

# **Abandoned Mining Sites in British Columbia: Managing Environmental Liabilities**

by

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## **Abstract**

Mining is a core industry in British Columbia's economy. However, the economic benefits of mining exploration, development, and production, have corresponding environmental risks and liabilities. To protect against the risk of public assumption of environmental liabilities, the Government of British Columbia collects financial securities for mine reclamation from proponents of mining operations. A gap between the amount of held financial securities and total estimated reclamation liability has characterized this policy for decades. This gives rise to disproportionate public exposure to mine reclamation liabilities. This study examines several policy approaches to reforming the approach to financial assurance. I examine four other jurisdictions, conduct interviews, and analyze quantitative data. The result is the articulation of three policy options, the advantages and disadvantages of which are presented. One option is recommended to provincial decision-makers as the best approach to reforming mine reclamation and financial assurance policy.

**Keywords:** mine reclamation; assurance; liability; environmental bonds

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## **Executive Summary**

British Columbia's mining industry continues to bring substantial economic benefits to the province. Along with the benefits, however, are varying degrees of environmental risks and liabilities associated with mining activities. To insure against public assumption of these environmental liabilities, the Government of British Columbia currently collects financial assurances from mine proponents, which can be refunded in full upon sufficient reclamation of a mine site. Despite this regulatory approach, responsible parties do not always undertake satisfactory reclamation of mine sites. Additionally, historic mining sites, which operated in full compliance with the regulatory requirements of their time, may now pose a risk to human health and environmental sustainability.

In recent years, a divergence has emerged between the amount of financial assurances held by the Province and total estimated liabilities. In 2016, this gap reached an estimated \$1.2 billion. This prompted many observers to call for a reform of the regulatory system for mining in British Columbia, particularly with respect to matters of financial assurance.

The primary aim of this research is to identify and articulate the advantages and disadvantages of alternative approaches to collecting financial assurances for mine reclamation. This study offers an assessment of financial assurance policies that are most appropriate to induce responsible resource development while maintaining the economic competitiveness of the jurisdiction.

The methodology employed in this study includes a review of the literature, a cross-jurisdictional case study, and interviews with informed persons. I investigated the policy framework in Western Australia, Nevada, Ontario, and Alberta. Three interview participants, each of whom held a unique depth of experience in the mining industry, were interviewed for the study. The study also benefitted from numerous conversations with sources from the mining industry who preferred to remain anonymous.

Mine reclamation policy is a complex issue with many competing interests. This study articulates the trade-offs between alternative approaches to collecting financial assurances from the mining industry. Several measures beyond financial assurance need to be considered in tandem with any financial assurance program. While these other policy mechanisms are addressed where warranted, the focus of this research is on financial assurance rules for mining in British Columbia.

The study identifies three policy options. The first, the *pooled reserve fund* option, follows the example of Western Australia in collecting a non-refundable, transferable reclamation levy in place of the current environmental bonding rule. The second option, the implementation of *financial securities with added reclamation fund*, constitutes an integration of the non-refundable levy program with existing bonding rules. Finally, the *minimum financial security rates with low-liability bond pool* option involves increasing the rate of bond application against estimated liabilities while introducing a bond pool provision for capital-constrained firms.

The options were assessed against five criteria. The distribution of reclamation liability both between the public and the industry and among firms within the industry featured as a prominent criterion, as did the viability of the funding model for existing orphaned, abandoned, and historic mine sites and the projected impact of a policy on the social efficiency of new mine development. Finally, I projected the degree of acceptance of the policy by stakeholders, as well as the administrative and legislative complexity of each policy option.

The recommended approach is the third policy option— *minimum financial security rates with low-liability bond pool*. This policy has the benefit of maintaining industry reclamation incentives via the collection of financial assurance contributions, matching those contributions more closely to estimated reclamation liability. It also adds a mechanism to improve government funding for addressing existing sites in need of attention. While the design of alternative policies offer certain benefits, the recommended option meets the evaluation criteria in a manner that is most consistent with key policy objectives.

# Chapter 1. Introduction

## 1.1. Overview

In a province endowed with an abundance of natural resources, the mining industry has long been a pillar of British Columbia's economy (Stano, 2012). The province is home to a range of mineral deposits—in 2015, coal mines comprised approximately 44% of total revenues from the mining industry, followed by copper (35%) and gold (7%) (Ministry of Energy and Mines, 2015). Capital expenditure in the mining industry amounted to \$1.24 billion in that year, while spending on exploration and development was some \$330 million (Government of British Columbia, 2015). In 2015, the total value of mineral production in the province was an estimated \$6.9 billion (Stano, 2012; Ministry of Energy and Mines, 2015). The industry brings significant employment benefits, directly providing jobs for approximately 9,000 people (Ministry of Energy and Mines, 2015).

Notwithstanding the economic benefits, the adverse environmental impacts of the industry can also be significant. Mine features such as waste dumps, structures, and effluents each represent an environmental management liability (Simate and Ndlovu, 2014; Mining consultant, personal communication, 2016). To mitigate the many environmental risks, the Government of British Columbia oversees mining operations through regulation. Objectives of the province's regulatory framework include ensuring the occupational health and safety of workers and maintaining environmental standards (BC Mines Act, c. 293; Heath, Safety, and Reclamation Code for Mines in British Columbia, 2008). This paper focuses on the latter—policies that support environmental protections in the mining industry, a joint responsibility of the province's Ministry of Energy and Mines (MEM) and Ministry of Environment (MoE).

Under the *British Columbia Mines Act (RSBC 1996)*, owners, agents, or managers ("proponents") of a mine project must submit plans for the reclamation of the "land, watercourses, and cultural heritage resources" affected by mining activity as a condition of receiving a Mines Act permit ("permit") (BC Mines Act, c. 293, s.10.1). The province's Chief Inspector of Mines ("Chief Inspector") is an individual appointed by the Minister and authorized to enforce the Mines Act and accompanying regulations,

including discretion over granting mine permits (BC Mines Act, c.296). Subordinate mine inspectors are appointed to regional committees by the Chief Inspector and assess permit applications (BC Mines Act, c.296). Upon receipt of a permit, proponents are bound to comply with environmental standards over the project's duration (BC Mines Act, c.293; BC Environmental Management Act, c. 53). While there is wide variation across operations, the reclamation of a single mine site can take from 2 to 10 years at a cost upwards of \$150 million (Indigenous and Northern Affairs Canada, 2007).

Despite this regulatory approach, proper reclamation of lands is not always pursued by responsible parties. This phenomenon can occur at abandoned mines, where mineral claims have reverted to the government upon satisfaction of all regulatory requirements but where “work may [still] be required in, on, or about” the mine to avoid human health risks, property damage, or pollution (BC Mines Act, c.296 s.17). Mines may also be orphaned, which is the case where relevant owners cannot be found, are insolvent, or are uncooperative in facilitating proper reclamation (Castrilli, 2007). Lastly, British Columbia designates sites that operated or closed prior to 1969 – when mine reclamation was introduced to the province’s regulatory framework– as historical. Approximately 1,900 of these sites have been identified in British Columbia (Barrazuol and Stewart, 2003; BC Technical and Research Committee on Reclamation, n.d.)

To induce sufficient reclamation of mine sites, the Chief Inspector may require that a proponent post a mine reclamation security (British Columbia, Office of the Auditor General, 2016; BC Mines Act, c. 296). The purpose of this security, also known as a bond or financial assurance rule, is to ensure that mine proponents provide sufficient resources to cover any unattended environmental liabilities in the future (BC Mines Act, c. 296; Boyd, 2001).

A discrepancy between held financial securities and total liability for mine reclamation has been a feature of this policy for decades. Today, while the MEM holds approximately \$900 million in financial securities, estimates for total liability are \$2.1 billion, resulting in a potential funding shortfall of \$1.2 billion (British Columbia, Office of the Auditor General, 2016). In view of this shortfall and the risk that mine sites are orphaned or abandoned before proponents fulfill their reclamation duties, the Government of British Columbia stands to benefit from considering alternative approaches to the collection of financial assurance from the mining industry. While the

government uses several techniques to manage environmental risk, the focus of this study is mine reclamation securities.

## **1.2. Policy problem and study aims**

Chronic inadequacies in the collection of financial assurances against the adverse environmental impacts of mining have resulted in too much public exposure to environmental risks, and too few options to perform sufficient reclamation of existing, contaminated mine sites in British Columbia. This study aims to identify and analyze a range of policy option to improve the long-term management of environmental liabilities while ensuring that British Columbia remains an economically competitive mining jurisdiction.

## **1.3. Outline**

This paper is organized as follows. Chapter 2 provides additional background on mine reclamation policy in British Columbia. Chapter 3 provides an outline of the methodology employed for the study, and Chapter 4 follows with a synopsis of the data drawn upon for subsequent analysis. Chapters 5- 7 are comprised of an articulation and assessment of the policy options stemming from the research. Chapter 8 provides a recommended policy option and offers concluding remarks.

## **Chapter 2. Background**

### **2.1. Overview**

In 2015, a total of 11 metal mines operated in the province, along with 30 industrial minerals mines and 1,000 aggregate mines (Ministry of Energy and Mines, 2015). Coal (primarily metallurgical) was produced at five large open-pit sites and one underground operation in that year (Ministry of Energy and Mines, 2015). Over 45,000 hectares of land have been disturbed by mining activity since the late 1960's; of this, approximately 19,400 hectares have been reclaimed (BC Technical and Research Committee on Reclamation, n.d.). This chapter provides a review of the theory underpinning financial environmental bonding systems and a synopsis of the regulatory history of the industry in the province.

### **2.2. Literature review**

#### ***Financial assurance and environmental economics***

The notion of environmental bonds as financial assurance is rooted in the theory of "materials-use fees," first developed in the early 1970's. Various economists advocated programs where governments would collect a materials-use fee from industry when they could be found responsible for releasing harmful substances into the environment (Solow, 1971; Mills, 1974; Bohm, 1981; Bohm and Russell, 1985). The fee would be refunded to parties who can verify that they had disposed of materials, with the generosity of the refund varying in accordance with the chosen disposal method (Solow, 1971). As this early work on the topic suggests, the collection of financial assurance by regulators is grounded in the polluter-pays-principle (PPP), which holds that agents responsible for damages compensate all other affected parties (Ambec & Ehlers, 2016; Gerard, 2000; Cooter & Ulen, 2000; Becker & Stigler, 1974). The PPP is in turn underpinned by the notion of strict liability, which holds that financial liability for adverse environmental impacts should be ascribed to the responsible party (Cropper & Oates, 1992).

Two additional concepts justify a compensatory transfer from mining proponents to the public in the form of financial assurance (Kosenius & Horne, 2016). The first is a

recognition of a principal-agent problem, which describes situations where imperfect monitoring of firms increases the risk that they might shirk costly responsibilities (Gerard, 2000; Shogren et al., 1992; van Egteren, et al., 2004; Allan, 2016). This problem can be addressed by assigning liability to the responsible party either by stringent regulation or by incentives inducing compliance, which can be effective in the absence of costly monitoring. This is often achieved through an environmental bond, the release of which is made conditional on some behavior or activity. This form of financial assurance is used to induce firms to engage in a socially efficient level of environmental restoration under conditions of imperfect monitoring (Gerard, 2000; Shogren et al., 1992). It also has the effect of transferring the burden of proof in a legal dispute from the damaged to the responsible party (Gerard, 2000). In theory, the prospect of being refunded the bond also provides an incentive for the resource user to use cost-effective mitigation strategies (Costanza & Perrinos, 1990).

Second, environmental bonds are considered a method of inducing full consideration of the externalities, which are those costs imposed on an unrelated third party for which they are not compensated (Pigou, 1932; Cornes & Sandler, 1986). Evidence abounds that negative environmental externalities often result from mining activity, and mine proponents are unlikely to account for the external costs of their activity in the absence of either effective enforcement or market incentives (Kosenius & Horne, 2016; Shruti et al., 2012). Experts argue that agents should be “confronted with a ‘price’ equal to the marginal external cost of their polluting activities to induce them to internalize... the full social costs of their pursuits” – financial assurance rules represent a policy mechanism to implement this price (Cropper & Oates, 1992, p. 680).

Moral hazard and environmental externalities are two concepts that underpin the policy problem, and they constitute the fundamental economic principles that inform the present study.

### ***Limitations of environmental bonds***

Collecting financial assurance through environmental bonds mitigates the adverse impacts of resource depletion, providing enforcement through market-based incentives leading to low cost land reclamation (Peck and Sinding, 2000; Bohm and Russell, 1985). The literature also includes a countervailing perspective, however,



stressing the limitations and key trade-offs associated with financial assurance policies. I now turn to a summary of various limitations and critiques.

First, the refundability of environmental bonds is effective in inducing socially efficient environmental outcomes only if it reflects the social cost of misbehavior (Gerard, 2000). Risk-pooling policies such as environmental insurance have emerged as a potential complement to bonding as part of a broad environmental policy (Poulin & Jacques, 2007). Similarly, a policy mix of an environmental bond and a modified Pigouvian tax (or a land-damage tax) has been advocated to achieve both risk-sharing and efficiency objectives (White et. al, 2012; Farzin,1993). As a central issue in environmental policy, I return to evaluate the relative merits and key trade-offs between such risk-pooling programs in Chapter 7.

Concerns regarding the imposition of liquidity constraints on mine proponents also give rise to the consideration of insurance as either a complement or substitute to environmental bonds (Shogren et al., 1993; White et al., 2012). Some suggest that the availability of insurance products would relieve the liquidity constraint associated with bond rules (Shogren et al., 1993). In the absence of private options for insurance<sup>1</sup>, a state-sponsored institution offering insurance products might be considered an alternative method of addressing the liquidity concerns implicit to an environmental bonding scheme.

A further limitation to environmental bonds is that they often reflect minimum reclamation costs (Peck and Sinding, 2009). Under conditions of imperfect monitoring, the efficient value of an environmental bond should be set to reflect both the value of shirking and the probability of detection (Shogren et al., 2000). In other words, this theory of environmental policy holds that, when set at a sufficient level, environmental bonds can increase the costs of shirking to a level that aligns firm behavior with social preferences for environmental quality (Shogren et. al, 2000). When bonds are set too low relative to the gains from shirking on environmental responsibilities, the costs of doing so would not be sufficient to penalize poor performance in reducing environmental damages. Parties responsible for environmental damages would then be able to shift the related risks to the rest of society at a low cost (Costanza and Perrings, 1990).

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<sup>1</sup> Likely due to information asymmetries and self-selection bias; see Akerlof, 1970.

Relatedly, uncertainty limits the ability of decision-makers to demand the efficient bond level from relevant parties— where the “range and probability of the future effects of present actions are not known, it is not possible to calculate an expected value for the outcome of those actions” (Costanza and Perrings, 1990, p. 67). Arriving at an estimate of reclamation liability ex ante is difficult, particularly with the ongoing risk of catastrophic events.

### **2.3. Legislative framework in British Columbia**

Under section 92 (13) of the Constitution Act, 1867, provincial governments have full authority over legislation with respect to the exploration, development, conservation, and management of non-renewable natural resources (Constitution Act, 1867). An estimated 85-95% of mining activity in British Columbia is conducted on Crown land (Ministry of Forests, Lands, and Natural Resources, 2010). Mine proponents may stake a claim on land (that may subsequently be replaced by a lease) for a period no longer than thirty years (BC Mineral Tenure Act, c. 292). While a broad definition of provincial Crown lands is used in this study for consistency with existing legislation, this issue must be considered in the context of affirming the Aboriginal and Treaty Rights of the Indigenous peoples of British Columbia (BC First Nations Energy and Mining Council, 2010). In this context, reference to the Crown land does not suppose title over the land on the part of the Government of British Columbia; indeed, the Supreme Court of Canada (SCC) has ruled that Aboriginal Title over land constitutes an encumbrance on Crown title (Delgamuukw and Gisdayway v. British Columbia, 1997). In 2014, the SCC affirmed title over approximately 200,000 hectares of land held by the Tsilhqot'in Nation in north-central British Columbia (Tsilhqot'in Nation v. British Columbia, 2014; Assembly of First Nations, 2014). Where public policy with respect to natural resource extraction in British Columbia is concerned, an affirmation of Aboriginal Title and Treaty rights of First Nations peoples in British Columbia is of utmost importance to understanding fully the scope of the consequences of environmental practices in mining.

British Columbia began regulating mine reclamation in 1969, when legislative amendments introduced the practice for “major coal mines and hard rock mineral mines” (Errington, 2001). The framework for mining regulation is provided by the *Mines Act*, the *Mineral Tenure Act*, the *Environmental Assessment Act* (EAA) and the *Environmental Management Act* (EMA) (Environmental Management Act c. 53; Environmental

Assessment Act c. 43; Mineral Tenure Act c. 292, Mines Act, c. 293; Allan, 2016). While both the EMA and the EAA govern environmental practices, the *Mines Act (RSBC, 1996)* is the legislation applicable to “all mines during exploration, development, construction, production, closure, reclamation, and abandonment,” including establishing the basis for collecting financial assurances (BC Mines Act, c. 293). Under the Act, applicants for mining permits are required to submit a plan for the reclamation of “land, heritage, and cultural heritage resources” affected by mining activity (BC Mines Act, c. 293). Once a mine closure plan is filed in sufficient detail, along with financial assurance in the “form and amount” deemed acceptable by the province’s Chief Inspector of Mines, a mine permit may be issued (Ministry of Energy and Mines, 2016; BC Mines Act, c. 293). The permit obliges the mine proponent to assume responsibility for the reclamation of the site and to “provide for the protection of, and mitigation of damage to, watercourses and cultural heritage resources affected by the mine” (BC Mines Act, c. 293). Just as the Chief Inspector may alter the financial securities required of mine proponents, this appointee has the authority to cancel the lien and permit the transfer of lands to some other party, effectively indemnifying the party initially responsible for disturbing the land (BC Mines Act, c. 293).

**Table 1: Forms of financial assurance accepted, British Columbia**

Guaranteed investment certificate	Cash and cash equivalents	Reclamation surety bonds	Irrevocable standby letters of credit (ISLOCs):
Held under agreement where the principal security is pledged to the province, and interest accrues to the mine operator. Available only for security obligations no greater than \$25,000.	Includes certified cheques and bank drafts, where no interest accrues to mine operator.	Comprised of a bond held with a licensed surety under conditions	Issued by a financial institution, an ISLOC guarantees payment of financial security in the event of a default on obligations

Sources(s): Ministry of Energy and Mines, n.d.

Despite being a condition on which mining permits are issued, reclamation obligations are not always fulfilled by mine owners (Office of the Auditor General of British Columbia, 2016, Allan 2016). The Mines Act guides the processes for mustering a policy response to those sites in need of reclamation efforts that have not been met by the responsible party. If a site is deemed to require attendance to avoid “danger to

persons or property or to abate pollution of the land and watercourses affected by the mine,” the Chief Inspector of Mines is authorized to remediate the land or otherwise mitigate hazards (BC Mines Act, c. 293). This work must be funded by appropriation of site-specific financial securities and by drawing from consolidated revenue, as there is no mechanism whereby the province can draw on earmarked funds collected from the mining industry or elsewhere. The amount expended (including accrued interest) forms a lien on the mineral title in favor of the government (BC Mines Act, c. 293). Notice of the lien settles in the land title office in the form of a charge, barring transfer of the mineral title on the land until the outstanding debt obligation is fulfilled (British Columbia Mines Act, c. 293).

## **2.4. Contemporary issues**

Recent years have seen increasing recognition that mining activity can bring adverse environmental, social, and community impacts. This has emerged in academic studies, industry and stakeholder accounts, and government reports, each of which point with varying force to the “toxic legacy” of mine sites (Keeling and Sandlos, 2009; Keeling, 2010; Keeling, 2011; Office of the Auditor General of British Columbia, 2002, 2016). The Office of the Auditor General of British Columbia (OAGBC) raised the issue of mine reclamation in a 2002 report concerning the management of contamination on provincial lands. The report points to contaminants remaining on former mining sites on public and private lands in the province, arguing that the extent to which these substances are found in soil and water often threatens both environmental sustainability and human health (Office of the Auditor General of British Columbia, 2002). It recommended that the province identify a leading ministry to oversee a government framework for managing contaminated sites, develop a method of collecting information sufficient to determine where scarce resources should be allocated for remediation, and establish a management accountability framework measure progress in managing contaminated sites (British Columbia, Office of the Auditor General, 2002; Mines, n.d.; Stewart & Johnstone, 2007).

In response, the province established the Crown Contaminated Sites Program (CCSP), a system of managing tracts of land requiring environmental restoration (Stewart & Johnstone, 2007). As per the recommendation of the Auditor General, the CCSP is now overseen by the Ministry of Forests, Lands, and Natural Resource

Operations (FLNRO), which organizes the remediation of contaminated provincial lands for which government is liable (Crown Contaminated Sites Program, 2016). Where poor mine site reclamation is found to pose significant risks to either environmental sustainability or human health, mineral claims may revert to the government prior to the fulfillment of the conditions of a mining permit (Crown Contaminated Sites Program, 2016). These are the sites managed under the CCSP. Contaminated sites include orphaned and abandoned mines, but may also involve sites contaminated for other reasons, such as abandoned fuel stations and gas wells (Crown Contaminated Sites Program, 2016). However, mining sites comprise the bulk (approximately 75%) of contaminated sites in the program (Ministry of Finance, 2015). In 2015, the CCSP drew \$192 million from consolidated revenue to remediate lands and carried \$508 million in liability for contaminated sites (Crown Contaminated Sites Program, 2016).

Despite this policy framework, insufficient reclamation of mine sites has remained a problem and has re-emerged as a topical issue in the province triggered by singular events. In 2014, a massive tailing storage facility breach at the Mount Polley mine, an open-pit copper and gold mine in south-central British Columbia, invigorated concerns over the severity of the environmental risks associated with mining (IEEIRP, 2015). The event spurred widespread discussion regarding the long-term environmental management practices at mine sites, including an independent review which concluded that similar events should be expected to recur every five years in the province (IEEIRP, 2015). Recent analysis suggests that thirty-five First Nations communities stand to be affected by similar tailings breaches in northern British Columbia alone (BC First Nations Energy and Mining Council, 2015). According to some observers, this event prompted a more circumspect approach to the permitting process on the part of the Mines branch at the MEM (Mining consultant, personal communication, November 2016).

In 2016, the OAGBC published a subsequent report investigating the compliance and enforcement outcomes in mining as overseen by the MEM and the MoE. The report calls on the MEM to address the issue of “financial security deposits for major mines [being] under-secured by more than \$1.2 billion,” imploring the development of a policy response to the issue (British Columbia, Office of the Auditor General, 2016, p.41). Moreover, much of the securities held by government are illiquid and, if companies seek restructuring under the *Companies’ Creditor’s Arrangement Act, RSC 1985*, may not be available for mine site reclamation (Mining engineer, personal communication, 2016;

Allan, 2016; Companies' Creditors Arrangement Act, c. 36). Reviews of current policy conclude with various recommendations for reform, some of which are identified in the following chapters.<sup>2</sup>

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<sup>2</sup> These include the establishment of a pooled reserve fund, an extension of financial assurances for the risks of unexpected events, a general increase in the financial assurance requirements demanded of mine proponents, the creation of an independent compliance and enforcement branch at the Ministry of Energy and Mines, and increased organizational transparency with respect to the mine permitting process (Allan, 2016; Office of the Auditor General of British Columbia, 2016).

## **Chapter 3. Methodology**

### **3.1. Overview**

This study seeks to identify and analyze options for financial assurance rules that could mitigate public exposure to mine reclamation liabilities while maintaining the economic competitiveness of the mining industry. I employ a mixed-methods approach to this end, using both semi-structured interviews and cross-jurisdictional case study analysis to define policy options and arrive at recommendations. This approach was selected for pursuing a pragmatic line of inquiry, triangulating data sources using methods drawn from both qualitative and quantitative research traditions (Creswell, 2003). A summary of the methodological approach is provided below.

### **3.2. Cross-jurisdictional review**

This research method involved a review of literature on the topic of policies in other jurisdictions. Academic articles, research reports, government and industry publications, legislation, regulations, and other publicly available data sources were employed to first identify those jurisdictions to be included in the analysis, and then to collect and analyze the outcomes in the respective jurisdictions.

Jurisdictions were selected after a summary literature review identified those for which mining constitutes a significant role in the economy, and experiences with alternative models of financial assurance provision could be evaluated in terms of their relevance and applicability to British Columbia. Alberta and Ontario comprise the provincial jurisdictions included in the case study analysis. The Australian state of Western Australia (WA), along with Nevada of the United States, constitute the international jurisdictions included in the study.

### **3.3. Interviews with informed persons**

Semi-structured interviews were conducted with three individuals to generate supplementary data. I contacted interviewees from three primary perspectives: experts in mining policy, industry proponents, and mining engineers. Interviews were conducted between November 2016 and January 2017. While I secured interviews with individuals

with extensive experience in consulting private firms on reclamation and land management, I was unsuccessful in securing the representation of active mining companies. The opinions of interview participants regarding policy options were sought to qualify the data collected under the cross-jurisdictional analysis, and to provide the information required to assess the relative importance of trade-offs among policy options.

### **3.4. Methodological limitations**

The methodology outlined above was employed to define the policy problem, generate a set of alternatives to address the issue, analyze each policy option in turn, and to draw upon subsequently to formulate recommendations.

Limitations to this study's methodologies attend to the case study analysis and the semi-structured interviews. First, much of the information gathered during the case study analysis has limited applicability with respect to projecting the outcomes of alternative policies in British Columbia. Due to heterogeneity across the jurisdictions, assessing the merit of a policy approach as found in other contexts has inherent limitations. For this reason, I chose to review sub-national jurisdictions within federal states, and sought to examine cases where a marginal variation in outcomes could be approximated after a discrete policy amendment. To the extent that I frame each of the policy options drawn from the experience of other jurisdictions, however, the policy analysis and recommendations component of the study are based on an assessment of the ways in which a given approach is expected to take effect in British Columbia. In short, the methodology is not designed to reach a definitive account of the relative merits of each of the policy options. Instead, it should be viewed as a process of organizing the options available to British Columbia as understood through the experiences of other jurisdictions and the perspectives of individuals familiar with the mining industry, highlighting key trade-offs among a set of options.

Second, the scope of the information gathered through semi-structured interviews is also limited in its effectiveness to evaluate the alternative policy options. Each participant brought a unique set of perspectives to the fore, drawing on their experiences and interpretation of issues as they stand with respect to mining in British Columbia. Interview participants are not expected to offer an evaluation of policy options



on a range of accounts; instead, participants provided insights as to the sort of incremental steps that might result in improvements to environmental bonding in the province. As with the case study component, the data gathered through semi-structured interviews are employed as a frame to understand the processes, institutions and other mechanisms causing the persistence of this problem in British Columbia.

Finally, this study benefitted from many discussions with individuals with extensive knowledge and experience on the topic. However, the contents of many of these discussions were not introduced as data in this paper. I respect the wishes of those who preferred to remain anonymous, and both research participants and uncited sources are acknowledged as making a critical contribution to the research presented herein.

## Chapter 4. Case studies

### 4.1. Overview

The bulk of the information presented in this section was collected in a cross-jurisdictional review. This chapter summarizes information gathered from various sources, and presents a collated summary of policy approaches across four jurisdictions—Western Australia, Nevada, Ontario, and Alberta.

### 4.2. Western Australia, Australia (WA)

#### *Overview*

Mining accounts for a large share of economic activity in Western Australia (WA); in 2012-13, the mining industry contributed 34.3% to Gross State Product (GSP) (Western Australia Bureau of Statistics). It is also a source of significant revenue for the state's government, with \$5.3 billion in royalties collected from the mining and petroleum industry in 2014-15 (Government of Western Australia, n.d.).

The Government of Western Australia's Department of Mines and Petroleum is (DMP) is responsible for regulating the mining industry and implementing the Government's mines policy. Prior to 2013, mine reclamation policy in WA required *Unconditional Performance Bonds* (UPB) of mine owners (Department of Mines and Petroleum, n.d.). UPBs are contracts that require some third party to pay an agreed sum to government if environmental management practices at a mining site are found to be unsatisfactory (Department of Mines and Petroleum, n.d.). In WA, UPBs were delivered to the Minister for Mines and Petroleum by an approved financial institution, which was then made liable for the bond amount even in the event of bankruptcy or liquidation on the part of the mineral claims holder (Department of Mines and Petroleum, n.d.). This approach was similar to British Columbia's current policy.

In 2013, WA's *Mining Rehabilitation Fund Act 2012*, which established the *Mining Rehabilitation Fund* (MRF), ushered in a new approach to financial assurances in the state. The MRF is a pooled fund dedicated to financial assurance against environmental

liabilities.<sup>3</sup> Contributions to the MRF are made annually by mining tenement holders, in a non-refundable amount that is calibrated to annual tenement disturbance data (Government of Western Australia, 2015). Should the regulator fail in multiple attempts to enforce sufficient reclamation by the parties responsible, resources can be drawn from the fund for post-closure reclamation efforts (Government of Western Australia, 2015). Upon the introduction of the MRF, the state has met initial levy contributions with the release of UPBs (Western Australia, Office of the Auditor General, 2014; Stantec, 2016).

### ***Determination of financial assurance***

Contributions to the MRF are based on tenement disturbance reports submitted to the regulator by tenement holders on an annual basis (Government of Western Australia, 2015). The MRF scheme incentivizes progressive reclamation (the address environmental liabilities as they are incurred), as the unit rate applied for the determination of the MRF levy is reduced for lands that have already been rehabilitated<sup>4</sup> (Department of Mines and Petroleum, n.d.). The levy amount is determined in accordance with the rules set out in corresponding regulations (Mining Rehabilitation Fund Act, 2012, s.11). The following equation illustrates the method of determining the levy amount per *Mining Rehabilitation Fund Regulations, 2013*:

#### **Equation 1: MRF Levy Amount, Western Australia**

$$\text{Fund Contribution Rate (FCR)} \times \text{Rehabilitation Liability Estimate (RLE)}$$

The regulations currently mandate an FCR of 1%, representing the proportion of the RLE payable to the MRF in each year (Department of Mines and Petroleum, Mining Rehabilitation Fund Regulations, 2013, r.4). The RLE is calculated by first determining the amount of and type of land disturbed, followed by applying a *unit rate* to each

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<sup>3</sup> The Mining Act 1978 (WA) (“Mining Act”) is the statute governing mining in Western Australia, which allows interested parties to apply for the rights to exploration and extraction of minerals (Western Australia. Environmental Defender’s Office, 2011).

<sup>4</sup> The unit rate for rehabilitated land is reduced to the minimum threshold of \$200 per hectare. For further detail, see Table A2 (Appendix A)

hectare of land under that category (Department of Mines and Petroleum, Mining Rehabilitation Fund Regulations, 2013, r.4.2). For mine tenements with an RLE of less than \$50,000 (AUS), the levy amount is waived (Department of Mines and Petroleum, Mining Rehabilitation Fund Regulations, 2013, r.4.3). The full unit rate schedule can be found in Table A2 (Appendix A).

### ***Minimum security requirements***

As noted in the previous section, the *Mining Rehabilitation Fund Regulations, 2013* provides the RLE schedule used to determine the levy amount.<sup>5</sup>

### ***Long-term management strategies***

In 2012, the DMP published a report inventorying the abandoned mine site features in the state (Geological Survey of Western Australia, 2012; Government of Western Australia, 2016). The Abandoned Mines Program, implemented in early 2016, is an extension of this 2012 report. The purpose of the program is to implement the Abandoned Mines Policy, directing MRF resources to prioritized abandoned sites (Department of Mines and Petroleum, n.d.). Through 2016, the DMP was in the process of improving the methods used both to identify sites that pose a high risk and to authorize the release of MRF funds for reclamation efforts.

### ***Performance***

Reports on pre-existing financial assurance policy prompted the introduction of the MRF. In 2011, the State held 4,500 UPBs amounting to approximately \$900 million, while earlier estimates put the total costs of rehabilitation at A \$4-6 billion (Western Australia, Office of the Auditor General, 2011). Since establishing the policy in 2013, the

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<sup>5</sup> While UPBs are no longer an active component of mine reclamation policy in Western Australia (they may still be required for mine sites deemed to pose a significant risk of rehabilitation liability reverting to the state), minimum financial assurance requirements applied in this former approach. Minimum financial assurances were required for tailings facilities, which are bonded at a minimum rate of A \$18,000 per hectare; waste rock piles were bonded at a rate of A \$15,000 per hectare (Western Australia, Department of Mines and Petroleum, 2010).

Mining and Rehabilitation Fund has reduced the state's liability for abandoned mines sites (Western Australian Auditor General's Report, 2014). Approximately \$45 million was collected under the MRF in 2014-15, and an estimated \$51 million in contributions was projected for 2015-16 (Government of Western Australia, 2015).

### **4.3. Nevada**

#### ***Overview***

The mining industry is prominent in Nevada's economy, with \$7.2 billion in mineral commodities produced and over 14,000 direct jobs provided in 2015 (Division of Minerals, 2015). The Bureau of Mining Regulation and Reclamation (BMRR) is responsible for issuing state mine reclamation permits to mine proponents, as well as other permits required for mining-related activities (Nevada Revised Statutes, Chapter 519A, 599; Nevada Division of Environmental Protection, n.d.). The BMRR, in collaboration with its parent department, the Nevada Division of Environmental Protection (NDEP), is responsible for the determination of state bond amounts. The policy evaluated for this study, however, is a system of reclamation bond pooling facilitated by the State's Division of Minerals. Access to the Nevada Reclamation Performance Bond Pool is offered to proponents with limited access to capital (State Bond Pool) (State of Nevada, Commission of Mineral Resources, n.d.). The bond pool accepts only sites with an estimated reclamation liability of less than \$3 million (USD). A proportion of the bond is collected as a deposit, and the state collects premiums on the unsecured difference (State of Nevada, Commission of Mineral Resources, n.d.). The deposit is refundable upon sufficient reclamation of lands, while the premiums are non-refundable (Nevada Revised Statutes, 519A.010) (See Nevada (Appendix D) for additional information).

#### ***Determination of financial assurance***

The BMRR and the NDEP determine the bond amount after collecting cost estimates from the proponent. Upon determination of the bond amount required of mine proponents by either the Nevada Division of Environmental Protection (NDEP) or the Bureau of Land Management (BLM), the Division of Minerals determines a percentage of the bond that is required as a contribution to its bond pool. As with the determination

of annual premiums on the unsecured portion, administrators use a formula to determine this amount (State of Nevada, Division of Minerals, n.d.).

### ***Minimum security requirements***

The amount of the surety bond required of mine proponents is equal to a full-cost estimate of reclamation as determined by the Bureau of Land Management (BML) (Bureau of Land Management, n.d.). Any number of bonds, by a multiplicity of financial instruments and for any regional coverage (for example, a single bond that covers multiple mine sites within the state) may be submitted (Bureau of Land Management, n.d.). As noted earlier, the Nevada Reclamation Bond Pool provides an alternative for some mine operators.

### ***Long-term management strategies***

With a mandate conferred by the Division of Minerals, Nevada's Abandoned Mine Lands (AML) program identifies and ranks the risks posed by abandoned mines, and remediate lands through either responsible owners or the Division (Bureau of Land Management, n.d.). Funding for the program is secured through mining claim filing fees, fees for surface disturbance of public lands, and through Assistance Agreements through both the Bureau of Land Management (BLM) and the United States Forest Service (Division of Minerals, 2016). Dedicated revenue to the AML program was \$682,655 in 2015 (Division of Minerals, 2016).

### ***Performance***

In 2015, 902 mine hazards were secured, 330 (33.4%) of which were performed by mine claimants and private property owners (Division of Minerals, 2016). The program identified and ranked 708 hazards over the course of that year, reaching a total of 19,468 discovered and ranked hazards over the course of the program. (Division of Minerals, 2016). The AML program appears effective in identifying, ranking, and securing hazards.

## 4.4. Ontario

### **Overview**

In 2014, Ontario accounted for 24.6% of the total share of mineral production in Canada, with a value of nearly \$11 billion (Ontario, Office of the Auditor General, 2015). The Mines and Minerals Division at Ontario's Ministry of Northern Development and Mines is responsible for administering the *Mining Act R.S.C 1990*, the legislation which governs the "prospecting, staking, and exploration for the development of mineral resources in the province (*Mining Act, c.m.14*). A requirement to rehabilitate lands affected by mining activity came into effect in 1991 when the *Mining Act* was revised (*Mining Act, c.m.14*; Ontario, Office of the Auditor General, 2015). Upon staking a mining claim on a parcel of land, mine proponents are required to submit a closure plan to the Directors of Exploration, Minister appointees responsible for reviewing closure plans and issuing permits (Ministry of Northern Development and Mines, n.d.; *Mining Act*).

The Act requires that certified closure plans, along with the provision of financial assurance, be filed prior to the launch of any advanced reclamation or production project (*Mines Act, c.m.14*). Forms of financial assurance are like those accepted in British Columbia, but are required of a proponent only if they fail to meet a series of financial tests (*Mining Act, c.m.14*). The costs of rehabilitation efforts can be supplemented by drawing on the specific special purposes account into which financial assurances are deposited (*Mining Act, c.m.14*). Should the Crown be impelled to carry out rehabilitation of lands, the amount becomes a debt due to the government collectable through court proceedings. Similarly, shortfalls in financial assurances with respect to requirements for mine site rehabilitation form a lien against the responsible party (*Mining Act, c.m.14*).

### ***Determination of financial assurance***

The determination of financial assurance is based on cost estimates submitted by mine proponents included in their filing of a closure plan with the Ministry of Northern Development and Mines (*Mining Act, c. 1 s. 26*).

### ***Minimum Security Requirements***

Ontario is notable for allowing companies in sufficiently sound financial standing to self-insure, relieving mine proponents of pre-emptive liability assurance obligations (Mines Act, c.m.14). This provision of the Act has been criticized by some observers, who note examples where firms with strong financial standing upon commencing a mining project have not maintained that status over time (Environmental Commissioner of Ontario, 2015; Office of the Auditor General, 2005, 2007, 2015). This leads some to regard the Government of Ontario as an unsecured creditor for the mining industry (Environmental Commissioner of Ontario, 2015).

### ***Long-term management strategies***

In 1999, the Government of Ontario established the Abandoned Mines Rehabilitation Program, the mandate of which is to organize the reclamation of contaminated sites. As of 2015, the program has received a total of \$138 million in funding, rehabilitating 75 abandoned mine sites over 17 years— annual expenditure ranged from \$1.6 million to \$6.7 million between 2010 and 2015 (Office of the Auditor General, 2015).

### ***Performance***

The Government of Ontario has assumed considerable liability for the reclamation of abandoned mines. In 2015, Ontario's Ministry of Northern Development and Mines reported \$303 million in liability for 44 abandoned, contaminated sites for which the government is, or is likely to be, responsible for restoration (Office of the Auditor General of Ontario, 2015). A further \$69 million in contingent liability was reported for twelve abandoned mines for which the government may become responsible (Ontario, Office of the Auditor General, 2015). The province has not commissioned an estimation of the total cost of rehabilitating the 4400 abandoned sites since 1993, which may range from \$163 to \$782 million (Office of the Auditor General, 2015).



## 4.5. Alberta

### Overview

The prominence of Alberta's oil, gas, and mining sector is unique in Canada, contributing nearly \$70 billion (18.3%) of the province's \$333.1 billion gross domestic product in 2015 (Government of Alberta, 2016). As with the mining industry, oil and gas development brings environmental risks in the event of the suspension and abandonment of oil and gas wells and facilities. This is salient considering commodity price volatility in recent years; 591 new orphan wells were identified in 2014/15 fiscal year, with an additional 248 in 2015/16 (OWA, 2016). In 2001, the Government of Alberta facilitated the establishment of the Orphan Well Association (OWA), a not-for-profit organization tasked with managing the reclamation of orphaned upstream oil and gas wells with authority from the province's Ministry of Energy and Mines (OWA, 2016). It is included to provide an account of the outcomes expected of a system wherein both a segregated compliance and enforcement organization is created along with a funding system that approximates a pooled reserve fund.

Under Alberta's *Oil and Gas Conservation Act (OCGA)*, the Minister of Energy and Mines is authorized to establish an Oil and Gas Orphan Fund. Authority over this fund has been delegated to the OWA, a not-for-profit organization that manages the fund and allocates resources toward reclamation or abandonment of existing orphan wells (OWA, 2016). In 2016, revenues of about \$33 million were collected by the OWA, the bulk of which (\$30 million) was collected under the orphan fund levy through the AER<sup>6</sup> (OWA, 2016).

Operators of oil and gas wells are required to contribute to the Orphan Mine Fund through both annual levies and licensing fees.<sup>7</sup> Funds can then be used for remediation activities at mine sites maintained through the Alberta Energy Regulator's Liability Management System, which manages properties designated to the program

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<sup>6</sup> OWA revenue is supplemented by direct funding grants from the AER, and interest accrued.

<sup>7</sup> The Orphan Fund levy is collected by the AER based on each licensee's calculated proportion share of total reclamation liability as per application of the AER's Liability Licensee Rating program starting on April 1, 2002 (OWA, 2016). These funds are then remitted to the Orphan Well Fund

because they are found, per the assessment of the AER, to be insolvent or otherwise not financially viable (OWA, 2016). 57% of the organization's 2015/16 expenditures (\$16.74 million) were dedicated to well abandonments, which was sufficient to address 185 orphan wells (OWA, 2016). Historically low commodity prices resulted in an abundance of orphaned sites between 2014 and 2016, increasing the share of funding that was dedicated to well abandonments (OWA, 2016).

While the dynamics of Alberta's oil and gas industry differ from those in BC's mining industry, both the organizational and funding models are relevant to the present study. Moreover, the collection of levies for a pooled reserve fund in the OWA provides an example of the viability of this approach in an additional sector of Canada's natural resources industry.

## **Chapter 5. Policy options**

### **5.1. Policy option 1: Pooled rehabilitation fund**

This policy option involves the pooling of a mine reclamation levy from mining activities to establish a pooled fund dedicated to the reclamation of mine sites in British Columbia. Western Australia (WA) has recently introduced regulations that set out to replace their reclamation bonding program with a mining rehabilitation fund, earmarking funds for reclamation in this way. This policy assesses this option as it might apply to British Columbia.

Statutory liability for mine reclamation continues to fall to mine proponents under this approach. However, the incentive for proponents to engage in mine reclamation is presumably not fulfilled by reclamation securities policy. This model tests the propriety of de-emphasizing financial securities as a method to induce the compliance of contemporary proponents with environmental rules, instead focusing on addressing existing orphaned, abandoned, and historic sites. It shares indirect similarities with the approach taken in both Nevada and Alberta, where the proponents similarly contribute in a similar way to a transferable, liquid rehabilitation fund. An analysis of various program design features, including the unit rates assigned to specific mine projects and activities, is presented in Chapter 7.

### **5.2. Policy option 2: Financial securities with added reclamation fund**

This option retains the current bonding system, but creates an earmarked account for mine reclamation funded by industry contributions. Funds would be applicable to the reclamation of historical mines, abandoned mines, and orphaned mines for which environmental liability would have otherwise been assumed by the state. This option has the benefit of establishing what amounts to a pooled reserve fund without forgoing the positive incentive effects retained under the current financial assurance system. A primary disadvantage of this approach is that it departs from the polluter-pays-principle, ascribing liability for sites abandoned or orphaned prior to establishment of the policy to contemporary mine proponents. In short, the option adopts an insurance

premium for the mining industry to create a financial assurances rule that combines both refundable bonds and non-refundable reserve contributions.

### **5.3. Policy option 3: Upward adjustment to financial security rates with low-liability bond pool**

This option involves an amendment to the status quo, altering the methods under which the Ministry of Energy and Mines (MEM) collects financial assurances under their current form. It amounts to a commitment to minimum bond rates, which are determined by assessing the proportion of estimated liability that is covered by reclamation bonds. In addition to this adjustment, the policy features a bond pool program targeted toward small, relatively low-liability mine proponents facing a scarcity of capital. Finally, the policy includes increased funding, from consolidated revenues, for state sponsorship of reclamation for mines for which the responsible party cannot be found or is otherwise incapable of funding proper reclamation.

In Chapter 6, I provide an overview of the evaluation criteria, including associated measures for each, by which I will assess the policy options.

### **5.4. Considerations**

“...the issue is that the mines branch is trying to support mining, trying to encourage mining, and at the same time trying to regulate it. You’ve got this dichotomy.”

*Mining consultant, personal communication, 2016*

In 2016, the BC Auditor General recommended that the Government “create an integrated and independent compliance and enforcement unit for mining activities” to separate the dichotomous mandate of the Mines branch. In response, the Government defended its current arrangement, claiming that it is the legislative framework, not the organizational structure, which “drives compliance and enforcement” (British Columbia, Office of the Auditor General, 2016). While not explicitly considered as a policy option, I consider the organization of regulatory mandates an issue that is pertinent to this study. Some interpret the current level of held mine securities as the result of a pattern of willful underestimation, not least due to the dichotomous mandate of the MEM’s Mines Branch (Mining consultant, personal communication, 2016). Moreover, the Office of the Auditor

General and others have called on the MEM to establish a separate compliance and enforcement branch to mitigate the risk of regulatory capture (British Columbia, Office of the Auditor General, 2016; Mining consultant, personal communication, 2016). Such a re-organization should not be a priority for financial reclamation assurance policy reform in BC. by some accounts, a dearth of resources available the MEM is more to blame for shortcomings in oversight than pervasive regulatory capture (Mining consultant, personal communication, 2016). I focus instead on the design of the regulatory system that defines the rules by which financial assurances are collected.

It is also important to consider options for the management of funds by some third-party, particularly under any iteration of the pooled reserve funding model. British Columbia does not have an arms-length program for organizing funds and managing the reclamation of contaminated sites in general (Stewart and Johnstone, 2007; British Columbia, Office of the Auditor General, 2016). Instead, it has an internal governmental program overseen by a committee of senior government officials.<sup>8</sup> As will be addressed later in this paper, the model statutorily delegated authority appears to be the appropriate structure for the organization fulfilling this role.<sup>9</sup> Especially when considering industry-based funding models, the Government of British Columbia should consider this organizational principle when considering the stewardship of existing contaminated sites.

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<sup>8</sup> The Crown Contaminated Sites Program (CCSP)

<sup>9</sup> Alberta provides an example of a jurisdiction that has delegated authority over managing both reclamation funding and the acceptance of orphaned sites into the government's reclamation program. Saskatchewan's Institutional Control Program (ICP) has also been cited as a strong model (See Appendix D)

## Chapter 6. Evaluation criteria for policy options

Each of the policy options for financial assurances for mine reclamation in British Columbia is evaluated by five criteria: (i) distribution of environmental liability; (ii) viability of funding for existing contaminated sites; (iii) stakeholder acceptance; (iv) social efficiency of new mine development; and (v) administrative complexity. While each of the criteria is given consideration in the analysis, three are deemed most important. First, the distribution of environmental liability criterion captures a fundamental aspect of the policy problem, and is therefore given a stronger weight in the analysis. Secondly, British Columbia, as in each of the jurisdictions reviewed in this study, has a concern with existing abandoned and orphaned mining sites in need of further reclamation—given the persistence of significant liabilities stemming from orphaned, abandoned, and historic sites, the viability of funding for existing contaminated sites has relative prominence as well. Lastly, the social efficiency of new mine development, or the equitable distribution of aggregate financial assurance contributions among mine and consistency with the polluter-pays-principle, is considered

The two remaining criteria—stakeholder acceptance and administrative complexity—are of secondary importance. While linked to the effectiveness of each policy option, the stakeholder acceptance criterion is relatively narrow in scope and takes a secondary role. The effects of a policy on the economics of BC's mining industry are better evaluated by the distribution of environmental liability and the social efficiency of new mine development. Finally, I also consider administrative complexity, including an account of relevant legislation and issues of administrative capacity within government as of slightly diminished criteria relative to other criteria.

To estimate the performance of each option, I developed the following method. The data for this exercise draws on both the MEM's *BC Mine Information* system and the *Mine Reclamation Securities in BC for Metal and Coal Mines, 2014*. While the *Mine Information System* provides current details on metal and coal mines in British Columbia, the reclamation bonding data provided in the *Mine Reclamation Securities* list provides a snapshot of both reclamation securities and estimated reclamation liabilities in 2014. To collate the data provided from these two sources, simplifying assumptions were made. While mines of all statuses contribute to total reclamation liabilities, only those which

were operating throughout or for most of 2015 were included among the mines whose outstanding financial assurance would be affected by this and other policy options.

A total of seven mines that were operational in 2014 (and thus included in the *Mine Reclamation Securities* document) were either closed or placed into care and maintenance during 2015. For the purposes of this study, they were kept in the pool of firms to which bond amount treatments were applied. This analysis is meant to provide a snapshot of a single year, demonstrating the projected outcomes of various policy options on held financial assurances for a set of operating mines. This exercise shows projected outcomes based on 2015 mines data. Subsequent research would benefit from continually updating these data sources to project the impact with further precision.<sup>10</sup>

Table 2 provides definitions for key terms used throughout the analysis in the following chapters. Each is important to the five criteria and the account of the data and method used to evaluate them, which are described in section 6.1.

**Table 2: Definition of key terms**

Term	Definition
Bond coverage rate	Financial assurances as a proportion of contemporary reclamation liabilities
Contemporary reclamation liabilities	Total reclamation liability estimate for operational mines
Total reclamation liabilities	Total reclamation liability estimate for each of operational, closed, orphaned, abandoned, and historic sites in British Columbia

## 6.1. Distribution of environmental liability

The distribution of environmental liability refers to the extent to which a policy is expected to alter the distribution of liability for mine reclamation between the government

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<sup>10</sup> Under the present method (1) proposed mines, (2) mines under construction, and (2) new mines not captured in the 2014 reclamation bond data were omitted from the data set.

and industry. This criterion focuses exclusively on current financial assurance as a proportion of contemporary mine reclamation liability. Projections of the effectiveness of reducing government liability will be found through an analysis of incentive effects, methods of determining financial assurance, and mode of financial assurance. This criterion relates closely to government budget impacts, as it accounts for the risk of government assumption of (financial) liability for contaminated sites. As will be outlined further in chapter 7, I use techniques in quantitative analysis to project the impacts of the policies on outcomes in British Columbia.

## **6.2. Viability of funding for existing contaminated sites**

This criterion considers the extent to which policy options provide a viable source of funding to supporting the reclamation of existing sites where no responsible party can be found or be made to pay for reclamation. The source of funding varies from each policy option, and I consider whether financial assurances are earmarked for the remediation of current contaminated sites, the transferability of funds to the pool lands requiring additional work, the refund-ability of the security made by mine proponents. I also consider whether the policy option is consistent with the polluter-pays-principle (PPP). This criterion is measured by assessing the magnitude of such funds against the assumed mining share of Crown Contaminated Sites Program (CCSP) expenditure (2015). Further details on this criterion are presented in Chapter 7.

## **6.3. Social efficiency of new mine development**

This criterion concerns the distribution of financial assurances requirements across mine sites to incentivize socially efficient mine development. While a policy approach may collect a large aggregate sum of financial assurances from the mining industry, it may distort incentives such that socially inefficient mine sites are favoured over relatively efficient ones. In addition to a concern with the distribution of environmental liability between government and industry (Section 6.1), the distribution among industry firms is important. The share of aggregate assurance contributed by individual firms should correspond narrowly to their share of liability. I also consider whether the policy aligns with the polluter-pays-principle, assigning costs in a way that induces a mine proponent to meet the social costs of their specific project.



## **6.4. Stakeholder acceptance**

Considering the response of stakeholders— chief among them mine owners, agents, and managers— is critically important for understanding the economic impact of each policy option. This is closely related to its political feasibility. The mining industry is a significant driver of the economy in British Columbia, and the response from industry to mine reclamation policy is an important consideration. Such responses for each policy option will be assessed under this criterion, the measure for which will be drawn primarily from secondary data from other jurisdictions and from interviews with representatives from industry.

## **6.5. Administrative complexity**

This criterion concerns whether the regulatory and legislative framework demanded by a policy suggests consistency with existing legislation and administrative capacity in British Columbia. To assess each policy option under this criterion, I will consult both statutory legislation and regulatory documents to evaluate the extent to which an option is plausible under current regulatory and legislative conditions. To evaluate this criterion, I score each of the policy options considered. Should a policy option require substantial statutory revision or otherwise re-organization of the current policy framework as it relates to mining reclamation, it will score 'high' with respect to administrative complexity. Where a policy option is consistent with the existing policy framework, that option will score 'low'.<sup>11, 12</sup>

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<sup>11</sup> See Table 8, Appendix A for a summary of the criteria and measures

<sup>12</sup> See Appendix B for outline of scoring scale and method

## **Chapter 7. Evaluation of options**

### **7.1. Policy option 1: Pooled reserve fund**

#### **7.1.1. Overview**

This policy option is an emulation of Western Australia's (WA) Mine Rehabilitation Fund program. Due to data limitations, however, analysis of this policy option applies the fund contribution rate (FCR) to 2014 estimates of mine reclamation liabilities in British Columbia. A more comprehensive analysis would seek to apply the unit rates defined in WA's Mine Rehabilitation Fund program to mines in BC, which could adjust the total liability estimates assigned to each site. However, granular land disturbance data at the mine site level was not readily available at the time of the study. I assume that the total liability estimates for mines in British Columbia are set at an appropriate level.

#### **7.1.2. Distribution of environmental liability**

This option encourages mine owners to engage in progressive restoration of mine site disturbances, as progressively reclaimed lands do not factor in the determination of the levy contribution. This is beneficial to the aim of limiting the share of environmental liability assumed by government. An experienced industry professional cited progressive restoration as a method of mitigating the adverse risk of future abandoned and orphaned mine sites (Mining consultant, personal communication, 2016). While WA excludes proponents with a mine reclamation liability of less than \$50,000, I assume that these mines will be subject to the levy (Department of Mines and Petroleum, Mining Rehabilitation Fund Regulations, 2013, r.4.3). The rationale for this decision is discussed further in section 7.1.2.

A total of seven mines which were operational in 2014 (and thus included in the *Mine Reclamation Securities* document) were either closed or placed into care and maintenance during 2015. For the purposes of this analysis, they were kept in the pool of firms to which bond treatments were applied. This analysis is meant to provide a snapshot of a single year, demonstrating the projected outcomes of various policy options on held financial assurances for a set of operating mines. This exercise

provides a sketch of projected outcomes were a given policy in force throughout 2015. Subsequent research would benefit from continually updating these data sources to project the impact with further precision.<sup>13</sup>

Table 3 shows the results of an analysis of the reclamation bonds held for mines which were operational in 2014. Following the example of WA, a fund contribution rate (FCR) of 1% against contemporary reclamation liability estimates would have yielded an aggregate levy of \$6.9 million in 2015— the net present value of the aggregate levy collected from the mine industry over a 20-year mine cycle amounts to 10.2% of total reclamation liabilities. An FCR of 3% results in the collection of 15.3% of total reclamation liability over a 20-year period<sup>14</sup>.

**Table 3: Estimation of levy (policy option 1)**

FCR	Annual levy (2015)	Aggregate levy <sup>15</sup> as proportion of contemporary reclamation liability
1% <sup>16</sup>	\$16.1 million	11.8%
2%	\$32.2 million	7%
3%	\$48,3 million	35.5%

*Source(s): Author's computations; Ministry of Energy and Mines, 2014, n.d.)*

A fund contribution rate (FCR) of 3% provides the assumed collection amount for this policy option. There are challenges involved in comparing this levy, which is collected over time, with the static financial securities typical of other approaches, including current policy. The nature of the financial resources collected for mine reclamation differs with a pooled reserve fund. I represent the aggregate annual levy as

<sup>14</sup> Each of the estimates was derived using a 6% social discount rate. This rate is commonly used to aggregate values over time by accounting for both pure time preferences and the social opportunity cost of capital. See Shaffer, 2010.

<sup>15</sup>  $Net\ Present\ Value = \sum_{t=1}^{20} \left( \frac{Annual\ Levy_t}{(1+i)^t} \right)$

<sup>16</sup> Represents a baseline, taken from the FCR currently employed in Western Australia (January 2017)

a net present value over a 20-year period to reconcile for comparative purposes. With an FCR of 3%, approximately \$48.3 million collected in financial assurance annually, a 20-year capitalized value of \$570.6 million (35.5% of contemporary liability estimate). Given the inter-temporal nature of the levy and the purposes for which the pooled fund may be appropriated under this policy, this estimate should be considered an upper bound. The current bond coverage rate for contemporary reclamation liability is 43%, so this policy option would amount to a regressive amendment on this criterion. For this reason, it receives a 'low' score for its performance in the distribution of environmental liability.

### **7.1.3. Viability of funding for existing contaminated sites**

This funding model provides a plausible resource pool for the reclamation of existing sites. As found in models of earmarked funding under the Superfund program (State of Nevada), Alberta's Orphan Well Fund, along with early evidence from the state of Western Australia show that transferable, earmarked funds for the reclamation of existing abandoned, orphaned, or historic sites show promise in reducing the number of poorly reclaimed abandoned mine sites. However, this represents a violation of the polluter-pays principle, as the mine proponents funding the program are guaranteed not to be the party responsible for the environmental issue being addressed. Under the methods of assessing the performance of these policies presented in Table B1 (Appendix B), this policy option scores relatively high in the viability of funding for existing contaminated sites. The annual contribution of transferable funds amount to 44.6% (FCR= 3%) of the presumed mine portion of the Crown Contaminated Sites Program's 2015 expenditure, or \$48.3 million. Relative to other options, this policy performs well in the provision of funds for the reclamation of existing sites— it receives a 'high' score under this criterion

### **7.1.4. Social efficiency of new mine development**

The measure employed to evaluate this option is the projected correlation between a mine's share of environmental liability and its share of aggregate liability. The figure generated from this equation provides an estimation of the degree to which the proportion of total financial assurance contributed by respective mines deviates from the share of contemporary reclamation liability for which they are liable. The magnitude of

the correlation coefficient will correspond to this deviation— a high, positive value suggests a high degree of social efficiency (see Appendix B, Table B1 for an outline of the scoring scale and method).

For this option, the correlation between assurances collected and share of aggregate liability for existing sites is nearly perfect each of the fund contribution rates (FCRs). This is due to the FCR rate schedule's being applied in direct correspondence to the estimated liability for each individual site. Performance under this criterion depends both on the accuracy of the estimated liability and the method of matching proportional assurance contributions to it. However, contributions to the pooled reserve fund can be appropriated for the reclamation of any orphaned, abandoned, or historic site in the province— as such, it departs from the polluter-pays-principle. The absence of refundable, site-specific securities, along with the sharp reduction in aggregate financial assurance contributions, brings into question the effectiveness of the policy to induce mine proponents to engage in proper reclamation.

### **7.1.5. Stakeholder acceptance**

In Western Australia, the introduction of the mining rehabilitation fund in 2013 has met with positive review from the mine industry (Cervantes et al., 2016). A significant departure from existing policy framework, the reform in WA benefitted from significant prior consultation with stakeholders. Observers note that the commitment to stakeholder engagement was critical to the eventual success in implementing of the policy (Gorey et al. 2016).

This degree of stakeholder acceptance is expected in British Columbia. Although non-refundable, the financial assurance requirements constitute a fraction of the amount required under current financial assurance rules. At \$571 million, the 20-year net present value of financial assurance collected under a fund contribution rate of 3% amounts to approximately 36% of total liability estimates for operational mines, compared to approximately 42% under the current securities policy. The primary concern cited by mining industry representatives regarding financial assurance rules are the adverse financial consequences of meeting the financial security requirements. The collection of the levy portion of financial assurance requirements might be delayed until the mine begins the production stage, when liquidity constraints are relieved and

operating costs per tonne are reduced (Indigenous and Northern Affairs Canada, 2007; Government of British Columbia, 2015). To the extent that this policy would reduce the aggregate financial assurance demanded of mine proponents, stakeholder acceptance is expected to be high. However, the non-refundable character of the contribution is likely to temper the favorability of the policy from the perspective of mine proponents. Mine proponents are already required to pay mineral land taxes (royalties) and other fees such as *Environmental Management Act* water discharge fees (OADGBC, 2016; BC Environmental Management Act, c. 53). Further levies may result in a prohibitively costly fee schedule in the aggregate.

### **7.1.6. Administrative complexity**

Mine proponents are currently required to submit annual reclamation reports under the *Mines Act* and the *Health, Safety and Reclamation Code for Mines in British Columbia* (Ministry of Energy and Mines, n.d.). This report includes information on surface disturbance, disposal and storage of all materials, and activities associated with implementing the site's reclamation program. In seeking to further their spatial data capabilities to monitor major mine activity, the MEM expanded the data required of mine proponents. These annual reclamation reports would likely satisfy the data requirements for the implementation of a levy and pooled reserve fund.

The *British Columbia Mines Act (RSBC 1996)* permits the Lieutenant Governor in Council to establish, through regulation, a mine reclamation fund "into which must be paid security," by an owner, agent, or manager (BC Mines Act, c. 293). Under current conditions, this holds mine reclamation securities. Appropriation of the funds, which must be assigned to specific, separate accounts for each mine proponent, may occur only to either reimburse the mine proponent (with interest) upon satisfactory reclamation efforts or to pay for the cost of remedial work required under the Act (BC Mines Act, c. 293). The upshot of the current legislative framework is that when the environmental or health risks associated with a site warrant action, government funds to address the issue may only be drawn from consolidated revenue (BC Mines Act, c. 293 s 17(2)). This requirement precludes the regulator from unilaterally establishing a pooled reserve fund for the purposes of mine reclamation. The Government of British Columbia currently collects levies based on mine site characteristics, such as the mineral land tax and *Environmental Management Act* waste discharge fees (OADGBC, 2016; BC

Environmental Management Act, c. 53). The realization of a transferable mine reclamation fund would therefore require an amendment of existing legislation, allowing for both the establishment of a pooled reserve fund and the appropriation of reclamation funds from it.

A further concern is the administrative capacity of government to identify, assess, and assume institutional control over mine sites in need of reclamation work. The CCSP currently performs this management function by applying a risk-assessment methodology to candidate sites, selecting sites for the program, ranking their urgency, and performing remediation (Crown Contaminated Site Program, 2016). Depending on consultation with industry, the province might review their approach to managing contaminated sites— both the mining industry and the public at large are likely to demand that government programs execute prudent management of funds and ensure expenditures are made in the public interest (NOAMI, 2016).<sup>17</sup>

**Table 4: Projected outcomes, policy option 1**

Measure	Projected value
Financial securities as share of contemporary reclamation liability	35.48%
Capitalized value of industry levies (NPV)	\$570,585,755
Estimated annual funds for the reclamation of existing reclamation liability	\$48,241,873

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<sup>17</sup> See Appendix D: Saskatchewan’s Institutional Control Program

## **7.2. Policy option 2: Financial securities with reclamation fund**

### **7.2.1. Overview**

This policy option comprises a mix of the environmental bonding system with the addition of a rehabilitation fund by levies on current mining activity. Under this policy, all mine proponents would remain liable for a reclamation bond, but would also be obliged to contribute to a mine rehabilitation fund. This policy option is an integration of the pooled reserve fund approach with a bonding system. Instead of replacing a bonding system, this policy supplements the existing policy by collecting levies, the bulk of which can then be used to remediate sites prioritized for remediation by the Crown Contaminated Sites Program (CCSP). While a range of FCR's are presented for reference, the analysis of this option proceeds under a rate of 1%.

### **7.2.2. Distribution of environmental liability**

Like the pooled reserve fund option, proper assessment of performance under this criterion demands a reconciliation of the ongoing (inter-temporal) levy and the static financial securities components, respectively. For consistency, I convert the levy portion to its net-present value over 20 years, which is then summed with the financial securities portion of the mine reclamation policy. The combination of hard securities and annual levies (20-year NPV) would amount to \$776,161,037 if applied to the pool of mines considered in this study. This constitutes 48.26% of the aggregate estimated liability for existing sites, an increase from 43.16% under the status quo.

### **7.2.3. Viability of funding for existing contaminated sites**

As financial securities are a component of this policy option, a pooled reserve fund amounts to a net increase to the financial burden faced by mine proponents at any rate. For this reason, the fund contribution rate (FCR) assumed to apply under this policy is to be kept at the relatively low annual rate of 1%. At this rate, the annual levy is



an estimated \$16.1<sup>18</sup>— 14.87% of the share of CCSP expenditure allocated to mine sites in 2015.

#### **7.2.4. Social efficiency of mine development**

As this policy introduces levies to the existing financial securities program, the levy component constitutes the marginal adjustment to financial assurance requirements. As the amount of the proposed levy tracks in direct proportion to a mine site's contribution to total environmental liabilities created by mining sites, levies have the effect of increasing the correlation between share of aggregate assurances and share of liability. The correlation between financial assurance and reclamation liability contributions remains high at each fund contribution rate considered. However, the sum of financial assurance remains a relatively low portion of outstanding liability. The pooling of reclamation liability is also a departure from the polluter-pays-principle, imposing the costs of reclaiming orphaned, abandoned, and historic sites on existing and prospective mine sites.

#### **7.2.5. Stakeholder acceptance**

This policy option brings a marginal increase to the financial assurance contributions required of mine proponents. While the amount in hard financial security is unchanged, mine proponents are required to submit an annual, non-refundable levy to a pooled fund. All else equal, this policy is expected to be met with a negative response from industry, not least because this policy entrenches the intergenerational transfer of mine liability within the provincial industry. The extension of dormant reclamation liability to contemporary firms presents a challenging issue given that many historic sites were compliant with the applicable regulatory standards of the time (Mining engineer, personal communication, 2016). I am sympathetic to this concern. However, the societal benefits of a viable and consistent source of transferable reclamation funding are significant. British Columbia's CCSP and Ontario's Abandoned Mines Rehabilitation Program both

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<sup>18</sup> Recall that this estimate is based on static mine liability data (see section 7.1.1). This method provides an estimate which is subject to change per the state of British Columbia's mining industry over time.

demonstrate that programs which rely on consolidated revenue generally receive low funding relative to outstanding reclamation liabilities (Crown Contaminated Sites Program, 2016; Office of the Auditor General, 2015). A matter of political prioritization, mine reclamation liabilities are often subject to a narrow budget constraint when falling to stewardship by the state (Mining consultant, personal communication, 2017). Moreover, this policy transfers only a portion of funding responsibility to mine proponents— the bulk of environmental risk still falls to British Columbian taxpayers.

### 7.2.6. Administrative complexity

The collection of a transferable mine reclamation levy prompts legislative concerns like those for policy option 1 (section 7.1.5). An amendment to existing legislation would be required to allow government to pool the aggregate levies in a fund which can be appropriated for use across a range of sites. While the administrative and legislative concerns are non-negligible, it is unclear whether issues will impose a serious burden on decision-makers and administrators. As with policy option 1, this option receives a score of ‘medium’ on this criterion.

**Table 5: Projected outcomes, policy option 2**

Measure	Projected value
Financial securities as share of contemporary reclamation liability	48.26%
Capitalized value of industry levies (NPV)	\$190,195,251
Estimated annual funds for the reclamation of existing reclamation liability	\$16,080,624

## **7.3. Policy option 3: Minimum financial security rates with low-liability bond pool**

### **7.3.1. Overview**

This option addresses concerns regarding the shortfall in financial assurance collected from the mine industry. It involves increasing the financial securities required of mine proponents to a minimum level of their estimated liability, restricting the discretion currently afforded to the Chief Inspector of Mines and their subordinates. This policy has the benefit of increasing held financial securities, but comes at the cost of a significant increase to the financial burden faced by mine proponents.

To mitigate the adverse impact of the increase to financial security requirements, the option includes a bond pool provision for eligible firms. Following the model of Nevada's Reclamation Performance Bond Pool, this policy would allow mine proponents with an estimated reclamation liability below some threshold access to a bond pool. This would provide eligible mine proponents an alternative to the hard security requirements. Instead, they would post a relatively small, refundable security deposit and become liable to submit periodic, non-refundable levies as a portion of the outstanding shortfall between the amount of the security and total liability. This feature is included to relieve capital-constrained firms from the increased stringency of reclamation securities requirements.

Finally, this approach includes increased public funding from consolidated revenues for the CCSP. This avoids the intergenerational transfer of liability within the mining industry while preserving the social benefit of reclaiming existing orphaned, abandoned, and historic sites (Mining consultant, personal communication, 2016). While responsible parties are not held to account (in violation of the polluter-pays principle), this policy avoids relying on existing or prospective mine proponents by socializing the costs of reclaiming historic, orphaned, and abandoned mine sites in the province.

### **7.3.2. Distribution of environmental liability**

This option has the potential to decrease the amount of environmental liability for mine reclamation for which government is liable. Flexibility in the determination of financial assurances, particularly in cases where regulators consider the financial state

of a mine proponent while determining the amount of assurance, has been met with criticism from many observers (Environmental Commissioner of Ontario, 2015; Office of the Auditor General, 2005, 2007, 2015).

To analyze the impact of this policy option, I employ the 2014 reclamation bond data used for the evaluation of policy option 1. The minimum bond coverage rate is applied only to mine sites with reclamation liability sufficient to exceed the designated low-liability threshold. I assume that the bond pool reserve program will be made available to mine proponents facing a reclamation liability estimate under \$3.9 million USD.<sup>19</sup> The bond amount required as a deposit for the fund is set at 50%, the minimum level required in Nevada's bond pool reserve fund program.

Under this policy, mines ineligible for the low-liability bond pool will be required to post a bond as a proportion of their estimated liability. Under current conditions, this rate varies significantly among operating mines. There is a significant shortfall in held financial assurances as a proportion of outstanding liability for operational mines. This policy mandates a minimum bond coverage rate for all mine sites, imposing a floor on the ratio of held financial securities and estimated reclamation liability. This effectively limits the discretion currently afforded to the Chief Inspector of Mines. Table 6 shows the projected aggregate bond coverage rates corresponding to various minimum bond levels. It also shows the number of sites for which the bond coverage floor would have affected the level of their outstanding bonds. For example, a bond coverage floor of 20% would result in a ratio of aggregate bonds to total estimated liability of 44.7%— only one mine site (operational in 2015) would have had the amount of their bond affected by such a floor.

Were a minimum bond coverage rate of 50% established in 2015, the ratio of aggregate financial assurance to total reclamation liability from contemporary mines would have reached a projected 54.8%. This is a marginal increase of nearly 12% from the current aggregate bond rate, corresponding to a 'high' score under this criterion. Of

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<sup>19</sup> Nevada's Bond Pool Reserve Program is available to proponents whose mine liabilities are less than \$3 million. I converted this amount to CAD using the 12-month average USD/ CAD rate of exchange through December 2016. See Bank of Canada. (n.d). *USD/CAD Closing Rate Summary*. Retrieved from <http://www.bankofcanada.ca/rates/exchange/usd-can-summary>

the mines assumed to be operational in 2015 for the purposes of this analysis, six had submitted bonds at a rate of less than 50%. By bringing the rates faced by each mine to a minimum of at least 50%, the external costs and environmental risks would be distributed across the mining sector with equity and consistency.

**Table 6: Distribution of environmental liability (policy option 3)**

	Minimum bond rate					
	20%	30%	40%	50%	60%	70%
Projected bond coverage rate, 2015	44.7%	45.8%	47.8	54.8%	63.2%	72.1%
Number of affected sites	1	2	4	6	8	8

Policy makers may be averse to a mandated minimum bond coverage rate. While the discretionary approach may have contributed to the chronic shortfall in financial assurances in BC, regulators may regard the rigid imposition of minimum bond coverage rates as unnecessarily burdensome (Mining consultant, personal communication, 2016). Some may argue that the varying degrees of held financial securities are the result of discretion employed within a systematic risk-management framework (EY, 2017). If this is the case, the province might consider a policy which increases the marginal bond coverage rates demanded of individual mine proponents. Without imposing a minimum bond rate, this option has the benefit of increasing the amount of held financial securities without imposing rigid bond coverage rules. However, it is blind to initial bond rates, and imposes proportional costs on sites that are relatively well-covered by existing bonds. To demonstrate, I project the outcome of this policy using the following method. Increases to bond levels were applied in ten point increments at the mine level. Mines were excluded from further treatment once the bond coverage rate met or exceeded 100% of the full estimate of their reclamation liability. For this reason, there was a diminishing marginal increase to the aggregate bond coverage rate. An increase of 20% resulted in the highest marginal increase to the bond coverage rate for contemporary reclamation liabilities, and was chosen as the incremental rate increase for this policy. The sum of the increase in financial assurance

held in increased bonds, the bonds held in the bond pool, and the 20-year NPV of government contributions to the bond pool reserve amount to \$931,117,975 of the aggregate liability for outstanding mine— amounting to 58% of outstanding reclamation liability for existing mine sites.

### **7.3.3. Viability of funding for existing contaminated sites**

This option provides a non-refundable, transferable funding mechanism for the remediation of existing contaminated sites. However, these funds are collected only from very small operators, resulting in the collection of a very low amount being contributed to the designated reclamation fund. Under this program, funds from industry are a latent result of a liquidity relief program for low-capital firms.

However, additional funding is committed by government under this approach, which calls on the province to index contributions of transferable reclamation funds to the outstanding liabilities of operational mine sites. This funding structure socializes the costs of the reclamation while tying contributions to a proxy for ongoing economic development in the mining sector. The proposed model is like the FCR- based program for industry contributions. If annual funding were increased at a rate of 3% of total outstanding liability for operational mines, marginal expenditure would equal \$48.2, or 35.48% of 2015 CCSP expenditure. In addition to the industry contributions from the bond pool reserve fund, which should be expected to remain a small portion the proposed marginal government funding, this program has the potential to achieve a significant level of funding for the reclamation of abandoned, historic, and orphaned sites. As contributions are to be drawn from consolidated revenue, this approach would take the political will to prioritize mine site reclamation. However, with the gap between bonds held and estimated liability for in-operational mine sites reaching approximately \$330 million in 2014, along with the nearly 36,000 hectares of post-1960 mining lands which have yet to be reclaimed, the public is set to face ongoing exposure to reclamation liability, and the attendant risks, regardless of the funding effort (BC Technical and Research Committee on Reclamation, n.d.).

In the absence of parties to which responsibility can be ascribed, public funding for socially beneficial land reclamation would be economically efficient. Moreover, provincial coffers benefit from significant contributions from the mining industry in the form of *Mineral Land Tax* and the *Mineral Tax* (which summed to nearly \$150 million in 2015) (Mining Association of Canada, 2013). Considering the expected future benefits of the mining industry to the province and the economic benefits of legacy sites, the government might bear some of the cost for reclaiming sites for which the prevailing regulatory system failed to assure acceptable environmental outcomes. As an alternative to assigning of pooling responsibility within the contemporary mining industry, this modest increase to public funding provides a viable model for increased facilitation of reclamation efforts for orphaned, abandoned, and historic sites. It scores 'high' on this criterion.

#### **7.3.4. Social efficiency of new mine development**

This policy option is consistent with the polluter-pays-principle. Reclamation bonds are site-specific, refundable, and are designed to impose a cost on proponents which corresponds to the environmental liability expected to result from their mine project. The bond pool component of this option provides a framework for ensuring that relatively small operators (with limited access to capital) are not unduly impacted by increased financial assurance demands exacted on industry. While mining projects with a relatively small liability are not devoid of moral hazard risk, increased securities requirements would have a particularly adverse impact on firms with limited access to capital. By adhering to minimum bond coverage rates applicable to all mine projects, the proportion of financial assurance is more closely aligned with the reclamation liability estimates for individual mines. By assigning liability through refundable, site-specific bonds, this option is also consistent with the polluter-pays-principle.

### **7.3.5. Stakeholder acceptance**

“Obviously, companies do not want to put more into a bond than they have to—it ties up their capital”

*Mining consultant, personal communication, 2016*

Industry groups have called for flexibility in the determination of form and amount of financial assurance required of mine proponents, including consideration of the financial strength and track record of the company (ICMM, 2006). Indeed, by the representation of some observers, making financial assurance requirements too onerous risks driving the mining industry away from the province (Mining consultant, personal communication, 2016). This follows an intuitive interpretation of the effect of the incentives faced by profit-maximizing firms. The introduction of heightened stringency in the demands of financial assurances is likely to face strong opposition from industry and stakeholders.

### **7.3.6. Administrative complexity**

While the pooled reserve component of this policy is expected to be relatively small in magnitude, as with the other options current legislation precludes the establishment of a transferable fund. However, this option has the potential for three additional concerns regarding administrative complexity. First, current legislation affords significant discretion to the regulator to set financial security requirements. Financial securities are set in “the amount and form, and subject to conditions, specified by the chief inspector” (BC Mines Act, c. 293). While a statutorily mandated minimum bond rate would require a legislative amendment, a policy commitment from the Chief Inspector to employ their discretion to uphold a minimum bond coverage rate would require only a political commitment. Second, the maintenance of an effective bond coverage floor requires frequent updates to held financial securities based on annually updated reclamation liability estimates and land disturbance data, which may impose an incremental administrative burden (OADGBC, 2016; BC Environmental Management Act, c. 53). Finally, while the analysis of this option assumes that the threshold for access to the bond pool program would be equal to Nevada’s, ongoing research would be required to ensure that the amount is set at a level that is appropriate for British Columbia. This is an important and contentious policy design feature, as it would



determine whether the capital-constraint relief function works properly. This policy option ranks higher than the alternatives in administrative complexity.

**Table 7: Projected outcomes, policy option 3**

Measure	Projected value
Financial securities as share of contemporary reclamation liability	48.26%
Capitalized value of industry levies (NPV)	\$0 <sup>20</sup>
Estimated annual funds for the reclamation of existing reclamation liability	\$48,241,873

## 7.4. Evaluation matrix

This section provides a synopsis of the analysis presented above. I collate the scores assigned to each policy option in the three leading sub-sections of the chapter.

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<sup>20</sup> Recall the increase in government funding in lieu of industry contributions (Section 7.3.2)

**Table 8: Policy evaluation matrix**

	<b>Option 1: Pooled reserve fund</b>	<b>Option 2: Reclamation bonding with reclamation fund</b>	<b>Option 3: Minimum financial security rates with low-liability bond pool</b>
<b>Distribution of environmental liability</b>	Low: 35.48% of total liability estimate assumed by mining industry over a 20-year period (NPV),	Medium: 44.6% of the total liability estimate assumed by industry (20-year NPV applied to levy portion)	High: 58% of total estimated reclamation liability for operational mines assumed by industry
<b>Viable funding for existing contaminated sites</b>	High: 35.48% of assumed mine proportion of CCSP expenditure, or an estimated \$48.3 million per year	Medium: 11.83% of assumed mine proportion of CCSP expenditure (2015), or an estimated \$16.1	High: 35.48% of assumed mine proportion of CCSP expenditure, or an estimated \$48.3 million per year
<b>Social efficiency of new mine development</b>	Medium: Financial assurance contributions are closely assigned with contribution to aggregate reclamation liability, but are set at a relatively low level. This brings into question incentives for mine proponents to engage in proper reclamation. The pooled reserve fund is also inconsistent with the polluter-pays-principle, and maintains the relatively inconsistent bond coverage rates which characterizes the present approach to financial securities.	Medium: While the correlation between financial assurance and aggregate liability contributions is high, the pooling of risk is not consistent with the polluter-pays-principle, and maintains the relatively inconsistent bond coverage rates which characterize the present approach to financial securities.	High: When a consistent, minimum bond rate is applied across all existing and prospective sites, the correlation between financial assurance and aggregate reclamation liability contributions is high. This policy is consistent with the polluter-pays-principle, as existing or prospective mine proponents do not assume responsibility for orphaned, abandoned, and historic mine sites
<b>Stakeholder acceptance</b>	High: High stakeholder approval in other jurisdictions; uncertainty regarding industry's response to the violation of polluter-pays principle; low level of aggregate contribution in non-refundable format	Medium: While this option maintains the current financial assurance system, mine proponents are likely averse to additional contributions through levies; uncertainty regarding the response to the violation of polluter-pays principle	Low: Mine proponents are averse to increased financial security requirements, and very few sites are expected to be eligible for the bond pool provision. While consistent with the polluter-pays-principle, this constitutes an increase in financial burden in the form of an upward adjustment to bond coverage rates
<b>Administrative complexity</b>	Medium: Requires amendment to the Mines Act to permit appropriation of reserve fund	Medium: Requires amendment to the Mines Act to permit appropriation of reserve fund	High: Requires amendment to the Mines Act to permit appropriation of reserve fund, and requires the establishment and maintenance of a bond pool reserve fund for capital-constrained firms. The maintenance of the minimum bond coverage rate may require frequent updates to financial securities collection due to amended reclamation liability estimates.

## Chapter 8. Recommendation and conclusion

While each approach has distinct advantages and disadvantages, the recommended option is to implement the third policy option, the establishment of *minimum financial security rates with low-liability bond pool*. This policy option has the advantage of increasing the share of contemporary reclamation liability assumed by existing and prospective mine projects while increasing the public funds available for the reclamation of orphaned, abandoned, and historic sites.

The primary expected disadvantage relates to stakeholder acceptance. One can expect industry to oppose any incremental increase to financial assurance contributions. However, unlike alternative options, this policy avoids both the pooling of reclamation liability risk across the cohort of contemporary mine operations and the intergenerational transfer of liability within the industry. The amount of the bond remains proportional to the reclamation liability ascribed to the project for which it is submitted, internalizing the social cost of environmental risks. That is, compared to other policy options, the increased bonding rate is consistent with the polluter-pays-principle. Moreover, only mines which are bonded at a relatively low coverage rate would face increased financial assurance requirements.

Several caveats accompany this recommendation, each of which calls for a nuanced approach to financial assurance policy reform in British Columbia. To the extent that this policy option will reduce environmental risks and liabilities assumed by government, it is the most suitable of the options considered. However, it is not without costs, particularly to mine proponents that would face increased capital constraints. This policy should be implemented in close collaboration with a broad range of stakeholders to ensure that the economic vitality of the industry is preserved. Furthermore, the underlying principles of financial assurance rules for the mining industry should not depart significantly from those applicable to other sub-sectors of the natural resources industry in British Columbia. For example, oil and gas companies are required to pay an Orphan Site Reclamation Fund Tax, which covers the cost of abandonment and reclamation of orphaned pool and gas features by the Oil and Gas Commission (OGC) Government of British Columbia, n.d.). Moreover, the financial assurance procedures should not depart significantly from practices in competing mining jurisdictions. Nevada

(at least nominally) sets bonds equal to the full amount of reclamation liability estimates (Bureau of Land Management, n.d.). Western Australia's former UPB system was characterized by minimum bond coverage rates prescribed by the character of land disturbance activities (See Appendix A, Table A2) (Western Australia, Department of Mines and Petroleum, 2010). This proposal to shift toward minimum standards for bonding would not appear to put BC's approach to bonds at odds with those applied in other prominent mining jurisdictions. Finally, a commitment to uphold the polluter-pays-principle (PPP) should apply across all industries for which the distribution of environmental risk between industry and the public is a concern.

This option offers a compelling approach to improving the distribution of future reclamation liability between contemporary mining firms and the public. By the account of some mine industry professionals and analysts, bond coverage rates are chronically inadequate (OADGBC, 2016; Mining consultant, personal communication, 2016). A modest increase to bonding rates is an effective way to achieve a simple transfer of liability; as noted, the disadvantage of this policy is the increased burden it would place on the mining industry. However, it also avoids imposing on contemporary mining proponents environmental liability for which they are not responsible. In the case of orphaned, abandoned, and historic sites, it is BC's regulatory system that has failed to induce proper reclamation. For this reason, responsibility for the reclamation of these sites should fall to the government. This commitment to ongoing funding for orphaned, abandoned, and historic sites should incent successive governments to ensure that unattended reclamation liabilities do not accumulate in the future. By increasing bonding rates for existing sites while providing an alternative for low-liability proponents and increasing funding from consolidated revenues, BC stands to benefit from an improved policy approach to managing environmental liabilities within the mining industry.

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## Appendix A: Supplementary figures and tables

Table A1. Criteria and measures

Criterion	Definition	Evaluation Method
<i>Distribution of Environmental Liability</i>	<b>Marginal impact on distribution of environmental liability between the mine industry and Government of British Columbia</b>	<i>Quantitative/ qualitative account of the extent to which the amount of financial assurance collected under the proposed policy might change. Drawing on the experiences of other jurisdictions and interviews with informed persons, the relative merit of each policy regarding the change in government exposure to environmental liability</i>
<i>Viable Funding for Existing Contaminated Sites</i>	<b>Degree to which method of collecting financial assurance provides a viable funding model for the remediation of contaminated sites for which government is current liable</b>	<i>Quantitative account of projected amounts collected from mine proponents beyond which should be held as assurance for the proponent's site. Qualitative account of the transferability of funds across sites based on reclamation priority, along with an evaluation of the ability of government to establish the institutions required to manage the contributions effectively and reclaim abandoned, orphaned, or historic sites</i>
<i>Stakeholder Acceptance</i>	<b>Extent to which method of collecting financial assurance does not constitute an impediment to current or future investment in mining activities in British Columbia</b>	<i>Qualitative account of industry response to a given policy approach, drawn from data generated through interviews with stakeholders and industry representatives</i>
<i>Social Efficiency of New Mine Projects</i>	<b>Incentives for proponents of mine proposals to incorporate and account for the externalities associated with insufficient remediation. A policy which achieves this will produce incentives for socially efficient mine development over proposals for inefficient mines</b>	<i>Quantitative/ qualitative account of the extent to which financial assurance requirements correspond to individual mine proponent's contribution to aggregate reclamation liability. Considers the consistency of a policy options with the polluter-pays-principle.</i>
<i>Administrative complexity</i>	<b>Degree of consistency with existing statutes, regulation, and general policy framework</b>	<i>Analysis of relevant legislation and regulatory documents supplemented by information gathered through interviews with experts,</i>

**Table A2. RLE Unit Rate, Mining Rehabilitation Fund, Western Australia**

Description of infrastructure or land	Unit Rate
"Tailings or residue storage facility (class 1); Waste dump or overburden stockpile (class 1); Heap or vat leach facility; Evaporation pond; Dam — saline water or process liquor"	\$50,000
"Tailings or residue storage facility; Waste dump or overburden stockpile; Low-grade ore stockpile (class 1); Plant site; Fuel storage facility; Workshop; Mining void (with a depth of at least 5 metres) — below ground water level; Landfill site; Diversion channel or drain; Dam — fresh water"	\$30,000
"Low-grade ore stockpile (class 2); Sewage pond; Run-of-mine pad; Building (other than workshop) or camp site; Transport or service infrastructure corridor; Airstrip; Mining void (with a depth of at least 5 metres) — above ground water level; Laydown or hardstand area"	\$18,000
"Land (other than land under rehabilitation or rehabilitated land) that has been disturbed by exploration operations"	\$2000
"Land under rehabilitation (other than land that has been disturbed by exploration operations); Topsoil stockpile"	\$2000

Source: Mining Rehabilitation Fund Regulations, 2013, r.3 and 4(4)

**Table A3. Overview of policy options**

	Option 1: Pooled reserve fund	Policy option 2: Financial securities with reclamation fund	Option 3: Upward adjustment to financial security rates with bond pool
Method of financial assurance collection	Replaces the current bonding system with a pooled reserve fund reliant on contributions from industry and government, charging periodic premiums on mining activity.	Retains the current bonding system with an added superfund component from which funds can be drawn for the reclamation of abandoned, orphaned, or historical sites	Imposes minimum bond coverage rate for refundable deposits, providing capital-constraint for low-liability mine proponents. Increases government funding for the reclamation of orphaned, abandoned, and historic sites
Refundable	No	Yes and no	Yes

## Appendix B: Scoring scale and method

**Table B1. Outline of scoring scale and method**

Criterion	High	Medium	Low
<b>Distribution of environmental liability</b>	>10% marginal change to ratio of total (marginal) assurances to total (marginal) liability	0-10% marginal change to ratio of total (marginal) assurance to total (marginal) liability	<0% marginal change to ratio of total (marginal) assurance to total (marginal) liability
<b>Viable funding for existing contaminated sites</b>	Application of all assurance funds is highly transferable across sites. Aggregate funds exceed 15% of mine proportion Crown Contaminated Sites reclamation expenditure in 2015 <sup>21</sup>	Some portion of financial assurance collected transferable across sites. Aggregate funds amount to 10-15% of mine proportion Crown Contaminated Sites reclamation expenditure in 2015 <sup>21</sup>	No portion of financial assurance collected is made available for the remediation of existing contaminated sites. Aggregate funds amount to between 0-10% of mine proportion Crown Contaminated Sites reclamation expenditure in 2015 <sup>21</sup>
<b>Social efficiency of new mine development</b>	Financial assurance requirements demanded of mine proponents approximate a full account of the benefits and costs associated with specific mine developments. Correlation coefficient between contribution to outstanding operational liability and contribution to aggregate assurance nearly perfect. Consistent with the polluter-pays-principle.	Moderately effective methods of inducing the incorporation of externalities by mine proponents. Correlation between contribution to outstanding operational liability and contribution to aggregate assurance relatively high. Partially consistent with the polluter-pays-principle	Ineffective or limited methods of linking financial assurance requirements to the externalities associated with specific mine sites. Correlation coefficient between contribution to outstanding operational liability and contribution to aggregate assurance relatively low— constitutes a departure from the polluter pays-principle
<b>Stakeholder acceptance</b>	All mine proponents are provided access to relief from liquidity or capital constraints; positive views expressed during interviews with informed persons; positive response documented in case studies	Targeted application of capital or liquidity constraint alleviation; Mixed views expressed during interviews with informed persons; both positive and negative responses documented in case studies	No provision for to relieve liquidity constraint faced by mines operators; unfavorable views expressed during interviews; negative responses documented in study of cases
<b>Administrative complexity</b>	Requires relatively minor amendment or adjustment to existing legislation or regulatory structure. Involves modest adjustments to existing policies	Requires modest amendment to existing legislation and regulation. Demands moderate upward adjustment to institutional capacity for monitoring, enforcement, and data collection and verification	Requires substantive reform to existing legislative and/ or regulatory structures. Demands significant upward adjustment to institutional capacity for monitoring, enforcement and data collection and verification

<sup>21</sup> Mine sites (as a proportion of total contaminated sites) multiplied by total expenditure: 0.75\*\$192.1 million= \$144.1 million

## **Appendix C: Case study methodology**

To organize the case study data, I use a taxonomy of policy components with respect to financial assurance rules and long-term environmental management practices. This framework guides the cross-jurisdictional case study analysis and the semi-structured interviews. The following sub-categories are used to organize the data generated in from both the case-study and the semi-structured interviews:

### ***Determination of financial assurance requirements***

*Methods of calculating financial assurance requirements, including acceptable forms of security, ongoing fee collection, reporting standards, and models of regulatory oversight.*

### ***Minimum security requirements***

*Extent to which minimum security requirements are assigned based on various aspects of mine activity, including disturbance of lands, type of mineral extracted, the nature of mine projects, proximity to population centers, and other factors*

### ***Long-term management strategies***

*Approach to bridging financial assurance requirements with long-term management strategies for abandoned, orphaned, and historic mine sites*

### ***Outcomes***

*Extent to which financial assurance provision has improved reclamation outcomes in the jurisdictions while giving due consideration to supporting economic activity*

## **Appendix D:**

### ***Nevada***

Federal policy and regulation also have bearing on mining activity in Nevada, particularly under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (Kline, 2010). This legislation established the framework for the federal Superfund program, designed to address hazardous waste contamination at abandoned or uncontrolled sites (Kline, 2010; US Environmental Protection Agency, n.d.). It manages a National Priorities List (NPL), which identifies sites slated for cleanup. The Superfund program considers the enforcement of reclamation requirements its primary mandate. However, it also features a component called the Superfund trust fund, which is available for appropriation when parties responsible for mining cannot held liable for various reasons (US Environmental Protection Agency, 1990; n.d.). Contributions through excise taxes on extractive natural resources activity, as well as through Superfund Special Accounts, fund the program. Money received through settlement with potentially responsible parties (PRP) funds the special accounts. Transactional in nature, they are site-specific, interest-bearing accounts. PRPs are indemnified for future work required at the site upon contributing to a special account (US Environmental Protection Agency, n.d.). Between 1990 and 2015, the EPA created over 1,300 such special accounts, thereby depositing \$6.3 billion, accruing \$445 million in interest, and closing 283 special accounts upon satisfactory reclamation of lands (US Environmental Protection Agency, 2015). State and federal authorities are highly interwoven with respect to delivering the Superfund program in the United States (Markell, 1993). As in all states, the role of the Superfund program looms large in the state of Nevada's broad environmental policy framework.

### ***Saskatchewan's Institutional Control Program***

In Saskatchewan, a model for the long-term stewardship of mine facilities and lands has proven to be a successful, innovative approach to managing mine sites. To buttress the long-term management of decommissioned mine and mill sites in the

province, the Government of Saskatchewan established the Institutional Control Program (ICP), which provides the regulatory framework to maintain control of a site post-project-completion (Hebedo et al., 2015). The program's aim is to provide an option for mine proponents to turn over their long-term management obligations (such as water treatment or tailings and engineered structures) to the state, providing financial resources for that purpose. Authority to oversee the program falls to the ministries charged with management; currently, the Saskatchewan Energy and Resources at the Ministry of the Economy is responsible for managing the program (Hevbedo et al., 2015). Importantly, the program's mandate does not include the decommissioning or reclamation of mine sites. In fact, proper remediation of land is a governmental condition for custodial oversight, which includes long term monitoring and maintenance of a former mine site under the ICP (Hevbedo, 2015). The primary strength of the program is its success in increasing capacity for risk analysis, ranking, and registrar and data management with respect to decommissioned mine sites (NOAMI, 2016). However, two ICP funding mechanisms are pertinent to the present study. In exchange for assuming stewardship responsibilities, the ICP program requires mine proponents to contribute financial resources to both the *Institutional Control Monitoring and Maintenance Fund (ICMMF)* and the *Institutional Control Unforeseen Events Fund (ICEUF)* (Ministry of Energy and Resources, 2012). Mine proponents must contribute an amount sufficient to generate revenues to cover future liabilities in perpetuity. This amount is determined with review of a proponent's monitoring and maintenance plan (Hevbedo et al., 2016). Monies are held in a site-specific fund separate from consolidated revenue, and can only be appropriated for site-specific monitoring and maintenance (Hevbedo, 2015). Contributions to the institutional control unforeseen events fund are meant as a supplement to cover unexpected future events. For sites without tailings and engineered structures, the required contribution is 10% of the total ICMMF contributions— for those sites with such hazards, the required amount is 20% of the ICMMF (Saskatchewan Government, 2007; Hevbedo et al., 2015). Additional fees to transfer sites to the ICP can be expected to reach up to \$100,000 (Hevbedo et al., 2015).

While the mandate of this program differs from that which would address the policy problem central to this study, the ICP represents a policy approach to mine reclamation liabilities which might offer British Columbia a model to build upon.