There is a Monster Under the Ground: Commemorating the History of Arsenic Contamination at Giant Mine as a Warning to Future Generations

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John Sandlos

Arn Keeling

Caitlynn Beckett

Rosanna Nicol

Network in Canadian History and Environment
Department of History
York University
2140 Vari Hall, 4700 Keele Street
Toronto, Ontario, M3J 1P3

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The great industrial acceleration of the late nineteenth and twentieth centuries can be remembered for many things, not least the technological developments that have changed almost every aspect of the way humans work, communicate with each other, and interact with the natural world.[1] As Claire Campbell has argued, historical sites in Canada (and one might add historical sites and museums in many other parts of the world) have generally adopted commemorative strategies that celebrate resource development, technological advancement, and the extension of modern national boundaries.[2] Often ignored are the environmental and colonial legacies of these processes and events. To take just one prominent example, Canadian and U.S. approaches to commemorate the Klondike Gold Rush (at sites in Skagway, on the Chilkoot Trail, and in Dawson) have adopted an overwhelmingly celebratory narrative of plucky and determined miners bringing civilization to remote corners of the Yukon and Alaska. Commemorative material at the sites (plaques, information panels, pamphlets) have generally ignored the economic and cultural challenges mining introduced to the Tr'ondëk Hwëch'in who live near Dawson, or the environmental impacts of river dredging, hydraulic mining, woodcutting (to melt permafrost), and overhunting that are visible on the landscape today.[3] Campbell's work highlights how, as in the Klondike,

most historical sites tend to avoid the colonial aspects of expansionist narratives and the environmental effects of human "progress" on the environment.

There is no shortage of contaminated sites across the globe, each presenting unique environmental challenges in the present day. In Canada, the Federal Contaminated Sites Inventory lists 5058 active contaminated sites across the country, 608 of these designated as "high priority" for remediation. In the territorial north, the Northern Contaminated Sites Program identified 79 contaminated sites (47 of them high priority) in 2010, many inherited by the Canadian government as abandoned mines after the low mineral prices of the 1990s produced a wave of bankruptcies in the industry.[4] On a global scale, thousands of abandoned industrial sites have left a legacy of chemical and radiological contamination that forces us to confront tough environmental and historical questions. Whether it is abandoned mines, nuclear waste repositories, chemical waste dumps, or other contaminated sites, any honest commemorative strategy would force visitors to confront the environmental costs and consequences of industrial development. Some historic industrial sites do incorporate narratives of environmental cleanup into a broader story of industrial expansion[5] but often (and ironically) environmental cleanup at abandoned sites erase the industrial heritage of waste that might force visitors to confront the toxic legacies of the past. While few would dispute the need to remediate sites that are dangerously toxic or unsafe, historian Fred Quivik has argued that the preservation of industrial waste can serve a valuable purpose at abandoned mines. According to Quivik, "The contested terrain of industrial waste has characterized human life ever since people learned to manipulate environments in large-scale ways. Keeping that contested terrain before the public's eyes in appropriate locations and with appropriate interpretation can help citizens appreciate the importance of

properly regulating, managing, and remediating industrial wastes."[6] Similarly, anthropologist Sebastien Ureta invites us to consider the heritage qualities of the microscopic, "chemical rubble" of mine tailings, "for which we have to take responsibility just as much as we have for more conventional ruins."[7] For the most part, however, historical contaminated sites remain hidden, ignored because they do not fit the narrative arc of industrial progress and because few are likely to attract visitors.

As a result, very little thought has been applied to the question of how contaminated sites might be marked and commemorated, even from the *practical perspective of warning current and future generations about the inherent dangers at these sites*. Indeed, toxic waste sites have been forgotten (with dire consequences) within a few short decades at places such as the Spring Valley (near Washington, DC), where suburban housing was built on top of a World War Two–era chemical dump discovered in 1993; at Carson, CA, where houses were built on top of a contaminated soil associated with a former Shell oil storage site; and most infamously Love Canal, NY, where local activists discovered in the 1970s that their houses (built in the 1950s) sat on top of toxic waste that Hooker Chemical had buried in the 1940s. While environmentalists may find it no surprise that industry and government are not keen to fund commemorative laments of the age of contamination, it is startling that so little thought, creativity, and funding has been directed toward more concrete strategies, at least to provide basic warnings to people of the long-term dangers of these sites.

The abandoned Giant Mine near Yellowknife, Northwest Territories, presents a particularly vexing case study of the commemorative and communication challenges associated with toxic waste. As the result of historic gold mining from 1948 to 2004, surface and underground environments are contaminated with arsenic trioxide and other wastes. Most alarming is the 237,000 tonnes of arsenic trioxide waste held in

twelve underground mining stopes and purpose-built chambers within the abandoned mining works. The federal and territorial governments plan to freeze this material underground using passive heat exchange technology, an interim measure (of up to a century), until new technology can be developed to safely remove the arsenic. However, until the development of new technology is assured, the freeze-in-place strategy raises the possibility that large amounts of toxic material will remain at the site for long periods of time—possibly forever. Questions of how to commemorate and perpetually care for this permanently toxic site emerged forcefully during the recent controversial environmental assessment of the Giant Mine Remediation Project, with the Mackenzie Valley Review Board concluding in its decision that "without a plan to communicate important aspects of the Project to people in the distant future, they will likely lack the information that is a necessary to enable them to manage the Project properly."[8]

As part of our work on the Toxic Legacies Project, a SSHRC-funded community research partnership with Yellowknives Dene First Nation (YKDFN) and the environmental and social justice group Alternatives North, the authors have worked to conduct research and co-produce community responses to remediation strategies at Giant Mine. In this paper we focus on strategies for communicating toxic hazards to future generations. What follows is discussion of our work in Yellowknife, beginning with a review of the extensive work facilitated by the U.S. Department of Energy on communicating nuclear waste hazards to future generations at a nuclear waste repository in New Mexico. We then show how we applied and extended these approaches through community-engaged research in Yellowknife, including the reflections of a local Communicating with Future Generations (CFG) working group and the

results of collaborative workshops with Yellowknives Dene Elders and youth in local schools.

In keeping with Quivik's analysis, participants did (often creatively) confront the practical issue of communicating the arsenic hazard to future generations, but also insisted that commemorative strategies at the Giant Mine site must acknowledge historic arsenic contamination, particularly the environmental injustices mine pollution inflicted on the Yellowknives Dene. Time and again we heard that commemorative monuments at Giant Mine should not only serve as warning for the multiple dangers at the site, but also be accountable to a history of sickness, displacement, and death associated with arsenic contamination in the local landscape. If the remediation project is to offer an opportunity for reconciliation, YKDFN community leaders argue that it should include compensation for environmental and health damages due to arsenic contamination, and a prominent role for the YKDFN in the long-term care and communication strategies at the site. In keeping with such sentiments, our work suggests that community engagement in the conceptualization and design of commemorative plans offers important opportunities to address the historical injustices associated with contaminated sites, and to develop locally driven and culturally appropriate strategies to communicate toxic hazards across generations.

Learning from the Waste Isolation Pilot Project

ONE OF THE SIGNAL CHALLENGES of managing toxic chemical or radiological hazards is the fact that these materials are not easily rendered safe and may remain toxic for centuries, even millennia. Radioactive and chemical pollution thus presents not only a problem of current and near-term management, but demands containment and communication strategies over extremely long time scales.[9] Perhaps the most

comprehensive and well-documented effort to address these challenges is associated with the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico, the first permanent underground nuclear waste repository to be constructed in the United States. From 1982 to 2004, the U.S. Department of Energy drew on the expertise of futurists, linguists, semioticians, scientists, and specialists in material properties to devise a communication strategy to warn future generations of the dangers at WIPP for the almost unimaginably long period of 10,000 years (the period over which the radioactive waste would remain dangerous). The task was formidable: from the very beginning those who worked on the project acknowledged the difficulty of designing messages directed at a deep future (10,000 years constitutes a staggering 3,000 human generations) that possibly will have endured war, changing political boundaries, shifting ideological commitments, and the inevitable evolution of culture, language, and technology.

The earliest official government reports on the issue of communicating nuclear hazards to future generations were not specific to WIPP, but drew upon historical experience and sometimes fantastical imaginings of the future to address the general challenge of sending messages to the deep future at any potential nuclear waste repository. In 1982 archaeologist Maureen F. Kaplan produced a lengthy report highlighting monuments from the deep past, analyzing them for their durability (the Pyramids, the Great Wall, and Stonehenge doing well on this front; the Acropolis highlighted for its accelerating state of decay). Kaplan noted that people in the present maintained a much better understanding of the messaging behind monuments built by highly literate cultures (and here the Acropolis was effective; Stonehenge and the Serpent Mounds of Ohio less so).[10]

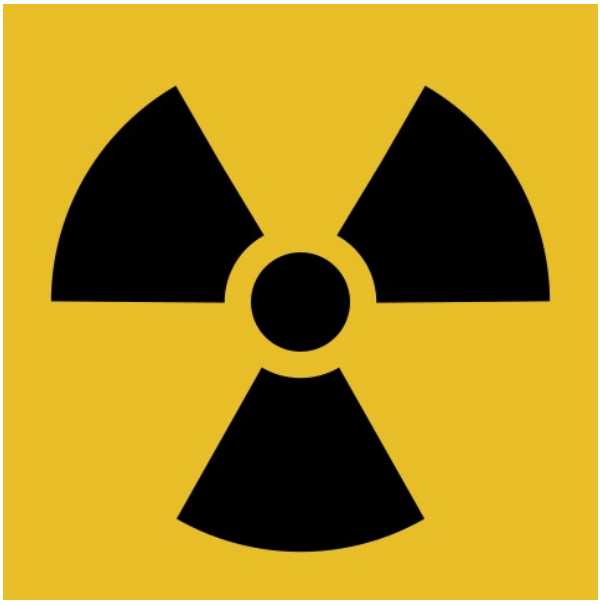


Figure 1: Trefoil radiation symbol, developed in 1948. Source: Wikimedia Commons.

Subsequent WIPP reports examined the effectiveness of the so-called universal symbols such as the trefoil (Figure 1) for communicating messages over deep time, or the potential for existing institutions (the U.S. Geological Survey, offsite archives) to preserve information about the location, hazards, and technical details of nuclear waste repositories. In one particularly imaginative report, Indiana University linguist Thomas Sebeok emphasized that messaging systems to the distant future ought to communicate through a variety of means (linguistic, symbolic, iconic) and should include high degrees of redundancy (so if one element is lost or misunderstood, the overall message will still be clear). To ensure that warning messages maintain integrity as languages and cultures change, Sebeok envisioned "relay systems" that would instruct the audience to translate text or modify symbolic messages every three generations so they remained comprehensible over time. Perhaps somewhat whimsically, Sebeok noted the long-term continuity of various religious institutions and suggested the creation of a "nuclear priesthood" who would conduct

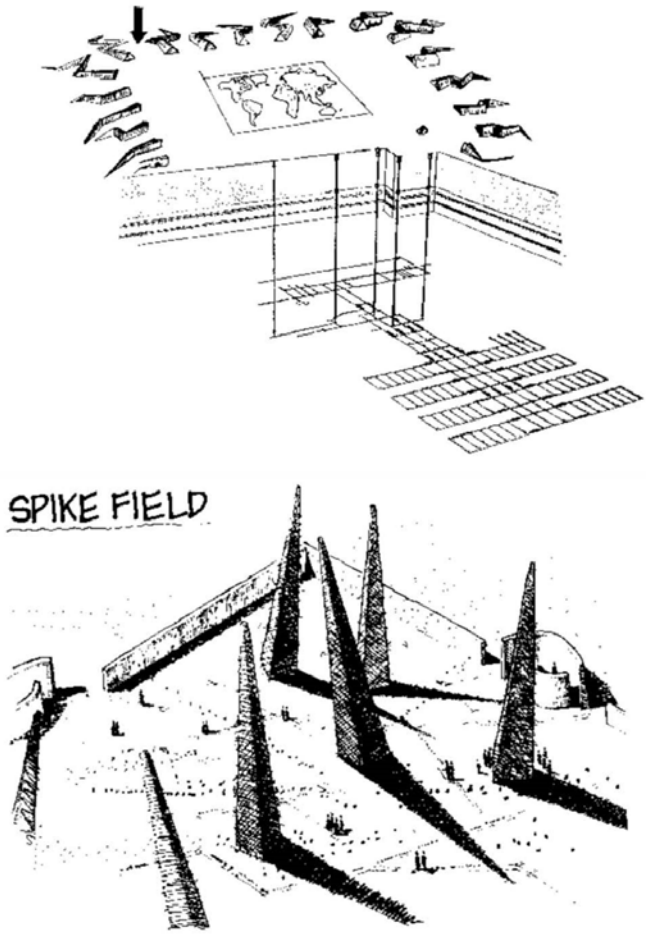


Figure 2: Early conceptual drawing of a spiky field at the Waste Isolation Pilot Plant. Source: U.S. Department of Energy. Used by permission.

regular rituals at the WIPP and ensure the symbolic integrity of the messaging system.[11]

These early discussions culminated in the comprehensive report of the Human Interference Task Force. This expert panel proposed using multiple levels of messaging for nuclear waste repositories, ranging from warning symbols (the trefoil, the biohazard symbol) to simple text in multiple languages, to more complex technical messages (and possibly full archival information) about the purpose of the repository. The task force imagined a grand-scale statement involving huge earthworks surrounding the site, a central monument, and peripheral markers carrying symbolic and textual messages with varying levels of complexity (Figure 2).[12]

By the early 1990s, research at WIPP turned to the question of identifying a precise strategy for communicating with future generations. The Department of Energy contracted Sandia National Laboratories (a corporation with private and government connections and a long history of research on nuclear weapons and related issues), which in turn convened four expert judgment teams to assess the probability of intrusion at the site and to address the more challenging question of what kind of future society might inhabit the region surrounding the WIPP. While there was some variation among the panels, most agreed that societies that had experienced a dramatic loss of technology (to the point where they would not have the capacity to dig underground) presented little threat, as did the opposite scenario of a society with a great deal of technological capacity, in which case some knowledge of atomic physics is likely to be retained. It was the middle scenario—a society retaining roughly nineteenth-century levels of technological capacity—that presented the greatest risk, raising the possibility of exploratory drilling, the use of underground explosives, or other types of inadvertent intrusion through resource development.[13] One report concluded, somewhat alarmingly, that "it is thinkable that a 120th

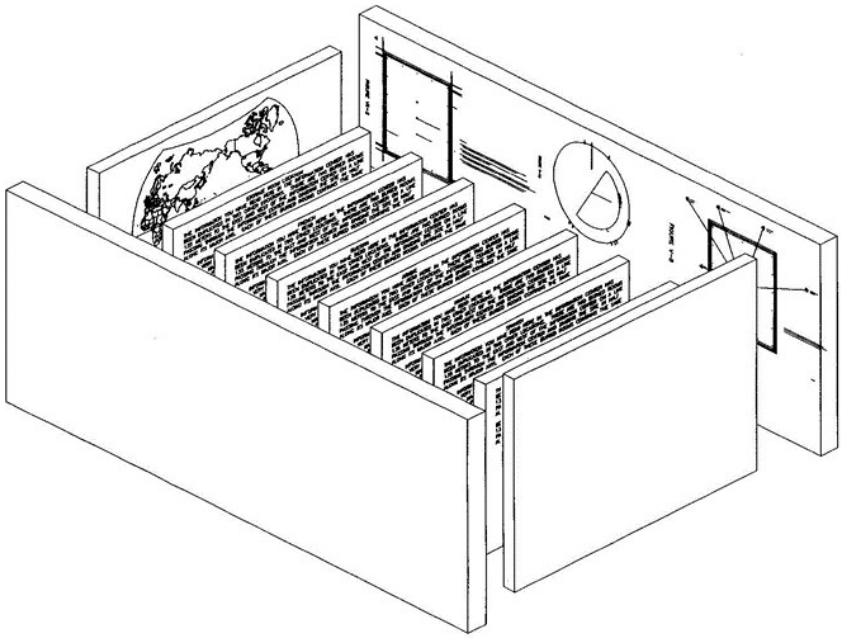


Figure 3: Design for the information centre to be located on the surface ground at WIPP. Source: U.S. Department of Energy. Used by permission.

Century rig would be able to excavate the entire WIPP site in, say, a day or in any case well before its operating crew was able to comprehend what it had done."[14] The future scenarios panellists conceived of the WIPP site as a potential Pandora's Box, a wellspring of danger for any society that had the technology and the will (or perhaps the ignorance) to open it.

Mitigating the risk of intrusion at WIPP, then, was not as simple as placing surveillance on the site or erecting physical barriers around it. The four teams emphasized that "active controls" at the site—fences, armed guards, walls—were likely to break down within the first two centuries of the WIPP's existence. While some of this abandonment of the site could be attributed to the loss of inter-institutional memory, the future panellists concluded that the U.S. government was unlikely to maintain control over the WIPP facility over such a long period.[15] So-called passive controls—the signs, symbols, monuments, and textual messages first imagined in the

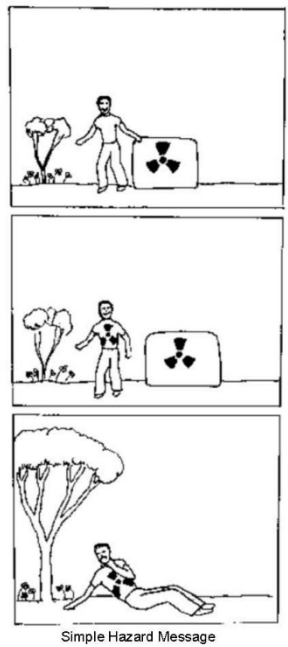


Figure 4: Early concept drawing warning of danger at the WIPP. Source: U.S. Department of Energy. Used by permission.

1980s—presented the only hope for deterring human intrusion at the site over the longer term. In 1993 two new expert panels produced a massive report outlining conceptual designs for a messaging system at WIPP, a sprawling collection of ideas for symbolic markers and textual messages that includes spiky fields, mini-comics evoking death from radiation, a trefoil symbol etched into the landscape, a star map showing the WIPP material becoming safe in 10,000 years, and a welcome kiosk and information centre at the site (Figures 4 and 5).[16]

As the issue of nuclear waste storage began to garner attention in the public sphere, task force members and other scholars extended their thinking about communicating with future generations through the publication of academic articles or popular writing. Among many remarkable ideas, physicist and science fiction author Gregory Benford imagined a configuration of monoliths that might channel wind so as to

create a low, moaning lament as an aural warning.[17] Stephen Hora and Detlof von Winterfeldt envisioned a WIPP museum attracting hordes of tourists and a popular character Mickey Nuke (presumably of the cartoon variety) who would keep the memory of WIPP alive over multiple generations.[18] Among many proposals in a special issue of the journal *Zeitschrift für Semiotik* devoted to communicating with future generations, Philipp Sonntag suggested an artificial moon as a warning sign along with a data repository in a cellar.[19] In the same issue, Françoise Bastide and Paolo Fabbri's proposed the genetic engineering of "ray cats" who would change colour if exposed to radiation,[20] an idea that generated a cultish following, spawning a cottage industry of cultural products such as the "earworm" song "Don't Change Color, Kitty" by EmperorX, and an entire art and design project devoted to the creation of ray cat iconography (complete with T-shirts for sale and a short film).

If thinkers and pundits at times applied an overtly whimsical creative energy to the task of communicating hazard to future generations, the fantastical nature of the problem they faced—sending comprehensible messages to people 10,000 years in the future—almost demanded these unusual responses.

Of course, the inherently provisional nature of a communications initiative reaching so far into the unknowable future also attracted a fair share of critical responses. One early skeptic, W. B. Mann, suggested that future civilizations were extremely unlikely to lose the knowledge and capacity to manage nuclear waste. Regardless, Mann argued that the amount of nuclear waste at WIPP and other proposed sites remained small, compared to the widespread long-term hazards associated with chemical wastes (a salient point we will return to below).[21] Many critics have questioned or satirized what they see as the "nutty" or "kooky" aspects of the WIPP communication strategy, while others (including some members

Figure 5: Early concept drawing for WIPP combining images and text. Source: U.S. Department of Energy. Used by permission.

of the WIPP teams) have questioned whether it would be better simply to bury and forget the nuclear waste, given that the monuments may do more to attract interest in the site than repel people.[22] At least one critic, Andrew Moisey, has questioned whether the low risk of deaths due to human intrusion at WIPP had been weighed against the cost of building monuments and other passive institutional controls. Moisey suggests that scientists and managers at the Onkalo nuclear waste repository in Finland, as documented in the film *Into Eternity,* display a far more realistic attitude than their American counterparts when they advocate simply burying and hiding the underground storage chambers as the best way to meet their obligation to future generations.[23]

In an episode titled, "Ten Thousand Years," the podcast *99% Invisible* queried a fundamental design problem with WIPP: the shifting meaning of symbols and icons over time (i.e., what might communicate danger today could seem attractive to people in the future, a problem the WIPP panellists acknowledged but did not fully resolve). A recent film, *Containment,* by Peter Galison and Rob Moss does emphasize the radical hopefulness of any effort to mitigate our impact on future generations, but also questions the fundamental ability of WIPP to contain radiation, as it documents a highly publicized and controversial 2014 leak that closed the site for over two years. How can the public maintain confidence in a plan to protect people 10,000 years from now when it is not clear that the WIPP facility represents an impermeable barrier to danger in the present?[24]

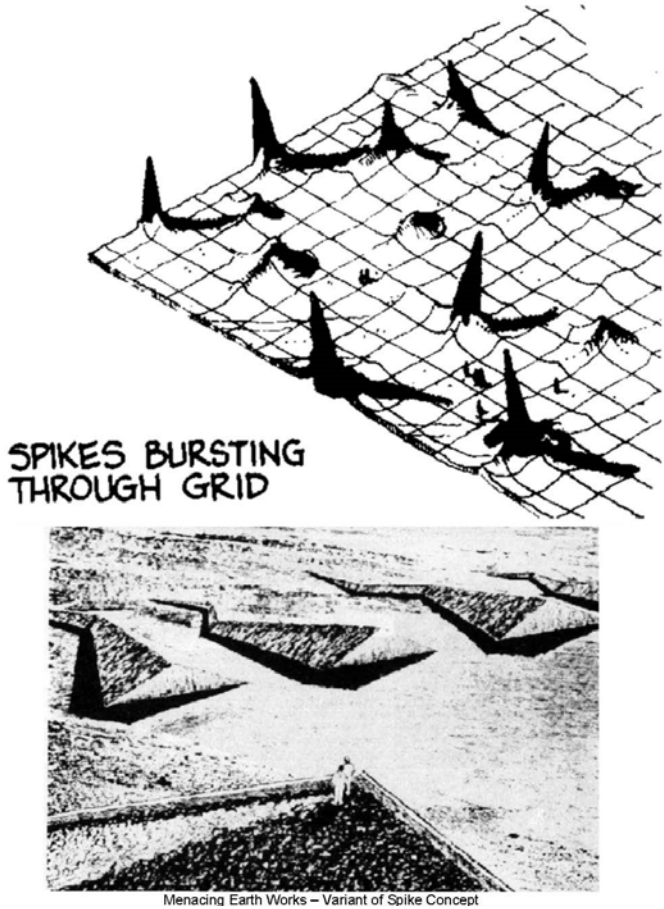


Figure 6: An early concept variation (on the spiky field) termed "the menacing earthworks," WIPP. Source: U.S. Department of Energy. Used by permission.

Perhaps acknowledging at least some of these criticisms, the final site design for WIPP represented a victory of functionality over some of the more creative ideas produced in the 1980s and 1990s. In 2004 the Department of Energy (DOE) produced a permanent markers implementation plan that called for thirty-two markers, each comprising two stone monoliths with a variety of messages (images, simple text, and complex text) to be placed around the perimeter of the so-called controlled

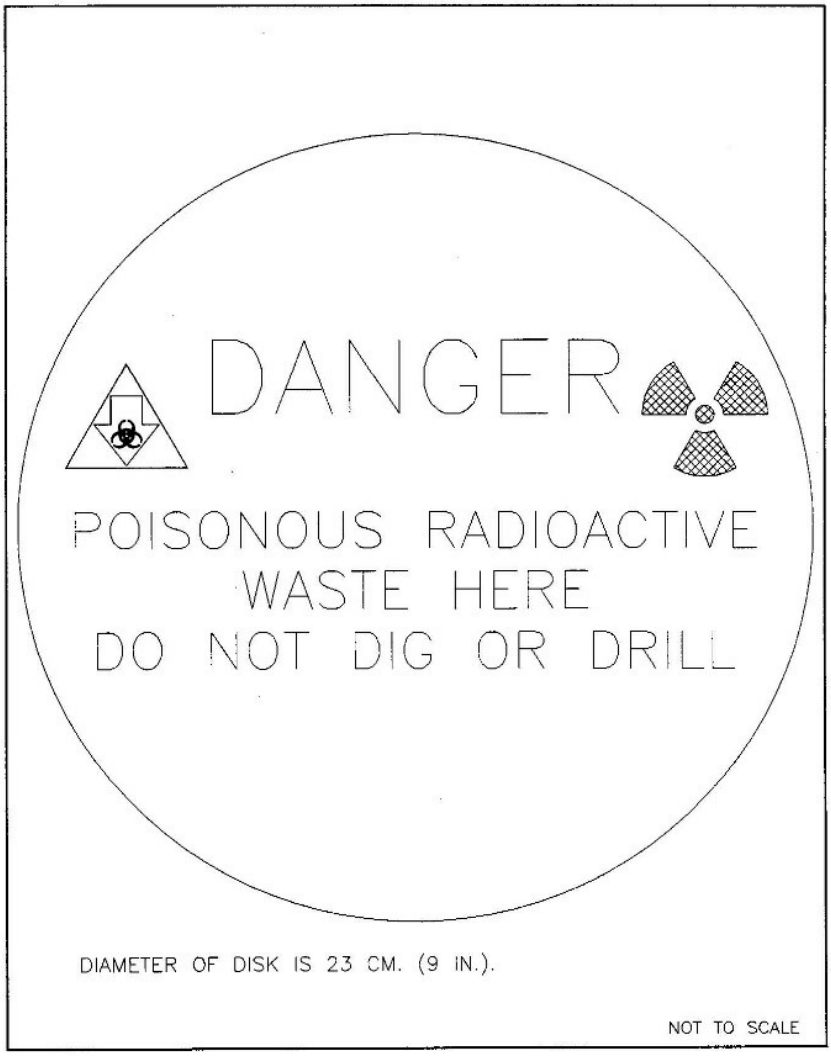


Figure 7: Draft design for text and pictures to be used on subsurface markers at WIPP. Source: U.S. Department of Energy. Used by permission.

area (covering sixteen square miles, making the site one of the largest public monument projects in the world). The DOE plan calls for sixteen additional monuments (similar to the ones described above) around the footprint of the actual repository (2165 by 2670 feet). Small subsurface markers with simple textual messages and detectable magnets will be buried throughout the site, and also within a large berm (constructed of compacted salt, riprap, and caliche) that will surround the repository area. A comprehensive information centre will be constructed on the surface, while two buried storage rooms with complex textual messages will be placed below the surface (all text will appear in seven languages: English, French, Spanish, Chinese, Arabic, Russian, and Navajo/Diné). The site designers also suggested an existing buried "hot cell" (a chamber meant to contain radioactivity) will serve as a further deterrent to anybody excavating the site, though they are not specific about what messages will accompany this structure to explicitly identify the dangers at the site. Instead, the two key permanent marker plans include substantial detail about the more global, landscape aspects of the communication strategy, but several design features (most notably the actual text on the markers) remain in draft form until the final testing and implementation of the permanent markers plan sometime in 2033.[25]

The creative discussion and planning surrounding communicating with future generations at WIPP has generally been overlooked at other post-industrial sites across North America and internationally. Many of these sites, including Giant Mine, present the need for perpetual care similar to that for radioactive wastes. Indeed, for many hard-rock mine sites, contamination from mine tailings and waste rock does not have a half-life. At acid-generating sites, unless mine wastes can be entirely sealed off from the acidifying influences of oxygen and the flow of water, the potential for further contamination will persist forever.[26] In addition,

unlike nuclear waste, mining waste is seldom moved to specifically designed, long-term waste management areas, but is contained in structures such as tailings ponds that are prone to leakage and structural breakdown. Many communities living close to such sites do not have the option to just bury the waste; they face the layered complexities of living with waste in perpetuity.

The WIPP example provides useful insight into some of the issues related to perpetual care and communicating with future generations at such sites. Yet, beyond including Navajo/Diné as one of the messaging languages, the WIPP process failed to consider the justice implications of storing nuclear wastes on Indigenous territories or the possible contribution of Indigenous knowledge to the problem of perpetual care.[27] Subsequent scholarship explicitly highlights the intersections of waste, race, and settler-colonial ideas of nature in the "sacrificial landscapes" created by uranium mining, nuclear testing, and nuclear waste storage in Diné territories of the U.S. Southwest.[28] From this perspective, the WIPP construction of the New Mexico desert as suitable for long-term disposal of nuclear waste reproduced what Voyles calls a discourse of "wastelanding," whereby Diné territories were understood as empty and useless lands amenable to both resource extraction and waste disposal.[29]

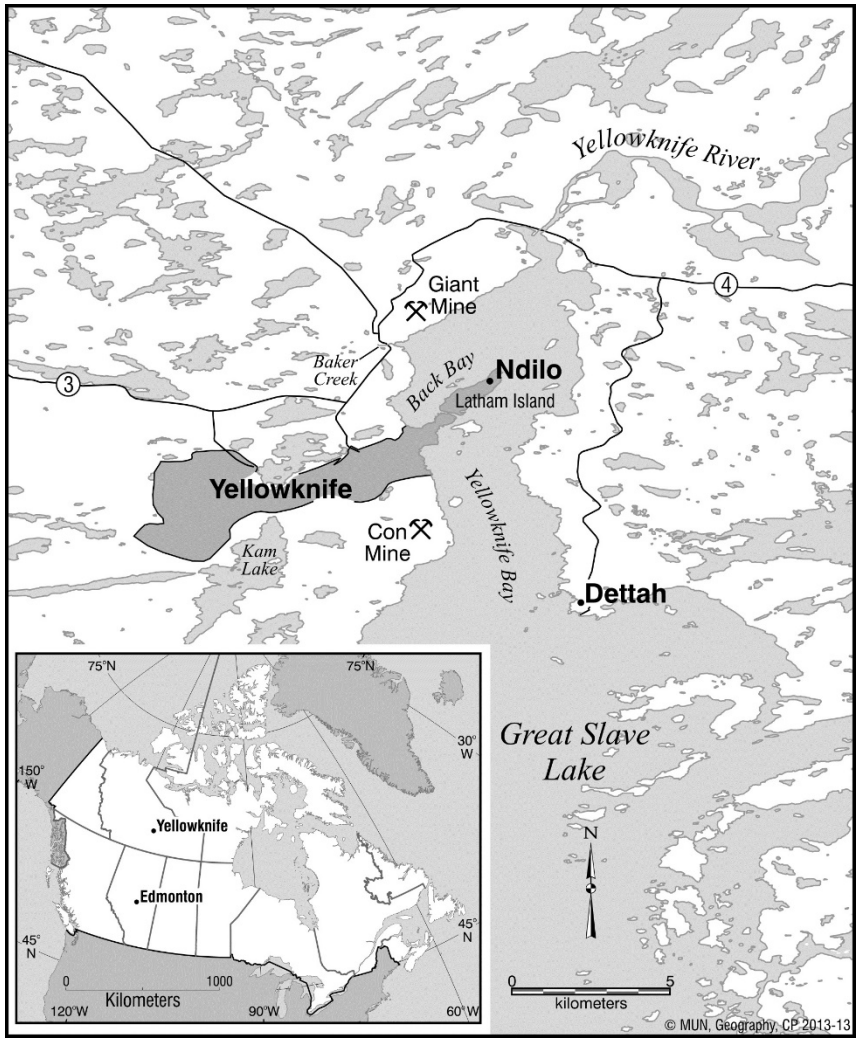
Similarly, in its early planning and assessment stages, the Giant Mine Remediation Project (the Project) avoided discussions of environmental injustice and perpetual care; only through community demands and activism has the Project been forced to confront these issues. Responding to these community concerns, and building upon the WIPP research, the Toxic Legacies Project endeavoured to initiate discussion and planning for communicating with future generations at the Giant Mine. But whereas WIPP employed a top-down, expert-driven approach to the long-term management of nuclear waste, our project promoted a ground-up

approach that generated locally relevant and culturally appropriate insights into perpetual care and communicating with future generations.

The Giant Mine Remediation Project and Environmental Assessment

OPERATING FROM 1948 TO 2004, Giant Mine produced over seven million ounces of gold, earning the city of Yellowknife the Dene moniker Somba K'e, or "money place." As a by-product of roasting gold-bearing ore, operations at Giant produced arsenic-laden tailings and over 237,000 tonnes of arsenic trioxide dust. For the first three years of operations, arsenic trioxide was pumped out of a roaster stack and dispersed across the traditional territory of the Yellowknives Dene First Nation (YKDFN), including the nearby settlements of Ndilo (adjacent to Yellowknife's Old Town) and Dettah (across Yellowknife Bay).

The human health effects of this early exposure to arsenic trioxide are not well documented.[30] However, in 1951 a Dene boy died of acute arsenic poisoning after drinking contaminated snow-melt.[31] This fatality forced the company (Giant Yellowknife Gold Mines, Ltd.) to implement pollution control to collect the arsenic from the smokestack. The resulting arsenic trioxide dust collected was stored in underground chambers (old mine stopes). The mining company insisted that the surrounding permafrost would block water access to the arsenic chambers and would safely contain the arsenic "in perpetuity," though there was little evidence for this assertion.[32] These pollution controls did not stop all arsenic emissions (although pollution controls did get progressively better); in addition, arsenic-laden tailings dust was known to blow into nearby communities, and tailings dams succumbed to multiple leaks and failures, polluting Yellowknife Bay.[33] Warnings of contamination were few and often provided only in English. In spite of ongoing public concerns, several



Map 1: Yellowknife and surrounding area. Map by Charlie Conway.

health studies carried out throughout the 1960s and 1970s proved inconclusive.[34]

When the mine's last owner, Royal Oak, went bankrupt in 1999, responsibility for the Giant Mine and its extensive legacy of pollution reverted to the federal government. Yellowknife citizens were affected both by the loss of economic opportunities and the uncertainty of how the

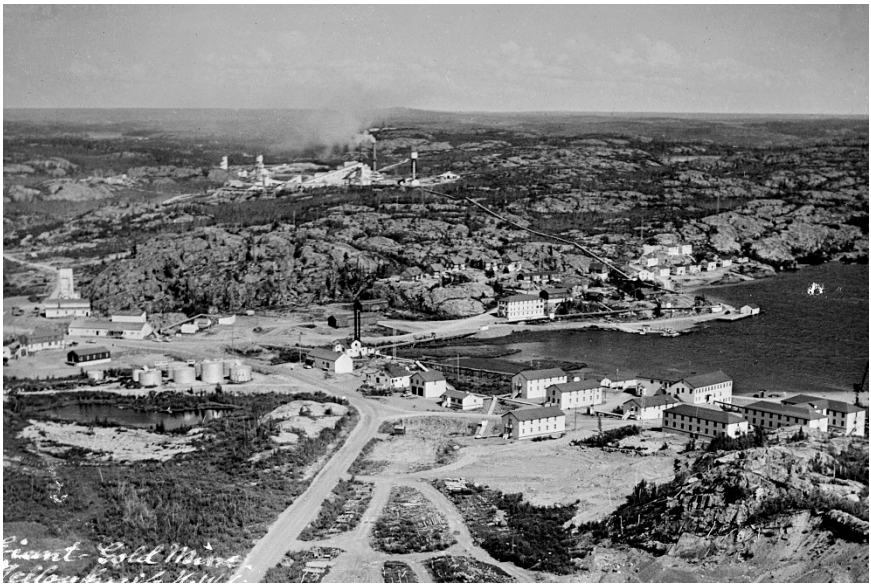


Figure 8: Aerial view, Giant Yellowknife Mine headframe and buildings nearby, 1955. Credit: Busse/NWT Archives/N-1979-052-1927. Used by permission.

accumulated arsenic would be remediated and managed into the future. The Yellowknives Dene, along with community stakeholders, were initially marginalized from remediation planning and had little say in defining or setting objectives for remediation. In an early planning workshop, entitled "Giant Mine Final Management Options Workshop," community members expressed concern that none of the options offered a final, long-term solution. One person commented, "The in-situ alternative is not a final solution—at best it provides a temporary holding pattern, leaving the responsibility for final treatment to future generations. It is not a responsible act by this generation, who benefited from the gold mine, to leave a burden for future generations."[35] The realities of this complex site were not communicated or discussed in a meaningful way through initial planning.

In 2007 the Giant Mine Remediation Project Team (GMRPT) published a remediation plan featuring the "frozen block method" as the best option for arsenic remediation at the Giant Mine.[36] This method uses

thermosyphon technology to freeze the ground around the arsenic chambers, essentially sealing these areas off from the surrounding rock.[37] This plan required that the site be monitored and maintained, and residual mine water pumped and treated, in perpetuity. Many community members were unsatisfied with the plan because it was framed as a final solution and did not address concerns about the legacies of the mine, independent oversight, and the related challenges of perpetual care and communicating with future generations. For these reasons, the YKDFN and Alternatives North petitioned the City of Yellowknife to request an environmental assessment of the remediation plan from the Mackenzie Valley Environmental Impact Assessment Board.[38] The environmental assessment, completed in 2013, led to the signing of the Giant Mine Remediation Project Environmental Agreement in June 2015.[39]

During the initial scoping of the Giant Mine Remediation Project Environmental Assessment, the project was strictly limited to technical aspects of the remediation plan. The historical legacies of the Giant Mine site were excluded from assessment, and the plan was evaluated as a twenty-five-year project (covering essentially the period of active remediation and initial monitoring). The proponent (the federal government) provided no indication of a perpetual care plan beyond twenty-five years, simply stating that care and maintenance would be required forever.[40] Unsatisfied with the vague time horizons for the project, community stakeholders, specifically the YKDFN and Alternatives North, insisted on framing the remediation as a perpetual care project. In 2011, while the environmental assessment continued, Alternatives North and the YKDFN hosted a community workshop on perpetual care that included Elders, community members, and invited experts.[41] Workshop participants identified fifteen actions required to develop a perpetual care plan alongside remediation. These included setting up regular

communications with the community; creating stewardship programs; designating the Giant Mine as a heritage site or a park; memorializing the legacies of the site; setting up a knowledge/research centre; changing the framework of the remediation from a permanent "walk-away" solution to an interim one; establishing independent oversight; and demanding an official apology and compensation for the YKDFN. Participants reflected that long-term monitoring of the project needed to include both cultural and environmental indicators.

These proposed actions focused on two themes: justice for future generations and justice for the YKDFN. Thinking far into the future, one participant stated, "The safety of the Giant Mine site relies on healthy societies being here to care for the site."[42] In order to ensure that such healthy societies can exist, and to "do justice to future generations, we need to do justice to current generations…. [T]here needs to be an apology for the injustice of the Giant Mine."[43] In this sense, participants connected planning for perpetual care to the legacies of the mine, and to intergenerational justice and communication with future generations: "The challenge when remediating the Giant Mine is to change the goal from cleaning up as well as we can to transforming the site from one of despair to one of wisdom. Giant Mine can be a place where wisdom sits because of the work that local people do."[44]

Building on these themes and actions (and subsequent reports commissioned by Alternatives North and YKDFN),[45] future land use and communicating with future generations became focal points of public hearings on the Giant Mine Remediation Project in September 2012. At these hearings, community intervenors repeatedly expressed their concerns about a lack of planning for future land use and, in turn, a lack of responsibility for perpetual care. Dr. Ian Gilchrist, a former chief medical officer of health and member of the NWT Water Board stated, "It sounds

to me like a good thing, the perpetual care of the Giant site. I would suggest that that title, that topic, needs to be accompanied by another one, which is: *perpetual caring, perpetual caring for people*. And I think it leads you to go beyond some of the very physical, technical stuff that we have seen here."[46] Community suggestions for perpetual care and communicating with future generations included acknowledging different cultural perceptions of time, building a database or library with records, creating stories, developing specific land use regulations, education programs, developing an interpretive centre, and ensuring consistent funding and resources for future generations. Throughout the environmental assessment, community stakeholders redefined remediation and questioned the implications of a perpetual care site and how the stories of Giant Mine would be told and experienced for generations to come.[47]

In 2013 the results of the environmental assessment turned the remediation process on its head. The remediation project mandate changed from a permanent solution to an interim solution, recognizing the need to continue researching better solutions and to be flexible in the care of this site far into the future. An environmental agreement, signed in 2015 by three levels of government, Indigenous organizations, and Alternatives North, included the establishment of the Giant Mine Oversight Board (GMOB) to carry out further arsenic research, education programs, and independent reviews of the remediation project. In addition, surface remediation designs have been reconfigured using community-based objectives.[48] Research for ongoing health and environmental monitoring has been expanded.[49] However, there is no comprehensive perpetual care plan, making it difficult to envision how the above initiatives will incorporate a strategy for communication with future generations about arsenic or long-term stewardship of the site.[50]

The Toxic Legacies Project and Communicating with Future Generations

CONCEIVED PARTLY AS A RESPONSE to the perceived deficiencies of the environmental assessment and remediation, the Toxic Legacies Project was created in 2013 as a community-university partnership to address local perspectives on remediation, perpetual care, and communicating with future generations at Giant Mine. The partnership included researchers from Memorial University (including two of the authors, John and Arn) and Lakehead University; the Goyatiko Language Society of the Yellowknives Dene First Nation; and Alternatives North. Funded through a SSHRC Partnership Development Grant, part of the project's mandate was to generate public dialogue about perpetual care and communicating with future generations, building on previous efforts such as the 2011 perpetual care workshop. To achieve this goal, project partners worked together to create accessible resources and to organize activities and events to raise awareness and develop a community-based strategy for communicating with future generations at Giant Mine.

So why not simply import ideas from WIPP to warn future generations of the underground arsenic hazard at Giant Mine? While there may be some role at Giant Mine for signs, symbols, and monuments similar to those envisioned for WIPP, there are several key differences between the threats at the two sites. First and foremost, the arsenic at Giant Mine will not break down and cease to be a threat after 10,000 years; it will remain a toxic threat for eternity if technology is not developed to remove it from the site. This makes it difficult to identify a temporal end for any messaging system. Second, the major risk at Giant is not so much inadvertent intrusion. Instead, the slow and inadvertent abandonment of the site presents the greatest danger, as any breakdown in the freeze system will lead to thawing of the arsenic chambers (although this would likely take

two decades if not noticed and repaired). Long-term failure of the water pumping and treatment system, if neglected, would lead to flooding around the arsenic chambers (and eventually within the chambers, if they melt) with consistent (and possibly very large) leakage of contaminated water into the surrounding environment. Hence, a strategy to communicate with future generations at Giant Mine is likely to require the transfer of comprehensive technical knowledge, both locally and at scattered archival repositories, so that knowledge of the site is not lost and the site can be repaired and maintained over long periods. Moreover, at Giant Mine, much more emphasis might need to be placed on systems of relaying information from one short-term target (i.e., every few decades) to the next, as environmental conditions change and governments develop new technical solutions for the arsenic problem. Rather than attempt to scare people from the site, the key may be to actively engage people through operational tours, annual ceremonies (such as the healing ceremony the Yellowknives Dene have regularly held at or near the mine), and a visitor information centre detailing the perpetual care requirements of the site. For the Giant Mine Remediation team, maintaining detailed continuity of knowledge about the site over potentially large time spans presents a much greater challenge than simply imparting a vague notion of danger to the deep future.

Unlike the purpose-built WIPP site, Giant Mine also presents complex questions about representing the history of labour and environmental change at the site. Many Yellowknifers justifiably feel proud of their forbearers' work at the site and the contribution of mining heritage to the city's growth and cultural identity. At the same time, Giant Mine was home to one of the most violent and deadliest strikes in post-war Canadian labour history, notorious for striking worker Roger Warren's bombing murder of six men who crossed the picket line and three replacement

workers in September 1992. Giant Mine's dark historical legacy also stems from the massive arsenic trioxide emissions sent up the stack of its gold roasting facility, beginning in the 1950s. The Yellowknives Dene are adamant that commemorations at Giant Mine include a lament for the environmental damage and human suffering caused by the mine. Their relationship with the site, and what their knowledge and traditions (including oral tradition) offer in tools for stewardship are further important differences between the context at Giant Mine and the WIPP.

To confront the questions of perpetual care and communicating with future generations, the first step for the Toxic Legacies Project was to assemble, digest, and disseminate relevant research and information on this issue. Project partners created a "community primer" on communicating with future generations that explored previous research on this issue (some of which is discussed above) and related it to the specific challenges at Giant. The report (and two-page summary) was distributed via the Toxic Legacies Project website and Facebook group. Although building on ideas from the WIPP project, the report suggested that a community-based exploration of the issues related to CFG would more appropriately reflect the diverse interests of the Yellowknife community and the contentious history of Giant Mine. This report formed the basis for an initial set of presentations and workshops with Yellowknives Dene community members and other stakeholders in 2015 and 2016. It also led to the formation of a "Communicating with Future Generations (CFG) Working Group" that included a wider set of actors, including representatives of the project proponents (Indigenous and Northern Affairs Canada and the government of the NWT), Alternatives North, the City of Yellowknife, YKDFN, and the North Slave Métis Alliance, as well as Toxic Legacies project participants.

The Communicating with Future Generations (CFG) Working Group

The CFG Working Group met regularly for about a year and a half. From the start, this group was conceived as an open forum for wide-ranging discussion about the best tools to communicate the dangers of Giant Mine into the distant future. The working group was also an information-sharing space, tasked with developing content to bring to larger community workshops. The collegiality and creativity expressed in the group was notable. In small cities like Yellowknife, residents wear many hats, and most members already knew one another from some forum, or previous work, sometimes adversarial, related to Giant Mine. Deftly navigating their relationships, participants were willing to discuss ideas (in creative and vulnerable ways) about what their city might look like in 100 years, in 10,000 years, and beyond. The group included Indigenous, settler, and new immigrant members, reflecting the diversity of Yellowknife. It also included members with significant knowledge of the Giant Mine site, and others relatively new to the project. In keeping with the "ground-up" approach required at Giant Mine and reflected in the environmental assessment, these meetings were grassroots in the sense that many members brought their citizen perspectives to bear, in addition to their institutional affiliations.

The meetings were moderated by the local project coordinator (co-author Rosanna), and the discussion focused on the application of lessons learned from the WIPP to the Giant Mine context, generating a number of key "take-away" ideas. As mentioned, there is limited scientific research into communicating to future generations, and the working group members would not claim any formal training on that subject. The expertise available was the research about WIPP, the lived experience of members, and their knowledge of the Giant Mine context. The meetings loosely followed the Five Levels of Messaging outlined in the WIPP project

Figure 9: Thermosyphons in a test plot at the Giant Mine site. Hundreds of thermosyphons will be installed to ensure the underground chambers remain frozen. Photo: Arn Keeling

and included guest speakers. The following is a short summary of the discussions and key findings (a full record of the working group's work is contained in the group's meeting minutes and final report). While developing formal actions coming from these findings was not part of the working group's mandate, there were key players in the room contributing to the discussions. As remediation at the Giant Mine site unfolds, it will be interesting to see if these discussions inform design decisions.

Many working group discussions focused on Dene knowledge and the way that stories are connected to physical features in the land. By linking stories to places, the group suggested, evidence of the history of contamination remains in the public realm, even if physical monuments collapse over time. The group talked about the hundreds of thermosyphons that are part of the long-term freezing of the site, asking what stewardship is required to maintain them into eternity. In addition to their technical function, thermosyphons will be iconic, visible cues on the landscape of the

poison underground, providing at least some physical marker of the contamination and suggesting, however vaguely, the care requirements at the site. Group members also discussed means to engage the public with the site, including stewardship activities, cultural events, school trips, interpretive signage, and even a running loop at the site. Echoing some of the early WIPP discussions, the group discussed the idea of the Yellowknives Dene organizing ceremonial events at the site as a cultural practice for passing on knowledge into the future. Such ceremonial engagement might include a participatory monument where individuals lay down a stone each year as way to retain memory of the site's dangers. Throughout, the group wrestled with the tension between encouraging access (and possibly creating a familiar, normalized, "safe" place), and warning people away, and thus creating a forbidden place, a strategy that many suggested carried too much risk that the mine would be forgotten.

The CFG Working Group also invoked parts of the WIPP framework for passive institutional controls, discussing long-term messaging systems (signs, symbols, simple text) that would endure over long periods of time. Given the ongoing maintenance requirements at Giant Mine, messaging that encourages the long-term relationship required between people and this site should be emphasized—for example, signage should say, "Maintenance Required," in addition to "Danger." The working group noted that that over the long term, there will inevitably be a break in communication. This means diverse, simple depictions of the danger and the care required should be placed in multiple locations. This will increase the chances that information about the site will be rediscovered and the chain of communication mended. Low-tech design is also critical if the messages are to endure possible futures where technological capacity is reduced.

The working group discussed the use of increasingly complex messaging systems, including those that do not rely on permanent images and text, particularly cultural institutions that might effectively curate the key messages at the mine. For instance, a guest artist led the group in a discussion of culture and how to build a subculture of stewardship. Looking to local Yellowknife examples, such as the role of Dene Elders and institutional religious examples, the group suggested something akin to the aforementioned "nuclear priesthood" with a visual identity (uniform, ceremonial clothing) and a prescribed public role. Other concrete suggestions included building a cultural institution like the poet laureate of Yellowknife, or the "Stewards of the Giant Mine" to spearhead the public's ongoing maintenance of this knowledge.

The working group also considered how to maintain information systems that are highly complex and technical. The territorial archivist joined the group for this discussion and suggested that, unlike WIPP recommendations for paper document preservation in the 1990s, today Giant Mine's public archive would better be preserved in an electronic repository of PDF-A documents. Many group members suggested that the scientific aspects of the contamination, the care requirements of the site, geological features, and other technical information will need to be stored in a number of formats and locations (on site, the NWT Archives, and possibly Library and Archives Canada in Ottawa) to ensure their survival and potential retrieval. More generally, the group's discussion highlighted the challenge of ensuring that the technical and maintenance requirements of the site are communicated in a way that is comprehensible to future generations.

Public History in Action

As the CFG Working Group pursued its discussions, the release of the film *Guardians of Eternity* brought wider public attention to the issue. Directed by Yellowknife filmmaker France Benoit (working in collaboration with producer Kelly Saxberg of Sheba Films and Toxic Legacies project partner Ron Harpelle of Lakehead University), *Guardians of Eternity* is a forty-six-minute documentary tracing the history of Giant Mine and the perpetual care challenges that its environmental legacies pose for the community, particularly the Yellowknives Dene.

In addition to documenting some of the activities discussed in this paper, the film also aimed to generate public awareness and dialogue around communicating with future generations. To this end, the film premiered in Yellowknife in October 2015 to an audience of about two hundred people, including both Indigenous and settler community members. The film has subsequently been widely screened in communities, classrooms, and public events in Yellowknife, around Canada, and beyond. It has also been made freely available for streaming online.[51] Finally, *Guardians of Eternity* inspired an episode of CBC Radio's *Ideas*, bringing the issue of perpetual care to a national audience.[52]

Alongside the film and the activities of the working group, a more targeted set of activities engaged Yellowknives Dene Elders and youth. Project partners held a series of workshops to engage with Indigenous knowledge and oral traditions in thinking about the future at Giant Mine. For our youth engagement, we drew loosely on ideas of "speculative design,"[53] Cecile Massart's "Laboratories" concepts for "constructing memory" at radioactive sites, and the art-based practice (and materials!) of Memorial University colleague Max Liboiron. We hoped to get participants thinking about the challenges of commemoration and communication at Giant by building models of what the mine site might

look like in the future, much in the way WIPP researchers created concepts for signs and markers for nuclear waste sites. We piloted this activity with geography students at Memorial, then held a series of model-building workshops with Dene youth, ranging from grades 7–12 at Chief Drygeese Centre in Dettah, elementary students at Kaw Tay Whee Elementary in Dettah, and at St. Patrick's School in Yellowknife, where both Indigenous and non-Indigenous grade 11 students participated. The purpose was not to realistically model the site, but for the youth to use the activity as a way to "blue-sky" think about the challenges of managing a toxic site in perpetuity.

Using a box of random objects, ranging from blocks to game pieces to craft materials and bits of "junk," the students created a series of fascinating landscape models, from completely fortified enclosures to a theme park with a zip wire. As our post noted, four main themes emerged from the models (and the discussions that followed):

1. **Containment:** The arsenic at Giant is proposed to remain underground, possibly forever, so most builders included some form of containment, ensuring the arsenic remained secure. Essentially, containment and exclusion went hand-in-hand: fencing of various types, whether walls, electrified barriers, or moats, aimed to exclude unwary and/or unwanted people from the site.
2. **Surveillance**: In addition to containment and exclusion, surveillance was a surprisingly common element of these models. Guard towers with domed observation decks, cameras, and other forms of site surveillance (outwardly or inwardly directed) were often included. It wasn't always clear who was doing all this

"watching," but it was clear that monitoring and protection of the site was an important principle.

3. **Messaging**: Participants made signs of various kinds, although few examples addressed the need for various levels of messaging, the question of language, or other forms of communication. Some models included information centres. Mainly, there was ample "Keep Out" signage and imagery, aimed at supporting the mission of containment/exclusion.
4. **Remediation and reuse**: Somewhat related to point 1, there was a range of forecast land use goals envisioned or implied. One Dettah participant, William Lines, focused on leaving the site "ugly" and unusable, to keep people away from the danger and to commemorate the site's legacy (which he discusses in *Guardians of Eternity*). Most models seemed to track a kind of middle ground on end land use, with heavily contaminated areas not being used at all, but some areas remediated for future use.

Although they rarely elicited strictly "practical" solutions, we found the model-building activities a creative way to engage youth (and adults) in a wide-ranging discussion of the challenges of dealing with a perpetually toxic site like Giant. Rather than flood participants with a barrage of overwhelmingly negative information about the mine, the "learning by doing" aspect of the workshops reinforced (we hope) the idea that local citizens can play a crucial role designing the future landscape at Giant Mine.

Workshops with Yellowknives Dene Elders sought to address Indigenous perspectives and modes of communicating with future generations, particularly the oral tradition that was largely discounted by

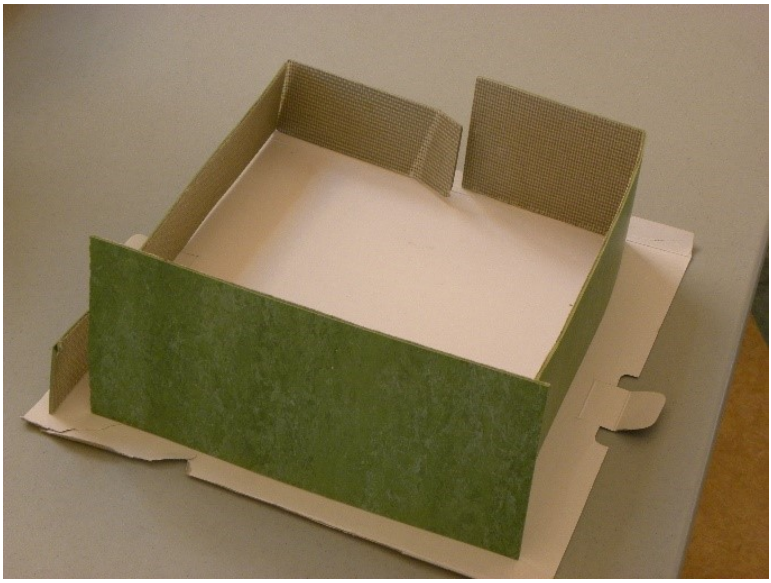


Figure 10: YKDFN student model for Giant Mine surface design (with an emphasis on containment). Photo by John Sandlos.

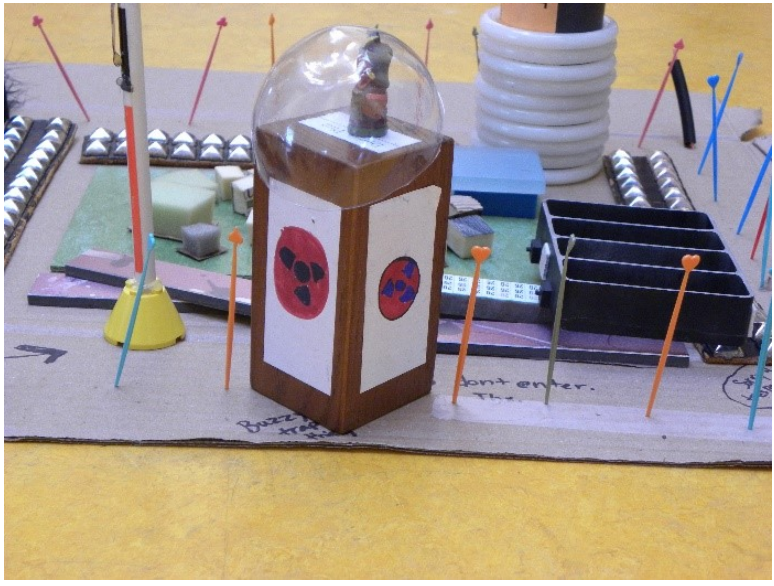


Figure 11: YKDFN student model for Giant Mine monuments and surveillance towers. Photo by John Sandlos.

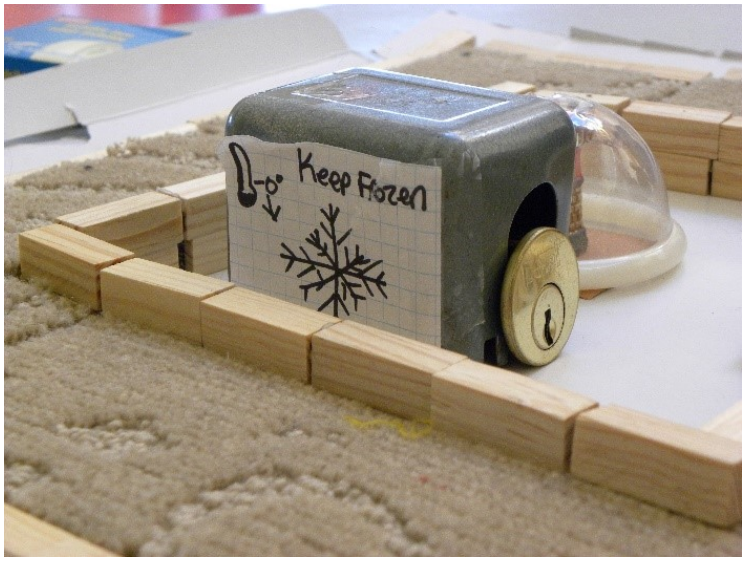


Figure 12: YKDFN student model for Giant Mine with text and image messaging. Photo by John Sandlos.

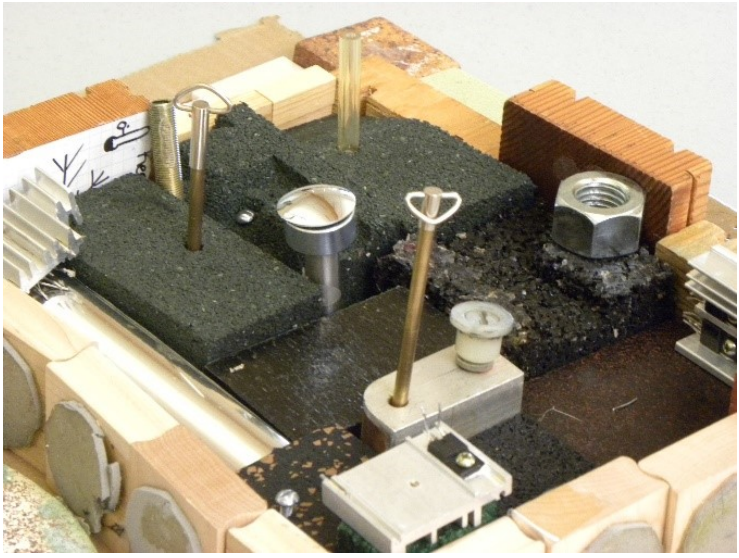


Figure 13: YKDFN youth design showing ugly landscape at Giant Mine. Photo by John Sandlos.

WIPP researchers. The first workshop, held at Dettah in 2015, was facilitated by Sandlos and Keeling, along with Toxic Legacies partner Mary Rose Sundberg of the Goyatiko Language Society. After an introduction to the idea of communicating with future generations, the Elders explored stories and experiences related to Giant Mine, and their thoughts about how to preserve the memories of what happened there. It became quickly apparent that for the Elders, the issue of how to address the future is closely tied to remembering the past. This echoes the observation (in the context of uranium mine remediation) of Indigenous legal scholar Rebecca Tsosie (Yaqui) that "for Native peoples, the discussion about reparations … is a discussion of how the past, present, and future are co-joined and interdependent."[54] Elders were adamant that commemoration strategies reference the mine as a symbol of the damage done to the land by settlers, and the poisoning of people and the environment by historic arsenic emissions. With respect to strategies for communicating knowledge (whether about arsenic, history, or the land), the participants suggested oral traditions, stories, and annual ceremonies at the Giant Mine site be supplemented with information that is accessible and relevant for youth.

These connections between past and future, and strategies for how to communicate between them, came into greater focus during a follow-up workshop in 2017 (see the full report here). The first day of this two-day event brought together Yellowknives Dene Elders to further discuss the challenges in commemorating Giant Mine and warning the future. Reflecting the greater awareness of this issue generated by the environmental assessment report, the film, and previous workshops, the Elders' discussion coalesced around the idea of creating a story or legend, in order to both commemorate the mine's history and warn future generations about this site. One idea was to create a story similar to those featuring Yamozha, an important Dene cultural figure, that commemorate

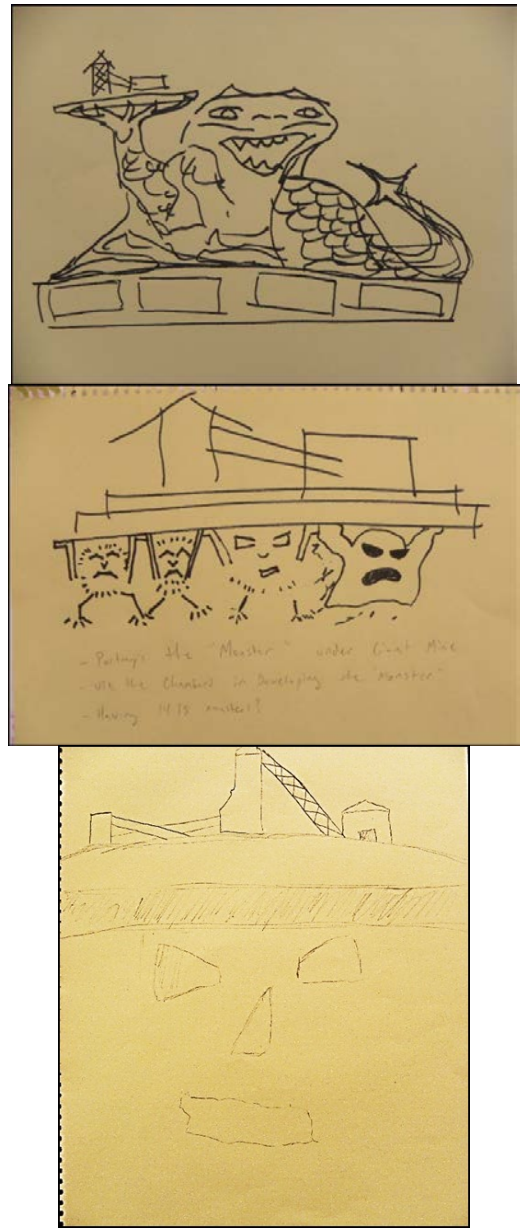
important historical deeds and places in Denendeh. For some Elders, the idea of "making up" a legend—especially one about contamination—seemed troubling. Another idea—discussed in the workshop as well as *Guardians of Eternity*—suggested creating a story about the arsenic being an underground "monster" that community members must guard and keep in place, so it does not emerge to harm people and the land. Workshop participants generally acknowledged that such stories must be created with care, faithfully represent the Yellowknives Dene historical experience, and be transmitted in a variety of forms, including oral stories, books, comics, and other media.

Indeed, for a workshop on communicating with the future, we devoted a great deal of time to reckoning with the injustices of the past. YKDFN Elders frequently returned to the impacts of the arsenic pollution on community health, not only due to direct exposure, but also because people feared formerly reliable sources of food (especially fish and berries) and water. The Elders at one point suggested that the whole history of the mine could be etched in words and pictures into the granite rocks at the site, commemorating difficult issues such as the death of Dene children due to arsenic pollution in the 1950s and even the Giant Mine strike in the early 1990s. Any historical account of the mine should also, according to the Elders, acknowledge that their communities have for decades been paying for clean water to be trucked from outside, substituting for a resource that was freely available in vast quantities prior to the advent of the mine. The Elders also insisted that commemorative material at the mine should acknowledge the community's long-standing belief that it was one of their own, Liza Crookedhand, who showed prospectors where to find gold in the area, a sharing of knowledge for which she was given a mere stovepipe. Highlighting these stories of economic and environmental injustice, the Elders spoke passionately about reconciliation hinging on financial

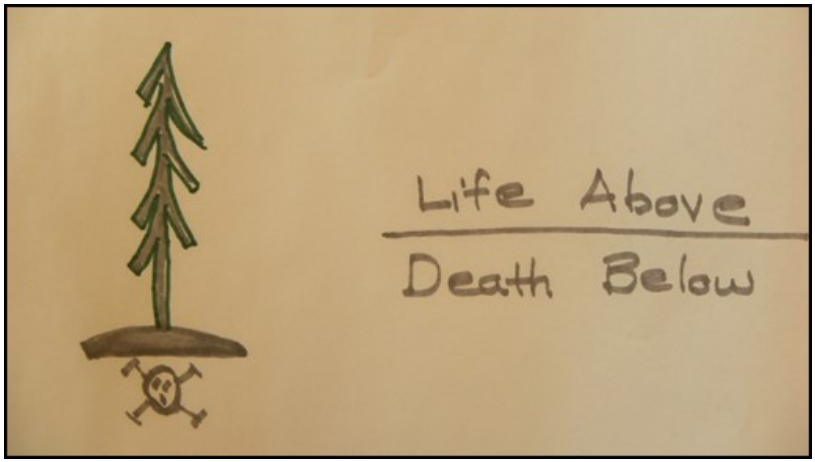
Figure14: Liza Crookedhand (at far left with pipe), small girl, and two other women. YKDFN archive. Used by permission.

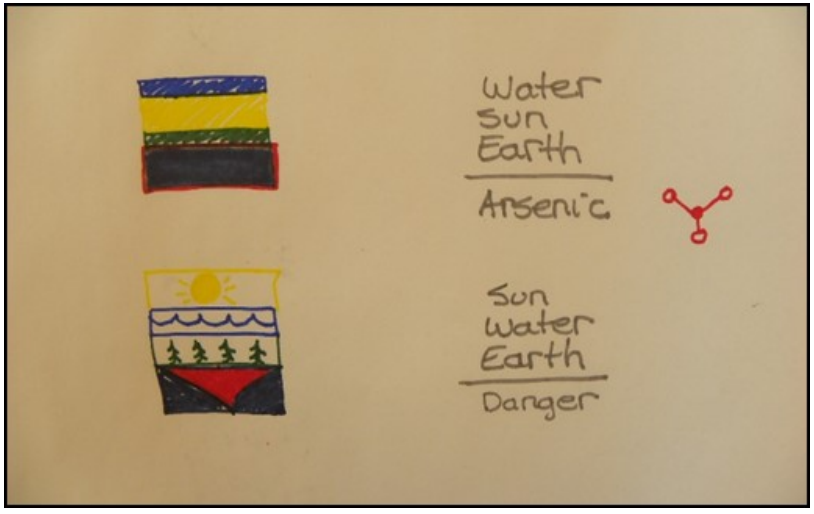
compensation for the historical impacts of the mine. While such claims must be pursued directly from government (and thus the Elders' concerns could not be addressed through the workshop process), for YKDFN participants it was crucial that practical commemorative goals of communicating with future generations should not mask or paper over their negative historical experiences of mining and pollution.

The second day of the workshop harnessed the creative energy of the participants for the production of visual imagery and landscape designs. We doled out sketch pads, pencils, markers, and other drawing material so that participants could begin to imagine what a system of signs, symbols, and monuments might look like. We divided into several small groups that generated a fascinating array of results, from simple images to full landscape designs for the site. Some images drew on an emerging local



Figures 15-17: Variations on the "monster underground" theme, Toxic Legacies Workshop. Drawings by Ben Nind. Photo by John Sandlos.





Figures 18–19: Variations of the "life above, death below" them, Toxic Legacies workshop. Drawings by Ben Nind. Photo by John Sandlos.

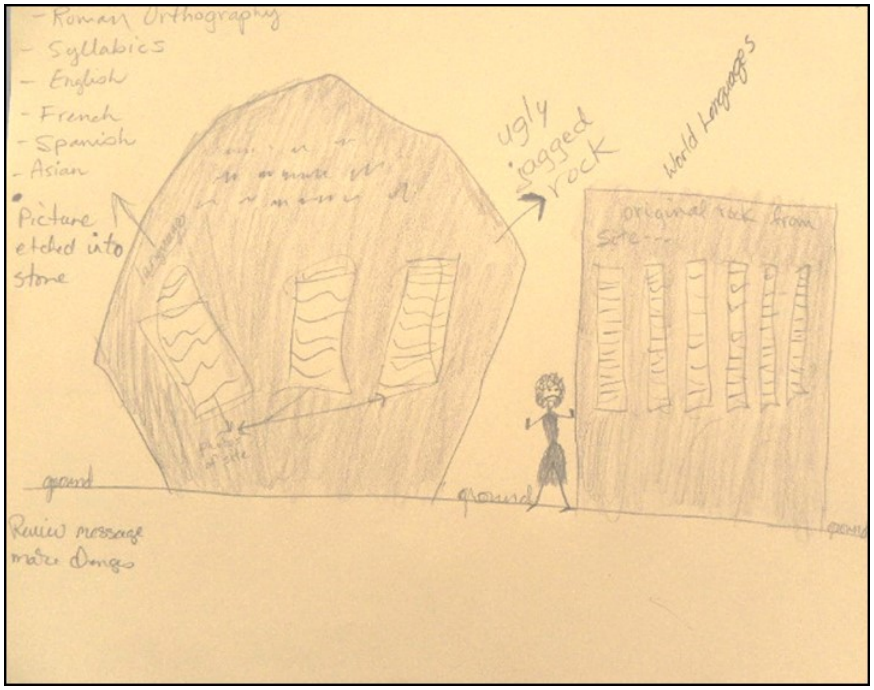


Figure 20: YKDFN Elders concept for "Big Ugly Rocks." Concept by Madeline Beaulieu, Modeste Sangris, Peter D. Sangris, Eddie Sikyea, Mary Louise Drygeese, Isadore Tsetta, Mary Rose Sundberg, and Tee Lim. Photo by John Sandlos.

conceptualization of the underground arsenic, producing several images that conveyed the idea of a monster underground. Another produced a series of images with simple text that conveyed the idea of life existing above ground while death lurked in the underground.

Echoing the WIPP approach, the Elders developed an idea for big ugly rocks that would warn people away from the site, a message reinforced with textual messages in several languages (in addition to the historical material discussed above). Some of the groups attempted full landscape design for the site, including one conceptual model where monuments and messages would mirror the chemical structure of arsenic trioxide (replete with repeated reproductions of the chemical symbol for arsenic from the periodic table).

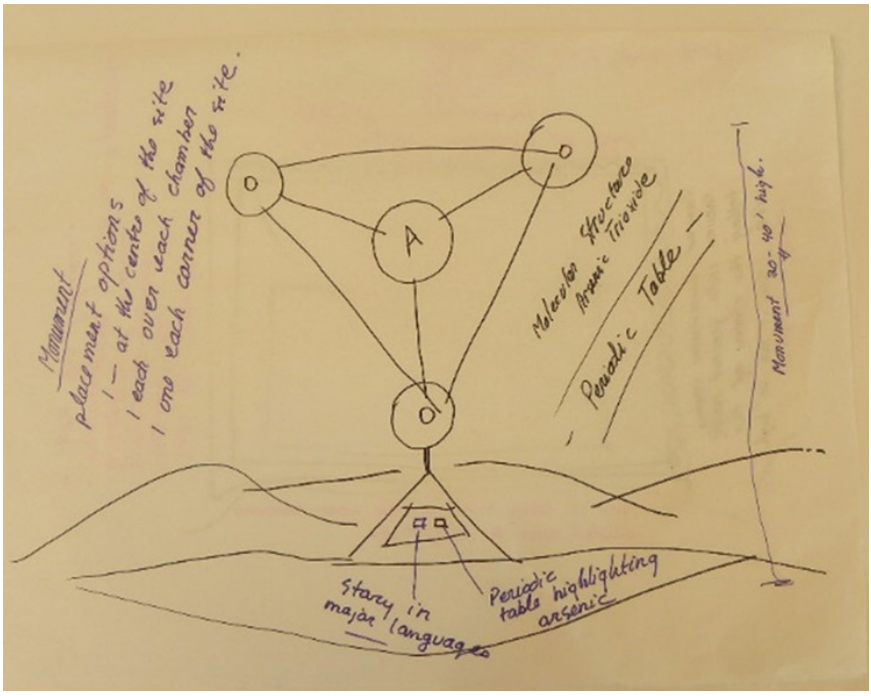


Figure 21: Conceptual surface design drawing for Giant Mine using the molecular structure for arsenic trioxide, Toxic Legacies workshop. Concept by France Benoit, Amy Guile, Letitia Pokiak, and Erika Nyyssonen. Photo by John Sandlos.

Another group, echoing the thinking of the CFG Working Group, tried to reckon with the fact that the clusters of thermosyphons would themselves form a kind of monument, one that visitors would have to be warned not to damage so the containment system for the arsenic remains intact.

The workshop participants and facilitators all were painfully aware of the problems with their ideas (i.e., language evolution, the physical deterioration of monuments over time, the misinterpretation of symbols, etc.), but most saw the value of at least beginning to generate and record ideas (even if much work still needs to be done). The engagement activities of the Toxic Legacies project, while outside the formal mandates of the Giant Mine Remediation Project or the newly established Oversight Board,

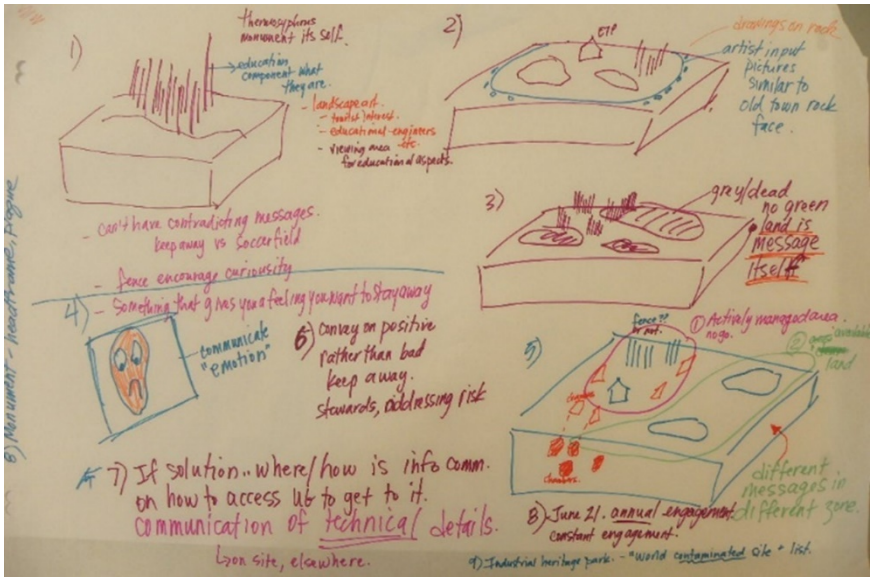


Figure 22: Surface design ideas using the thermosyphons that will eventually be built at Giant Mine. Concept by France Benoit, Amy Guile, Letitia Pokiak, and Erika Nyyssonen. Photo by John Sandlos.

provided a forum for community members, particularly Yellowknives Dene, to explore the issue of communicating with future generations, at a time when this challenge had been sidelined by debates over arsenic storage technologies and surface remediation. Questions of commemoration and communication with the future are complicated, as the ample research conducted for the WIPP project demonstrates. By engaging community members, our project sought not to "solve" these problems, but to explore strategies that reflected the particular cultural and historical-geographical context of Giant Mine and Yellowknife/Somba K'e. The working group created an informal forum for stakeholders, including community members and project proponents, to engage in a freewheeling and open discussion of challenges of communicating with future generations. Their ideas, along with the generative process of "speculative design" for the future, were brought together with Yellowknives Dene traditional

knowledge in the final workshop. Communicating with the future, Yellowknives Elders insisted, entails not only signage and fences, but also a full and truthful reckoning with the history of the site. To this end, ceremonial gatherings and story could play important roles in both acknowledging and reconciling with Giant Mine's troubling histories as well as transmitting knowledge of the site and its ongoing threats to the future.

Conclusion

IN 2007, right before the publication of the Giant Mine Remediation Plan, there was an unauthorized water discharge from the water treatment facility with elevated levels of arsenic.[55] The new care and maintenance operator, Det'on Cho/Nuna Logistics Joint Venture, was unfamiliar with how a particular valve worked, meaning that it had not been closed properly and water was unknowingly discharged.[56] Incidents such as this illuminate the day-to-day difficulties of remediation, care, and communication for such a site.[57] Small human errors, the challenge of passing down intimate, experiential details of site maintenance and care from one person to another, and the changing nature of the site and the people who work there, can cumulate in disaster for the surrounding environment and community. Over the decades and centuries, the day-to-day care, repair, remediation, and maintenance on this site will change; as many in the Yellowknife community have pointed out, ensuring the continuity of this care is a moral obligation to future generations. Environmental change over very long periods of time—most obviously the impact of climate change on the long-term viability of the freezing strategy—only heightens the need for continuity of knowledge about the site. Thus, a strategy for communicating with future generations must be at the core of ongoing remediation at Giant.

The potentially very long-term storage of arsenic at Giant Mine raises difficult conceptual and practical issues. The emergence of perpetual care and communicating with future generations throughout the Giant Mine Remediation Environmental Assessment and more recent consultation has highlighted the importance of community engagement in remediation planning. Thinking about the legacies of Giant Mine in the context of these issues forces remediation to consider issues beyond simply the containment of the arsenic, towards discussions about what it would mean to live with this contamination forever and how to plan for permanent pollution. As one community member stated: "It is scary, but … that's one thing that people can agree is a problem and people can get creative."[58] Seeing remediation as a perpetual care situation *is* scary, but it can also open up creative discussions of how to live with waste, rather than just how to contain the arsenic. Such an approach resists quick fixes or easy gestures towards technical resolution. As Anna Storm asserts with respect to the "post-industrial landscape scars" encountered by local communities, "To heal a mental or physical wound into a scar that one can live with is to recognize key signs of difficult or ambiguous pasts and to point towards possible reconciliation."[59]

Ultimately, what concerns many Yellowknife community members and local Dene is that this site will become forgotten about or abandoned, and that their history of contamination will be forgotten as well. In this sense, the Elders remind us that our duty to warn the future is also a responsibility to acknowledge and remember the past. Much of the scholarship on historical commemoration has been devoted to its political and social aspects, including nation building, the reinforcement of identity for both dominant and marginalized groups, and the invocation of heritage as a hedge against change.[60] The toxic legacies of the industrial era demand new ways of thinking of commemorative activities—as a form of

knowledge transfer about the dangers and care requirements of contaminated sites, but also as an act of reconciliation with communities who bore the health and environmental impacts of industrial pollution.[61] Indeed, the Giant Mine Remediation Project represents an opportunity to confront the legacies of contamination and colonialism, to come together to care for the land that was damaged, and to look forward for ways to ensure this site is cared for in perpetuity. As John Baeten suggests, robust commemorative efforts should incorporate historical thinking—an awareness of environmental and social change, continuity, and uncertainty over time[62]—as well as concrete and culturally appropriate communication strategies, including stories, ceremonies, monuments, and archives. Within its modest time frame, the Toxic Legacies Project did not generate specific designs or definitive plans. Nevertheless, the insights generated through it illustrate that community-driven strategies are likely to provide the most effective—and ethical—approaches to the complex technical and cultural challenges of perpetual care and communicating with future generations.

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