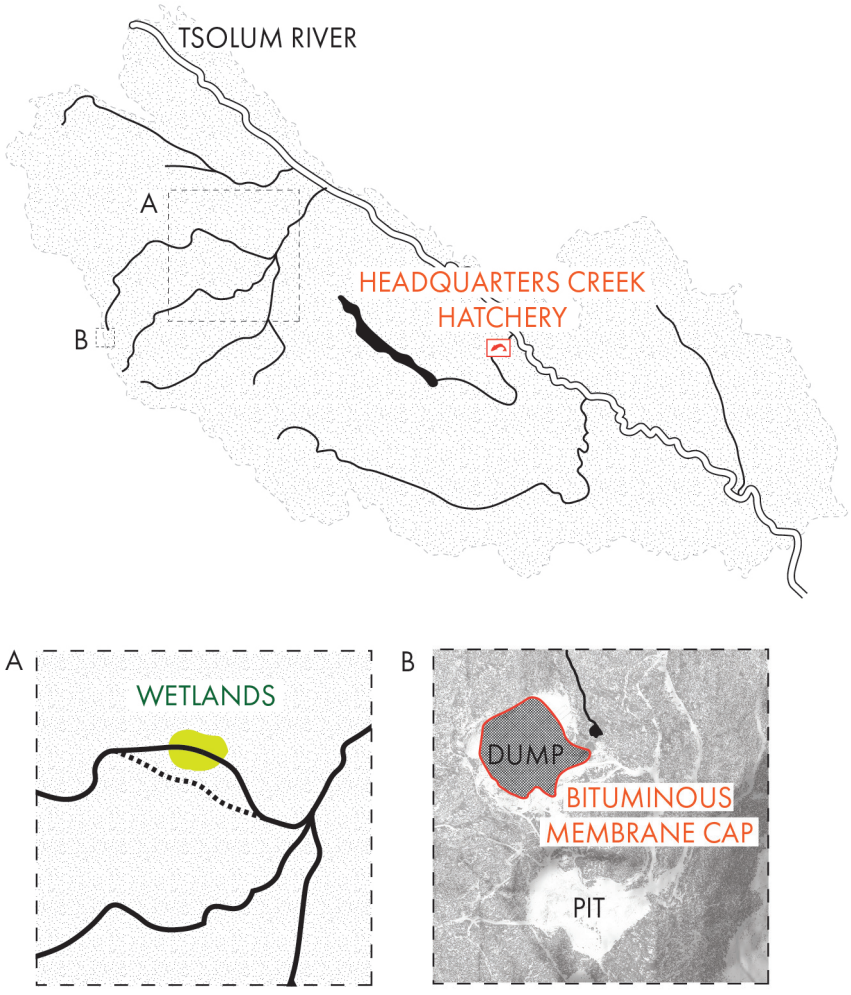


Fig. 4.13 Reference maps to locate the hatchery, wetlands, and mine site. Drawing by author.

32 Tsolum River Restoration Society, "Goals and History."

33 Tsolum River Restoration Society, "Goals and History."

34 "Mt. Washington copper mine remediation project: Bringing salmon back to the Tsolum River," Tsolum River Partnership, https://bc-mlard.ca/files/presentations/2011-10-DE-NISEGER-HEALEY-mt-washington-copper-mine-remediation.pdf.

35 Tsolum River Restoration Society, "Tsolum River Recovery Plan: Tsolum River Watershed," August 2016, http://www.tsolumriver.org/uploads/4/0/5/7/4057952/tsolum_river_recovery_plan-vaug2016.pdf.

Fig. 4.14 Mt. Washington mine site before remediation. (Source: Photo used with permission from the Tsolum River Restoration Society, BC)

Fig. 4.15 Headquarters Creek Hatchery. (Source: Katherine Bickford, 2018.) (Image removed for UW space upload.)

Fig. 4.16 First remediation efforts diverted the creek through wetlands. (Source: "Mt. Washington copper mine remediation project," BC MEND ML/ARD) (Image removed for UW space upload.)

Fig. 4.17 The installation of the bituminous membrane cap. (Source: Photo used with permission from the Tsolum River Restoration Society, BC)

Perpetual Care: Mine Site

The cap is considered a successful permanent solution but requires long term monitoring for wear. The detailed design plan report prepared for the Tsolum River Partnership by SRK Consulting outlines a long-term monitoring plan. It includes annual groundwater sampling at the cover site, as well as inspection and maintenance of the earthworks.[36] The cost estimate includes maintenance and operating costs for five years after project completion.[37]

The Ministry of Energy, Mines and Petroleum Resources completed inspections in 2018 and 2019, where they determined the cap was functioning as expected.[38] Still, community member Wayne White is concerned about the maintenance plan, as over the past decade parts of the cap not revegetated have started to erode, and UV radiation might start to compromise the membrane.[39] In order to maintain the integrity of these engineering structures, care should be proactive, not reactive, so as to avoid catastrophic damage.

It is unclear to me if there is consistency in the official maintenance team, which would affect the level of care in long-term monitoring. Community members like White who have an attachment to the landscape, however, seem to be developing their own skills in noticing subtle signs of erosion. It is also unclear how long funding for the inspection and maintenance of the cap is secured for, although plans for continuing practices exist.

Remediation and Perpetual Care: Tsolum River

Although the waste cap ensures no future leaching of toxins from the Mt. Washington mine site, it does not mend all past damage in the larger ecosystem. This illustrates Beckett and Keeling's argument that industry and government remediation is often limited to a mine site. The TRRS, however, continues to work on a broader remediation and perpetual care of the Tsolum River watershed.

Structuring this group around the watershed – a not owned, but shared part of the community that borders many properties and is touched by many industries – gives the organization a sustainable mission. As Sibyl Diver argued, the concept of a watershed can be an important way to organize not only water, but people. The community understood that the impact of mining was not limited to the property boundaries, but a broader region. The TRRS works to further repair the Tsolum River, as well as educate the community to strengthen its relationship to the land.

The Tsolum River Restoration Society's care practices include educating youth on stewardship, protecting the watershed from future damaging activities, monitoring water quality and fish levels, and restoring affecting habitats.[40] This organization was created by a group of volunteers worried about their home, not by the government during remediation, but similar structures could be supported, created and/or funded in institutionalized remediation and perpetual care of post-extraction landscapes.

The TRRS is a non-profit organization, led by a group of volunteer Board of Directors. Community volunteers help ensure the success of the TRRS, as

36 SRK Consulting, "Mt. Washington Mine Remediation Detailed Design," Prepared for Tsolum River Partnership, December 2007, 24, http://www.llbc.leg.bc.ca/public/PubDocs/bcdocs/437471/DetailedDesignReport.pdf.

37 SRK Consulting, "Detailed Design," 39.

38 Andrew Findlay, "Three Years of Mining."

39 Andrew Findlay, "Three Years of Mining."

40 Tsolum River Restoration Society, "Goals and History."

they complete annual fish counts, help with educational events, and support restoration and assessment projects.[41] The TRRS projects are funded partially by membership fees and monthly donations, but also have a number of larger donors, which include government and industry.[42]

Remediation and Perpetual Care: K'ómoks First Nation

The K'ómoks First Nation were part of the Tsolum River Partnership that worked to remediate the mine site and continue to work with the TRRS. In terms of perpetual care, the K'ómoks have a Guardian Watchmen group, who define themselves as the "eyes and ears of the land and sea, thriving to protect everything from the tops of the mountains to the bottom of the oceans, and everything in between."[43] Stewardship practices include tracking fish counts and eco-cultural restoration.

The K'ómoks First Nation are working to "reclaim cultural expression and relationship with the 'land of plenty'" that colonial policies damaged.[44] They are currently undergoing Stage 5 of 6 in treaty negotiations with British Columbia and Canada.[45] The K'ómoks Treaty has many chapters, one of which looks at *lands*. While still in negotiations, the land package includes around 12,500 acres, in comparison to the 813.5 acres of current K'ómoks reserve lands.[46] In terms of sub-surface minerals, existing mineral interests will continue as they are but the K'ómoks will own and control all mineral resources.[47] This treaty would legally return some of the land and minerals privatized by the 1884 land grant back to the K'ómoks, although the 12,500 acres are still a fraction of their traditional territory.

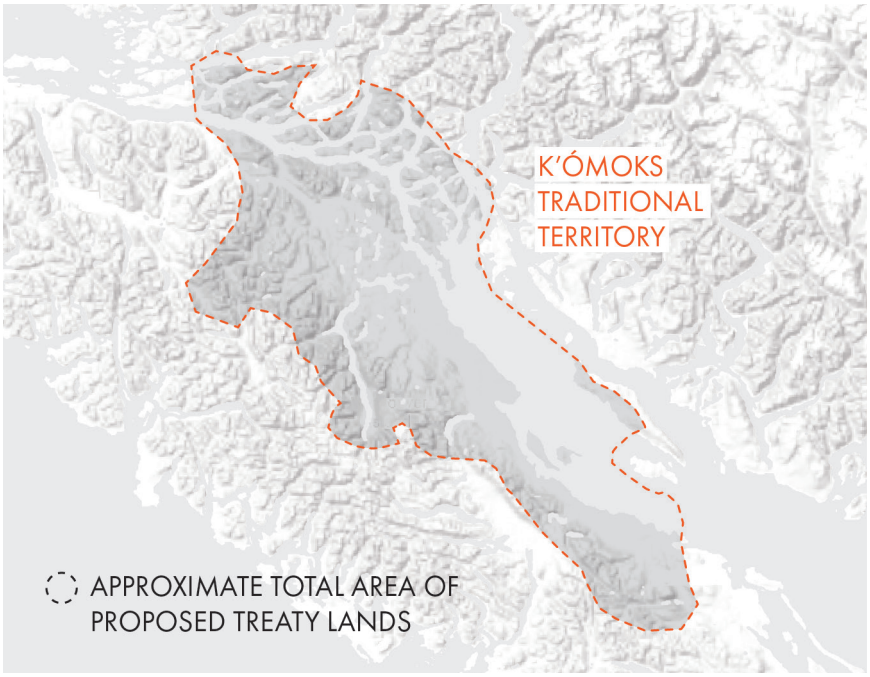


Fig. 4.18 Approximate total area of proposed treaty lands in comparison with K'ómoks traditional territory. Drawing by author.

41 "Volunteer," Tsolum River Restoration Society, accessed February 23, 2022, http://www.tsolumriver.org/volunteer.html.

42 "Funders and Partners," Tsolum River Restoration Society, accessed February 23, 2022, http://www.tsolumriver.org/funders-and-partners.html.

43 "Guardian Watchmen," K'ómoks First Nation, accessed March 14, 2022, https://komoks.ca/department/guardian-watchmen/.

44 K'ómoks First Nation, "K'ómoks First Nation."

45 "Treaty Process," K'ómoks First Nation, accessed March 14, 2022, https://komoks.ca/treaty#treatyoverview.

46 "K'ómoks First Nation Treaty Chapter Summaries," K'ómoks First Nation, accessed March 14, 2022, https://komoks.ca/stages-of-treaty/#Lands.

47 K'ómoks First Nation, "Treaty Chapter Summaries."

Fig. 4.19 The bituminous cap. On the right side of the image you can see the revegetated cap, on the left you can see areas where drainage is wearing down the gravel cover. (Source: Taylor Roades / The Narwhal) (Image removed for UW space upload.)

Fig. 4.20 The bituminous cap. (Source: Taylor Roades / The Narwhal) (Image removed for UW space upload.)

Fig. 4.21 Tsolum River Restoration Society educational programs. (Source: Photo used with permission from the Tsolum River Restoration Society, BC)

Fig. 4.22 Tsolum River Restoration Society at work. (Source: Photo used with permission from the Tsolum River Restoration Society, BC)

Fig. 4.23 Sub-surface minerals, mine leases, and property boundaries at the scale of the Tsolum River watershed. Mining leases are bold (teal), showing their superiority to surface land parcel boundaries (light green). The mineral lease grid is overlaid, once again showing the simplification of sub-surface mineral rights. Mt. Washington sub-surface minerals are shown both in plan and section, and the current mining lease at Mt. Washington are drawn in white. Drawing by author.

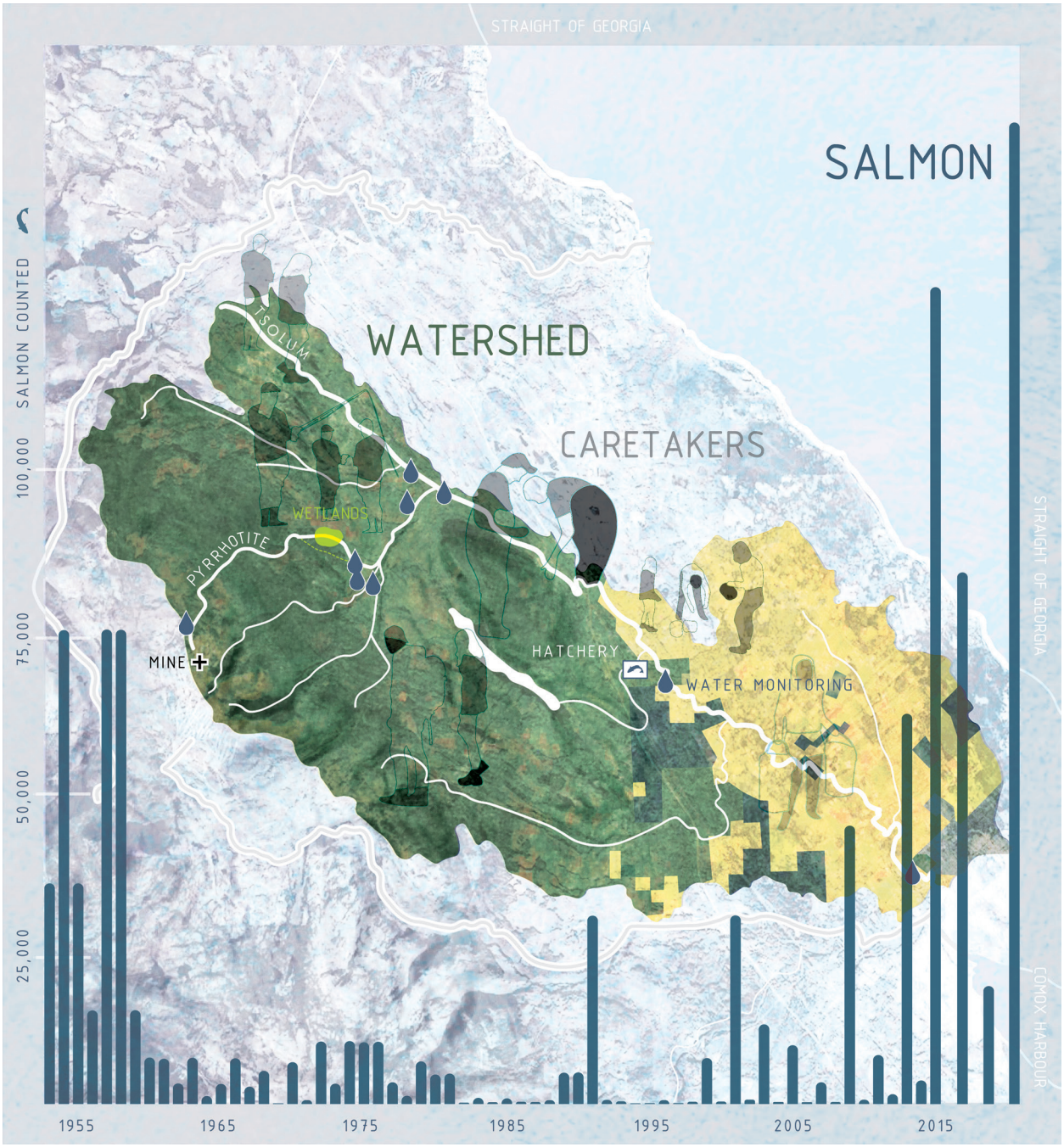


Fig. 4.24 The post-extraction landscape at the scale of the Tsolum River watershed. This drawing illustrates the watershed as a structure for perpetual care, noting water monitoring sites and community cleanup practices. The bar graph on the bottom axis shows salmon counts in the Tsolum River over time. Counts dropped dramatically at the beginning of mine operations and have recently recovered with remediation and care practices. Figures 4.24 and 4.25 contrast mineral extraction with remediation and care practices, comparing their scale of impact. Drawing by author.

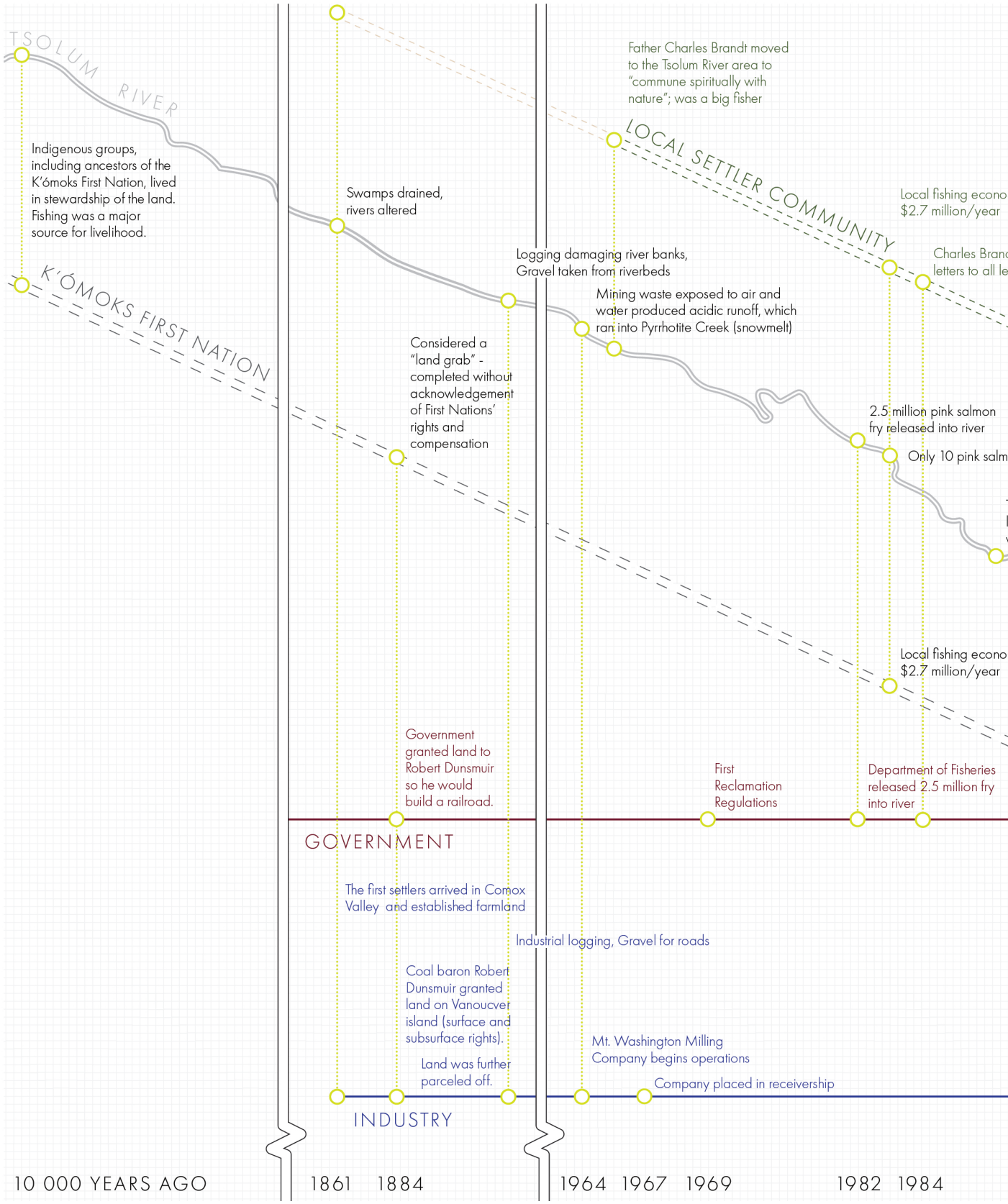
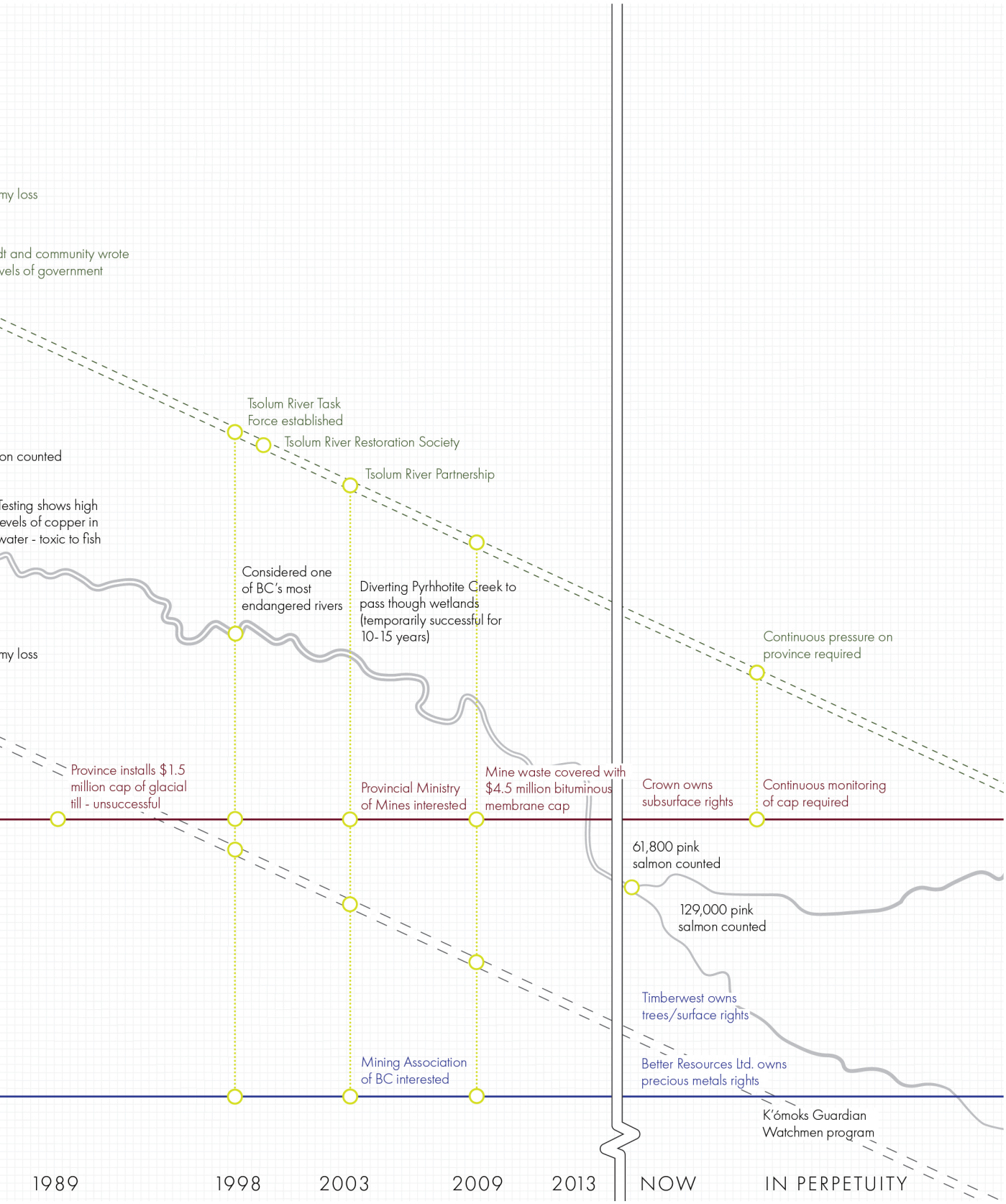


Fig. 4.25 Timeline of key events. Drawing by author.


my loss
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Tsolum River Task
Force established
Tsolum River Restoration Society
Tsolum River Partnership
Considered one
of BC's most
endangered rivers
Diverting Pyrhhotite Creek to
pass though wetlands
(temporarily successful for
10-15 years)
Continuous pressure on
province required
Province installs $1.5
million cap of glacial
till - unsuccessful
Provincial Ministry
of Mines interested
Mine waste covered with
$4.5 million bituminous
membrane cap
Crown owns
subsurface rights
Continuous monitoring
of cap required
61,800 pink
salmon counted
129,000 pink
salmon counted
Timberwest owns
trees/surface rights
Mining Association
of BC interested
Better Resources Ltd. owns
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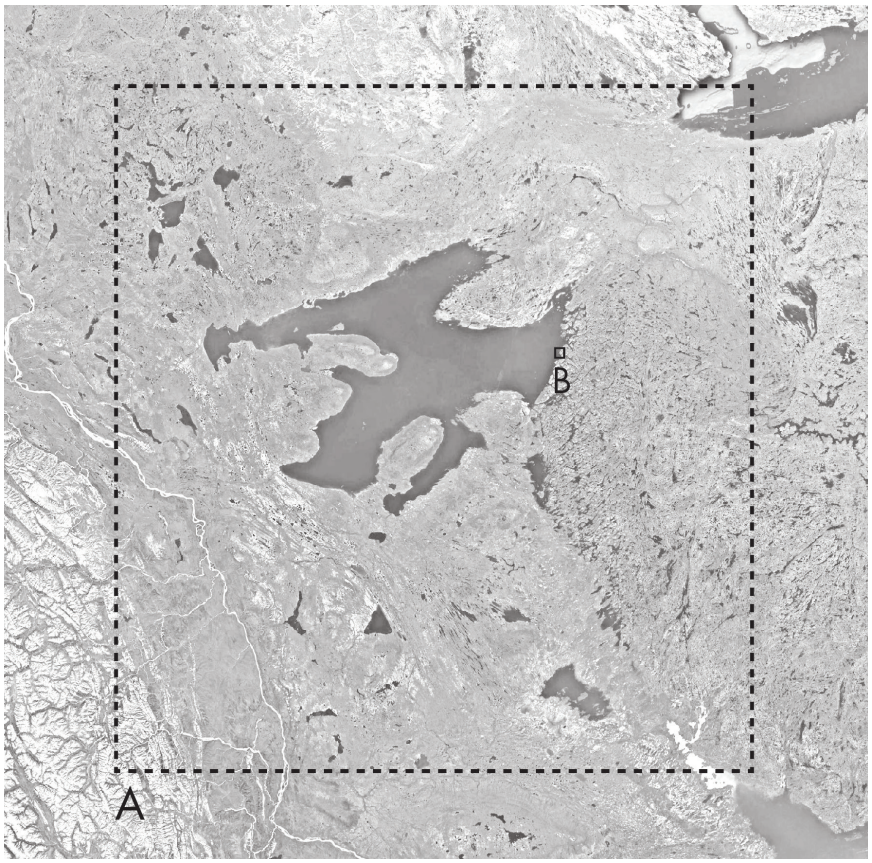
IN PERPETUITY

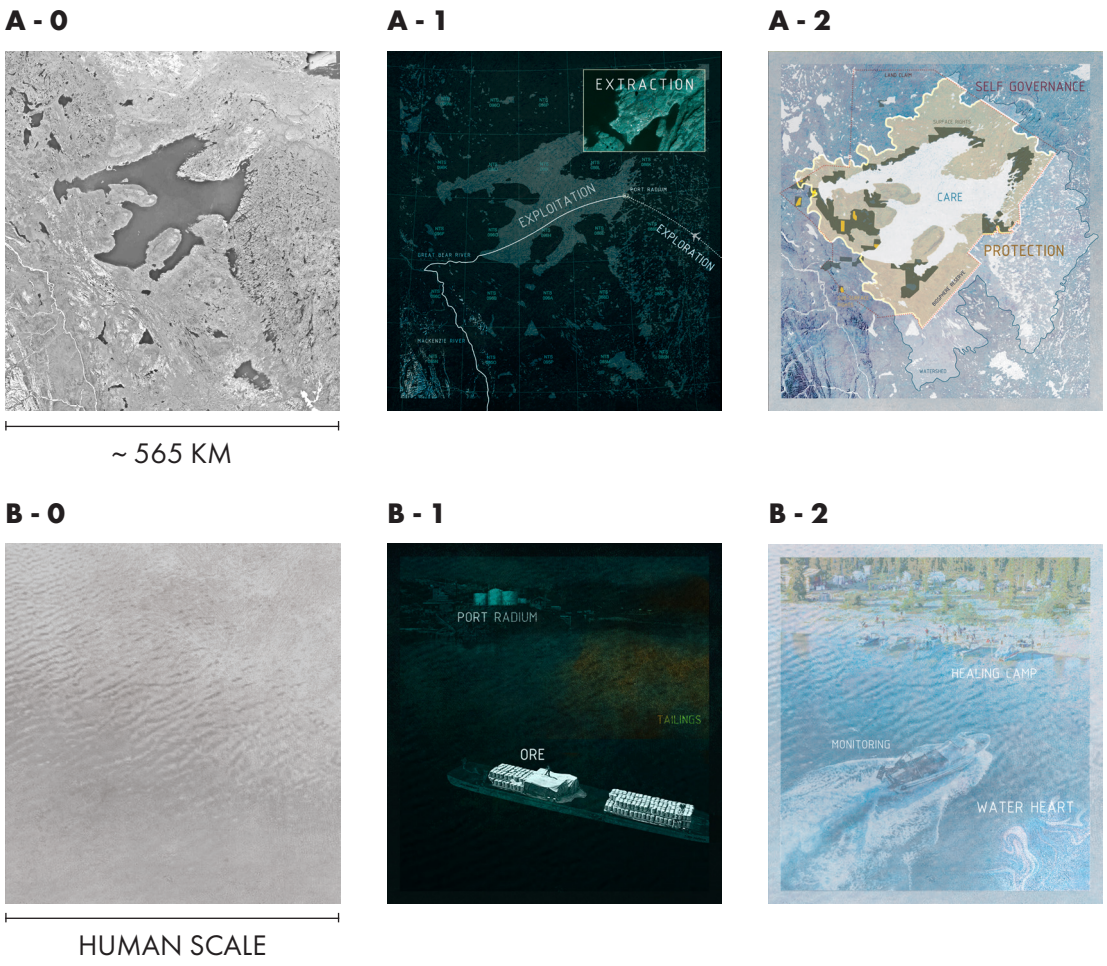
4.2 Port Radium Mine // Lake Sahtú



A - Scale of Lake Sahtú (Great Bear Lake)

B - Human scale on the lake

Fig. 4.26 Context map illustrating the three drawing scales. Drawing by author.



- 0 Base map (included for context)

- 1 Drawing minerals, extraction, and profits

- 2 Drawing ecosystems, communities, and care

Fig. 4.27 Drawing matrix/legend. Drawing by author.

Port Radium Mine: Extraction

Although first mining operations at Port Radium began in 1932 with the extraction of radium, silver, and copper, [48] the site became increasingly active a decade later. In the early 1940s, Eldorado Mining and Refining Limited began mining uranium at Port Radium. At the time, the mined uranium contributed to an order of 60 tonnes of uranium oxide for the Manhattan project, the development of the first nuclear weapons during World War II.[49] Uranium is currently used to fuel nuclear power plants and is considered a zero-emissions, although still non-renewable, energy source.

In 1944, Eldorado Mining and Refining Limited became a crown corporation as uranium was of interest to the Canadian Government.[50] It continued to operate and extract uranium. Ore was barged across Great Bear Lake and further transported along the Great Bear River and Mackenzie River southwards. In 1960, the Eldorado mine closed.

Echo Bay Mines Limited operated a silver mine at the site from 1964 to 1982. Afterwards, the land returned to the Crown.

Port Radium Mine: Waste

In Eldorado's production of the uranium ore, approximately 910,000 tons of uranium tailings were produced.[51] Around 19% were discarded at a depression in the Silver Point area of Port Radium, but the rest of the tailings were dumped into various locations in Great Bear Lake. [52] Uranium mine tailings emit radiation that poses health risks to those living on or near the site. At the time of closure, there were no government regulations for reclamation so other than the removal of some equipment, the site was left as it was. [53]

There were also approximately 800,000 tons of silver tailings produced, which were dumped into McDonough Lake. [54] At the time of the Echo Bay Mines closure, the tailings were covered with waste rock, and site infrastructure was demolished. [55]

The mineral extraction at Port Radium environmentally degraded the site, but their impacts include much more. The industry and government overburdened the Délı̨nę Dene First Nation with other negative impacts.

48 Canada-Déline Uranium Table, "Canada-Déline Uranium Table – Final Report: Concerning Health and Environmental Issues Related to the Port Radium Mine," August 2005, 4, https://assembly.nu.ca/library/Edocs/2005/001195-e.pdf.

49 Paul Barnsley, "'Village of widows' wants gov't attention," *Windspeaker Publication* 16, no.4 (1998).

50 Canada-Déline Uranium Table, "Canada-Déline Uranium Table – Final Report," 4.

51 Canada-Déline Uranium Table, "Canada-Déline Uranium Table – Final Report," 4.

52 Canada-Déline Uranium Table, "Canada-Déline Uranium Table – Final Report," 4.

53 Canada-Déline Uranium Table, "Canada-Déline Uranium Table – Final Report," 26.

54 Canada-Déline Uranium Table, "Canada-Déline Uranium Table – Final Report," 4.

55 Canada-Déline Uranium Table, "Canada-Déline Uranium Table – Final Report," 3.

Fig. 4.28 Great Bear Lake and its surrounding area. This drawing illustrates the exploration, extraction, and transportation of uranium ore at Port Radium. The ore was transported in barges across Great Bear Lake and along Great Bear River to the Mackenzie River. The drawing shows the movement of minerals and Port Radium as a remote site from which to extract and profit. As valuable minerals left the area, toxic tailings were left to contaminate the land and water. Drawing by author.

Fig. 4.29 Building and storage tanks at the Eldorado Mine in Port Radium, 1936. (Source: NWT Archives/Edmonton Air Museum Committee Collection/N-1979-003: 0089.)

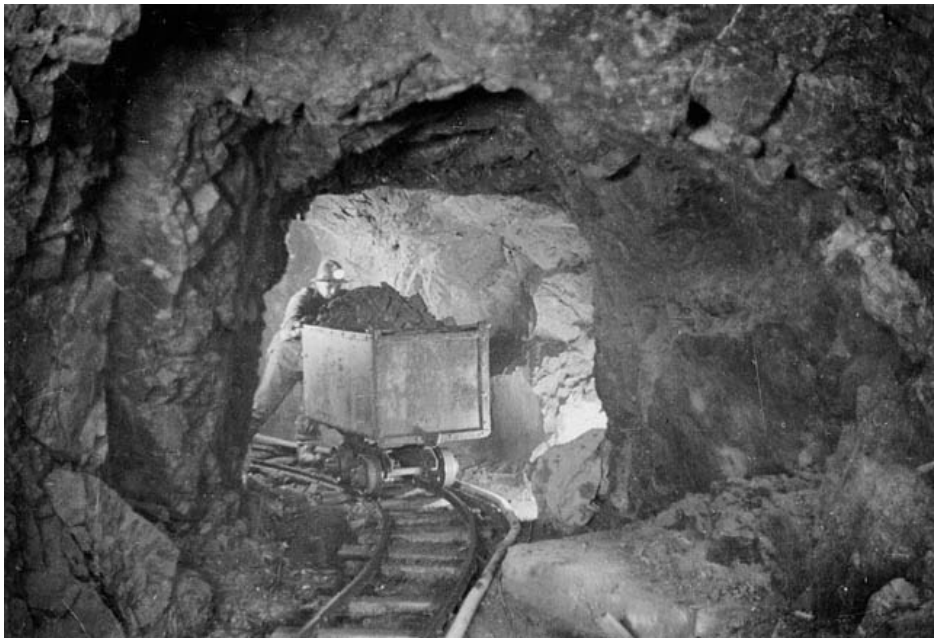


Fig. 4.30 A miner and car of silver radium ore underground at the Eldorado Mine in Port Radium, c.a. 1930 (Source: Eldorado Mining & Refining Ltd. / Library and Archives Canada / C-023983.)

Fig. 4.31 The tugboat and barge that transported the ore across Great Bear Lake. (Source: NWT Archives/Henry Busse fonds/N-1979-052: 3295.)

Fig. 4.32 Sacks of pitchblende concentrate at Port Radium, 1939. (Source: NWT Archives/ Richard Finnie fonds/N-1979-063: 0081.)

Context: Dene First Nation

Great Bear Lake had been home to the Dene First Nation for thousands of years before mining brought damage to both the enormous freshwater lake and the community. The Dene refer to Great Bear Lake as "Sahtú." Its people rely upon Sahtú but are also stewards of the lake and the surrounding land. In 1975 Chief Frank T'Seleie said of Dene First Nations:

> "Our Dene nation is like this great river. It has been flowing before any of us can remember. We take our strength and our wisdom and our ways from the flow and direction that has been established for us by ancestors we never know, ancestors of a thousand years ago… We will live out our lives as we must and we will die in peace because we will know that our people and this river will flow on after us."[56]

The Délı̨nę Dene First Nation, one of four Dene communities, currently resides mostly on the west side of Sahtú, by the mouth of the Great Bear River. The name Délı̨nę, which means *where the water flow,*[57] reflects the community's connection to water.

The Délı̨nę did not have fixed property boundaries and they view themselves as caretakers, rather than owners of land or water. Alfred Taneton, an elder, explains how "the water is really important for everything. If the water is gone, we are going to be very poor. We have to really respect it."[58] The Délı̨nę believe in "a powerful force called *Tudze*, the water heart of Sahtú," which is protected by a diverse range of fish species.[59] This water heart is crucial to the health of the lake and the community.

Mineral extraction in the region, which started with the southerners' discovery of oil near Normal Wells in 1919, negatively impacted the Dene. [60] One of these impacts is the dispossession of the Dene's land with the signing of Treaty 11 a year later. As the Sahtú Renewable Resources Board writes,

> "According to the treaty document, Dene and Métis peoples ceded their title to 599,000 square kilometres, stretching northward from the 60th parallel to the Arctic Ocean, and eastward from the Mackenzie Mountains to Great Slave Lake. Oral testimony shows that the Dene people did not understand the Treaty to be extinguishing title to their traditional lands."[61]

56 Sahtú Renewable Resources Board, "The Sahtú," accessed February 23, 2022, https://www.srrb.nt.ca/index.php?option=com_content&view=article&id=210&catid=99.

57 Sahtú Renewable Resources Board, "The Sahtú."

58 TVO, "Tsa Tue Biosphere Reserve."

59 TVO, "Tsa Tue Biosphere Reserve."

60 Sahtú Renewable Resources Board, "The Sahtú."

61 Sahtú Renewable Resources Board, "The Sahtú."

A second detrimental impact was the increased government interest in the Délıne that came with mineral extraction nearby, as children were taken from their homes and placed in residential schools.[62] This threatened the survival of the Délıne's spoken language and their language of the land.

A third large impact of colonialism directly related to the Port Radium Mine was the exploitation of Dene men in the transportation of radioactive ore via barges west across lake Sahtú to Great Bear River. Employers did not inform the Dene men of the health risks associated with their work and did not equip them with adequate protection. By 1998, "14 of the 26 men who carried ore during the mid-1940s [had] died of cancer."[63]

The dumping of tailings into lake Sahtú threatened the health of the lake, which the Délıne relied on for their livelihood. As the Sahtú and Délıne are so interconnected, negative impacts to one greatly impacted the other.

Fig. 4.33 Blue paths show the Délıne's traditional trail network. (Source: Sahtu Renewable Resources Board) (Image removed for UW space upload.)

62 TVO, "Tsa Tue Biosphere Reserve."

63 Barnsley, "'Village of widows."

After the Mine: Advocacy and Remediation

The Dél̨ı̨nę community learned about the dangers of radium and uranium exposure in the 1980s and were concerned about the health of their lake, land, and food.[64] After decades of the community raising their concerns with the federal government, in 1999, the Canada-Dél̨ı̨nę Uranium Table (CDUT) was formed by the two groups to study the human and environmental impacts. The CDUT completed a report with recommendations for remediation in 2005.

In 2008, Crown-Indigenous Relations and Northern Affairs Canada (CIRNC) acknowledged the waste that existed on the site and completed remediation based on physical concerns (for example, openings and buildings), environmental concerns (tailings, water quality, gamma levels), and risks to ecology and humans.[65] Along with removing infrastructure and closing up underground openings, the remediation program capped mine tailings to limit the levels of radiation. The project was 75% employed by local Dél̨ı̨nę community members.[66]

The Great Bear Lake Remediation Project, a part of the Northern Contaminated Sites Program, is still underway to address other abandoned mines near the lake. CIRNC currently claims that in this program,

> "the contamination of these properties is the result of private sector mining and oil and gas activities and government military activity that occurred more than 50 years ago, when environmental impacts were not fully understood."[67]

However, the risks mining waste posed were known, but ignored by the government at the time of operations. This is seen in an investigation by Calgary Herald former environmental reporter Andrew Nikiforuk in 1998, which

> "unearthed formerly secret documents that showed atomic energy officials in Canada and the United States possessed scientific studies which concluded that even tiny amounts of radon, a radioactive gas which is freed during the processing of uranium ore, causes a wide variety of cancers."[68]

The Port Radium mine was owned by a Canadian Crown Corporation, whose focus on the valuable minerals and profits led them to ignore careful waste management both during and after mining operations. Although remediation in the 2000s contained previously exposed waste, the tailings dumped in lake Sahtú remain as they were.

64 Canada-Déline Uranium Table, "Canada-Déline Uranium Table – Final Report," ii.

65 Indian and Northern Affairs Canada, "How has the Port Radium Remediation Project made the site safer for people, animals, and the environment?," Winter 2009, https://publications.gc.ca/collections/collection_2013/aadnc-aandc/R3-88-2008-eng.pdf.

66 Indian and Northern Affairs Canada, "Port Radium Remediation Project."

67 "Northern Contaminated Sites Program," Government of Canada, last modified August 16, 2018, https://www.rcaanc-cirnac.gc.ca/eng/1100100035301/1537371472183.

68 Barnsley, "'Village of widows."

Fig. 4.34 Port Radium remediation. (Source: Crown-Indigenous Relations and Northern Affairs Canada)

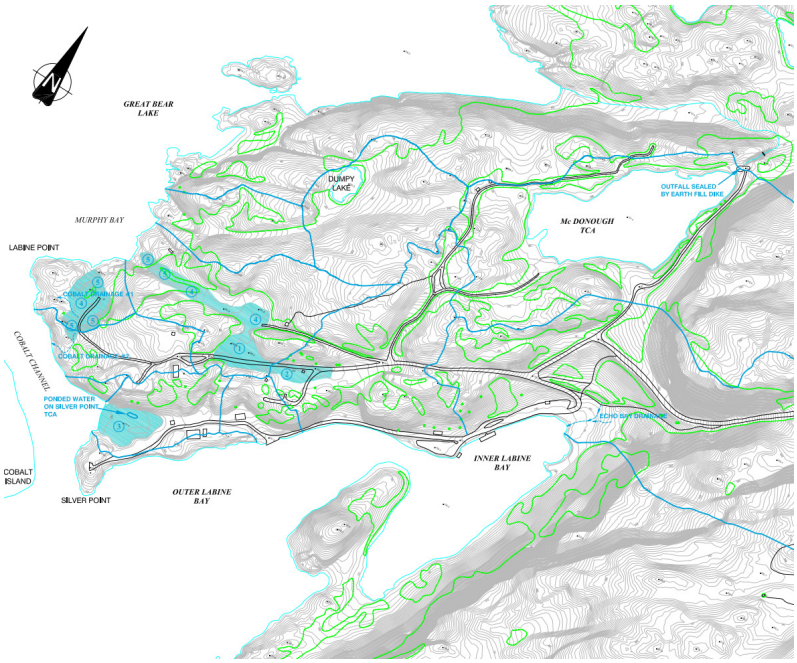


Fig. 4.35 Port Radium Site Assessment. Blue areas show tailings. (Source: Crown-Indigenous Relations and Northern Affairs Canada)

Perpetual Care: Mine Site

Although on-site remediation was considered complete by 2009, the CIRNC continued to monitor the site for three ongoing concerns: radiation, elevated levels of metals in the soil and surface water, and hydrocarbon contaminated soils.[69] Monitoring activities include checking water health (surveying small resident fish species, benthos, and sediments), gamma radiation levels, and inspecting geotechnical caps.[70] In 2017, CIRNC was set to create a new long term monitoring plan was set to be made in 2017 with the Port Radium Working group, which includes members from the local Délı̨nę community.[71] The progress on this working group is unclear, as the project reports have not been updated. Like at Mt. Washington Copper Mine, the government led remediation and care largely focused on technical fixes and inspections, however the monitoring program at Port Radium aims to involve the nearby community and its traditional knowledge.

Perpetual Care: Water Monitoring

Water monitoring programs are a big part of the Délı̨nę's perpetual care of Sahtú, as the lake is the "biggest remaining example on earth of a fully functioning, cold water ecosystem."[72] The Délı̨nę community is working for a water monitoring program led by Fisheries and Oceans Canada since the early 2000s to figure out how their traditional knowledge can best work together with science in the care of the lake. Some elders approve of the scientific monitoring methods, while others argue for more traditional ways to monitor the lake that respect the water and the beings living within it.[73] For example, scientific measurements show shallow water temperatures to be rising in the last few years, but the Délı̨nę say this can also be concluded from observations about a reduced ice season and the need to check fish nets more frequently so they do not spoil.[74] Ultimately, the Fisheries and Oceans Canada group is working closely to learn from the Délı̨nę community and vice versa. Fisheries and Oceans Canada are employing Délı̨nę members in this program.

The Délı̨nę are currently creating their own "Guardians" program – training began in 2018 with the Fisheries and Oceans Canada team. [75]

69 "Port Radium," Government of Canada, last modified October 2, 2017, https://www.rcaanc-cirnac.gc.ca/eng/1445630103716/1618401563211.

70 Government of Canada, "Port Radium."

71 Government of Canada, "Port Radium."

72 TVO, "Tsa Tue Biosphere Reserve."

73 TVO, "Tsa Tue Biosphere Reserve."

74 TVO, "Tsa Tue Biosphere Reserve."

75 TVO, "Tsa Tue Biosphere Reserve."

Fig. 4.36 Great Bear Lake. (Source: Screenshot at -19:26 of "Striking Balance: Tsa Tue Biosphere Reserve", created by Yvonne Drebert and Zach Melnick, 2020. Premiered October 4, 2020.)

Fig. 4.37 Water monitoring. (Source: Screenshot at -4:00 of "Striking Balance: Tsa Tue Biosphere Reserve", created by Yvonne Drebert and Zach Melnick, 2020. Premiered October 4, 2020.)

Community Healing

As Sarah M. Gordon states, healing from the impacts of colonialism is an important part of healing from the extraction industry's impacts.[76] One element of this healing is regaining governance over land and water. For decades, the Dene negotiated with the government to gain back control of their community and the land. In 1993, with the Sahtú Land Claim Agreement, the government returned the title to 41,437 square kilometers; only 1,838 square kilometers of these included rights to subsurface resources.[77]

Although the Délı̨nę did regain self-governance and some land with the 1993 Sahtú Land Claim Agreement, they were not able to regain governance of the water. "They said you can't claim water, lakes," Michael Neyelle, former president of Délı̨nę's renewable resources council, stated. [78]

In 2016, however, the Délı̨nę succeeded by establishing a UNESCO biosphere reserve, which includes the entire lake and most of the surrounding watershed. The biosphere designation has no regulatory power, but it does bring attention to the Délı̨nę's stewardship of the land and water. As Gina Bayha, the co-ordinator of Tsá Tué International Biosphere Reserve says, it also gives the lake a voice.[79] Walter Bezha, the Elders representative Délı̨nę G'otine Government, explains that

> "The first thing they do is respect the environment. How do you put that in a legal system? How do you get people to do that? It's above those laws. It's you, your relationship with the land."[80]

The biosphere reserve designation also helps ensure that there will be funds to support the future health of the lake. Unlike most National Parks, which are void of human settlements, biosphere reserves are "learning places for sustainable development,"[81] which acknowledges that humans are part of the natural ecosystem.

The Délı̨nę community is addressing other cultural impacts of the mine in a variety of ways, one of which is running knowledge and healing camps.[82] These camps bring together multiple generations, as elders share their knowledge of the culture and land with the youth. In an interview with TVO, Camilla Tutcho, an elder, explains how she wants to share her knowledge "because she is grateful to those who taught her these practices, after she returned from residential school."[83] Activities vary from foraging for food to cleaning

76 Gordon, "Narratives Unearthed," 80.

77 Sahtú Renewable Resources Board, "The Sahtú."

78 Julien Gignac, "First Indigenous-led biosphere reserve in the world featured in new Canadian TV series," *The Narwhal,* October 4, 2020, https://thenarwhal.ca/tsa-tue-biosphere-reserve-striking-balance/.

79 "Canada's First UNESCO International Biosphere North of 60," High North News, August 25, 2016, https://www.highnorthnews.com/en/canadas-first-unesco-international-biosphere-north-60.

80 TVO, "Tsa Tue Biosphere Reserve."

81 "Biosphere Reserves," United Nations Educational, Scientific and Cultural Organization, accessed February 23, 2022, https://en.unesco.org/node/314143.

82 TVO, "Tsa Tue Biosphere Reserve."

83 TVO, "Tsa Tue Biosphere Reserve."

Fig. 4.38 The current protection and care of lake Sahtú. This drawing overlays the watershed, land claim area, and the Tsá Tué International Biosphere Reserve's boundary. It also shows the Délıné's surface and subsurface rights, which represent only a fraction of the land claim area, watershed, and biosphere. Figure 4.37 illustrates self-governance and care practices as opposed to exploitative, extractive processes in Figure 4.29. Drawing by author.

fish, but the main goal is to share the love for Sahtú, so that the younger generation will gain respect for the land and water and wish to care for it as their elders have for thousands of years. These healing camps are organized by the new local government and supported by Parks Canada, as it is in their interest for the community to gain knowledge about caring for the land and water.[84]

Strengthening the Délıné's language is another important aspect of their self-governing structure. All that was lost with residential schools has not been regained and there are some language barriers between generations, but "there's a feeling that the land and the language are so intertwined [in the Délıné community], that youth cannot truly understand Sahtú without it."[85]

In the Sahtú Land Use Plan, the Délıné outline The Sahtú Vision, a future of the post-extraction landscape that addresses all the elements of mining overburden – the ecological, cultural, and political:

> "The ecological integrity of the region is maintained… The region has cultural integrity…Communities have sufficient authority, capacity, and involvement in managing and monitoring land use to work in true partnership with land and resource managers, co-management Boards, and regulators."[86]

The monitoring and care structures in place are about self-determination, listening to the land and water, and planning for a sustainable future. The Délıné say that the key to protecting the lake is understanding that they are part of the environment, like their grandparents did.[87]

They demonstrate how the community, ecosystem, and perpetual care are all intertwined. The Délıné have been caring for Sahtú for thousands of years, and therefore demonstrate a structure which could successfully continue caring for Sahtú in perpetuity.

84 TVO, "Tsa Tue Biosphere Reserve."

85 TVO, "Tsa Tue Biosphere Reserve."

86 Sahtu Land Use Planning Board, "Sahtu Land Use Plan," April 29, 2013, https://sahtulanduseplan.org/sites/default/files/sahtu_land_use_plan_april_29_2013.pdf.

87 TVO, "Tsa Tue Biosphere Reserve."

Fig. 4.39 The community arrives at the healing camp. (Source: Screenshot at -33:21 of "Striking Balance: Tsa Tue Biosphere Reserve", created by Yvonne Drebert and Zach Melnick, 2020. Premiered October 4, 2020.)

Fig. 4.40 A Deline elder teaches youth how to harvest medicine from the land. (Source: Screenshot at -30:58 of "Striking Balance: Tsa Tue Biosphere Reserve", created by Yvonne Drebert and Zach Melnick, 2020. Premiered October 4, 2020.)

Fig. 4.41 Extraction process up close. This drawing shows a barge transporting ore across Great Bear Lake. The ore is highlighted while the barge and its workers are muted. The lake is also dark, as its value as a healthy freshwater resource was ignored. Toxic mine tailings were dumped in various unknown locations across the lake. The Port Radium facilities can be seen glowing in the back. Drawing by author.

Fig. 4.42 Care practices up close. This drawing illustrates the Délınę's view of the lake as something to protect and care for. The Délınę speak of a water heart, which just like the tailings is in a generally unknown location. The water heart, protected by fish, is necessary for the health of the ecosystem. The drawing also illustrates water monitoring practices and healing camps, both aspects of the remediation and care from mining impacts.Drawing by author.

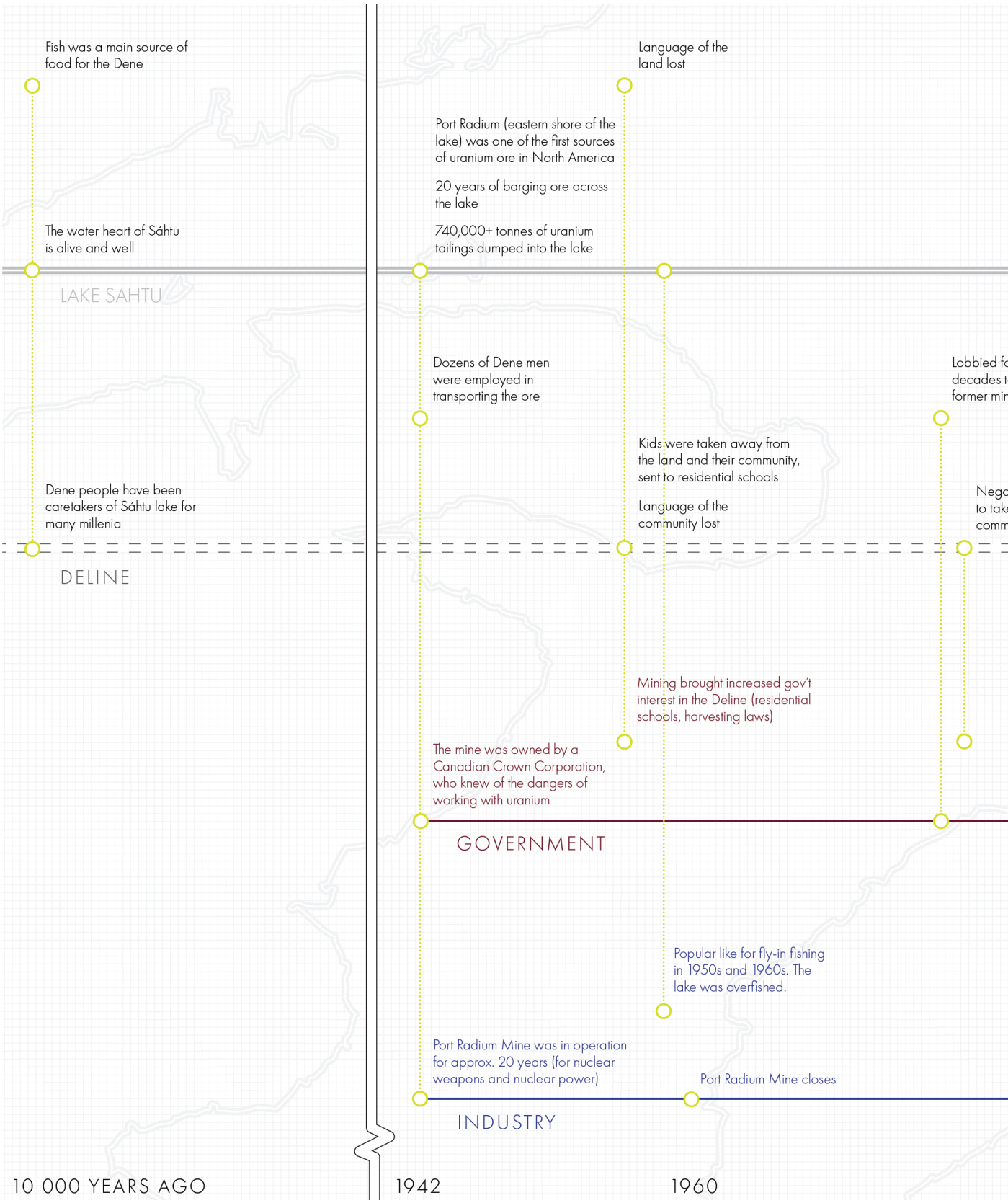
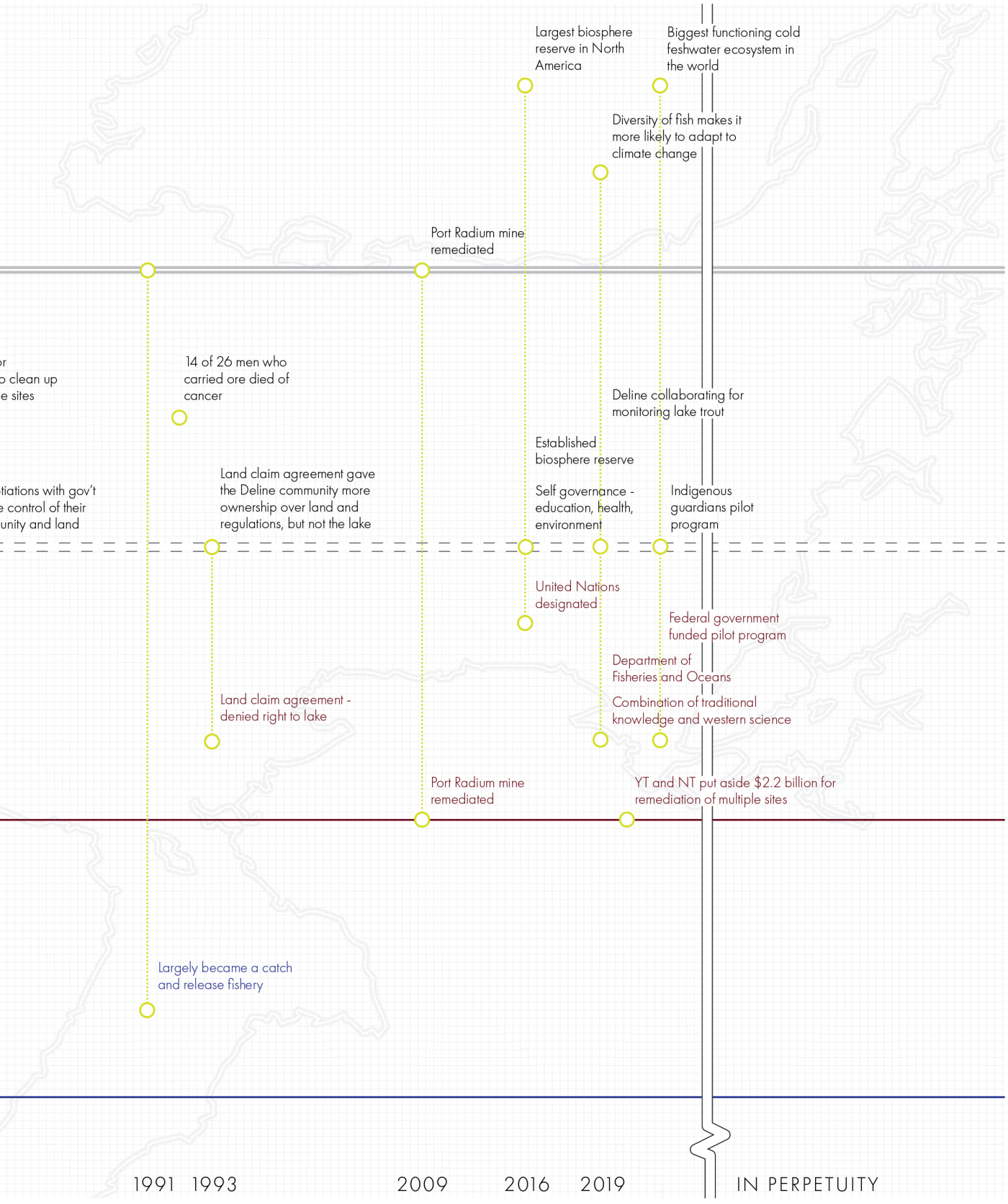


Fig. 4.43 Timeline of key events. Drawing by author.


Largest biosphere reserve in North America
Biggest functioning cold freshwater ecosystem in the world
Diversity of fish makes it more likely to adapt to climate change
Port Radium mine remediated
or
o clean up
e sites
14 of 26 men who carried ore died of cancer
Deline collaborating for monitoring lake trout
Established biosphere reserve
tiations with gov't
e control of their
unity and land
Land claim agreement gave the Deline community more ownership over land and regulations, but not the lake
Self governance - education, health, environment
Indigenous guardians pilot program
United Nations designated
Federal government funded pilot program
Department of Fisheries and Oceans
Land claim agreement - denied right to lake
Combination of traditional knowledge and western science
Port Radium mine remediated
YT and NT put aside $2.2 billion for remediation of multiple sites
Largely became a catch and release fishery
1991
1993
2009
2016
2019
IN PERPETUITY

5 Reflection

Reflecting, not Concluding

Reflecting on my research, I have more questions than answers. As I gained a better understanding of post-extraction landscapes, I increasingly realized how much I have yet to know. The issues discussed in this thesis are complicated and remain unresolved.

Still, the following pages outline what I've learned from connecting the four parts of this thesis. I've included my key takeaways as an architect and designer, and I've noted a few of my outstanding questions.

Comparing Remediation and Care Approaches

The case studies explored in Part 4 stood out to me because they demonstrate remediation and care practices based in attachment to and love for local landscapes. Although these community practices are now supported and funded by the government and/or industry, they only exist because of years of volunteer organizing and advocacy. The communities had great concern for the health of their water, food, and people, and therefore pressured the government to act on the cleanup of these sites. In both cases, the community should not have had to take on this responsibility, but the pressure is what led to the remediation and monitoring practices that exist.

After decades of work, the communities have now established funding to support their practices. But these perpetual care structures are also sustainable because of the communities' long history of stewardship and respect for land and water. It is therefore hard to compare this community level of care to that of an inspector paid to visit a site just once a year. But we can ask: How can lessons from these models of perpetual care be applied to more institutionalized systems? How can successful perpetual care be established in areas without a longstanding community? These case studies showed me that in cases where a local community exists, they and their knowledge are important in designing successful remediation and perpetual care initiatives.

Government policy plays an important role in industry practices, both in relation to the care of existing post-extraction sites and future ones. As learned in Part 1, current mine closure planning largely focuses on short-term, technical fixes and does not remediate all negative impacts. This is in part due to a lack of robust regulations, but it is also due to a lack of enforcement. How can the government implement stricter regulations and enforcement when it is so closely tied to the Mining Lobby? As Canada continues to produce new extraction sites, it must take greater action to remediate and care for the thousands of abandoned mines that already exist.

It needs to reframe its relationship to land, what it calls natural resources, and the extraction industry. Canada needs to prioritize the health of communities and ecosystems.

The literature in Part 3 offers ways to reframe this relationship to land and communities, from a culture of extraction to one of care. The discussed theory amplifies neglected and overlooked ways of thinking. After collecting these different perspectives on extraction and perpetual care practices, I was able to identify three common themes that are overlooked aspects of post-extraction landscapes and should be addressed for successful design, remediation, and perpetual care:

(1) *Perpetuity*: As mining relies on the natural formation of minerals that occur over deep time, those extracting must take responsibility for these damaged landscapes in perpetuity. The mining industry's short-term approach must be updated to focus on necessary long-term planning and care practices.

(2) *Communities*: Historically, the extraction industry has not only negatively impacted the environment but also nearby communities. Remediation and care must address the colonial history of mining, support community healing, and rebuild broken trust and relationships.

(3) *Ecosystems*: As toxic waste can flow beyond property boundaries, remediation and care of landscapes must include larger watersheds and ecosystems.

These themes helped me analyze projects and identify successful practices. They also helped me think critically about who/what each example of remediation and care is for, and who/what they exclude.

My research on architect and designer involvement in mine reclamation (Part 2) started with the question: What agency do/can designers have in the repair of these damaged landscapes? Reflecting on this research, I do not think that formal design is necessary for successful remediation and care. I do, however, think that design's greatest strength in mine reclamation could be to create additional value to a site, and with it bring attention and support for greater care.

After reviewing several existing projects, I have a few takeaways for architects and others participating in the design of post-extraction sites. First, designers must view themselves as one player in an interdisciplinary team, rather than the central visionary. They must be humble and focused on the local community's perspective of its landscape. D.I.R.T.'s Studio's *AMD & ART*

Reclamation Park is a good example of this, as the design was created with impacted communities and considered the broader watershed. Second, designers must think critically about who/what their work is serving and who/what it is excluding. In Part 2, I found that designers were often hired to improve *aesthetics* of a post-extraction site. Designers must ask: What aesthetics are valued? What is motivating the desired aesthetics? Many of the landscape architects discussed in Part 2 were hired by mining companies. These companies asked designers to subdue the sites' exploitative past by making them more beautiful.

In some instances, monuments (such as sculpted earthworks) may be considered a corporate cover-up, but monuments can also be long-term symbols of meaning in post-extraction landscapes. As the case studies in Part 4 show us, intergenerational memory of a landscape is an important part of its perpetual care. Monuments have the potential to physically hold and convey this memory. Sculpting overburden or mining waste can be a way to return land once again to the sacred. But meaning and monuments can also be found in more subtle forms, such as a healthy, restored watershed. Both types of monuments have the potential to bring communities together, as well as honour land and water. Each place requires a unique and appropriate way of keeping the long narrative and memory of a landscape alive. Designers can play a role in the development of this storytelling. They have the tools to help translate memory into physical forms that can communicate meaning to future generations.

Drawing Extraction and Care

Designers can also play a role in post-extraction site design, remediation, and care by drawing. Speculative mappings, for example, can critically engage viewers and expand their understanding of complex historical, geographical, and social contexts of post-extraction sites. Drawings can convey the power of destructive practices and illustrate overlooked elements of communities and ecosystems.

Throughout the thesis, I created drawings which all have a common thread. They all illustrate contrasting perspectives on mining and post-extraction landscapes. For example, in Part 1, I counter Natural Resources Canada's *critical minerals* poster with one that illustrates Ontario's *critical peatlands.* In the *Communities* section of Part 3, I contrast the mining industry and Jennifer Wenzel's definitions of overburden. In *Ecosystems,* I contrast Canada's national and provincial borders with watershed drainage basins. By pairing drawings, side by side, I hope to reveal these differences.

I continued to develop this drawing methodology in creating the sets of posters found in Part 4. The development of my drawing methodology furthered my own thinking about these sites. When layering evidence of how land is described in the *extractive* drawing, I was forced to find corresponding evidence for the *care* drawing. For example, in the Vancouver Island scale drawings for the Tsolum River case study, the land grant boundaries defined by straight lines led me to drawing traditional territory boundaries defined by watersheds.

These drawings were also a tool for me to visually explore the three themes of *perpetuity*, *communities*, and *ecosystems*. First, the posters draw the landscapes at various times, looking back at the thousands of years Indigenous communities have cared for their land and water, the short duration of mine operations, and current long-term monitoring practices. Second, they draw nearby communities, looking at the negative impacts of extraction on them and their established remediation and care practices. Third, they illustrate various scales, connecting large scale decisions (such as a land grant) with smaller sites (such as a mine lease).

Reflecting on the current state of my drawings, I acknowledge that there are ways in which they could be further developed. As much as my methodology made me contemplate what I did and did not include in the drawings, I was limited by a few aspects. First, without a personal relationship to these sites or communities, I remain to some extent distant from these landscapes. Community participatory mapping would strengthen the drawings and illustrate a more holistic picture of these ecosystems. Also, although I did layer images and graphs onto the drawings, basing them in cartography limited the contrast in perspectives I was trying to convey. Mixing cartographic elements with other drawing devices could be further experimented with.

My current drawings can play a role in general education and awareness raising, but I think that drawings such as these could be developed to help specific communities advocate for the remediation and care of existing abandoned mines, as well as defend their land from future extraction processes.

Designer Takeaways: Perpetuity, Communities, and Ecosystems

I've just reflected on two ways architects and other design professions do and can play a role in post-extraction sites. The first is the agency we can have in the design, remediation, and perpetual care of post-extraction sites. The second is our ability to use drawings to convey a fuller understanding of these sites, as well as support local communities and ecosystems. This can include

drawing elements and relationships often invisible, revealing injustices, and amplifying overlooked ideas. I will now reflect on a third role, from which this research first stemmed.

I originally chose to study extraction sites, because as an aspiring architect, I struggle with understanding how I can design sustainably and ethically. All materials have some cost and their extraction sites and supply chains are not easily understood. While data on carbon emissions associated with materials is becoming more readily available, it is still difficult to understand other ecological and social implications of specifying a material. Living in a city, disconnected from these material extraction sites, I started my graduate studies with the goal to increase my understanding of some or even one of these connections. As I dove into the broad topic of mine sites, I was struck by the contrast between the short duration of mining operations and the perpetuity of toxic waste produced. This led me to further explore the remediation and care of post-extraction landscapes.

Reflecting back on this original intention, I do not feel more sure about specifying materials. But in addition to learning about ways designers can play a role in post-extraction sites, I have gathered some directives in this research that I can transfer to my general approach on architectural design. Although I chose the three themes of *perpetuity*, *communities*, and *ecosystems* for the study of extraction sites, these themes should be important to designers more generally.

(1) *Perpetuity*: Designers need to contemplate the deep time history and implications of their designs. Looking at the past, we need to understand both natural and manufactured systems that create materials we design with. Looking to the future, we need to consider the lifetimes of our designs and what happens after. We also need to design with maintenance and care structures of buildings in mind.

(2) *Communities:* Designers need to understand the values of the community they are designing for and think of themselves as a team player, not a solitary visionary. We need to reflect on who our designs include and exclude, as well as who they give power to.

(3) *Ecosystems:* Designers need to look beyond a site's boundaries to understand a design's impacts on the local neighborhood and extraction, transportation, and processing sites much further away.

By addressing these aspects in practice, we can design projects that care for both communities and natural ecosystems globally.

Going Forward

As the global transition to renewable energy paradoxically requires an unprecedented increase in mining, there is no simple solution to the problem of extraction. I align myself with MiningWatch Canada's directives discussed in Part 1 that argue for reduced consumption of minerals and only allowing mining developments that have both gained community support and have a robust plan for the protection, remediation, and care of the site and its surrounding landscape. As *critical* as these minerals may be, communities and landscapes they are harming are also *critical*.

We need to work towards repair and care at the planetary scale. To me, this seems most feasible through the growth and accumulation of local advocacy, remediation, and care practices. Studying existing designer projects and community care case studies can help us develop successful strategies to implement at sites elsewhere.

As designers, we can work towards planetary care by ensuring that our projects help ecosystems, rather than hinder them. Our designs must not be extractive. We must design with care.

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