Attention: Tanya Twynstra
Director, Citizen Engagement
PO Box 9484 Stn Provincial Government
Victoria, BC V8W 9W6

October 25, 2019

Subject: Formal Submission – Proposed Changes to the Mines Act

The Canadian Geothermal Energy Association (CanGEA) is the collective voice of Canada's geothermal energy industry, and our membership includes companies across the geothermal resource development value chain. On behalf of our members, we are pleased to provide feedback on proposed changes to British Columbia's *Mines Act*.

In the course of exploring for geothermal resources, and related activities, relevant mining deposits may be discovered, prompting a developer to embark upon mineral recovery. However, regulatory definitions currently preclude some of our members from moving forward with economically beneficial and environmentally friendly mining projects in BC. It is from this perspective that CanGEA submits the following feedback regarding amendments to the *Mines Act.*

Note: It is important to convey that for the purpose of this submission, the terms "geothermal energy" and "geothermal resource" are used in general terms to describe reservoirs of heat that exist at different temperatures and depths in the subsurface of the Earth. Thus, CanGEA's use of these terms does not follow the legal definition of a "geothermal resource" as stated in British Columbia's *Geothermal Resources Act*, RSBC 1996, c 171, p 1:

> "the natural heat of the earth and all substances that derive an added value from it, including steam, water and water vapour heated by the natural heat of the earth and all substances dissolved in the steam, water or water vapour obtained from a well, but does not include
>
> a) water that has a temperature less than 80^{o}C at the point where it reaches the surface, or
> b) hydrocarbons"

CanGEA is available to answer any questions relating to the information enclosed. As a note, given relevance to the Ministry of Environment and Climate Change, I have copied Honourable George Heyman.

Sincerely,

Christal Loewen, BComm, MPA Candidate
Policy Director, CanGEA

CC: Peter Robb, Assistant Deputy Minister, EMPR
Hon. George Heyman, Minister of Environment & Climate Change
Enclosed: CanGEA's Formal Submission: Proposed Changes to the Mines Act

Canadian Geothermal Energy Association
P.O. Box 1462 St. M, Calgary, Alberta, T2P 2L6, Canada
info@cangea.ca

Stakeholder Engagement: Proposed Changes to British Columbia's *Mines Act*

Formal Submission

Canadian Geothermal Energy Association (CanGEA)

Submitted October 25, 2019

Canadian Geothermal Energy Association
P.O. Box 1462 St. M, Calgary, Alberta, T2P 2L6, Canada
info@cangea.ca

Table of Contents

Canadian Geothermal Energy Association
P.O. Box 1462 St. M, Calgary, Alberta, T2P 2L6, Canada
info@cangea.ca

About CanGEA

The Canadian Geothermal Energy Association (CanGEA) is the collective voice of Canada's geothermal energy industry. CanGEA works to advance policies and regulations that enable the transition of Canadians towards the use of geothermal energy for electricity and heat, as applicable. CanGEA acts as the conduit between industry and government to ensure that there is a supportive ecosystem for development across Canada. CanGEA participates in engagements with all levels of government, including federal departments and committees, provincial/territorial governments and utility commissions, municipal governments, and Indigenous Peoples.

Introduction

In the course of exploring for geothermal resources, and related activities, relevant mining deposits may be discovered, prompting a developer to embark upon mineral recovery. However, regulatory definitions preclude some of our members from moving forward with economically beneficial and environmentally friendly mining projects in BC. It is from this perspective that CanGEA submits the following feedback regarding amendments to the *Mines Act.*

Note: It is important to convey that for the purpose of this submission, the terms "geothermal energy" and "geothermal resource" are used in general terms to describe reservoirs of heat that exist at different temperatures and depths in the subsurface of the Earth. Thus, CanGEA's use of these terms does not follow the legal definition of a "geothermal resource" as stated in British Columbia's *Geothermal Resources Act,* RSBC 1996, c 171, p 1:

> "the natural heat of the earth and all substances that derive an added value from it, including steam, water and water vapour heated by the natural heat of the earth and all substances dissolved in the steam, water or water vapour obtained from a well, but does not include
> a) water that has a temperature less than 80^{o}C at the point where it reaches the surface, or
> b) hydrocarbons"

Feedback on Proposed Amendments

1. Formalize Structural Separation Between Regulatory Functions

CanGEA supports proposed amendments to enhance the separation between EMPR's regulations functions by establishing a new statutory decision-maker for permitting, distinct from the health, safety, and enforcement functions.

CanGEA members currently have projects under development in British Columbia. One of these projects is located in the Northwest Mining Region and is overseen by the Smithers EMPR Regional Office.

The first-hand experience of our membership in engaging with the Smithers Regional Office is that processing times for exploration permits are beginning to approach 1 year. This is out of step with other EMPR regional offices and also with industry expectations. CanGEA supports any

measures with an intended outcome of improving permitting timelines, including the proposed measure of separating the permitting regulatory function from other regulatory functions. CanGEA is also in support of all capacity investments made in the Smithers Regional Office, as outlined in the following section.

1.1 Review Resource Allocation for Regional Offices

The *Mining Jobs Task Force Final Report*, published in December 2018, lists the following as an action to be undertaken in order to boost EMPR's position as a world-leading regulator:

> "Provide EMPR Regional Offices with sufficient resources to ensure EMPR permitting procedures align with government's commitment to the adoption and implementation of UNDRIP, and to permit efficiently, to support a healthy and competitive mining sector;"[1]

Further to a separation of regulatory functions, CanGEA suggests a review of resource allocation be undertaken for all 5 EMPR regional offices in order to improve permitting efficiency. In addition to the anecdotal evidence offered by our member, CanGEA submits Figure 1 as evidence of the Smithers Office being disproportionately responsible for project permitting. The Figure shows that 81 of the 261 active projects in BC are located in BC's Northwest Mining Region. This means that the permitting and administrative burden of 31% of projects falls on the Smithers Office staff. In order for office capacity to be commensurate with the proportion of permitting applications received, the Smithers Office may require more staff and resources than other regional offices in order to achieve the same permit processing rates.

Figure 1 – Regional Highlights in Exploration[2]

Region	Number of Projects	Mineral Exploration Expenditures (C$ millions)
North Central	36	32.7
Northwest	81	164
Northeast	8	6.3
South Central	47	56
Southwest	18	7.8
Southeast	71	64.5
TOTAL	**261**	**331.3**

[1] Government of British Columbia, "Mining Jobs Task Force: Final Report," (Dec, 2018), pg. 32, https://www2.gov.bc.ca/assets/gov/business/natural-resource-industries/mineral-exploration-and-mining/memp_10535_task_force_report_final-rev.pdf

[2] Government of British Columbia, Mineral & Coal Exploration, "Regional Highlights in Exploration," https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/exploration-in-bc/regional-highlights-in-exploration

It is worth noting, from Figure 1, that fully 50% of capital being invested in exploring BC's mineral resources is being invested in the Northwest region. Any processing efficiencies that can be gained will improve investor certainty, and could drive even greater economic benefit for the region as a result of increased exploration activities.

2. Formally Establish an Independent Oversight Function

At this time, CanGEA has no comment on this proposed change.

3. Enhance Compliance and Enforcement

At this time, CanGEA has no comment on this proposed change.

Other Input

Although beyond the scope of changes addressed in the *Intentions Paper*, **CanGEA suggests that a definition for brine mining be included among proposed amendments to the *Mines Act*.** Currently, the *Mines Act* does not include the recovery of minerals from brine in its definition of "mining activities," and the *Mineral Tenure Act* does not include minerals hosted in brine in its definition of mineral. Thus, brine mining activities are not permitted. Other jurisdictions in Canada and the United States are already benefitting economically from the recovery of lithium and rare earth elements from brine, and British Columbia could experience similar benefit by enshrining brine mining in the *Mines Act*.

1. Mineral recovery from brines

Water pumped from underground naturally contains minerals and other metals that are found in hot rock below the Earth's surface.[3] This fluid and its dissolved contents is commonly referred to as *brine*. Brine may be brought to the surface for the sole purpose of removing naturally dissolved materials, or as a by-product of other activities, for example:

1) in a geothermal energy project, hot geothermal brine is brought to the surface in order to harness the heat for direct use or for electricity generation; and
2) during petroleum extraction processes, co-produced water (i.e. brine) is brought to the surface alongside oil or gas.

Some brines may contain concentrated amounts of minerals or metals that are quite valuable. Historically, these elements have been recovered by creating very large, multi-phased solar evaporation ponds (see Appendix 3). Unfortunately, this method typically results in <50% recovery, is very slow and incurs a large environmental footprint.[4] Further, high mineral concentrations are requisite to economic viability.

[3] Office of Energy Efficiency & Renewable Energy, "New Rare Earth Element Extraction Technology," (Sept 2016), https://www.energy.gov/eere/ampedup/articles/new-rare-earth-element-extraction-technology
[4] Wall, Anna, National Renewable Energy Laboratory, "Mineral Recovery from Geothermal Brines: Resources, Technologies, and Economics," (Oct 2016), pg. 9
https://geothermal.org/PDFs/California_Geothermal_Forum/Session_4_1_Wall.pdf

In recent years, however, a growing portfolio of research and technology has been dedicated to finding unique methods of extracting lithium, manganese, boron, zinc and other elements from brine.[5] These brine mining techniques can be employed in BC in order to diversify the Province's economic portfolio and build on its well-established reputation in the global mining industry.

1.1 Case Study: U.S. Department of Energy

In 2014, the Geothermal Technologies Office (GTO) of the U.S. Department of Energy created a targeted funding program to explore new processes for extracting the valuable resources that are sometimes dissolved in fluid that is brought to the surface by geothermal energy projects. Although the produced fluid *volume* of such projects is very high, often the *concentration* of dissolved elements is very small, making conventional extraction methods uneconomical.[6]

The GTO program focused on mineral recovery from low- to moderate-temperature geothermal resources. Nine (9) awards were administered for "feasibility studies aimed at better understanding extraction technologies and process economics, assessing the current critical materials resource base, and researching and developing innovative extraction methods."[7]

This funding has bolstered the development of technologies that facilitate brine mining, and expanded the spectrum of project sites where it may be economically and technically feasible.

1.2 Case Study: European CHPM2030 Project

The European Commission has been funding a combined heat, power and metal extraction (CHPM) project that began in January 2016, and published its final impact factsheet in October 2019. The project was designed to develop a technology that combines geothermal energy production with metals extraction in a single interlinked process (see Appendix 1). This project proved that gas-diffusion electroprecipitation and electrocrystallization (GDEx) is a novel way to recover metals from dilute solutions, and a patent for this process was granted in Europe.[8] It also examined the economics of adding revenue-generating activities to geothermal energy projects.

1.3 Case Study: Lithium

Lithium is an alkali metal that is primarily produced in Australia, Chile, Argentina and China, with Australia's 2017-18 production being valued at A$1.6 billion.[9] Batteries account for over half of

[5] Ibid, pg. 4.
[6] Office of Energy Efficiency & Renewable Energy, "New Rare Earth Element Extraction Technology," (Sept 2016)
[7] Office of Energy Efficiency & Renewable Energy, "Low-Temperature Mineral Recovery Program FOA Selections," https://www.energy.gov/eere/geothermal/downloads/low-temperature-mineral-recovery-program-foa-selections
[8] Richter, Alex, "Project outcomes of CHPM2030 project," *Think GeoEnergy*, (Oct 2019), http://www.thinkgeoenergy.com/project-outcomes-of-chpm2030-project-combined-geothermal-heat-power-and-metal-extraction/?utm_source=ThinkGeoEnergy+List&utm_campaign=162a5cbbb7-TGE_Newsletter_RSS1&utm_medium=email&utm_term=0_657e42f767-162a5cbbb7-415259377
[9] Government of Western Australia, Department of Mines, Industry Regulations and Safety, "Western Australian Mineral and Petroleum Statistics Digest 2017-18," http://www.dmp.wa.gov.au/Documents/About-Us-Careers/Stats_Digest_2017-18.pdf

the global end-use market for lithium, as it is essential to manufacturing rechargeable lithium-ion batteries used in laptops, cellphones and electric vehicles.[10] Worldwide lithium production increased by 23% in 2018, totally 85,000 tons of lithium content.[11]

Demand for lithium has grown as a result of electrification and energy storage trends. The BC Government's passing of the Zero-Emission Vehicles Act in May 2019, setting a target for all new light-duty cars and trucks to be emissions free by 2040, is just one signal that demand for rechargeable lithium ion batteries will continue to rise. In fact, Elon Musk has stated that Tesla might get into the mining business due to fears of an impending lithium shortage and its necessity for electric vehicle production.[12]

Commercial lithium can be recovered from two major sources: underground brine deposits and hard rock (spodumene) deposits.[13] A report prepared for Environment Canada's Mining and Processing Division states that "brine based lithium extraction is said to be far more cost effective than hard rock mining."[14] As evidenced in Appendix 3, the traditional method of brine based lithium salt extraction involves creating very large, multi-phased solar evaporation ponds. This process is lengthy and often uneconomical. More recently, however, companies have worked to develop alternative techniques of extracting commercial volumes of lithium from host brines with lower concentrations of minerals. At least 2 lithium exploration companies have offices in Vancouver:

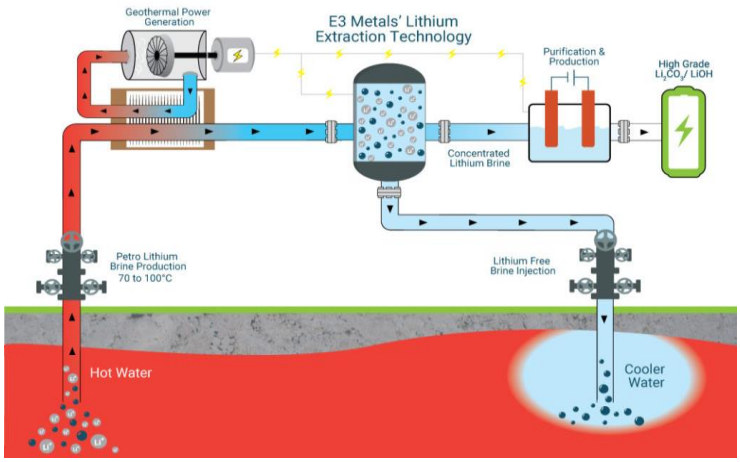
MGX Minerals Inc.
MGX developed an economically viable, rapid lithium extraction technology to remove lithium from host brine, and is exploring the potential of recovering lithium from an unconventional source – oil sands wastewater.[15] With their engineering partner PurLucid Treatment Solutions Inc., MGX has developed high temperature filtration that allows for the extraction of metals and minerals from geothermal brines without requiring a reduction in brine temperature.[16]

E3 Metals
E3 Metals is targeting the development of petro-lithium, a new source of lithium from reservoirs associated with oil and gas production. Their focus is on an ion-exchange process, and they have

[10] U.S. Geological Survey, "Mineral Commodity Summaries – Lithium," (February 2019) https://prd-wret.s3-us-west-2.amazonaws.com/assets/palladium/production/atoms/files/mcs-2019-lithi.pdf
[11] Ibid.
[12] Knowles, Tom, "Elon Musk: Tesla could go into lithium mining to power electric car batteries," *The Times*, (June 2019), https://www.thetimes.co.uk/article/elon-musk-tesla-lithium-mining-car-electric-battery-rechargeable-sgd7xhq9x
[13] SAMCO, "What is Lithium Extraction and How Does It Work?" (July 2018), https://www.samcotech.com/what-is-lithium-extraction-and-how-does-it-work/
[14] Cheminfo Services Inc. "Review of the Rare Earth Elements and Lithium Mining Sectors," (2012), Prepared for Environment Canada, http://reviewboard.ca/upload/project_document/EA1011-001_Review_of_the_Rare_Earth_Elements_and_Lithium_Mining_Sectors.PDF
[15] Government of Alberta, "Coal and Mineral Development – 2018 Year in Review," pg. 5, https://open.alberta.ca/dataset/35ee97e3-63d7-4c32-9e3b-c64407f31221/resource/314a5662-5e57-423c-888c-85fac4b5bf4b/download/coal-and-mineral-development-in-alberta-year-in-review-2018-cmd-yr-08.pdf
[16] Press Release, MGGC Minerals Inc. "MGX Minerals Announces Ultra High Temperature Filtration for Extraction of Lithium from Geothermal Brine," (Nov 2017), https://www.mgxminerals.com/investors/news/2017/293-mgx-minerals-announces-ultra-high-temperature-filtration-for-extraction-of-lithium-from-geothermal-brine.html

partnered with a laboratory at the University of Alberta to develop this technology (see Figure 2). Alberta Innovates and Natural Resources Canada's Industrial Research Assistance Program have supported this research. One of their project sites in Alberta has a defined NI 43-101 compliant resource estimate of 1.9 million tonnes (inferred) lithium carbonate equivalent.[17]

Figure 2: E3 Metals' lithium extraction technology[18]



1.4 Case Study: Rare Earth Elements

Rare earth elements (REEs) are a group of 15 elements in the periodic table of elements, and are also referred to as the lanthanide series. REEs are essential to the manufacturing of many high-tech electronics, driving demand in the clean technology, aerospace, automotive and defence sectors. The majority of the world's supply of REEs is produced by China, approximately 135,000 tonnes annually.[19] Canada currently produces no REEs, despite exploration projects underway (see Appendix 2 for a table of current producers).[20] The global REE market was valued at USD 2.8 billion in 2018, with an expected compound annual growth rate of 10.4% over the next 6 years.[21]

Economic opportunity and national security concerns[22] have bolstered industry initiatives to "examine potential rare earth element resources apart from virgin ore bodies."[23] Similar to lithium,

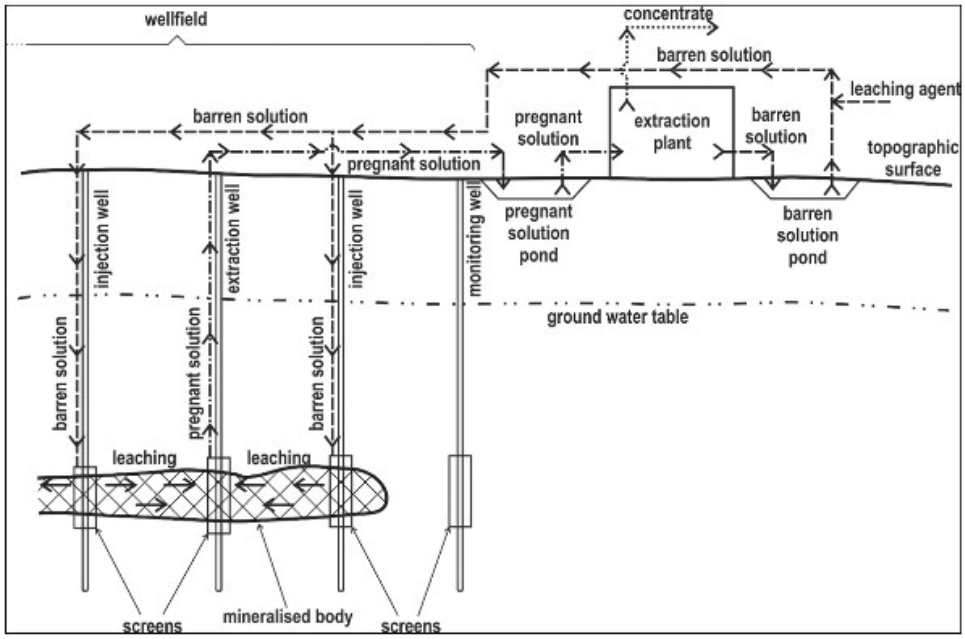
[17] Government of Alberta, "Coal and Mineral Development – 2018 Year in Review," pg. 5.
[18] E3 Metals, "Projects: Alberta Lithium," 2018.
[19] Natural Resources Canada, "Rare Earth Elements Facts," https://www.nrcan.gc.ca/our-natural-resources/minerals-mining/minerals-metals-facts/rare-earth-elements-facts/20522
[20] Ibid.
[21] Grand View Research, "Rare Earth Elements Market Size, Share & Trends Analysis Report By Product, By Application, By Region, and Segment Forecasts, 2019-2025," (Sep 2019), https://www.grandviewresearch.com/industry-analysis/rare-earth-elements-market
[22] Presidential Memorandum for the Secretary of Defense, "Presidential Determination Pursuant to Section 303 of the Defense Production Act," (July 22, 2019), https://www.whitehouse.gov/presidential-actions/presidential-determination-pursuant-section-303-defense-production-act-1950-amended-6/
[23] Smith, York, Pankaj Kumar and John McLennan, "On the Extraction of Rare Earth Elements from Geothermal Brines," *Resources* 2017, *6*(3), 39, https://doi.org/10.3390/resources6030039

there is an opportunity to recover REEs from geothermal brines, and co-recovery of REEs with geothermal energy production has been found to be technically possible.[24]

2. In pursuit of a definition

It is important to distinguish brine mining from other solution mining activities, namely in-situ leaching. In-situ leaching, also known as in-situ recovery, is a "mineral extraction method where ore is dissolved by a lixiviant, leached and pumped to surface."[25] Once minerals are dissolved underground in a solvent, acid or alkali, the pregnant solvent is pumped into a surface-treatment facility (see Figure 3). In-situ leaching is commonly used for recovering potash and uranium in porous rock. Though this method of mining is not as invasive as open-pit or underground mining, it often requires the disposal of large amounts of waste water through re-injection into an aquifer, and has the potential to lead to groundwater contamination.[26]

Figure 3: In-Situ Leaching Process[27]



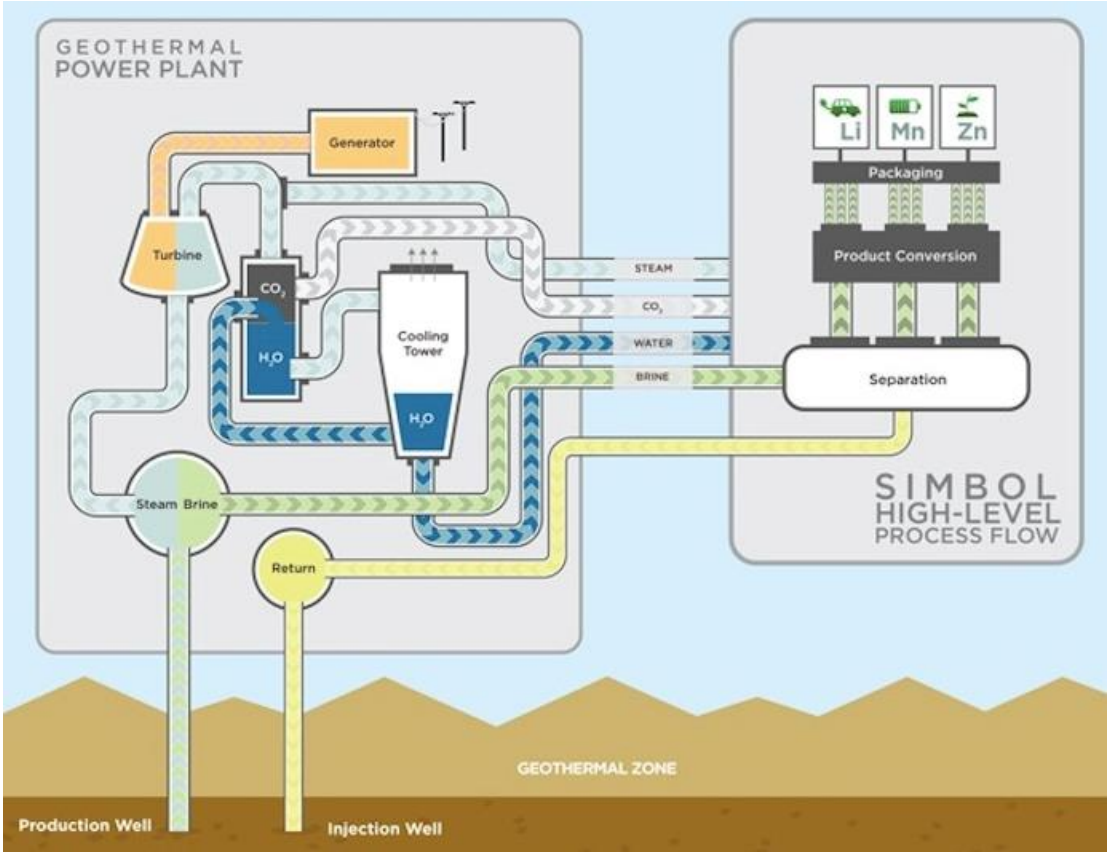
Though related, "brine mining" activities are quite distinct from in-situ leaching. In some cases, such as the Clayton Valley lithium project in Nevada, a production well is drilled for the primary purpose of mineral recovery. In other cases, co-recovery of metals and minerals occurs with geothermal energy production, adding an additional revenue stream (see Figure 4) or a "two-for-one" value for capital investment. In this way, brine mining can support the building of clean energy projects that would not have been economically viable without additional revenue sources.

[24] Ibid.
[25] Queens University Mine Design, "Solution Mining," https://minewiki.engineering.queensu.ca/mediawiki/index.php/Solution_mining
[26] http://large.stanford.edu/courses/2018/ph241/bashti1/docs/csiro-aug04.pdf
[27] Queens University Mine Design, "Solution Mining," https://minewiki.engineering.queensu.ca/mediawiki/index.php/Solution_mining

Brine mining is more environmentally friendly than open-pit mining or underground mining. It also does not pose the same risks as in-situ leaching: as no solvent is injected into the aquifer, there is no risk of contaminating groundwater.

Further, current brine mining techniques are much more environmentally friendly than traditional methods. Traditional methods have a relatively large physical footprint (see Appendix 3), and are very time intensive. One of the main operations involving brine mining is the San Pedro de Atacama Lithium extraction plant in Chile. Covering a total active area of 9,629 ha, the operation's environmental impact includes depletion of the natural water sources in sensitive areas, and land disturbances in the drilling/surveying areas, which encompass 119,041 ha.[28] By comparison, the environmental footprint of a geothermal plant, that re-injects its brine, ranges from 0.4 to 3.2 ha/MW.[29]

Figure 4: Geothermal Brine Mining Process[30]
Source: Simbol Materials



[28] Calculated via satellite imagery (2019) from Google Earth
[29] US Office of Energy Efficiency & Renewable Energy, "Geothermal Power Plants – Minimizing Land Use and Impact," https://www.energy.gov/eere/geothermal/geothermal-power-plants-minimizing-land-use-and-impact
[30] Richter, Alex, "New piece of legislation in California aims to clarify regulation on mining lithium from geothermal brine by making it exempt from certain state and federal regulation as are other byproducts of geothermal power production," *Think GeoEnergy*, (July 2012), http://www.thinkgeoenergy.com/california-legislation-to-help-mine-lithium-from-geothermal-brine/

Brine mining can supply many of the elements needed for manufacturing clean technologies, such as lithium and rare earth elements, without the environmental cost other methods of extraction can incur. In this way, brine mining can help BC maintain its place as a leader in innovation and environmental best practices pursuant to the vision outlined in the *Mining Jobs Task Force Final Report*:

> "British Columbians are proud of our growing mining industry as the backbone of an inclusive, progressive and low carbon economy."[31]

3. Interjurisdictional Scan

Other jurisdictions have already identified the economic opportunities that brine mining and solution mining can generate, and have taken legislative measures to promote such activities. Alberta, Saskatchewan, California, and Nevada are examined in the sections that follow.

3.1 Alberta

In Alberta, mining activities are regulated under *The Mines and Minerals Act, 2000.* The definition for "mine" and "mineral" are described in chapter M-17, section 1(n, p), and copied in the excerpts below:[32]

n.	"mine" means any opening or excavation in, or working of, the surface or subsurface for the purpose of working, recovering, opening up or proving any mineral **or mineral-bearing substance**, and includes works and machinery at or below the surface belonging to or used in connection with the mine;
p.	"minerals" means all naturally occurring minerals, and without restricting the generality of the foregoing, includes: j. gold, silver, uranium, platinum, pitchblende, radium, precious stones, copper, iron, tin, zinc, asbestos, salts, sulphur, petroleum, oil, asphalt, bituminous sands, oil sands, natural gas, coal, anhydrite, barite, bauxite, bentonite, diatomite, dolomite, epsomite, granite, gypsum, limestone, marble, mica, mirabilite, potash, quartz rock, rock phosphate, sandstone, serpentine, shale, slate, talc, thenardite, trona, volcanic ash, sand, gravel, clay and marl…"

Further, section 2(a) states that *The Act* applies to all mines and minerals, pore space and related natural resources vested in or belonging to the Crown in right of Alberta.

[31] Government of British Columbia, "Mining Jobs Task Force: Final Report," (Dec, 2018), pg. 1.
[32] RSA 2000, c M-17, s 1(n,p).

Chapter M-17, section 15.1(1) elaborates on the definition of pore space:[33]

a. no grant from the Crown of any land in Alberta, or mines or minerals in any land in Alberta, has operated or will operate as a conveyance of the title to the **pore space contained in, occupied by or formerly occupied by minerals or water** below the surface of that land,
b. the pore space below the surface of all land in Alberta is vested in and is the property of the Crown in right of Alberta and remains the property of the Crown in right of Alberta whether or not
    i. this Act, or an agreement issued under this Act, grants rights in respect of the subsurface reservoir or in respect of minerals occupying the subsurface reservoir, or
    ii. minerals or water is produced, recovered or extracted from the subsurface reservoir

3.2 Saskatchewan

In Saskatchewan, mining activities are regulated under *The Mineral Industry Environmental Protection Regulations, 1996.* The definitions for "mineral" and "mining" are described in chapter E-10.2, Regulation 7, section 2(i, j), and copied in the excerpts below:[34]

i. "mineral" means any non-living substance formed by the processes of nature that occurs on or under the surface of the ground, **irrespective of its chemical or physical state**, both before and after extraction, but does not include:
    i. petroleum;
    ii. naturally-occurring surface water;
    iii. agricultural soil; or
    iv. sand and gravel;

j. "mining" includes:
    i. a mode or method of working in which the soil, earth or any mineral may be disturbed, removed, carted, carried, washed, sifted, **leached**, **dissolved**, roasted, smelted, refined, crushed, ground or dealt with by another similar process for the purpose of obtaining a mineral, whether the mineral was previously disturbed or not;
    ii. boring or drilling to extract a mineral;
    iii. working the ground for the purpose of underground storage of a mineral; and
    iv. **drilling, installing or operating wells** for the purpose of formation testing, mining, waste disposal, deep well injection or dewatering related to the development or removal of a mineral;

[33] RSA 2000, c M-17, s 15.1(a,b).
[34] RRS 1996, c E-10.2, Reg 7, s 2(i,j).

These regulations are written in a way that specifically makes allowance for in-situ leaching, which is a common mining activity in the potash-rich western Canadian province.

3.3 California

California's Imperial Valley is home to 11 geothermal electricity plants that provide clean, renewable, continuous baseload electricity to the Golden State. As California's renewable electricity targets have become increasingly more ambitious, so too has their commitment to developing their geothermal resources. In 2018, Senate Bill 100 was signed into law, committing the State's electricity generation to be completely emissions-free by 2045.

In recent years, California has recognized that the geothermal energy industry offers more to combatting climate change that clean energy. Geothermal brines are host to lithium, rare earth elements, and other minerals that are integral to the manufacturing of electric vehicles, solar storage, and other clean technologies. Further, mining lithium and rare earth elements is a strategic industry, given that much of the equipment manufactured for the US Department of Defense also relies on these elements, and China is the world's 4th largest producer of lithium, and meets about 86% of the world's total REE demand (Appendix 2). In July, 2019, the following amendment was made to the Defense Production Act of 1950 by way of Presidential Memoranda:

> "I hereby determine, pursuant to section 303(a)(5) of the Act, that the domestic production capability for Rare Earth Metals and Alloys is essential to the national defense."[35]

Recognizing the economic and strategic opportunity, Californian companies developing mineral extraction technologies have found natural business partners in geothermal electricity plants, given that these plants produve very large volumes of brine daily. In 2012, a State bill was brought forward in order to "clarify that existing regulations and exemptions that apply to geothermal plants also apply to new processes that extract materials from geothermal waste in connection with that plant in a closed-loop system. The proposed amendment is intended to provide certainty to both geothermal developers and extraction companies, ensuring that neither party's geothermal exemption will be imperiled due to the extraction of beneficial commercial substances."[36] Essentially, this Bill was introduced in order to clarify the regulatory pathway for companies developing mineral extraction technologies in the Salton Sea region.

Since that time, companies have been able to demonstrate such technologies. In October 2019, California-based EnergySource Minerals announced having successfully developed a lithium extraction technology to recover battery-spec lithium from geothermal brine, and are proceeding

[35] Presidential Memorandum for the Secretary of Defense, "Presidential Determination Pursuant to Section 303 of the Defense Production Act," (July 22, 2019), https://www.whitehouse.gov/presidential-actions/presidential-determination-pursuant-section-303-defense-production-act-1950-amended-6/

[36] Richter, Alex, "New piece of legislation in California aims to clarify regulation on mining lithium from geothermal brine by making it exempt from certain state and federal regulation as are other byproducts of geothermal power production," *Think GeoEnergy*, (July 2012), http://www.thinkgeoenergy.com/california-legislation-to-help-mine-lithium-from-geothermal-brine/

toward a commercial lithium extraction initiative.[37] The CEO stated that, "the design can be applied to existing or proposed Salton Sea geothermal plants and other brine resources."[38]

3.4 Nevada

Activities that extract lithium from brines and/or ores has been expressly supported by the State of Nevada and the Nevada Division of Environmental Protection – Bureau of Mining Regulation and Reclamation (NDEP-BMRR). Please see Appendix 4.

Whereas certain mining and exploration activities have been exempted from the NDEP-BMRR regulatory permitting program, lithium exploration and extraction have not. This is due to potential degradation of State surface and groundwaters. In order to obtain a permit, an applicant must complete and submit a Mining Water Pollution Control Permit Application.

As per NAC 445A.424, "Limitations on degradation of water; exemptions:"

> "The groundwater produces a mineral, hydrocarbon or geothermal fluid which the applicant can demonstrate to the satisfaction of the Department exists at a concentration that is expected to be capable of commercial production and that releases by the facility will not affect this production;"[39]

4. Recommendation

In BC, the *Geothermal Resources Act* (GRA) governs geothermal resources, as defined in British Columbia's *Geothermal Resources Act*, RSBC 1996, c 171, p 1: [40]

> "the natural heat of the earth and all substances that derive an added value from it, including steam, water and water vapour heated by the natural heat of the earth **and all substances dissolved in the steam, water or water vapour obtained from a well**, but does not include
>
> a) water that has a temperature less than 80°C at the point where it reaches the surface, or
> b) hydrocarbons"

However, any other brine-related activities or projects, at any temperature, are not currently contemplated by British Columbia's *Mines Act*. Therefore, brine mining activities are not permitted. **CanGEA suggests that by amending the definition of "mining activities" in the *Mines Act* to include mineral recovery from brine, the BC Government will enable valuable minerals to be recovered.** In so doing, the BC Government can build on its well-established reputation in the global mining industry, and potentially create a domestic supply of lithium and other rare earth elements without transporting or smelting ores. Co-recovery of minerals also adds

[37] Richter, Alex, "Minerals arm of EnergySource successful in Lithium extraction from geothermal," *Think GeoEnergy*, (Oct 2019), http://www.thinkgeoenergy.com/minerals-arm-of-energysource-successful-in-lithium-extraction-from-geothermal/
[38] Ibid.
[39] NAC 445A.424
[40] Geothermal Resources Act, RSBC 1996, c 171, p 1

an additional revenue stream for geothermal* energy project developers, in turn lowering the price of energy for ratepayers, promoting industry growth and increasing the BC Government's royalty revenues.

Currently, the *Mines Act* defines "mining activities" as any activity related to:

> "a) the exploration and development of a mineral, a placer mineral, coal, sand, gravel or rock, or
> (b) the production of a mineral, a placer mineral, coal, sand, gravel or rock,"[41]

Currently, the *Mineral Tenure Act* defines a "mineral" as:

> "an ore of metal, or a natural substance that can be mined, that is in the place or position in which it was originally formed or deposited or is in talus rock, and includes:
> a) rock and other materials from mine tailings, dumps and previously mined deposits of minerals,
> b) dimension stone, and
> c) rock or a natural substance prescribed under section 2 (1)[42]

Because the recovery of minerals hosted in brine is not included in the *Mines Act*'s definition of "mining activities," there are positive, environmentally friendly brine mining projects that are not currently permissible in the Province.

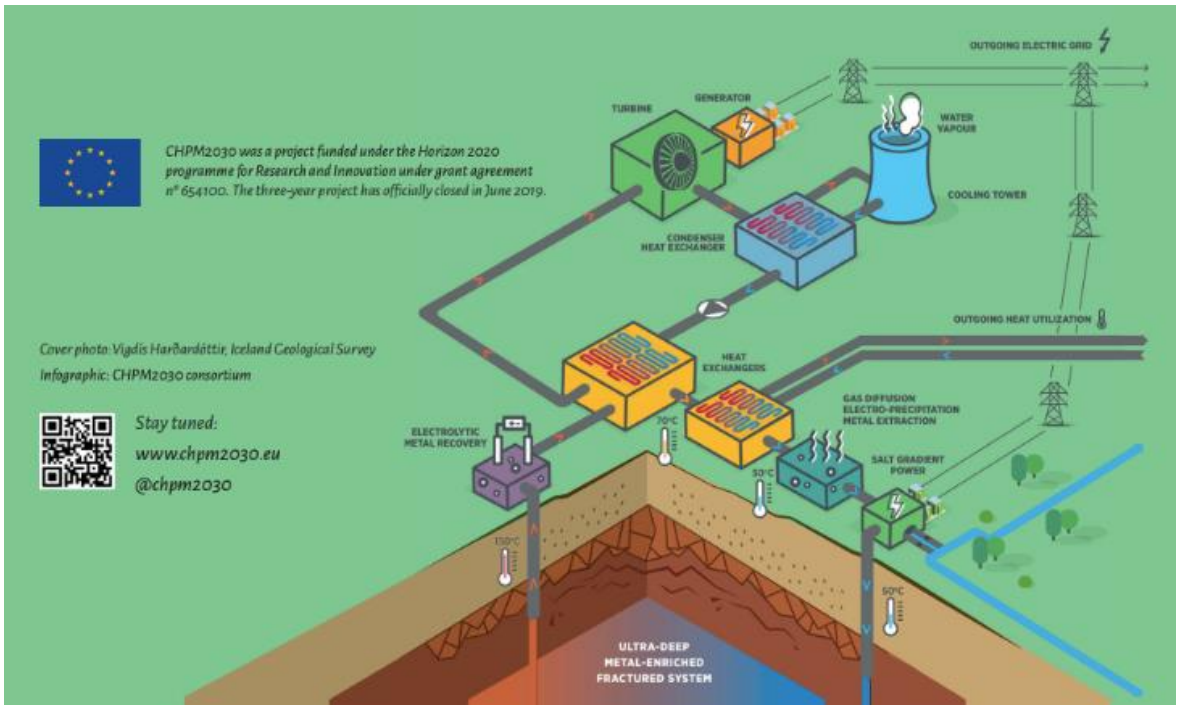
As adjacent jurisdictions have already opened their doors to companies recovering minerals from brine, as well as those testing new extraction technologies, BC risks losing local developers to other regions. It also risks dampening the development of a clean, renewable energy industry, namely geothermal,* by removing mineral recovery as a potential project revenue stream. **Thus, it is CanGEA's recommendation that a definition for brine mining be included among proposed amendments before British Columbia's *Mines Act* is brought forward to the next stage in the Legislative process.**

* It is important to convey that for the purpose of this submission, the terms "geothermal energy" and "geothermal resource" are used in general terms to describe reservoirs of heat that exist at different temperatures and depths in the subsurface of the Earth. Thus, the use of these terms does not follow the legal definition of a "geothermal resource" as stated in British Columbia's *Geothermal Resources Act*.

[41] Mines Act, RSBC 1996, c 293, s 1
[42] Mineral Tenure Act, RSBC 1996, c 292, s 1

Canadian Geothermal Energy Association
P.O. Box 1462 St. M, Calgary, Alberta, T2P 2L6, Canada
info@cangea.ca

Appendix 1: CHPM2030 Project[43]



Appendix 2: World production of REEs, by country, 2017[44]

Ranking	Country	Thousand tonnes	Percentage of total
1	China	116.9	86.6%
2	Australia	13.4	9.9%
3	Myanmar	2.3	1.7%
4	Russia	2.2	1.6%
5	Malaysia	0.3	0.2%
Total		**135.0**	**100.0%**

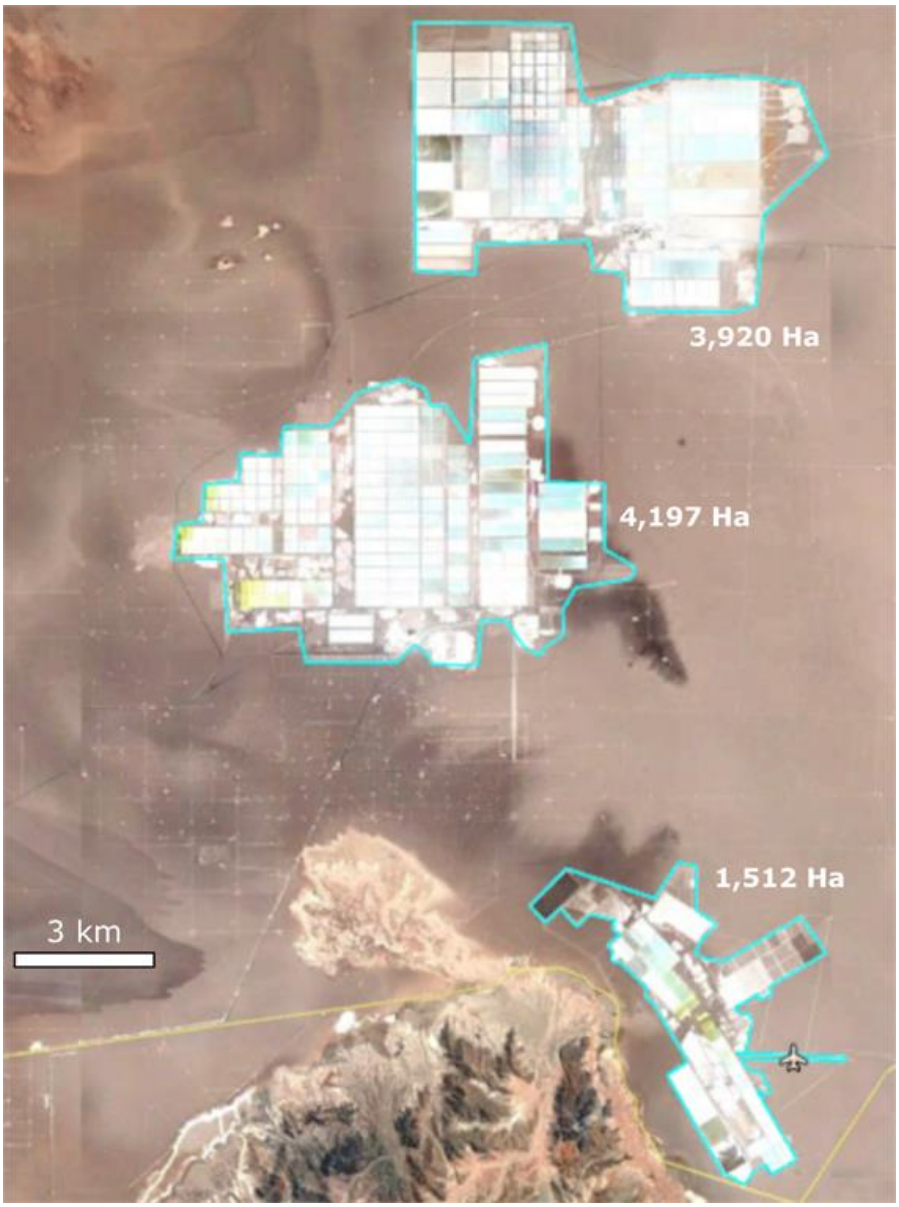
[43] Richter, Alex, "Project outcomes of CHPM2030 project," *Think GeoEnergy*, (Oct 2019), http://www.thinkgeoenergy.com/project-outcomes-of-chpm2030-project-combined-geothermal-heat-power-and-metal-extraction/?utm_source=ThinkGeoEnergy+List&utm_campaign=162a5cbbb7-TGE_Newsletter_RSS1&utm_medium=email&utm_term=0_657e42f767-162a5cbbb7-415259377

[44] Natural Resources Canada, "Rare Earth Elements Facts," https://www.nrcan.gc.ca/our-natural-resources/minerals-mining/minerals-metals-facts/rare-earth-elements-facts/20522

Canadian Geothermal Energy Association
P.O. Box 1462 St. M, Calgary, Alberta, T2P 2L6, Canada
info@cangea.ca

Appendix 3: Solar Evaporation Pond Images

Google Earth Image: San Pedro de Atacama Lithium extraction plant in Chile[45]

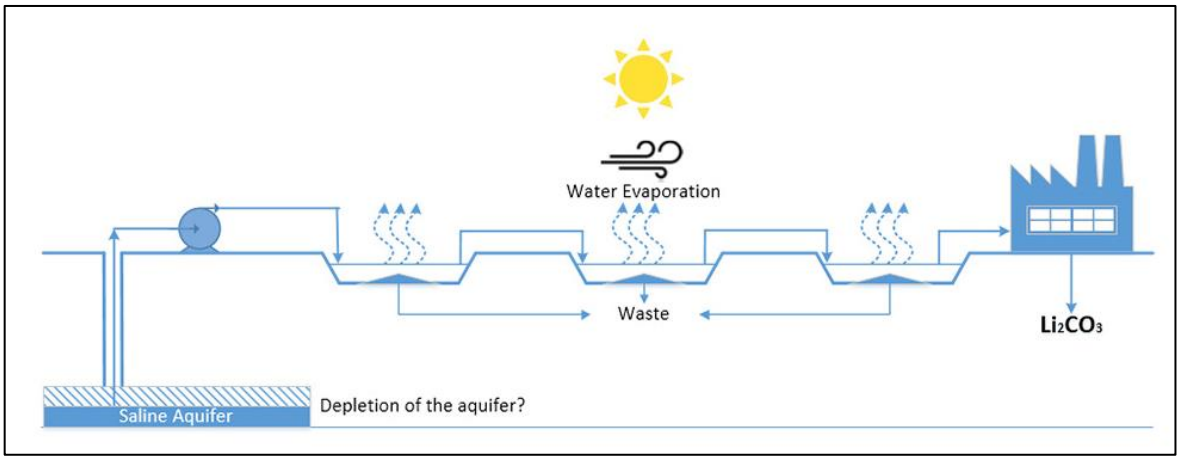


[45] Satellite imagery (2019) from Google Earth

Canadian Geothermal Energy Association
P.O. Box 1462 St. M, Calgary, Alberta, T2P 2L6, Canada
info@cangea.ca

Arial Photo: SQM's lithium brine plant in the San Pedro de Atacama salt flats[46]

Infographic of solar evaporation ponds[47]



[46] Reuters, 2019, "Chile taps China, Japan in lithium-for-tech push, faces touch sell," https://www.reuters.com/article/us-chile-lithium/chile-taps-china-japan-in-lithium-for-tech-push-faces-tough-sell-idUSKBN1W22DF

[47] Flexer, Victoria, Baspineiro, Celso Fernando, and Galli, Claudia Ines, "Lithium recovery from brines: A vital raw material for green energies with a potential environmental impact in its mining and processing," *Science of the Toal Environment* V 639, Oct 2018, pg. 1188-1204, https://www.sciencedirect.com/science/article/pii/S0048969718318746

Appendix 4: Selected Excerpts: State of Nevada Permitting Requirements for Lithium Exploration and Extraction Activities[48]

Nevada Division of Environmental Protection—Bureau of Mining Regulation and Reclamation
Permitting Requirements for Lithium Exploration and Extraction Activities

The State of Nevada, Division of Environmental Protection – Bureau of Mining Regulation and Reclamation (NDEP-BMRR) has learned of your company/agency/organization's interest in exploring and potentially extracting lithium from brines and/or ores in Nevada. The State of Nevada and NDEP-BMRR are supportive of these activities and is available to provide assistance and guidance to your company during the environmental permitting process. It is the primary mission of NDEP-BMRR is to ensure that Nevada's waters are not degraded by these activities and that the lands disturbed as a result of these activities are reclaimed to safe and stable conditions to ensure a productive post-mining land use.
…

A WPCP application should be submitted at least 180 days prior to the planned construction date of any component of a mining operation or the planned start of mining. It takes approximately 180 days to obtain a WPCP. This time frame includes the public notice and a 30-day public review and comment period. A WPCP is valid for a 5-year duration, provided the operator remains in compliance with the regulations.

A permit renewal is required to continue the mining operations beyond 5 years. Monitoring is required by the permit on a process and site-specific basis and reporting is required quarterly. Fees associated with the WPCP include application, annual, and renewal fees as specified at NAC445A.232. Prior to submitting a WPCP application, the prospective applicant must meet with Division representatives to discuss location, operating plans, and general characteristics of the facility. The application, in addition to basic ownership and facility information, must include meteorological information, a complete description of the proposed activity, characterization of the ore, waste rock, and all potential receiving waters, and the production rate in tons of ore per year or in the case of a discharge, gallons of water per day. The application must be accompanied by required supporting documents on the design, construction, operation, and closure of operations. Documentation of notice to the local board of county commissioners is also required.
…

Exploration Drilling and Bulk Sample Collection
NDEP-BMRR issues Temporary Discharge Permits for mineral exploration projects on a regular basis, typically for well pump testing and temporary dewatering for mineral exploration projects.

A Temporary Discharge Permit is required if the following three (3) conditions are met: 1) The discharge is greater than 250 gallons per minute; 2) The test is greater than 48 hours in duration; and 3) The discharge water has the potential to violate any water quality standard.

[48] Nevada Division of Environmental Protection – Bureau of Mining Regulation and Reclamation, "Permitting Requirements for Lithium Exploration and Extraction Activities," http://minerals.nv.gov/uploadedFiles/mineralsnvgov/content/Programs/DMRE/201804RK-Lithium%20Permitting%20Requirements.pdf

Canadian Geothermal Energy Association
P.O. Box 1462 St. M, Calgary, Alberta, T2P 2L6, Canada
info@cangea.ca

CanGEA

CANADIAN GEOTHERMAL ENERGY ASSOCIATION