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Avoiding a Celestial Anthropocene Epoch: A Framework for Space Resources Extraction Reclamation.

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Abstract

As the demand for minerals and metals soars and supplies diminish, mining operations are consuming a larger footprint on the planet and creating more mining wastes. Humans have created an Anthropocene epoch on Earth.

Mining companies are seeking new sources from the depth of the seas to the heavens above. In recent years, mining of the Moon and other celestial bodies has become feasible.

This thesis considers the question, 'What is a logical and defensible legal framework for post-space resources extraction treatment, given terrestrial best practices?' It does so through a doctrinal and comparative analysis of Australian and Canadian mining laws regarding terrestrial post-resources extraction treatment of the mined area. It also considers international environmental law on sustainable development and outer space law in order to draw together key legal touchstones. The thesis concludes by recommending a framework for protecting the celestial environment, and avoiding a celestial Anthropocene epoch, while ensuring the benefits of space resources extraction are realised by all humankind.

Keywords

Anthropocene epoch, Australia, Canada, in-situ space resource utilization, ISRU, mining in space, Moon, Outer Space Treaty, remediation, sustainable development.

Summary for Lay Audience

The Anthropocene epoch is the controversial geological time we are currently in, that has been created by humankind. One of the major contributors to the epoch is the mining industry. As the demand for metals soars, terrestrial supplies are dwindling, and miners have started to explore the depths of the oceans and the heavens above, namely the Moon and other celestial bodies. The current laws surrounding outer space are ambiguous as to the legality of mining the Moon and other celestial bodies, little is mentioned about space resources extraction, and the post-extraction aspect is completely ignored. Without a framework for post-space resources extraction treatment, an Anthropocene epoch in outer space is sure to happen.

This thesis reviews the mining laws of Australia and Canada, outer space law, and international environmental law on sustainability to develop a framework for the post-mining treatment of the Moon and other celestial bodies, while sharing the benefits with all humankind.

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Chapter 1. Introduction

With the increase in urbanization, population and technological developments, there has been an increase in the demand for mineral resources.[1] At the same time, there has been a decrease in the supply of these same minerals; for example, there is a projected deficit of 10 million tons of copper by the year 2035.[2] Therefore, new sources of supply are needed to be found. Miners have set their sights on unexplored areas of our world and its universe, such as the deep oceans and the Moon and other celestial bodies.

Mining is by its very nature an ecologically unfriendly activity. To produce a few grams of precious metal such as gold or kilograms of a base metal like copper, it is necessary to blast, dig, crush, and grind millions of tons of rock, then dispose of the non-valuable portion of the extracted material. The footprint that mining requires, and the vast areas of waste disposal are contributing to a new geological time, referred to as the Anthropocene epoch.[3]

To prevent an Anthropocene epoch from occurring on the Moon, laws and regulations must be established to protect the environment of outer space. One current focus of the

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[1] "Climate-Smart Mining: Minerals for Climate Action", online: *World Bank* <https://www.worldbank.org/en/topic/extractiveindustries/brief/climate-smart-mining-minerals-for-climate-action>; IEA, "*Critical Minerals – Topics*", online: <https://www.iea.org/topics/critical-minerals>.

[2] IEA *supra* note 1.

[3] A name given to the most recent period of Earth's history when human activity started to have a significant impact on the planets and ecosystems. Recently, the International Union of Geosciences rejected the recommendation of it working group to officially declare the existence of the Anthropocene Epoch.

Legal Sub-Committee of the United Nations (UN) Committee on the Peaceful Uses of Outer Space is the legality of space resource extraction and utilization.[4] Once the legality of extracting resources from celestial bodies is determined, the international community will need a set of regulations addressing post-mining treatment, to ensure that space resource extraction and utilization that takes place in-situ (referred to as in-situ space resource utilization or ISRU), or that involves return of the space resources to Earth, does not become the 'Wild West of outer space'.

To avoid uncontrolled destruction of the Moon, this thesis explores how best practices in terrestrial mining laws, regulations, and guidelines on mining can be applied to Moon mining. It also proposes an international legal framework for post-mining treatment of mining sites on the Moon. This framework would hopefully allow resources on the Moon to be removed and utilized without the long-lasting environmental impacts of the mineral extraction industry felt on Earth.

These best practices were adopted belatedly: terrestrial mining jurisdictions have only recently started to introduce laws and regulations to control the disposition of waste material and closure of mining sites. The focus of these laws is the establishment of financial surety to allow governments to reclaim abandoned mining sites, in the event that the mine operator does not have the financial resources to complete the clean-up.[5]

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[4] In 2021, the UN Committee's Legal Sub-Committee created a Working Group on Legal Aspects of Space Resource Activities to discuss this issue, see https://www.unoosa.org/oosa/en/ourwork/copuos/lsc/space-resources/index.html.

[5] See for example RSO 1990, c M-14 sec. 145.

However, a simple transposition of these laws to cover the Moon is not the answer, as they contain some gaps. For example, the financial surety provisions of most mining laws neglect the time value of money, that is to say, a dollar today is worth more than a dollar in the future. A lump sum financial surety posted today equivalent to the cost of reclaiming a mining site at the end of its life, will be less than the actual cost of post-mining treatment. For example, $1,000,000 at the end of 15 years at a discount rate of 5% is worth $481,000 in terms of 2024 dollars. This issue is explored further in subsequent chapters.[6] The next section explains the legal norms governing resource extraction in outer space.

1.1 Norms Governing Mining of the Moon

There are five treaties relating to outer space law, namely: the Outer Space Treaty,[7] the Rescue Agreement,[8] the Liability Convention,[9] the Registration Agreement[10] and the

[6] To give a preview of the argument developed in this thesis on this issue, a law should recognize the time value of money by requiring the mining company to post financial surety equivalent to the reclamation present value (RPV) at some prescribed discount rate and require that the RPV be recalculated every few years and the mining company required to increase the financial surety with the review: Matthew Hawkins, "Rest Assured? A Critical Assessment of Ontario's Mine Closure Financial Assurance Scheme" (2008) 26:4 Journal of Energy and Natural Resources Law, online: <https://www.tandfonline.com/doi/epdf/10.1080/02646811.2008.11435197?needAccess=true>. This would ensure that the surety at the end of the mine's life would equal the actual cost of reclamation.

[7] Treaty on Principles governing the Activities of States on the Moon and Other Celestial Bodies, ,1967, 18 U.S.T. 2410, 610 U.N.T.S. 205, entered into force Oct 10, 1967 (OST).

[8] Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 1968,19 U.S.T. 7570, 672 U.N.T.S. 119, 7 I.L.M. 149, entered into force Dec 3, 1968.

[9] Convention on International Liability for Damage Caused by Space Objects, 1971, 24 U.S.T. 2389, 861 U.N.T.S. 187, 10 I.L.M. 965 (1972), entered into force Sep 1, 1972.

[10] Convention on Registration of Objects Launched into Outer Space,1975, 28 U.S.T. 695, 1023 U.N.T.S. 15, 14 I.L.M. 43 (1975), entered into force Sep 15, 1976.

Moon Agreement.[11] Of the five, only the Outer Space Treaty and the Moon Agreement are applicable to space resources extraction. This section will examine the relevant treaties.

1.1.1 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, Otherwise known as the Outer Space Treaty[12]

The Outer Space Treaty (OST) was adopted by the UN General Assembly on 19 December 1966 and is considered to be the central, most important foundational framework covering activities in outer space.[13] To date, 134 countries are either parties or signatories of the Treaty.[14] The OST is best known for Article I, which declares outer space to be the "province of all [hu]mankind" and Article II, which prohibits appropriation of celestial bodies.[15] There is no mention in the OST of space resources. This has led to some debate

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[11] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 1984, 1363 U.N.T.S. 22, 18 I.L.M. 1434 (1979), entered into force Oct 30, 1980 (Moon).

[12] See OST, *supra,* note 7.

[13] See Charles Bjork, "Guides: Space Law: The Law of Outer Space: Treaties & International Agreements", online: <https://guides.ll.georgetown.edu/c.php?g=1037047&p=7518561>.

[14] United Nations Treaty Collection, online:<https://treaties.un.org/pages/showdetails.aspx?objid=0800000280128cbd>.

[15] OST *supra* note 6. Article I states:
"The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all [hu]mankind.
Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.
There shall be freedom of scientific investigation in outer space, including the Moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation.
Article II states: "'Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."

as to how removal of space resources can be done so as to respect both Articles I and II[16]. As the OST does not directly address space resources, it also does not address post-mining treatment.

1.1.2 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies[17]

The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement) was adopted by the UN General Assembly on 18 December 1979 and to date has been ratified by only 11 nations, none of which are spacefaring countries, save for Australia and India.[18] The Agreement specifically mentions space resources and establishes, in Article 11.5, a regime to govern the exploitation of the natural resources of the Moon when such exploitation *is about to become feasible*.[19] The Moon Agreement may, therefore, provide guidance on how to control Moon mining, though its guidance may be hampered by the low levels of state support for this treaty.

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[16] See e.g. Aaron Boley & Michael Byers, eds, "Space Mining" in *Who Owns Outer Space?: International Law, Astrophysics, and the Sustainable Development of Space* Cambridge Studies in International and Comparative Law (Cambridge: Cambridge University Press, 2023) 130.

[17] See Moon, *supra*, note 11.

[18] *"UNODA Treaties*", online: <https://treaties.unoda.org/t/moon>.

[19] See Moon *supra* note 10, emphasis added. Technology has advanced to a stage that extraction of minerals and water from the Moon's regolith is now possible: See e.g. Diane L Linne et al, Overview of NASA Technology Development for In-Situ Resource Utilization (ISRU) (Adelaide, 2017) NTRS Author Affiliations: NASA Glenn Research Center, NASA Johnson Space Center, NASA Kennedy Space Center, Jet Propulsion Lab., California Inst. of Tech., NASA Headquarters NTRS Report/Patent Number: GRC-E-DAA-TN46532NTRS Document ID: 20180000407NTRS Research Center: Glenn Research Center (GRC).

However, the Moon Agreement does not address post-mining treatment and therefore cannot provide guidance in that respect.

1.1.3 UN Convention on the Law of the Sea[20]

The Earth's oceans have been described by many as Earth's final frontier and the UN Convention on the Law of the Sea (UNCLOS) bears similarities to the Moon Agreement in that the oceans outside of a nation's economic zone are declared to be the common heritage of [hu]mankind.[21] UNCLOS – which has a high rate of ratification[22] – created an entity, the International Seabed Authority (ISA), to manage the exploitation of resources in the oceans outside of nations' economic zones.[23] UNCLOS may therefore provide a framework for controlling the exploitation of the Moon. UNCLOS does not deal with post-mining treatment, however, and neither do the draft Regulations.

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[20] *UN Convention on the Law of the Sea*, Dec 10,1982, 1833 U.N.T.S. 397, entered into force Nov 1, 1994.

[21] See Patricia Minola, "The Moon Treaty and the Law of the Sea" (1981) 18 San Diego Law Review. at 455.

[22] 157 states have signed UNCLOS, see https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XXI-6&chapter=21&Temp=mtdsg3&clang=_en.

[23] *Ibid.* Art 137.

1.2 The Mining Lifecycle

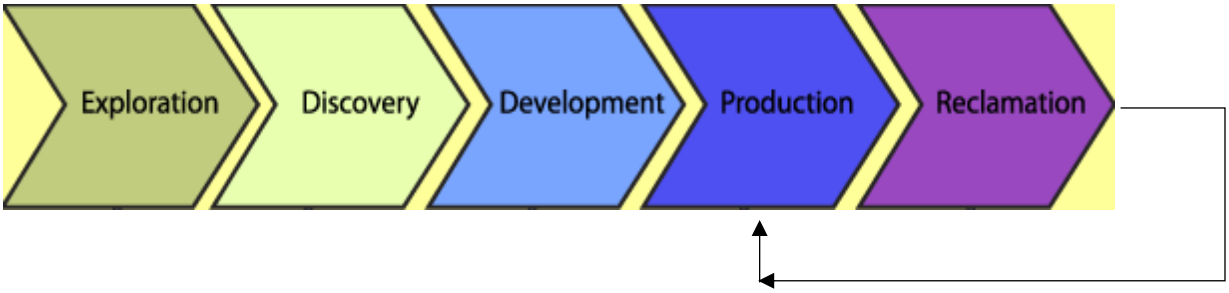

Figure 1. Mining Lifecycle.[24]

The mining lifecycle consists of five stages and one feedback loop.[25] Each stage has an effect on the amount of waste produced, and each stage is described below.

1.2.1 Exploration: To find an economically viable orebody, extensive exploration must be undertaken. Using chemical and physical exploration techniques, valuable minerals are located, and the extent of the deposit determined. In the exploration stage, little waste or environmental degradation is created, with the waste being mainly recyclable or removeable garbage and site clearance.

1.2.2 Discovery: Once a financially viable deposit is delineated, the project may proceed to the planning stage. Various plans are developed, and a preliminary economic assessment is created, in order to determine if further exploration is required.[26] A

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[24] "MiniingCycleLarge.png (582×351)", online: <https://novascotia.ca/natr/meb/images/MiniingCycleLarge.png>.

[25] See "The stages of mining: 5 lifecycle processes explained - Opens", online: <https://www.cruxinvestor.com/article/the-stages-of-mining>.

[26] *Ibid.*

feasibility study is prepared to evaluate the mining project. Finally, a bankable feasibility study is prepared, to support the fundraising phase for the next stage of the lifecycle, development. Once In the discovery stage, minor waste is generated from exploratory shafts or pits and adits. The waste is mainly broken rock. In mining the Moon, this stage may be negligible, due to the lack of overburden on the regolith.[27]

1.2.3 Development: In development, the infrastructure for the mine site is created. This phase may take 10-20 years to bring the mine into production, most of which is consumed by the obtaining of permits. Firstly, the access infrastructure has to be built. Roads need to be constructed to move large equipment into the mine-site and finished mineral products out. Processing plants have to be constructed and environmental storage areas prepared. The development phase of the mine lifecycle generates large amounts of broken rock during the preparation of the mining site, either from digging a pit or sinking a shaft. The broken rock must be stacked safely for future post-mining treatment activities. In the case of space resource extraction on the Moon, the regolith is already reduced to a coarse sand like material, with electrostatic properties, so it should stack with few problems.

1.2.4 Production: In this stage, the valuable mineral is separated from the host waste material, which must be stored safely for eventual post-mining treatment. In the production stage, the largest amount of waste is generated, as additional rock is broken

[27] Regolith is the surface soil of the Moon and is expected to be simple to remove as it is already broken by the solar winds and meteorite collisions.

to expose the mineral ore. When mining the Moon, this is expected to be minimal, as the regolith is already exposed. The processing of the regolith will produce most of the waste in mining the Moon. The remnants of the regolith will be dry and need to be stacked for future post-mining treatment.[28]

1.2.5 Reclamation: Once all the valuable minerals have been removed from the orebody, the site needs to be reclaimed. The infrastructure and the stored waste must be removed, and the site returned to the topology that existed prior to the mining operations. Because there is no vegetation, or fauna and flora, on the Moon to be restored, the reclamation operation will be relatively simple (given the lack of flora and fauna), returning the stored waste to where it was removed and restoring the topography to its previous form. (Note, however, that this relates only to topography reclamation, and not restoration of previous geologic density or radiation markers.) The equipment then must be removed. Another possible reclamation process that may be employed is to recycle the waste regolith, either to reprocess the waste or use it for an alternative purpose, such as building the infrastructure for lunar habitation or extraction of oxygen.

[28] See below under 1.4 Assumptions for a further discussion.

1.3 The 4 Rs: Remediation, Restoration, Reclamation and Rehabilitation

In terrestrial mining, when seeking exploitable metals from the earth, billions of tonnes of rock must be removed to expose the small amounts of the valuable minerals. Most of the extracted rock is of no value and must be stockpiled as waste, which is not only a blight on the landscape but a potential source of acid rock drainage, which may pollute the surrounding watershed. On the Moon and other celestial bodies, this scenario is not likely, as there is no liquid water or oxygen to react with mineral sulphides to create the acid rock drainage. Also, the minerals on the Moon do not include iron sulphides.[29] However, this stage must be carefully carried out, so as not to create space debris from the extracted rock, due to the Moon's low gravity.

To separate the valuable minerals from the waste, the rock must be crushed and ground to the consistency of coarse flour. Mixed with chemicals, the metal contents are removed, and the remaining waste ground rock is impounded in large open-air ponds, where the solids precipitate and the liquid either evaporates or is recycled as process water. The solids contain a small amount of liquid which may threaten the water supply, or a mechanical failure of the impounding pond may threaten life and limb of nearby

[29] See "Sulfur in the Apollo Lunar Basalts and Implications for Future Sample-Return Missions" (2020) 16:5 Elements 361–362, online <https://pubs.geoscienceworld.org/msa/elements/article/16/5/361/592263/Sulfur-in-the-Apollo-Lunar-Basalts-and>.

populations. On the Moon, the celestial environment is devoid of liquid water, so large waste or tailings ponds are not feasible and the possibility of tailings-related contamination non-existent. The spent regolith will be stacked close to the point of extraction to allow for easier post-extraction treatment.

When the mine's ore reserves are depleted, the waste stockpiles and tailings ponds must be removed, and the topology of the landscape restored to its original condition. The process may be referred to by one of four interchangeable terms: remediation, restoration, reclamation, or rehabilitation. For the purpose of this and further discussions, each will be defined as follows.

1.3.1 Remediation. Remediation occurs when the waste is contaminated by the beneficiation process, and it is necessary to remove the contaminants to reduce the risk to humans and wildlife.[30] Remediation targets a specific environmental function and proposes remedial actions to resolve it, and "needs to occur before re-establishing a land-use."[31]

1.3.2 Restoration. Restoration aims to assist in the reestablishment of the ecosystem to the precise pre-existing ecosystem before mineral extraction took place.[32] Restoration

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[30] Ana T Lima et al, "The legacy of surface mining: Remediation, restoration, reclamation and rehabilitation" (2016) 66 Environ Sci Policy 227–233, online: <https://linkinghub.elsevier.com/retrieve/pii/S1462901116304518 at 228.

[31] *Ibid.*

[32] Lima *, supra* note 30.at 228.

may be too idealistic to achieve, and, if unscathed, the same ecosystem may have evolved into something very different than the pre-existing one.[33]

1.3.3 Reclamation. If the mining site is not capable of being restored to the precise pre-existing conditions, then one or more of the features, such as a species that serves the same function as one destroyed by the mining operation, may be established. Reclamation is very similar to restoration, except that it focusses on a limited portion of the ecosystem rather than the ecosystem as a whole. Reclamation results in a replacement ecosystem.[34]

1.3.4 Rehabilitation. Rehabilitation focusses on the return of the area for future use, albeit not necessarily the same use as before mining. For example, the area may be rehabilitated for agriculture or housing.[35] In Chapters 2-4 of this thesis, the terms used in the legislation, regulations, and guidelines, will be used. In Chapters 1, 5, and 6, the term 'post-mining treatment' will be used to express the act of cleaning up the space resource extraction sites.

1.4 Assumptions

This thesis adopts the following assumptions about exploiting the Moon's mineral and water resources, in order to proceed to analysis of post-mining treatment of space

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[33] Rebecca C Rooney & et al, *"Oil sands mining and reclamation cause massive loss of peatland and stored carbon." (2012)* 109:13 Proc Natl Acad Sci USA 4933–4937 *at4933.*

[34] Lima*, supra* note 30 at 229*.*

[35] *Ibid.*

resources: first, space resource extraction and utilization (whether in-situ or for use on Earth) will be deemed as legal; second, minerals will be extracted by electrostatic separation methods and any residue will still have binding characteristics; third, space resource extraction and utilization will be economically and technically feasible; fourth, there is no biological life, as we know it, on the Moon; and fifth, the Moon has no atmosphere. This thesis has made these assumptions – many of which are still subject to debate[36]– in order to bring a crisp focus to the subject of this thesis: post-mining treatment.

1.5 Research Question and Methodology

This thesis aims to answer the research question: 'What is a logical and defensible legal framework for post-space mining treatment, given terrestrial best practices?'. In order to answer this question, a doctrinal approach combined with a comparative analysis will be employed.

Doctrinal analysis is the dominant legal methodology used in the common law world,[37] which is why this method is used in this thesis. As defined by Hutchinson, legal doctrinal analysis involves a "critical conceptual analysis of all relevant legislation and case law to

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[36] See e.g. Linne et al, *supra* note 19; Cecilia Jamasmie, "Mining the Moon to lift off within 10 years, says NASA", (28 June 2023), online: *The Northern Miner* <https://www.northernminer.com/news/mining-the-moon-to-lift-off-within-10-years-says-nasa/1003856321/>.

[37] Terry Hutchinson, *"The Doctrinal Method: Incorporating Interdisciplinary Methods in Reforming the Law."* (2015) 8:3 Erasmus Law Review 130–138.at 131.;Terry Hutchinson & Nigel Duncan, "What and Describing What We Do: Doctrinal Legal Research." (2012) 17:1 Deakin Law Review 83–120.at 85.

reveal a statement of the law relevant to the matter under investigation."[38] It has also been described as "provid[ing] a systematic exposition of the rules governing a particular legal category, analyz[ing] the relationship between rules, explain[ing] areas of difficulty and, perhaps, predict[ing] future developments."[39] Primary (legislation, regulations, and case law) and secondary (journal articles and other writings) sources, are utilized to undertake a "critical analysis and synthesis of the law".[40] The purpose of this form of research, is "to provide explicit normative comment ('how things should be') for the purposes of devising 'needed proposals for improvement'".[41] The focus of the doctrinal methodology is "primary sources,[…] with secondary sources as 'subsidiary means' for the determination of rules of law".[42]

Whilst the doctrinal method uses treaties, legislation, regulations, and case law as primary sources, the field of space law has few cases to act as precedent. Most of the so-called

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[38] Hutchinson 2015, *supra* note 37 at 131.

[39] Hutchinson & Duncan*, supra* note 37 at 101.

[40] *Ibid.* at 130.

[41] Fourie, *"Expounding the Place of Legal Doctrinal Methods in Legal-Interdisciplinary Research" (2015)* 8:3 Erasmus Law Review 95 -110 at 96*,* citing J Vranken*, "Exciting Times for Legal Scholarship"* 2 Recht en Methode in Onderzoek en Onderwijs 42 at 43 (2012).

[42] Jenny Hiu Kwan Poon*, Safeguarding the Principle of Non-Refoulement in Europe: Counteracting Containment Policies in the Common European Asylum System", 2020.* Electronic Thesis and Dissertation Repository. 7111, https://ir.lib.uwo.ca/etd/7111 *at 15.*

space cases[43] actually revolve around other areas of law, other than ISRU, such as air pace over private property,[44] wrongful death,[45] breach of contract,[46] anti-trust,[47] and taxation.[48]

The only case involving ownership of lunar regolith was termed 'One Blue Lucite Ball'.[49] In this case, the United States sought forfeiture of a blue Lucite ball containing a Moon rock mounted on a wooden plaque. The Moon rock was a gift from US President R.M. Nixon to the government and people of Honduras. The claimant, Mr. Alan Rosen, claimed to have purchased the object from a retired Honduran colonel for $50,000. The US government asserted that the property had been stolen and then introduced into the United States. The judge ruled that "Mr. Rosen had failed to rebut the government's showing of probable cause"[50] and ordered forfeiture of the object. The subject of appropriation of lunar material was not addressed in the case. Another example directly related to space involved the Convention on International Liability for Damage Caused by

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[43] *See* ESA*, "Space Law Cases",* online: Space Law Cases <https://www.esa.int/About_Us/ECSL_-_European_Centre_for_Space_Law/Space_law_cases>.

[44] See e.g. *United States v Causby,* 328 US 256 (1946), decided May 17,1946.

[45] See e.g. Smith v. United States (91-1538), 507 U.S. 197 (1993), decided March 8,1993.

[46] See e.g. Hughes Communications Galaxy, Inc., Plaintiff-appellant, v. the United States, Defendant-appellee, 998 F.2d 953 (Fed. Cir. 1993)", (16 April 2024), online: Justia Law <https://law.justia.com/cases/federal/appellate-courts/F2/998/953/48364/>. Decided October 23, 1993.

[47] See e.g. "Alpha Lyracom Space Comm. v. Comsat Corp., 113 F.3d 372, online: <https://casetext.com/case/alpha-lyracom-space-comm-v-comsat-corp>. decided May 15,1997.

[48] See e.g. "Communications Satellite Corp. v. Franchise Tax Bd. (1984)", (16 April 2024), online: Justia Law <https://law.justia.com/cases/california/court-of-appeal/3d/156/726.html>.decided May 31, 1984.

[49] United States of America v One Lucite Ball containing lunar material (Moon rock), 2003 US District Court Southern District of Florida, Miami Division. 01-0116-CIV-JORDAN. Decided March 24, 2003.

[50] *Ibid.*

Space Objects.[51] This treaty was tested when Canada claimed compensation from the Union of Soviet Socialist Republics for damages incurred from the re-entry of the Cosmos 954 satellite, which landed on Canadian territory, spreading radioactive debris over the Northwest Territories, Alberta, and Saskatchewan.[52] A liability agreement was reached on April 2, 1981, for $3,000,000.[53] Neither of these cases provide guidance on post-space mining treatment and therefore case law will not form a key part of the doctrinal analysis.

This thesis also employs a comparative analysis in the form of comparing the Australian and Canadian mining laws with respect to mine-site post-mining treatment. "[T]he aim of comparative law [is] to understand the legal rules and patterns of order that drive a given society".[54] The method:

> [I]nvolves certain rules, namely: considering underlying concepts, beliefs and reasons that underlie the law and that help drive and structure the law; comparing the law of one country against that of another country, considering the similarities and differences; and understanding the forces that lie beneath the surface of the law.[55]

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[51] Liability, *supra* note 9

[52] "3-2-2-1 Settlement of Claim between Canada and the Union of Soviet Socialist Republics for Damage Caused by 'Cosmos 954' (Released on April 2, 1981)", online: <https://www.jaxa.jp/library/space_law/chapter_3/3-2-2-1_e.html>.

[53] *Ibid.*

[54] Edward E Eberle, "The Methodology of Comparative Law" (2011) 16:1 Roger Williams University Law Review 51–72. *at 58.*

[55] Poon*, supra* note 42 *at* 19, citing Eberle, *supra* note 17, at 60-61,63.

This thesis does not delve into the cultural underpinning of the laws, as the mining traditions of both countries are similar, as is their colonial backgrounds and use of the common law tradition, but does compare the similarities and differences of the laws. The comparative methodology also requires that the source of law is considered, which, in this thesis, not only looks at the legislation, but also the associated regulations and guidelines regarding post-mining treatment issued by government bodies. The use of these two methodologies -- legal doctrinal and comparative -- are appropriate in this thesis, where the objective is to synthesize best practices in terrestrial laws into a framework for space resources extraction.

1.6 International Environmental Law and Sustainable Development

The overarching lens this thesis uses for its analysis of both terrestrial and extraterrestrial mining law on remediation is that of sustainable development, inspired and guided by the SDGs. This section will therefore begin with a brief explanation of international environmental law and then turn to a subset of that law: the law of sustainable development.

Arguably, international environmental law was born in Canada. In 1941, the United States sued Canada because of air pollution in the state of Washington emanating from a smelter owned by a Canadian corporation, in Trail, British Columbia, since 1906. The arbitration decision stated that:

> (u)nder the principles of international law… no state has the right to use or permit the use of territory in such a manner as to cause injury by fumes in or to the territory of another of the properties or persons therein, when the case is of serious consequences and the injury is established by clear and convincing evidence.[56]

The subsequent award held Canada liable for damages sustained and for future adverse transborder effects to the contiguous United States property. The "judges (also) declared that Canada would have to ensure that detrimental activity in its territory ceased, if persistent and grave environmental damage was to be expected."[57] While not binding on other states, this arbitration award has become an important precedent for the development of the principle of the limits of territorial sovereignty regarding transboundary harm: the principle that no state can use or allow the use of its territory in a manner that causes significant harm in the territory of other states. The precedent was applied in the decision of the International Court of Justice in the 1949 *Corfu Channel* case, when the interests of sovereignty and territorial integrity had to be balanced with this transboundary harm principle.[58]

In 1968, responding to a rapidly increasing risk of environmental pollution, the United Nations convened the Stockholm Conference on the Human Environment, which was

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[56] *Trail Smelter* decision *(United States v Canada)* (1938 and 1941) 3 R.I.A.A. 1905, as reproduced in Ulrich Beyerlin & Thilo Marauhn, International Environmental Law (Bloomsbury Publishing, 2011) at 39.

[57] *Ibid. at 4.*

[58] *Ibid* at 6.

ultimately held in June 1972. Resulting from this Conference, the Stockholm Declaration was issued.[59] Principle 21 of the Stockholm Declaration indicates that "states have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own natural resources pursuant to their own environmental policies and the responsibility to *ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or of areas beyond the limits of national jurisdiction*."[60] This built on the *Trail Smelter* arbitration and became the cornerstone of modern international environmental law. Principle 21 confirms the right of a country to exploit its natural resources, to the extent that it does not harm the environment of other states or the environment of global commons.[61] This principle is known as the principle of harm prevention (or the no harm principle) and has evolved to encompass the prevention of various types of environmental harm.[62] Since the Stockholm Conference, many multilateral environmental treaties incorporating the

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[59] *Report on the United Nations Conference on Human Environment,* by United Nations, A/CONF.48/14/Rev.1 (Stockholm, 1972).

[60] Emphasis added.

[61] Sumudu A Atapattu, *Emerging Principles of International Environmental Law*, International Law and Development (Ardsley, NY.: Transnational Publishers, Inc.). *at xxiv.*

[62] *Ibid.*

principle of harm prevention have been negotiated, adopted, and ratified.[63] There are more than a hundred such treaties.[64]

As the membership of the United Nations changed following decolonization, the new members demanded a change in international economic relations, including with respect to natural resources.[65] In 1962, the UN General Assembly adopted a resolution titled 'Permanent Sovereignty over Natural Resources'.[66] Permanent sovereignty meant the right of countries "exercised in the interest of their national development and of the well-being of the people concerned".[67] No mention of resource conservation or sustainable use of water, land, or living resources was made at that time.[68] However, over time, this combination of concern for economic development, freedom to plot one's own course for development, and state sovereignty over natural resources led to the adoption of a different approach.[69] The World Commission on Environment and Development articulated the approach of sustainable development in its 1987 report, known as the

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[63] For example: Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora of 3 March 1973; Convention on the Conservation of Antarctic Marine Living Resources 20 May 1980; Vienna Convention for the Protection of the Ozone Layer of 22 March 1985.

[64] Ulrich Beyerlin & Thilo Marauhn, *International Environmental Law* (Bloomsbury Publishing, 2011) Google-Books-*I*D: . At 11.

[65] See Patricia Birnie & Alan Boyle*, International Law & the Environment,* second ed (New York, NY: Oxford University Press, 2002*)* at 40.

[66] UNGA *Permanent Sovereignty over Natural Resources.,* -RES-1720XVI 1962*.*

[67] "Resolutions adopted on the reports of the Second Committee", online: <documents-dds-ny.un.org/doc/RESOLUTION/GEN/NR0/193/11/PDF/NR019311.pdf>*.*

[68] Birnie & Boyle, *supra* note 65 at 41*.*

[69] *Ibid.*

Brundtland Report after its chairperson,[70] which defined sustainable development as a process that "meets the needs of the present without compromising the ability of future generations to meet their own needs."[71] The Brundtland Report called upon the UN to transform its conclusions into a Programme of Action on Sustainable Development.

Following the Brundtland Report, the United Nations Conference on Environment and Development was held in Rio de Janeiro in 1992, to "elaborate strategies and measures to halt and reverse the effect of environmental degradation in the context of increased national and international efforts to promote sustainable and environmentally sound development in all countries."[72] The UN General Assembly drew upon the Brundtland Report[73] to prescribe a comprehensive catalog of measures in the field of environment and development for the conference.[74] It was hoped that the Conference would "produce an Earth Charter, setting out the principles of conduct for environmental protection and sustainable development".[75] It was hoped that another outcome of the Conference would be identification of the goals of sustainable development and a plan for achieving them.[76]

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[70] See generally Brundtland, Gro Harlem. Our Common Future. 1987.;Beyerlin & Marauhn, *supra* note 64.;Rakhyun E Kim, "The Nexus between International Law and the Sustainable Development Goals" (2016) 25:1 Review of European, Comparative & International Environmental Law 15–26, online: <onlinelibrary.wiley.com/doi/abs/10.1111/reel.12148>.

[71] Birnie & Boyle, *supra* note 65.;.Beyerlin & Marauhn*, supra* note 64. *At 74.*

[72] *United Nations Conference on Environment and Development,* RES 44/228.1989.

[73] Brundtland, *supra* note 70*;* Marie-Claire Cordonier Segger & Ashfaq Khalfan, *"Origins of the Sustainable Development Concept"* in Marie-Claire Cordonier Segger & Ashfaq Khalfan, eds, *Sustainable Development Law: Principles, Practices, and Prospects* (Oxford University Press, 2004*)* 15-23.

[74] Beyerlin & Marauhn*, supra* note 64 at 13.

[75] Birnie & Boyl*e, supra* note 65 at 41.

[76] *Ibid.*

The Conference delivered, by adopting: first, *The Rio Declaration on Environment and Development* consisting of 27 principles setting out the basis of sustainable development;[77] second, *Agenda 21,*[78] which contains an action plan consisting of forty chapters, covering diverse issues; and, third, the *Framework Convention on Climate Change* and the *Convention on Biological Diversity*.[79]

The Declaration, Agenda 21, and other sources have led to the identification of four key principles that underlie the concept of sustainable development: no harm, precautionary approach, common but differentiated responsibilities, and polluter pays. These four principles will be used as a sustainable development lens in evaluating the mining laws of Australia and Canada. They are, however, conceived to operate at a national level. Therefore, to be applicable to the situation covered in this thesis, the principles are modified to be valid at a project level.

For the purposes of this thesis, the no harm principle, which was designed to prevent trans-border pollution, will be considered to be met if the legislation under analysis specifically calls for protection of the environment. Similarly, the common but differentiated responsibilities principle, which recognizes that lesser developed nations have fewer economic resources to protect the environment and therefore carry different

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[77] *Ibid,* at 43.*; Report on United Nations Conference on Environment and Development, A/CONF151/26 (Vol I) 12* August 1992*.*

[78] United Nations*, United Nations Sustainable Development (Agenda 21) (1992).,*online: sustainabledevelopment.un.org/content/documents/Agenda21.pdf>.

[79] *Ibid.;* Report on United Nations Conference on Environment and Development, A/CONF151/26 (Vol I) 12 August 1992.

levels of responsibility than more developed countries. At the project level, this thesis considers this principle to be met if the laws being analysed recognize that different regions require different post-mining treatment methods - because not all sites will be the same, a common reclamation process may not be applicable.

"The concept of the precautionary approach provides the basis for early action to address serious environment threats in cases where there is ongoing scientific uncertainty with regard to these threats".[80] In this thesis' analysis of Australian and Canadian legislation, this principle will be considered to be met if progressive reclamation is required. The polluter pays principle is found in Principle 16 of the 1992 Rio Declaration:[81] "[n]ational authorities should endeavour to promote the internalisation of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the costs of pollution."[82] Therefore, in this thesis' analysis, any mechanism that requires an operator to put forward financial assurance for post-mining treatment will be considered to meet this principle.

The integration of environmental law and the right to development through the concept of sustainable development was endorsed by the 1972 Stockholm Declaration and has been incorporated in certain regional agreements.[83] It has also been incorporated into

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[80] Beyerlin & Marauhn*, supra* note *64* at 47.

[81] *Report on United Nations Conference on Environment and Development, supra* note 77*.*

[82] *Ibid.*

[83] The Declaration speaks to the idea, that natural resources must be used sustainably and the need for integration of environment protection and development. An example of this concept is the project, that

national environmental law and policy. The integration between environmental protection and economic development was regarded by the International Court of Justice in the *Gabcikovo-Nagymaros* case.[84]

While there is widespread agreement on these four aspects above, there are also debates within literature on the content of other aspects of sustainable development, such as intergenerational equity, elimination of unsustainable patterns of production, and consumption. For example, Crawford argues that the very existence of sustainable development as a distinct legal concept is controversial because the concept should be considered "as a collection or collocation of different legal categories , and as a 'general guideline'."[85] Dembach argues that the concept of sustainable development is too vague and will only have meaningful content if real, implementable, measurable targets are created and applied.[86] Kotze also views sustainable development as a weak concept as it

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resulted in the *Gabcikovo-Nagagymaros* case. In 1977, Hungary and Czechoslovakia signed a treaty to build dams and other projects along the Danube river to generate hydroelectricity and prevent flooding.

[84] Gabcikovo-Nagymaros Project, *Hungary v Slovakia*, Judgement, Merits, ICJ GL No 92,[1997] ICJ Rep 7[1997] ICJ Rep 88(1998) 37 ILM 162, ICGJ 66 (ICJ 997), 25 September 1997, International Court of Justice [ICJ].

[85] James Crawford, *Brownlie's Principles of Public International Law.,* eighth ed (Oxford, UK: Oxford University Press*,* 2012*)* at 342.

[86] See John C Dembach*, "Targets, Timetables and Effective Implementing Mechanisms; Necessary Building blocks for Sustainable Development"* 27:1 William & Mary Environmental Law and Policy Review. *at* 88.; Louis J Kotze & Duncan French, *"The anthropocentric Ontology of International Law and the Sustainable Development Goals; Towards an Ecocentic Rule of law in the Anthropocene"* 7:1 Global Journal of Comparative Law. At 6.

is anthropocentric.[87] He proposes that a better framework for the environment would be adoption of the World Charter for Nature.[88]

Notwithstanding these concerns about the principle of sustainable development, it is a useful lens for analysis in this thesis. This is because the principles of sustainable development are becoming accepted as a principle of international law[89] and as such, would likely form the basis of how the world would expect future celestial miners to act. Indeed, some countries have made it clear in the UN Committee on the Peaceful Uses of Outer Space (COPUOS) that they expect sustainable development to inform any future principles on the exploration, exploitation, and use of space resources.[90] Therefore, the sustainable development concepts of no harm, precautionary action, polluter pays, and common but differentiated responsibilities will be used as a benchmark throughout this thesis against which to measure remediation laws as they apply in Canada, Australia, and outer space.

1.7 Literature Review

Little has been written about reclaiming mining sites on the Moon. The focus of the legal writing has been around the legality of space resource extraction and utilization, with no

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[87] Kotze & French*, supra* note 86 at 6*.*

[*88*] See Chapter 2.1.4. for further details*.*

[89] Christina Voigt, *"Chapter 6. Sustainable Development As A General Principle Of Law" in Sustainable Development as a Principle of International Law* (Brill Nijhoff, 2009).at 146*;* Daniel Bodansky*, "Customary (And Not So Customary) International Environmental Law"* 3:1 Ind..J. Global Legal Stud., at 108-109*.*

[90] *Report of the Legal Subcommittee on its Sixty-second Session, held in Vienna from 20 to 31 March 2023,* UN Doc A/AC.105/1285 (13 April 2023) at para 169.

consensus on the subject.[91] As mentioned above, the Legal Sub-Committee of COPUOS has been deliberating on the question and has established a working group on space resources. The Working Group will next report to the annual COPUOS meeting in Vienna in June 2024.[92] The outcome of the Working Group's work is vitally important: Steyn[93] and Cannon[94] have both written about the necessity for clear rules regarding the legality of space resources extraction, to give legal certainty to companies interested in exploiting space resources, allowing them to raise the necessary capital for the venture.

Given the complete lack of legal literature on post-space mining treatment, it is important to also examine whether there is helpful legal literature on terrestrial post-mining treatment. Again, the answer is a relative 'no'. There is little scholarly writing on terrestrial post-mining treatment, and the literature that does exist tends to focus on the need for financial surety to reclaim abandoned mining sites if the operator fails to reclaim their

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[91] See e.g. Tronchetti,Fabio, "Legal aspects of space resource utilization" in Handb Space Law, 1st ed (Edgar Elgar Publishing Ltd., 2015); "Who Owns the Moon?", online: <https://books-scholarsportal-info.proxy1.lib.uwo.ca/en/read?id=/ebooks/ebooks0/springer/2009-12-01/8/9781402091353#page=5>; Frans von der Dunk, "Property Rights Over the Moon or On the Moon? The Legality of Space Resource Exploitation on Celestial Bodies" (2023) 6:1 J Law Innov 95–134, online: <https://scholarship.law.upenn.edu/jli/vol6/iss1/3>; Philip de Man, In-Situ Resource Utilization: Legal Aspects, at 211, in Anja Nakarada Petjulic & Matteo Tugnoli, Promoting Productive Cooperation Between Space Lawyers and Engineers, Government & Law for 2019 (Hershey PA 17033: IGI Global, 2019). See section 2.1 for further discussion

[92] See https://www.unoosa.org/oosa/en/ourwork/copuos/lsc/space-resources/index.html.

[93] Elizabeth Steyn, "Space mining is not science fiction, and Canada could figure prominently", (4 April 2021), online: *The Conversation* <http://theconversation.com/space-mining-is-not-science-fiction-and-canada-could-figure-prominently-155855>.

[94] Cannon, *Towards the future international framework* (Luxembourg, 2024). Presented at Space Resources Week in Luxembourg, March 25, 2024.

property in the event of financial insolvency.[95] None of the scholarly literature dealing with this subject addresses the time value of money, although Hawkins does recommend periodic reviews of the surety for coverage.[96]

Given this dearth of legal scholarly literature on either space or terrestrial post-mining treatment, this thesis relies, for the most part, on primary sources. The applicable space law has already been described in section 1.1 above, along with the relevant example of UNCLOS. In addition to those treaties, this thesis considers legal frameworks or secondary industry guidance directly applicable to the topic of post-mining treatment: the United Nations Sustainable Development Goals (SDGs), adopted by consensus of the UN Member States in 2015 in the 2030 Agenda for Sustainable Development;[97] the Initiative for Responsible Mining Assurance standards;[98] the Global Industry Standard on Tailings Management,[99] the International Council of Mining and Minerals Principles,[100] and the Mining Association of Canada Towards Sustainable Mining guiding principles;[101] Each of these frameworks/forms of guidance is briefly described in turn.

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[95] See for example, Hawkins, *supra* note 6; Etienne Ravilet Guzman, "Canadian Financial Assurance Frameworks for the Remediation of Mining Sites: An Assessment of Ontario's, British Columbia's and Quebec's Schemes and" (2017) 31:1 J Environ Law Practice; Raising the Stakes: A comparative review of Canadian Mining Laws and Responsible Mining Standards., by Innes, Larry et al (Yellowknife, NWT: Olthuis Kleer Townshend, 2019).

[96] Hawkins, *supra* note 6 at 523.

[97] Transforming our world: the 2030 Agenda for Sustainable Development. GA Res A/RES/70/1, UNGA, 2015, UN Doc A/RES/70/1.

[98] Initiative for Responsible Mining Assurance, "IRMA Standard v1.0".

[99] *Global Industry Standard on Tailings Management* (2020).

[100] "ICMM", online: *Open graph* <https://www.icmm.com/>.

[101] Mining Association of Canada, *TSM 101: A Primer* (2022) online <https://www.tsminitiative.com/>.

1.7.1 United Nations Sustainable Development Goals

The United Nations SDGs are a blueprint for achieving a sustainable future.[102] There are 17 goals relating to, among other topics, poverty, inequality, climate change, environmental degradation, peace, and justice.[103] The SDGs are an outcome of the 1992 Rio Earth summit, when Agenda 21, a global plan to build a global partnership to improve human lives and protect the environment by sustainable development, was adopted.[104] The SDGs tend to be aspirational. The no harm principle is demonstrated in the environmental degradation goal (Goal 15). The reduction of inequality within and among countries (Goal 10)0, is the basis for the common but differentiated responsibility principle. The precautionary approach and polluter pays principles appear to be absent.

1.7.2 Initiative for Responsible Mining Assurance

The Initiative for Responsible Mining Assurance (IRMA) is a coalition of non-governmental organizations and businesses that purchase minerals and metals, thus affecting communities and labour unions, to address environmental and social issues in mining.[105] The IRMA standards not only address issues directly concerned with mining, but also with end-users, such as automobile manufacturers. Using internationally recognized

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[102] *"Take Action for the Sustainable Development Goals",* online: UN Sustain Dev <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>.

[103] *Ibid.*

[104] *"THE 17 GOALS | Sustainable Development",* online: <https://sdgs.un.org/goals>.

[105] "History", online: *IRMA - The Initiative for Responsible Mining Assurance* <https://responsiblemining.net/about/history/>.

standards, IRMA certifies social and environmental performance at mine sites.[106] IRMA is an iterative process, and the final version of IRMA was released in the fall of 2023. As a result of the IRMA verification process, end-users such as jewellery manufacturers, automobile manufacturers, electronics manufacturers, and construction firms who follow this process will have assurance that the metals they procure for their operations are mined in a responsible fashion.

The common but differentiated responsibilities principle is evident throughout the IRMA Standard, for example, in Standard 4.1.23 a waste mitigation hierarchy is established, with different mitigation protocols for each level of the hierarchy.[107] The precautionary approach is evident in the requirement for concurrent reclamation.[108] Finally, the polluter pays is embedded in the need to establish, "guaranteed, reliable and readily liquid" financial assurance.[109]

1.7.3. Global Industry Standard on Tailings Management

The Global Industry Standard on Tailings Management (GISTM),[110] is a framework designed collaboratively between the United Nations Environment Program, the International Council on Mining & Metals, and the Principles for Responsible Investment.

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[106] *Ibid.*

[107] Initiative for Responsible Mining Assurance, "IRMA Standard v1.0",at 4.1.2.3.

[108] *Ibid.* at 2.6.1.2.

[109] *Ibid.* at 2.6.3.1.

[110] *Global Industry Standard on Tailings Management* (2020).

The goal of the GITSM is achieve "zero harm to people and the environment with zero tolerance for human fatality."[111] The Standard consists of fifteen principles grouped into six topics: affected communities; integrated knowledge base; design; construction; operation and monitoring of a tailings facility; management and governance; emergency response and long-term recovery; and public disclosure and access to information.

The design, construction, operation, and monitoring of a tailings facility topic contains requirements that the consequence of failure of a tailings facility be classified in a "*Dam Safety Review"*[112]when the facility is first designed and must be reviewed at least every five years, "or sooner if there is a *material* change in the social, environmental and local economic context."[113] Similarly, The design should be reviewed "in response to *material* changes in the tailings facility's performance.[114] "The design should include closure and progressive *reclamation* during operations."[115] The principle of no harm is clearly embedded in the IRMA Standard. Similarly, the requirement of progressive reclamation is evidence of the precautionary approach and classification of failure risk could be considered use of the common but differentiated responsibility principle. There is no evidence of the polluter pays principle in the Standard. However, as the aim is to attain

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[111] *Ibid.* at 04.

[112] *Ibid.* at 10, Req. 4.2.

[113] *Ibid.*

[114] *Ibid.* Req. 5.2.

[115] *Ibid.* Req. 5.6.

zero harm to the environment, it could be argued that the principle is moot, as there is no pollution created if the Standard is applied.

1.7.4 International Council of Mining and Minerals Principles

The International Council of Mining and Minerals (ICMM) is an organization that works towards "a safe, just and sustainable world that is enabled by responsibly produced minerals and metals."[116] The ICMM principles consist of 39 performance expectations that define environmental, social and governance best practices for mining companies. Implementing the ICMM mining principles lead to progress towards achieving the UN Sustainable Development Goals and the Paris Agreement on climate change.[117] For example, one such best practice is that mine closure should be a dynamic and integrative process that considers social and economic issues.

Principle 6, which states "[p]ursue continual improvement in environmental performance issues, such as water stewardship, energy use and climate change,"[118] has as a performance expectation, "implement measures to address closure-related environmental and social aspects, and make financial provision to enable agreed closure and post-closure commitments to be realised."[119] This follows the no harm principle of

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[116] *Supra* note 99.

[117] *Ibid.*

[118] "ICMM Mining with Principles", (June 2023), *Performance expectations*. online: https://www.icmm.com/website/publications/pdfs/mining-principles/mining-principles.pdf?cb=59962.

[119] *Ibid.* at 6.1.

the sustainable development lens. Making financial provisions to realize post-closure commitments is also a tenuous attempt to meet the polluter pays principle. Meanwhile, another performance expectation is ”implement measures to address closure-related environmental and social aspects, and make financial provision to enable agreed closure and post-closure commitments to be realised”,[120] which may be construed to meet both the common but differentiated responsibilities and precautionary principles. Although the ICMM Principles appear to meet all four principles of the sustainable development lens, the vagueness of the wording means only the no harm principle is fully met.

1.7.5 Mining Association of Canada ‘Towards Sustainable Mining’ Guiding Principles

The Mining Association of Canada is the voice of the Canadian mining industry promoting the industry nationally and internationally.[121] “Towards Sustainable Mining” (TSM) “is a globally recognized sustainability program that supports mining companies in managing key environmental and social risks.”[122] TSM has a set of guiding principles which includes protocols, indicators and criteria that support the commitments to sustainability. TSM requires site-level assessment coupled with external verification, to report on 30 different performance indicators, such as treating mine water release and the protection of wildlife.[123] The program is mandatory for all company members of the Mining Association

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[120] *Ibid.* at 6.4.

[121] “Home”, online: *The Mining Association of Canada* <https://mining.ca/>.

[122] *“TSM | Home”,* online: TSM <https://www.tsminitiative.com/>.

[123] *Ibid.*

of Canada, as well as members of internationally associated organizations. Thirteen international mining associations have adopted the TSM as of April 2024, including mining powerhouses such as Argentina and Australia.[124]

The TSM tailings management protocol has, as its objective, working towards minimizing harm which encompasses both the physical and chemical risks associated with tailings.[125] This meets the no harm principle. Under the same protocol, preparations must be made to respond to a potential tailings facility failure.[126] This is an example of the precautionary approach. In the mine closure framework, members are required to establish financial assurance, making the polluter pay.[127] The TSM, therefore, provides some best practice examples regarding post-mining action by owners.

1.8 Structure of the Thesis

This thesis consists of six chapters. The present chapter sets the context for the thesis, provides a brief overview of the laws to be examined in more detail in subsequent chapters, discusses the legal methodologies employed to answer the research question, and reviews the pertinent literature. The sustainable development lens - through which

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[124] MAC, *"TSM News and Updates",* online: <https://mining.ca/towards-sustainable-mining/>.

[125] *A Guide to the Management of Tailings Facilities. Version 3.2*, by MAC (2021).online: https://mining.ca/wp-content/uploads/dlm_uploads/2021/06/MAC-Tailings-Guide-Version-3-2-March-2021.pdf>.

[126] *Ibid*. at 4.

[127] "TSM mine closure framework", online: *The Mining Association of Canada* <https://mining.ca/search/mine+closure/>.

the various laws, regulations, and guidelines are examined in later chapters - is explained in this chapter. Finally, Chapter 1 explains how the thesis addresses a gap in international law and therefore how it may contribute to legal development.

Chapter 2 reviews the international treaties that govern activities beyond Earth, particularly with respect to the Moon and other celestial bodies. Chapters 3 and 4 consider the mining laws of Australia and Canada regarding post-mining treatment through the lens of sustainable development. These chapters examine the mining laws of Canada and its provinces and territories as well as the laws of Australia and its states, as well as associated regulations. Additionally, government-issued guidelines or handbooks are also explored. Chapters 3 and 4 identify a number of best practices on reclamation of mining sites which also help to inform the final framework set out in Chapter 6. (Canada and Australia have been selected because both countries have a deep mining history, a common law heritage and, geologically, they are the same age as the Moon.[128])

Chapter 5 synthesises the information presented in the previous three chapters and lays the groundwork for Chapter 6, which outlines the proposed framework for the treatment of post- space resource extraction areas.

[128] Choosing countries with similar geological ages, removes any bias in the laws that might be related to the geology, for example, treating sedimentary and igneous rocks differently from a legal position.

1.9 Contribution to Legal Development

As mentioned above, the focus of the space law community has been on the legality of space resources extraction and utilisation. Once the COPUOS Working Group on Legal Aspects of Space Resource Activities finishes its work, and potentially provides clear guidance on how the exploitation of lunar resources may be done legally, companies such as SpaceX will be ready to launch rockets to the Moon to extract water from the lunar regolith and reduce it to its components of hydrogen and oxygen, to be used as fuel for propelling rockets to further bodies in our universe (such as Mars). Unless rules and regulations are in place at the beginning of this mining phase, the Moon will be exploited in an unregulated fashion and a 'Wild West' attitude will exist with the first-come taking full advantage of being there first.

If a 'Wild West' attitude is allowed to exist, then we will be well on the way to creating a celestial Anthropocene epoch. Adopting a framework for post-mining treatment will not stop mining operations from altering the landscape of the Moon, but it will mitigate the effects of mining. Mitigation requirements are a key aspect of preventing the destruction of the lunar environment and preventing unremediated abandoned mining sites. Such requirements would create a scenario where the mining operations progress in an orderly manner, where the sites are reclaimed as the exploitation occurs. A framework of post-mining treatment rules and regulations would provide mining companies wanting to exploit space resources with certainty of not only the legality of extraction, but the post-

mining treatment steps required, which should help them when raising capital for the project.

Chapter 2. Legal Framework

International law governing space mining is relatively undeveloped. Outer space law provides the framework in which to consider the extraction and use of space resources, notably the recognition that all countries have the right to explore and use space but are prohibited from appropriating space, including celestial bodies. However, this framework is general, and does not address the post-mining scenario, particularly post-mining treatment of mining sites. The generality of this framework, coupled with the lack of consideration of post-mining treatment, leaves important gaps in international law's understanding of the legality and parameters of space resource extraction. Many scholars turn to the UN Convention on the Law of the Sea (UNCLOS) and other treaties for analogies and guidance on space mining, but no treaties and few scholars have considered the post-mining phase. This chapter therefore aims to highlight the existing legal framework on space mining to illustrate the depth and breadth of the silence on post-mining treatment.

The review commences with a study of United Nations (UN) treaties covering space resource extraction and utilization and its legality, particularly the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty)[129] and the Agreement Governing

[129] OST*, supra* note 7.

the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement).[130] This chapter will evaluate the extent to which these sources of law provide any guidance on post-mining treatment. The chapter will then turn to consideration of other treaties, beginning with the UN Convention on the Law of the Sea (UNCLOS)[131] with the proposed regulations on exploitation of mineral resources the Area.[132] This latter treaty is included because the world's oceans have been described as the last frontier of human exploration, and there are therefore similarities to space mining. The last international treaty to be studied is the Antarctic Treaty,[133] and a soft-law document the World Charter for Nature, is also considered.[134] Two further documents are examined, the Artemis Accords,[135] and the Hague Building Blocks.[136]

Thee review of these UN treaties and other documents in this chapter is meant to provide a frame of legal guidance into which the best practices uncovered in the analysis of the laws of Australia and its states, and Canada and its provinces, in Chapters 3 and 4 will be

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[130] Moon, *supra* note 11.

[131] UNCLOS, *supra* note 20.

[132] Draft Regulations on Exploitation of Mineral Resources in the Area, by Legal and Technical Commission, ISBA 25/C/WP.1 (Kingston, Jamaica: International Seabed Authority, 2019).

[133] *The Antarctic Treaty*, 402 UNTS 71;TIAS 4780; 12 UTS 794; UKTS 1961 No 97 1959.

[134] *World Charter of Nature*, UN A/RES/37/7 1982.(Nature).

[135] *The Artemis Accords (2020). (*Artemis)

[136] The Hague International Space Resources Governance Working Group, "Building Blocks for the Development of an International Framework on Space Resources Activities", (November 2019). online: <https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht--en-ruimterecht/space-resources/bb-thissrwg--cover.pdf>.

situated. All of this will inform the framework for mining on the Moon proposed in Chapters 5 and 6.

2.1 International Treaties and Other Documents Relevant to Space Law

As mentioned in Chapter 1, the United Nations has adopted several treaties regarding conduct of activities in outer space; namely, the Outer Space Treaty,[137] the Moon Agreement,[138] the Rescue Agreement,[139] the Liability Convention,[140] and the Registration Convention.[141] Of these treaties, the two most appropriate to post-mining treatment are the Outer Space Treaty and the Moon Agreement, which are examined below. Given the gaps demonstrated in these two treaties, the remainder of this section discusses the UN Convention on the Law of the Sea,[142] the Antarctic Treaty,[143] the non-binding World Charter for Nature,[144] the government-to-government non-binding Artemis Accords,[145] and civil society-drafted Hague Building Blocks,[146] will be examined in subsequent sub-sections.

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[137] OST *supra* note 7.

[138] Moon *supra* note 11.

[139] Rescue*, supra* note 8.

[140] Liability, *supra* note 9.

[141] Registration, *supra* note 10.

[142] UNCLOS, *supra* note 20.

[143] The Antarctic Treaty, *supra* note 133.

[144] Nature, *supra* note 134,

[145] Artemis*, supra* note *135.*

[146] Brooke F Benjamin et al, *",The Hague international Space Resources Group: Reflections on the Building Blocks for an international Framework." (2019)* 43:1 J Space Law. *(Hague BB).*

2.1.1 The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty)

Considered to be the cornerstone of the laws pertaining to outer space and activities therein,[147] the Outer Space Treaty or OST was adopted by the UN General Assembly Resolution 2222(XXI) in October 1966, and entered into force in October 1967. To date, 112 countries, including all the spacefaring countries, have ratified the treaty.[148]

The Outer Space Treaty does not specifically refer to space resource extraction, but it does lay out the basic framework for international space law in which space mining must be considered. The core of that legal framework is found in Article I of the OST, which sets out a general principle that all states have the right to freely explore, use, and access space and that such activities shall be for the benefit and interests of all countries:

> Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.[149]

The second core provision is found in Article II, which puts limits on the free use of space, as it prohibits states from claiming territory in space: "[o]uter space, including the Moon

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[147] Bjork, *supra* note 13

[148] "UNODA Treaties" online: <https://treaties. noda.org/t/outer_space>.

[149] OST *supra note 7.*

and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means." This is commonly referred to as the non-appropriation article.[150]

These two paragraphs should govern how states exploit minerals on the Moon and other celestial bodies, as well as the post-mining treatment necessary after the exploitation. Relying on the freedom of use of the Moon and celestial bodies, it is argued by some that minerals may be freely extracted from the Moon and celestial bodies and such minerals should remain the property of all humankind.[151] Contrary to this position, authors have pointed to the appropriation clause in Article 2, arguing that resources removed from the surface of the Moon and celestial bodies are the property of the party that expended labour to remove them.[152] This latter position is becoming the predominant position and aligns with the view expressed in the Artemis Accords.[153]

The remainder of the articles in the OST provide additional guidance on the overarching principles governing space law. Article III requires the state parties to conduct activities in a peaceful manner "in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and

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[150] Bjork, *supra* note *13* See e.g. Tronchetti, *supra* note 91.

[151] *See* Stephen Gorove*, "Freedom of Exploration and Use in the Outer Space Treaty: Benefits and Interests" 13 Proceedings on the Law of Outer Space* at 74.*;*Report of the 54th Conference of the I.L.A., by Aldo Armando Cocca*,.* at 434*.*

[152] Daniel Goedhuis, Report on the 54th Conference of the I.L.A. (1970) at 434.*;*Sylvia Maureen Williams, "The Law of Outer Space and Natural Resources" (1987) 36:1 The International and Comparative Law Quarterly 142–151, online: <https://www.jstor.org/stable/760465> at 147*.*

[153] Artemis *supra* note 13. Section 10. Further description of the Artemis Accords is found at 2.2.3 below.

promoting international co-operation and understanding."[154] Relatedly, Article IV prohibits the placement of nuclear weapons in orbit around the Earth. The second paragraph prohibits establishing "military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies" is created.[155] (This is important for space mining: a mining base cannot also be a military base or fortification.)

Another article that contributes to the framework of space law is Article V, a precursor to the Rescue and Return of Astronauts Agreement,[156] in that the Article establishes astronauts as envoys of humankind and requires that they be rendered assistance in the case of emergencies. A requirement to inform the UN Secretary-General of the discovery of phenomena in outer space that could harm the astronauts, rounds out this Article.

Importantly for space mining, Article VI imposes on State Parties a responsibility for the actions of "governmental agencies or by non-governmental entities", and that the activities be authorized and continually supervised by the State Party.[157] This means that countries must authorize and supervise space resource extraction and utilization activities, including with respect to the post-mining phase.

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[154] It is this clause that is recalled by the International Space Station Agreement. Signed Jan 29,1998, entered into force Mar 27, 2001.

[155] OST *supra* note 7 article IV. It should be noted here that the OST was negotiated after the USSR launched Sputnik. The US was concerned that the USSR would have an advantage in outer space, which would threaten US national security.

[156] See Rescue *supra* note 8*;* OST *supra* note 7 Art. V.

[157] OST *supra* note 7 Article VI. This provides the counter argument to the OST applying only to states. The continual supervision allows private actors to use the Moon with State party supervision.

Article VII addresses liability for damage to the Earth or any celestial body, which is accorded to the state from the territory of which an object is launched.[158] This is another reason for states to be very involved in tracking and regulating the actions of commercial space mining entities. This provision is a precursor to the Liability Agreement.[159]

Article IX of the OST is also very important for the issue of space mining. It indicates that, "[i]n the exploration and use of outer space, including the moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space … with due regard to the corresponding interests of all other States Parties to the Treaty." [160] Thus, some form of cooperation is expected among those removing space resources and any others conducting activities on the celestial body. There is also an environmental aspect: "States Parties to the Treaty shall "avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose". If a State Party to the OST "has reason to believe that an activity or experiment planned by it or its nationals in outer space … would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space", it must "undertake appropriate international consultations before proceeding". The final aspect

[158] OST *supra* note 7 Article VII.

[159] Liability *supra* note 9.

[160] OST *supra* note 7 Article XI.

of this 'environmental' article is that, if a State Party believes "that an activity or experiment planned by another State Party in outer space … would cause potentially harmful interference with activities in the peaceful exploration and use of outer space", it "may request consultation concerning the activity". While 'harmful contamination' and 'harmful interference' are not defined, scholars have discussed their likely parameters. 'Harmful contamination' is related to the introduction of Earth-bound biological contamination of the Moon and other celestial bodies and the potential of the return to Earth of celestial biological contamination. Because the radio spectrum in space is considered a natural resource, the term 'harmful interference' was originally meant to apply to interference with the radio communications of another state,[161] although it could also be interpreted more widely as physical interference with another entity.

The application of Article IX to post-mining treatment will be key. While 'harmful contamination' is interpreted to apply to biological contamination and therefore is likely not to be of concern for post-mining treatment on the Moon's surface, post-mining treatment activities may be of concern to states for their 'harmful interference' potential.

While the Outer Space Treaty provides a general framework for activities on the Moon and other celestial bodies; the vagueness of the wording of the treaty, especially Articles

[161] Biswanath Gupta & Tamoghna Agasti*, "The Curious Case of Article IX and Outer Space Environment" (2022)* 2:02 J Environ Impact Manag Policy JEIMP ISSN2799-113X 7–25, online*:* <http://hmjournals.com/journal/index.php/JEIMP/article/view/464>.

I and II, has led to disagreement between authors on the subject.[162] Despite a half century of discussion, the UN Committee on the Peaceful Uses of Outer Space is no nearer to resolving ambiguities in the OST. Those ambiguities are currently being considered in the context of natural resources on and under the surface of the Moon and other celestial bodies, with the focus of the Committee's Working Group being on the legality of space resources extraction and utilisation, and the need for deconfliction and coordination among states. The Committee is not focused at all on the post-mining scenario, which is the subject of this thesis.

2.1.1.1 Coherence with the Sustainable Development Principles

To understand how the Outer Space Treaty would help regulate the remediation of space resources extraction of the Moon, the treaty is examined through the lens of sustainable development.[163] Recall that the four principles of sustainable development are: the no harm concept, the precautionary approach, the polluter pays, and common but differentiated responsibilities. The no harm concept is a derivative of the *Trail Smelter* case.[164] The manner in which the concept is presented makes it clear that it not only

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[162] Stephan Hobe, *"Adequacy of the Current Legal and Regulatory Framework Relating to the Extraction and Appropriation of Natural Resources"* Proc IIS*L* at 1*,* along with commentary from Profs. Vladimir Kopal, at p.25. and Frans von der Dunk at.32.

[163] See sub-chapter 1.6 above.

[164] *Ibid.*

"protect[s] the environmental integrity of other states, but also the environment in common areas, such as Antarctica, the high seas, the deep-seabed and outer space."[165]

Article XI of the OST makes specific reference to the avoidance of harmful contamination and interference, as described in section 2.1.1. above. This is an example of the precautionary approach, to avoid forward and backward contamination of the Earth and celestial bodies. Thus, any post-mining remediation must be conducted in a manner that avoids such contamination. Harm to the surface of Earth, on the other hand, is covered in Article VII and the *Convention on International Liability for Damage Caused by Space Objects*, an example of polluter pays.[166]

Article V of the OST requires that:

> Parties to the Treaty shall immediately inform the other States Parties to the Treaty or the Secretary-General of the United Nations of any phenomena they discover in outer space, including the Moon and other celestial bodies, which could constitute a danger to the life or health of astronauts.[167]

The intent of this article could be construed to extend beyond the safety of astronauts to that of the environment, and be considered an example of the precautionary approach. At the time of the OST being negotiated, there was little appetite for considering anything other than the peaceful use of outer space, and commercial exploitation of space minerals

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[165] Birnie, *supra* note 65 at 535.

[166] See Liability, *supra* note 9.

[167] OST, *supra* note 7, Article V.

was not a consideration, so there is no mention of pollution and no specified penalties for violations of the OST. Similarly, the OST provides identical treatment to State Parties, so there is no reference to differentiating between them in terms of their activities. This is so even though only developed countries have access to the expensive technology needed to exploit the Moon and celestial bodies.

2.1.2 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (The Moon Agreement)

The Moon Agreement was negotiated as a refinement of the OST and intended to address the subject of the use of natural resources.[168] The Agreement builds on the OST and duplicates some of the provisions therein. Under the Moon Agreement, exploration is an important precursor to exploitation and is covered in Article 2, where it must be carried out in accordance with international law.[169] The use of equipment and facilities for exploration is exempt from the prohibition of the establishment of military bases, installations and fortifications in Article 4.1.[170] Exploration should be carried out in a spirit of co-operation and mutual assistance on a multilateral basis.[171] Details of the exploration

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[168] *Bin Cheng, "The Moon Treaty: Agreement Governing the Activities of States on the Moon and Other Celestial Bodies within the Solar System other than the Earth." in Studies in International Space Law (Oxford University Press, 1997), at 218.*

[169] Moon, *supra* note 11.

[170] *Ibid.* Art. 4.1.

[171] *Ibid. Art.* 4.2.

efforts shall be communicated with the UN Secretary-General "to the greatest extent feasible and practical.[172]

Exploration may be carried out anywhere on the surface of the Moon and its sub-surface and State Parties may 'place their personnel, space vehicles, equipment, facilities, stations and installations anywhere on or below the surface of the Moon",[173] although placement of the facilities must not "impede the free access to all areas of the Moon […] by other State Parties".[174]

The safety of other persons on the Moon is assured by Article 10, which requires the adoption of all "practical methods to safeguard the life and health of other persons on the Moon",[175] by considering them to be astronauts within the meaning of Article V of the OST. The right to explore the Moon is made "without discrimination of any kind, on the basis of equality and in accordance with international law and the terms of [the Moon] agreement".[176] National responsibility for "damage caused on the Moon by a non-governmental entity under the jurisdiction" of the State Party shall be borne by the State Party.[177] Other State Parties have the right of inspection of any "space vehicles,

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[172] *Ibid.* Art. 5.1*,* This is contrary to the practice in terrestrial mining, where exploration details are a loosely guarded secret.

[173] *Ibid.* Art. 8.2(b)., If the exploration turns into exploitation, then the permanency of the facilities may violate Article II of the Outer Space Treaty, in that they may be considered appropriating the surface of the moon.

[174] *Ibid.* Art. 9.2.

[175] *Ibid* Art. 10.1.

[176] *Ibid.* Art. 11.4.

[177] *Ibid.* Art. 14.1.

equipment, facilities, stations and installations on the Moon",[178] to ensure that the activities of the other are carried out in accordance with the provisions of the Agreement.[179]

Exploitation, the next stage of the mining cycle after exploration, is covered in Article 11.[180] "The Moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement, in particular in paragraph 5 of this article."[181] Under Article 11, "[t]he Moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation , or by any other means."[182] Natural resources in place on or below the surface of the Moon are not the property of any state or any natural person, with the exception of a regime established under article 11.5.[183] Samples for scientific examination are permitted to be removed by State Parties, and should be made available to the international scientific community for study.[184]

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[178] *Ibid.* Art. 15.1.

[179] *Ibid.*

[180] *Ibid.* Art. 11.

[181] *Ibid.* Art 11.1.; The common heritage of mankind is extremely controversial and has become to mean the bestowing of property rights on the natural resources of the Moon, but not the ownership of the surface of the Moon. See Grier C Raclin, "From Ice to Ether: The Adoption of a Regime to Govern Resource Exploitation in Outer Space" (1986) International Law. At p.737; Gregory Radisic, "From Sea to Sky: Can the Law of the Sea Act as a Successful Model for a Future Asteroid Mining Framework?", (22 November 2022), online: <https://www.cba.org/Sections/Air-and-Space-Law/Resources/Resources/2022/EssayWinner2022Air>.

[182] Moon, *supra* note 169, Art.11.2.

[183] *Ibid.* Art.11.3.

[184] *Ibid.* Art. 6.2.

A regime to govern the exploitation of the natural resources of the Moon is to be established when the exploitation is about to be feasible.[185] To determine this timing, State Parties are to inform the UN Secretary-General of any discovery of any natural resources on the Moon.[186] The purposes of the regime are:

> (a) 2The orderly and safe development of the natural resources of the Moon; (b) The rational management of those resources; (c) The expansion of opportunities in the use of those resources;(d) An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the Moon, shall be given special consideration.[187]

The Agreement makes no reference to rehabilitation or remediation, but as purpose (b) is the rational management of resources, post-exploitation activities would be part of the management thereof.

The use of both the "province of mankind" and "common heritage of mankind"[188] language was explained by various United States officials in response to questions from the US Senate. In response to the chairman and ranking minority member of the Senate

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[185] *Ibid.* Art 11.5. The point of feasibility is not defined, is it technically feasibility of economic feasibility?

[186] *Ibid*. Art. 11.6. This may be compared to the terrestrial requirement of the Canadian Securities Association to disclose discoveries under the National Instrument 43-101.

[187] *Ibid*. Art. 11.7.

[188] *Ibid. Art. 4.1 and 11.1.*

Committee on Foreign Relations, regarding their concerns "that several aspects of the Moon Treaty, including the meaning attached to the concept, "common heritage of mankind"".[189] Secretary of State Cyrus Vance replied "The 1967 Outer Space Treaty, which the United States ratified with the Senate's advice and consent, already had provided that outer space was the "common province" of mankind […]".[190] The secretary went on the say about the OST, "the Treaty contains no moratorium on exploration and, in fact, has provisions designed to facilitate and encourage such exploitation."[191] Referring again to the OST, the Secretary went on to say;

> this non appropriation principle applies to the natural resources of celestial bodies only when such resources are "in place". Thus, article XI [3] would permit ownership to be from their place on or below the surface of the Moon or other celestial bodies.[192]

In response to a later question from Senator Richard Stone, the Assistant Secretary of State for Congressional relations replied:

> [N]either the "common heritage of mankind" concept as embodied in the Moon Treaty nor any other provision of the Treaty compels any specific form of the international arrangement for the regulation of the exploitation of Moon or other

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[189] Marion L Nash*, "Contemporary Practice of the United States Relating to International Law"* (1980) 74:2 Am J Int Law at p. 422.

[190] *Ibid.*

[191] *Ibid.*

[192] *Ibid.*

> celestial body resources. Neither the treaty nor the "common heritage" concept entails any specific obligation on states in regard to the establishment of such a regime except the commitment to engage in good faith negotiations to establish a mutually acceptable international regime to govern the exploitation of natural resources on celestial bodies when exploitation of such natural resources is about becoming feasible.[193]

This position is supported by Christol, who postulates that there is no moratorium on space resource utilization until feasible and that a State or individual could extract resources at will until the regime is established.[194]

Finally, the last stage of the mining cycle - rehabilitation or remediation - is addressed in Article VII, under which State Parties are required to take steps to avoid adverse effects to prevent disruption to the balance of the Moon's environment or to introduce extra-environmental matter.[195]

2.1.2.1 Coherence with Sustainable Development Principles

The Moon Agreement contains few provisions related to the Sustainable Development Principles, which is not surprising as the Agreement was adopted prior to the introduction

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[193] *Ibid.*

[194] Carl Q Christol, "THE 1979 Moon Agreement Where is it Today?" 27:1 Journal of Space Law. at 32.

[195] Moon, *supra* note 11 Art. VII. "In exploring and using the Moon, States Parties shall take measures to prevent the disruption of the existing balance of its environment, whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extra-environmental matter or otherwise. States Parties shall also take measures to avoid harmfully affecting the environment of the earth through the introduction of extraterrestrial matter or otherwise.".

of the Principles. That said, Article VII could be construed to be a recognition of the no harm principle as it admonishes State Parties from adversely affecting the environment, and mining is often a huge disruption to any environment. The principle of common but differentiated responsibilities may have its expression in Article IV.1 that exploration and use of the Moon […] be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development.[196] Article VII may also satisfy the precautionary principle; in that State Parties must avoid introduction of extra-environmental matter to the Moon and extraterrestrial matter to the Earth.[197]

2.1.3 United Nations Convention on the Law of the Sea

Although UNCLOS does not strictly apply to the exploitation of natural resources of celestial bodies,[198] there are several similarities between the two treaties that may be useful to consider when thinking about a framework for post-mining remediation in space:

> non-appropriation and freedom of use, use for peaceful purposes, international responsibility of states for national activities; a growing recognition of claims to equitable access and sharing of benefits by "have not" states; and finally the

[196] *Ibid.* Art. IV.1.

[197] *Ibid.* Art. VII.1.

[198] UNCLOS, *supra* note 20.

adoption of the Common heritage of Mankind doctrine with regard to exploration and exploitation of natural resources.[199]

UNCLOS provides potential precedent in that it provides regulations pertaining to an area that is remote and inhospitable – the deep seabed – but provides the opportunity to supply an abundance of natural resources. UNCLOS and the Moon Agreement share approaches on the non-appropriation and freedom of use of space; use for peaceful purposes; state responsibility for their nationals; and the 'common heritage of mankind' approach concerning exploration and exploitation of natural resources, which in the case of UNCLOS refers to mineral resources in the deep seabed.[200]

UNCLOS consists of a comprehensive set of laws and regulations aimed at controlling the oceans and their resources.[201] Enshrined in UNCLOS is "the notion that all problems of ocean space are closely interrelated and need to be addressed as a whole."[202] Section 1 of UNCLOS establishes the legal status of the sovereignty of the sea and air over the territorial sea and its bed. A nation's sovereignty is further defined in Section 2,

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[199] PPC Haanappel, *"Comparisons between the Law of the Sea and Outer Space Law: Exploration and Exploitation" (1985)* 28 Proceedings of 28th Colloquium on the Law of Outer Space. At 145.

[200] UNCLOS *supra* note 20 Art. 132.

[201] *"Overview - Convention & Related Agreements",* online: <https://www.un.org/depts/los/convention_agreements/convention_overview_convention.htm>.

[202] *Ibid.*

establishing a coastal nation's right to territorial waters extending 12 nautical miles from the low water mark of its coast.[203]

Article 77 grants coastal nations exclusive rights to explore,[204] including drilling (Art.81) and exploit its natural resources and if not exercised, the coastal national may authorize others to explore and exploit.[205] If exploitation of the natural resources from its continental shelf results in a surplus in the coastal nation, then a payment must be made by the coastal nation to the International Seabed Authority (Art.82).[206]

Part XI of UNCLOS addresses the resource extraction regime of the deep seabed. It is the longest part of the Convention, and is arguably the most controversial;[207] after the adoption of the UNCLOS, some states decided not to ratify because of the deep seabed extraction regime's resource sharing provisions using 'common heritage of mankind'. In order to allow the UNCLOS to gain enough ratifications to enter into force, changes to that section were negotiated and adopted in July 1994. States then ratified the UNCLOS, allowing it to come into force. In particular, in July 1994, the UN General Assembly adopted a separate Agreement to implement Part XI of the UNCLOS.[208] Consequently,

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[203] UNCLOS *supra* note 20 Art. 3. The type of water area determines the ownership and rights to the natural resources.

[204] UNCLOS *supra* note 20 Art. 77.1.

[205] UNCLOS *supra* note 20 Art. 77.2, Art. 81.

[206] UNCLOS *supra* note 20 Art 82. Referred to as the ISA or Authority.

[207] Han-Taek Kim*, A Comparative Study between Space Law and the Law of the Sea* (Seoul, Korea, 2009). at 196.

[208] *Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea.,* UNST/LEG(092)/A31. 1994.

UNCLOS must be read and applied in connection with this Agreement Relating to the Implementation of Part XI.[209]

Part XI defines resources as "[…]all solid, liquid or gaseous mineral resources in situ in the Area at or beneath the seabed, including polymetallic nodules; these resources when extracted are referred to as minerals.[210] The core to Part XI is the "Area", which in Article 1 (1) is defined as "the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction (Art 134) with it and its resources being the common heritage of mankind.[211] Article 137(1) reiterates the non-appropriation clause of the Outer Space Treaty. Subsection (b) of this Article vests the resources in the Authority on behalf of humankind. Furthermore, Article 137 only allows the Authority to control the "alienation" of minerals from the Area.[212] Article 139 holds the State Party responsible for damage caused by itself, state enterprises or natural persons who are nationals of the State Party. This is similar to Article 12 of the Moon Agreement and Article VII of the Outer Space Treaty.[213]

Article 140 declares that the activities carried out in the Area are "for the benefit of mankind as a whole irrespective of the geographical location of States" and "open for use exclusively for peaceful uses by all States […] and without discrimination and without

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[209] *Ibid.*

[210] UNCLOS*, supra* note 20 Art.133(b).

[211] *Ibid.* Art. 134, Cf "The Moon Agreement Art. 9.1".

[212] UNCLOS *supra* note 20 Art.137.2 and 3. Alienation in this context means removal.

[213] Haanappel, *supra* note 199 at 195*;* Han-Taek Kim, *supra* note 207. at 455.

prejudice. The wording is similar to that of the Moon Agreement Article 11.4. Article 143 allows scientific research to be carried out for peaceful purposes and for the benefit of humankind as a whole and also allows the Authority to conduct such research itself or contract it out.

Arguably, one of the most contentious Articles in UNCLOS is Article 144, which grants the Authority "(a) to acquire technology and scientific knowledge relating to activities in the Area; and (b) to promote and encourage the transfer to developing States of such technology and scientific knowledge so that all States Parties benefit therefrom". It is this clause that resulted in President Reagan's refusal to ratify the Treaty.[214]

Articles 145 to 149 are the most relevant to future space resources extraction as they deal with the marine environment and activities in the Area. Article 145 requires States to protect the environment "from harmful effects that may arise from such activities". The Authority is given exclusive rights to regulate waste removal and is required to implement procedures for *inter alia*:

> (a) the prevention, reduction and control of pollution and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment, particular attention being paid to the need for protection from harmful effects of such activities as drilling, dredging, excavation, disposal of waste, construction and operation or maintenance of installations, pipelines and other devices related to such

[214] United States, *"The Department of State Bulletin"* (1982) 82 at 71.

activities; (b) the protection and conservation of the natural resources of the Area and the prevention of damage to the flora and fauna of the marine environment.

Subsection (a) specifically lists all of the stages of exploration and exploitation of a mineral resource, with the exception of processing and closure of the project, which are covered in the "Draft regulations on exploitation of mineral resources in the Area"[215] (see section 2.3.1). Article 146 ensures the safety of human life and Article 147 prevents activities from interfering with other activities in the Area. The participation of developing States is encouraged in Article 148.

The development of the Area should proceed in a safe and rational manner, in accordance with the principles of conservation and minimal unnecessary waste.[216] Other states must be able to participate in future opportunities,[217] revenues of the Authority,[218] and the transfer of technology to the Enterprise,[219] as well as developing additional reserves to meet consumer demand,[220] while maintaining stable prices and equilibrium between supply and demand.[221]

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[215] *Draft regulations on exploitation of mineral resources in the Area*, by Legal and Technical Commission, ISBA 25/C/WP.1 (Kingston, Jamaica: International Seabed Authority, 2019). (The Regulations).

[216] This approach should be a foundation for avoiding a celestial Anthropocene epoch.

[217] UNCLOS *supra* note 20 Art. 150 (b).

[218] *Ibid.* Art. 150 (c).

[219] *Ibid..* Art. 150 (d). The Enterprise is an organ of the authority that carries out activities in the Area and transports, processes, and markets the minerals recovered from the Area, as defined in Article 170.

[220] *Ibid.* Art. 150(e).

[221] *Ibid.* Art. 150 (f).

The potential economic effects of mining the seabed are covered, in that there should not be an adverse effect on the economies or export earnings caused by activities in the Area, [222] and a monopoly by a Contractor is to be prevented, [223] nor should the products of activities in the Area benefit from more favourable treatment in import regulations.[224] The protection of the economies of developing countries is further enhanced by the establishment of production limits, especially for nickel.[225]

The activities in the Area require a written plan of work,[226] which is included as a contract with the state-sponsored entity.[227] Compliance with the contact is monitored by the Authority.[228]

Section 4, Articles 156-191, define the workings of the Authority, its composition, financial arrangements, legal status, privileges and immunities, suspension of the exercise of rights and privileges of members, as well as settlement of disputes and advisory opinions.[229]
Part XII of UNCLOS deals with the protection and preservation of the marine environment. Article 193 grants sovereign states the right to "exploit their natural resources according

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[222] *Ibid.* Art. 150 (h).

[223] *Ibid. Art. 150 (g).*

[224] *Ibid.* Art. 150 (j).

[225] *Ibid.* Art. 151. Canada led objections to production limits and succeeded in imposing major limitations on the production limits: G Winthrop Haight, "Comments on Judge Oda's Approach to the Common Heritage of Mankind." (1981) 3:1 Journal of International and Comparative Law. at 18.

[226] *UNCLOS supra* note 20 Art. 153.3.

[227] *Ibid.* Art 153.6., providing the Contractor with security of tenure.

[228] *Ibid.* Art. 153.4, holding the states liable for damages caused by their sponsored parties.

[229] *Ibid.* Art 156-191.

to their environmental policies" that are enacted to meet the states' obligations to protect and preserve their marine environment.[230] This section of UNCLOS is designed to prevent pollution from all sources, such as land-based sources, vessels, and " pollution from installations and devices used in exploration or exploitation of the natural resources of the seabed and subsoil."[231] In doing so, a state cannot interfere with activities carried out by another State.[232] Nor can a State in the act of preventing pollution transfer damage or hazards from one area to another, or convert the form of pollution.[233] The prevention of the introduction of alien or new species into the environment is similar in wording to Article VII of the Moon Agreement.[234] When a State becomes aware of imminent damage of the marine environment by pollution, it is required of the State to "immediately notify other States it deems likely to be affected by such damage, as well as the competent international organizations."[235]

Pollution caused by coastal states to their marine environment by seabed activities in areas of their national jurisdiction shall be regulated by national legislation, which must be no less "effective than international rules, standards and recommended practices and procedures."[236] International rules, regulations, and procedures must be established in

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[230] *Ibid.* Art. 193.

[231] *Ibid.* Art. 194.3 (c)

[232] *Ibid.* Art. 194.4.

[233] *Ibid.* Art. 195.

[234] *Ibid.* Art. 196.1.

[235] *Ibid.* Art 198, *Cf* Moon *supra* note 11 Art.5.3. and UNCLOS *Note 20.* Art 206.

[236] *Ibid.* Art 208. 2 & 3.

accordance with Part XI, in order to prevent, reduce and control pollution of the marine environment from activities in the Area. These rules, regulations and procedures must be reviewed from time to time, as necessary.[237]

Articles 211-237 cover the enforcement of environmental protection with regards to maritime traffic and do not affect the Area.[238]

Section XIII grants the right to States and competent organizations to conduct scientific research without interference with other activities and gives coastal states the power to refuse this right in their territorial waters, if the conditions in Article 248 are not complied with.[239] All states have the right to conduct scientific research in the Area.[240]

Any disputes that arise from the interpretation of the Convention may be presented to the International Tribunal for the Law of the Sea, the International Court of Justice, or an arbitral tribunal as provided for in annexes to UNCLOS.

Annex III to UNCLOS addresses the basic conditions for prospecting, exploration and exploitation.[241] The Annex provides direction as to what regulations regarding the exploitation of lunar mineral resources may look like. The ownership of minerals in the Area passes upon recovery.[242] Prospecting of the Area is to be encouraged by the

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[237] *Ibid.*Art.209.1.

[238] *Ibid.* Art. 210-237.

[239] *Ibid.* Art. 238 & 253.

[240] *Ibid.* Art. 256.

[241] *Ibid.* Annex III.

[242] *Ibid.* Article 1. To whom title passes, the recoverer, the State sponsor or the Authority, is unclear. The change in title is similar to the interpretation of the distinction between the province and the common heritage of mankind found in the Moon Agreement. See Note 27.

Authority, but only following written agreement of the prospector to comply with the terms of the Convention.[243] While the prospector has the right to recover a "reasonable quantity of minerals for testing", the prospector does not have the rights to the resources.[244] Furthermore, more than one prospector may search the same area at the same time.[245] Exclusivity of prospecting prevents "claim jumping" activities that were prevalent in the mid 1850s gold rushes.

"State Parties and other entities", as well as the Enterprise may present a plan of work for the Authority's approval.[246] The Enterprise may apply for any part of the Area, whereas other applicants are subject to restrictions applying to reserved areas.[247] The Enterprise may, however, enter into a joint venture with State Parties and others to present a plan of work for a reserved area.[248] State Parties and others are treated differently from the Enterprise, in that their approved plan of work is granted in the form of a contract, the Authority not being able to enter into a contract with a body of itself.[249]

To file a plan of work, the applicant must be a national of or under the control of a State Party, along with the financial and technical capabilities.[250] It is the sponsoring State Party

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[243] *Ibid.* Article 2 (a)& (b).

[244] *Ibid.* Art. 2.1 (a) & (b).

[245] *Ibid.* Art. 2.1(c).

[246] *Ibid.* Art. 3.1.

[247] *Ibid.* Art 3.2.

[248] *Ibid.* Art. 9.1.

[249] *Ibid.* Art. 3.5.

[250] *Ibid.* Art. 4.2 & 3.

that is responsible for ensuring that the applicant adheres to its obligations under its contract, by applying the state's own legislation.[251]

As part of the plan of work presented for approval, a list of equipment and methods to be used for recovering the minerals, as well as non-propriety information about such technology and availability of the technology, must be presented.[252] The applicant has to make all efforts to allow the Enterprise to obtain the technology at "fair and reasonable commercial terms and conditions."[253]

Applications for permits to exploit the Area are considered in the order in which they are received and allocated until the Area is completely allocated.[254] The allocation may be disallowed, if the Authority considers the part of the Area to be exploited would cause serious harm to the environment,[255] or if the area exceeds an area of 120,000 square kilometres.[256] The application may also be rejected if the area to be removed exceeds 2% of the total seabed area.[257] Similarly, if the approval of a production authorization exceeds

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[251] *Ibid.* Art. 4.4.

[252] *Ibid.* Art 5.1. This clause is similar to the transfer of technology of the Moon Agreement (See Note 47) The transfer of technology is presumably to allow the Enterprise to exploit the reserved area without being at a technological or economic disadvantage.

[253] *Ibid.* Art. 5.

[254] *Ibid. Art. 6.3. On March 31, 2023, the International seabed Authority announced that the first applications would be accepted commencing July 9, 2023. "UN to start taking deep-sea mining applications this July",* online: MININGCOM <https://www.mining.com/web/un-to-start-taking-deep-sea-mining-applications-this-july/>.

[255] *Ibid.* Art. 6.3(b).

[256] *Ibid. Art.* 6.3(c)(i).

[257] *Ibid. Art.* 6.3(c)(ii).

the production limits in Article 151.[258] When the production limits are reached, the Authority shall select applications based on applications that will:

> (a) give better assurance of performance, considering their financial and technical qualifications and their performance, if any, under previously approved plans of work; (b) provide earlier prospective financial benefits to the Authority, taking into account when commercial production is scheduled to begin; (c) have already invested the most resources and effort in prospecting or exploration.[259]

The submitted application shall be large enough to allow two mining operations that are of equal commercial value, one of which shall be reserved for the Enterprise to develop, or in association with a State Party or other entity.[260] This dual operation, coupled with the transfer of technology, will allow the Enterprise to produce minerals on an equitable basis with the adjacent commercial concession, for the common heritage of humankind. The Enterprise may also decide not to exploit the reserved area, but to develop it in collaboration with a State Party or entity and offer financial incentives to their joint venture partners.[261]

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[258] *Ibid.* Art. 7.1.

[259] *Ibid.* Art. 7.3.

[260] *Ibid.* Art. 8.

[261] *Ibid.* Art. 11.

The contracts the Authority enters into with applicants ensure that the Authority receives the optimum revenues from commercial production,[262] and attract investments and technology to the exploration and exploitation of the area.[263] The transfer of technology and training of Authority personnel to enable the Enterprise to engage in seabed mining,[264] while not subsidizing Contractors or giving them a competitive advantage over land-based miners,[265] is a major objective of the contract.

These contract terms allow for the Authority to direct some of the commercial benefits to flow to developing states and ensure that the Area is developed in an orderly manner and for the common heritage of humankind. The Authority also collects an administrative fee for processing the applications and an annual fee.[266] In addition, the holder of a production authorization is required to pay a production charge on a sliding scale based on the rate of return.[267] The investment used to calculate the rate of return is calculated as 10% of the development costs of the Contractor, with a floor based on the minerals recovered.[268] This approach encourages the Contractor to spend funds to develop their recovery processes and maintain the technology.[269]

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[262] *Ibid.* Annex III Art. 13.1 (a).

[263] *Ibid.* Art 13.1 (b).

[264] *Ibid.* Art 13.1 (d).

[265] *Ibid.* Art 13.1 (f).

[266] *Ibid.* Art 13.2 & 3.

[267] *Ibid.* Art. 13.

[268] *Ibid.*

[269] The 1994 Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 removed some of the clauses, such as most of Article 151, the original

The concept of using UNCLOS as a model for a legal framework for space resources extraction has been presented by several authors.[270] Both outer space and the deep ocean bed present similar problems, in that they are both remote and have harsh and extreme working conditions, as well as not being subject to national appropriation. The law of the sea faces many similar issues and concerns as the legal framework governing the world's second largest global commons. The International Seabed Authority (ISA) is tasked with approving and overseeing the deep-sea mining activities occurring in international waters, as well as allocating a significant amount of the profits from deep-sea mining in international waters to developing countries. In order to obtain a contract from the ISA, a mining company must be sponsored by a state party to the UNCLOS and must designate in its application two mining areas for potential development. Only one of these areas will be awarded to the company: the other will be reserved by the Authority for exploration and exploitation by the Enterprise. Radisic and others have suggested that this approach, and that of the common heritage of humankind, should be adopted as the model for natural resource exploitation on the Moon and other celestial bodies.[271]

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text is reviewed here as a guideline to regulations that may be applicable to exploitation of resources on the Moon.

[270] See generally Minola, *supra* note 21.*; Grier* C Raclin, *"From Ice to Ether: The Adoption of a Regime to Govern Resource Exploitation in Outer Space" (1986)* International Law*;* Gregory Radisic, *"From Sea to Sky: Can the Law of the Sea Act as a Successful Model for a Future Asteroid Mining Framework?",* (22 November 2022), online: <https://www.cba.org/Sections/Air-and-Space-Law/Resources/Resources/2022/EssayWinner2022Air>.

[271] *Ibid.*

Like the Moon Treaty, the United States is not a signatory or ratifier . Some of the issues that prevented the United States from joining UNCLOS include the burdensome international regulation on the development of deep seabed resources, the discriminatory advantages granted to the Enterprise, the mandatory transfer of technology, and the imposition of production limits.[272]

2.1.3.1. Coherence with the Sustainable Development Principles

UNCLOS contains numerous references to the prohibition of harmful discharges into the oceans during activities in the Area, thus is coherent with the no harm approach.[273] By defining various types of marine limits with different forms of jurisdiction and sovereignty,[274] UNCLOS is applying the concept of common but differentiated responsibilities. The precautionary approach is detailed only for marine vessels to prevent pollution, but is not applied for the exploitation of the ocean's natural resources.[275] There is no clause related to penalties, so the polluter pays concept is not addressed.

2.1.4 Draft Regulations on Exploitation of Mineral Resources in the Area

The draft regulations on exploitation of mineral resources of the Area, are set out in Article 17 of Annex III of UNCLOS.[276] The Legal and Technical Commission of the

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[272] Edward Dangler, "An Ocean Miner's View of rhe Draft Convention" (1981) 3:1 Journal of International and Comparative Law. at 31.

[273] See e.g. UNCLOS Art. 145; Art.194.3(a); Art 221.

[274] Coastal waters, Exclusive Economic Zones and the Area.

[275] See e.g. UNCLOS Art. 23 and 115.

[276] Kathy-Anne Brown, *"The Draft regulations on Exploitation of Mineral Resources in the Area. "A Work in Progress" i*n U N Conv Law Sea Part XI Regime Int Seabed Auth Twenty-Five Year Journey (Leiden: Koninklije Brill, 2022) at 313.

International Seabed Authority published draft regulations for the exploitation of the Area, consisting of 13 parts, 10 annexes, 4 appendices and a schedule,[277] in July 2019, and they have been under discussion since. For all intents and purposes, the draft regulations (the Regulations) echo the contents of Annex III of UNCLOS, and therefore only those that relate to activities related to rehabilitation or remediation will be addressed in this sub-chapter.

The Introduction of the Regulations, re-iterates the freedom of scientific research accorded in Article 87, 143 and 256 of UNCLOS, in Regulation 1.4.[278] Continuing, the Introduction, recognizes that the rights in the resources "are vested in mankind as a whole, on whose behalf the authority shall act."[279] The need to develop the Area in an economic and balanced manner while promoting overall international development is also stated in the Introduction.[280]

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[277] *Ibid.* at 316.

[278] The Regulations*, supra* note 215.

[279] *Ibid.* Reg. 2 (a).

[280] *Ibid.* Reg. 2 (b). (i) The development of the Resources of the Area; (ii) Orderly, safe and rational management of the Resources of the Area, including the efficient conduct of activities in the Area and, in accordance with sound principles of conservation, the avoidance of unnecessary waste; (iii) The expansion of opportunities for participation in such activities consistent, in particular, with articles 144 and 148 of the Convention; (iv) Participation in revenues by the Authority and the transfer of technology to the Enterprise and developing States as provided for in the Convention and the Agreement; (v) Increased availability of the minerals derived from the Area as needed in conjunction with minerals derived from other sources, to ensure supplies to consumers of such minerals; (vi) The promotion of just and stable prices remunerative to producers and fair to consumers for minerals derived both from the Area and from other sources, and the promotion of long-term equilibrium between supply and demand; (vii) The enhancement of opportunities for all States Parties, irrespective of their social and economic systems or geographical location, to participate in the development of the resources of the Area and the prevention of monopolization of activities in the Area; (viii) The protection of developing countries from serious adverse effects on their economies or on their export earnings resulting from a reduction in the price of an affected Mineral or in the volume of exports of that Mineral, to the extent that such reduction is caused by activities

The second part of the Regulations deals with the plan of work that has to be filed with any application for a contract to exploit the resources in the Area.[281] the application may be filed by :

> (a)The Enterprise, on its own behalf or in a joint arrangement; (b) States parties, State enterprises or natural or juridical persons which possess the nationality of States or are effectively controlled by them or their nationals, when sponsored by such States, or any group of the foregoing which meets the requirements of these Regulations.[282]

Each application has to be submitted by a State Party, State enterprise or natural or juridical person sponsored by the State, as required by regulation 5 1 (a).[283] This make the State liable for the applicants actions under Articles 139, 153 and Article 4(4) of annex III of UNCLOS, dealing with compliance and liability of the applicant with respect to the preservation of the Marine environment.[284]

The applications has to be accompanied by a

> (a) Mining Workplan […]; (c) A Financing Plan […] (d) An Environmental Impact Statement […]; (e) An Emergency Response and Contingency Plan […]; (f) A Health

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in the Area; (ix) The development of the common heritage for the benefit of mankind as a whole; and (x) That conditions of access to markets for the imports of minerals produced from the resources of the Area and for imports of commodities produced from such minerals shall not be more favourable than the most favourable applied to imports from other sources.

[282] *Ibid.* Reg. 5.1.

[283] *Ibid.*

[284] *Ibid.* Reg. 6.3 (f).

> and Safety Plan and a Maritime Security Plan […]; (g) A Training Plan […]; (h) An Environmental Management and Monitoring Plan […]; (i) A Closure Plan […];

each of which has model plan in the Annexes to the regulations.[285]

In addition, the Environmental Plan has to be published on the Commission's website for 60 days for public input as well as that of the Commission.[286] the applications are to be reviewed in the order in which they are submitted.[287] The Commission will not approve any plan of work that would cause a monopoly with regard to any resource category (polymetallic sulphides, polymetallic nodules and ferromanganese crusts).[288]

If awarded a contract by the Authority, the Contractor would be granted an exclusive contract to exploit a particular resource category in the area designated in the contract.[289] However, another Contractor may be granted a contract for exploitation of a different resource category in the same area, if it does not interfere with the Contractor's rights.[290] The Regulations grants the Contractor no interest or rights of appropriation.[291] The awarded contract is valid for a maximum period of 30 years and be renewable for a maximum of 10 years, if the resource category remains commercial and profitable and

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[285] *Ibid.* Reg. 7.2.

[286] *Ibid.* Reg. 11.

[287] *Ibid.* Reg. 12 cf. Note 77.

[288] *Ibid.* Reg. 3.2.

[289] *Ibid.* Reg. 18.1 (b).

[290] *Ibid.* Reg. 18.3.

[291] *Ibid.* Reg. 18.5.

the Contractor is compliant with the terms of the exploitation contract.[292] The Contractor must remain sponsored by a State and in the event of loss of sponsorship, shall find another sponsor.[293] If the Contractor fails to find an alternative sponsor, the original sponsor is not relieved of their legal rights and obligations created during the sponsorship, so would be held responsible for any post-mining treatment of the mining concession.[294]

Although the Contractor gains no rights or interest in the Area or its resources,[295] the Contractor may "mortgage, pledge, lien, charge or otherwise encumber" its interest in the contract, to raise financing to carry out the contract.[296] When a Contractor receives an exploitation contract, the Contractor has to lodge an Environmental Performance Guarantee with the Authority upon commencement of operations.[297] the Guarantee shall reflect the projected costs of :

> (a) The premature closure of Exploitation activities; (b) The decommissioning and final closure of Exploitation activities, including the removal of any Installations and equipment; and (c) The post-closure monitoring and management of residual Environmental Effects.[298]

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[292] *Ibid.* Reg 20.6 & 7.

[293] *Ibid.* Reg 21.3.

[294] *Ibid.* Reg. 20.4, comment added.

[295] *Ibid.* Reg 18.5.

[296] *Ibid.* Reg. 22.1.

[297] *Ibid.* Reg. 26.1.

[298] *Ibid.* Reg. 26.1.2.

The amount of the Environmental Performance Guarantee, may be paid by installment over the specified period.[299]The amount payable may be reviewed at any time by the Commission and additional funds deposited by the Contractor within 60 days of the review.[300] The payment of the "Environmental Performance Guarantee[…] does not limit the responsibility and liability of the Contractor."[301]

The Contractor is expected to maintain commercial production as per the contract; however, it shall temporarily suspend operations to protect the Marine environment or human health and safety.[302] Market conditions may allow the Contractor to suspend operations for up to twelve months,[303] beyond this, may require the Contractor to submit a final closure plan,[304] but if operations cease for more than five years, the contract may be terminated, and a closure plan implemented.[305]

Part IV entitled "Protection and preservation of the Marine Environment" is arguably one of the most important parts of the Regulations with regard to post-mining treatment activities, in that it defines the steps to be taken to reduce the pollution of the Marine environment by mining activities.[306] The Regulations require the "Authority, sponsoring

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[299] *Ibid.* Reg. 26.3.

[300] *Ibid.* Reg. 26.5.

[301] *Ibid.* Reg. 26.8.

[302] *Ibid.* Reg. 28.

[303] *Ibid.* Reg. 29.1.

[304] *Ibid.* Reg. 29.3.

[305] *Ibid.*

[306] *Ibid.* Reg 44-53. The definition of the Marine Environment in the schedule to the regulations," includes the physical, chemical, geological and biological components, conditions and factors which interact and determine the productivity, state, condition and quality and connectivity of the marine ecosystem(s), the

States and Contractors [to] plan, implement and modify measures [to ensure] effective protection of the Marine Environment from harmful effects".[307] In compliance with the Regulation, the states and Contractors shall

> (a) Apply the precautionary approach, as reflected in principle 15 of the Rio Declaration on Environment and Development, to the assessment and management of risk of harm to the Marine Environment from Exploitation in the Area; (b) Apply the Best Available Techniques and Best Environmental Practices in carrying out such measures; (c) Integrate Best Available Scientific Evidence in environmental decision-making, including all risk assessments and management undertaken in connection with environmental assessments, and the management and response measures taken under or in accordance with Best Environmental Practices; and (d) Promote accountability and transparency in the assessment, evaluation and management of Environmental Effects from Exploitation in the Area, including through the timely release of and access to relevant environmental data and information and opportunities for stakeholder participation.[308]

The Environmental Standards proposed in the Regulations, following Reg. 94 of the Regulations, requires the inclusion of "(a) Environmental quality objectives, (b) monitoring procedures; and (c) Mitigation measures.[309] Along with these objectives, the

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waters of the seas and oceans and the airspace above those waters, as well as the seabed and ocean floor and subsoil thereof."

[307] *Ibid.* Reg. 44.

[308] *Ibid.*

[309] *Ibid.* Reg. 45.

Contractor shall implement an environmental management system that is site-specific, cost effective, auditable by an accredited international organization and permit reporting to the Authority.[310]

Section 2 of the Part, requires the preparation of an Environmental Impact Statement (EIS) to "document and report the results of the environmental impact assessment [EIA]."[311] The process commences with screening and scoping the environmental effects allowing the prioritization of "the main activities and impacts associated with the potential mining operation."[312] From the "predict[ion] of the nature and extent of the Environmental Effects",[313] the measures required to mitigate the effects may be identified, leading to the creation of an Environmental Management and Monitoring Plan (EMMP) to maintain the impacts within acceptable levels.[314] The acceptable levels are not defined in the Regulations, but the plan should use "Good industry Practice, best Available Scientific Evidence, Best Environmental Practices and Best Available Techniques",[315] and so will be a living document.

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[310] *Ibid.* Reg. 46.

[311] *Ibid.* Reg. 47.1.

[312] *Ibid.* Reg. 47.1 (b), The Environmental effects are described in the Schedule of the Regulations as "any consequences in the Marine Environment arising from the conduct of Exploitation activities, whether positive, negative, direct, indirect, temporary or permanent, or cumulative effect arising over time or in combination with other mining impacts." The definition therefore includes activities other than mining, such as construction and decommissioning of mining activities in the Area.

[313] *Ibid.* Reg 47.1(c).

[314] *Ibid*. Reg. 47.1(d).

[315] *Ibid. Reg.* 473 (d.)

> The EMMP should provide an effective response to the projected environmental effects and set out commitments and procedures on how the mitigation measures will be implemented and their effectiveness monitored, the management responses to the monitoring results, and the reporting systems to be adopted and followed.[316]

The performance assessments are essential to the evaluation of compliance of the activities in the Area and the continuing adequacy of the plan.[317]

Part VI may be as important as Part IV, in terms of post-mining treatment, as it addresses Closure Plans. A Closure Plan shall set out:

> [T]he responsibilities and actions of a Contractor for the decommissioning and closure of activities in a Mining Area, including the post-closure management and monitoring of residual and natural Environmental Effects. Closure also includes a temporary suspension of mining activities.[318]

Any negative residual environmental effects need to be identified and quantified and a Mitigation Plan prepared.[319] Any restoration or rehabilitation commitments, not

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[316] Brown*, supra* note 276. at 331*, Ibid.* Reg. 48.

[317] *T*he Regulations, *supra* note 215 Reg.51(c).

[318] *Ibid.* Reg. 59.1*,* Brown*, supra* note 276.at 332*.*

[319] *Ibid.* Reg. 59.2(e).

specified, need to be fulfilled,[320] the Contractor needs to continue to monitor the Marine Environment for a period specified in the Closure Plan.[321]

Parts VII and VIII of the Regulations are the financial terms of an exploitation contract and set out in more detail the terms described earlier in the Regulations, with the balance of the Regulations related to administrative aspects of the authority and information gathering. The Annexes give templates for the various plans that need to be submitted to the Authority, *inter alia*: Mining Workplan, Financing Plan, Environmental Impact Statement, Emergency Response and Contingency Plan, Health and Safety Plan and Maritime Security Plan, Environmental Management and Monitoring Plan, Closure Plan, and standard clauses for the exploitation contract.

2.1.4.1 Coherence with the Sustainable Development Principles

Principle 15 of the Rio Declaration on the Environment and Development is specifically referenced in respect to the harming of the environment and the avoidance of such.[322] The principle of common but differentiated responsibilities is covered under Regulation 3.2. of Annex IV concerning the Environmental Impact Statement (EIS),[323] which requires the EIS to give details regarding the type of resource to be exploited. Again, Principle 15 of the Rio Declaration on the Environment and Development is invoked in the assessment

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[320] *Ibid.* Reg. 59.2(f).

[321] *Ibid.* Reg. 61.2.

[322] *Ibid.* Reg. 2(c).

[323] *Ibid.* Annex IV Reg. 3.2.

and management of the marine environment from the exploitation of the Area, by use of the precautionary approach.[324] All four principles of sustainable development are therefore covered in the Draft Regulations.[325] The Draft Regulations ensure that the polluter pays: Regulation 80 allows the Council to impose a monetary penalty for any violation of the contract.[326] The Draft Regulations is one of the few international treaties studied in this thesis to encompass all four of the sustainable development principles.

2.2 Other International Agreements and Documents

There are a number of other international agreements which may have a bearing on a framework for space resource extraction post-mining treatment, namely, the binding Antarctic Treaty, the non-binding World Charter of Nature, the non-binding Artemis Accords, and the Hague Building Blocks (created by an expert group and not a state-focused agreement).

2.2.1 The Antarctic Treaty

The Antarctic continent has been suggested as an analog for outer space, in that it is *res communis,* or the territory of no nation,[327] and has harsh climatic conditions. "The

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[324] *The Regulations,* supra note 215 Reg. 44.

[325] This is probably due to the popularity of the principle of sustainable development at the time the draft regulations were developed (2019), as opposed to when the OST and Moon Agreement were adopted (1967 and 1994 respectively).

[326] The Regulations *supra* note 215. Reg. 80.

[327] See generally, Barbara E Heim, *"Exploring the Last Frontiers for Mineral Resources: A Comparison of International Law Regarding the Deep Seabed, Outer Space, and Antarctica";* Fabio Tronchetti, *"The*

Antarctic Treaty System is considered [by some, to be] the most successful legal structure to govern operations in an international area and has allowed for more than 50 years of peaceful scientific and environmental protection of the Antarctic area."[328]

The Antarctic Treaty[329] is the cornerstone legal document governing Antarctica, and with the Agreed Measures for the Conservation of Antarctic Fauna and Flora,[330] the Convention for the Conservation of Antarctic Seals,[331] the Convention on the Conservation of Antarctic Marine Living Resources,[332] and the Convention on the Regulation of Antarctic Mineral Resource Activities,[333] comprise the Antarctic Treaty System.

The Antarctic Treaty was originally signed by twelve states,[334] each with a claim to a portion of the continent and a common interest in the preservation of Antarctica and the ongoing scientific research of the continent. The Antarctic Treaty established a

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Exploitation of Natural Resources of the Moon and Other Celestial Bodies: A Proposal for a Legal Regime" in *Exploitation of Natural Resources on the Moon and other Celestial Bodies* (Brill Nijhoff, 2009).

[328] Tronchetti, Fabio, *"Legal aspects of space resource utilization"* in Handbook of Space Law, 1st ed (Edgar Elgar Publishing Ltd., *2*015) at 803.

[329] The Antarctic Treaty, *supra* note 133. Done 1 December 1959 entered into force 23 June 1961. (Antarctic).

[330] *Agreed Measures for the Conservation of Antarctica Flora and Fauna*, 17UST 996; TIAS 6058 (1966) 1964. 2 June 1964 entered into force 1 November 1982.

[331] The Convention for the Conservation of Antarctic Seals, TIAS 8826;27 UST 441; ATS 1987 No 11;11 ILM 251 (1972) 1 June 1972 entered into force 11 March 1972.

[332] *Convention on the Conservation of Antarctic Marine Living Resources,* TIAS 10240; ATS 1982 No 9; 19 ILM 841 (1980). 20 May 1980 entered into force 7 April 1982,

[333] *Convention on Regulation of Antarctic Mineral Resources,* 27 ILM 868 (1988) 2 June 1988, not yet entered into force.

[334] Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, South Africa, the United Kingdom, the United States, and the Soviet Union.

"framework for the preservation of Antarctica and the promotion of scientific research without prejudicing the positions or territorial claims of any of the states involved."[335]

The treaty contains 14 articles. It prohibits weapons testing, military maneuvers, military bases, nuclear explosions, and nuclear waste disposal in Antarctica.[336] Freedom of scientific investigation and cooperation to that end is guaranteed in Article II.[337] The contracting parties are required to exchange to the "greatest extent feasible and practicable;[338] information regarding plans for scientific programs, scientific personnel and observations and results of said programs;[339] and the establishment of cooperative working relations with other like-minded organizations.[340] "Article IV preserves the positions of claimants and nonclaimant states in Antarctica and provides that no activities performed by the parties during the effective period of the Treaty shall create a basis for 'asserting, supporting or denying a claim to territorial sovereignty in Antarctica or create any rights of sovereignty in Antarctica.'"[341] Article VI provides that nothing in the treaty should "prejudice or […] effect the rights, or exercise of the rights, of any state may have

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[335] Deborah Waller, *"Death of a Treaty: The Decline and Fall of the Antarctic Minerals Convention" (1989)* 22:3 Vanderbilt Journal *of* Transnational Law 631*,* online: <https://scholarship.law.vanderbilt.edu/vjtl/vol22/iss3/4> at 638*.*

[336] Antarctic *supra* note 329 Art. I and V.1.

[337] *Ibid.* Art. II*.*

[338] *Ibid.* Art III*.*

[339] *Ibid.*

[340] *Ibid.*

[341] Waller, *"Death of a Treaty", supra* note 335. At 639.

under the international law [of] the high seas"[342] in the treaty area, defined as south of 60° S latitude. All "Contracting Parties"[343] have the right to access any area and inspect all installations, vessels, and aircraft in Antarctica.[344] Personnel are subject to their national laws in Article VIII.[345]

If disputes arise between parties, they are to consult among themselves to have the dispute resolved by "negotiation, inquiry, mediation, conciliation, arbitration, judicial settlement or any other peaceful means of their own choice."[346] If the issue is not resolved between the parties, with consent the parties may refer the matter to the International Court of Justice for settlement.[347]

The Antarctic Treaty contains no reference to the environment or natural resources, thus the parties reached a series of agreements: *Agreed Measures for the Conservation of Antarctica Flora and Fauna; The Convention for the Conservation of Antarctic Seal; Convention on the Conservation of Antarctic Marine Living Resources*, and of more interest to the topic of remediation, *Convention on Regulation of Antarctic Mineral Resources*, which will be reviewed in more detail below.

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[342] Antarctic*, supra* note 133 Art. VI.

[343] The signatories or others having significant scientific interests in Antarctica.

[344] Antarctic *, supra* note 133 Art. VII.

[345] *Ibid.* Art. VIII.

[346] *Ibid. Art XI Art. 1.*

[347] *Ibid.* Art. XI.

The 1988 Convention on Regulation of Antarctic Mineral Resources[348] is based on the following principles:

(1) The [Antarctic Consultative Parties] should continue to play an active and responsible role in dealing with the question of Antarctic resources.

(2) The protection of the unique Antarctic environment and its dependent ecosystems should be a basic consideration.

(3) The Antarctic Treaty must be maintained in its entirety.

(4) The interests of all humankind should not be prejudiced.

(5) The balance of interest embodied in Article IV of the Antarctic Treaty should not be endangered.[349]

In the Convention, mineral resources are defined as "all non-living natural non-renewable resources, including fossil fuels, metallic and non-metallic minerals",[350] and Antarctic mineral resources activities as "prospecting, exploration or development", but not scientific research activities.[351]

The Minerals Convention "is an integral part of the Antarctic Treaty system".[352] It requires that any mineral resource activities in Antarctica, should "take place in a manner

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[348] Tronchetti*, supra* note 328 at 804.

[349] Christopher C. Joyner, *"The Evolving Antarctic Minerals Regime"* 19:1 Ocean Development and International Law at 75.

[350] *Convention on the Regulation of Antarctic Mineral Resource Activities*, 27 ILM 859 (1988). Art. 1(6).

[351] *Ibid.* Art.1(7).

[352] *Ibid.* Art 2.1.

consistent with all the components of the Antarctic Treaty system and the obligations flowing therefrom."[353] Article 10 also provides that each party "shall ensure that Antarctic mineral resource activities take place in a manner consistent with compose of the Antarctic treaty system."[354] Article 3 is the keystone to the Convention, declaring "[n]o Antarctic mineral resource activity shall be conducted except in accordance with this Convention and measures in effect pursuant to it."[355] Article 4 provides that parties shall base all decisions concerning mineral resource activities on "information adequate to enable informed judgements to be made about their possible impacts and no such activities shall take place unless this information is available for decisions relevant to those activities."[356] Article 4.2 provides that no mineral resources activities shall take place until they are judged acceptable, based on an assessment that the activities were not caused or tend to cause "significant adverse effects" or "significant changes" in the Antarctic environment or its dependent or associated ecosystems.[357] Between these two articles, mineral resource activities are either not allowed, or if so, severely restricted based on the probable effects on the Antarctic environment.

Article 5 restricts the Convention to the "seabed and subsoil beyond the geographic extent of the continental shelf as the term continental shelf is defined in accordance with

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[353] *Ibid.* Art. 2.2.

[354] *Ibid.* Art. 10.1.

[355] *Ibid.* Art. 3.

[356] *Ibid.* Art. 4.1.

[357] *Ibid.* Art 4.2.

international law.[358] Article 6 seeks to encourage international participation in Antarctic mineral resource activities, particularly from developing countries.[359] The legal status quo in Antarctica is preserved in Article 9, which incorporates Article IV of the Antarctic Treaty.[360] Articles 11 and 12 are the inspection clauses of the Convention, with Article 12 adding to the inspection provisions of the Antarctic Treaty in Article 11, by setting forth inspection rights to "all stations, installations and equipment related to Antarctic mineral resources.[361] Article 13 prohibits activities in the "Specially Protected Area[s] or Site[s] of special Scientific Interest", established in Article IX(I) of the Antarctic Treaty.[362] Activities are also prohibited in areas that are designated " for historical, ecological, environmental, scientific or other reasons[363] "Finally, article 16 provides that 'to the greatest extent practical and feasible', data and information gathered during mineral resource activities should be made freely available."[364]

The Convention on the Regulation of Antarctic Mineral Resource Activities was signed by 33 states,[365] but due to pressure from international environmental organizations, notably Jacques Cousteau,[366] Australia and France withdrew their support and so the Convention

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[358] *Ibid.* Art. 5.3. This allows the Convention to comply with the terms of UNCLOS.

[359] *Ibid.* Art. 6.

[360] *Ibid.* Art. 9(a).

[361] *Waller, supra* note 335 at 649.

[362] Antarctic Mineral Resources *supra* note 333 Art. 13.1.

[363] *Ibid.* Art. 13.2.

[364] Waller, *supra* note 335 at 650.

[365] *Ibid.* at 631.

[366] *Ibid.* at 665.

was not ratified by the seven states with territorial claims to Antarctica.[367] The Convention is still not in force.

Three years later, the Protocol on Environmental Protection to the Antarctic Treaty[368] was negotiated and adopted. Antarctica is designated a natural reserve, devoted to peace and science.[369] The aim is to "limit adverse impacts on the Antarctic environment and dependent and associated ecosystems."[370] Adverse effects on climate or weather patterns; air or water quality; atmospheric, terrestrial, or glacial core marine environments; the distribution, abundance, or productivity of fauna and flora; or substantial risk to "areas of biological, scientific, historic, aesthetic, or wilderness significance"[371] are to be avoided.

Priority is given to scientific research activities, "to preserve Antarctica as an area for the conduct of such research".[372] "The Protocol supplements the Antarctic Treaty.[373] The core of the Protocol is found in Article 7, which simply states "*Any activity relating to mineral resources, other than scientific research, shall be prohibited."*[374] Any activities must have

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[367] *Ibid.* at 663.

[368] *Protocol on Environmental Protection of the Antarctic Treaty,* UKTS 1999 No 6; Cm 1960; ATS 1998 No 6; 30 ILM 1455 (1991) 1991.

[369] *Ibid.* Art. 2.

[370] *Ibid.* Art. 3.2(a).

[371] *Ibid.* Art. 3.2(b).

[372] *Ibid.* Art. 3.3.

[373] *Ibid.* Art. 4.1. Thus, existing land claims are protected.

[374] *Ibid.* Art.7. Emphasis added.

a prior environmental impact assessment before proceeding.[375] The Protocol is to be administered at Antarctic Consultative Meetings,[376] and have a Committee for Environmental Protection,[377] to advise the Consultative Meetings.

2.2.1.1 Coherence with the Sustainable Development Principles

Both the Antarctic Treaty and the Protocol are specific in preventing harm to the environment. The precautionary approach is evident in Article 4 of the Convention on Regulation of Antarctic Mineral Resources, but is absent from the Protocol. There is no evidence of common but differentiated responsibilities. Similar to the Outer Space Treaty and Moon Agreement, there is no mechanism for making a polluter pay. With an outright ban on exploitation of mineral resources in Antarctica, the question of sustainable development is evident: if there is no development, then sustainability is ensured.

2.2.2 World Charter for Nature

The World Charter for Nature[378] was proposed by the President of Zaire in 1975 as a non-binding statement on nature conservation[379] "by which all human conduct affecting nature is to be guided and judged."[380] The Charter was adopted by a vote of 111-1, with

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[375] *Ibid.* Art.8.1.

[376] *Ibid.* Art. 10.

[377] *Ibid.* Art. 11.

[378] Nature, *supra* note 134.

[379] Wolfgang E Burhenne & Will A Irwin, *The World Charter for Nature* (Berlin: Fund for Environmental Studies, 1983). at 14.

[380] *Ibid.*

the United States being the only dissenting voice.[381] The underlying idea of the Charter is that the "seas, the oceans, the upper atmosphere belong to the human community."[382] The principles of the Charter therefore can be considered relevant to space resources extraction because it is an alternative to the Sustainable Development Principles, which Kotze thinks are too anthropocentric.[383] They are therefore examined in turn.

The Charter contains three sections; I. General Principles, II. Functions and III. Implementation. Among the general principles are: "[n]ature shall be respected[,] and its essential processes shall not be impaired";[384] "[s]pecial protection shall be given to unique areas, to representative samples of all the different types of ecosystems and to the habitats of rare or endangered species";[385] "resources … shall be managed to achieve and maintain optimal sustainable productivity, but not in such a way as to endanger the integrity of those other ecosystems or species with which they coexist";[386] and "nature shall be secured against degradation caused by warfare or *other hostile activities"*.[387]

The Functions section lays out how nature may be used, indicating that "due account shall be taken of the fact that the conservation of nature is an integral part of those

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[381] *Ibid* at 16.

[382] *Ibid.* at 14.

[383] See Kotze, *supra* note 86.

[384] Nature, *supra* note 134 at 1.

[385] *Ibid.* at 3.

[386] *Ibid.* at 4.

[387] *Ibid.* at 5. Emphasis added. Space resources extraction, may be considered a hostile activity.

activities."[388] In particular, "n[]on-renewable resources which are consumed as they are used shall be exploited with restraint"[389] and "activities which are likely to cause irreversible damage to nature shall be avoided". Environmental impact assessments are important and "where potential adverse effects are not fully understood, the activities should not proceed" and activities "shall be planned and carried out so as to minimize potential adverse effects".[390] "Discharge of pollutants into natural systems shall be avoided".[391]

The Implementation articles of the Charter indicate that "[t]he status of natural processes, ecosystems and species shall be closely monitored to enable early detection of degradation or threat, ensure timely intervention and facilitate the evaluation of conservation policies and methods"[392] within the understanding of "the sovereignty of States over their natural resources"."[393]

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[388] *Ibid.* at 7.

[389] *Ibid.* at 10.

[390] *Ibid.* at 11. Mining usually results in irreversible damage, unless carefully planned from the beginning. Compare subsections (b) and (c) with terrestrial legislation details in chapters 3 and 4 following, and the draft guidelines under UNCLOS above.

[391] *Ibid.* at 12. This is now standard operating procedure for terrestrial mining operations.

[392] *Ibid.* at 19. Monitoring is an integral part of a good environmental program.

[393] *Ibid.* at 22. This statement mirrors the concept behind the *Trail Smelter* decision.

2.2.2.1 Coherence with the Sustainable Development Principles

Considering that the Charter was developed before the concept of sustainable development was published in the Brundtland report,[394] it would not be surprising if the sustainable development principles were not incorporated in the Charter. However, there are references to the concepts behind the principles throughout the Charter. The no harm principle, as previously pointed out,[395] is reflected in paragraph 22 of the Charter, at the same time recognizing a nation's sovereignty over its natural resources. Common but differentiated responsibilities can be seen in paragraph 16, with the establishment of ecosystem inventories and policies and activities designed specifically for the ecosystems.[396] The precautionary approach is reproduced in paragraph 11(c), where activities that may disturb nature shall only proceed after environmental impact assessments have been performed.[397] However, the Charter contains no provisions for requiring a polluter to pay for violating the Charter – not surprising for a non-binding document.

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[394] Brundtland *supra n*ote 70.

[395] *Ibid.*

[396] *Ibid.* at 16.

[397] *Ibid.* at 11(c).

2.2.3 The Artemis Accords

The Artemis Accords are a set of multinational agreements initiated by NASA, to govern the ongoing exploration of space and the use of its resources. To date, 28 countries have signed the Accords.[398]

The preamble to the Accords, states the importance of complying with the OST and other space treaties, though not the Moon Agreement [399] The purpose of the Accords is to provide "a common vision via a practical set of principles, guidelines and best practices to enhance the governance of the civil exploration and use of outer space".[400] The guidelines will result in increased safety and reduction of uncertainty, while promoting "the sustainable and beneficial use of space for all mankind".[401]

Sections 3 and 4, reiterate some of the wording of the OST, in that the Accords should be exclusively for peaceful purposes,[402] and that scientific information should be shared

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[398] Robert Lea, *"Artemis Accords: What are they & which countries are involved?",* (22 January 2023), online: <https://www.space.com/artemis-accords-explained>. Accessed August 21, 2023.

[399] Artemis *supra* note 135 at 1, online pdf: < https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf>

[400] *Ibid.* at 2. The use of the term 'civil' indicates that the signatories recognize that the future of outer space exploration will be with private companies partnered with national space programs, rather than solely with national space programs.

[401] *Ibid.* at 2. The beneficial use of space for all humankind refers to the principles in Article 1 of the OST.

[402] OST *supra* note 7. Art I.

freely.[403] Section 8 introduces, for the first time, the concept of preservation of outer space heritage.[404]

Section 10 is concerned with space resources. It is important, and can help to guide thinking about space mining, but not necessarily the post-mining phase:

> 1. The Signatories note that the utilization of space resources can benefit humankind by providing critical support for safe and sustainable operations. 2. The Signatories emphasize that the extraction and utilization of space resources, including any recovery from the surface or subsurface of the Moon, Mars, comets, or asteroids, should be executed in a manner that complies with the Outer Space Treaty and in support of safe and sustainable space activities. The Signatories affirm that the extraction of space resources does not inherently constitute national appropriation under Article II of the Outer Space Treaty, and that contracts and other legal instruments relating to space resources should be consistent with that Treaty.[…] 4. The Signatories intend to use their experience under the Accords to contribute to multilateral efforts to further develop international practices and rules applicable to the

[403] *Ibid.* Art. XI.

[404] Artemis s*upra,* note 135 at 4.

> extraction and utilization of space resources, including through ongoing efforts at the COPUOS.[405]

Recognizing that the exploration of the Moon and other celestial bodies, by numerous actors competing for the same resources, could lead to conflict, the Accords introduce the concept of safety zones.[406] This is understandable: safe working conditions are included in all terrestrial mining laws. The problem of one mining claim impinging on a contiguous claim has been a problem since the late 19th century with the gold and diamond rushes in North America and South Africa, and exists today with artisanal mining.

The Accords are somewhat aspirational, but are more like Dworkin's principles as they represent goals to be achieved,[407] not because they will advance "an economic, political or social situation",[408] but because they are a "requirement of justice and fairness or some other dimension of morality".[409] Some would argue that the Accords are US-centric.[410] The Accords do not include any reference to remediation, other than a commitment to "commit to limit, to the extent practicable, the generation of new, long-lived harmful debris released through normal operations."[411]

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[405] *Ibid.* at 4 & 5.

[406] *Ibid.* at 5.

[407] Ronald Dworkin, *Taking Rights Seriously*,(London, UK*:* Gerald Duckworth & Co. Ltd., 1977) at 22 .

[408] *Ibid.*

[409] *Ibid.*

[410] "*The Artemis Accords and the law: Is the Moon 'back in business'?"*, online: Public Interest Media <https://www.thebigq.org/2020/06/02/the-artemis-accords-and-the-law-is-the-moon-back-in-business/>.

[411] *Ibid.* Sec 12.2.

2.2.3.1 Coherence with Sustainable Development Principles

The no harm principle is included in the Accords in Section 11.3, where the signatories "commit to seek to refrain from any intentional actions that may create harmful interference with each other's use of outer space."[412] The precautionary principle is reflected in the mitigation of space debris. Reference to the principles of common but differentiated responsibility and polluter pays is absent from the Accords.

2.2.4 The Hague Building Blocks

The Hague Building Blocks are an outcome of the Hague Roundtable on the Governance of Space Mineral Resources, organized by The Hague Institute for Global Justice, as " a structured approach to the governance of space resources."[413] They are non-binding and are meant to be a thought experiment of sorts regarding how space mining might proceed in a logical and legal manner. It is therefore a helpful document when considering the potential framework which might guide the post-mining phase. The document consists of 19 "building blocks" covering, *inter alia*, "access to and rights over space resources, sharing of benefits from space resource activities and the establishment of safety zones around areas of extraction."[414]

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[412] Artemis*, supra* note 135 Sec 11.3.

[413] Benjamin, *supra* note 146 at 152.

[414] *Ibid.* at 155.

Space resources are defined in the document as "an extractable and/or recoverable resource *in situ* in outer space;"[415] and utilization of space resources as "the recovery of space resources and the extraction of raw mineral or volatile materials therefrom", excluding secondary utilization of space resources.[416] This definition distinguishes space resource extraction from appropriation of outer space as described in Article II of the Outer Space Treaty.[417] Building Block 2 also includes, as operators, "governmental, international or non-governmental entit[ies] conducting space resource activities.[418] Private operators are further covered, in that States are required to have regulations for the conduct of non-governmental entities (as an extension of the OST).[419]

Building Block 4 defines principles in a similar manner to the Outer Space Treaty, in that space resources are to be "used exclusively for peaceful purposes [and …] carried out for the benefit and in the interests of all countries and humankind irrespective of their degree of economic and scientific development."[420] Space resource activities "shall be undertaken in accordance with Article XI of the OST if there is a reason to believe that any potentially harmful interference may be caused".[421] This may prove difficult, as mining is an inherently dirty activity and, in an atmosphere lacking environment, travel on or disturbance of the

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[415] The Hague International Space Resources Governance Working Group., *supra* note 136. Sec 2.1

[416] *Ibid.* Sec 2.2.

[417] Benjamin*, supra* note 146.*;* See also OST *supra* note 7*.*

[418] The Hague International Space Resources Governance Working Group., *supra* note 136. Sec. 2.6*.*

[419] *Ibid.* Sec 3.1. & Sec 5.1.

[420] *Ibid.* Sec 4.3 (a) & (b).; See also *supra* note 7*.*

[421] *Ibid.* Sec 4.3 (c); See also *supra* note7*.*

surface may cause harmful interference. Finally, "international cooperation in space resources activities shall be conducted in accordance with international law."[422]

Building Block 6 links "free access to all areas of outer space with the need of space resource operators" for security of their interests.[423] The framework calls for the attribution of priority rights for *in situ* recovery of space resources.[424] Building Block 8 calls for all nations to recognize the rights to space resources and for "domestic legislation, bilateral and/or multilateral agreements, be signed to legally acquire products derived from space resource activities.[425]

A precautionary approach to the conduct of space resource activities is proposed in Building Block 10, to "avoid and mitigate potentially harmful impacts"[426] on the safety of persons, the environment of Earth and celestial bodies, and to cultural heritage sites or sites of scientific interest on celestial bodies.[427]

Remediation is the subject of Building Block 11, and therefore can help inform thinking on post-mining requirements:

> 11.1 The international framework should provide that States and international organizations shall require the conduct of a review prior to a decision to proceed

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[422] *Ibid.* Sec 4.3 (d); See also *supra* note 7.

[423] Benjamin et al*, supra* note 146 at p. 162.

[424] The Hague International Space Resources Governance Working Group., *supra* note 135. Sec 7.

[425] *Ibid.* Sec 8.1.

[426] *Ibid.* Sec 10.

[427] *Ibid.* Sec 10 (a) to (i).

> with a space resource activity to ascertain that such an activity is carried out in a safe manner to avoid harmful impacts. 11.2 The international framework should encourage the development of: a) Procedures to ensure that equipment, operational procedures, and processes applied in space resource activities avoid harmful impacts; b) Methodologies to assess that equipment, operational procedures, and processes applied in space resource activities meet common technical standards (conformity assessment); c) Technical standards for equipment, operational procedures, and processes applied in space resource activities (standardization)[428]

Furthermore, the Building Blocks call for the establishment of safety zones, similar to the Artemis Accords,[429] to assure safety and avoid harmful interference with space resource activities:

> 11.3 Taking into account the principle of non-appropriation under Article II OST, the international framework should permit States and international organizations responsible for space resource activities to establish a safety zone, or other area-based safety measures, around an area identified for a space resource activity as necessary to assure safety and to avoid any harmful interference with that space resource activity. Such safety measure shall not impede the free access, in accordance with international

[428] *Ibid.* Sec 11.

[429] See Artemis Accords *supra* note 134. Sec 11.

> law, to any area of outer space by personnel, vehicles and equipment of another operator. In accordance with the area-based safety measure, a State or international organization may restrict access for a limited period of time, provided that timely public notice has been given setting out the reasons for such restriction. 11.4 The international framework should provide that appropriate international consultations are undertaken in case of possible overlap of safety zones or conflicts involving the freedom of access recognized by international law.[430]

The monitoring of any harmful impacts resulting from space resource activities are the subject of Building Block 12.[431] Any harmful impact that might occur, or is reasonably expected to occur, is the responsibility of the country responsible for the space resource activity.[432] It is assumed that, in the case of a private actor carrying out the space resource activity, the country that registered the launching of the spacecraft would be liable for the actions of the private actor.

The sharing of benefits is the focus of Building Block 13, which can also help to inform thinking about post-mining remediation:

> the international framework should provide that States and international organizations responsible for space resource activities shall provide for

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[430] Hague BB*., supra* note 136 Sec 11.

[431] *Ibid.* Sec 12.1.

[432] *Ibid.* Sec 12.2. See Chapter 5, for a discussion of monitoring space resource activity, specifically the rehabilitation.

> benefit-sharing through the promotion of the participation in space resource activities by all countries, in particular developing countries. Benefits may include, but not be limited to, enabling, facilitating, promoting, and fostering: a) The development of space science and technology and of its applications; b) The development of relevant and appropriate capabilities in interested States; c) Cooperation and contribution in education and training; d) Access to and exchange of information; e) Incentivization of joint ventures; f) The exchange of expertise and technology among States on a mutually acceptable basis; g) The establishment of an international fund. [433]

The balance of the Building Blocks reflect Articles of the OST, such as the provision of assistance in case of distress; [434]liability for damage resulting from space resources activities;[435] visits relating to space resource activities;[436] and the peaceful settlement of disputes arising from space resource activities through consultation and arbitration.[437]

Because the OST fails to address space resource activities, the Hague Building Blocks help to provide the idea of what a comprehensive framework to enable a space resource activities environment might look like: the idea behind the Building Blocks is to enhance

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[433] *Ibid.* sec 13.1.

[434] *Ibid.* sec 15.*;* See Rescue, *supra* note 8 Art V.

[435] *Ibid.* sec 16.; See also Liability, s*upra* note 9. Art VI and VII

[436] *Ibid.* sec 17*;* See also Moon *supra* note 11 Art XII.

[437] *Ibid.* sec 18.

cooperation, provide legal certainty, and provide the predictability that private companies involved in space resource activities have been searching for. The Building Blocks also provide – in principle, as they are non-binding and a civil society initiative - for the protection and preservation of the space environment.

2.2.4.1 Coherence with Sustainable Development Principles

The no harm principle is demonstrated in Block 11.1, requiring that countries conduct a review prior to a decision to proceed with a space resource activity, to ascertain that such an activity is carried out in a safe manner to avoid harmful impacts.[438] Block 11.2 also identifies procedures to "avoid harmful impacts".[439] As discussed previously, the precautionary approach is the basis of Block 10. Reference to the principles of common but differentiated responsibility and polluter pays are absent from the Hague Building Blocks.

2.3 Conclusions

While some of the document studied provide potential frameworks (or parts of frameworks) for the mining of space resources, none provide clear direction for post-space resource extraction remediation. The Outer Space Treaty provides the basic regulations for operating in outer space, but does not mention natural resources. The Moon Agreement specifically mentions natural resources and in Article 11.5 establishes

[438] *Ibid.* sec 11.1.

[439] *Ibid.* sec 11.2.

an "international regime,[…] to govern the exploitation of the natural resources of the Moon, as such exploitation is about to become feasible",[440] but does not consider the remediation once such exploitation is complete. UNCLOS anticipates the exploitation of mineral resources and establishes the International Seabed Authority to govern the exploitation of natural resources in international waters.[441] The Authority has issued draft regulations on the exploitation of mineral resources in the Area,[442] which lays out the regulations for exploiting natural resources, such as the disposal of waste into the water column,[443] but is silent on remediation of the concessions after exploitation is complete. Similarly, the Antarctic Treaty, the World Charter of Nature, and the Artemis Accords do not mention remediation.

All the documents refer to the need to prevent harm,[444] signalling that such an approach is also a requirement of post-mining remediation in space.

The common but differentiated responsibility principle is only covered by the UNCLOS draft regulations regarding the deep seabed and therefore this approach is likely not a requirement of space mining remediation. The precautionary approach is contained in UNCLOS and the draft regulations, but is reflected in space law on space debris mitigation (as seen in the Artemis Accords), and therefore would also likely be a required

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[440] Moon, *supra* note 11

[441] UNCLOS, *supra* note 20 Art. 137.1(b).

[442] Draft Regulations on exploitation of mineral resources in the Area, ISBA/25/C/\WP1 2019.

[443] UNCLOS*, supra* note 20 Art. 150(b).

[444] Stemming from Trail, *supra* note 56.

consideration for regulation of post-mining remediation in space. None of the frameworks contain any reference to making the polluter pay, though this is also part of liability under the OST. As well, the deep seabed draft regulations allow the Authority to cancel contracts if terms are violated: if a contract was cancelled because the contractor polluted the marine environment, the opportunity loss cost of cancellation could be considered a penalty on the polluter. Thus, polluter pays should also be considered when thinking of a remediation framework in space mining.

Having reviewed the international frameworks, the Australian and Canadian mining legislations will be reviewed and evaluated against the sustainable development principles in the following two chapters, to determine whether they also provide helpful guidance for an approach to remediation.

Chapter 3. Terrestrial Mining Legislation in Australia

International treaties regarding space and areas of the Earth that fall outside of national jurisdiction do not adequately cover the rehabilitation of space resources extraction sites. However, there is domestic legislation covering terrestrial mining and post-mining treatment which can provide some helpful direction for a framework for space related space resources extraction rehabilitation. Both Australia and Canada are leaders in the field of mining, with a large number of mining companies and significant domestic mining activity. Mining legislation in both countries addresses the full range of the life cycle of mines – from the initial granting of licences for prospecting, exploration and exploitation of mineral deposits, to the closures of mines. This chapter, and Chapter 4, consider those portions of the relevant Acts dealing with one specific point in that life cycle: rehabilitation or remediation and the accompanying financial surety. This chapter, which focuses on Australian mining laws, aims to highlight legal lessons learned from the Australian experience with respect to the remediation or rehabilitation of mining sites.

Australian laws require that, to obtain the necessary licences or permits to develop a mineral reserve, plans for the eventual closing and remediation of the mining site must be submitted to the appropriate body for approval and updated on a regular basis whenever there is a change to the mining plan. The licencing authority monitors the progress of remediation against the plan and has the power to impose penalties for deviation from the plan. Financial contributions by the project proponents to a Mining Reclamation treatment Fund are also required, to ensure that the state governments are not left holding the bag if the operator is financially unable to complete the remediation

task(s). This chapter argues that these legal commonalities in Australia provide helpful precedent for the formation of a framework for space resources extraction remediation. This chapter will therefore begin with an overview of Australia's legislative framework on mining, and then will review, state-by-state, the legislation pertaining to post-mining treatment in Australia, particularly binding regulations, as well as non-binding but persuasive guidelines. It proceeds state-by-state because mining regulation is a state and not federal matter. The chapter concludes by drawing out key aspects of the Australian legal framework that will be useful when considering the space resources extraction context.

3.1 Australia's Legislative Framework on Mining

Australia is a federal constitutional monarchy under a parliamentary democracy.[445] Title to minerals is vested in the state or territory where they are found.[446] "Given Australia's fragmented regulatory requirements[…] there have been few efforts to standardise mineral laws among states; however, since there are common features across the board, the country has a relatively uniform legal approach to mining."[447] This means that rehabilitation or remediation is addressed slightly differently across states, but there are similarities that can provide direction for space resources extraction sites. This will

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[445] Herbert Smith Freehills LLP-Geoff Kerrigan & Jay Leary*, "Spotlight: Mining law in Australia", (*11 October 2022), online: Lexology <https://www.lexology.com/library/detail.aspx?g=16760842-eb43-47ef-8f6a-41eb94dfd182>*.*

[446] *Ibid.*

[447] OECD, *"Mining Regulation in Australia", (2 February 2022),* online: <https://www.oecd-ilibrary.org/governance/regulatory-governance-in-the-mining-sector-in-brazil_63d60aa8-en>*.*

become apparent in the state-by-state descriptions below. To overcome the different regulation across states, the Australian government has also issued a number of handbooks detailing best practices for the mining industry. One of these documents, *Mine Rehabilitation, Leading Practice Sustainable Development Program for the Mining Industry* (Handbook),[448] outlines the importance of rehabilitation, establishment of objectives, targets, and success criteria, planning, integrating and implementing rehabilitation plans and monitoring and reporting mine-site rehabilitation performance. These guidelines have been very influential within the Australian mining community.

The Handbook adopts the following definition of rehabilitation: "rehabilitation comprises the design and construction of landforms as well as the establishment of sustainable ecosystems or alternate vegetation, depending upon desired post-operational land use," with the objective of ensuring "the long-term stability of the landforms, soils and hydrology, full or partial repair of the ecosystem and prevention of pollution of the surrounding environment."[449] While rehabilitation is expected to be progressive,[450] closure of the mine site provides the opportunity to fully rehabilitate the disturbed land to its post-mining use.[451] To secure a successful rehabilitation of the mine-site, careful planning and implementation is required. Targets and objectives need to be set and all

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[448] See Australian Government, *"Mine Rehabilitation, Leading Practice Sustainable Development Program for the Mining Industry"* online:2016 Australian Government www.industry.gov.au.

[449] *Ibid.* at 3.

[450] Progressive rehabilitation is where the rehabilitation of the mine-site is carried out concurrently with the mining operations.

[451] Australian Government*, supra* note 448 at 4*.*

stakeholders must be involved.[452] The Handbook also indicates that planning of rehabilitation should begin early in the mining cycle, with environmental baselines being set during the exploration stages, and final landforms for the mine-site rehabilitation established with the first mining plans.[453] The creation of a test site or analog should be part of the planning cycle so that there is a clear benchmark for the final rehabilitation of the mine-site.[454] The wastes generated should be characterized, to identify high-risk material requiring special handing or storage. This characterization can lead to the final landform,[455] with more competent waste being used for final stability.[456] The Handbook's approach is consistent with the sustainable development of common but differentiated responsibility.

In the view of the Australian government, the objective of rehabilitation, "is for the rehabilitated area to be self-sustaining and resilient and to require no more management effort than the surrounding undisturbed areas."[457] Consequently, the rehabilitation plan needs clear objectives, performance indicators and completion criteria to be established, which can be measured against realistic site-specific goals. When the actual

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[452] *Ibid.* at 7.

[453] *Ibid.*

[454] *Ibid.*

[455] Some Australian legislation follows the sustainable development principle of common but different responsibilities in the required remediation approaches, dependent on the final land use of the remediated site. See, for example, the Victoria mining guidelines (section 3.1.7 (c)) ; Victoria State Government, 2020 infra note 645.

[456] *Ibid.* at 17. Competent waste is the larger sized pieces of rock, removed in the mining process, that may be used to construct walls, roads and dams as part of the site infrastructure.

[457] *Ibid.* at 42.

measurements of the rehabilitation process are found to be outside the prescribed range of the criteria established in the rehabilitation plan, the rehabilitation management should be adjusted to bring the measurements back into the acceptable range.[458] All of this requires closure planning to start *before* (not after) mining begins and monitored throughout the mining cycle.[459] These guidelines have been adopted by the Australian states and are used where the states do not have their own specific guidelines.

3.1.1 New South Wales

The state of New South Wales (NSW) has a long history of mining, dating from the late 18th century with the discovery of coal. Over the past two centuries, there have been many abandoned mines, which have degraded the environment.[460] Mining rehabilitation is therefore a key issue in mining management in NSW.

Mining rehabilitation is minimally addressed through regulations in NSW, and those regulations stem from the *Mining Act of NSW 1992*.[461] Rehabilitation is also subject to governance through Guidelines, which direct the preparation of rehabilitation objectives and completion criteria. The next sub-section will explain the content and application of those regulations, while the following subsection will explain the role of the Guidelines in mining rehabilitation.

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[458] *Ibid.* at 6.

[459] *Ibid. at 5.* Emphasis added.

[460] "Mining History - NSW Mining", online: <https://www.nswmining.com.au/mining-history>.

[461] *Mining Act of NSW 1992 No 29* (NSW Mining Act).

3.1.1 (a) Legislation

The objectives of *The Mining Act* of NSW 1992 are:

> [T]o encourage and facilitate the discovery and development of mineral resources in New South Wales, having regard to the need *to encourage ecologically sustainable development*, and in particular … (e*) to require the payment of security to provide for the rehabilitation of mine sites, and (f) to ensure effective rehabilitation of disturbed land and water*,[462] and (g) to ensure mineral resources are identified and developed in ways that minimise impacts on the environment.[463]

Reclamation or rehabilitation is defined in the Act as: "the treatment or management of disturbed land or water for the purpose of establishing a safe and stable environment,"[464] and is treated under Part 11, Division 3 Environmental, rehabilitation and other directions.

Under the *Mining Act*, the Minister has powers to direct the owner to do certain things, such as: rehabilitate the "land on which prospecting or mining operations have been carried out;"[465] rehabilitate the land at the holder's cost;[466] and recover the costs from the

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[462] Emphasis added.

[463] NSW Mining Act*, supra* note 461. The objective thus firmly embeds the concept of sustainable development in the Act.

[464] *Ibid,* Schedule 7*.*

[465] *Ibid.* Sec 172 (2j).

[466] *Ibid.* sec 241.

holder, if they fail to carry out the rehabilitation and the state carries out the work.[467] The Minister may also declare any land that had been used for prospecting or mining operation and has been abandoned, as derelict.[468] The *Mining Act* establishes a "Derelict Mine Sites Fund" that may be used to cover the costs of rehabilitation of a derelict mine site.[469] The funds for the Fund come from: "(a) the balance of any money received from the sale of mining plant under section 246 after all deductions have been made in accordance with that section, and (b) the proceeds of investment of money in the Fund, and (c) money obtained under a security deposit that is payable into the Fund".[470] The conditions for a security deposit seem to be discretionary at the will of a decision maker.[471]

3.1.1.(b) Regulations

The *New South Wales Mining Regulations 2016* contain little reference to rehabilitation, other than the need for a statement of corporate compliance, environmental performance and financial capability, when applying for transfer of authorities.[472] Under the regulations, a work program is required when applying for an authority or tender, which includes

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[467] *Ibid.* Sec 242.

[468] *Ibid.* Sec 242A.

[469] *Ibid.* Sec 242A (1).

[470] *Ibid.* Sec 242C (3).

[471] Author's opinion.

[472] *Mining Regulation 2016* (NSW Legislation).

> (a)[…] the nature and extent of operations to be carried out under the authority, and(b) set out commitments relating to the conduct of the operations, including the timing of the operations, and(c) provide for the carrying out of activities, including community consultation and environmental management and rehabilitation, in connection with, or ancillary to, the operations.[473]

In other words, when applying for a permit to mine, a plan covering all aspects of the operations, including environmental and rehabilitation must be submitted at the start of the permitting process.

The *New South Wales Mining Regulations 2016* were amended in 2021 to include more rehabilitation-related regulations.[474] In particular, the amendments obligate the holder of a mining lease to prevent or minimize any harm to the environment and to rehabilitate any disturbance to land or water by mining activities, as soon as "reasonably practical after the disturbance occurs."[475] Additionally, the holder of a mining lease must prepare a rehabilitation risk assessment[476] that: "(a) identifies, assesses and evaluates the risks that need to be addressed to achieve the following in relation to the mining lease—(i) the rehabilitation objectives, (ii) the rehabilitation completion criteria".[477] From this risk

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[473] *Ibid.* Sec 35(1).

[474] *S*ee *Mining Amendment (Standard Conditions of Mining Leases—Rehabilitation)* Regulation (NSW) 2021.

[475] *Ibid.* Sec 5. De facto progressive rehabilitation.

[476] *Ibid.* Sec 7.

[477] *Ibid.*

assessment, the holder must prepare a rehabilitation management plan, which must be followed.[478] The balance of the regulations cover the reporting of the progress of the rehabilitation.

3.1.1(c) Guidelines

The New South Wales Resources regulator has issued a number of documents regarding rehabilitation. The most relevant of these is *Rehabilitation Objectives and Rehabilitation Completion Criteria.*[479] This document is designed to help a mining lease operator to prepare a rehabilitation objective and completion criteria statement, and a rehabilitation management plan, and to implement said plan.[480] The requirement for a lease operator to prepare the objectives and criteria is the development of rehabilitation outcomes as part of the development application stage under the *Environment Planning and Assessment Act 1979,* to ensure the outcomes are consistent with the final land use for the mining area.

The lease holder is required to rehabilitate, as soon as practically possible after the land disturbance occurs.[481] Final rehabilitation completion criteria must be submitted for approval at least three years prior to when the rehabilitation is proposed to be

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[478] *Ibid.* Sec 10 (4).

[479] NSW Resources Regulator, *"Rehabilitation Objectives and Rehabilitation Completion Criteria" (2021),* online: < https://www.resourcesregulator.nsw.gov.au/>.

[480] *Ibid.* at 4.

[481] NSW Legislation*, supra* note 472 Clause 5 schedule 8.

completed.[482] The final land use and mining domains need to be included in the rehabilitation objectives and completion criteria.[483] Progressive rehabilitation is encouraged by a partial release of the security deposit if successful rehabilitation is demonstrated.[484]

NSW has also developed guidelines for a Mining Operations Plan (MOP),[485] that performs the purpose of a rehabilitation plan and a mine closure plan, as well as being the basis for estimating the security deposit required under the Act.[486] The MOP is coordinated with the *Environmental and Planning Act 1997* Section 23[487]. The MOP is submitted to the NSW government for approval. It bears similarity to the Canadian National Instrument 43-101, required for mining companies when raising funds on the stock market.

The MOP divides the mine sites into domains or land management units and further categorises the domains into primary and secondary domains based on the post-mining land use.[488] Each domain is then assigned a final rehabilitation objective, that describes the "environmental, social and economic outcomes required to achieve the post-mining land use goal" for the domain.[489] The rehabilitation plan describes the activities that will

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[482] *Ibid.* Clause 15(3) Schedule 8A.

[483] NSW Resources Regulator, *supra* note 479.

[484] NSW Mining *supra* note 463.

[485] *ESG3: Mining Operations Plan (MOP) Guidelines,* by Trade & Investment NSW, (2013).

[486] *Ibid.*

[487] The Environmental Planning and Assessment Act 1997 is outside of the scope of this thesis.

[488] *Ibid.*

[489] *Ibid.*

be implemented on a domain by domain basis, to achieve the rehabilitation outcomes.[490] As the rehabilitation objectives are reached and the domain becomes self-sustaining, the security deposit is returned and the area is monitored.[491]

3.1.1.(d) Coherence with Sustainable Development Principles

The Mining Regulations' obligation that the holder of a mining lease prevent or minimize any harm to the environment[492] demonstrates that the no harm principle is embedded in the NSW mining laws. The *Rehabilitation Objectives and Rehabilitation Completion Criteria* require that the mining lease operator prepare a rehabilitation objective and completion criteria,[493] and Mining Operations Plan,[494] categorizing the site into domains. This is evidence of the common but differentiated responsibilities principle. There is no mention of the precautionary approach in any of the documents, so this principle appears to be absent. The requirement of payment of a levy to the Mining Remediation Fund[495] reflects the polluter pays principles. In sum, the NSW mining laws on rehabilitation reflect some, but not all, of the sustainable development principles.

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[490] *Ibid.*

[491] *Ibid.*

[492] NSW Legislation. *supra* note 472 21(b)(ii).

[493] NSW Resources Regulator. *supra* note 479.

[494] ESG3 *supra* note 485.

[495] NSW Mining *supra* note 461.

3.1.2 Northern Territory

The Northern Territory has been a world supplier of uranium over the latter half of the 20th century,[496] leaving behind many abandoned mines that have not been remediated to today's standards.[497] To address the mining industry's ongoing effects on the environment, *The Mining Management Act 2001* addresses the protection of the environment, with regulations governing the levying of fees to cover the costs of rehabilitation of the legacy mines. This section details the legislation and its associated regulations.

3.1.2 (a) Legislation

The Mining Management Act 2001(NT), 2020 provides "for the authorisation of mining activities, the management of mining sites, the protection of the environment on mining sites, the provision of economic benefits to communities affected by mining activities, and for related purposes."[498] The environment is protected by requiring a mine operator to establish and maintain a management system for the site as well as implementing audits, inspections, and other similar methods, to ensure compliance with agreed standards and criteria.[499] All persons on a mining site are obligated to respect and protect the

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[496] Northern Territory Government*, "Uranium", (1 June 2023),* online: Resourcing the Territory <https://resourcingtheterritory.nt.gov.au/minerals/mineral-commodities/uranium>.

[497] Northern Territory Government*, "Legacy mines", (30 June 2023),* online: NTGOVAU <https://nt.gov.au/industry/mining/legacy-mines-remediation/legacy-mines> .

[498] *The Mining Management Act 2001(NT), 2020,* preamble. (NT mining).

[499] *Ibid.* Part 1 3(b) (iii) & (iv.).

environment.[500] The mining industry introduced programs of continuous improvement to achieve best practice environmental management as one of its objects.[501] To minimize the liability of the Territory, a security payment for rehabilitation of mining sites and associated environmental harm rectification is required of the holder of an exploration or mining title,[502] as well as payment of a levy to provide funds for: "(i) a Mining Remediation Fund: and (ii) the effective administration of this Act in relation to minimising or rectifying environment harm caused by mining activities."[503]

The definition of environmental harm in the Act is any adverse effect or potential harm.[504] An environmental incident occurs when the environmental harm is caused on a mining site. Serious harm occurs when the cost of remediation exceeds A$50,000,[505] and includes all harm caused by any part of the mining cycle, including decommissioning or rehabilitation of a mining site.[506] The legislation includes all aspects of the mining cycle,

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[500] *Ibid.* Sec. 3(b)(v).

[501] *Ibid.* Sec 3(c).

[502] *Ibid.* Sec 33(e)

[503] *Ibid*. Sec 3(f); The levy may act as a disincentive for an operator to protect the environment. Defining environmental harm in monetary terms instead of the outcomes of the harm, may result in an increase in the environmental harm, as operators could discharge several small effluxes below the monetary threshold instead of an equivalent single discharge that would be considered serious.

[504] *Ibid.* Sec. 4.

[505] *Ibid.* It is interesting that environmental harm is defined in the terms of the cost to remedy. Given the cost of environmental protection equipment or rehabilitation, nearly every case of environmental harm will be considered to be material environmental harm.

[506] *Ibid.* This is a little bit of double jeopardy, as the incident may be less than the threshold, but exceeds the threshold because of the cost of rehabilitation. The cost of rehabilitation will most certainly exceed A$50,000. Barrick Gold recently announced that it will cost $136 million to close its failed Pascau-Lana gold and silver project, which did not make it to the production phase ."Barrick to spend $136 million on failed Pascua-Lama project", (31 January 2024), online: MININGCOM <https://www.mining.com/barrick-to-spend-136-million-in-failed-pascua-lama-project/>.

including decommissioning or rehabilitation of a mining site,[507] and liability for contravention of the Act rests with the owner, the one who holds the mining title with respect of the site, even if the owner is not the operator.[508] Part 3 of the Act specifies actions that must be taken to protect the environment, with a general obligation that "every person on a mining site has an obligation to take care of the environment."[509] The workers are specifically obligated to report the occurrence of an environmental incident or serious environmental incident.[510]

The level of penalty for violation of the Act depends on whether the incident results in material or serious environmental harm or nuisance and the degree of negligence.[511]

An Authorisation to carry out mining activities is only required if there is substantial disturbance of the mining site.[512] Nearly every aspect of the mining cycle is included in the list of activities that constitute a substantial disturbance, from land clearing to extracting resources from the land,[513] resulting in an Authorisation being required for any activity related to exploration and exploitation.

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[507] *Ibid.*

[508] *Ibid* .Sec 10(6*).*

[509] *Ibid*. Sec 13*.*

[510] *Ibid.;* Cf The Health and Safety Act R.S.O 1990 cO.1 Sec28 (1)(c), under which a worker must report defective or missing protective equipment.

[511] *Ibid.* Sec 26, 26A, 27, 27A, 28 and 28A*.*

[512] *Ibid.* Sec35 (*1).*

[513] *Ibid.* Sec 35(3).

The Minister may impose conditions on the Authorisation holder to protect the environment,[514] "provide social and economic benefits to communities outside the mining site and make public a periodic environmental report."[515] The environmental report describes the "operator's environmental performance in carrying out activities for mining minerals".[516] Also required, to obtain an authorization, the owner must provide a plan of activities involved in the closure of the mine along with the associated costs.[517]

An operator in the Northern Territory, except for the Ranger Uranium project,[518] must supply the Minister with security,[519] for the purpose of ensuring the operator complies with the Authorisation,[520] covering the costs in relation of any action taken by the Minister to "prevent, minimise or rectify environmental harm caused by mining activities,"[521] and costs and expenses should the Minister have to complete the rehabilitation of the mining site.[522]

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[514] *See* NT Mining, Sec 37(3)(a*).*

[515] See NT Mining, Sec 37(3) (c) & (e).

[516] *See* NT Mining , Sec 37(4).

[517] See NT Mining, Sec 40 (g).

[518] The Ranger mine is a depleted uranium mine that is situated in the Kakadu National Park and is administered by the Australian federal government.

[519] See NT Mining, Sec 42A & Sec 43(1).

[520] *Ibid.* Sec 43(2) (a).

[521] *Ibid.* Sec 43(2) (b).

[522] *Ibid.* Sec 43(2) (c).

A Mining Remediation Fund[523] is established under the *Financial Management Act* and is included in Sec 46A of *The Mining Management Act 2001*(NT), 2020.[524] The Fund is financed by a levy or tax on the mining activities at a rate of 1% of the security provided by the operator.[525] The purpose of the Fund, is to "hold money in trust to be used by the Agency in connection with minimizing or rectifying environmental harm caused by unsecured mining activities".[526] At least 33% of the levy paid by the operator must be paid into the Fund, for the purposes of "(a) identifying environmental harm caused by unsecured mining activities, (b) assessing the risk of the harm, (c) scientific studies and investigation of the harm, (d) preparation of remediation plans and (e) carrying out remediation."[527] Finally, a Mining Board is established,[528] to advise the Minister on best practices in mining activities and consistency of legislation inside and outside Australia.[529]

3.1.2 (b) Regulations

The Northern Territories *Mining Management Regulations 2001*, deal mainly with infringements of the *Mining Management Act* and the associated levies.[530] The

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[523] *Ibid.* Sec 46A.

[524] *Ibid.* Sec 46A(1).

[525] *Ibid.* Sec 44A(2) & 44B (1).0

[526] *Ibid.* Sec 46B(1), an unsecured mining activity is one where there is no financial 0security, or the security is insufficient to complete the rehabilitation.

[527] *Ibid.* Sec 46D.

[528] *Ibid.* Sec 49.

[529] *Ibid.*

[530] See *Mining Management Regulations 2001(NT).*

environment is briefly mentioned, in that the Regulations require the operator of a mining site to supply information regarding compliance with environmental obligations, but only as they apply to workers' health and safety, and any environmental incidents that occur.[531]

3.1.2 (c) Guidelines

The Northern Territories have no guidelines specific to mine rehabilitation but rely on the Australian guidelines described in the Handbook (*Mine Rehabilitation, Leading Practice Sustainable Development Program*).[532]

3.1.2 (d) Coherence with Sustainable Development Principles

Section 13 of the Act obligates every person to take care of the environment,[533] thus demonstrating that the no harm principle is embedded in the Northern Territory mining laws. The Ranger mine in the Northern Territory, which is carved out of the environmental regulations, which dictate that the Ranger mine must not "impact upon the values, attributes and ecosystem health of the Kakadu National Park",[534] is evidence of the common but differentiated responsibilities principle. This is because the responsibility lies with the federal government. There is no mention of the precautionary approach in any of the documents, thus steps such as progressive remediation are not required, so this

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[531] *Ibid.* Sec 3(a) & (b).

[532] See Australian Government, *supra* note 448.

[533] NT Mining. *Supra* note 498.

[534] *Aboriginal Land Rights (Northern Territory) Act 1976.* Appendix C.

principle appears to be absent. The requirement of a security payment to the Mining Remediation Fund,[535] shows that the Act follows the polluter pays principle.

3.1.3 Queensland

Like the Northern Territory, Queensland has a number of legacy mines resulting from a booming mining industry that dates from the late 19th century.[536] Because of abandoned mines, tailings ponds and unremediated open pit mines, the environment of Queensland has suffered from the mining industry.[537] *The Mineral Resources Act 1989* attempts to balance the expansion of the mining industry with the need to protect the environment, as reviewed in the next sub-section, with the regulations and guidelines following.

3.1.3(a) Legislation

To prevent the continuance of the negative mining environmental legacy, among the various objectives of *The Mineral Resources Act 1989* are the goals of minimising land use conflict with respect to prospecting, exploring, and mining,[538] encouraging environmental responsibility in prospecting and mining,[539] and responsible land care management.[540]

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[535] Mining Management Regulations*, supra,* note 530*.*

[536] Resources Safety and Health Queensland, "Mining legislation, standards and guidelines", (26 February 2015), online: <https://www.business.qld.gov.au/industries/mining-energy-water/resources/safety-health/mining/legislation-standards>. Coal, Gold, tin, copper, and uranium are among the metals that have been mined in Queensland.

[537] *Ibid.*

[538] *Mineral Resources Act 1989,(QL),* Sec 2(c) (Queens Mining.)

[539] *Ibid.* Sec 2(d).

[540] *Ibid.* Sec 2(g*).*

Within the objectives, the "Act does not create an estate in land and the grant of a mining tenement does not create an estate or interest in the land,"[541] leaving the ownership of the land and minerals vested in the Crown.

To allow the prospecting, exploration and development of a potential mining property, a permit is required. The Act establishes three types of permits: a prospecting permit, an exploration permit, and a mineral development licence. A prospecting permit requires that the applicant deposit a security to ensure "compliance with the conditions of the permit and the Act and to rectify any actual damage that may be caused by any person whilst purporting to act under the authority of the permit […]".[542] The amount of the security is set by the chief executive.[543]

Under section 83, security is also required before a mining claim is granted or renewed, with

> [T]he Minister taking into consideration the work program mentioned in section 61(1)(j)(iv), shall determine the amount of the security to be deposited by the holder of that mining claim as reasonable security for(a) compliance with the conditions of the mining claim; and (b) compliance with the provisions of this Act; and (c) rectification of any actual damage that may be caused by any person whilst purporting to act under the authority of the mining claim to pre-existing

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[541] *Ibid.* Sec 10. This phrase relates to ownership in minerals and is explained and discussed in Chapter 5.

[542] *Ibid.* Sec 26(1*).*

[543] *Ibid.* Sec 26(2*).*

> improvements for the mining claim; and (d) amounts (other than penalties) payable to the State under this Act.[544]

This means that financial surety must be posted before mining starts. This is good practice, as rehabilitation is planned before any construction starts (as anticipated by the Handbook), and lends itself to progressive rehabilitation.

Similarly, before an exploration permit is granted, renewed, or amended, the Minister must determine the security to be deposited, using the same criteria as laid out in section 83 above.[545] The same criteria are also applied to the granting, renewal, or amendment of a mineral development licence,[546] or a mining lease.[547] The form of security is determined by the Minister and may take the form of a

> bond or a guarantee or indemnity by, or other financial arrangement with, a financial institution, insurance company or other credit provider approved by the Minister or other form of security acceptable to the Minister has the whole of part of the security to be deposited under this section.[548]

The deposited security may be used to recover unpaid royalties from mining operation.[549] Thus, from the very start of the mining cycle, i.e. prospecting, the project proponent must

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[544] *Ibid.* Sec 83.

[545] *Ibid.* Sec 144.

[546] *Ibid. Sec 190.*

[547] *Ibid.* Sec 277.

[548] *Ibid.* Sec 190(5*).*

[549] *Ibid.* Sec 324.

provide financial surety to ensure their compliance with the environmental provisions of the Act. The purpose of collecting a security from the applicant for a permit or licence is to ensure that remediation of the exploratory or mine site takes place, and that the state is not left with a financial obligation to remediate the site when the operator has insufficient funds to complete the work.

When mining or exploration activities have ceased and there is no current mining claim or lease granted and no environmental authority in force, the mine site is considered to be abandoned.[550] If an abandoned mining site is subject to a progressive rehabilitation and closure schedule, the site is considered to be a final rehabilitation site and is treated differently from an abandoned mine site.[551]

An abandoned mine site may be remediated[552]. Remediation activity is composed of four parts; investigation; making the site safe; mitigating the pollution; and managing the mitigation.[553] The investigation stage requires investigating the condition of the abandoned mine site.[554] Following the investigation stage, the site must be made safe, starting with structures and equipment;[555] then capping and making safe the mine shaft or the open pit.[556] Furthermore, the mine shaft must be maintained, as must the site of

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[550] *Ibid.* Sec 344.

[551] *Ibid.*

[552] *Ibid.* An abandoned mine is one for which there is no environmental authority in force. Sec 344(c).

[553] *Ibid.* Sec 344A.

[554] *Ibid* .Sec 344A (a) & (b).

[555] *Ibid.* Sec 344A (d).

[556] *Ibid.* Sec 344 (c).

any historical abandoned site.[557] Once the site has been secured and made safe, mitigation can proceed, *inter alia* treating and cleaning up pollution,[558] repairing erosion of the affected land, and prevention of any further erosion.[559] For a final rehabilitation site, rehabilitation activity is required for the management of the environment or to satisfy an Environment Protection Agency (EPA) administering authority.[560] An abandoned mine requires considerably more work to remediate than a final rehabilitation site and provides the operator an incentive to obtain a progressive rehabilitation and closure plan from the EPA, to have the site declared a final rehabilitation site.

3.1.3 (b) Regulations

Queensland does not have regulations attached to its Act, but it issues standards. The issued standards deal with the health and safety of workers and has no reference to the environment.[561] Therefore, they are not of importance to the issue of post-mining rehabilitation.

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[557] *Ibid.* Sec 244A(d) & (e).

[558] *Ibid.* Sec 344A (f*).*

[559] *Ibid.* Sec 344A (g*).*

[560] *Ibid.* Sec 344B.

[561] Queensland*, supra* note 536.

3.1.3 (c) Guidelines

The Queensland Government has issued a guideline entitled "Rehabilitation requirements for mining activities" under the *Environmental Protection Act 1994,*[562] to assist mining companies to propose acceptable rehabilitation outcomes and strategies, for both progressive and final rehabilitation.[563] The guidelines develop a hierarchy of rehabilitation strategies to adopt, namely, in descending order;

1. avoid disturbance that will require rehabilitation[.]
2. reinstate a "natural' ecosystem as similar as possible to the original ecosystem[.]
3. develop an alternative outcome with a higher economic value that the previous land use[.]
4. reinstate previous land use (e.g. grazing or cropping)[.]
5. develop lower value land use[.]
6. leave the site in an unusable condition or with potential to generate future pollution or adversely affect environmental values[.][564]

The document distinguishes between its policy objectives and the rehabilitation objectives of the mining company's strategy, by referring to them as rehabilitation

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[562] *Rehabilitation requirements for mining resources activities, Guidelines, Guidelines (Queensland Government, 2014)., Environmental Protection Act (QLD) 1994.*

[563] *Ibid.* at.*2.*

[564] *Ibid.*at *5.* If this were to be applied to space resources extraction sites, this may violate Article IX of the OST because signatories to the Treaty agree to conduct exploration without causing harmful contamination.

goals. The rehabilitation goals set out in the document are that the disturbed areas are safe to humans and wildlife, non-polluting, stable, and able to sustain an agreed post-mining land use. [565] The rehabilitation outcomes must be defined for each of the domains in the mine site and the objectives "address potential environmental impacts; achieve the highest practical level in the rehabilitation hierarchy and be acceptable to the community".[566] This comprehensive approach may provide helpful guidance for post space resources extraction rehabilitation because it offers a method for rehabilitating different areas with procedures unique to the specific outcome that is required; this approach is in line with the sustainable development principle of common but differentiated responsibility.

The Queensland laws and regulations cover all of the sustainable development principles and require financial surety from the very beginning of prospecting, see section 3.1.3(d). They are also very specific in the remediation process, something few other states or provinces provide, making Queensland a candidate to be the model for a space resources extraction remediation framework.

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[565] *Ibid.* at *8.*

[566] *Ibid.* at *9.*

3.1.3(d) Coherence with Sustainable Development Principles

The objective of the Act is to "encourage environmental responsibility",[567] and "encourage responsible land care management in prospecting, exploring and mining"[568], which is another way of expressing the no harm principle. The Guidelines have a hierarchy of rehabilitation strategies, which indicates an adherence to the common but differentiated responsibility principle.[569] Financial security required under section 83,[570] making the polluter pay. As with the previous states, does not appear that the precautionary principle is addressed, due to the nature of remediation as a final step.

3.1.4 South Australia

Lead and silver have been mined in South Australia since 1840. Gold was discovered a decade later.[571] The South Australia government has not traditionally taken an active role in promoting the rehabilitation of its 'orphan' mines.[572] *The Mining Act 1971* addresses this attitude as discussed in the following sub-section. The *Mining Regulations 2020* control the Mining Rehabilitation Fund, which is the cornerstone of the legislation; both

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[567] *Queensland Mineral Resources Act (QL), 1989*, Sec 10 (Queens Mining*).*

[568] *Ibid.*

[569] Rehabilitation. *supra* note 562*.*

[570] Queens Mining*. supra* note 538*.*

[571] "A brief mining history of South Australia", (21 February 2018), online: <https://www.amcconsultants.com/a-brief-mining-history-of-south-australia>*.*

[572] *"SA – MINING LEGACIES", online: <https://www.mininglegacies.org/mines/south-aust/>.*

are reviewed in the subsequent sub-section. The guidelines addressed in the final sub-section describes the current rules for mine-site rehabilitation.

3.1.4 (a) Legislation

South Australia is one of the smaller states in Australia and its mining legislation reflects this. The legislation regarding rehabilitation is limited to a Mining Rehabilitation Fund and financial security. Similar to other states, the land and minerals are vested in the Crown.[573]

The definition of the environment is quite expansive, including;

> (a) land, air, water (including both surface and underground water and sea water), organisms, ecosystems, native fauna and other features or elements of the natural environment; and (b) buildings, structures and other forms of infrastructure, and cultural artefacts; and (c) existing or permissible land use; and (d) public health, safety or amenity; and (e) the geological heritage values of an area; and (f) the aesthetic or cultural values of an area.[574]

A Mining Rehabilitation Fund is established by the *Mining Act, 1971*.[575] The Act does not specify the objectives of the Fund; however, the source of funding is prescribed as

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[573] See *The Mining Act 1971,SA* Sec 16. *(*SA Mining).

[574] *Ibid.* Sec 6(1)(4.)

[575] *Ibid.* Sec 62AA(1).

amounts required to be paid into the Fund to achieve the appropriate environmental outcomes on mine closure,[576] and:

> (i) to reinstate, supplement or improve rehabilitation of land that fails to establish a safe, stable and self-contained environment; and (ii) to maintain environmental management processes; and (iii) to take further action to restore the environment because of environmental damage or impairment resulting from authorised operations.[577]

The Minister, who is given extensive rights under the Act, has the right to direct the monies in the Fund to be used:

> to fund monitoring and maintenance of any land in relation to which a requirement under this section has been imposed; (b) to fund programs, including as to the collection or provision of information and the carrying out of work, relating to the rehabilitation of any land in relation to which a requirement under this section has been imposed; (c) to achieve any other environmental outcomes that are related to the ceasing of authorised operations; (d) to fund other programs, or to achieve

[576] *Ibid.* Sec 62AAA 9a).

[577] *Ibid.* Sec 62AA(2).

> other outcomes, prescribed by the regulations; (e) to provide for the costs of administering the fund.[578]

The *de facto* objectives of the Mining Rehabilitation Fund are: (a) to monitor the maintenance of the land, (b) the collection or provision of information regarding rehabilitation, (c) rehabilitation of land affected by mining and (d) environmental outcomes that are related to cessation of mining operations. The creation of the Mining Rehabilitation Fund is important in that it not only protects the state from the cost of rehabilitation when the operator has insufficient funds to complete the rehabilitation, but also is coherent with the sustainable development principle of the polluter pays.

To ensure that an operator complies with the provisions of the Act, the Minister requires that the holder of a mineral tenement post a bond to cover;

> (a) any civil or statutory liability likely to be incurred by that person in the course of carrying out authorised operations; and (b) the present and future obligations of that person in relation to the rehabilitation of land disturbed by authorised operations, will be satisfied.[579]

The Minister may also require that the bond be secured.[580] The Minister is also able to direct an operator of a mineral tenement to rehabilitate adverse environmental effects

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[578] *Ibid. Sec 62AA(10).*

[579] *Ibid.* Sec 62(1).

[580] *Ibid. Sec 62(2).*

to a standard set out in the tenement conditions.[581] This direction will notify the operator of their non-compliance with the mineral tenement and could lead to the imposition of a penalty.

3.1.4 (b) Regulations

The South Australia *Mining Regulations 2020* mentions the prescribed period for the Mining Rehabilitation Fund,[582] which is set at 24 months,[583] and the rate for extraction of aggregates, but nothing about rehabilitation,[584] Indicating that rehabilitation of the mining site was not a high priority when the regulations were adopted, or could fall under general state environmental legislation or municipal bylaws.

3.1.4 (c) Guidelines

The guidelines issued by the South Australia Department of Energy and Mines focus on the holder of a mining tenement's responsibility to rehabilitate the land disturbed by the mining operations and the calculation of the financial assurance the owner must make to ensure that the rehabilitation does not become a liability of the state government.[585] The amount that the tenement owner must pay is 100% of the estimated rehabilitation liability as determined by the maximum third party cost of performing the rehabilitation

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[581] See SA Mining Sec 70F (1)(a) & 70A(1)(b) .

[582] Mining Regulations 2020 (SA), 2020. Sec 60.

[583] SA Mining *supra* note 573 Sec (3)(b).

[584] *Mining Regulations 2020*, *supra* note 582. Sec 61.

[585] *See Energy & Mining, "Mine rehabilitation and closure", (2 May 2023),* online: Energy & Mining <https://www.energymining.sa.gov.au/industry/minerals-and-mining/mining/regulating-mining-activity/Mineral-resources-regulation-report/mine-rehabilitation-and-closure>.

strategies "and include costs for project management, inflation, normal project variation, and contingency provision for risk associated with the strategies and uncertainty in the cost estimates."[586] The addition of a rehabilitation liability is in accordance with the sustainable development principle of the polluter pays, and covers the cost that would be borne by the state if the operator was not financially able to complete the rehabilitation and the state had to contract with a third party to complete the work. This is exactly the scenario that would be present if a space resources extraction operator was financially incapable of completing the rehabilitation of a space resources extraction operation.

3.1.4(d) Coherence to Sustainable Development Principles

As mentioned in sub-section 3.1.4(a), South Australian legislation does not mention the no harm principle, nor the precautionary approach. However, section 62AAA(1), establishes a Mining Rehabilitation Fund to make the polluter pay.[587] If an application for a licence in the Murray-Darling basin is made, then the Minister must take into account the objectives of the *River Murray Act 2003,* thus using the principle of common but differentiated responsibility.[588] This principle is also evident in the exclusion of the Pitjantjatjara and Maralinga lands from the application of the Act.[589] Unlike other states, South Australia does not require an operator to contribute to a Mining Reclamation Fund,

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[586] *Ibid.*

[587] SA Mining, *supra* note 573.

[588] *Ibid.* Sec 56F (2).

[589] *Ibid.* Sec 63Y.

but the Minister may direct the operator of a mineral tenement to rehabilitate adverse environmental effects.[590] This after-the-fact provision does not really conform to the spirit of the sustainable development principles, but does recognize that the operator is financially liable for the remediation of negative environmental effects.

3.1.5 Tasmania

Tasmania, the smallest of the Australian states, has had a mining industry since the early 19th century,[591] starting with coal (1833-48), progressing to gold, silver and tin (1852-1914), before base metals were discovered and mined (1896-1994).[592] The early mines had a long life and resulted in acid mine drainage from the abandoned mines, which seeped into the groundwater.[593] After the closing of the Mt. Lyell mine in 1995, the Rehabilitation Trust Fund was established to rehabilitate the mining legacy sites in the state.[594]

The Mineral Resources Development Act 1995 is the main legislation governing the mining industry in Tasmania. It is discussed in the first sub-section below. The regulations which set out the rules for the payment of fees by mining companies are discussed in the

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[590] *Ibid.* Sec 70F (10) (a)-(b).

[591] Peter Bell, *"History of Mining in Tasmania",* online: <https://www.academia.edu/23978814/History_of_Mining_in_Tasmania>.

[592] *Ibid.*

[593] *"TAS – MINING LEGACIES",* online: <https://www.mininglegacies.org/mines/tas/>.

[594] *Ibid.* A mere S160,000 A is spent on the rehabilitation of the 250 mine sites leaking AMD.

subsequent sub-section, and the guidelines for the development of Decommissioning and Rehabilitation Plans are reviewed in the final sub-section.

3.1.5 (a) Legislation

The Mineral Resources Development Act 1995 is designed to "provide for the development of mineral resources consistent with sound economic, environmental and land use management."[595] As with other Australian states, ownership of minerals is vested in the Crown.[596] The Act uses a Mining Lands Trust Fund and financial security payment system to manage the environmental ecosystems that include components referred to in paragraphs (a), (b), and (c).[597]

In order to obtain a licence under the Act, the applicant must provide "sufficient information relating to the likely impact on the environment or the activities under the license."[598] Also, the applicant must provide a security deposit.[599] The security provided is to cover damage to private property or cost of the failure to complete the rehabilitation work, or to mitigate damage to the environment during mining operations or exploration.[600] The Minister may use any amount of a security deposit provided by the

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[595] *Mineral Resources Development Act (TAS), 1995, (*TAS mining), Title.

[596] *Ibid*. Sec 6.

[597] *Ibid.* Sec 3. Different ecosystems , such as bogs, grasslands and forest may be present in a mining lease, so the effort to remediate will be different for each ecosystem, each with a different financial surety required.

[598] *Ibid.* Sec 17A(d).

[599] *Ibid.* Sec 17A(e.)

[600] *Ibid.* Sec 3.

licensee or lessee to remedy any damage to private property if the licensee or lessee fails to pay compensation under Part 8. The Minister may also use the funds to cover costs of complying with other parts of the Act, *inter alia* depositing with the Director any drill core or cutting that has not been deposited with the Director as required by or under the Act; to make safe any safety hazard caused by mining operations or exploration under a licence or lease held by the licensee or lessee; and to mitigate any damage to the environment caused by mining operations or exploration. The Minister may also draw down any amount of security deposit provided by a licensee, if the licensee fails to carry out a work program in respect of the licence.[601]

The Act, creates a Mining Lands Trust Fund[602] that accumulates monies to be applied to the purpose of the Act, which the Minister may "(a) cause any abandoned mining land or land affected by former exploration activities to be rehabilitated; and (b) enter into any contract relating to the environmental rehabilitation of any abandoned mining land or land affected by former exploration activities."[603] The funding for the Mining Lands Trust fund is financed by;

> (a) any money appropriated by Parliament for the purposes of this Part; and
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> (b) any money received from the sale of any building, machinery or property vested in the Crown under section 105 (4) ; and (c) any security deposit or

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[601] *Ibid.* Sec 196. Thus, the funds in the Rehabilitation Trust Fund may be used for other expenses other than rehabilitation.

[602] TAS mining *supra* note 597.

[603] *Ibid.* Sec 180.

> part of a security forfeited […] ; and (d) any other money received for the purpose of this Part; and (e) any money the Treasurer directs to be paid into the Rehabilitation Trust Fund.

The Minister, therefore, has a wide range of funding sources to ensure that there are sufficient funds available to remediate any mining site that the licensee is financially capable of remediating.

In return for a licence, "the licensee […] must carry out any exploration and rehabilitation of land consistent with the standards specified in the Code of Practice."[604] Rehabilitation is, therefore, a condition of receiving a mining licence.

3.1.5 (b) Regulations

Tasmania's *Mineral Resources Regulations 2016* specify the rules for calculating the funds received from the sale of minerals extracted in the state, and the royalties to be paid. There is no reference to rehabilitation in the Regulations,[605] indicating that the state's Regulations are focused on development, rather than sustainability.

3.1.5 (c) Guidelines

Tasmania has a program called the Decommissioning and Rehabilitation Plan, which sets out an "agreed documented environmental management strategy for the decommissioning and rehabilitation of an activity prior to and after cessation of the

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[604] *Ibid.* Sec 29(b), See section 3.1.5 (c) following for details.

[605] See *Mineral Resources Regulations 2016, 2016. (TAS).*

activity".[606] The Plan is developed jointly by the mine operator and the EPA and is intended to be a non-technical public document to encourage consultation and assessment of the work required to achieve the final objectives within the planned timeframe.[607] The consultative process with a wide range of stakeholders is meant to help define the future use of the site. In this process, the long-term land use should be considered and how the targets are to be met should be established.[608] "Ideally the plan should be developed a minimum of 2 years prior to the target date for mine closure and extend 5 to 10 years post closure."[609] However, using the progressive rehabilitation approach, the closure plan may be completed in a much shorter timeframe. The Decommissioning and Rehabilitation Plan should, therefore, reflect the desires of the communities likely to be affected by the mining operations and go a long way to establishing a social licence to operate, while presenting a roadmap to good rehabilitation.

3.1.5(d) Coherence with Sustainable Development Principles

The only sustainable development principle clearly reflected in the Tasmanian mining legislation, Regulations, and guidelines is the polluter pays. Like other states, Tasmania requires an operator to contribute to a Mining Lands Trust Fund.[610]

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[606] *EPA Tasmania, Decommissioning & Rehabilitation Plan (DRP) (2011).* at 1.

[607] *Ibid.* at 2.

[608] *Ibid.* at 4.

[609] *Ibid.* at 5. This timeframe is in sharp contrast with other states, where the closure plan must be developed prior to the commencement of operations, e.g., NSW*, supra* note 453.

[610] TAS mining *supra* note 595 Sec 180.

3.1.6 Victoria

Victoria, the most populated state of Australia, was the site of a gold rush in the 1850s, which left a visible scar on the environment, from the 1852 gold rush and the uncontrolled workings of 6,000 gold miners panning the river beds around Bendigo.[611] *The Mineral Resources and Extractive Industries Act 1990*[612] is the primary legislation governing mining operations in Victoria. The Act is reviewed in the following sub-section, the regulations follow in the next sub-section, and guidelines in the next.

3.1.6 (a) Legislation

The Mineral Resources and Extractive Industries Act 1990 is the only mining act in Australia that mentions sustainable development. The purpose of the Act is to "encourage mineral exploration and economically viable mining and extractive industries which make the best use of, and extract the value from, resources in a way that is compatible with the economic, social and *environmental* objectives of the State."[613] In the objectives, the rehabilitation of areas where stone has been mined is mentioned.[614] 'Stone' as defined in the Act, is stone removed for the purpose of construction, building roads, or

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[611] Precincts and Regions Department of Jobs*, "History of gold mining in Victoria", (*30 July 2019), online: Earth Resources <https://earthresources.vic.gov.au/geology-exploration/minerals/metals/gold/gold-mining-in-victoria>*.*

[612] Previously named *The Mineral Resources (Sustainable Development) Act 1990,* until renamed in 2023 under *The Mineral Resources (Sustainable Development) Amendment Act 2023.*

[613] *Mineral Resources (Sustainable Development) Act, 1990 (VIC),*(Victoria Mining); emphasis added.

[614] *Ibid.* sec 2 (1)(b)(iii).

manufacturing - in other words, aggregate.[615] It is unclear why the Act singles out stone, while not mentioning other minerals, which have a larger deleterious effect on the environment.

The definition of sustainable development in the Act,[616] looks like that of the Rio Declaration.[617] The *Mineral Resources (Sustainable Development) Act*, 1990, specifies the principles of sustainable development as: a pathway to economic development that safeguards the welfare of future generations;[618] to ensure equity within and between generations;[619] while enhancing environmental protection. [620] Where "there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation",[621] which may have been taken directly from the Rio Declaration.[622]

To apply for a licence for prospecting, exploration or mining, the applicant must satisfy the Minister that they are "able to finance the proposed work and rehabilitation of the land."[623] When granting a licence, the Minister may impose conditions concerning the:

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[615] *Ibid. Sec 4.*

[616] Victoria Mining *supra* note 613*.*

[617] Rio *supra* note 72*.*

[618] Victoria Mining, *supra* note 613*, 92.(VIC)* Sec 2(2)(a*).*

[619] *Ibid.* Sec 2A(2)(b).

[620] *Ibid.* Sec 2A(2)(d).

[621] *Ibid.* Sec 2A(2)(g).

[622] *Cf. UN Sustainable Development Guidelines* in Section 1.7.1.

[623] See Victoria Mining *supra* note 613 Sec 15.6(d).

> (a)[…]rehabilitation of the land; (b) elimination and minimisation of the risks that the work may pose to the environment, to any member of the public, or to land, property or infrastructure in the vicinity of the work; (c) protection of groundwater; (d) providing and implementing environmental offsets on the land or any other land; […and](g) entering into a rehabilitation bond.[624]

As with other states such as New South Wales and Tasmania, the applicant must also file a work plan with the application that includes a rehabilitation plan for the land covered by the licence.[625]

The Mineral Resources and Extractive Industries Act 1990 contains provisions for a Mine Land Rehabilitation Authority, to rehabilitate the Latrobe Valley.[626] The Authority, although designed to rehabilitate a specific coal mining area, has as its functions and powers: the monitoring and evaluation of the regional rehabilitation strategy, auditing of public bodies' rehabilitation planning activities, monitoring and evaluation of the strategy with respect to the framework, and review of any research in respect to the rehabilitation.[627] The state is more involved than others, almost

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[624] *Ibid.* Sec 26(2).

[625] See Victoria Mining. *supra* note 613 Sec 40 (3) (e*).*

[626] "Latrobe Valley | Victorian Places", online: <https://www.victorianplaces.com.au/latrobe-valley>.The Latrobe Valley is a coal mining area operating since the 1880s, supplying brown coal to generate electricity for the state of Victoria.

[627] Victoria Mining *supra* Note 613 Sec 84AL.

micro-managing the rehabilitation, due maybe to the proximity of mining sites to major population centres and the environmental sensitivity of the areas.[628]

To finance the Mine Land Rehabilitation Authority,[629] a Declared Mine Fund is established.[630] The funding comes from:

> (a) all money that is appropriated by the Parliament for the purposes of the Fund; and (b) all money that is received from the investment of money in the Fund; and (c) all money directed or authorised to be paid into the Fund by or under this or any other Act. [631]

Expenses of the Fund include; "(a) amounts authorised by the Minister to fund the cost of all or any part of the monitoring, maintenance and rehabilitation of registered mine land; and (b) amounts authorised by the Minister to fund the cost of unforeseen events in relation to registered mine land."[632] These powers are broad enough that they may be applied to any mining area that needs to be rehabilitated and the Minister has the power to declare a mine site a 'declared mine land' and prioritize its rehabilitation.[633]

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[628] The Latrobe Valley is a major water source for Melbourne.

[629] *Ibid.*

[630] *Ibid.* Sec 84AZZG.

[631] *Ibid.* sec 84AZZH.

[632] *Ibid.* Sec 84AZZI.

[633] *Ibid.* Sec 84AZT.

3.1.7(b) Regulations

The Victoria *Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019* covers royalty calculations, licences, work plans, reporting, requirements for declared mines, and closure and the declared mine fund.[634] The section on work plans includes the need to have community involvement in deciding the use of rehabilitated land,[635] criteria for measuring achievement of objectives,[636] and an assessment of risks the rehabilitated land may pose.[637] The Regulations also recognize the possibility of progressive rehabilitation.[638]

The Regulations set out the criteria for closure: the declared land must be made safe;[639] erosion must be minimized;[640] and land must be revegetated.[641] After rehabilitation, the land must be able to support the proposed land use outcomes, conforming to the surrounding area.[642] Water quality must be restored and have no impact on the broader water system.[643]

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[634] See *Mineral Resources (Sustainable Development) (Mineral Industries) Regulations (VIC) 2019.*

[635] *Ibid.* Sec 40(2)(a).

[636] *Ibid.* Sec 40(2)(d).

[637] *Ibid.* Sec 40(2)(f).

[638] *Ibid.* Sec 43(4)(b).

[639] *Preparation of Rehabilitation Plans (Victoria State government 2020).* Sec 64C(b).

[640] *Ibid.* Sec 64C (c).

[641] *Ibid.* Sec 64C (d).

[642] *Ibid.* Sec 64C (h).

[643] *Ibid.* Sec 64C (l).

The criteria are supported with Regulations regarding the plans for the post-closure period, which require ongoing monitoring and maintenance supported by a rehabilitation plan that the plant used to meet the closure plan in order to return the land to the Crown.

The contribution to the Declared Mine Fund includes an estimate of the *present value* of the future costs associated with the monitoring and maintenance obligations under the post-closure plan for the declared mine land.[644] Unlike any other state, Victoria uses the present value of the cost of rehabilitation, which could result in less money being put aside to complete the rehabilitation work, leaving the state to contribute the shortfall.

3.1.7 (c) Guidelines

The guideline "*Preparation of Rehabilitation Plans, Guideline for Mining & Prospecting Projects*" is designed to assist licence holders to develop rehabilitation plans to achieve sustainable rehabilitation outcomes.[645] The framework for developing a rehabilitation plan, as laid out in the guideline, is to: identify post-mining land forms, set rehabilitation objectives for each distinct rehabilitation domain, establish criteria for assessment of attainment of the objectives, rehabilitate the area as mining progresses, and identify risks associated with the rehabilitated land form.[646] The principles of plan preparation as defined in the guideline are: start early, involve the community, develop a knowledge

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[644] Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019, supra note 634 Sec 64N(c)(i). Emphasis added.

[645] *See Preparation of Rehabilitation Plans. supra* note 639

[646] *Ibid.* at 3.

base for the site, ensure that the objectives are clear and measurable, and make the plan appropriate to the environmental risk that exists.[647] By starting early in the plans for rehabilitation, the goals and objectives are upfront and visible, so any deviation from the plan may be caught and corrective action taken to bring the rehabilitation back into line with the agreed upon plan. Victoria is not the only state to include progressive rehabilitation in its remediation framework; it is also used in New South Wales, Queensland, and Tasmania.

3.1.7(d) Coherence with Sustainable Development Principles

Not surprisingly, given the name of the act, the *Mineral Resources (Sustainable Development) Act 1990* complies with all four principles of sustainable development. Any person entering on land must cause as little harm and inconvenience and do as little damage as possible, creating compliance with the no harm principle.[648] Common but differentiated responsibility is represented by the different treatment afforded to stone in section 4 of the Act.[649] The precautionary approach is included in objectives of the Act.[650] The polluter pays principle is evident in that the applicant for a licence must satisfy the Minister that they are able to finance the rehabilitation of the land.[651] However, as expressed above, the use of the present value of the cost of rehabilitation formulation

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[647] *Ibid.* at 8.

[648] Victoria Mining, *supra* note 613 Sec 12(.3)

[649] *Ibid.* Sec 4

[650] *Ibid.* Sec 2A (g).

[651] *Ibid.* Sec 15.6(d).

raises concern about how much the polluter pays. Despite this, Victoria is therefore one of the few states that meets all four of the sustainable development principles with its mining legislation and therefor is a good guide for the space resources extraction remediation framework

3.1.8 Western Australia

Western Australia is the largest Australian state and has a large iron ore mining industry. In 2020, a mining company engaged in the high-profile and heavily condemned destruction of ancient Aboriginal artifacts.[652] *The Mining Act 1978* is the main mining-related legislation for Western Australia, but it does not mention rehabilitation, so the first sub-section below reviews the provisions of *The Contaminated Sites Act 2003,* which is applicable to mining rehabilitation. Regulations and guidelines are discussed in subsequent sub-sections. The state of Western Australia also enters into state-level agreements with mining operators detailing "the rights, obligations, terms and conditions for the development of the specific project …".[653]

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[652] Calla Wahlquist, *"Rio Tinto blasts 46,000-year-old Aboriginal site to expand iron ore mine", The Guardian (26 May 2020),* online: <https://www.theguardian.com/australia-news/2020/may/26/rio-tinto-blasts-46000-year-old-aboriginal-site-to-expand-iron-ore-mine>.

[653] *"*State Agreements*", (4 January 2024),* online: <https://www.wa.gov.au/organisation/department-of-jobs-tourism-science-and-innovation/state-agreements>.

3.1.8 (a) Legislation

The *Mining Act 1978* of Western Australia makes no reference to rehabilitation. However, the Act must be read and construed subject to the *Environmental Protection Act 1986*.[654] If any section of the *Mining Act 1978* is inconsistent with *The Contaminated Sites Act 2003*, then the *Contaminated Sites Act 2003* prevails.[655] The *Environmental Protection Act 1986* also makes no mention of rehabilitation, so one must look to the *Contaminated Sites Act 2003* for legislation related to mine site rehabilitation.

The *Contaminated Sites Act 2003* of Western Australia "provid[es] for the identification, recording, management and remediation of contaminated sites."[656] The objectives of the Act are to "protect human health, the environment and environmental values by providing for the identification, recording, management and remediation of contaminated sites in the State, having regard to the principles" of the Act.[657] The principles of the Act are: the polluter pays, i.e. those who generate the pollution should pay for the containment and remediation;[658] full life cycle costs, prices of the goods and services should reflect the cost of the use of natural resources and the ultimate disposal of the associated waste; and waste minimization, meaning that waste generation should

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[654] *See The Mining Act 1978 (WA)* Sec 6(1).

[655] *Ibid.* Sec 6(3).

[656] *The Contaminated Sites Act 2003 (*WA contaminated) Title.

[657] *Ibid.* Sec 8.

[658] *Ibid.*

be minimised before discharge into the environment.[659] This provision reflects the sustainable development principle of polluter pays, which is not present in all of the states' laws, and recognises that pollution occurs at every stage of the supply chain, so mining operators should be conscious of the effects of their products on the environment, not only that which is caused by the mining cycle.

'Contaminated' under the Act is defined as: "in relation to land, water or a site, means having a substance present in or on that land, water or site at above background concentrations that presents, or has the potential to present, a risk of harm to human health, the environment or any environmental value."[660] Remediation is when:

> (a) the attempted restoration of the site to the state it was in before the contamination occurred; (b) the restriction, or prohibition, of access to, or use of, the site; (c) the removal, destruction, reduction, containment, or dispersal of the substance causing the contamination, or the reduction or mitigation of the effect of the substance; (d) the protection of human health, the environment or any environmental value from the contamination.[661]

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[659] *Ibid.*

[660] *Ibid.* Sec 4.

[661] *Ibid.* Sec 3(1).

Affected sites, i.e. those that are contaminated or have had a substance migrated to the site to the extent that it is contaminated,[662] are classified into one of five groups: not contaminated unrestricted use, contaminated-restricted use, remediated for restricted use, contaminated-remediation required, or decontaminated.[663] Any site that is classified as contaminated-remediation required must be remediated by the person who caused, or contributed to the contamination of the site.[664]

A Contaminated Sites Management Account has been created under the *Financial Management Act 2006*, into which are deposited funds from governmental appropriations for the account,[665] the sale of the orphaned site,[666] and fees collectable under the Act and Regulations.[667] The Minister may use the funds collected to remediate any site for which the state or a public authority is responsible.[668]The fund does not appear to allow the Minister to remediate sites where the operator does not have the finances to remediate the site themselves.

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[662] *Ibid.*

[663] *Ibid.* Sec 15(3).

[664] *Ibid. Sec 25.*

[665] *Ibid.* Sec 60(a).

[666] *Ibid.* Sec 60(b).

[667] *Ibid.* Sec 60(c)-(e).

[668] *Ibid*. Sec 60(3)(a).

3.1.8 (b) Regulations

The Western Australia *Mining Regulations 1981* covers permits, mining tenements, and production and royalties, but does not contain any regulations regarding rehabilitation,[669] other than the release of environmental information as part of an environmental report.[670]

3.1.8 (c) Guidelines

In December 2022, the Western Australia Department of Mines, Industry Regulation and Safety issued the *Exploration and Prospecting Rehabilitation Guidance* in draft form for industry comment. Whilst the document is targeted at the Exploration phase of the mining cycle, it yields insight into the approach that Western Australia is adopting towards mining rehabilitation. The objective of the guideline is to identify the Department's expectation of mining companies regarding rehabilitation. *The Mining Act*

> requires tenement holders to fill in or otherwise make safe to the satisfaction of a prescribed official all holes, pits, trenches and other disturbances to the surface of the land made while exploring for minerals and in the opinion of the prescribed official, likely to endanger the safety of any person or animal.[671]

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[669] *See Mining Regulations 1981(WA).*

[670] *Ibid.* Sec 96CA(2)(a).

[671] Department of Mines, Industry Regulation and Safety*, "Exploration and Prospecting Rehabilitation Guidance",* at 4, online:

The draft *Exploration and Prospecting Rehabilitation Guidance* also include a focus on the safety of persons or animals and the "prevention of contamination of groundwater resources."[672]

To achieve this new constraint, all drillholes must be permanently capped below the land surface and backfilled with "low permeability material"[673] to prevent the area from subsiding. The surrounding area must be landscaped with topsoil and revegetated with flora that is compatible with the surrounding area. Topography of the area must be terraformed to prevent erosion. Infrastructure must be dismantled, removed or buried and access roads scoured to promote natural revelation, and blocked to all access to allow natural revegetation to occur.[674] It is the unspoken aim of these guidelines that land disturbed by mining be returned to its natural environment and habitat. While the regulations of most of the other states have a similar aim, these guidelines are more specific as to the actions required to rehabilitate the mine site. They may therefore provide helpful considerations for space resources extraction remediation, even if the topography and environment in space requires additional or different considerations.

<https://www.dmirs.wa.gov.au/sites/default/files/atoms/files/exploration_and_prospecting_rehabilitation_guidance.pdf>.

[672] *Ibid.* at 5.

[673] *Ibid.*

[674] *Ibid.* sec 4.6.

3.1.8 (d) Coherence with Sustainable Development Principles

Western Australia fulfills one sustainable development principle most of the other states do not, namely, common but differentiated responsibility. By classifying contaminated land into five groups, each with a different remediation technique, the common but differentiated responsibility principle is incorporated into the legislation.[675] The polluter pays principle is embedded in the Act in section 8.[676]

3.1.9 Conclusions

From the above sub-sections, the following conclusions regarding the Australian approach to rehabilitation of mining sites may be drawn. Despite Australia's devolution of mining rehabilitation law, regulations, and guidelines to each individual state, there is a remarkable level of consistency across the country. In general, the Australian states licence an owner to prospect, explore, and exploit the mineral resources, requiring the owner to prepare closure plans prior to the operation's commencement and to post financial assurance so that the state is not left with the liability of rehabilitating the site if the owner is not financially capable.

The mining laws in most states and territories require mining lease holders to provide a rehabilitation bond to the Department of Mines, which is returned to the holder once the mined land is fully rehabilitated. Additionally, most regimes require a mining lease holder

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[675] WA contaminated *supra* note 656 Sec 15(3).

[676] "Those who generate pollution and waste should bear the cost of containment, avoidance or abatement."

to put in place a detailed rehabilitation plan, which generally requires complete costings of full rehabilitation activities to be submitted to the Department of Mines and regular updates if the scope of operations changes. Mining regulators in Australia know that they must be vigilant in their assessment and clarification of rehabilitation plans, and have the power to require changes or adjustments, as well as call for additional funds to be added to the rehabilitation bond if they deem it insufficient to repair the land in question after mining ceases. Mine rehabilitation has also become an increasing focus as a number of projects reach the end of their intended mining life and have been sold to smaller companies for a nominal consideration and assumption of rehabilitation obligations.[677]

Australian state regulations do not contain much related to rehabilitation, other than the Victoria *Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019*, regarding the post-closure criteria. Given the sustainable development focus of these regulations, they are useful to consider in a framework for space resource utilization.

Australian state guidelines set out a framework of steps required for a successful rehabilitation of mining sites: this framework is useful to consider in the rehabilitation of space resources extraction sites. In particular, an space resources extraction framework should consider the steps outlined in the state guidelines: establishing rehabilitation outcomes for each different area or domain on the site; developing rehabilitation plans

[677] Rob Stevens, *" Current status of mine closure readiness; are governments prepared?" (August 2021),* online; https://www.iisd.org/system/files/2021-08/status-mine-closure-readiness-en.pdf.

for each domain to achieve the rehabilitation outcomes; creating criteria for measuring the success of the rehabilitation efforts in reaching the outcomes; "identify[ing] and plan[ning] for the long-term management of any post-rehabilitation risks associated with any rehabilitated area that is not likely to be self-sustaining."[678] This approach to defining domains with similar remedial characteristic can speed up the site remediation. The definition of rehabilitation domains and rehabilitation plans are supported by a monitoring system, to ensure that sites are remediated in accordance with the agreed-upon plans. The posting of financial surety encourages the operators to comply with the plans. How exactly this approach can be applied to space resources extraction is as yet non-determinable, until more celestial exploration is conducted.

Despite the efforts of the federal and state governments, environmental incidents still occur, for example, the destruction of sacred Indigenous heritage sites at Juukan Gorge.[679] The destruction of the Gorge was permitted under the *Aboriginal Heritage Act 1972*.[680] New evidence as to the significance of the Gorge came to light a year after the permit was issued. However, there was no provision in the *Act* for the permit to be amended or cancelled. The *Act* has since been amended (November 2023).[681] This points to a final lesson that should be considered for a space resources extraction framework: Western Australia and South Australia are the only two states that include heritage in their

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[678] Victoria Government *supra note* 634.

[679] *C*alla Wahlquist*, supra* note 652.

[680] *Aboriginal Heritage Act 1972. (Western Australia), 1972.*

[681] Wahlquist, *supra,* note 652.

legislation regarding mining and the environment. Therefore, in Australia a comprehensive heritage act is probably required, and similarly, space heritage (particularly on the Moon) must be considered in the context of space resource utilization, and therefore in mining remediation.[682]

[682] *"For All Moonkind | Preserving Our First Off World Footsteps",* online: <https://www.forallmoonkind.org/>.

Chapter 4. Terrestrial Laws: Canada

Under *The Constitution Act 1867*,[683] the primary responsibility for natural resources in Canada lies with the provincial governments, with the federal government retaining responsibility for offshore resources. As with the Australian legislation, Canadian provincial mining laws focus mainly on the granting of rights to prospect, explore, and exploit mineral resources. With the notable exception of Ontario, remediation is not considered.

This chapter examines Canada's natural resources legislation, province-by-province (alphabetically), in order to evaluate how each province addresses the post-mining treatment of mine sites. It demonstrates that there is an almost unanimous practice with respect to the issuance of permits for exploration, development, and exploitation of a resource: when the mining permit is applied for, a closure plan (including post-mining treatment) is required, and a financial surety posted to cover the cost of post-mining treatment. Ongoing monitoring of the post-mining treatment site is required. It also explains that three provinces - Alberta, New Brunswick and Ontario - adhere to all four sustainable development principles. All other provinces, with the exception of Prince Edward Island, follow the polluter pays principle and most follow the precautionary approach. Thus,

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[683] Legislative Services Branch, *"Consolidated federal laws of Canada, THE CONSTITUTION ACTS, 1867 to 1982",* (7 August 2020), online: <https://laws-lois.justice.gc.ca/eng/const/page-3.html> Last Modified: 2020-08-07.

while Canadian provinces follow a similar practice, the underlying rationale for that practice differs between then. The common themes and approaches in the legislation, regulations, and guidelines help to provide insight into how outer space law might deal with mine remediation.

4.1 Alberta

Alberta, the energy capital of Canada, operated under the *Mines and Minerals Act 2000*, until March 1, 2023, when the *Mineral Resource Development Act 2021*[684] was enacted. The sections of both Acts relating to remediation are described in the following sub-section. Regulations stemming from both these Acts are discussed in the next sub-section, with guidelines in the subsequent sub-section. Alberta has a more flexible approach to mining permits (and therefore to post-mining treatment) than other provinces: an operator can approach the Alberta energy regulator to enter into an agreement to exploit a particular property rather that obtaining the exploratory and exploitation permits.[685] Other provinces do not do the same, and this difference is examined below.

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[684] See *Mineral Resource Development Act Chapter M-16.8, 2021. (*Alberta MRDA)

[685] *Mines and Minerals Act 2000 RSA 2000 Chap M-17* Sec 16. (Alberta M&M).

4.1 (a) Legislation

The *Mines and Minerals Act 2000* deals mainly with oilsands and gas but does have some generic rehabilitation clauses.[686] The Act establishes a Reclamation Stewardship Fund to be used:

> (a) for the purposes of monitoring the behaviour of captured carbon dioxide that has been injected pursuant to an agreement under this Part; (b) for the purposes of fulfilling any obligations that are assumed by the Crown pursuant to section 121(1)(b); 122(1)(c) for the purposes of paying for suspension costs, abandonment costs and related reclamation or remediation costs in respect of orphan facilities where the work is carried out (i) by the Regulator, (ii) by a person authorized by the Regulator, or (iii) by a Director or a person authorized by a Director in accordance with the *Environmental Protection and Enhancement Act*; (d)for the purposes of paying for costs incurred in pursuing reimbursement for the costs referred to in clause (c) from the lessee responsible for paying them; (e) for any other purpose prescribed in the regulations.[687]

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[686] *Ibid.*

[687] *Ibid.* Sec 122(2).

A similar fund called the Environment Protection Security Fund is established under the *Environmental Protection and Enhancement Act* 2000,[688] which receives funding from:

> All security required to be deposited with the Government in respect of an approval, a code of practice, a registration, a certificate of qualification or a certificate of variance or under section 88.2, 97, 135, 174 or 189 or with respect to an approval or licence under the Water Act shall be paid into the Environmental Protection Security Fund.[689]

A financial security may be required by Regulations authorised by the Lieutenant Governor in Council.[690]

Knowingly releasing a substance into the environment beyond the approved site is prohibited under section 109(1) of the *Mines and Minerals Act 2000*, but section 109(2) prohibits any release of a "substance that in an amount, concentration or level or at a rate of release that causes or may cause a significant adverse effect".[691] In the case where a substance is released, the responsible person shall:

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[688] See *Environmental Protection and Enhancement Act 2000, RSA 2000 Chap E-12* Sec 32(1).

[689] *Ibid.* Sec 32(2).

[690] *Ibid.* Sec 86(1)(d) & 88.2(1).

[691] See *Alberta M&M* Sec 109(1) & (2).

> (a) take all reasonable measures to (i) repair, remedy and confine the effects of the substance, and (ii) remediate, manage, remove or otherwise dispose of the substance in such a manner as to prevent an adverse effect or further adverse effect, and (b) restore the environment to a condition satisfactory to the Director.[692]

A site where a substance has caused significant adverse effect to the environment may be designated a contaminated site.[693] The person responsible for a contaminated site must prepare a remedial action plan for the contaminated site.[694]

The purposes of the *Mineral Resource Development Act* 2021 include provision of an "economic, orderly, efficient and responsible development in the public interest of mineral resources in Alberta."[695] Furthermore, the development of the mineral resources should "control pollution and […] ensure the protection of the environment."[696] The purpose is to "provide for the responsible management of wells, facilities, well sites. Facility sites, *mines, mine sites, external mine discard dumps and processing plants*[697] throughout their life cycle."[698]

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[692] *Ibid.* Sec112(1).

[693] *Ibid.* Sec 112(1)(5).

[694] *Ibid.* Sec 128(1) (a).

[695] Alberta MRDA, *supra,* note 684 Sec 2(a).

[696] *Ibid.* Sec 2(g)., the Act still focusses on the oil sands extraction as did the Mines and Minerals Act 2000, which was not repealed by the Mineral Resource Development Act 2021.

[697] Emphasis added.

[698] *Ibid.* Sec 2(c).

Part 3 of the Act applies specifically to "Mines, Mine Sites and Processing Plants."[699] To develop a mine, or resume operations at a suspended mine site, a permit is required.[700] To construct or operate an external discard dump or resume operations at a suspended site, a licence is required.[701] Similar restrictions on constructing a processing plant or resumption of operations at a suspended processing plant requires approval.[702] Failure to comply with the Act may result in the cancellation or suspension of the permit, licence, or approval.[703] Without prior permission from the Regulator, no part of the operations a mine or mine site or processing plant may be suspended for more than 3 months.[704] Abandonment is not permitted without the Regulator's permission.[705] On the other hand, the Regulator may order the suspension or abandonment of a mine, mine site, external mine discard dump, or processing plant,[706] where the "Regulator considers it necessary to do so in order to protect the public or the environment or for any other purposes set out in the regulations."[707] The owner is, in this case, still responsible for the control of the mine and its operations.[708]

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[699] *Ibid.* Part 3.

[700] *Ibid.* Sec 27(1).

[701] *Ibid.* Sec 28 (b) & (c).

[702] *Ibid.* Sec 29.

[703] *Ibid.* Sec31(a).

[704] *Ibid.* Sec 32(1) (a) & (b).

[705] *Ibid.* Sec 32(1) (c) & (d).

[706] *Ibid.* Sec 33(1).

[707] *Ibid.* Sec 33(3).

[708] *Ibid.* Sec 35.

Under the Act, the regulator is granted significant authority to make rule as to the suspension or abandonment of a mine,[709] and take measures to ensure mines "are left in a permanently safe and secure condition,"[710] and the "amount and form of deposits and security to guarantee the proper and safe suspension, abandonment, and reclamation of mines[…]and how they may be used, retained, forfeited and returned."[711]

4.1(b) Regulations

The Regulations concerning post-mining treatment may be found in the Mine Closure Regulations issued under the *Mines and Minerals Act 2000.* There are as yet no Regulations issued under the *Mineral Resource Development Act 2021*. The Regulations are purely administrative and relate mainly to the advanced extraction of hydrocarbons (fracking). The Alberta Energy Regulator (AER) is responsible for regulating post-mining treatment activities on both private and public land.[712] Under the *Environmental Enhancement and Protection Act 2000*, "companies must do everything they can to return the land to a state functionally equivalent to what it was before the development took place"[713].

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[709] *Ibid.* Sec 54(1)(dd).

[710] *Ibid.*

[711] *Ibid.* Sec 54(1)(kk).

[712] "Reclamation and Remediation Fact Sheet", online:<https://static.aer.ca/prd/documents/enerfaqs/RecRem_FS.pdf>.

[713] *Ibid.*

There are two Regulations under the *Environmental Enhancement and Protection Act 2000 (EPEA),* that pertain to post-mining treatment and remediation: Alberta Regulation 115/1993 and Alberta Regulation 154/2009. The objective of the former is to ”return the specified land to an equivalent land capability”.[714] Equivalent land capability means ”that the ability of the land to support various land uses after conservation and post-mining treatment is similar to the ability that existed prior to an activity being conducted on the land, but that the individual land uses will not necessarily be identical.”[715] In order to accomplish this, an operator is required to provide security.[716] The amount of security required is determined by the Director based on:

> (a) the estimated costs of conservation and reclamation submitted by the operator, (b) the nature, complexity and extent of the activity, (c) the probable difficulty of conservation and reclamation, giving consideration to such factors as topography, soils, geology, hydrology and revegetation, and (d) any other factors the Director considers relevant.[717] Separate securities may be required for different portions of the land,[718] and the Director may require an updated estimate of the security.[719] The form of the security may be:

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[714] See *Alta Reg 115/93* Sec 2.

[715] *Ibid.* Sec 1(e).

[716] *Ibid.* Sec 17(1).

[717] *Ibid.* Sec 18(1).

[718] *Ibid.* Sec. 19.

[719] *Ibid.* Sec 20.1(1).

> (a) cash; (b) cheques and other similar negotiable instruments payable to the President of Treasury Board and Minister of Finance; (c) Government guaranteed bonds, debentures, term deposits, certificates of deposit, trust certificates or investment certificates assigned to the President of Treasury Board and Minister of Finance; (d) irrevocable letters of credit, irrevocable letters of guarantee, performance bonds or surety bonds in a form acceptable to the Director; (d.1) qualifying environmental trusts within the meaning of subsection 248(1) of the *Income Tax Act (Canada)*; (e) any other form that is acceptable to the Director.[720]

The security may be returned when a reclamation certificate is issued.[721] Conversely, if the operator fails to comply with an environmental protection order and, in the Minister's opinion, interferes with the conservation of the land, the security may be forfeited,[722] with the funds being transferred to the General Revenue Fund.[723] The

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[720] *Ibid.* Sec 21. Cf *Ontario Mining Act* Sec. 145(1)

[721] *Ibid.* Sec 22(1).

[722] *Ibid.* Sec 24(1).

[723] *Ibid.* Sec 24(3).; this is in sharp contrast to the Australian practice of transferring the forfeited security to a fund for reclamation of mines.

Minister is not obligated to carry out conservation and post-mining treatment of the specified land.[724]

The second Regulation - Alberta Regulation 154/2009 - deals with the release of a substance into the environment and the remediation required to meet the Alberta Groundwater Remediation Guidelines.[725]

Thus, Alberta's Regulations provide much-needed detail with respect to the types of remediation required and the means by which this remediation will be paid.

4.1 (c) Guidelines

Much has been written regarding the remediation of oil sands mining sites.[726] The most relevant to rehabilitation is the Alberta Government's "*Criteria and Indicators Framework for Oil Sands Mine Reclamation Certification.*" A reclamation certificate is required under the *Environmental Protection and Enhancement Act 2018* when it is determined that reclamation is complete, and the former oil sand mining site may be returned to the

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[724] *Ibid.* Sec 24(7).

[725] See *Alta Reg,154/2009.*

[726] See generally*, "Criteria and Indicators Framework for Oil Sands Mine Reclamation Certification - July 2013" (2014).(*Alta. Guide.); Andries Benjamin Fourie, ed*s, Mine Closure 2011:* Pr*oceedings of the 6th International Conference on Mine Closure ; 18 - 21 September 2011, Lake Louise, Alberta, Canada (Nedlands, WA: Australian Centre for Geomechanics, 2011).;*R Holmes & G Stewart, *A guidance document for mine closure and management of long-term liabilities – examining a policy framework in Canada (Perth: Australian Centre for Geomechanics, 2011).;* T C Richens et al*, Regulatory requirements for reclamation and closure planning at Alberta's oil sands mines (*Australian Centre for Geomechanics, 2011*).*

province.[727] Once the certificate is issued, the operator is relieved of further post-mining treatment responsibility on the reclaimed land.[728] The goal of the framework is taken from the refinement of the EPEA operating approvals.[729] Of the 1,366.5 km^2 of approved oil sands footprint, only 1.0 km^2 have received certification.[730] The framework was developed to speed up the certification process and to apply the "reclamation criteria in a fair and consistent manner."[731]

The framework consists of:

> 1. Reclamation objectives, criteria, measures and methods based on current knowledge, best practices and technology. 2. [and a] management system to guide the use of criteria and indicators, compatible within Alberta's regulatory environment, to support oil sands mine reclamation certificate decisions.
>
> The intent of the framework is to provide a common approach across all oil sands mines to; support tracking the progress of reclamation, implement adaptive management activities when required, support determination of compliance with approval

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[727] Alta. Guide*, supra* note 726 at vi.

[728] *Ibid.* at *10.*

[729] Holmes, *supra* note 726.

[730] *Ibid.* at 10*.*

[731] *Ibid.*

> conditions and assess over-all reclamation success to meet the regulatory requirements of equivalent land capability.[732]

The framework is designed to be compatible with Alberta's "regulatory system which is built around a progressive and collaborative approach".[733] The framework is designed to be adaptive, in the case of unforeseen events over the period of the mine life, which may exceed 25 years.[734]

The Alberta Government prescribes the post-mining treatment goal or final result of the post-mining treatment effort at the time of the mine approval.[735] "The criteria and indicators framework defines the conditions that determine a successful reclamation. The purpose towards which the reclamation is directed is the objective".[736] The criteria describe the category of conditions or process by which achievement of a reclamation objective is assessed. There may be multiple criteria for an objective. "Indicators define an attribute that can be measured or described and are used to evaluate if a criterion has been achieved. Monitoring enables the evaluation of the reclamation success and inform adaptive management responses."[737]

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[732] *Ibid.* at 11.

[733] *Ibid.*

[734] *Ibid.*

[735] *Ibid.* at 13.

[736] *Ibid.*

[737] *Ibid.* at 14.

The goals that have been prescribed by the Alberta government are in the *Environmental Protection and Enhancement Act 2000*: mine approval may take place when "reclaimed soils and landforms are capable of supporting a diverse self-sustaining, locally common boreal forest landscape, regardless of the end land use."[738] From this goal, three objectives have been established for reclamation; namely:

> Objective 1. Reclaimed landscapes are established that support natural ecosystem functions.
>
> Objective 2. Natural ecosystem functions are established on the reclaimed landscape.
>
> Objective 3. Reclaimed landscapes support an equivalent land capability appropriate to the approved end land uses.[739]

Under this framework, the underlying premise is that "if criteria and objectives are achieved, the reclamation site is trending towards meeting the goal, subsequently fulfilling the regulatory requirement of equivalent land capability."[740]

4.1 (d) Coherence with Sustainable Development Principles

Alberta is one of the few provinces where the legislation and guidelines seek to implement the four sustainable development principles. The no harm principle is

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[738] *Ibid. at* 26.

[739] *Ibid.*

[740] *Ibid.* at 27.

demonstrated in the prohibition of knowingly releasing a substance that may cause a significant adverse effect on the environment.[741] Alberta Regulation 115/1993 requires that the land must be returned to the equivalent land capability after conservation and post-mining treatment,[742] and, together with the requirement in the same Regulation to post security dependent on the type of landform,[743] exhibits the principle of common but differentiated responsibilities. The precautionary principle is evident in the "*Criteria and Indicators Framework for Oil Sands Mine Reclamation Certification",* in that it is built around a progressive and collaborative approach to remediation.[744] Finally, the polluter pays principle is shown in that the operator of a mine must provide security to cover the costs of conservation and post-mining treatment.[745]

4.2 British Columbia

British Columbia was Canada's largest mineral producer by value in 2021.[746] The province was the site of a massive tailings dam accident at Mount Polley,[747] resulting in

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[741] Alberta M&M*, supra* note 685 Sec 109(1) & (2).

[742] Alta Reg*. supra* note 714 Sec 2.

[743] *Ibid.* Sec 19.

[744] Alta. Guide. *supra* note 726 at11.

[745] Alta Reg. supra note 714 Sec 17(1).

[746] Natural Resources Canada, *"Minerals and the economy", (*25 January 2023), online: <https://natural-resources.canada.ca/our-natural-resources/minerals-mining/mining-data-statistics-and-analysis/minerals-and-the-economy/20529> .

[747] Ministry of Environment and Climate Change Strategy*, "Mount Polley Mine Tailings Dam Breach - Province of British Columbia",* online: <https://www2.gov.bc.ca/gov/content/environment/air-land-water/spills-environmental-emergencies/spill-incidents/past-spill-incidents/mt-polley>.

changes to the legislation being implemented. That legislation is reviewed along with the regulations and guidelines.

4.2 (a) Legislation

The British Columbia *Mines Act* 1996,[748] "applies to all mines during exploration, development, construction, production, closure, *reclamation* and abandonment."[749] An abandoned mine is one where "all permit obligations under the Act have been satisfied and in respect of which the mineral claims have reverted to the government."[750] When obtaining a permit to exploit a resource, the owner must file a plan with an inspector outlining the work plan and a program for the "conservation of cultural heritage resources and for the protection and reclamation of the land, watercourses and cultural heritage resources affected by the mine […]".[751]

In addition, the owner may be required to post security for "(a) for mine reclamation, and (b) to provide for protection of, and mitigation of damage to, watercourses and cultural heritage resources affected by the mine."[752] Failure to comply with the terms and conditions, including reclamation, to the satisfaction of the chief inspector, may result in an order requiring the owner to stop operations and the chief inspector may cause the

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[748] *The Mines Act 1996, RSBC 1996, Chap 293,* (BC Mines) Sec 2

[749] Emphasis added.

[750] *Ibid.* Sec 1.

[751] *Ibid.* Sec 10 (1). The reference to cultural heritage is similar to the Acts of South and Western Australia and probably reflects that there are no treaties with the First Nations in British Columbia.

[752] *Ibid.* Sec 10 (4).

work to be done, applying all or part of the security to the cost of the work and if necessary close the mine and cancel the permit and may find the owner legally responsible for damages caused.[753]

The Lieutenant Governor in Council may establish a Mine Reclamation Fund, financed by payment, in money, by the owner.[754] The Minister may use the Fund to pay for the work to mitigate damage done to watercourses and cultural resources.[755] The Minister may also pay out of the Fund money and interest, where the chief inspector considers that the fund is no longer required to remediate the mine, or watercourses affected by the mine.[756]

4.2 (b) Regulations

The Regulations governed by the *Mines Act 1966* are contained in the *Health, Safety and Reclamation Code.*[757] Part 10 is specific to reclamation, with Section 10.6 concentrating on mine closure. The requirements are detailed. An owner must give no less than 7 days notice of intent to stop work in, on, or about a mine.[758] When mining operations ease, the operator is required to continue with the permit conditions and maintain and monitor

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[753] See BC Mines *supra* note 748 Sec 10.1.*;"CEO of defunct Banks Island Gold guilty of environmental violations at British Columbia mine", (14 July 2023),* online: MININGCOM <https://www.mining.com/ceo-of-defunct-banks-island-gold-guilty-of-environmental-violations-at-british-columbia-mine/>.

[754] See BC Mines Sec 12(2).

[755] See BC Mines Sec 12 (4)(b).

[756] *See BC Mines* Sec 12(4)(a).

[757] See *Mines Act of BC , Health, Safety and Reclamation Code,* 2016, 10.

[758] *Ibid.* Sec 10.6.1.

the site.[759] If operations cease for more than one year, a new plan must be submitted to an inspector for approval, identifying hazards and make plans available to local emergency organizations.[760] Within 90 days of closure, the inspector must be provided with plans of the surface and underground workings, identifying any underground workings that come within 25 metres of the surface.[761] All practical measures shall be taken to prevent "inadvertent access to mine entrances, pit and openings that are dangerous[..]".[762] Specific steps for securing dumps, impoundments, tailings storage facilities, spillways and landforms are listed.[763] The conditions for return of security are specified.[764]Progressive reclamation is required to be instituted in accordance with the standards specified in the code.[765] The land surface is to be reclaimed to an end land use approved by the chief inspector that is similar to previous or potential uses.[766] Watercourses and access roads must be "left in a manner that ensures long-term physical and geochemical stability."[767] The land must be revegetated to "a self-sustaining states using appropriate plant species."[768] The owner, agent or manager must establish a

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[759] *Ibid.* Sec 10.6.2(1).

[760] *Ibid.* Sec 10.6.2(2).

[761] *Ibid.* Sec 10.6.3.

[762] *Ibid.* Sec 10.6.4.

[763] *Ibid. Sec* 10.6.4 to 10.6.14.

[764] *Ibid.* Sec 10.6.15 & 16.

[765] *Ibid.* Sec 10.7.1 to 10.7.20.

[766] *Ibid.* Sec 10.7.4.

[767] *Ibid*. Sec 10.7.6.

[768] *Ibid.* Sec 10.7.7.

monitoring program to demonstrate to the chief inspector that the reclamation objectives have been attained, upon which the responsible person will be released from all further obligations under the *Mines Act.*[769]

4.2 (c) Guidelines

The guidelines regarding reclamation are designed for handling of spills occurring during oil and gas operations and do not relate to mining operations.[770] They therefore are not helpful with respect to the focus of this thesis.

4.2 (d) Coherence to Sustainable Development Principles

British Columbia's legislation and regulations address two of the four core sustainable development principles identified in Chapter 1. The no harm principle is reflected in the rules relating to the conservation of cultural heritage resources and the protection and reclamation of the land.[771] This same protection of cultural heritage may also be considered as reflecting the precautionary principle: the polluter is required to pay by the fact that the owner must post security for mine reclamation and damage mitigation.[772] Also, a Mine Reclamation Fund is established, with the owner being required to finance the Fund.[773]

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[769] *Ibid.* Sec 10.7.21&22.

[770] See *Site Remediation and Reclamation Manual, by BC Oil and Gas Commission, v 1.60 (2022).*

[771] BC Mines *supra* note 748 Sec.10(1).

[772] *Ibid.*

[773] *Ibid. Sec. 12(2).*

4.3 Manitoba

Manitoba' mining industry is centred around Thompson/Flin Flon in the north centre of the province, where base metals (copper, zinc and nickel) are produced.[774] The following subsections describe the legislation, regulations and guidelines for mining reclamation in Manitoba.

4.3 (a) Legislation

The purpose of *The Mines and Minerals Act 1991*[775] "is to provide for, encourage, promote and facilitate exploration, development and production of minerals and mineral product in Manitoba, consistent with the principles of sustainable development,"[776] as expressed in section 2(2) of the Act. As with other Acts from former British colonies, the ownership of mineral resources is vested in the Crown.[777]

Under this Act, the Director of Mines has the right to order or withhold permission to proceed with certain activities until plans to rehabilitate are filed or a security is

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[774] *"Manitoba...rocks! | Kids Rock! | Manitoba Rocks! | Manitoba Economic Development, Investment and Trade | Province of Manitoba",* online: <https://www.gov.mb.ca/iem/min-ed/kidsrock/mrocks/index.html>.

[775] *The Mines and Minerals Act, C.C.S.M. c. M162, 1991.*

[776] *The Mines and Minerals Act 1991 C.C.S.M. c.M.162 (*Man Mine) Sec 2.1.

[777] See Man Mine Sec2(1*).*

deposited.[778] The lessee is responsible for the rehabilitation of a site, even after the mineral lease has expired, been surrendered, or cancelled.[779]

Manitoba follows a regime of progressive rehabilitation, which is imposed on the proponent of a project.[780] This obligation continues regardless of the operations being discontinued or closed.[781] If the Minister issues an order under section 193(3),[782]and the Director of Mines is of the opinion that the rehabilitation work is not proceeding, that person may order that rehabilitation work be done,[783] and may use funds from the rehabilitation funds to meet the costs of the rehabilitation.[784] The money collected as rehabilitation security is deposited in a Mine Rehabilitation Fund,[785] and it is from these funds that the Minister may cover the costs of rehabilitation if the Minister issues an order under section 193(3).[786]

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[778] Man Mine Sec 74(2) for advanced exploration sites and Sec 111(2)(a) and (b).

[779] *Ibid.* Sec 127(10)(b).

[780] *Ibid.* Sec 188.

[781] *Ibid.* Sec 189 (1).

[782] *Ibid.* Sec 195(3).

[783] *Ibid.* Sec 193(10).

[784] *Ibid.* Sec 193(3).

[785] *Ibid.* Sec 195(1).

[786] *Ibid.* Sec 195(3).

4.3 (b) Regulations

A closure plan must be filed under section 111 of the *Mines and Minerals Act 1991*.[787] Under Manitoba's associated regulations, the plan shall consist of: the name and address of the proponent or operator; the surface rights, mineral rights, or mineral access rights associated with the mine; a description of the land disturbance which may have resulted from the operation; current activities and security measures on the site; a plan of the property and buildings; and the procedures used to evaluate compliance with the plan, during operation and closure.[788] The closure plan must include the estimated costs, both capital and operating, certified by a professional engineer, geologist or practising accountant, to rehabilitate the site and monitor it after closure.[789] Financial security in cash must accompany the plan.[790]

As well, the operator must submit an annual report to the Director, detailing the nature and extent of the rehabilitation for the previous year and an evaluation of the approved plan's ability to properly rehabilitate the site.[791] A proponent of a mine who intends to suspend or close the operation of a mine for not less than 90 days, must give written notice to the Director no less than 90 days prior to the suspension or closure.[792] The

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[787] *Mine Closure Regulations 67/99.,* Sec 7.; Man Mine, *supra* note 778.

[788] See *Ibid.* Sec 9.

[789] *Ibid.* Sec 18(1) & (2).

[790] *Ibid.* Sec 19.

[791] *Ibid.* Sec 10.

[792] See *Mine Closure Regulations 67/99*, *supra* note 784. Sec 6.

proponent must take all preventative measures possible to avoid personal injury, damage to property or environment.[793] The measures to be taken must be signed under seal by a professional engineer.[794]

4.3 (c) Guidelines

Manitoba's *General Closure Plan Guidelines*[795] are not designed to replace the regulations, but to emphasize the main requirements of the Act and Regulations relating to mine closure plans.[796] The aim of rehabilitation is to eliminate unacceptable health hazards and ensure public safety, limit the production and circulation of substances that could damage the receiving environment and, in the long-term, eliminate the need for maintenance and monitoring, restore the site to a condition in which it is visually acceptable to the community and, reclaim for future use the areas where infrastructures are located.[797] "All areas affected by mining activities (building sites, tailings ponds, sedimentation ponds, waste rock piles, etc.) must be revegetated to control erosion and restore the site's natural condition."[798] Contaminated soil must be

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[793] *Ibid.* Sec 15(1).

[794] *Ibid.* Sec 16.

[795] *"General Closure Plan Guidelines | Mines (Regulatory) | Resource Development | Economic Development, Investment and Trade | Province of Manitoba",* online: <https://www.manitoba.ca/iem/mines/acts/closureguidelines.html>.

[796] *Ibid.*

[797] *Ibid.*

[798] *Ibid.*

removed and placed in a designated and properly managed contaminated area which will not cause harm to public health and the environment.[799]

All infrastructure must be removed above ground level and topped with material to promote revegetation.[800] Where feasible, open pits must be backfilled and fenced if not backfilled.[801]

4.3 (d) Coherence with Sustainable Development Principles.

Embedded in purpose of the Act is the desire of the government to produce "minerals and mineral products,[…] consistent with the principles of sustainable development".[802] However, the Act's definition of sustainable development is weighted towards the development side of the scales rather than the sustainable side. Under the Act, the no harm approach is evident, in that mining activity decisions must respect the "protection and management of the environment […] for the benefit of present and future generations.[803] As well, the precautionary principle is reflected, in that hazards to the environment must be prevented and policies, "programs and decisions that have a significant adverse environmental […] impact,[804] must be avoided. A progressive rehabilitation regime must additionally be adopted.[805] A Mine Rehabilitation Fund is

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[799] *Ibid.*

[800] *Ibid.*

[801] *Ibid.*

[802] Man Mine*, supra* note 776 Sec. 2(2).

[803] *Ibid,* Sec. 2(2)(b).

[804] *Ibid.* Sec. 2(2)(d).

[805] *Ibid.* Sec. 189(1).

created with monies deposited as security by the owner, which is indicative of the polluter pays principle.[806]

4.4 New Brunswick

New Brunswick, has a relatively young mining industry, commencing with the opening of Heath Steel, producing copper, zinc and lead in 1957, The world class Bathurst camp started in production in 1964, also producing copper, zinc and lead.[807] Potash was produced in 1986, until 2016.[808]

4.4 (a) Legislation

New Brunswick's *Mining Act 1985* does not state any objectives but does vest the minerals of the province in the Crown.[809] Under the Act, a holder of a mineral claim may apply for a mining lease with a program for the post-mining treatment and rehabilitation of the environment, and give a security for the costs with respect to the protection, post-mining treatment, and rehabilitation of the environment.[810]

The lessee shall:

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[806] *Ibid.* Sec. 195(1).

[807] "New Brunswick government can help mining sector satisfy global demand for minerals: op-ed", (24 July 2023), online: *Fraser Institute* <https://www.fraserinstitute.org/article/new-brunswick-government-can-help-mining-sector-satisfy-global-demand-for-minerals>.

[808] "*Sussex Mine"*, online: <https://mininglifeonline.net/company/sussex-mine/7566>.

[809] *The Mining Act, 1985, S.N.B. 1985, c M-14.1, (*NB Mine), Sec 2(1).

[810] *Ibid.* Sec 68(1)(c)(i)) &(iv)C.

> (a) institute and carry out a program for the protection of the environment affected by the mining operation under the lease; and
>
> (b) undertake and complete a program for the reclamation and rehabilitation of the environment affected by the mining operation and to leave the environment in a condition satisfactory to the Minister.[811]

When a mining lease expires, is surrendered, or cancelled, in New Brunswick, the lessee is responsible for any monies owing with respect to the rehabilitation or reclamation of the lands as soon as the lease terminates.[812]

Before causing any damage to the use and enjoyment of property other than Crown Lands, the lessee must obtain the agreement of the landowner and the Recorder to a rehabilitation program and pay the proscribed security.[813] Any security placed with the province is credited to a Mine Reclamation Fund.[814] This Fund may be used for:

> (a) performing such work as is considered necessary by the Minister and required by the relevant program for the protection, reclamation and rehabilitation of the environment approved by the Minister, and

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[811] *Ibid.* Sec 78. Whether the program has to be a progressive rehabilitation program, is unclear.

[812] *Ibid.* Sec 88.

[813] *Ibid.* Sec 109 (1) & (3.1). The Recorder keeps records of mining leases, agreements and all "instruments affecting mining leases and claim maps showing the location of land covered by mining leases". Sec 14(3).

[814] *Ibid.* Sec 111.2(1).

> (b) refunding any residual money, including interest, to the holder of the mining lease or the operator of the mine, or anyone acting on behalf of such person, when the Minister has determined that the money is no longer required as security.

In addition to the legislation, the Lieutenant-Governor in Council may make regulations regarding reclamation and rehabilitation at any time.[815]

4.4 (b) Regulations

New Brunswick's General Regulations enacted under the M*ining Act 1985,* has several parts, including "fees, charges, rents, royalties and interest; staking and recording mineral claims; required work; reports of work; mining development and reclamation; security; confidentiality; special lands and New Brunswick mineral and petroleum grid".[816] Only the parts regarding reclamation and security are germane to the discussions of this thesis.

Mining is defined by the Regulations as:

> searching for or obtaining a mineral or mineral-bearing substance by disturbing, removing, crushing, washing, sifting, concentrating, roasting, dissolving, leaching, smelting, refining, reducing or otherwise treating or dealing with soil, earth, rock, stone or other material whether or not the soil, earth, rock, stone or other

[815] *Ibid.* Sec 115(1).

[816] See *NB Reg 86-98.* The grid determines the location of NB mineral claims.

> material has been previously disturbed, removed, crushed, washed, sifted, concentrated, roasted, dissolved, leached, smelted, refined, reduced or otherwise treated or dealt with[.][817]

The owner is required to inform the Minister of any failure of a dam of tailings pond, subsidence of underground mine workings, and contamination of the environment caused by mining operations, which is in excess of the *Clean Environment Act 1973.*[818] Plans of the property and underground workings must be updated quarterly and filed annually with the Minister,[819]and updated plans must be filed if operations will be discontinued or any part of the mine will be made inaccessible.[820] A program for the protection, reclamation and rehabilitation of the environment must be submitted to the Minister for a mining lease.[821] This program must include, *inter alia*, "the potential uses for the lease after the mine has ceased operation".[822] This program is referred to as the mining plan[823] and includes a "detailed analysis of the potential hazards to the environment and plant and animal life of the lease area and surrounding area associated with the mining operation",[824] along with "a detailed description and a schedule of the

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[817] *Ibid.* Sec 23(c).

[818] *Ibid.* Sec 24(a), (c), and (d).

[819] *Ibid. Sec 25.*

[820] *Ibid.* Sec 26(4).

[821] NB Mine *Supra* note 809, Sec 66(1)(c)(i).

[822] *NB Reg 86-98,* Sec 30(2)(k).

[823] *Ibid.* Sec 30(3).

[824] *Ibid.* Sec 30(3)(l).

planned procedure for protection, reclamation and rehabilitation of the lease area, including, where applicable monitoring the environment, backfilling, contouring, benching, sloping, grading, seeding and reforestation.[825] When a mine ceases working and is abandoned, the owner may be required "to cover or fence the top of the shaft or other pits and openings, which the Minister considers dangerous due to their depth or other conditions."[826] Security given under the *Mining Act* for compensation for actual damage caused by the lease owner is set at $10,000 per mining lease.[827] Security with respect to the payment of costs for protection, reclamation and rehabilitation of the environment during and on discontinuance of mining, is set at "one thousand five hundred dollars per hectare of Crown Lands to be disturbed, and three thousand dollars per hectare of private land to be disturbed."[828] The final concept of the mine site at closure, will include how tailings ponds will be reclaimed and potential land uses post mine closure.[829] Post closure security and monitoring will complete the report.[830]

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[825] *Ibid.* Sec 30(3)(n).

[826] *Ibid.* Sec 37(1).

[827] *Ibid.* Sec 43(1).

[828] *Ibid.* Sec 43(2)(a) and (b).

[829] *Ibid.*

[830] *Ibid.* at 6.

4.4 (c) Guidelines

The government has issued a *Guide to the Development of a Mining and Reclamation Plan in New Brunswick.*[831] The intent of this guide is to assist in the creation of a mining and reclamation plan that allows for the evaluation of environmental risks associated with a mining project and ensures progressive rehabilitation.[832] The mining plan should include a description of the progressive reclamation program that will be implemented, with objectives and timelines.[833] The reclamation plan describes "how all buildings will be demolished and disposed of", as well as how roads, railways, and other means of access will be removed.[834] The description of the site rehabilitation will include how the land will be recontoured to reduce hazards and achieve water management to enable revegetation, as well as what efforts will be expended to establish "effective ground cover for revegetation".[835]

4.4 (d) Coherence with Sustainable Development Principles

New Brunswick is therefore one of only three Canadian provinces to reflect all four sustainable development principles in its mining laws and guidelines. In particular, the no harm principle is seen in the requirement that any mining program must protect the

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[831] See *Guide to the Development of a Mining and Reclamation Plan in New Brunswick.,* by Department of Energy and Resource Development (Province of New Brunswick).

[832] *Ibid.* at 1 and 4.

[833] *Ibid. at 4.*

[834] *Ibid.* at 5.

[835] *Ibid.*

environment and include a reclamation and rehabilitation plan for the environment.[836] The Act carves out the Grand Lake coal mining district under the *Grand Lake Development Act 1968*,[837] which establishes a reclamation plan for mines in the area, [838] and demonstrates the common but differentiated responsibility principle. The *Guide to the Development of a Mining and Reclamation Plan in New Brunswick* includes the precautionary approach principle in section 2.4, which incorporates progressive rehabilitation into the mine development process.[839] Finally, the polluter pays principle is demonstrated by the requirement to place security in a Mine Reclamation Fund.[840]

4.5 Newfoundland

Newfoundland and Labrador has a varied mining industry, from the world class iron ore deposits of western Labrador around Wabush and Labrador City, to the newly developing gold mines in central Newfoundland.[841] The legislation, regulations, and guidelines regarding rehabilitation are presented in the following sub-sections.

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[836] *NB Mine supra* note 809 Sec. 78.

[837] *Ibid.* Sec. 132.

[838] *Ibid.* Sec 10 e.

[839] *Department of Energy and Resource Development, supra* note 831.

[840] NB Mine *supra* note 809 sec 111.2(5).

[841] Jackson Chen, "Marathon Gold on schedule to begin production in early 2025", (4 May 2023), online: *The Northern Miner* <https://www.northernminer.com/news/marathon-gold-on-schedule-to-begin-production-in-early-2025/1003854759/>.

4.5 (a) Legislation

The *Mining Act 1999* is unique in terms of rehabilitation among the Acts reviewed in this chapter, in that it deals almost exclusively with rehabilitation. Under the Act, rehabilitation is defined as taking measures in accordance with the standards prescribed by the regulations with respect to a site so that the use or condition of the site.

(i) is restored as close as is reasonably possible to its former use or condition,

(ii) is restored to a condition that is acceptable to the Minister, or

(iii) is made suitable for a use that the Minister considers appropriate.[842]

When applying for a lease to operate a mine, the applicant must submit a rehabilitation and closure plan, as well as financial assurance as required by the Minister.[843] The plan, which has been reviewed by a qualified person,[844] must contain a progressive rehabilitation program, too which the lessee is expected to adhere.[845] If the Minister considers the rehabilitation is not progressing as per the plan, they may impose

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[842] *The Mining Act, NLSC 1999, Chap M15-1, (*NL Mine) Sec2(o).

[843] See NL Mine*, Sec 4.*

[844] See NL Mine, sec 10(2).

[845] See NL Mine, Sec 9.

requirements on the lessee and, if not adhered to within a reasonable time, the Minister may issue a stop work order and the project must cease operation.[846]

The financial assurance given to the Minister may be in the form of:

> (a) cash; (b) a letter of credit from a bank named in Schedule I of the *Bank Act* (Canada);(c) a bond; (d) an annual contribution to a financial assurance fund established for the project;[847] or
>
> (e) another form of security acceptable to the Minister.[848]

An inspector is appointed to monitor the operations with respect to the rehabilitation and closure plan.[849] If, in the inspector's opinion, the rehabilitation or closure is not proceeding, the Minister may enter onto the site to implement a rehabilitation program.[850] In such an instance, the cost involved with the rehabilitation may be recovered from the financial assurance.[851] Finally, the lessee is responsible for the rehabilitation upon expiry or cancellation of a lease until the project has been closed out to the satisfaction of the Minister.[852]

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[846] See NL Mine, Sec 9(4) & (5).

[847] Cf Ont. Mine, Sec 145.1.

[848] NL Mine, Sec 10(3).

[849] See NL Mine, Sec 11(2).

[850] See NL Mine, Sec 13(1).

[851] See NL Mine, Sec 13(3).

[852] See NL Mine, Sec 14(1).

4.5 (b) Regulations

Newfoundland and Labrador's Regulations present the form which the development, operational and rehabilitation and closure plans must follow. The rehabilitation and closure plan must describe the "work to be done; [along with] the detailed scheduling and cost of all rehabilitation and closure activities".[853] The plan should also consider "the intended use and ownership" after mining has ceased.[854] All rehabilitated areas must be revegetated.[855] As well, financial assurance is based on the rehabilitation and closure plan.[856]

4.5 (c) Guidelines

The *Guidelines to the Mining Act* give proponents a template for submitting applications for mining leases including rehabilitation and closure plans.[857] Development plans submitted for a mine lease must include 'a description of tailings disposal method and description of tailing impoundment area showing total volume available for disposal and anticipated active life of the area",[858] accompanied by a description of the methods used for treatment of effluents.[859]

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[853] *Nfld. Reg42/00,* Sec 7(2)(a)&(b)

[854] *Ibid.* Sec 7(3).

[855] *Ibid.* Sec 7(4).

[856] *Ibid.* Sec 8(1).

[857] See *"Guidelines to the Mining Act Part 1".Government of Newfoundland and Labrador.*

[858] *Ibid.* Sec 9(j).

[859] *Ibid.* Sec 9(1)(k).

The rehabilitation and closure plan must include plans to

> rehabilitate all tailings impoundment areas;[860] rehabilitate all waste rock areas and ore stockpile areas;[861] […] remove all power transmission lines, poles, substations, transformers and associated electrical infrastructure[…];[862] remove all buildings, headframes, and other structures including their foundations[…];[863] backfill all shafts, raises, portals or stopes open to the surface[…];[864] openings shall be capped with reinforced concrete;[865][and] rehabilitate all open-pits[…].[866]

Sites should be progressively rehabilitated including:

> [R]e-vegetation of disturbed areas[…,] re-vegetation of abandoned or filled mine waste area including tailings impoundment areas;[867] removal and/or disposal of any obsolete structures and materials[…];[868] backfilling of approved underground or surface

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[860] *Ibid.* Sec 12(1)(a).

[861] *Ibid.* Sec 12(1)(b).

[862] *Ibid.* Sec 12(1)(d)

[863] *Ibid.* Sec 12(1)(e).

[864] *Ibid.* Sec 12(1)(f).

[865] *Ibid.* Sec 12(1)(g).

[866] *Ibid.* Sec 12(1)(h).

[867] *Ibid.* Sec 13(3)(a).

[868] *Ibid.* Sec 13(3)(b).

> excavations using mill tailings to reduce tailings impoundment areas;[869] […] reduce or eliminate soil erosion and stabilization of the site which will facilitate re-vegetation and reclamation;[870] and placement of waste rock in the underground workings or open pits, or by covering the waste rock with till or topsoil and then re-vegetating in an acceptable manner.[871]

In 2022, the Department of Industry, Energy and Technology started a series of discussions with interested parties on ways to improve and modernize the *Minerals Act*, "to ensure exploration for, and development of, the province's mineral resources occur in a manner that is responsible, timely,[and] sustainable[…].[872] The responses received and community consultation suggested that the purpose of the Act be expanded to include reduction of environmental impact and reflect consideration for environmental, social, and governance (ESG) matters.[873] In terms of the financial assurance that must be supplied to provide sufficient assurance to rehabilitate the project, it was felt that the current provisions of the Act were appropriate and efficient. It was suggested that a pool of funds be established to cover unexpected liabilities.[874] It was also suggested that the

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[869] *Ibid.* Sec 12(3)(c).

[870] *Ibid.* Sec 13(3)(d).

[871] *Ibid.* Sec13(3)(e).

[872] *What We Heard, by Department of Industry, Energy and Technology (February 2023).* at 1.

[873] *Ibid.* at 3.

[874] *Ibid.* at 7.

"development plans, operational plans and rehabilitation and closure plans should be articulated and entrenched in the Regulations as opposed to in guidelines".[875]

4.5 (d) Coherence to Sustainable Development Principles

As mentioned above, the *Mining Act 1999* deals almost exclusively with rehabilitation and makes no reference to the environment, so the no harm principle is excluded from the Act. The Act recognizes that small scale operations require special attention and exempts them from the Act as per the criteria in the Regulations,[876] thus includes the principle of common but differentiated responsibilities. The precautionary principle is included through the progressive rehabilitation program in the Act and Regulations.[877] The polluter pays principle is exhibited in the fact that financial assurance to cover the costs of the rehabilitation and closure plans is required.[878]

4.6 Northwest Territories

The Northwest Territories legislation regarding mining was enacted in 2019. Previously, the legislation was imposed by the federal department responsible for Northern Affairs. The developing legislation, regulations and guidelines is presented in the following sub-sections.

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[875] *Ibid.* at 9.

[876] NL Mine, *supra* note 842 Sec. 3. The criteria for exemption do not appear in the Mining Regulations 42/00.

[877] *Ibid.* Sec.8 *and Mining Regulations 42/00* Sec. 5(2)(c).

[878] *Ibid.* Sec 4.

4.6 (a) Legislation.

The *Mineral Resources Act 2019* is perhaps the newest and shortest mining legislation in Canada and was adopted from Aboriginal and Northern Affairs Canada.[879] The purpose of the Act is:

> to provide a framework for responsible and balanced mineral prospecting, exploration, development and production, while recognizing the following goals: (a) to regulate mineral interests efficiently, effectively and in a transparent manner; (b) to support the economy of the Northwest Territories; (c) to realize benefits from mineral development for Indigenous governments and organizations, communities and the people of the Northwest Territories; (d) to ensure that wealth generated by mineral resources will be used for the benefit of present and future generations of the people of the Northwest Territories; (e) to encourage positive relationships between proponents, Indigenous governments and organizations, communities and the Government of the Northwest Territories; (f) to respect Aboriginal and treaty rights; (g) to complement the systems for collaborative management of land and natural resources in the

[879] *Mining Regulations R-015-2014.*

> Northwest Territories; (h) to improve geological knowledge in the territory; (i) to recognize sustainable land use.[880]

There is no mention of rehabilitation or requirement to post a financial assurance in the Act.

4.6 (b) Regulations

The Northwest Territories Mining Regulations are published under the *Northwest Territories Land Act 2014.*[881] The majority of the Regulations apply to the establishment of mining claims, as the Territory does not, even in 2024, have a computerized land claim registry system, such as found in other provinces of Canada. The Regulations do, however, establish a mining reclamation trust or security posted [882] as a condition of a lease issued under the *Northwest Territories Land Act Regulations.*[883] Funds deposited to a mining reclamation trust are not deductible from income for the purposes of calculating exploration costs.[884] The mining reclamation trust remains an asset of the mine in the event of a change of ownership of the mine,[885] and must be reported to the Chief

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[880] *The Mineral Resources Act 2019,* (NWT Mine) sec 2.

[881] Mining Regulations R-015-2014, *supra* note 879.

[882] *Ibid.* Sec 1(1).

Ibid. Sec 1(1)(b)(ii).

[884] [884] *Ibid.* Sec 70(1)9g)(ii).

[885] *Ibid.* Sec 71(1).

inspector of Mines annually.[886] No detailed regulations as to mine closure or reclamation are contained in the Regulations.

4.6 (c) Guidelines

In 2002, the Department of Indian Affairs and Northern Development, now called Crown-Indigenous Relations and Northern Affairs Canada, issued a policy paper entitled *Mine Site Reclamation Policy for the Northwest Territories* for the protection of the environment and the disposition of liability related to mine closures in the Northwest Territories.[887] The paper was part of a departmental initiative to seek "opportunities to improve the way [the Department] carries out its resource management responsibilities."[888] The objectives of the reclamation policy are to "ensure the impact of mining on the environment and human health and safety is minimized; reduce the environmental liability that falls to government to the greatest extent possible; [and] provide industry and the public with a clear signal of the government's expectations."[889]

The policy would apply to new mines and not to activities undertaken in the prospecting and exploration stages of a mineral property.[890]

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[886] *Ibid.* Sec73(1)(j).

[887] See Mine site reclamation policy for the Northwest Territories: a policy for the protection of the environment and the disposition of liability relating to mine closures in the Northwest Territories (Ottawa: Minister of Indian Affairs and Northern Development, 2002).(AIND Canada*).*

[888] *Ibid.* at 1.

[889] *Ibid.* These are the same objectives a policy for in-situ space resources utilization may have, protect the environment and give clarity and security to space resource extractors.

[890] *Ibid.* at 4.

The principles of the reclamation policy are:

> Mine site reclamation should reflect the collective desire and commitment to operate under the principles of sustainable development, including 'polluter pays' principle. The required standard of reclamation should be based on the 1994 Whitehorse mining initiative definition:[891] returning mine sites and affected areas to viable and, wherever practical, self-sustaining ecosystems that are compatible with a healthy environment and with human activities; every new mining operation should be able to support the cost of reclamation; Adequate security should be provided to ensure the cost of reclamation, including shutdown, closure and post closure, is born by the operator the mine rather than the Crown; best management practices, including progressive reclamation, should be applied to advance environmental protection and reduce environmental risks.[892]

To achieve these objectives, every mine should have a mine closure and reclamation plan for both permanent and temporary closure that are developed as an integral part of the of the mine design planning and should be sufficiently flexible to allow adjustments

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[891] The Whitehorse mining initiative is designed to create a "socially, economically and environmentally sustainable, and prosperous mining industry, underpinned by political and Community consensus".

[892] *Ibid.* at 5.

throughout the mine life.[893] Post-closure mine owners, current or future, should continue to be responsible for the site. Financial assurance for final reclamation should be sufficient to cover the cost of a third-party reclamation of the land and water. These securities should include a mine reclamation fund and be easily liquidated by the government in the event of the insolvency of the owner.[894] Financial security for the mine site reclamation must be readily convertible to cash and remain beyond the control of the mining company and be equal to the total outstanding reclamation liability.[895]

Specific to the mine closure and reclamation plan, planning should commence before development is approved as this ensures the "reclamation takes place and the responsibility for costs is borne by industry".[896] The plan should fully address: progressive rehabilitation; the removal of any structures and workings that may pose a threat to public safety; tailings and waste rock disposal areas should meet engineering standards, as should reclamation of the surface.[897]

Progressive reclamation throughout the life of the mine is preferable from both an environmental and financial liability perspective. Not only does this approach ensure that the remediation is performed, but the financial liability is gradually reduced. When the final reclamation is completed, the financial security may be returned to the owner. The

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[893] *Ibid.*

[894] *Ibid.* at 6.

[895] *Ibid.*

[896] *Ibid.* at 7.

[897] *Ibid.* at 9.

reclaimed site will be allowed to stabilize and monitored by the owner and regulatory body.

4.6 (d) Coherence with Sustainable Development Principles

The Northwest Territories' legislation, regulations, and policy paper reflect three sustainable development principles. The no harm principle is buried in the Act where a lease may be cancelled, if environmental damage is done.[898] The precautionary approach principle is applied through the requirement to progressively rehabilitate the site.[899] There are also several references to the polluter paying in both the Act and policy paper, such as for example, the *Mine site Reclamation Policy for the Northwest Territories*,[900] states that "The purchaser would remain fully liable for the remediation costs of any environmental impact resulting from its operations at the site",[901]and the imposition of penalties for violations of the Act.[902]

4.7 Nova Scotia

Nova Scotia has a long history of coal mining in Cape Breton. The mining legislation, however, is non-coal specific and is reviewed in the next sub-section, followed by a discussion of Regulations and Guidelines.

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[898] NWT Mine *supra* note 880 Sec. 67 (10 (a).

[899] AIND Canada*, supra* note 887 *at 5.*

[900] *Ibid.* at 14.

[901] *Ibid.* Mining Regulations *supra* note 879 Sec. 1(1).

[902] *Northwest Territories Land Act, 2014.* Sec 25 (1) and (2).

4.7 (a) Legislation

The purpose of the Nova Scotia *Mineral Resources Act 2016* is:

> to support and facilitate responsible mineral resource management consistent with sustainable development while recognizing the following goals: (a) providing a framework for efficient and effective mineral rights administration; (b) encouraging and facilitating mineral exploration, development and production; (c) providing a fair royalty regime; and (d) improving and ensuring the retention of the knowledge of mineral resources in the Province for the future benefit of the Province.[903]

If a person holds an exploration permit, they may be issued a mineral lease if they post a reclamation security[904] and outline a reclamation plan.[905] The Minister may demand additional security if, upon review of the lease, the posted security "no longer meets the prescribed level for reclamation of the peak reclamation activities, as filed under the lease."[906] If the reclamation plan is not completed, the security is forfeited to the Crown.[907]

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[903] *Mineral Resources Act, 2016 C 3 1 2018.* (NS Mine)Sec2(1). The purpose seems to be fully on the development side.

[904] *Ibid.* Sec 64(1)(f).

[905] *Ibid.* Sec 86(1).

[906] *Ibid* Sec74(1)(e).

[907] *Ibid.* Sec 87(2).

When the orebody is mined out, the lessee must give a report to the Minister, containing "(a) the reason for the closure; (b) the nature and amount of any mineral remaining in the mine; (c) the reclamation completed to date; [and] (d) the plans for future reclamation activities."[908] The lessee remains responsible for reclamation, regardless of the status of the mineral lease, whether it has been surrendered, cancelled or expired.[909]

The requirement to post financial assurance extends to any disturbance or excavation of the land, and if the reclamation plan is amended, the amendment must show how the cost of reclamation has changed from the original plan.[910] If the reclamation plan is not completed to the satisfaction of the Minister within the timeframe in the lease, the security that was posted will be forfeited.[911] Similarly, if production ceases and a restart date is not communicated to the Minister, the security will be forfeited.[912] Assignment of the leased land under the *Bankruptcy and Insolvency Act (Canada) 1985* or the *Companies Winding Up Act* 1985 results in the security being forfeited.[913]

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[908] *Ibid.* Sec 74(5).

[909] *Ibid.* Sec 85(2).

[910] *Ibid.* Sec 88(1).

[911] *Ibid.* Sec 88(2)(a).

[912] *Ibid.* Sec 88(3).

[913] *Ibid.* Sec 88(4).

4.7 (b) Regulations

The costs involved in site rehabilitation are considered to be allowable expenses in calculating the work acceptable for work credit to keep the exploration permit valid.[914] Under the Act,[915] the amount of financial security posted for a mineral lease is the sum of:

> The total third-party cost estimated for labour, equipment, supplies and services for the purposes of reclaiming the property at a level to represent peak reclamation liability acceptable to the Registrar; a cost of reclamation monitoring; a contingency amount equal to 20% of the [previous two amounts], and an additional contingency amount equal to 10% of the [previously described amounts] for the cost of procurement, engineering and management.[916]

The reclamation plan, must "protect the environment against adverse effects resulting from operations in the area; minimize the detrimental impact of operations on adjoining lands; minimize hazards to the public safety resulting from the operations; [and] leave the area in a state that is compatible with adjoining

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[914] *Ibid.* Sec 31(3).

[915] NS Mine, *supra* note 903

[916] *Ibid.* Sec 72(2).

land uses […]".[917] The plan must be prepared under the seal of an engineer.[918] The lessee must continue to monitor until reclamation is completed to the satisfaction of the Minister,[919] within the timeframe of the time set out in the reclamation plan, or a time acceptable to the Minister.[920]

4.7 (c) Guidelines

Nova Scotia does not have applicable guidelines: "[t]here are currently no mine reclamation guidelines for mining projects in Nova Scotia that require a mineral lease or non-mineral registration under the Mineral Resources Act (MRA)."[921]

4.7(d) Coherence with Sustainable Development Principles

Nova Scotia's legislation and regulations reflect two of the sustainable development principles. The Regulations require that the reclamation plan must protect the environment and minimize the impact of the operations on adjoining lands, satisfying the criteria for the no harm principle.[922] The polluter pays principle is also exhibited in the need for a reclamation security to be posted when a mineral lease is issued.[923]

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[917] *Ibid.* Sec 73(1).

[918] *Ibid.* Sec 74(2).

[919] *Ibid.* Sec 77.

[920] *Ibid.* Sec 78.

[921] E-mail from Scott Hearn, Manager, Mineral Development and Policy, Department of Natural Resources and Renewables, Geoscience and Mines Branch, Nova Scotia, August 10, 2023. On file.

[922] NS Mine, *supra* note 903 Sec 73(1).

[923] *Ibid.* Sec.64(1)(f).

4.8 Nunavut

Nunavut is home to the Medellin, Meadowbank and Hope Bay gold mines, and the Mary River iron ore mine.[924]

4.8 (a) Legislation

The current legislation regarding mine reclamation in Nunavut[925] falls between two Acts, The Territorial Lands Acts Financial Administration Act,[926] and the Nunavut Waters and Nunavut Surface Rights Tribunal Act.[927] The Territorial Lands Act deals with the format for registering a claim and the awarding of exploration and mining rights. There is no reference to either reclamation or rehabilitation. The Nunavut Waters and Nunavut Surface Rights Tribunal Act focuses on the administration of water use and waste disposal.[928] Part 1 of the Act is devoted to Nunavut's waters and allows for the use of water and deposition of waste. As mine tailings are sometimes disposed of by discharging them into a nearby water source, and the effluent from a tailings storage area will eventually percolate into the nearby groundwater, the Nunavut Waters and Nunavut

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[924] *"Our Industry",* online: <https://www.miningnorth.com/our-industry>.

[925] On January 18,2024, Canada, Nunavut, and Nunavut Tunngavik (NTI) signed the Nunavut Lands and Resources Devolution Agreement, transferring control of Crown lands in Nunavut to NTI effective April 1, 2027. See "Nunavut to take control of Crown land within territory following devolution agreement with Canada", online: *Osler, Hoskin & Harcourt LLP* <http://www.osler.com/en/resources/regulations/2024/nunavut-to-take-control-of-crown-land-within-territory-following-devolution-agreement-with-canada>.

[926] *See Territorial Lands Act, RSNWT 1988 C8 1993.*

[927] *See Nunavut Waters and Nunavut Surface Rights Tribunal Act*, SC 2002, c,10 2009.

[928] *Ibid.* Sec 4.

Surface Rights Tribunal Act apply to mining operations. The term 'waste' is defined under the Act as:

> any substance that, by itself or in combination with other substances found in water, would have the effect of altering the quality of any water to which the substances add it to the extent that it is detrimental to its use by people or by any animal, fish or plant, […].[929]

Waste may be deposited if a licence has been issued.[930] "Any person who is adversely affected by a licensed use of waters or deposit of waste, […] is entitled to be compensated […]."[931] The compensation payable is determined by the Nunavut Water Board and considers all relevant factors including:

> a) provable loss or damage; (b) potential loss or damage; (c) any adverse effect on the quality, quantity or flow of waters; (d) the extent of the use of waters by persons who would be adversely affected; (e) any nuisance, inconvenience or disturbance, including noise; and (f) the cumulative effects of the use of waters or deposits of waste proposed by the applicant and any existing uses of waters and deposits of waste.[932]

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[929] *Ibid.*

[930] *Ibid.* Sec 11(1).

[931] *Ibid.* Sec 13(1).

[932] *Ibid.* Sec 61.

When applying for a licence to deposit waste, the applicant must furnish details of the method of disposal, measures to compensate persons, and the monitoring of the impact of the use of the waters and waste disposal.[933] The applicant must present an environmental and closure plan before the licence application can be approved.[934]

At the awarding of a licence, the Board may impose conditions and may also require the applicant to furnish and maintain security with the Minister.[935] The security may be used to compensate any person who is entitled to compensation under section 13 if they have been unsuccessful in recovering such compensation directly from the mine owner.[936] The security may be returned when the mine is permanently closed or abandoned.[937] The amount of the security may be adjusted following periodic review.[938]

4.8 (b) Regulations

The Regulations regarding mining in Nunavut are issued as regulations of the Territorial Lands Act.*[939]* A mining reclamation trust is defined as a

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[933] *Ibid.* Sec 48(30(c-g).

[934] *Ibid.* Sec. 57.

[935] *Ibid.* Sec 76(1).

[936] *Ibid.* Sec 76(2). See *supra* note 931.

[937] *Ibid.* Sec 76(5).

[938] *Ibid*. Sec 76.1(b*)*

[939] See Nu Reg 69-2014, s. 1(1).

> trust […] established for a mine and that is created (a) for the purposes of subsection 76(1) of the *Nunavut Waters and Nunavut Surfaces Rights Tribunal Act;* or (b) as a condition of (i) a lease under the *Territorial Land Regulations*, [or] (ii) a contract with the Minister relating to the reclamation or environmental management of a mining property,[…].[940]

A renewable licence is issued for a year,[941] and allows the holder to remove minerals or develop a mine.[942] A mill, concentrator, or tailings disposal area cannot be constructed without a licence.[943]

4.8 (c) Guidelines

Indian Affairs and Northern Development Canada has issued guidelines for mine site reclamation in Nunavut,[944] which are identical to those issued for the Northwest Territories,[945] and contain progressive rehabilitation as a best practice.[946]

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[940] *Ibid.* Sec 1(1).

[941] *Ibid.* Sec 3(3).

[942] *Ibid.* Sec 7(1).

[943] *Ibid.* Sec 7(3).

[944] Government of Canada; Crown-Indigenous Relations and Northern Affairs Canada; "Mine Site Reclamation Policy for Nunavut", (13 January 2009), online: <https://www.rcaanccirnac.gc.ca/eng/1100100036042/1547658056831>

[945] NIAND Canada*, supra* n*ote 887.*

[946] Government of Canada*, supra* note 944.

4.8 (d) Coherence with Sustainable Development Principles

Nunavut's legislation, regulations, and guidelines reflect three sustainable development principles. A proponent for a licence to deposit waste must include measures "to take to compensate persons, including the designated Inuit organization, who are adversely affected" by the proponents' actions,[947] indicating that no harm is a principle with respect to the Indigenous population, and that there is a financial incentive not to harm any waters in Nunavut.

Like the Northwest Territories, the guidelines for mine site reclamation contain an expectation of precaution in progressive reclamation.[948] The principle of polluter pays is one of the principles for the mine site reclamation guidelines,[949] listing the 'polluter pays' principle as the first general principle of the guidelines.

4.9 Ontario

Ontario is the third largest mining province in Canada,[950] with a century old gold mining industry in Northern Ontario from Lake Superior to the Quebec border. Base metals[951], such as nickel, are found around Sudbury and uranium in Elliott Lake. The legislation,

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[947] *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, *supra* note 924. Sec 48(1)(c).

[948] Canada, s*upra* note 944 at 5.

[949] *Ibid.*

[950] Employment and Social Development Canada, "Sectoral profile - Mining: Ontario 2022-2024 - Job Bank", online: <http://www.jobbank.gc.ca/contentjmr.xhtml>.

[951] "base metals - Quick search results | Oxford English Dictionary", online: <https://www.oed.com/search/dictionary/?scope=Entries&q=base+metals>. Base metals are metals considered less noble or valuable than gold and silver, such as lead, tin, iron and copper.

which was amended in 2023,[952] is presented with the regulations and guidelines in the subsequent sub-sections.

4.9(a) Legislation

The *Mining Act 1990* contains a part (Part VII) entitled "Rehabilitation and Remediation of Lands", which deals with the rehabilitation of mining sites.[953] A proponent is required to take all steps to progressively rehabilitate a site, whether it is included in a closure plan or not.[954] Progressive rehabilitation is the process of rehabilitation carried out throughout the life cycle of the mine, with rehabilitation meaning returning the site to its former use or condition or made suitable for uses other than mining.[955] Nobody who files a rehabilitation plan is required to perform the rehabilitation, but if the plan is accepted by the Director of Mine Rehabilitation,[956] the person filing the rehabilitation plan becomes liable, and if the work is not performed to the satisfaction of the Director, then the person may be required to do the work by an order issued by the Director.[957] The person receiving

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[952] *"Amendments to the Mining Act: Closure Planning | Environmental Registry of Ontario", (16 June 2023),* online*:* <https://ero.ontario.ca/notice/019-6718>*.*

[953] See *The Mining Act , R.S.O 1990, c. M-14* (Ont. Mine), Sec 139-153*.*

[954] See Ont. Mine sec 139(1).

[955] *Ibid.*

[956] In the *Building More Mines Act, 2023,* the role of the Director of Mine rehabilitation, has been given to the Minister. "Bill

[957] *Ibid.* Sec 139.2(6)& 139.3.

the order may appeal to the Director to modify the rehabilitation plan, and, upon appeal, the Director's decision is final.[958]

Financial assurance is required for all mine sites and must be in the form of cash, letter of credit, bond, mining reclamation trust, compliance with a corporate financial test, or "[a]ny other form of security or any other guarantee or protection, including a pledge of assets, a sinking fund or royalties per tonne, that is acceptable to the Director."[959]

If the Minister has reasonable grounds to believe that rehabilitation has not been or will not be carried out in accordance with the rehabilitation plan, then the Minister may cause the rehabilitation to take place, with the costs being covered by the financial assurance posted by the proponent.[960] Similarly, if the Minister believes there has been a failure to rehabilitate the site, then the Minister may refuse to accept the voluntary surrender of the lands to the Crown.[961] The Minister may also place a lien on the land or any assets situated on the land to cover costs of rehabilitation the Minister may have completed.[962]

As well as covering the costs that the government may have to pay for rehabilitating a mine site, the *Mining Act* also allows for the recovery of minerals

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[958] *Ibid.* Sec 139.3.

[959] *Ibid.* Sec 145(1). The mining reclamation trust in the Income Tax Act was repealed in 1998. However, the Ontario government introduced a mining reclamation trust in the Fewer Fees, Better Services Act 2022. Compare to the Alberta Regulation115/93 Sec 21(d.1).

[960] *Ibid.* Sec 145(5).

[961] *Ibid.* Sec 149.

[962] *Ibid.* Sec 151.

from the tailings or other waste materials,[963] under the condition that "the environment is improved by the recovery and remediation."[964]

4.9 (b) Regulations

Ontario Regulation 240/00, entitled 'Advanced Exploration, Mine Development and Closure under Part VII of the Act', deals with rehabilitation plans and introduces a Rehabilitation Code, which details the steps required to meet the standards set in the Regulations.[965] For the purposes of this chapter, the regulations will be presented in this sub-section and the Code as a guideline in the following sub-section.

Prior to rehabilitating a mine, a proponent must submit a closure plan[966] and conduct consultations with Indigenous communities.[967] The proponent must submit a progressive rehabilitation report to the Director describing the nature and extent of the rehabilitation work performed on each mine hazard and how the work meets the prescribed standards.[968]

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[963] *Ibid.* Sec 152(1).

[964] *Ibid.* Sec 152(2).1.

[965] See *O Reg 240/00.*

[966] Ont. Mine *supra* note 953 Sec 140(1).

[967] *O Reg 240/00* Sec 8.1 (1)(b).

[968] *Ibid.* Sec 9(2)(5).

A closure plan submitted must be prepared by a professional engineer,[969] contain costs based on market value of the goods and services required,[970] and provide financial assurance sufficient to cover the cost of the rehabilitation work.[971] Financial assurance may be based upon the corporate credit rating received from two of Dominion Bond Rating Services Limited, Moody's Investors Services Inc, and Standard and Poor's Inc. and is considered to meet the financial assurance test for the life of the mine.[972] Proponents who meet the bond rating standards at a lower level are considered to have complied with the financial assurance test for the first half of the life of the mine.[973] If a proponent uses the credit rating test as the form of financial assurance, they may have to provide 25 percent of the financial assurance they would otherwise have had to provide, if the project is temporarily suspended.[974] However,

> The Director may exempt a proponent from complying with any standard, procedure or requirement in the regulation, if the Director determines that the closure plan meets or exceeds the objectives of the provision in which the standard, procedure or requirement is set out.[975]

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[969] *Ibid.* Sec 12(2)(b).

[970] *Ibid.* Sec 12(2)(c).

[971] *Ibid.* Sec 12(2)(d).

[972] *Ibid.* Sec 16(1).

[973] *Ibid. Sec 17(1).*

[974] *Ibid.* Sec 19.

[975] *Ibid.* Sec 21.

In the case of a mine closure then the proponent must complete minimum procedures specified in the regulations; the proponent must also restore the site to its former use or condition.[976]

4.9 (c) Guidelines

The Mine Rehabilitation Code is embedded in the Regulations as Schedule 1 and details the steps to be taken in rehabilitating a closed mine site. The details are very specific, including down to the materials.

Mine openings to the surface have to be closed to prevent inadvertent access to the mine workings, using steel caps or backfilling the shafts, raises and stopes.[977] Open pits, crown pillar, and room and pillar operations, must be closed to "limit potential hazards and maintain public safety and restore the site to an appropriate land use".[978]

Tailings dams and other containment structures have to be decommissioned and monitored to "ensure the long-term physical stability of [the] tailings dams and other containment structures",[979] by complying with the safety guidelines issued by the Canadian Dam Association. Surface water must be monitored to "ensure that [the] water quality is demonstrated to be unimpaired and that it is satisfactory for aquatic life and

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[976] *Ibid.* Sec 24(3).

[977] *Ibid.* Sched 1, Part 1, 1 & 2(1).

[978] *Ibid.* Parts 2 & 3.

[979] *Ibid.* Part 4.

other beneficial uses.[980] Similarly, ground water must be monitored "to identify and characterize any potential impediments to beneficial use of ground water as a result of the presence of migration of contaminants."[981]

All remaining materials at the mine site must be sampled for the potential to leach significant metal or cause acid mine drainage and implement "effective prevention, mitigation and monitoring strategies".[982] Any "water management structures and other mine-related structures [must be] left in a stable condition."[983] Finally, the site must be revegetated to prevent erosion caused by wind and water; improve the appearance and aesthetics of the site; "enhance natural vegetation growth and establish self-sustainable vegetation growth; and support the designated end use of the site."[984]

4.9 (d) Coherence with Sustainable Development Principles

In Ontario, the legislation, regulations, and Code reflect all of the sustainable development principles. A proponent of a mine hazard that causes, or is likely to cause, an immediate and dangerous adverse effect must do everything practicable to prevent, eliminate, and ameliorate it.[985] Harm is in the definition of adverse effect,[986] meeting the

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[980] *Ibid.* Part 5.

[981] *Ibid.* Part 6.

[982] *Ibid.* Part 7.

[983] *Ibid.* Part 8.

[984] *Ibid.* Part 9.

[985] Ont. Mine, *supra* note 953, Sec 148(1).

[986] *Ibid.* sec. 139(1).

criterion of the no harm principle. The Act allows for the recovery of minerals from tailings, carving them out from the Act treating them differently from similar tailings storage areas, meeting the common but differentiated responsibility principle[987] A proponent may progressively rehabilitate a site without a permit, so the precautionary approach is included in the Act.[988] Finally, financial assurance is required before a permit is issued for advance exploration and a rehabilitation plan must be submitted: the polluter, therefore, pays for any clean-up necessary.[989]

4.10 Prince Edward Island

Prince Edward Island is Canada's smallest province and has very little mining industry and is included here only for completeness. The industry, which comprises mainly of aggregates, is governed by the *Mineral Resources Act,* which is described in the following sub-section with the regulations and Guidelines in subsequent sub-sections.[990]

4.10 (a) Legislation

The Mineral Resources Act 2022 vests all minerals in the Crown.[991] What constitutes a mineral is decided by the Lieutenant Governor in Council.[992] The Lieutenant Governor in

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[987] *Ibid.* Sec. 152.1.

[988] *Ibid.* Sec 139(1).

[989] *Ibid.* Sec140(1).

[990] *Mineral Resources Act, RSPEI Chapter 7 2022.*

[991] *Ibid.* Sec 2.

[992] *Ibid.* Sec 3(1).

Council make the regulations "respecting the disposal of tailings, slimes, waste products, or any noxious or delirious substances."[993] The Lieutenant Governor in Council may also "prescrib[e] conditions for the closure of mines".[994]

When a licence holder surrenders the mining licence, the holder remains liable for all terms and conditions of the lease[995] and may not remove any buildings or tailings from the property without written authorization of the Minister.[996] No security is demanded of a licence holder, other than compensation to a landowner.[997]

4.10 (b)Regulations

The Regulations issued under the *Mineral Resources Act,* relate to the calculation of work requirements to maintain the licence. They do not relate to remediation.

4.10 (c) Guidelines

Similarly, there are no guidelines regarding remediation of mine sites issued in Prince Edward Island.

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[993] *Ibid.* Sec 9(1)(a & b*).*

[994] *Ibid.* Sec 9(1)(i).

[995] *Ibid.* Sec 52.

[996] *Ibid.* Sec 53(1).

[997] *Ibid. Sec* 56(3).

4.10(d) Coherence with Sustainable Development Principles

The sustainable development principles are not reflected in Prince Edward Island's legislation or regulations.

4.11 Quebec

Quebec's mining industry is the second largest in Canada,[998] and includes Canada's largest gold mine. The industry is governed by the *Mining Act 2002,* which contains the Regulations described below, as well as guidelines.

4.11 (a) Legislation

The Quebec *Mining Act 2022* is the guiding legislation, and it does not make any mention of rehabilitation.[999] The *Environment Quality Act 1990* has a division on Land Protection and Rehabilitation, the purpose of which is to protect the environment and the living species inhabiting it, to the extent provided for by law.[1000] The Act makes it possible to take into consideration issues related to the protection of human health and safety as well as the realities of the territories and the communities living in them, which would cover mining activities such as a tailings storage facility.[1001]

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[998] Natural Resources Canada, *"Canadian Mineral Production", (17 July 2015),* online: <https://natural-resources.canada.ca/maps-tools-and-publications/publications/minerals-mining-publications/canadian-mineral-production/17722> Last Modified: 2022-07-13.

[999] *See The Mining Act M 13-1*

[1000] *See Environment Quality Act, Q-2 1984.* (QC.Envir) Div.IV.

[1001] *Ibid.*

The Act covers any contaminants that exceed the limit of the levels specified in the regulations, that adversely affect life, health, welfare or comfort of human beings, ecosystems, other living species, or the environment in general.[1002] When the Minister believes that contamination has occurred or is about to occur, they may order any person to submit for approval a rehabilitation plan and that the notice of contamination be registered in the land register.[1003] If the plan submitted contains levels of the contaminant that are greater than the levels allowed in the regulations, the plan must contain a "statement of the land use restrictions that will apply."[1004] Once the plan is registered in the land registry, it is effective against third parties and any future owner of the land.[1005]

When an industrial or commercial activity, such as a mine, ceases operations, a characterization study must be performed and sent to the Minister within 12 months of the cessation.[1006] If the characterization study, which has been prepared by an approved person,[1007] shows contaminants above the allowable limits, then a rehabilitation plan must be sent to the Minister within three months.[1008] A "deposit of liability insurance or a financial guarantee […] intended to cover costs related to carrying out a rehabilitation

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[1002] *Ibid.* Sec 31.43.

[1003] *Ibid.* Sec 31.44.

[1004] *Ibid.* Sec 31.45.

[1005] *Ibid.* Sec 31.47.

[1006] *Ibid.* Sec 31.51.

[1007] See *QC Envir,* Sec 31.65.

[1008] *Ibid.* Sec 31.51.

plan," must be made.[1009] Where a voluntary rehabilitation is proposed, the Minister's approval to a rehabilitation must be obtained before work commences, along with a characterization study.[1010]

In either a case of voluntary rehabilitation or notice from the Minister, failure to perform the characterization study or register the plan, the Minister may take any measure necessary to remedy the default and recover from the person in default the direct and indirect costs incurred.[1011]

4.11 (b)Regulations

Quebec, being governed under Civil Law, has its Regulations written into the legislation.

4.11 (c) Guidelines

The Guidelines for Preparing Mine Closure Plans in Quebec is published by the Ministère de l'Energie et Ressources Naturelles (MERN) to "facilitate the preparation of the land rehabilitation and reclamation plan (hereinafter the "closure plan") required under the Mining Act."[1012] Persons who participate in exploration or mining work must submit a closure plan to the MERN for approval. The plan must also receive the approval of the Ministère du Développement Durable, de l'Environnement et de la Lutte contre les

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[1009] *Ibid.* Sec 31.51.0.2.

[1010] *Ibid.* Sec 31.57.

[1011] *Ibid. Sec* 31.62.

[1012] Gouvernement du Quebec*, Guidelines for Preparing a Mining Site Rehabilitation Plan and General Mine Site Rehabilitation Requirements. (1997)* at 7.

changements climatiques (MDDELCC). Provisions on land characterization and rehabilitation applicable to mining operations were added to the *Environment Quality Act 1990* in 2003. These requirements deal with the post-closure environmental monitoring.[1013]

Exploration involving more than 5,000m^3 or 10,000m^3 as well as sampling of more than 500 metric tons are required to submit closure plans if the work is on state-owned land.[1014] If inert tailings are used in construction, a closure plan is also required, as are mining operations.[1015] To obtain a mining lease, the closure plan must be approved by MERN, and MDDELCC must issue a certificate of authorization.[1016] Site(s) for tailings storage require Ministerial approval.[1017] The Minister may also cause the closure plan work to be performed at the lessee's cost.[1018]

Where there is a temporary suspension of the mining operations, the MERN and MDDELCC must be informed within 10 days of the date of suspension of operations and supply maps of the workings within four months. Measures to ensure public safety and environmental protection with monitoring procedures must be established.

[1013] *Ibid.* at 9.

[1014] *Ibid.* at 11.

[1015] *Ibid.* at 12.

[1016] *Ibid.*

[1017] *Ibid.*

[1018] *Ibid.*

The measures must include: ensuring the safety of surface openings; restricted access to the site, the buildings and other structures; water management for the mine site; environmental monitoring; storage of all types of chemical and petroleum products and hazardous waste; the physical and chemical stability of accumulation areas particularly tailings impoundment centre must be assured, along with the installation of security measures; and an inspection schedule.[1019]

A financial guarantee, to ensure that funds will be available to carry out the work provided for in the closure plan, should cover the entire cost of land rehabilitation and reclamation work for the full mine site. The financial guarantee must be submitted to the MERN before work begins on exploration. The guarantee maybe paid in three installments, the first of which must be made within 90 days of the plan's approval and each subsequent payment must be on the anniversary of the closure plan's approval. The first payment must be 50% of the total amount of the guarantee and the second and third payments 25% of the total.[1020] The guarantee may be made in one of the following forms or a combination there of: cash, bonds issued by Quebec or another province of Canada or Canada, guaranteed investment certificates or term deposit certificates, an irrevocable and unconditional letter of credit, security or guarantee policy, and/or a trust to ensure completion of the work.[1021] If the proponent contravenes any section of the Act governing

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[1019] *Ibid.* at 16.

[1020] *Ibid.* at 17.

[1021] *Ibid.* at 18.

work requiring a guarantee, the proponent is liable to a fine of 10% of the total amount of the guarantee.[1022] The guarantee must stay in effect until a certificate of completion is issued following the Minister's satisfaction that the closure plan has been successfully completed. The closure plan must be revised every five years and the guarantee adjusted accordingly.[1023]

Post-closure, an annual report must be submitted to the MERN to inform it of the progress of the rehabilitation, which must commence within three years of cessation of operations.[1024] A certificate of release will be issued when the MERN is

> satisfied that the closure work has been completed in accordance with the closure plan;[…] the MERN is satisfied that the condition of the area affected by the mining operations no longer poses a risk for the environment or for human health and safety and, in particular, poses no risk of acid mine drainage.[1025]

4.11 (d) Coherence with Sustainable Development Principles

The purpose of Quebec's *Mining Act* is to promote mining in the province in accordance with sustainable development principles,[1026] while the *Environment Quality Act* has as its

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[1022] *Ibid.* at 13.

[1023] *Ibid.* at 19.

[1024] *Ibid.* at 20.

[1025] *Ibid.* at 21.

[1026] See *The Mining Act M 13-1* Sec. 232.2

purpose the protection of the environment and the living species inhabiting it.[1027] Both of these pieces of legislation reflect the no harm principle. Progressive rehabilitation is encouraged in the *Mining Act*, thus shows the precautionary principle is in play.[1028] As with many other provinces, a financial surety is required to ensure that the polluter pays.[1029]

4.12 Saskatchewan

Saskatchewan is the largest producer of potash in the world.[1030] Uranium is also extracted in the North of the province. Saskatchewan has legislation, regulations, and guidelines addressing remediation issues, all of which are described in the following sub-sections.

4.12 (a) Legislation

Saskatchewan's *The Energy and Mines Act*, *1982-3* was repealed in 2004, and in its place *The Environmental Management and Protection Act, 2010* regulates the environment, which impacts the mining industry, although not directly applicable to it.[1031] In general, Division 1 of this Act describes unauthorized discharges as "discharge of a substance into

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[1027] "- Environment Quality Act", online: <https://www.legisquebec.gouv.qc.ca/en/document/cs/Q-2>. Preamble.

[1028] Mining Act*, supra* note 999, Sec. 232.2(2*)*

[1029] *Ibid.* Sec. 31.57.

[1030] Canada*, supra* note 998.

[1031] See *The Environmental Management and Protection Act, 2010., Sask., c. E-10.22 .*

the environment in any amount, concentration or level or the rate of release that may cause or is causing an adverse effect unless otherwise expressly authorized pursuant [to the Act]".[1032] In the case of the discharge that adversely affects the environment, a corrective action plan must be proposed to the Minister and financial assurance must be given that will ensure that the site is ultimately reclaimed. The financial assurance must be in the amount and in a form that it is acceptable to the Minister.[1033]

The Lieutenant Governor in Council may make regulations respecting "any substance dealt with without processing, arising from any activity of all or part of the mining industry or the development of or exploration for, any mineral resource;"[1034] and respecting the closure or abandonment and the decommissioning and reclamation of any mining site or any part of a mining site.[1035]

4.12 (b)Regulations

The *Mineral Industry Environmental Protection Regulations* appear at first glance not to apply to the mining industry, until one reads the definition of 'pollutant control facility', which is defined as "a facility or area for the collection, containment, storage, transmission, treatment or disposal of any pollutant arising from any mining operations or from the development of or the exploration for any mineral [,] and includes

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[1032] *Ibid.* Sec 8(1).

[1033] *Ibid.* Sec 17(1) & (2).

[1034] *Ibid.* Sec 98(1)(gg).

[1035] *Ibid.* Sec 98(1)(hh).

environmental protection components."[1036] The Regulations further define a mine site as being ": (i) a mine or mill; (ii) a tailings management area; (iii) an ore storage facility;(iv) a waste rock disposal area; (v) a mine overburden or spoil disposal area; […]. "[1037]

The Minister must approve the operation or permanent closure of a pollutant control facility, including, for the latter, a decommissioning and reclamation plan.[1038] The Minister also must approve "a proposal for an assurance fund to ensure the completion of the decommissioning and reclamation for the mining site", and that fund must be established to the Minister's satisfaction.[1039] Similarly to Alberta, Manitoba, Newfoundland, and Ontario, an assurance fund is required by these regulations in an amount and form approved by the Minister and may consist of:

> (a) cash;
>
> (b) cheques and other similar negotiable instruments; (c) government bonds, government guaranteed bonds, debentures, term deposits, certificates of deposit, trust certificates or investment certificates;

[1036] *Mineral Industry Environmental Protection Regulations 1996 c. e10.2 Reg 7,* Sec 2(m)

[1037] *Ibid.* Sec 2(m).

[1038] *Ibid.* Sec 12.

[1039] *Ibid.*

> (d) guarantees, irrevocable letters of credit, irrevocable letters of guarantee, performance bonds or surety bonds;
>
> (e) security interests in goods, documents of title, securities, chattel papers, instruments, moneys, intangibles or interests that arise from an assignment of accounts that secure the performance of a decommissioning and reclamation plan approved by the minister pursuant to section 14;
>
> (f) any other financial instrument or security that is acceptable to the minister;
>
> (g) anything mentioned in clauses (a) to (f) together with an agreement for staged decommissioning and reclamation, with each stage of the decommissioning and reclamation to be completed in accordance with that agreement; or
>
> (h) any combination of things mentioned in clauses (a) to (g).[1040]

The assurance fund must be reviewed every 5 years or when the pollutant control facility is decommissioned, and increase the assurance fund if it has a shortfall.[1041] If the assurance fund is insufficient to complete the decommissioning plan, then

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[1040] *Ibid.* Sec 15(1).

[1041] *Ibid.* Sec 16(1).

the Minister may recover funds from the person who obtained the approval of the reclamation plan.[1042]

4.12 (c) Guidelines

The province has issued "*Mineral Exploration Guidelines for Saskatchewan*" which address remediation.[1043] Under the guidelines, disturbed areas must be returned to an acceptable natural and productive state. To accomplish this, proper planning must take place at the pre-exploration phase.[1044] Reclamation measures must be indicated as part of the exploration application.[1045]

The reclamation plan must include removal of all infrastructure and waste, water works, intakes, culverts, and bridges.[1046] Surface disturbances must be re-contoured to as close as possible to the original state and soil replaced in the same horizons as they were stripped and stored. Erosion control measures must be employed to stabilize the soil spread on the disturbed area during restoration.[1047]

[1042] *Ibid. Sec 21*

[1043] See *Saskatchewan Mineral Exploration and Government Advisory Committee, "Mineral Exploration Guidelines for Saskatchewan.", (August 2016),* online: <http://saskmining.ca/ckfinder/userfiles/files/BMP%20August%202016_Draft.pdf>.at p. 85-890.

[1044] *Ibid.* at 85.

[1045] *Ibid.* at 86.

[1046] *Ibid.*

[1047] *Ibid.*

The Ministry of Environment may require revegetation. If so, only native plant species may be used, and the soil quality must be such that the plants are capable of self-sustainability[1048]

4.12 (d) Coherence with Sustainable Development Principles

Saskatchewan reclamation practices only comply with one sustainable development principle, polluter pays. An assurance fund must be established to ensure the decommissioning and reclamation of the mining site.[1049]

4.13 Yukon

The Yukon is the home of the original gold rush of 1896,[1050] with gold mining occurring along the riverbanks, which led to the *Placer Mining Act 1985.*[1051] As the gold placers were depleted, attention turned to the hard rock mines, and the *Quartz Mining Act 2003*[1052] came into existence. Both of these acts are detailed in the next sub-section of this thesis. The associated regulations and guidelines on mine site reclamation and closure follow in the later sub-sections.

[1048] *Ibid.* at 87.

[1049] Mineral Industry *supra,* note 220 Sec. 12.

[1050] *"Klondike Gold Rush",* online: <https://www.thecanadianencyclopedia.ca/en/article/klondike-gold-rush>.

[1051] *The Placer Mining Act, 2003, SY2003 c. 13* (YK Placer).

[1052] *Quartz Mining Act, SY 2003, c14* (Quartz).

4.13(a) Legislation

Mining in the Yukon is regulated by one of two Acts, the *Quartz Mining Act 2003* or the *Placer Mining Act 1985*, dependent on the geological occurrence of the orebody. Both Acts date back to the 19th century and the Klondike Gold Rush era and are currently under review, with public discussion having been completed in May 2023.[1053]

The *Placer Mining Act* covers gold or other precious metals found in the riverine areas of the Yukon. Before a person commences mining, adequate security for any loss or damage must be provided.[1054] Part 2 of the Act indicates the purpose of the Act:

> [T]o ensure the development and viability of a sustainable, competitive and healthy placer mining industry that operates in a manner that upholds the essential socio-economic vales of the Yukon and respects the aboriginal and treaty rights referred to in section 35 of the Constitution Act 1982.[1055]

The Chief of Placer Lands (the Chief) establishes "operating conditions to protect the environment, socio-economic, cultural and historical values of the special operating area[s]".[1056] The Chief must review applications for a Class 1 placer use operation to

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[1053] *"Yukon asks public to weigh in on Gold Rush-era mining laws | CBC News",* online: <https://www.cbc.ca/news/canada/north/yukon-mining-regulations-1.6742618>.

[1054] YK Placer. Sec 18.

[1055] *Ibid.* Sec 100.

[1056] *Ibid.* Sec 101.01(1).

determine its adverse environmental or socio-economic effects, initiate consultations with the First Nations, and ensure that appropriate actions are taken to mitigate any adverse effects.[1057] At any time during the currency of the notification, First Nations are kept informed of the status of the application and mitigation actions.[1058] "Where there is a risk of significant adverse environmental effect from a planned" operation,[1059] the Chief may require security to be posted and applied to costs incurred by the Commissioner.[1060] The *Quartz Mining Act*, has similar provisions.[1061]

An Inspector may order cessation of operations if that person believes "that a person has terminated, temporarily or permanently, or has abandoned a placer land use operation "and has endangered the environment.[1062] The *Quartz Mining Act*, has similar provisions.[1063]

4.13(b) Regulations

The Regulations applicable to the *Quartz Mining Act* and the *Placer Mining Act* mirror one another with the exception of regulations regarding exploration, which is required more for hard rock mining than placer mining. When applying for an operating licence, an

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[1057] *Ibid.* A Class 1 placer operation is one that requires less than 600 m^2 of stripping.

[1058] *Ibid.* Sec 103(2)(b).

[1059] *Ibid.* Sec 106(1). In determining the potential for significant environmental effect, the Chief takes into consideration the past performance of the operator.

[1060] *Ibid.* Sec 101(6)(3).

[1061] *Quartz Mining Act.* Sec 17.

[1062] *Ibid.* Sec 114.

[1063] Quartz*, supra* note 1052 Sec 146(1).

operating plan must be submitted, which details the areas to be eventually reclaimed,[1064] and procedures to mitigate any "adverse environmental effects".[1065]

Where security is to be posted under section 106 of the *Placer Mining Act* it shall not be more than the total costs of (a) abandonment of the operation; or (b) the restoration of the site of the operation.[1066] The form of the security may take the form of: (a) a promissory note guaranteed by a bank in Canada and payable to the Government of Yukon; (b) a certified cheque or bank draft drawn on a bank in Canada and payable to the Government of Yukon; (c) a government guaranteed bond; or (d) an irrevocable letter of credit from a bank in Canada.[1067]

4.13(c) Guidelines

The *Yukon Mine Site Reclamation and Closure Policy for New Mine*, issued in 2006, makes it the "duty of mine operators to plan, implement and fund mine site reclamation and closure."[1068] The goals of the policy are to;

> Ensure the development and viability of a sustainable, competitive and healthy mining industry that operates in a manner that upholds the essential socio- economic and environmental values of the

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[1064] *Placer Mining Land Use Regulation, 2014.* Sec 9(1)(ii).

[1065] *Ibid.* Sec 9(1)(e).

[1066] *Ibid.* Sec 17(1)(a & b).

[1067] *Ibid.* Sec 17(3).

[1068] *Yukon Mine Site Reclamation and Closure Policy, by Energy, Mines & Resources, Government of Yukon (2006).* At 1.

> Yukon; ensure mine operators manage their mind sites in an environmentally sound manner and reclaim these sites to meet the principle stated in the policy; fully protect public and environmental health and safety and ensure that any potential discharges during the mine operation and following mine closure will be managed to prevent harm to the receiving environment or to the public.[1069]

The principles for quartz mines include an approved reclamation and closure plan developed at the time of developmental planning for the mine and which accounts for the measures to be taken in the event of a temporary or seasonal closure.[1070] The plan must include ”ongoing environmental and technical studies that have clear objectives, completion dates and reporting requirements.”[1071] Under the guidelines, “a monitoring plan to assess the effectiveness of reclamation and closure strategies will be maintained and implemented by the mine operator to provide the framework for progressive reclamation activities and plan adjustments as needed.”[1072]

[1069] *Ibid.* at 3.

[1070] *Ibid.* at 4.

[1071] *Ibid. at* 5.

[1072] *Ibid.*

4.13(d) Coherence with Sustainable Development Principles

Surprisingly, given the age of the legislation, there is a high coherence with the relatively recent sustainable development principles. In fact, the Yukon is only non-compliant with the principle of common but differentiated responsibilities. The no harm principle is set out in the regulations, calling for the mitigation of adverse environmental effects.[1073] The precautionary approach principle is contained in the use of progressive reclamation.[1074] Finally, the polluter pays principle is reflected in the requirement to pay financial assurance.[1075]

4.14 Conclusions

As with the Australian approach to mining rehabilitation, the Canadian provinces and territories take divergent approaches on how to legislate the rehabilitation of mining sites. Even so, there is almost unanimous agreement on the structure of issuance of permits for exploration, development, and exploitation of a resource. At the time a mining permit is applied for, a closure plan is required to be prepared and financial surety posted. A fund for remediation or rehabilitation of mine sites in the case of the owner not fulfilling its clean-up obligations is part of most Canadian mining legislation. Applicants for advanced exploration or production permits must submit, with their application, a work

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[1073] See *Placer Mining Land Use Regulations 2014* Sec 9(1)(e).

[1074] See *Yukon Mine Site Reclamation and Closure Policy,* at 5.

[1075] See *Placer Mining Land Use Regulations 2014* Sec. 17(1) (a,b).

and closure plan for approval, which in some jurisdictions a qualified person must certify. In addition to the closure plan, the permit application must be accompanied by a security deposit for an amount that will cover the cost of rehabilitation. The acceptable form of the financial assurance varies province by province, with payment in cash or cash equivalents. Some provinces - Alberta, Northwest Territories, Nunavut, Ontario, and Quebec - allow the establishment of an environmental trust as a form of assurance, whilst Ontario waives the financial assurance for companies with the highest credit ratings with bond companies. One major difference between Australian and Canadian legislation regarding the posting of financial assurance is that Canada requires the surety be posted for individual projects, while Australia requires contributions to a reclamation fund to cover all mines.[1076]

The various regulations of the provincial and territorial governments all carry the same components: submission of reclamation and closure plans at the time a mining licence is applied for; the need for progressive reclamation to lower costs and give early warning of deviations from the plans; and ongoing monitoring of the reclamation and continuous effluent streams before that mine site is returned to the Crown.

Most of the provincial and territorial guidelines provide a template for operators to follow, to allow easier evaluation of the applicant's plans. There is some indication in the Quebec and Yukon guidelines of ways to lessen the financial impact of the financial

[1076] See chapter 5, following, for further discussion of forms of financial assurance.

assurances at the start of the construction phase of the mining cycle. It should be noted that Ontario's Bill 81 *Build More Mines Act* allows the Minister to defer the initial payment of the financial assurance, which is in line with Hawkins' suggestion.[1077]

Three provinces - Alberta, New Brunswick, and Ontario – reflect all four sustainable development principles. All other provinces, with the exception of Prince Edward Island, follow the polluter pays principle and most follow the precautionary approach, but not the common but differentiated responsibility principle.

In conclusion, there are several lessons to be drawn from this review of Canadian mining remediation legislation, regulations, and guidelines that are useful when considering space resources extraction treatment; first and foremost, progressive reclamation should be adopted to ensure final reclamation is achieved. The closure plan should be supported by a financial assurance to allow for the government to complete the reclamation in the event that the mine operator does not have the financial resources to complete the reclamation. Mining laws should commit to the protection of the environment in their objectives. Allowance for differences in detriment to the environment, such as tailings storage areas and rock waste piles, should be made in the regulations regarding reclamation.

[1077] Hawkins, *supra* note 6 At 512.

Chapter 5. Issues Affecting a Legal Framework for Space Resources Extraction Treatment

This thesis has reviewed the terrestrial and outer space-related laws governing reclamation of mining sites, once mining activity comes to a close. It has done so through the lens of four sustainable development principles: no harm, precaution, polluter pays, and common but differentiated responsibilities (the latter adapted for the focus of this thesis). This chapter will amalgamate the analysis of the previous chapters, in order to evaluate those approaches that are closest to holistic sustainability. The conclusions of this analysis lead to a proposal for a legal framework for the post-mining treatment of space resources extraction sites. The needs of the lesser developed nations will also be addressed in a section regarding ownership of resources of the Moon and other celestial bodies, leading to a recommendation on an international governance structure.

5.1 Coherence with Sustainable Development Principles

From the analysis presented in the three previous chapters, five legal frameworks fulfill all four of the sustainable development principles, namely: the draft guidelines of UNCLOS for exploitation;[1078] the Australian state of Victoria's legislation, regulations, and guidelines;[1079] Alberta's legislation, regulations, and guidelines;[1080] New Brunswick's

[1078] See Section 2.4.

[1079] See Section 3.5.

[1080] See Section 4.1.

legislation, regulations, and guidelines;[1081] and Ontario's legislation, regulations, and guidelines.[1082] This adherence is presented in summary form in Table 1 below.

[1081] See Section 4.3.

[1082] See Section 4.10.

	No harm	CBDR	Precautionary	Polluter Pays
SDG	Y	Y	N	N
IRMA	N	Y	Y	Y
GITMS	Y	Y	Y	N
CIMM	Y	P	P	P
TSM	Y	N	Y	Y
Outer Space Treaty	Y	N	Y	N
Moon Agreement	Y	Y	Y	N
UNCLOS	Y	Y	N	N
Draft Guidelines	Y	Y	Y	Y
Antarctic Convention	Y	N	Y	N
Code of Nature	Y	Y	Y	N
Hague Building Blocks	Y	N	Y	N
Artemis Accords	Y	N	N	N
New South Wales	Y	Y	N	Y
Northern Territory	Y	Y	N	Y
Queensland	Y	Y	N	Y
South Australia	N	Y	N	Y
Tasmania	N	N	N	Y
Victoria	Y	Y	Y	Y
Western Australia	N	Y	N	N
Alberta	Y	Y	Y	Y
British Columbia	Y	N	Y	Y
Manitoba	Y	N	Y	Y
New Brunswick	Y	Y	Y	Y
Newfoundland	N	Y	Y	Y
North West Territories	Y	N	Y	Y
Nova Scotia	Y	N	N	Y
Nunavut	Y	N	Y	Y
Ontario	Y	Y	Y	Y
Prince Edward Island	N	N	N	N
Quebec	Y	N	Y	Y
Saskatchewan	N	N	N	Y
Yukon	Y	N	Y	Y

Table 1: Coherence of laws and treaties to the sustainable development principles.

Given the application of the sustainable development principles to outer space law, as outlined in Chapter 1.6, these five legal ecosystems are therefore excellent candidates to provide a logical baseline for a recommended framework for space resources extraction post-mining treatment. This is clear when one examines the sustainable development principles in turn.

5.1.1 No Harm Principle

The no harm principle is manifested in the UNCLOS Draft Regulations by, requiring Contractors to ensure protection of the marine environment from harmful effects.[1083] In Victoria, Australia, the principle is inherent in requiring persons to create as little damage as possible, when entering on land.[1084] Alberta prohibits the release of a substance that may cause a significant adverse effect to the environment.[1085] New Brunswick has mining programs including reclamation and rehabilitation plans for the environment in the approved mining plans.[1086] Ontario takes a more reactive approach to the principle, in that any proponent must do everything practical to prevent, eliminate, and ameliorate adverse effects to the environment.[1087] Looking at all of these examples, it appears that the Draft Guidelines on exploitation of mineral resources in the Area provide the most fulsome direction on how to apply no harm in the space resources extraction context:

[1083] The Regulations *, supra* note 215

[1084] Victoria Mining*, supra* note 613.

[1085] Alta M&M, *supra* note 685.

[1086] NB Mine, *supra* note 809.

[1087] Ont. mine, *supra* note 953.

these Draft Guidelines are based on the environmental principles defined in the Rio Declaration and are directly related to mining operations in the Area, that is beyond national sovereignty.[1088]

5.1.2 Common but Differentiated Responsibilities

The five legal frameworks address common but differentiated responsibilities in different ways than the no harm principles. The Draft Guidelines on Exploitation of Mineral Resources in The Area address this principle simply by defining various boundaries as to where UNCLOS applies. Since, at present, outer space does not have such defining boundaries between different regions (except between terrestrial airspace and outer space), they do not provide a relevant model for the space resources extraction framework. Victoria differentiates on the grounds of difference between stone and other minerals, which is a very weak interpretation of the principle. However, the Australian government document titled Preparation of Rehabilitation Plans, Guideline for Mining & Prospecting Projects[1089] contains detailed procedures for the designation of different rehabilitation methods, providing an excellent framework that should be incorporated into the space resources extraction post-mining treatment framework. In particular, the

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[1088] See Lance N Antrim*, "The United Nations Conference on Environment and Development"* in Allan E Goodman, ed, The Diplomatic Record 1992-1993, 1st ed (Routledge, 2019) at 189 .

[1089] Victoria State Government*, "Preparation of Rehabilitation online Plans, Guidelines for Mining and Prospecting Projects",* Resources Victoria, online: <*https://earthresources.vic.gov.au/data/assets/pdf_file/0018/513342/Preparation-of-rehabilitation-plans-Guideline-for-mining-and-prospecting-projects-February-2020.pdf*>.

dividing the site into domains, each requiring a different post-mining treatment method or end use.

Alberta Regulation 115/1993[1090]; requires that the land be returned to an equivalent land capacity after conservation and reclamation.[1091] New Brunswick's coherency to this sustainable development principle is based on the carving out of specific legacy areas from the Act.[1092] In Ontario, the principle is applied to the reprocessing of old tailings,[1093] which may become applicable to space resources extraction, once the industry becomes established. Of these, Alberta's approach is the most useful at this early stage of space resources extraction because currently, little is known about the surface of celestial bodies and a precautionary approach should be adopted in defining how an area is to be reclaimed.

The Australian government's Preparation of Rehabilitation Plans document provides excellent guidance for defining the actions required to reclaim and rehabilitate the land used for terrestrial mining, but the lack of knowledge of differing landforms on celestial bodies at the present moment may be too detailed an approach at this early stage of space resources extraction. Therefore, using the approach of Alberta's Regulation on returning to an equivalent land capacity will suffice in the initial framework.

[1090] See Alta Reg 115/1993.

[1091] Alta Reg, *supra* note *714*

[1092] NB Mine, *supra* note 809 .

[1093] Ont. Mine, *supra* note 953.

5.1.3 Precautionary Approach

All five sustainable development compliant treaties/documents employ the concept of progressive rehabilitation. Progressive rehabilitation is a result of preparation of a mining plan that develops the mine footprint in such a manner that post-mining treatment may occur at the same time as the valuable mineral is being extracted.[1094] Progressive rehabilitation should be included in the space resources extraction post-mining treatment framework because it allows for the post-mining treatment to be completed in a shorter timeframe than by conducting post-mining treatment as a separate operation from the extraction of the mineral ore. Furthermore, the exposure to a government for the post-mining treatment of a mine site that has been abandoned due to the operator's financial ability to continue to operate is significantly reduced because most of the post-mining treatment work has been completed, leaving little for the government to do except remove the remaining infrastructure. Therefore, the approach of any of the five governance mechanisms may be used in a space resources extraction treatment legal framework.

5.1.4 Polluter Pays

Unsurprisingly, all jurisdictions require some form of financial surety be posted. The assurance is held by the government to defray the potential cost of having to remediate

[1094] An example of progressive rehabilitation can be seen with an open pit mine. The non-valuable material called overburden is removed to expose the valuable ore. The overburden is stored adjacent to the working pit, where it may be returned to the pit when the valuable ore extraction is completed. This practice is considered to be the best practice and is becoming commonplace.

a site in the event the operator does not have the financial ability to complete the task. There are marked differences in the way that the jurisdictions handle the funds and what financial instruments are acceptable.

In Australia, the prospective mining company must deposit funds in a general remediation fund that the government may use to complete the post-mining treatment of any mine site, legacy mine site, or the proposed operation. This approach could lead to an increasing number of legacy sites being in need of post-mining treatment if the funds are used for post-mining treatment of legacy sites rather the sites for which a contribution to the remediation fund has been made.

In Canada, the financial assurance must be made for a particular mining operation or advanced exploration site.[1095] The financial assurance is supported by a closure plan that has to be revised periodically and the amount of financial assurance adjusted upon review. This review is a two-edged sword, in that the periodic review may require additional assurance that makes the operation financially infeasible and results in the mining company seeking bankruptcy protection, leaving the government to handle the post-mining treatment with insufficient funds in the surety.[1096] The frequency of closure

[1095] Currently, Ontario has $2.6 billion in financial assurance. This sum is less than the expected cost of cleaning up the Elk Valley river in BC, which was polluted by the coal mining activities of Teck Resources, estimated at $4.7 billion. Norther Miner March 19, 2024.

[1096] See Gabrielle Plonka · CBC News ·, *"Yukon gov't to spend 3 years remediating abandoned Minto mine site* | CBC News", (1 March 2024), online: CBC <https://www.cbc.ca/news/canada/north/minto-mine-remediation-plan-three-years-yukon-1.7130386>.

plan review varies between 2 and 5 years, so 3 would seem to be a reasonable frequency for the space resources extraction framework.

The type of acceptable financial assurance varies among the jurisdictions. All accept cash and near cash forms,[1097] as financial assurance. Some jurisdictions, notably Ontario, also accept other forms, such as the highest of financial rating as issued by bond rating services, such as Dun and Bradstreet, Standard and Poor's, and Dominion Bond Services. However, these ratings do not assure the government of a company's ability to complete its post-mining treatment obligations. An operating company's parent may have an AAA bond rating and the precarious financial position of the rated company's subsidiary may not affect the bond rating. The corporate veil may shield the parent from the government's attempts to recover the cost of the post-mining treatment work.[1098] Furthermore, the bond rating is a lagging indicator of the financial position of a company, so the company could be close to bankruptcy before the bond rating reaches junk status, making it impossible for the government to obtain additional financial assurance.

Environmental trusts are an instrument that is beginning to acquire popularity as a form of financial assurance. The attractiveness of an environmental trust is that a company may put a portion of the company's profits from current operations into the trust and receive tax credits as the operations progress, arguably matching the funds for post-

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[1097] Near cash instruments include, government bonds, insurance policies and letters of credit.

[1098] See Jackie Hong · CBC News ·, *"Remediation, closure activities underway at abandoned Minto mine, Yukon government says CBC News", (*1 March 2024), online: CBC <https://www.cbc.ca/news/canada/north/minto-mine-tech-briefing-remediation-1.6983583>.

mining treatment to the amount of pollutants discharged into the environment. Once the operations have ceased and post-mining treatment is underway, the trust may be collapsed and used to finance the post-mining treatment process. The tax rate on the proceeds from the trust are lower than during the operations because there is no other source of income at this time. As taxes are a national responsibility, there is no financial rationale behind them being used in space resources extraction framework.

Outside of the sustainable development principles, most jurisdictions follow a pattern in their mining laws of issuing permits for prospecting, exploration, and exploitation. In some jurisdictions, namely Western Australia and Alberta, contracts replace the permits. To obtain such permits, mining plans must be submitted for approval. The mining plan must contain a closure plan with cost estimation. The closure plan must be accompanied by a financial assurance in an acceptable form. The space resources extraction framework should include a form of closure plan and financial assurance for completion of the work.

5.2 Is a Framework for Post-space Resources Extraction Treatment Necessary?

Before designing a framework for space resources extraction, it is necessary to ask the question, 'is a framework for post-space resources extraction treatment necessary, or do existing laws and regulation sufficiently prevent damage to the celestial environment?' Article VI of the Outer Space Treaty,[1099] requires that State Parties "bear international responsibilities for national activities in outer space, […] whether such activities are

[1099] OST*, supra* note*. 7* Art. VI.

carried on by governmental agencies or by non-governmental entities,"[1100] and "[t]he activities of non-governmental entities in outer space, shall require authorization and continuing supervision by the appropriate State Party to the Treaty."[1101] It could be argued then that if space resources extraction sites are not remediated, the sponsoring state would be held liable for any damage done by the space resources extraction operation to the environment.

As articulated in the Liability Convention,[1102] damage is defined as damage caused by a space object to another space object or to a property or person. In the context of space resources extraction, this approach is complicated by the fact that there is no property ownership of the space environment permitted under article 2 of the Outer Space Treaty.[1103] Consequently, it is necessary to have a framework on damage for post-space resources extraction treatment: unregulated access to space mining sites would result in disputes over valuable areas, which has the potential to cascade into conflict on Earth.[1104]

5.3 Applying Sustainable Development Principles.

It would be easy at this stage to propose a framework for space resources extraction treatment that contained the common elements of the five legal models reviewed that

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[1100] *Ibid.*

[1101] *Ibid.*

[1102] Liability *supra* note 9.

[1103] Emily Pierce, attorney advisor at the US Department of State, in verbal response to question at Space Resources Week 2024, Luxembourg March 27, 2024. https://www.youtube.com/watch?v=CC-HBXA7HeE.

[1104] Andrew J Cannon, *The Necessary Extension of the Rule of Law to Space Mining* (Rochester, NY, 2023*).*

met all four sustainable development principles. Such a framework would have the minerals vested in a controlling body - the Crown in the case of Australia and Canada - which would issue permits for exploration and exploitation to qualified operators, and which would register a claim to the mineral rights and gain ownership of said minerals. To monitor the operator's adherence to the terms of the permits, the operator would need to submit to the governing body a mining plan which included a closure plan. The operator would have to post financial surety to ensure that the state was not left holding a financial liability in the event that the financial surety was insufficient to cover the total cost of the final post-mining treatment of the site. Although this framework has worked successfully in jurisdictions on Earth, it is imperfect, as there are 10,000 orphaned and abandoned mine sites in Canada,[1105] as well as the case of mines such as Minto,[1106] and the portion of the Alberta oilsands tailings ponds that have been left un-remediated. Thus, while the laws are sufficient to control the post-mining treatment of closed mine sites, the enforcement mechanism is insufficient to cover all locations. It is therefore important to go beyond this collection of best practices to consider governance of space resources extraction.

[1105] Joseph F Castrilli, *"National orphaned/abandoned mines initiative advisory committee" (2003).* <online: www.nrcan.gc.ca/canmet-mmsl>.

[1106] Plonka *supra* note *1096.* Also see Alta Guide *supra* note *726.* Minto was a copper producer in the Yukon. Upon producing the required update to their closure plan, the Yukon government requested an increase in the financial assurance in the order of billions of dollars. This made the continued operation of the mine economically infeasible. Minto decided to immediately close the mine and seek bankruptcy protection.

5.4 Governance of Space Resources Extraction

To administer the space resources extraction industry, there will need to be a controlling body, to ensure compliance with the framework. With UNCLOS, the International Seabed Authority was established, to ensure that the development of the Area is developed in a safe and rational manner.[1107] Similarly, such a body is envisaged in section 11.5 of the Moon Agreement.[1108] A body, referred to here as the Celestial Commodities Council (CCC) should be created as an agency of the UN Office of Outer Space Affairs (UNOOSA), whose roles and responsibilities are discussed in the remainder of this chapter.

Post-space resources extraction treatment must be viewed in the wider context of the Outer Space Treaty's "for the benefit of humankind". The debate over the benefit of humankind is as divided as the debate over whether space resources extraction is legal, with on one hand, the United States takes the position that the natural resources become the property of the exploiter, who removes them from their place in-situ, and the financial benefits should accrue to the exploiter; where as China and the G77, lesser developed countries, argue, the financial benefits should be shared equitably among all humankind. The benefits of space resources extraction, both financial and technical, should benefit all nations and peoples, not just spacefaring nations. To this end, the ownership of the celestial bodies, which under the Outer Space Treaty, are the province of all (hu)mankind, and should be vested in the United Nations and administered by the CCC. As discussed in

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[1107] UNCLOS*, supra* note 20*.*

[1108]Moon, *supra* note 11.

Chapter 2, countries such as the United States argue that, while no country or company can own (appropriate) celestial bodies, resources that are removed from their original location can be owned. However, this thesis posits that such an approach is likely to cause conflict among countries and companies, and therefore the CCC is needed to regulate space resources extraction.

The CCC would enter by tender into contracts with mining companies, to supply the CCC with a specific volume of mineral from a specific area in a specific time. To encourage the company to enter into an agreement with the CCC, the CCC could offer to purchase the minerals at a price that would result in the company receiving a reasonable return on their investment (ROI). To bring benefits from the space resources extraction contract to lesser developed nations, the CCC would offer a higher ROI to the mining company if they were to partner or collaborate with a lesser developed country, by for example, launching from or creating a tracking facility in the partner country. This collaboration would result in investment in the country and potentially transfer technology to the country. Once a memorandum of understanding between the CCC and the mining company is signed, the mining company would have to produce a post-mining treatment plan and post financial assurance against that plan. The plan would have to be reviewed periodically (3-year intervals is suggested), and financial assurance posted.

The advantage to the company of a contract with a reasonable rate of return is that it reduces the financial risk in specifying the return, rather than the ROI being a nebulous figure based on a set of assumptions. The signed contract can then be used to obtain

financing for the project. This is a win-win situation for the company and country. Once the contract is signed, a launch slot can be arranged.

5.5 Contract or Royalty?

It has been suggested,[1109] that instead of a system of contracts, a royalty system should be created, whereby permits would be issued by the CCC and a royalty be paid by the Contractor for each unit of regolith removed. Using a series of permits would impose a set of enforceable rights without a change in ownership of the land, especially as land in space cannot be owned.[1110]

The advantage of a mining contract over permits, is that the contract can be tailored to the specific conditions that exist in the contract area, a flexibility that would be useful in the early years of space resources extraction, as more details become known about the environment of outer space. Furthermore, disputes over the contract can be resolved at the Permanent Court of Arbitration, whereas, with permits, a 'legal' system must be established, to ensure compliance. If the Contractor is non-compliant with the terms of the contract, then the established court system may be used. Furthermore, by establishing contracts for a specific volume of extracted mineral, the supply going to the market may be controlled, whereas, royalties are a reactive measure, being charged on the volume extracted. A result of royalties could be an oversupply of a particular mineral

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[1109] *Andrew J Cannon, supra* note 1104 *(*Rochester, NY, 2023*);* Carlos D. Espejel, Business Lead,, Euro2Moon, personal communication March 27,2024.

[1110] Ibid.

because of the extraction rate being determined for the benefit of the exploiter, rather than for humankind.

The post-space resources extraction treatment plan should include *intra vires* the removal of all infrastructure including landers and rovers; restoration of the topology of the area, and increasing the slope stability of the walls of craters over 10 km in diameter. Specifically excluded from the area to be mined would be historical artifacts, such as Neil Armstrong's footprints, the first landers, and souvenirs left on the Moon surface.[1111] Strictly excluded would be any activity that change the Moon's most well-known features, commonly known as the 'Man in the Moon'.

5.6 Sharing Benefits with Lesser Developed Nations

Once the contracted volume of mineral is delivered to the CCC, the CCC would market the minerals on the open market. The CCC would moderate the volume of minerals released to the market, to maintain the price level. Also, the CCC would not want to release a large amount of mineral to the market[1112] and negatively distort the economy, for example, releasing large amounts of nickel, so that the GNP of Indonesia collapses. This form of price maintenance should also increase the profits that the CCC derives from the sales.

The 'profits' from the CCC should return to the United Nations for use in funding their development agencies and programmes. From this increased funding, the lesser

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[1111] For more on cultural preservation on the Moon, see "For All Moonkind", online https://www.forallmoonkind.org/.

[1112] UNCLOS, *supra* note 131 Art 150(j).

developed nations will be able to predict the flow of developmental funds and should be considered as a win.

The third stakeholder in the benefits of humankind is the developed nations. With the increased flow of funding to the UN development agencies from celestial minerals, the developed countries will have a decreased requirement to fund the agencies, so the proposed framework should be considered a win for them.

The proposed framework may also be applied to in-situ use of minerals. It would be bureaucratic overload for the CCC to purchase the extracted minerals from the exploiter to turn around and sell the minerals back to them as feedstock. In the case of in-situ use, it is recommended that the same framework apply, but a royalty be paid to CCC instead of the contract being based on a sale price.

5.7 Financial and Legal Security of Space Resources Extraction

Both Elizabeth Steyn[1113] and Andrew Cannon[1114] have written or presented the basic legislative needs for space resources extraction to succeed. Steyn wrote that there are three basic criteria, namely security of tenure in secure and stable rights; a bankable project; and a feasible project; whilst Andrew Cannon spoke of the need for secure title to the minerals; approved regulations; and agreement of landowners.[1115] The proposed

[1113] Steyn*, supra* note 93

[1114] Cannon, *supra* note 94.

[1115] The financial feasibility is not considered in any of the documents reviewed in Chapter 2 of this thesis.

framework meets all of these criteria to some extent. Security of tenure is gained from the ownership of the extracted natural resources being vested in the CCC, giving security to the mining company that ownership will not change during the life of the contract. The contract itself also offers a degree of security. With a signed contract with the CCC, the mining organization could raise the necessary capital to proceed with the project and the fact that CCC is requesting a contract is an indication of its feasibility. Thus, all of Steyn's criteria are met.

Although title to the minerals would not be in the name of the extractor, the fact that title is vested in the CCC provides security to the extractor. The contract lays out the rules and regulations, thus satisfying Cannon's second criterion. Considering that the CCC would be an agency of the United Nations, which represents all humankind, the final criterion is satisfied. Thus, the proposed framework fulfills all of criteria of Andrew Cannon's presentation. The legislative framework for space resources extraction success would be present.

5.8 Monitoring of Compliance to the Framework

All the provincial and state legislations regarding post-mining treatment contain provisions related to the monitoring of compliance with the legislation, either by regular reporting or by ministry inspection. A post-space resources extraction treatment framework should include provision for monitoring the progress of both the exploitation and the post-space resources extraction treatment. The monitoring could be done using orbiting satellites with the results transmitted back to the CCC. The establishment of

tracking stations on earth could be another form of extending benefits to all humankind, especially lesser developed countries. Lesser developed nations could be the host of the tracking stations, where they would benefit from the financial investment and the technical knowledge which would have to be transferred to the host nation.

5.9 Summary

From the above, a framework for post-space resources extraction treatment that takes into account the sustainable development principles and dispenses benefits to all stakeholders would contain the following provisions: the celestial natural resources would be vested in a United Nations body called the Celestial Commodities Council, which would administer the awarding of contracts for any disturbance of the surface and sub-surface of a celestial body. The contract would include specific provisions for the post-space resources extraction treatment of the property through an agreed-upon post-space resources extraction treatment plan, including progressive rehabilitation. The Contactor would also be required to supply financial assurance to cover the cost of the post-space resources extraction treatment in the event that the Contractor does not have the financial ability to complete the post-space resources extraction treatment.

The CCC would sell the delivered minerals on the open market, restricting supply to ensure that prices for the commodity are maintained and the earthly economy is not negatively affected. The surplus of the trading account over and above expenses of the CCC, would be used to finance UN development projects. The next chapter will contain details of the framework.

Chapter 6. Conclusion

The previous chapters set out applicable space law, analyzed the Australian and Canadian legislation, regulations and guidelines, and consolidated the best practices stemming from that analysis. It is now possible to put together the framework for post- space resources extraction treatment of operations. The proposed framework is just that, and is not intended to be a definitive document, but the skeleton for legislation, either as a stand-alone treaty or addition to the Outer Space Treaty. The proposed framework is designed to satisfy the needs of the exploiters, for financial gain, while at the same time satisfying the desire of lesser developed nations for a share of the benefits from space resources extraction and respecting sustainable development principles.

6.1 The Framework

Article 1.

All space resources extraction operations shall be carried out in accordance with Principle 21 of the 1972 Stockholm Declaration. That is, there is a "responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment."[1116]

[1116] United Nations, *supra* note 59. at 5. This embodies the principle of no harm.

Article 2.

The Moon and other celestial bodies and their resources are the province of all humankind.[1117]

Article 3.

The Moon and other celestial bodies and their resources are not appropriable by any state, organization or person, by claim of sovereignty, by means of use or occupation, or by any other means.[1118]

Article 4.

The United Nations shall be the representative of all humankind in all affairs dealing with the natural resources of the Moon and all other celestial bodies.

Article 5.

The United Nations shall establish a body called the Celestial Commodities Council, consisting of representatives of those nations that have ratified the Outer Space Treaty, to administer all matters pertaining to natural resources of the Moon and other celestial bodies.[1119]

[1117] The province of humankind is found in the Outer Space Treaty (Art. 1) and the Moon Agreement (Art. 4).

[1118] The non-appropriation of the Moon and other celestial bodies is the subject of Art. 2 of the Outer Space Treaty.

[1119] The CCC is similar in concept to the International Seabed Authority established by UNCLOS (Art.156).

Article 6.

No State, organization or person, shall disturb the surface or sub-surface of the Moon or other celestial bodies, without a contract with the Celestial Commodities Council.[1120]

Article 7.

i. The Celestial Commodities Council shall tender for contracts with mining companies, to supply the Celestial Commodities Council with certain quantities of finished minerals from the natural resources of the Moon or other celestial bodies.

ii. The contract prices for the supplied materials shall be set as to furnish the Contractor with a reasonable return on its investment.

iii. The reasonable rate of return mentioned in sub-section ii of this Article shall be increased, if the Contractor involves a lesser developed nation,[1121] as defined by the United Nations Department of Economic and Social Affairs, as " low-income countries confronting severe structural impediments to sustainable development. They are highly vulnerable to economic and environmental shocks and have low levels of human assets",[1122] in its response to the tender.[1123]

[1120] Contracts are an essential part of both the Western Australia and Alberta mining legislations and UNCLOS (Art 153.6).

[1121] *International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States*, is the subject of the United Nations General Assembly Resolution A/RES/51/122 adopted 4 February 1997.

[1122] "*Least Developed Countries (LDCs) | Department of Economic and Social Affairs*", online: <https://www.un.org/development/desa/dpad/least-developed-country-category.html>.

[1123] The intention here is to encourage bidders to involve lesser developed nations in the project. The involvement should include capital investment in the nation as well as some form of technical knowledge transfer. Such involvement, could include, launch site for the space vehicles, tracking and communication

Article 8.

i. Notwithstanding Article 7, parties interested in using in-situ space resources for their own use shall acquire from the Celestial Commodities Council a contract to extract a certain volume of natural resources for their own use, and shall pay to the Celestial Commodities Council a royalty.

ii. The royalty shall be set at a level that allows the proponent to achieve a reasonable rate of return on their investment.

iii. The royalty shall be reduced if the Contractor involves a lesser developed nation in its response to the tender.

Article 9.

The contract with the Celestial Commodities Council shall include an agreed upon post-space resources extraction treatment plan for the disturbed area, which shall include, but not be limited to;[1124]

i. An environmental impact assessment.

ii. All post-space resources extraction treatment plans must be based on the concept of progressive treatment.

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centres, or the design and manufacture of the vehicles used for extracting the minerals from the Moon or other celestial bodies.

[1124] All of the Australian and Canadian mining legislations are reflected in parts of this Article. For example, see the Victoria *Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019,* Sec 43(4)(b), and *Ontario Mining Act 1990,* sec 139(1).

iii. Removal of all infrastructure, other than that used to consume the natural resources in-situ. This include all landers, rovers, and extraction vehicles.[1125]

iv. Restoration of the topography to approximately the same profile that existed before extraction of the natural resources. All waste storage material shall be returned to the area from which it was removed.

v. All reasonable measures must be taken so as not to create space debris.

vi. Where extraction involves an area in or contiguous to a crater greater than 10 kilometres in diameter,[1126] the walls of said crater shall be stabilized to prevent collapse or erosion.

vii. The post-space resources extraction treatment plan shall be reviewed for completeness every three (3) years.

Article 10.

i. The Contractor shall furnish to the Celestial Commodities Council, financial assurance in cash or other marketable securities, in the amount of the cost to complete the post-space resources extraction treatment plan referred to in Article 9.[1127]

ii. In the circumstances that the Contractor is unable to complete the work outlined in the post- space resources extraction treatment plan developed in Article 9, the

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[1125] For example, the Ontario *Mining Act 1990*, Sec 139(1).

[1126] The diameter is for illustration purposes only and does not reflect any analysis of the size of lunar craters.

[1127] All terrestrial mining legislation reviewed, with the exception of Western Australia and Prince Edward Island, require some form of financial assurance.

Celestial Commodities Council shall use the financial assurance funds to complete the work of the post- space resources extraction treatment plan.

iii. On completion of the triennial review of post-mining treatment plan as per Article 9(iv), the financial assurance shall be adjusted by the Contractor.

iv. Upon completion of the contracted extraction contract and post- space resources extraction treatment, the contract shall be terminated, and any remaining financial assurance returned to the Contractor.

Article 11.

No authorization to launch shall be granted until the Contractor has complied with Articles 9 and 10.

Article 12.

Upon delivery of the minerals under a contract of extraction as described in Article 7(i), the Celestial Commodities Council shall market the minerals in such a fashion to maximize the return to the Celestial Commodities Council, and in such a manner as not to affect the market price for the mineral, nor the economies of nations.[1128]

[1128] This is similar to the provisions in UNCLOS that limit the production of certain minerals.

Article 13.

Funds received from the trading activities of Article 12, or the royalties received from Article 8, shall be used by the United Nations Development Programme, after the expenses of the CCC are paid.[1129]

Article 14.

Contract disputes shall be settled by mediation. In the event of non-settlement, they may be referred to the Permanent Court of Arbitration.[1130]

6.2 Summary

The doctrinal and comparative study of the Australian and Canadian mining laws in previous chapters has provided the building blocks for the formation of a proposed framework for post- space resources extraction treatment of space resources extraction. The framework proposed seeks to protect the celestial environment, whilst satisfying the needs and desires of the divergent stakeholders: spacefaring states, member states of the Outer Space Treaty, the exploiting companies, and lesser developed nations. The exploiting companies aim to maximize their profits in order to provide their shareholders with a rate of return, which will entice them to invest capital in the company's shares. At

[1129] UNCLOS directs some of the commercial benefits of deep-sea mining to flow to developing nations, Art. 13.2 and 13.3. Also, the UNGA Resolution A/RES/51/122 that international cooperation should consider the most effective and appropriate commercial modes.

[1130] OST Article XIII directs that questions arising shall be resolved by the appropriate international organization. Disputes regarding international mining agreements are referred to this court.

the same time, the lesser developed nations desire to share in the benefits from space resources extraction, fulfilling the promise of Article 1 of the Outer Space Treaty. These benefits may come in the form of monetary benefits, investment in space-related infrastructure, or transfer of technical knowledge and education.

The proposed framework addresses these competing outcomes, while ensuring that the overarching objective of ensuring that space resources extraction does not leave the Moon and other celestial bodies with the same blights on the environment that terrestrial resource extraction has. This is achieved by requiring the exploiting company to agree to a post-space resources extraction treatment plan and post financial assurance prior to being authorized to start operations (Article 11).

The exploiting companies are guaranteed a reasonable rate of return on their investment (Articles 7 and 8), thus providing an incentive for investors to back such ventures. The rate of return will increase if the exploiter involves lesser developed nations in its missions, thus providing investors with an additional incentive for investing in the space resources extraction project, creating investment in the lesser developed nations, and generating knowledge transfer to the lesser developed nations. This is a win-win situation for both parties.

Lesser developed nations will benefit from the framework, in that they will receive funding from the United Nations Development Programme (UNDP), that derives its funds from the profits of the space resources extraction products trading efforts of, and the royalties paid to the Celestial Commodities Council. The UNDP will be able to plan its activities based on

a predictable flow of funding, rather than relying on current funding from "member states; multi-lateral partners; non-governmental entities; private and philanthropic sectors and financial institutions,"[1131] none of whom can be considered to be guaranteed sources of funding. The developed nations which are contributors to the UNDP may see their contributions decrease, so we have another win-win situation by adopting the proposed framework.

Including in-situ users in the framework (Article 8), recognizes that while their space resources extraction operations are self-contained, they may have as large or larger impact on the celestial environment than space resources extraction operations carried out on behalf of the Celestial Commodities Council and for potentially longer term. For example, supplying oxygen for celestial habitation could be multi-generational and expose an ever-increasing area to the ravages of space resources extraction. Without the constraints of Article 9(i) (progressive reclamation), the post- space resources extraction treatment efforts may be huge and be unaffordable to reclaim, such as some of the legacy sites on Earth.

In sum, this thesis proposes a framework, that will control the use of space natural resources and ensure that space resources extraction sites are remediated. At the same time, the framework, directs the profits of the CCC towards the United Nations Development Programme, so that lesser developed nations receive benefits from space

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[1131] "*Top Contributors*", online: UNDP <https://www.undp.org/funding/top-contributors>.

resources extraction, whilst the developed nations receive financial gain from the investment in funding and technology.

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