

Research Article

## Arsenic Lost Years: Pollution Control at Giant Mine from 1978 to 1999

Sally Abbott Western

British Columbia Northern Health Authority, Office of Health and Resource Development

**Abstract:** Arsenic pollution of the air, land, and waters surrounding the Giant Gold Mine in Yellowknife, Northwest Territories, has been an ongoing public health crisis since the mine was opened in 1948. This article focuses on the story of Giant Mine from 1978 to 1999, paying particular attention to environmental health policy reform in the mine's later years in the 1990s. I argue that regulatory action was delayed and ultimately prevented by the inability of regulators to respond to the risks that continuous exposure to low doses of arsenic posed to the community around Giant Mine. This article uncovers a trail of government, activist, and industry discourse that illuminates the extent to which the Canadian environmental regulatory structure was paralyzed by a lack of certainty on how toxins like arsenic interact with the human body.

---

## Introduction

On January 28, 1998, the Northwest Territories Water Board met to review Royal Oak's request to renew its Water Use and Waste Disposal permit for the operation of the Giant Gold Mine in Yellowknife. When it came time for the Department of Indian Affairs and Northern Development (DIAND) to present as the lead federal department of environmental monitoring at Giant Mine, Dr. Bill Cullen stood to offer his opinion. Cullen was a well-established arsenic expert, a University of British Columbia researcher of inorganic and environmental chemistry who also advised the United States Environmental Protection Agency on arsenic issues. After a twenty-minute presentation on the characteristics and history of arsenic, Cullen ended his testimony by summing up the problem of arsenic at Giant Mine:

So, where do we stand in terms of Canada's regulation? In 1978, there were research recommendations that research was needed on the mobilization of large quantities of arsenic, the by-product of all sorts of things. Then this situation was revisited again recently by the Canadian Government in terms of—1993 regulations I think—and this resulted in arsenic being declared a substance that had to be regulated and regulations are in place. But one of the disturbing things about this as far as I am concerned, is that the recommendations that are associated with this particular act and other things are effectively the same as were made twenty years or ten years ago. So really, progress in this area, I think has been distressingly slow and I urge that everybody sort of get together with what I think is a very important act of trying to do something about this. This is a pretty major problem.<sup>1</sup>

Cullen was referring to two federal investigations: one by the Canadian Public Health Association (CPHA) in 1977, and one conducted in 1994 as part of a nationwide series of investigations on the efficacy of the Canadian Environmental Protection Act. Both studies had investigated the arsenic air and water effluent produced by the gold roasting process used at Giant Gold Mine. The first study ended several decades of heightened controversy by concluding that arsenic was no longer a serious concern for the community of Yellowknife. Not quite thirty years later, five decades of research, controversy, and regulatory discussion surrounding arsenic emissions at Giant Mine had failed to solve the threat that arsenic posed to the surrounding community's health and safety. (Even though by this time, regulations—which were and are, by definition, enforceable—had been

formally passed for reducing arsenic). Any expansions of scientific knowledge and regulatory interest in the past half-century had resulted in only “distressingly slow” progress, as Cullen had said. What can be asked is, in revisiting the problem of residual and ongoing arsenic pollution at Giant in the 1990s, how and at what point did the regulatory discussions of arsenic toxicity and public health come about, and why did these discussions fail to make substantive progress beyond where they began with the 1977 investigation?

This article argues that in the 1990s, despite government efforts to balance economic growth, jobs, and environmental health concerns, the attempted regulation of arsenic at Giant Mine served private industry's interests above those of public health. Despite increasing regulatory scrutiny and public awareness, this misalignment was enabled by a regulatory process that was unable to negotiate unknowns of carcinogenic pollutants—i.e., arsenic. Drawing on the content of public hearings, government and community correspondence, and media publications, I will demonstrate that regulator actions and discussions at the territorial level relied on the projected economic certainties associated with keeping the mine open, rather than more thoroughly considering the uncertainties of toxic exposure and repercussions for public health.

In exploring the ultimate causes of regulators' failure to resolve questions of health and arsenic around Giant Mine, my research will consider the incorporation of scientific data both in regulatory decision making and in the influence of industry interests. This article is organized into three main sections: the first section addresses the causes of the 1977 arsenic debate, how the CPHA report that followed left questions of arsenic exposure in the community unanswered, and how the debates on arsenic and public health revolved around competing scientific definitions of toxicity. The second section describes the political, social, and environmental concerns that arose in the 1990s as new scientific understandings of arsenic's toxicity renewed the regulatory debate between territorial and federal medical officers, government leaders, and Giant Mine's management and ownership. The third and final section considers what happened at Giant Mine after arsenic was put on the federal Priority Substances List, which necessitated further federal oversight and intervention in the Giant Mine discussion.

Before moving to the main body of evidence and analysis, a review of the relevant literature is necessary. Giant Mine's geographic location in the Canadian North provides the wider context for this analysis, which therefore includes northern political economy literature on resource projects like Giant Mine, and discussions of northern industrialization as a modern colonial dynamic.<sup>2</sup> In order to address the environmental health effects of industrial pollutants wrought by such development, this article heavily relies on historians of occupational and environmental toxins whose research concerns the evolving definitions of toxicity

in the wake of rising cases of chemical-induced illnesses in the postwar era.<sup>3</sup> As scholars like Christopher Sellers, Nany Langston, and Linda Nash have discussed extensively, early twentieth century toxicology's primary tenet was "the dose makes the poison," a principle readily adopted by industry regulators.<sup>4</sup> This concept meant that no matter the chemical, person, or context of exposure, there was always a dosage level or "threshold" below which a chemical exposure was rendered safe, and that, by extension, there was always an acceptable level of industrial pollution. Such exposures were categorized as below the Threshold Limit Values (TLV).<sup>5</sup>

This emphasis on specific doses of exposure—as originally scientifically established and verified in controlled laboratory conditions—meant that establishing proof in circumstances outside of the laboratory was often problematic.<sup>6</sup> For the typical individual or community, the interaction of exposures to different substances in varying contexts at different rates obscured cause and effect. Translated into environmental health, exposure to toxic substances can be difficult to prove as the cause for human illnesses unless the symptoms are severe enough to point directly to illness associated with high-dose poisoning. Low-dose, long-term exposure, therefore, has historically defied provability, as Linda Nash has discussed in the case of California orchard workers in the mid-1900s who became ill after exposure to pesticides over weeks and months.<sup>7</sup>

As Canada and the United States launched their parallel regulatory overhauls in the 1960s and 1970s, "threshold modelling" began to lose its currency among regulators at the newly established Environment Canada and the United States Environmental Protection Agency. This was in no small part due to new scientific research that revealed that highly carcinogenic synthetic chemicals were proven to have no threshold—or even, in the case of endocrine-disrupting synthetic hormones, to have *increased* potency at lower doses.<sup>8</sup> By the 1990s, TLVs were no longer the assumed model for understanding the mechanism for all toxic exposures. The regulatory process was therefore cast into uncertainty. How could a toxin be regulated if it could not be determined at what level exposure was safe?<sup>9</sup> Or, as historians would ask, what if there was simply no safe level, given the widely accepted notion that pollution was necessary for economic and social progress?<sup>10</sup>

Since the 1990s, toxicological historians Soraya Boudia and Nathalie Jas have argued that once thresholds were rejected as a constant regulatory principle, regulators bypassed scientific uncertainty by addressing political, social, and economic interests directly, rather than relying on ironclad scientific proof.<sup>11</sup> These historians have categorized this shift as a movement from "risk analysis" to "risk management" where, rather than definitively identifying and eliminating health and environmental risks with certainty, regulators and scientists sought to manage *potential* or *likely* risks.<sup>12</sup> In so doing, scholars describe this regulatory tactic as one based in principles of accountability, tethered less to what was scientifically

"correct" or objectively safe, in favour of what was *reasonable* given social demands and competing economic and industry interests.

Canadian political scientists have used regulatory studies to interrogate a related problem: why has pollution dangerous to health continued to proliferate despite the overall increase in regulation—in every government sector environmental or otherwise—since the 1960s?<sup>13</sup> Scholars David Richard Boyd, Robert Paehlke, and Douglas Torgerson point to long-standing structural issues of Canadian federal enforcement power. Rather than regulations, Canada's federal environmental regulatory system prefers to offer recommendations and guidelines, giving provincial governments discretion over whether or not to adopt them.<sup>14</sup> Even today Canada still lacks enforceable federal environmental standards concerning air and water quality. With provinces left to navigate the ambiguities of toxin regulation on the ground, a wide variety of regulatory mishaps and mismanagement have resulted, as scholar Kathryn Harrison describes.<sup>15</sup> Political scientists use the case of the Sudbury, Ontario, nickel smelters to illustrate how early-1980s regulation failed to mitigate acid rain caused by sulphur dioxide emissions because provincial regulators were too hesitant to enforce their own laws.<sup>16</sup> In other cases, scholars cite the preference of provincial regulators to give industries more freedom in order to promote economic growth out of a sense of "symbiotic relationship."<sup>17</sup> More generally, these works demonstrate that economic considerations had more weight at the provincial level, leaving provinces more vulnerable to industry influence.

Political scientist Robert Gibson takes these veins of inquiry one step further. Drawing from case studies such as lead poisoning in Toronto in 1965, Gibson argues that in modern environmental policy, the uncertainty inherent in toxicology short-circuits the standard logic of regulatory decision making.<sup>18</sup> Government administrations, Gibson argues, thrive on certainty—something toxicologists can almost never offer, at least not to the satisfaction of government bureaucrats' standards of proof.<sup>19</sup> It is difficult to build a case, beyond a reasonable doubt, that might force any company such as Inco Limited, of the Sudbury nickel mine, to invest in costly pollution abatement. The range and variables of human and ecological exposures were too complex to determine sulphur dioxide's effect with certainty. Accordingly, no matter how many studies have been done, there would always be uncertainties over the effects of toxins on humans.<sup>20</sup> Add to this the fact that while provincial regulators can choose how they negotiate pollution management with industry, regulators have little incentive to form "adversarial" relationships with industry.<sup>21</sup>

Returning to Yellowknife, recent research on Giant Mine has brought the history of this "symbiotic relationship" into clearer relief. This article also builds on the exhaustive research of Indigenous voices and colonialism at Giant Mine

by Arn Keeling and John Sandlos, extending their analysis into the unaddressed 1990s time period where, as possible, the article incorporates undercurrents of historical environmental injustice embedded in regulatory discourse around the extractive industries.<sup>22</sup> By engaging with the conclusions of historians of toxicology and political science, and the archival findings of Sandlos and Keeling from the 1950s through the 1970s, the article contributes fresh material as a hybrid of Canadian environmental regulation and northern extractive-industry history, which observes looming themes of environmental justice in the political dynamics of community, state, and industry.

### **1977 Investigation: A Conclusion to Arsenic Controversy?**

Controversy and debate around arsenic emissions at Giant Gold Mine are almost as old as the mine itself. The Yellowknife Giant Gold Mine was established in the Northwest Territories near the beginning of the postwar mining boom in the Canadian Subarctic and across North America.<sup>23</sup> The expanded development of the Canadian North in the 1930s drove the settlement of the present-day Northwest Territories capital of Yellowknife around the staking of Con Gold Mine. As the years went on, other large stakes were claimed and developed, including the Negus Mine in 1939 and Giant Gold Mine, which began full operation in 1948 under the ownership of Giant Yellowknife Gold Mines, Ltd.<sup>24</sup>

The gold formation at Giant required an environmentally destructive processing method that would, within years, cause the death of people and animals around Yellowknife. Giant roasted the raw ore to separate the gold from the arsenopyrite and pyrite sulfides to which it was bonded. The byproduct of this process was a highly toxic arsenic trioxide dust that spewed out of the mill smokestack and sprinkled the nearby town of Yellowknife and the surrounding communities. In the early 1950s, Con and Giant's combined air emission rate was 22,000 pounds of arsenic dust per day.<sup>25</sup> By 1951, there were multiple reports of illness in the area—in particular, in the Yellowknives Dene (Weledeh) settlement on Latham Island, as well as the Yellowknives Dene community on the east side of Yellowknife Bay. Both communities remained off the City of Yellowknife's drinking water supply, and instead gathered their water from the lake and snow—sources eventually established as primary arsenic exposure pathways.<sup>26</sup> While there is some uncertainty about the number of cases of acute arsenic poisoning in the Yellowknife area, there were several reports of sick livestock, and at least one confirmed arsenic poisoning of a child. (The Yellowknives Dene report significantly more cases that were not included in government reports.)<sup>27</sup> In response, the federal government began to warn locals of the presence of arsenic in water. Additionally, both federal regulators and Giant Mine representatives met

in Ottawa and determined that, in order to reduce arsenic emissions, a pollution control mechanism would need to be installed on the Giant Mine stack.<sup>28</sup>

Giant agreed to install an electrostatic precipitator, a filtration device installed over a mine stack that captures metallic particles by generating a magnetic field.<sup>29</sup> Though the precipitator successfully reduced arsenic emissions by almost 15,000 lbs a day in 1954, and then to 695 lbs per day after an additional air filtration system was applied in 1958, this still amounted to a significant quantity of arsenic dust accumulating on land and in waters in the Yellowknife region.<sup>30</sup> Federal monitoring reports show mean values of arsenic levels in vegetation that ranged from 18 to 2,228 parts per million (ppm) throughout the 1950s and 1960s—what Giant Mine historians Arn Keeling and John Sandlos refer to as “staggeringly high levels of arsenic contamination”—in comparison to the 1 ppm value recommended by the United States Public Health Service.<sup>31</sup> However, according to archival evidence there was sparse discussion between the federal and territorial health representatives over this period.<sup>32</sup>

A medical report published in 1970 would soon change this silence. Dr. A.J. de Villiers from the Department of National Health and Welfare's Occupational Health Division led a three-year study of medical records and health surveys drawn from the population of Yellowknife. Known as the “de Villiers report,” it concluded that several symptoms of arsenic exposure—including “abnormal electrocardiographic changes,” skin lesions, and acute respiratory disease—were prevalent in both mine workers and community members in Yellowknife.<sup>33</sup> This conclusion suggested that the reductions or arsenic emissions in the 1950s had not been significant enough to prevent the effects of long-term arsenic exposure at lower doses. But the de Villiers report remained unknown to the public until an anonymous person mailed a copy to the CBC Radio show “As it Happens” in 1975. The broadcast that followed stirred widespread concern and extensive controversy over why the results had not been made public before.<sup>34</sup>

The de Villiers report raised numerous questions from the public and the medical community, and so was followed by a back and forth series of studies between Health and Welfare Canada and the National Indian Brotherhood (NIB), who collaborated with the NWT Indian Brotherhood and the University of Toronto.<sup>35</sup> In its several studies on collections of community urine samples, Health Canada determined that arsenic levels fell within “acceptable norms,” with 91.7% of Yellowknife inhabitants who had no occupational exposure showing under 5 ppm in hair follicle samples, and therefore “similar to levels in a non-exposed population.”<sup>36</sup> But the NIB was concerned for those in Yellowknife who the Health Canada studies had left out—in particular, Yellowknives Dene children from Latham Island, and from Dettah on the east side of Yellowknife Bay.<sup>37</sup> In response, NIB commissioned a study testing the hair follicle samples of Giant

workers as well as Dene and Dene children. The NIB results contradicted those of Health Canada and concluded that all people sampled carried an increased arsenic load and significantly more arsenic than the control group sampled from Whitehorse. Of the Whitehorse group, no First Nations children had 1 ppm or more of arsenic in their hair samples. In the Yellowknife group of First Nations children, all except two had more than 1 ppm.<sup>38</sup> Dr. Robert E. Jervis, University of Toronto collaborator from the Department of Chemical Engineering, concluded: “Our finding indicates a significant local environmental contamination level in Yellowknife.”<sup>39</sup>

Responding to these contradicting conclusions, in 1977 federal Minister of Health Marc Lalonde contracted an independent study through the non-profit Canadian Public Health Association (CPHA).<sup>40</sup> The CPHA was to investigate whether or not arsenic posed a serious health hazard to the Yellowknife community.<sup>41</sup> After a year of synthesizing the past decade of environmental and health studies data from the Yellowknife area and its inhabitants—data that incorporated results from those living within the greater city limits of Yellowknife, including Yellowknives Dene children from Latham Island and Dettah—the CPHA Task Force on Arsenic published their report. The report concluded that, based on exposure indicated in samples from hair and urine, the greater Yellowknife community did not display significant arsenic exposure.<sup>42</sup>

The Task Force’s conclusion most crucially relied on their determination that arsenic trioxide had a “threshold level.” In other words, they determined that arsenic, which was known to be cancer-causing, could exist at certain low levels that were non-carcinogenic in the environment and people’s bodies, regardless of the duration or chronic nature of exposure.<sup>43</sup> The CPHA argued against assertions that low-dose exposure could be dangerous, stating: “This premise would apply only if there were no threshold dose for cancer induction ... The no-threshold concept also ignores the body’s ability to detoxify arsenic in small doses.”<sup>44</sup>

Drawing from its conclusions that thresholds did exist for all substances, the CPHA suggested occupational standards at levels that contradicted those endorsed by the NIB and its partner, the United Steel Workers (USW). These organizations knew that other countries, including the United States, had established significantly lower standard levels.<sup>45</sup> At this time, the United States Occupational Safety and Health Administration had set a 10 ppm occupational ambient air standard for arsenic, which was far lower than the CPHA’s recommended 30 ppm.<sup>46</sup> Some in the toxicological medical field also criticized the report for its failure to recognize the effects of long-term low-dose exposure to arsenic.<sup>47</sup> Dr. Hector Blejer, the CPHA toxicologist consultant appointed by the USW and NIB, remained skeptical and commented that the report was “saying that thus far no data really exists to prove one thing or the other” about arsenic’s

health effects in Yellowknife.<sup>48</sup> Blejer recognized the uncertainty at hand that the Yellowknife community’s safety had yet to be proven.

There was also skepticism around the CPHA report’s attendant forty-six recommendations, which described precautions to be taken around drinking water and eating country foods, and priorities for environmental cleanup and the continued health monitoring of at-risk Yellowknife residents and workers.<sup>49</sup> The USW and NIB did support some aspects of these recommendations; they were, among other things, to set a groundwork of regular evaluation of human health and environmental standards and conditions.<sup>50</sup> But Métis Association Vice President Joe Mercredi pointed out another glaring shortcoming when he stated that it was “not clear as yet who will be enforcing the recommendations.”<sup>51</sup>

Mercredi’s question spoke directly to larger questions of Canadian federal and provincial environmental regulation. Both the federal government and the Northwest Territories government lacked regulations for air emissions. At the time the CPHA report was published, federal air emissions guidelines operated under the 1971 Clean Air Act, which had enacted a system of suggested maximum emission limits, general air quality objectives, and monitoring networks—but not enforceable limits (i.e., regulations) for specific chemical substances.<sup>52</sup> The Northwest Territories also had no regulatory body for monitoring air emissions. There was no local or territorial regulatory body equivalent to the NWT Water Board, which reviewed permitting related to industrial projects and water effluent. Community members in Yellowknife had good reason to wonder who or what would enforce the CPHA’s suggested improvements to air emissions.

But during and after the period of the CPHA investigation, the federal government did consider setting an enforceable limit—i.e., a regulation—for arsenic air emissions produced by gold roasters like Giant.<sup>53</sup> In the mid-1970s, the federal Department of Fisheries and Oceans (DFO) initiated a discussion of federal regulations after the Department of National Health and Welfare reviewed the toxicological and health effects of arsenic in its various compounds.<sup>54</sup> Having found that “arsenic emissions could constitute a significant danger to the health of persons,” federal regulators and industry representatives formed the Gold Roasting Industry Task Force on Arsenic Emissions.<sup>55</sup> Indeed, while the Yellowknife Task Force on Arsenic completed its official investigation in late 1978, some members were simultaneously meeting with the Gold Roasting Industry Task Force to weigh in on the proposed regulations.<sup>56</sup>

While the Gold Roasting Task Force continued to discuss regulations, in 1980 Giant Mine agreed to install new technology in the stack to proactively reduce emissions that would meet the pending regulations.<sup>57</sup> Reports also remarked that arsenic emissions had been successfully reduced from 76.6 mg/m<sup>3</sup> (milligrams per cubic meter) in 1975 to 14.07 mg/m<sup>3</sup> in 1981, an 81.6%

reduction which meant that Giant was already operating within the proposed regulatory limit of 20 mg/m<sup>3</sup>.<sup>58</sup>

But by the early 1980s, many members of the Gold Roasting Industry Task Force were skeptical of the proposed regulations. Dan Billing, chair of the territorial government's Standing Committee on Arsenic, repeatedly emphasized that there was no need for the enforcement of arsenic regulation at the federal level. Billing reasoned that the CPHA report in Yellowknife had determined that there was "no risk."<sup>59</sup> There was, at least, no risk of imminent death as in prior decades of Giant's history, and combined with Giant's voluntary reductions to emissions, it seemed that regulatory urgency had diminished.<sup>60</sup> Thus, while federal-level discussions of gold roaster arsenic emissions continued several years beyond the resolution of the 1977 Yellowknife Task Force on Arsenic, regulations never materialized.<sup>61</sup> This was the last gasp of federal regulatory interest in public health and arsenic air emissions around Giant Mine for the next decade. The overall result of the 1977 investigation, then, was to put to rest greater questions of public health and arsenic air emission regulation at the federal level.

#### 1990–1994: Giant Mine under Ownership of Royal Oak, Ltd.

In 1990, the American corporation Royal Oak Resources Ltd. purchased Giant Mine from owner Amour Inc. From the beginning of Royal Oak's ownership, Giant's operation was fraught with problems. Royal Oak's unpopular owner Margaret "Peggy" Witte would eventually drive the company's environmental record and labour standards to new lows, cutting costs at every opportunity to create a more efficient mining operation. As this section will discuss, even amidst Giant's plummeting reputation, and as local community members and federal investigations reinvigorated interest in public health and pollution issues at Giant Mine, Government of Northwest Territories (GNWT) regulators continued to allow Giant to exceed pollution levels. Arsenic regulation was obstructed by a government that, to guide its own decision making, relied on Giant's operating limitations.

In this policy vacuum, local activists reawakened regulatory interest in pollution and public health at Giant in April 1991. Regulators were forced to refocus their attention when Yellowknife activists Kevin O'Reilly and Chris O'Brien contacted the NWT Minister of Renewable Resources, Titus Allooloo, in a series of letters drawing attention to recent studies on sulphur dioxide and arsenic at Giant that called into question the safety of emissions.<sup>62</sup> The studies first pointed to the "premature yellowing and falling of leaves in a number of species of trees within 5 km of the Giant Stack," that appeared to result from the sulphur dioxide produced by the mine roaster, among other clearly visible signs of environmental degradation.<sup>63</sup>

Yet while sulphur dioxide provided much of the initial pressure to re-examine pollution at Giant, the request from O'Brien and O'Reilly also asked questions about arsenic. The activists' intervention reminded the NWT Department of the Environment that community concerns about arsenic had not fully dissipated since their articulation in the 1970s. But their letters also reflected larger shifts in the global awareness of arsenic toxicity and the long-term threat of carcinogens. The timing of O'Reilly and O'Brien aligned with a wider recognition of the fallibility of the threshold model that spread in the early 1990s; health organizations now officially recognized that some substances were toxic at any level.<sup>64</sup> In the case of arsenic, global health-care leaders like the World Health Organization now had adequate data drawn from long-term arsenic exposure cases, such as those of arsenic-tainted tube wells in Bangladesh in the late 1980s where poisoning occurred on a scale large enough to provide for statistically accurate epidemiology analysis.<sup>65</sup> By the early 1990s, arsenic was widely cited as a carcinogen with low-dose prolonged exposure associated with bladder, skin, and liver cancer.<sup>66</sup> The recommended dose-rate arsenic exposure varied between countries—for drinking water, the World Health Organization recommended ten parts per billion (ppb) as of 1993, although the United States Environmental Protection Agency did not adopt this recommendation until 2001.<sup>67</sup> While some toxicologists had said as much before and during the 1977 CPHA investigation, there was now growing agreement within the scientific community of the 1990s that arsenic, and all carcinogens, had no safe level of human exposure.<sup>68</sup>

Unfortunately, the NWT Department of Renewable Resource's response to the inquiry by O'Reilly and O'Brien was delayed by a controversial workers' strike from 1991 to 1993. Under the oversight of Peggy Witte, Royal Oak had adopted increasingly harsh worker and management policies after purchasing the mine in 1990: the company quickly laid off long-time workers deemed superfluous, punished accident-prone workers, and was charged with a number of mine safety violations as its non-striking employees worked overtime underground, beyond the hours allowed by the Northwest Territories Mine Health and Safety Act.<sup>69</sup> On September 18, 1992, Giant made national news when a bomb, planted by a striker, exploded in one of the underground chambers, killing nine replacement workers.<sup>70</sup> In spite of such radical actions that drew media attention, the strike continued and only ended in November 1993 after the Canada Labour Relations Board intervened.<sup>71</sup>

With the immediate chaos around the Giant strike, it was not until July 1993 that the Department of Renewable Resources completed an investigative report on arsenic and sulphur dioxide.<sup>72</sup> The report drew ambiguous conclusions on arsenic. Arsenic was a known carcinogen but lacked federal air quality guidelines to establish ideal or maximum allowable doses.<sup>73</sup> Consequently, the report stressed

that there was no urgent threat, stating: “the data, with all its limitation, does not indicate the presence of an imminent health hazard in Yellowknife as a result of emissions from the mine.”<sup>74</sup> This conclusion avoided any concrete statements or extrapolations about the overall or long-term threat of pollutants.

After examining the report for its health implications, the NWT departments of health and the environment downplayed arsenic’s threats in various reports and public statements. Commenting on arsenic’s threat level, the NWT Department of Health stated:

While arsenic is known to cause cancer, one must carefully consider the level of exposure of the population when considering potential risks. It is important to note that the levels reported in the Yellowknife area have dropped dramatically since the mine opened, and now fall within the normal range of values found in other Canadian cities.<sup>75</sup>

Through statements like this, the Department of Health attempted to normalize arsenic levels in Yellowknife. In the statement quoted above, the Department of Health misrepresented the data on Yellowknife’s airborne ambient arsenic: the NWT Renewable Resources 1989 report on “Air Quality Monitoring in the Northwest Territories” found arsenic air concentrations to be eight times *higher* than major Canadian cities.<sup>76</sup> Likewise, as was reported during the strike, ambient air arsenic samples indicated slightly higher arsenic concentrations in recent years than those past.<sup>77</sup>

Because there were no federal regulations of arsenic emissions, the territorial Department of Health resorted to using the gold roaster regulations from Ontario, the only province in Canada with enforceable limits for arsenic air emissions. The 1993 investigative report concluded, “total arsenic levels in Yellowknife air have remained at levels well below the Ontario 24-hour limit of .3 micrograms/cubic meter since 1988.”<sup>78</sup> As it happened, the Ontario limit in 1993 was the same regulation used as additional evidence in the early 1980s by the Gold Roasting Task Force on Arsenic to determine that Giant’s stack arsenic effluent was acceptable; it was also the standard that guided the federal determination that there was no need to institute arsenic regulations within the Clean Air Act.<sup>79</sup> The NWT Environmental Protection Division and Department of Renewable Resources would continue to cite the .3 microgram standard in territorial and federal discussions until at least 1996.<sup>80</sup>

The use of the Ontario limit illustrated several practical obstacles for the regulation of Giant’s arsenic emissions in the 1990s. Progress around toxicological and public health advances at Giant was blocked in large part by a federal system

whose governing body for the environment made suggested limits, rather than enforceable ones (i.e., regulations), for maximum allowable industrial emissions. In this way the Giant Mine case exemplifies what political scientists have discussed in the context of the discretionary nature of the federal environmental regulatory system being a barrier to public health protection.<sup>81</sup> Even as environmental regulation and bureaucracy had increased through the 1970s and 1980s, there was not in 1993, just as there is not in present day Canada, a federal law governing enforceable air emissions standards for most substances.<sup>82</sup> Indeed, the Northwest Territories also still had no air regulations, to speak of, for roaster stacks.<sup>83</sup>

It is also possible federal regulation of airborne arsenic was further complicated by the atypical nature of Giant’s ore-processing methods. At this time in history, Giant was one of the few point sources of airborne arsenic in North America. In Canada, there had only been four other roasters operating as far back as 1972.<sup>84</sup> There were three in Ontario (hence Ontario’s regulations), and one that had recently closed in British Columbia.<sup>85</sup> None of these roasters were operating by 1994, as all had closed for environmental, economic, or safety concerns.<sup>86</sup> Giant was one of the last of an uncommon kind, which made for only a few dated references for the capacity of its equipment under contemporary notions of pollution reduction.

While the lack of direct regulation and comparable industrial operations left the Department of Renewable Resources searching for legitimate standards in response to the request from O’Reilly and O’Brien, federal health regulators were increasingly less convinced of the Ontario limit’s utility. Accordingly, they warned the NWT Department of Health that the Ontario limit was dated and unreliable. In a letter to Dr. Ian Gilchrist, the Medical Director of Northwest Territories Health, the Director General of Federal Environmental Health J.R. Hickman commented as a medical professional on the 1993 report, making clear that, while there were no *imminent* risks associated with the levels of arsenic represented, the Ontario standard was an unreliable one for comparison with Giant Mine. Hickman noted:

In comparing your 24-hour levels to the Ontario standard of .3 micrograms per cubic meter, we would caution that the Ontario standard was based on epidemiologic studies of cancer incidence in workers in industrial settings of high exposure. It is our understanding that this standard is under revision in order to take into account more recent scientific findings.<sup>87</sup>

Hickman stressed that the Ontario standard was as an *occupational* standard, established for high-exposure industrial professions, not public or environmental

health. Occupational exposure standards have typically been established at higher thresholds under the assumption that workers are exposed only while working—that is, for shorter periods of time—compared to people in a community near a contaminant point source where people would be exposed all of the time.<sup>88</sup> Regardless, according to Hickman, the Ontario standard was in the process of being revised to reflect more up-to-date scientific understanding. The Ontario standard, in other words, was not suitable for establishing environmental standards to protect human health in any context. Yet, despite the federal government’s warnings, the Department of Renewable Resources and NWT Health continued to use it.

However, because there was still a consensus that “arsenic should be kept to the lowest levels possible,” or “reduced wherever possible,” territorial government officials did ask Giant to lower emissions.<sup>89</sup> Soon after the Department of Renewable Resources published the 1993 investigative report, officials from the territorial Department of Health and Department of Renewable Resources began to meet with Giant officials and encouraged them to reduce emissions as a “good corporate citizen.”<sup>90</sup> Without regulations for arsenic in Canada, all the territorial government could do was ask Giant to comply voluntarily.<sup>91</sup> Officials at Royal Oak Mines were not interested. According to July 1993 news releases, Royal Oak refused to attempt lowered emissions rates, as “the technology needed to cut that level of emission is still too expensive.”<sup>92</sup> Giant made it clear that it would not participate in emission reductions that could negatively affect their bottom line.

Though the federal Department of Health had cautioned the NWT Department of Renewable Resources about using the Ontario limit, it did not intervene further other than to review and respond to the NWT 1993 report.<sup>93</sup> Correspondence between the Health Canada Priority Chemicals Section and the Criteria Section, and the NWT Medical Directorate, also reveal that the federal government did not consider direct interference, in part because Environment Canada was investigating whether arsenic and all of its non-organic compounds should be added to the pending 1994 federal Priority Substances List. As Dr. Hickman of the Environmental Health Directorate explained to the Director of NWT Health Dr. Gilchrist:

Arsenic is currently under review as part of the CEPA [Canadian Environmental Protection Act] Priority List Evaluations. Based on the outcome of this assessment, which includes an assessment of both toxicity and exposure, an air quality guideline will possibly be established.<sup>94</sup>

Finally, in 1994, arsenic in all its forms was listed as a priority substance and officially included under the Canadian Environmental Protection Act (CEPA). In reference to the plan of action necessitated by this listing, the Priority Substances List Assessment Report stated, “this approach is consistent with the objective that exposure to non-threshold toxicants should be reduced, wherever possible, and obviates the need to establish an arbitrary *de minimis* level of risk for determination of “toxic” under the Act.”<sup>95</sup>

### 1994–1998: New Investigations until Closure

After Environment Canada officially placed arsenic on the Priority Substances List, any situation concerning arsenic pollution entered the realm of federal interests under CEPA. This designation came at the same time as Environment Canada’s larger planned review of CEPA efficacy—for the first time since the legislation’s initial enactment in 1988.<sup>96</sup> In 1995, as a part of Environment Canada’s broader mandate to reform and improve CEPA, the House of Commons Standing Committee on Environment and Sustainable Development was tasked with conducting public hearings in communities across Canada to allow Canadian citizens to speak on their experience and concerns with local environmental issues.<sup>97</sup> Yellowknife was one of those communities.<sup>98</sup>

In the report that followed, the CEPA committee was highly critical of the current and past state of arsenic management around Giant Mine. Committee members were perplexed that arsenic could be such a historically troublesome issue in Yellowknife, yet remain unresolved even as toxicological breakthroughs had been integrated into federal government recommendations over the previous five years. In particular, the committee pointed to the contradicting conclusions between federal regulators and NWT health and environmental agencies: Environment Canada and Health Canada had concluded in 1993 that “the current concentrations of inorganic arsenic in Canada may be harmful to the environment and may constitute a danger in Canada to human life or health.”<sup>99</sup> At the same time, territorial regulators had concluded that drinking water was safe under Water Board Regulations and that air emissions were satisfactory under the Ontario standard.<sup>100</sup> In its concluding report, the CEPA committee thus found, “the apparent inconsistency between the reassuring conclusions reached regarding the safety of Yellowknife air and drinking water on the one hand, and the toxicity finding on the other, to be disturbing.”<sup>101</sup> The committee recommended that the minister of health and the minister of the environment come up with an action plan by December 1995 to address this inconsistency.<sup>102</sup>

The CEPA committee’s statement illustrated a tension that political scientists have described between federal and provincial regulators—namely, that the discretionary nature of the Canadian system creates more ambiguities



for provincial regulators to negotiate on a case-by-case basis.<sup>103</sup> Giant Mine was located in a territory, rather than a province, and each Canadian territory has had its own processes and timelines of devolution. As highlighted earlier, long before the mid-1990s the Northwest Territories had well-established their own body for regulating water through the territorial Northwest Territories Water Act under the Mackenzie Valley Land and Water Board, but created no equivalent regulatory body in relation to air pollution. It appeared that the question of jurisdiction on the matter was unclear to many even in the upper ranks of federal and territorial environmental regulation, as transcripts from the 1995 CEPA hearing suggest.<sup>104</sup> When the topic of federal versus territorial jurisdiction over air regulation arose, Silas Arngna'naaq, Minister of Renewable Resources for the Government of the Northwest Territories, stated:

The Government of the Northwest Territories has a number of complications compared to other jurisdictions in the provinces, simply because we don't have the authority in some cases to work with what would come naturally for a provincial jurisdiction ... even in the Canadian Environmental Protection Act there is confusion as to who is responsible for what. Because of the way the act is written, it is not clearly stated who will be responsible. So some things are up in the air. We don't know who is responsible for what.<sup>105</sup>

Clearly there was significant confusion. The aforementioned insights of political scientists are even stronger in the case of Giant Mine: territorial regulators were not exercising their ability to act because of their economic interest in Giant Mine, *and also* because it was unclear if they had the ability to act at all. This uncertainty made it even easier for territorial governments to privilege discourses of economic growth over those of public health.<sup>106</sup>

Yet, even as the CEPA committee met in 1995, regulators at the territorial level were shifting their discussions of arsenic risks. With the 1994 placement of inorganic arsenic on the Priority Substances List, the territorial government revived its interest in reducing ambient arsenic from the year before—the listing meant that a minimum level of arsenic exposure had to be more concretely determined. In NWT statements and correspondence, arsenic was no longer a *possible* carcinogen as the Department of Renewable Resources had claimed in 1993 but, rather, a known one. In 1995 the department officially stated: “any exposure presents some level of risk.”<sup>107</sup> Local Yellowknife governance structures soon followed suit when the municipal government, which had a stake in the Giant debate as the mine was within city limits, also demanded that the territorial

and federal governments “take immediate steps to introduce enforceable binding regulation dealing with sulphur dioxide and arsenic.”<sup>108</sup>

Despite the conclusions of federal and territorial regulators that arsenic should be significantly reduced, Royal Oak still resisted reducing pollution levels. Royal Oak responded in a similar fashion as with the 1993 Department of Renewable Resources arsenic reduction recommendations, except now they flatly refused to stay open if their emission limits were lowered.<sup>109</sup> In a letter to Yellowknife Mayor David Lovell on October 4, 1995, Sade E. El-Alfy, Vice President of Royal Oak, threatened that, should the effluent levels proposed by city council be adopted, Royal Oak would be forced to shut down Giant Mine because of the logistical and economic strains such regulation would effect.<sup>110</sup> He noted, in a passage worth quoting at length:

The implementation by either the federal or territorial level of government of new regulation, that is specifically intended to render the fluid bed roasting process employed at the Giant Mine obsolete, would have dire consequences on the continued economic viability of the mine ... Royal Oak will continue to make its business decisions with due regard to all applicable legislation and regulation imposed by duly elected governments. These decisions will be based on the economics of the individual mine but at no time will Royal Oak continue to operate where a mine has to be economically subsidized over an extended period.<sup>111</sup>

If regulatory standards became more stringent, the roaster would require extensive technical upgrades, and the mine, according to El-Alfy, would close. Giant knew its technical capacity could exercise a weighty influence on enforcement decisions. In response, activists O'Reilly and O'Brien vigorously criticized Royal Oak's claims. In statements to the press, O'Reilly repeatedly pointed out that updated technology was available and utilized within other mines and provinces in southern Canada.<sup>112</sup> According to O'Brien, Royal Oak was merely refusing to make the investment: “the technology exists to clean up this problem. But Royal Oak simply is not willing to do it, even though they seem to have found enough money to make a takeover bid of Lac Minerals and acquire new properties.”<sup>113</sup> To O'Reilly and O'Brien, Royal Oak's refusal to invest in upgraded equipment was guided by profit priorities, rather than technical constraints.

Yet, regulators would prove ultimately unwilling to push past Royal Oak's defiant stance, despite the CEPA committee's 1995 demand for action; historical records show no sign of Environment Canada's discussions approaching a concrete regulation to enforce for Giant Mine. As far as their investigations

went, Environment Canada could not find substantial concrete toxicological or statistical health evidence to determine what action Royal Oak should take to reduce air emissions.

In response to the CEPA committee's conclusions Environment Canada completed and published a series of socio-economic studies that concluded pursuing the discussion of ideal pollution limits should not be determined by health and toxicological science. In the 1996 report titled "Socio-Economic Analysis of Three Management Options to Reduce Atmospheric Emissions of Arsenic from Gold Roasting," researchers analyzed the cost of different ways that air emissions could be significantly reduced (to less than 1.0 mg/m<sup>3</sup>) and what benefit reductions would have on community health in the Yellowknife area. Health unknowns aside, the reports commissioned by Environment Canada suggested that the technologies most commonly used to reduce arsenic trioxide would not be cost-effective.<sup>114</sup> The reports determined, first, that technical options for reducing arsenic air emissions—that is, updating the roasting process with scrubbers, biological leaching, or atmospheric leaching—would place too much financial burden on Giant Mine and cause it to close.<sup>115</sup> The socio-economic analysis further stated that significantly reducing arsenic air emissions through official government, industry, and community negotiations, such as a covenant or structured voluntary agreement (SVA), would also likely cause the mine to close.<sup>116</sup> It noted, "there do not appear to be compelling reasons that might induce Royal Oak Mines to negotiate an agreement focused exclusively on atmospheric arsenic emissions with either the community or the government."<sup>117</sup>

The report also included a section of health-oriented risk analysis based on environmental data, which predicted the long-term effect of airborne arsenic on cancer rates at current estimated exposure rates in the Yellowknife area. The report determined that the current levels of arsenic emissions would correlate to an increased cancer risk that, with the population of 15,175 (Statistics Canada 1993): "translates to between .14 and .86 additional deaths due to lung cancer attributable to exposure to airborne arsenic via inhalation over the 70 years life span of the exposed population."<sup>118</sup>

After qualifying the health risk involved in allowing pollution to continue unchecked, and the benefit of reducing emissions to almost zero, the report went on to compare the estimated health benefits to the costs of achieving them—which it already had concluded would cause the mine to shut town.<sup>119</sup> While a prior Environment Canada report predicted that the suggested updates to the roaster would significantly reduce arsenic emissions, the 1996 socio-economic analysis concluded that the cost of performing such updates, in addition to the cost of regulating and negotiating with Giant in the process, would outweigh the benefits to human health in the community, namely because the mine would shut

down.<sup>120</sup> This conclusion was further cited and supported in a later discussion paper issued by Environment Canada, Health Canada, and GNWT Health and Social Services in April of 1997.<sup>121</sup>

But the socio-economic report also admitted that if more concrete knowledge on the behaviour of arsenic was found to exist, in addition to any data that could reflect the actual exposure rates of people in the Yellowknife community, their conclusions could very well be different.<sup>122</sup> The report pointed out that there were, first, a multitude of variables that would affect exposure rates of people in Yellowknife, such as the age and time span living in Yellowknife.<sup>123</sup> The report also noted the uncertainties inherent in the estimations of cancer risk.<sup>124</sup> The socio-economic report stressed the unfading obstacle of toxicological uncertainty: "Estimation of the overall potential benefits associated with these reductions is extremely difficult due to data limitations and prevailing scientific uncertainty about the behaviour of arsenic ... considerable uncertainty surrounds estimates of health effects at the very low concentrations observed in Yellowknife air."<sup>125</sup> This statement conceptually aligns with historians of toxicology and their descriptions of the problem of proving the causality of low-dose exposure and illness—that the muddle of potential exposures and varying times of exposure was too complex to draw conclusions.<sup>126</sup> The Environment Canada socio-economic analysis suggested that technical updates *might* significantly improve health risks. But given the costs, and uncertain value of using additional studies to prove such health hazards (epidemiological studies or demographic studies of nearby First Nations communities, for example), the socio-economic study could not endorse a certain plan for arsenic reduction based on health.

Regulators were therefore left at an impasse: according to these conclusions, they had no clear way to follow the CEPA committee's request without shutting down the mine. This scenario was a prime example of toxicology historians' observations of the historical move from "risk analysis" to "risk management" to cope with toxicological uncertainty.<sup>127</sup> Since the data related to human health failed to provide the certainty required to make a decision, regulators instead used political and economic rationale.<sup>128</sup> Eliminating the source of risk by shutting down the mine was assumed to not be an option. After five decades of discussing the arsenic at Giant Mine, NWT regulators and Environment Canada regulators finally had a means through which to enforce a regulation, but they lacked the will.

As a result, the instances where Royal Oak publicly dug in its heels dramatically shaped the conclusions of the federal-led investigations that followed from the CEPA committee's 1995 demand for action. The subsequent studies conducted by Environment Canada, Health Canada, and various GNWT departments did little to determine what level of arsenic was outright "safe" for community health. Instead, these studies from 1996-1997 concluded what

levels of arsenic were *realistic*, based primarily on technical and socio-economic factors. Between the fundamental uncertainties of arsenic trioxide's toxicological mechanism, and the demographic exposure variables, Royal Oak's unwillingness to negotiate set the parameters for arsenic limit levels that regulators would push.

There was an echo to these reports in the sentiment of local voices as expressed in public hearings and workshops over the same time period. Though Giant was unpopular with many locals (thanks largely to their dramatic labour relations earlier in the decade), many also expressed that Giant should remain open—or, at least, not *necessarily* shut down. In a 1997 public workshop where participants reviewed the Environment Canada CEPA response reports, groups of Yellowknife residents offered their opinions of what and how arsenic air emissions at Giant should be reduced. According to the report responses, no one raised the matter of whether or not Giant should continue to operate.<sup>129</sup> But in order to establish and implement effective rules under CEPA, participant groups also called for heightened accountability for pollution at Giant Mine: groups consistently called for significant “penalties” and “incentives to discourage non-compliance” such as larger performance bonds.<sup>130</sup> In essence, many locals wanted the economic benefits—taxes, jobs, utility payments—that Giant had to offer, but did not want Royal Oak to run the show. Ironically, giving Giant more leeway to follow regulations at its convenience, rather than hold it accountable, was exactly what regulators suggested was necessary to keep Giant operational.

Outside of these official consultation sessions, there were those who were more directly critical of the mine and the regulators overseeing it. While O'Reilly and O'Brien continued to monitor the mine via local non-governmental organizations, from the time of the CEPA hearings onward, local Métis and Yellowknives Dene members increased their advocacy in public hearings, letters, and press releases.<sup>131</sup> In the 1998 Water Board meeting, Dene Nation Chief Bill Erasmus and Yellowknives Dene Chief Fred Sangris gave statements on the future of Giant's water use permit in Yellowknife. Not only did these leaders not believe that Giant should receive a permit under then current conditions, but they also spoke out against the general conditions the mine had created for their communities both past and present.<sup>132</sup> Chief Sangris stated:

I would also like to remind you that even to this day, my people can't use the water. The fish are contaminated. My people are dying of cancer. In the last five years, cancer has risen very high. We live right across from Giant Mine and we can see the Giant stack. People still fish, still hunt for traditional food, still pick berries and still gather wood for firewood and cooking. Developers and explorations don't have any respect for my people's way of life or what is important to them.<sup>133</sup>

Bob Turner, representing the North Slave Métis Alliance, followed with a presentation in a similar vein, and also stated his concern for the lack of accessible information offered to the public:

I think we all know that the Mine is polluting our environment. We have experts saying discharge water is below allowable limits. What our people need is assurance that we can understand. At these points of discharge, where they say the allowable limits are drinkable, I think we would agree with it if we were to see these experts drinking that water. If not, the recommendation we would like to make is for the safety of the public because we hear, unofficially, you sure wouldn't want to drink that water.<sup>134</sup>

Chief Sangris's and Bob Turner's statements were clear examples of the mistrust built over the decades. Both illustrated the decades old issue of environmental regulation being established with little regard for different ways of living outside of the conventional southern Canadian norm; established standards of toxic exposure did not consider the interests of those who relied on country foods as a primary food source and relied on the lake for drinking water. Chief Sangris and Turner were less focused on economic development as they were still concerned with the fundamental, physical safety of the Yellowknives Dene and Métis communities.

As the investigations continued and branched out into community consultations in 1997 and 1998, other discussions of regulating arsenic emissions at Giant were replaced by discussions of how to keep Giant open at all. While this might be the product of a potential gap in archival material (or the author's inability to locate it), Environment Canada was unable to make an official decision before attention had shifted to Giant's looming debts and the still unaddressed arsenic accumulating underground. Regulators became increasingly worried about the 237,000 tons of arsenic accumulated and stored in underground mine shafts under Giant. The arsenic had been amassing underground since the early 1950s when the owner at the time, the Consolidated Mining and Smelting Company (CM&S), reduced Giant's initial air emissions rate by installing an electrostatic precipitator to capture arsenic.<sup>135</sup> Though this technology dramatically reduced the airborne arsenic emitted, the captured arsenic had to go somewhere.<sup>136</sup> Storing the arsenic underground had been a “temporary” solution—in the decades following, regulators and community members had posed questions about the underground arsenic but it had repeatedly been put off, and the arsenic stockpile continued to build.

Questions about the underground arsenic arose in discussions around the 1998 Water Board hearing when federal and territorial representatives questioned

Giant's failure—and later outright refusal—to submit an Abandonment and Restoration (A&R) plan as it had originally agreed in their 1993 water licence. Instead, the company requested an extension on the A&R plan until 2000.<sup>137</sup> An A&R plan was standard procedure for mine operation and licensing and would have forced Royal Oak to account for cleaning up and restoring the mine site to non-hazardous and contained status whenever the mine closed. This A&R proposal demanded that Royal Oak make a plan for the stored arsenic.<sup>138</sup>

Royal Oak blamed their delay with the Water Board review process on a lacklustre gold market, which had caused a diminishing cash flow and operational capacity.<sup>139</sup> Royal Oak was indeed struggling financially. As of late December 1997, the company was \$122.8 million dollars in debt.<sup>140</sup> As Larry Connell, Royal Oak's manager of environmental services, explained to the NWT Water Board in 1999:

... in reality little progress was made during the fourth quarter of 1998 on advancing proposals for the extraction and recovery of the baghouse material from the existing underground storage vaults ... the current low gold and copper prices have created a severe cash flow and liquidity problem at Royal Oak.<sup>141</sup>

Royal Oak was struggling to complete a new mine in British Columbia—once this was operational, and the price of gold stabilized over the next few years, Royal Oak claimed that the company would be able to run more smoothly.<sup>142</sup>

Now, with Royal Oak's growing financial instability and lacklustre environmental record, and with no up-to-date approved plans for post-closure cleanup, regulators were growing more uneasy about the still unaddressed underground arsenic. Despite their concern, keeping the mine open remained a priority for territorial and municipal regulators in the Northwest Territories and Yellowknife, even if it meant temporarily subsidizing the mine and giving Royal Oak more latitude following regulations. In 1998, the Water Board provided Royal Oak with a seven-month extension to form a remediation plan for the stored arsenic underground, just as the territorial government, under the leadership of the Department of Resources, Wildlife, and Economic Development, developed a seven-year program to subsidize \$1.5 million in further exploration and development for gold.<sup>143</sup> The City of Yellowknife was also preparing to provide funding.<sup>144</sup> But the remediation plan was never completed. On April 16, 1999, Giant went into receivership and every member of the board of directors resigned.<sup>145</sup> By this time Royal Oak owed over \$14 million to creditors in the local Yellowknife area.<sup>146</sup>

From 1991 to 1999, controversy over arsenic, pollution, and public health arose when low-dose exposure was better understood. Yet, territorial and federal regulators' failure to take stronger action to regulate Giant raises the research question: was the definition of lowest acceptable level of exposure at all different from the "lowest possible" amount of arsenic effluent that could be economically produced by Giant Mine? Regulators knew arsenic was dangerous. But the regulatory discussion in the 1990s suggests that curbing Giant Mine's arsenic problem was not just a matter of designating arsenic as officially toxic, with established *enforceable* limits. Nor was it as simple as declaring it a non-threshold carcinogen. The 1990s Giant Mine debacle was also defined by the way in which regulators kept Giant—an uncooperative, highly indebted mine using outdated technology—in operation. Environment Canada did attempt to follow the CEPA committee's recommendations in conducting their investigation. But for a controversy spurred by concern for human health, there was little investigation of actual human health risks once they were deemed too uncertain to be concretely established. Instead, these studies paid more attention to Giant's presence as an economic benefactor in Yellowknife by letting Giant's technical shortcomings guide regulators' rationale for arsenic management.<sup>147</sup>

## Conclusion

Giant Mine is a blemish of near-unprecedented scale in the history of environment and toxins regulation in Canada. The shocking quantity of arsenic stored underground—and the current estimated \$900 million cleanup—can overshadow the legacy of arsenic left around the surface of the mine.<sup>148</sup> The 237,000 tonnes of underground arsenic may be enough to kill the world's population several times over, but unknown quantities of surface dust and debris remain. Why did regulatory discussions of arsenic and public health fail to make substantive progress past the 1977 Canadian Public Health Association report? To this day it is not known how detrimental these arsenic traces could be.

Progress on the pollution issue at Giant Mine was inhibited by conflicting governance priorities and the territorial departments' unwillingness to push past Royal Oak's refusal to be regulated. The vagueness of Canadian environmental law in a territory with no air regulations further exacerbated the situation. But even after scientific and activist concern around arsenic became strong enough to warrant federal involvement in 1995, Environment Canada's subsequent studies continued to assume that Giant Mine must remain open. Considering the assertion of political scientists that regulators are more easily swayed by the lure of economic interests at the territorial and provincial level, it was not surprising that the Northwest Territories government would support industry above hazy threats of toxicological risk, even to the extent that they would elect to subsidize

Giant to keep it running.<sup>149</sup> But even Environment Canada, a federal regulator, was slow to take a definitive stance with on-the-ground implementation, and had inadvertently aligned its conclusions with the interests of Royal Oak.

In the course of addressing the arsenic issue at Giant Mine, the federal government—Environment Canada, Health Canada, Indian Affairs and Northern Development, Environmental Protection Services—set aside emerging evidence of potential exposure risks. Historians of toxins exposure regulations argue that science is not a stand-alone object; that scientific conclusions and systems of thought are not immune to political, social, and historical contingencies and assumptions.<sup>150</sup> And so the process of translating any science into public policy and decision making is complex. In the uncertainties that resulted, regulatory agencies (both territorial or federal) sought pollution limits that were, if not certifiably correct according to environmental health specifications, then technically and economically realistic. But this regulatory tack allowed Royal Oak to leverage their financial limitations and technical incapacities against toxicological uncertainty.<sup>151</sup> Regulators were unable to produce unassailable arguments that Giant should reduce arsenic air emissions—not because evidence between health and exposure risks did not exist, but because available data could not correspond to the reductive templates of cause-and-effect needed to compel regulatory decisions.<sup>152</sup>

Returning to the 1998 NWT Water Board hearing and Dr. Bill Cullen's observation that government recommendations essentially remained the same in 1994 as thirty years earlier, it must be noted that the substance of these respective investigations were quite different from each other. The 1977 CPHA report took test samples from the hair and urine of people around Yellowknife and concluded that some arsenic accumulated in a human body was acceptable. But in Giant's last five years of operation, actual human health testing was not conducted—there was too much uncertainty to know if it was worth the expense. The arsenic inquiry at Giant Mine was only within the scope of regulatory investigative abilities if studies excised toxicological uncertainties and their associated health questions. By the end, the Environment Canada pollution investigations were hardly a question of health at all.

Judging by the past decade of government approach to the Giant Mine cleanup, there has been a significant attitudinal shift since the 1994 Environment Canada investigations. In acknowledging several generations of unaddressed concerns around arsenic in Yellowknife—particularly for the Yellowknives Dene First Nation—studies are being conducted to characterize the traces of arsenic from Giant Mine in the greater Yellowknife area. In November 2017, as mandated in 2014 by the Mackenzie Valley Environmental Impact Review Board in Giant Mine's remediation plan, a research team began taking samples of toenail clippings, urine, and saliva from local Yellowknife residents as part of the

Health Effects Monitoring Program: “the most comprehensive study undertaken on the concentration of mine contaminants in people living in Yellowknife.”<sup>153</sup> By many accounts, then, territorial and federal regulators have learned from the questions left hanging from the 1990s arsenic investigations. When regulators decided to dispel uncertainty around the long-defunct Giant Mine, the result has not only strengthened scientific certainty of the health threat of arsenic, but also created greater trust from a community that has lived for several generations in the presence of Giant Mine and its pollutants. Studies like the Health Effects Monitoring Program are a way for government and regulators to recognize local concerns. Even if neither government nor science can fully understand how arsenic behaves at the molecular and cellular level, they may at least understand, and respond to, the concerns of the Yellowknife community.

## Notes

1. Northwest Territories Water Board Public Hearing, “Application by Royal Oak Mines Inc. Giant Mine for Water Use and Waste Disposal in a Mining and Milling Undertaking Water License N1 L2-0043,” Yellowknife, NWT, January 28/29, 1998, 58, Mackenzie Valley Land and Water Board
2. Frank J. Tester, D.E. Lambert, and T.W. Lim, “Wistful Thinking: Making Inuit Labour and the Nanisivik Mine Near Ikpiarjuk (Arctic Bay), Northern Baffin Island,” *Études/Inuit/Studies* 37, no.2 (2013): 15–36, <https://doi.org/10.7202/1025708ar>; John Sandlos and Arn Keeling, “Ghost Towns and Zombie Mines: The Historical Dimensions of Mine Abandonment, Reclamation and Redevelopment in the Canadian North,” in *Ice Blink: Navigating Northern Environmental History*, ed. Stephen Bocking and Brad Martin (Calgary: University of Calgary Press, 2017), 377–420; John Sandlos and Arn Keeling, “Toxic Legacies, Slow Violence and Environmental Injustice at Giant Mine, Northwest Territories,” *The Northern Review* 42 (2016): 7–2, <https://doi.org/10.22584/nr42.2016.002>; John Sandlos and Arn Keeling, “Claiming the New North: Development and Colonialism at the Pine Point Mine, Northwest Territories, Canada,” *Environment and History* 18 (2012):5–34, <https://www.jstor.org/stable/23250891>.
3. As historian Nancy Langston described of the early use of the endocrine disruptor diethylstilbestrol (DES), regulators in the 1940s were unable to keep up with the rate at which technology and industry expanded during this period. Nancy Langston, “Precaution and the History of Endocrine Disruptors,” in *Powerless Science?: Science and Politics in a Toxic World*, ed. Soraya Boudia and Nathalie Jas (New York: Berghahn Books, 2014): 29–38; Nancy Langston, *Toxic Bodies: Hormone Disruptors and the Legacy of DES* (London: Yale University Press, 2010); Christopher Sellers, *Hazards of the Job: From Industrial Disease to Environmental Health Science* (Chapel Hill: The University of North Carolina Press, 1997); Linda Nash, *Inescapable Ecologies: A History of Environment, Disease, and Knowledge* (London:

- University of California Press, 2007); Sarah A Vogel, "From 'the Dose Makes the Poison' to 'the Timing Makes the Poison': Conceptualizing Risk in the Synthetic Age," *Environmental History* 13 (October 2008): 667–673, <https://www.jstor.org/stable/25473294>.
4. Ibid.
  5. Or, depending on the country and regulatory department, "Maximum Allowable Concentration" or "Acceptable Daily Intake."
  6. Linda Nash, "Purity and Danger: Historical Reflections on the Regulation of Environmental Pollutants," *Environmental History* 13, no. 4 (Oct 2008), 651–658, <https://www.jstor.org/stable/25473292>; Nash, *Inescapable Ecologies*, 143–161.
  7. Nash, *Inescapable Ecologies*, 127–179.
  8. Soraya Boudia, "Managing Scientific Risk and Political Uncertainty: Environmental Risk Assessment in a Historical Perspective," in *Powerless Science?: Science and Politics in a Toxic World*, ed. Soraya Boudia and Nathalie Jas (New York: Berghahn Books, 2014): 95–97; Langston, *Toxic Bodies*; Vogel, "From 'the Dose Makes the Poison,'" 667–673.
  9. Langston, "Precaution and the History of Endocrine Disruptors"; Vogel, "From 'the Dose Makes the Poison'"; Boudia, "Managing Scientific Risk".
  10. Vogel, "From 'the Dose Makes the Poison,'" 669.
  11. Soraya Boudia and Nathalie Jas, "Introduction: The Greatness and Misery of Science in a Toxic World," in *Powerless Science?: Science and Politics in a Toxic World*, eds. Soraya Boudia and Nathalie Jas (New York: Berghahn Books, 2014); See also: Soraya Boudia and Nathalie Jas, *Studies for the Society for the Social History of Medicine: Toxicants, Health and Regulation Since 1945* (New York: Routledge, 2013); Soraya Boudia, "Managing Scientific Risk and Political Uncertainty," 95.
  12. Olive, Andrea. *The Canadian Environment in Political Context* (Toronto: University of Toronto Press, 2016), 142; Boudia and Jas, "Introduction," 11.
  13. The notion of expanding bureaucracy is implicit in my references to the formation of new federal and provincial ministries to protect the environment and environmental health, thus "Canada has many laws, regulations, policies, and institutions intended to protect the environment, at the federal, provincial, and local levels. Most were created in the last three decades, as the need to protect the environment from human despoliation became increasingly clear": David Richard Boyd, *Unnatural Law: Rethinking Canadian Environmental Law and Policy* (Vancouver: UBC Press, 2003), 11.
  14. Boyd, *Unnatural Law*, 231; See also Robert Paehlke and Douglas Torgerson, *Managing Leviathan: Environmental Politics and the Administrative State* (Peterborough, ON: Broadview Press 2005).
  15. Kathryn Harrison and George Hoberg, *Risk, Science and Politics: Regulating Toxic Substances in Canada and the United States* (Montreal and Kingston: McGill-Queen's University Press, 1994), 6–21; Kathryn Harrison, *Passing the Buck: Federalism and Canadian Environmental Policy* (Vancouver: UBC Press, 1996).
  16. Douglas Macdonald, *Business and Environmental Politics in Canada* (Ontario: Broadview Press, 2007).
  17. Macdonald, *Business*, 5–7, 95–103, 130–134; Boyd, *Unnatural Law*, 203, 255, footnote 27; Harrison, *Passing the Buck*, 17.
  18. Robert B. Gibson, "We Just Don't Know: Lessons about Complexity and Uncertainty in Canadian Environmental Politics," in *Managing Leviathan: Environmental Politics and the Administrative State*, eds. Robert Paehlke and Douglas Torgerson (Peterborough, ON: Broadview, 2<sup>nd</sup> Edition, 2005), 162–170. Gibson predates Langston and Nash but makes near-identical assertions of the importance of thresholds in toxicological modelling. From his case study on lead poisoning in Toronto in 1965, Gibson concludes: "*Environmental health cause-effect relations can be exceedingly difficult, if not impossible, to prove.* This is the case even when the questions involve a single contaminant acting on a reasonably well-defined population of receptors (e.g., children in specific neighbourhoods). Years of research effort and shelves of carefully designed studies may still leave uncertainties about the threshold exposure and ingestion levels beyond which health damage may occur. Indeed, it is not safe to assume there is such a threshold. Because of the multiplicity of sources, it is difficult to link particular sources to particular exposures. And because of the multiplicity of influences on health, it is difficult to link particular exposures to particular health effects": Gibson, "We Just Don't Know," 148.
  19. Gibson, "We Just Don't Know," 145.
  20. Ibid.
  21. Ibid., 148–149.
  22. Sandlos and Keeling, "Toxic Legacies," 7–2; John Sandlos and Arn Keeling, "Ghost Towns and Zombie Mines," 377–420; For additional relevant work on colonial dispossession and industrial waste see also: Traci Brynne Voyles, *Wastelanding: Legacies of Uranium Mining in Navajo Country* (Minneapolis: University of Minnesota Press, 2015), 1–13; Nancy Langston, "Toxic Inequities: Chemical Exposures and Indigenous Communities in Canada and the United States," *Natural Resources Journal* 50, 2(2010): 393–406, <https://www.jstor.org/stable/24889683>; Richard S. Newman, *Love Canal: A Toxic History from Colonial Times to the Present* (New York: Oxford University Press, 2016).
  23. Liza Piper, *The Industrial Transformation of Subarctic Canada* (Vancouver: University of British Columbia Press, 2008), 83, 117–119.
  24. 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 (Calgary: University of Calgary Press, 2015), 342–343.
  25. Sandlos and Keeling, "Claiming the New North," 3.
  26. Lloyd Tataryn, "Arsenic and Red Tape," in *Dying for a Living* (Ottawa: Deneau and Greenburg Publishers Ltd., 1979), 112–114.
  27. See for example the words of Rachel Ann Crapeau and Therese Sangris, who spoke of four children dying in the spring of 1951, among others who died in rising rates of cancer over the decades. Yellowknives Dene, "Impact of the Yellowknife Gold mine on the Yellowknives Dene: A Traditional Knowledge report" (Dettah: Yellowknives Dene First Nation Council, 2005), 16–17.

28. John Sandlos and Arn Keeling, "Giant Mine: Historical Summary," Report submitted to the Mackenzie Valley Environmental Impact Review Board (St. John's, NL: Memorial University, 2012), 2, accessed February 23, 2016, [http://www.reviewboard.ca/upload/project\\_document/EA0809-001\\_Giant\\_Mine\\_History\\_Summary.PDF](http://www.reviewboard.ca/upload/project_document/EA0809-001_Giant_Mine_History_Summary.PDF).
29. O'Reilly, "Liability, Legacy, and Perpetual Care," 347.
30. Sandlos and Keeling, "Giant Mine: Historical Summary," 6–10.
31. Ibid, 9–12.
32. Ibid, 10.
33. A.J. de Villiers and P.M. Baker, "An investigation of the health status of inhabitants of Yellowknife, Northwest Territories" (Ottawa: Canada Department of Health and Welfare, 1970), LAC RG 29 vol. 2977, file 851-5-2, pt. 4.
34. Tataryn, *Dying for a Living*, 112.
35. Canada Department of Health and Welfare, "News Release: Yellowknife Arsenic Study Results Published" (May 27, 1975), LAC, RG29 accession 1996-97-706, box 6, file 8726-1-1, vol. 2.
36. Canada Department of Health and Welfare, "News Release," May 27, 1975.
37. Ibid.; Tataryn, *Dying for a Living*, 118–119.
38. Tataryn, *Dying for a Living*, 117, 130; Statement by Prof. Robert E. Jervis, Department of Chemical Engineering and Applied Chemistry, and Institute of Environmental Studies, Re: Yellowknife Arsenic Pollution Problem, University of Toronto, 15 January 1977, University of Alberta Library.
39. Ibid.
40. Canadian Public Health Association, *Task Force on Arsenic: Final Report, Yellowknife, Northwest Territories* (Ottawa: The Association, 1977), 24.
41. CPHA, *Task Force*, 24.
42. CPHA, *Task Force*, 11–13, 44, 67, 107–112.
43. CPHA, *Task Force*, 93–95. See CPHA, *Task Force*, 89 for discussion of the existence of a cancer-causing threshold and proof of dose-rate relationship. For additional connection to the academic literature, see Christopher Sellers's discussion of the regulation of "acceptable" low-dose chemical exposures and the normalization of toxins in the environment. *Hazards of the Job: From Industrial Disease to Environmental Health Science* (Chapel Hill: The University of North Carolina Press, 1997).
44. CPHA, *Task Force*, 90–93.
45. Marsh Hawes, "Task force on arsenic report draws criticism from union," *News of the North*, January 11, 1978.
46. Tataryn, *Dying for a Living*, 142; United States Department of Labor, Occupational Safety and Health Administration, "Part 1910 – Occupational Safety and Health Standards, Occupational Exposure to Inorganic Arsenic," *Federal Register* 43, no. 88, May 5, 1978.
47. Tataryn, *Dying for a Living*, 144, in reference to H.P. Blejer, Occupational Health Department, "Evaluation of Canadian Public Health Association," *Task Force on Arsenic, Interim Report* (Duarte, California: City of Hope Medical Center, May 1977).
48. Rosemary Cairns, "Most of Yellowknife Safe from Arsenic: But There are High Levels in Both Soil and Snow," *News of the North*, January 8, 1978; Tataryn, *Dying for a Living*, 136–142.
49. CPHA, *Task Force*, 13–22.
50. For example, see Recommendation 33: "That a strong environmental health program be established for carrying out health studies, for providing health interpretation and consultation, for establishing occupational and community environmental guidelines and standards based on human health and for reviewing the adequacy of occupational and community environmental monitoring for health purposes": CPHA, *Task Force*, 17.
51. Cairns, "Most of Yellowknife Safe from Arsenic," January 8, 1978.
52. Peter N Nemetz, "Federal Environmental Regulation in Canada," *Natural Resources Journal* 26 (1986): 554, <https://www.jstor.org/stable/24882983>.
53. "Water Board Meets on Arsenic Waste Report," *News of The North*, January 18, 1978.
54. David Halliburton, "Atmospheric Arsenic Emissions and Control Technology: Gold Roasting Operations," Mining Mineral and Metallurgical Division, Abatement and Compliance Branch, Air Pollution Control Directorate, Third Draft, April 1978, PWNHC, G-1993-006, box 52, file 10-017-113, vol. 1.
55. Ibid.
56. Ibid., Other than the Northwest Territories, there were only roasters operating from a few mines in Ontario.
57. Kent, "A Report on Arsenic Emissions," 1982, 1–2.
58. Ibid.
59. Summary of meeting from attached Memorandum: to Members and Observers of Gold Roasting and Arsenic Task Force-June 30, 1978, Gold Roasting Industry Task Force on Arsenic Emissions – Notes on Third Meeting Location: Place Vincent Massey, Hull, Quebec, May 17, 1978, 2–3, PWNHC, G-1993-006, box 52, file 10-017-113, vol. 1; Correspondence from Barry A. Brown, Regional Director, N.W.T. region, to Mr. Mike Hewitt, Assistant Deputy Minister, Department of Justice and Public Service, Government of the N.W.T., Yellowknife, N.W.T. "Re: Arsenic Monitoring – Giant Mines," July 6, 1982, PWNHC, G-2008-028, box 9, file 17.
60. Kent, "A Report on Arsenic Emissions," 1–2; Sandlos and Keeling, "Giant Mine: Historical Summary," 5; Sandlos and Keeling, "Ghost Towns and Zombie Mines," 391.

61. 1981 Water Board Public Hearing, 85; Correspondence from Associate Director General, Eastern Operations, Medical Services Branch, to Mr. Maurice Aked, Regional Director, Northwest Territories Region, Subject: "Inquiry concerning the Report on of the CPHA Task Force On Arsenic," August 22, 1984, PWNHC, G-2008-028, box 9, file 17; In 1982 the Environmental Protection Service issued a report that determined the Giant Yellowknife Mine roaster to be technically capable of complying with the pending federal regulations: Kent, "A Report on Arsenic Emissions," 1982, 1-2.
62. They built their case by invoking the newly passed Environmental Rights Act, which enabled citizens to request government investigations of proven environmental threats. (citation refers to this statement and the one footnoted above) Correspondence from Chris O'Brien and Kevin O'Reilly to Hon. Titus Allooloo, Minister NWT Renewable Resources, April 22, 1991, O'Reilly Collection; John Sandlos, and Arn Keeling, Giant Mine: Historical Summary," 2012, [http://www.reviewboard.ca/upload/project\\_document/EA0809-001\\_Giant\\_Mine\\_History\\_Summary.PDF](http://www.reviewboard.ca/upload/project_document/EA0809-001_Giant_Mine_History_Summary.PDF); O'Reilly and O'Brien referred to the report: D. Maynard and S. Malhotra, "Impact of SO(2) on the Soils ad Vegetation near Giant Mine" (Ottawa: Forestry Canada, 1990).
63. O'Reilly and O'Brien to Minister Allooloo, April 22, 1991; Sandlos and Keeling, "Giant Mine: Historical Summary," 2012, 6; Francis Thompson, "Monitoring of Giant Mine Emissions Begins," *The Yellowknifer*, Nov 7, 1991.
64. Vogel, "From 'the Dose Makes the Poison,'" 668-72; Langston, *Toxic Bodies*, 17; Boudia and Jas, "The Greatness and Misery of Science," 8-15.
65. Andrew A. Meharg, *Venomous Earth: How Arsenic Caused the World's Worst Mass Poisoning*, (New York: Macmillian, 2005), 2. In particular Meharg refers to original ground-breaking research by A.K. Chakraborty and KC Saha as published between 1984 and 1988: KC Saha, "Melanokeratosis from Arsenic in Contaminated Tubewell Water," *Indian Journal of Dermatology* 29, no. 4 (1984): 37-46; KC Saha and D Podder, "Further Studies on Chronic Arsenical Dermatitis," *Indian Journal of Dermatology* 31, no. 2 (1986): 29-33; DN Guha Mazumder and AK Chakraborty, A Ghose, JD Gupta, DP Chakraborty, SB Dey, N Chattopadhyay, "Chronic Arsenic Toxicity from Drinking Tubewell Water in Rural West Bengal," *Bulletin of the World Health Organization* 66, no.4 (1988): 499-506.
66. Meharg, *Venomous Earth*, 11-13, 162-163.
67. *Ibid.*, 162.
68. *Ibid.*, 11; For discussions of thresholds and carcinogenic substances from this era internationally and in Canada see: I.F.H. Purchase and T.R. Auton, "Thresholds in Chemical Carcinogenesis," *Regulatory Toxicology and Pharmacology* 22 (1995): 199-205, <https://doi.org/10.1006/rtph.1995.0001>; M.E. Meek and K. Hughes, "Approach to Health Risk Determination of Metals and Their Compounds under the Canadian Environmental Protection Act," *Regulatory Toxicology and Pharmacology* 22 (1995): 206-212, <https://doi.org/10.1006/rtph.1995.0002>; Also stated by Bertram Carnow in the 1975 CBC "As It Happens" episode on arsenic in Yellowknife discussing the conclusions of the "de Villiers report." Tataryn, *Dying for a Living*, 112-114.
69. Lee Selleck and Francis Thompson, *Dying for Gold: The True Story of the Giant Mine Murders* (Toronto: HarperCollins Publishers Ltd, 1997), 14-19; Francis Thompson, "Royal Oak Asking for Wage Cut, CASAW Flyer Claims," *News/North*, April 20, 1992; Pierre Malloy, Francis Thompson, and Trish Saywell, "Royal Oak Charged for Safety Violations," *News/North*, June 15, 1992.
70. Peeter Kopvillem, "The Hunt for a Killer; The Mounties say a Bomb Caused a Mine Tragedy," *Maclean's*, October 5, 1992.
71. Silke, *History of Mines*, 267.
72. Environmental Protection Division, "An Investigation of Atmospheric emissions from the Royal Oak Giant Yellowknife Mine, Yellowknife, Northwest Territories," (Yellowknife, NWT: Department of Renewable Resources, June 1993); Northwest Territories Water Board Public Hearing, "Application by Royal Oak Mines Inc.—Giant Mine for Water Use and Waste Disposal in a Mining and Milling Undertaking Water License N1 L2-0043," Yellowknife, NT, January 28/29, 1998, Mackenzie Valley Land and Water Board.
73. *Ibid.*
74. *Ibid.*; Northwest Territories Department of Health, "Anticipated Oral Question. Issue: Press Release on the Human Health Risk Assessment on Emissions of Sulfur Dioxide and Arsenic from the Royal Oak Giant Yellowknife Mine," July 21, 1993, O'Reilly Collection.
75. *Ibid.*
76. According to this report, Giant's average level of arsenic was .013 micrograms per cubic meter; every other major Canadian city had .001 or .000. Yellowknife's one year average was measured to be 85 micrograms/cubic meter, compared to the maximum acceptable level of 70, as recommended by the Canadian Environmental Protection Act. Department of Renewable Resources, "Air Quality Monitoring in the Northwest Territories 1989 Data" (Yellowknife: Environmental Protection Division, 1989), 95-96; Correspondence from Kathy Hughes, Priority Chemicals Section to Stephen MacDonald, Criteria Section, Subject: "Arsenic Air Hazard Inquiry," June 18, 1993, O'Reilly Collection.
77. Francis Thompson, "Arsenic Emissions Alleged," *News/North*, July 6, 1992.
78. Environmental Protection Division, "An Investigation of Atmospheric Emissions from the Royal Oak Giant Yellowknife Mine, Yellowknife, Northwest Territories" (Yellowknife, NWT: Department of Renewable Resources, June 1993), 28.
79. Gold Roasting Industry Task Force on Arsenic Emissions, "Notes on Third Meeting Summary of meeting from attached Memorandum: to Members and Observers of Gold Roasting and Arsenic Task Force-June 30, 1978," Place Vincent Massey, Hull, Quebec, May 17, 1978, PWNHC, G-1993-006, box 52, file 10-017-113, vol. 1.



80. Resources Futures International, "Socio-Economic Analysis of Three Management Options to Reduce Atmospheric Emissions of Arsenic from Gold Roasting" (Ottawa: Environment Canada, September 9, 1996); Correspondence from Luke Parsons to Kevin O'Reilly, "Memo-Giant Mine Emissions Re: Yellowknife City Council Meeting held November 14, 1995," O'Reilly Collection.
81. Boyd, *Unnatural Law*, 231; See also Pehlke and Torgerson, *Managing Leviathan*; Harrison and Hoberg, *Risk, Science and Politics*, 6–21; Harrison, *Passing the Buck*.
82. For example, see Environmental Protection Division, "Investigation of Atmospheric Emissions," 5.
83. Department of Renewable Resources, "Giant Mine Atmospheric Emissions," Meeting notes, Nov. 28, 1994, O'Reilly Collection
84. Department of Renewable Resources, "Giant Mine Atmospheric Emissions," Nov. 28, 1994.
85. Ibid.
86. Ibid.
87. Correspondence from Dr. J.R. Hickman, Director General, Environmental Health Directorate, Environmental Health Centre, Tunney's Pasture, Ottawa, to Dr. Ian Gilchrist, Medical Director, Northwest Territories Health, July 6, 1993, O'Reilly Collection.
88. Canadian Centre for Occupational Health and Safety, "OSH Answers Fact Sheets: Occupational Hygiene – Occupational Exposure Limits," accessed November 30, 2020, [https://www.ccohs.ca/oshanswers/hsprograms/occ\\_hygiene/occ\\_exposure\\_limits.html?=&wbdisable=true](https://www.ccohs.ca/oshanswers/hsprograms/occ_hygiene/occ_exposure_limits.html?=&wbdisable=true).
89. J.R. Hickman to Kathy Hughs, July 6, 1993; Doug Schmidt, "No 'imminent health hazard' from Giant emissions report," *The Yellowknifer*, July 23, 1993, O'Reilly Collection; Correspondence between Kathy Hughs, Priority Chemicals Section and Stephen MacDonald, Criteria Section, "Subject: Arsenic Air Hazard Inquiry," June 18, 1993, O'Reilly Collection.
90. Schmidt, "No 'imminent health hazard'," July 23, 1993.
91. Editorial, "Cleaning up the neighbourhood," *The Northern Star*, July 7, 1993.
92. "Royal Oak will not clean up mine stack," *The Northern Star*, July 14, 1993; Doug Schmidt, "Giant disputes gov't SO(2) Numbers," *The Yellowknifer*, July 14, 1993.
93. J.R. Hickman to Kathy Hughs, July 6, 1993.
94. Correspondence from J.R. Hickman, Director General, Environmental Health Directorate, Environmental Health Centre, Tunney's Pasture, Ottawa, to Dr. Ian Gilchrist, Medical Director, Northwest Territories Health, July 6, 1993, O'Reilly Collection; See also: Correspondence from Kathy Hughs, Priority Chemicals Section to Stephen MacDonald, Criteria Section, "Subject: Arsenic Air Hazard Inquiry," June 18, 1993, O'Reilly Collection.
95. Environmental Protection Services, "Reducing Arsenic Releases to the Environment in the Northwest Territories: Action Plan to Develop Management Options" (Ottawa: Environment Canada, May 9, 1996), 1, O'Reilly Collection; For additional information on the analysis of carcinogenicity in arsenic and other metals for the Canadian Priority Substances List at this time see: M.E. Meek and K. Hugh, "Approach to Health Risk Determination of Metals and Their Compounds under the Canadian Environmental Protection Act," *Regulatory Toxicology and Pharmacology* 22 (1995), 206–212.
96. Charles Caccia, *It's about Our Health!: Towards Pollution Prevention: CEPA Revisited: Report* (Ottawa: Canada Communication Group, 1995), xix.
97. Ibid., 3.
98. Ibid., 196; The committee was shocked to hear community, and particularly Indigenous community, experiences expressed around the topic of arsenic: "In its Yellowknife session the Committee heard several elders who spoke about the environmental changes they had experienced in their lifetime—the pollution water bodies, the transformation of the landscape the disruption to wildlife. These changes had occurred as a result of mining development and had clearly proved detrimental to the traditional way of life of the local inhabitants. The Committee was disturbed by the elders' resulting loss of confidence in the government's ability to protect their environment and health. Nowhere was this loss of trust more apparent than on the issue of arsenic pollution."
99. Ibid., 196, Footnote 7: Act, Canadian Environmental Protection, "Priority Substances List Assessment Report—Arsenic and Its Compounds" (Ottawa: Environment Canada and Health Canada, 1993), vii.
100. Ibid.
101. Ibid.
102. Ibid. For the original CEPA hearings see: House of Commons Standing Committee on Environment and Sustainable Development, "Parliamentary Hearings on Canadian Environmental Protection Act, Meeting #123," Yellowknife, NWT, May 11, 1995, accessed June 13, 2016, [http://www.parl.gc.ca/content/hoc/archives/committee/351/sust/evidence/122\\_95-05-11/sust122\\_blk-e.html](http://www.parl.gc.ca/content/hoc/archives/committee/351/sust/evidence/122_95-05-11/sust122_blk-e.html); House of Commons Standing Committee on Environment and Sustainable Development, "Parliamentary Hearings on Canadian Environmental Protection Act, Evidence of Meetings # 122," Yellowknife, NWT, May 11, 1995, accessed June 13, 2016, [http://www.parl.gc.ca/content/hoc/archives/committee/351/sust/evidence/122\\_95-05-11/sust122\\_blk-e.html](http://www.parl.gc.ca/content/hoc/archives/committee/351/sust/evidence/122_95-05-11/sust122_blk-e.html).
103. Harrison, Hoberg, *Risk, Science and Politics*, 6–21; Harrison, *Passing the Buck*; Boyd, *Unnatural Law*, 231
104. House of Commons Standing Committee on Environment and Sustainable Development, "Parliamentary Hearings on Canadian Environmental Protection Act, Meeting #123," Yellowknife, NWT, May 11, 1995, lines 1700–1720, accessed June 13, 2016, [http://www.parl.gc.ca/content/hoc/archives/committee/351/sust/evidence/122\\_95-05-11/sust122\\_blk-e.html](http://www.parl.gc.ca/content/hoc/archives/committee/351/sust/evidence/122_95-05-11/sust122_blk-e.html)
105. Ibid.
106. Boyd, following Harrison, argues that: "Resource industries and provincial governments enjoy a 'symbiotic relationship,' meaning that laws and policies favourable to industry are generally perceived as benefiting provinces as well Boyd, *Unnatural Law*, 203, 255, footnote 27: Harrison, *Passing the Buck*, 17.

107. Department of Renewable Resources, "Giant Mine Atmospheric Emissions," Nov. 28, 1994.
108. "Minutes of Yellowknife City Council- Motion #041795," August 28, 1995, O'Reilly Collection.
109. "Royal Oak will not clean up mine stack," *Northern Star*, July 14, 1993.
110. Correspondence from Sadek E. El-Alfy, Vice President of Operations, Royal Oak Mines to Mayor Dave Lovell, City of Yellowknife, October 4, 1995, O'Reilly Collection.
111. Ibid.
112. Correspondence from Kevin O'Reilly, Canadian Arctic Resources Committee, Yellowknife, NWT to Bruce Valpy, Editor, *The Yellowknifer*, Re: "Paying for sins of the past," July 20, 1995, O'Reilly Collection.
113. House of Commons Standing Committee on Environment and Sustainable Development, "Parliamentary Hearings on Canadian Environmental Protection Act, Evidence of Meetings #122," Yellowknife, NWT, May 10, 1995, accessed June 13, 2016, [http://www.parl.gc.ca/content/hoc/archives/committee/351/sust/evidence/122\\_95-05-11/sust122\\_blk-e.html](http://www.parl.gc.ca/content/hoc/archives/committee/351/sust/evidence/122_95-05-11/sust122_blk-e.html).
114. Resource Futures International, "Socio-Economic Analysis," 1996; Environment Canada, Health Canada, GNWT Health and Social Services, "Controlling Arsenic Releases to the Environment in the Northwest Territories: Discussion of Management Options, for consultation" (Yellowknife: NWT, Environmental Protection Branch, April 1997), 46, O'Reilly Collection.
115. Resources Futures International, "Socio-Economic Analysis"; Environment Canada, Health Canada, GNWT Health, and Social Services, "Controlling Arsenic Releases."
116. Resource Futures International, "Socio-Economic Analysis," 35–49; Environment Canada, Health Canada, NWT Health, and Social Services, "Controlling Arsenic Releases."
117. Resources Futures International, "Socio-Economic Analysis," 49.
118. Ibid, 13.
119. Ibid. In particular see Introduction, p. 5–15, for more details on statistical considerations and health effects.
120. The 1996 "Socio-Economic Analysis" report (p. vi.) cites: Hatch Engineering Ltd., Arsenic Emission Control from Pyrometallurgical Operations (Ottawa: Environment Canada, 1996), see p. 43 for a concise summary of management conclusions.
121. Environment Canada, Health Canada, GNWT Health and Social Services. "Controlling Arsenic Releases to the Environment in the Northwest Territories: Discussion of Management Options," April 1997.
122. Resource Futures International, "Socio-Economic Analysis," vi, footnote 5.
123. Resource Futures International, Socio-Economic Analysis, 12–14.
124. Ibid., viii.
125. Ibid., vi.
126. Nash, 2008; Nash, *Inescapable Ecologies*, 1994. See also: Gregg Mitman, Michelle Murphy, and Christopher Sellers, "Introduction: A Cloud over History," *Osiris* 19 (2004): 1–17.
127. Boudia, Jas, "Managing Scientific Risk and Political Uncertainty," 11,12.
128. Ibid.
129. Environment Canada, "Workshop Report: Workshop on Controlling Arsenic Releases into the Environment in the Northwest Territories" (Yellowknife, NWT: Environmental Protection Branch, 1997), O'Reilly Collection.
130. Environment Canada, "Workshop Report," 14–17.
131. See for example: Letter from Chief Bill Erasmus, Chief Jonas Sangris, Chief Darrell Beaulieu Dene Nation, Denedeh National Office, sent to Mary O'Neil, Special Assistant, Office of the Minister of the Environment, May 17, 1995, O'Reilly Collection.
132. See also correspondence from Bill Erasmus, Dene Nation Chief, to Mr. Gordon Wray, Chairman Northwest Territories Water Board, February 5, 1998, O'Reilly Collection.
133. 1998 Water Board, 131.
134. Ibid, 135.
135. Sandlos and Keeling, "Giant Mine Historical Summary," 20, 3; O'Reilly, "Liability, Legacy, and Perpetual Care," 347.
136. Sandlos and Keeling, "Giant Mine Historical Summary," 9.
137. "Meeting Minutes," Ad Hoc Committee Meeting – Giant Mine, December 9, 1997, PWNHC, G-2012-026, box 1, file 8.
138. Correspondence from Edmund Szol, Executive Vice-President and COO to Mr. Gordon Wray Chairman – NWT Water Board, "Re: Water Register NIL 2-0043," February 26, 1998.
139. As cited in O'Reilly, "Liability, Legacy, and Perpetual Care," 352, footnote 39: Correspondence from Larry Connell, Manager of Environmental Services, Royal Oak Mines Inc., to Gordon Wray, Chairman, NWT Water Board, and Bob Overvold, Regional Director General, Indian and Northern Affairs Canada, February 5, 1999, NWT Water Board Public Registry N1L2-1563; For more information on the process of Water Board licensing at Giant Mine see Department of Indian Affairs and Northern Development, "Royal Oak Mines Inc.: Level I Environmental Screening: Royal Oak Mines Inc. – Giant Mine License Renewal," sent in letter from David Livingstone, Director, Renewable Resources and Environment, Dec, 2, 1997, PWNHC, G-2013-007-015, box 2, file 7.
140. Allan Robinson, "Losses Mount at Royal Oak," Report on Business: *Canada's Business Newspaper*, April 1, 1998.
141. As cited in O'Reilly, "Liability, Legacy, and Perpetual Care," 352, footnote 39: Correspondence from Larry Connell, Manager of Environmental Services, Royal Oak Mines Inc., to Gordon Wray, Chairman, NWT Water Board, and Bob Overvold, Regional Director General, Indian and Northern Affairs Canada, February 5, 1999, NWT Water Board Public Registry N1L2-1563.

142. Allan Robinson, "Losses Mount at Royal Oak."
143. Anne Marie Jennings, "Giant Gets a break," *Yellowknifer*, April 1, 1998; Department of Resources, Wildlife, and Economic Development, "Communications Plan: GNWT Exploration and Development Assistance to Royal Oak Giant Mine," October 10, 1998, O'Reilly Files; O'Reilly, "Liability, Legacy, and Perpetual Care, 351, endnote 35: "Royal Oak Receives Subsidy, NWT Approves \$1.5 Million, City Gives Additional Dollars," *Yellowknifer*, October 2, 1998, A2.
144. Ibid.
145. O'Reilly, "Liability, Legacy, and Perpetual Care, 353, footnote 43: Dane Gibson, "Cashless Mine Owes Big, Royal Oak Yellowknife Creditors Holding Their Breath on Getting What's Owed," *Yellowknifer*, May 7, 1999.
146. Ibid.
147. Just as political scientist Robert Gibson described (Gibson, "We Just Don't Know," 162–170).
148. CBC News North, "Feds Award Multimillion Dollar Contract to U.S. Company for Giant Mine Cleanup," February 20, 2018, accessed October 30, 2020, <https://www.cbc.ca/news/canada/north/giant-mine-contract-awarded-1.4542635>.
149. See Katheryn Harrison, *Passing the Buck*.
150. See Nash, *Inescapable Ecologies*; Langston, "Precaution and the History of Endocrine Disruptors"; Sellers, *Hazards of the Job*; Vogel, "From 'the Dose Makes the Poison."
151. See Gibson, "We Just Don't Know."
152. See Nash, *Inescapable Ecologies*, 1994; Gibson, "We Just Don't Know." Boudia, "Managing Scientific Risk and Political Uncertainty."
153. Kate Kyle, "Toenails, Saliva and Urine Could Answer Questions about Giant Mine's Toxic Legacy," CBC North, November 07, 2017; Health Effects Monitoring Program in Yellowknife, Ndilo, and Dettah, accessed July 4, 2019, <http://www.ykhemp.ca/about.php>.

## Research Article

# Investigating Standards for Small Water and Wastewater Systems in Northern Canada

Paul Steenhof

Project Manager, Natural Resources, CSA Group

Michel Duteau

Water Sciences Specialist, Duteau Bioresource Contracting

**Abstract:** Research investigating the potential of standards for the build, operation, and maintenance phases of small water and wastewater systems in the Canadian North was conducted to identify opportunities for standards to help ensure safe, accessible, and high-quality drinking water and sanitation for all northerners. This involved a review of literature, a survey of northern water system users and practitioners, and key informant interviews. The study highlights a general trend of low adaptation to local conditions for standardization documents on many technical topics in northern Canada. A number of major themes and corresponding recommendations are subsequently drawn with respect to potential for standardization efforts. Of these, training and certification/classification were identified as a key area that has many gaps, challenges, and potential opportunities with respect to the use of standardized procedures for small-scale water and wastewater systems. Subsequently, this is also identified as the area where standardization efforts may have the broadest social benefit, urgency, as well as potential feasibility.