NEVADA DIVISION OF MINERALS
Commission on Mineral Resources

Lithium Exploration and Mining in Nevada

State Land Use Planning Advisory Council

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Global Demand For Lithium

- The Tesla/Panasonic battery factory alone needs 5X the amount of lithium mined annually in Nevada.

Source – thundersaidenergy.com
Lithium Prices: January 2016 - April 2022

USD / Tonne

Jan 16 Nov 16 Sep 17 Jul 18 May 19 Mar 20 Jan 21 Nov 21
US Magnesium began producing lithium in 2020.
# Lithium in Brine vs. Lithium in Clay/Rock

## Lithium Brine
- Albemarle’s Silver Peak mine is the only active lithium mine in US, operating since 1966.
- Solar evaporation in ponds over 18-24 months increases concentration of lithium chloride (100X, ~0.54%) prior to processing into lithium carbonate.
- Cheaper processing costs but lower recovery %s (~50%).
- Requires placer mining claims and significant water rights
- Newer technologies may not require same timeframe nor large consumptive water use
- 17 other playa basins in Nevada being explored (>21 projects)

## Lithium in Clay/Hard Rock
- No current mines, but 3 projects are in various stages of permitting:
  - Thacker Pass, Humboldt Cty
  - Rhyolite Ridge, Esmeralda Cty
  - TLC Project, Nye Cty
- Resources typically very large with long mine-life
- Processing is more expensive but yields higher recovery %s (~85%)
- Requires location of lode mining claims
- Much less water consumption but high sulfuric acid consumption
- At least five additional exploration projects in Nevada
Silver Peak Lithium Operations

- 1912: Sodium and potassium brine discovered in Clayton Valley
- 1936: Leprechaun Mining secures first mining and milling water rights
- 1950s: Leprechaun Mining discovers lithium in groundwater
- 1964: Foote Mineral Co. acquires land in Clayton Valley
- 1966: Lithium mining operations begin
- 1967: Lithium carbonate first produced
- 1981: US Federal Court of Claims determines that lithium is locatable
- 1988: Cyprus Amax Minerals acquires Foote
- 1991: BLM acknowledges that Cyprus has the right to mine lithium within the patented area
- 1998: Chemetall purchases Cyprus Foote
- 2004: Rockwood Specialties Group buys Chemetall Foote
- 2015: Albemarle buys Rockwood Lithium
- 2021: Produced 12.7M pounds of lithium carbonate
Clayton Valley Brine Aquifers

6 main aquifers, ranging in thickness from <1’ to >350’
Clayton Valley Faults

Numerous faults create discontinuity of Li-brine aquifers which can restrict production or require increased number of production wells.
New Tech - Direct Lithium Extraction

Source: Lithium South Development Corp. website

Source: E3 Metals company presentation courtesy of Jade Cove partners
Lithium in the 1872 Mining Law

- Lithium is a locatable mineral on Federal land under the General Mining Law of 1872
- Placer claims are used to locate potential lithium brine deposits
- Lode claims are used to locate potential lithium clay or hardrock resources
- Initial exploration performed under a BLM Notice (not a permit) which is a quick process
  - Only 15 days advance notice
  - Bond required before commencement of surface disturbance activities
  - Non-discretionary
The Challenge to Lithium Brine Exploration in Nevada

- Water belongs to the State of Nevada.
- The State Engineer regulates quantity and beneficial use.
- To pump and test for lithium in brine you need a water right, which is not a quick process and is subject to appeal.
- Some lithium brine projects located on top of active oil and geothermal leases.
  - Each party is entitled to explore but are regulated under two different “rulebooks”.
  - BLM can’t require lithium brine explorer to use blowout prevention equipment – potential safety issue in geothermal areas.
- Typical locatable mineral explorers not accustomed to drilling and designing wells for testing of water or use of precautionary measures for hot water.
- New law was needed to create a streamlined path for safe exploration of lithium brine with limited pumping.
DISSOLVED MINERAL RESOURCE EXPLORATION (DMRE) - STATUTES AND REGULATIONS

• Sponsored by Governor Sandoval, Assembly Bill 52 was passed by the Nevada legislature in 2017.
• Created Chapter 354B in Nevada Revised Statutes, effective January 1, 2018.
• Established authority for the Division of Minerals to regulate exploration of dissolved mineral resources – NDOM regulates oil, gas, and geothermal exploration and development.
• NDEP, NDWR and NDOM jointly developed regulations.
• Regulations became effective May 16, 2018.
• First DMRE well approved January 10, 2018.
• First DMRE borehole approved February 1, 2018.
What is in the Statute?

- Defines a “dissolve mineral exploration borehole” and allows for sampling of water in exploration boreholes.
- Defines “dissolved mineral resource exploration well” and enables an application process by NDOM.
- DMRE approved well permits expire after 2 years, can be extended for 2 more years.
- Defines a “dissolved mineral resource exploration project” as a notice or plan-level approved project on Federal lands (claims), or a defined project area on non-federal lands.
- Requires a Nevada licensed water well driller to drill DMRE boreholes and wells.
What is in the Statute?

• Allows for up to 5 acre-feet (6,165 cubic meters) of water to be pumped for testing per project (not annually).
  – This volume is considered adequate to determine presence of a resource but not necessarily to quantify and fully model it.
• > 5 acre-feet requires a water right from NDWR.
• Does not change the appropriation procedures in NRS/NAC 533, 534
• Allows for application fee for wells and fines for violations
What is in the Regulations?

• Exploration Boreholes: notice of intent form required, no fee, allows for sampling (e.g. HydraSleeve) but not pumping

• DMRE wells: permitting process, application fee ($1,000/well)

• Well design approval required: casing, seals, etc.

• Regulations are very similar to those for NDWR

• Well permits not retroactive to existing MM waivers or existing permitted rights issued by NDWR
What is in the Regulations?

- Drilling within “Areas with Limitations” subject to additional conditions
- 100’ setback from existing oil, geothermal or water wells.
- No limit on number or boreholes or wells, but total pumping for sampling is limited to <5 AF per project.
- Plugging logs signed by licensed water well driller to be submitted for all boreholes and wells.
- Reclamation bonding required
  - Held by BLM if on federal land
  - Held by NDOM if on private land
Areas With Limitations

- Regulatory mechanism for additional review to ensure proposed DMRE activity is safe and doesn’t impact permitted oil, gas, and geothermal (OGG) wells and resources.
- Uses map published on NDOM website depicting:
  - NDOM-permitted OGG wells
  - Federally-authorized oil, gas, and geothermal leases
  - Groundwater basins having increased thermal gradient (125°F at 1,500 ft or 52°C at 460 m, using gradient of 67.42°C/km)
- Depth limitations for drilling without Blowout Prevention Equipment
- Monitoring of drilling mud temperatures with requirement for cooling equipment when mud is >125°F/52°C
As of April, there were 14,971 placer claims located for lithium brine exploration - 6% of all mining claims.
Lithium Americas – Thacker Pass Project

- Reserves – 3.1M tonnes LCE at 2,358 ppm Li
- Strip ratio – 1.6:1
- Mine life – 46 years
- Processing time - <24 hours
- Lithium recovery – 83%
- Pilot plant operational in Reno
- BLM issued Record of Decision on 1/15/2021
- ROD appeal expected to be complete by Q3/2022
- NDEP permits issued 2/25/2022, appealed by GBRW, to be heard by SEC end of June
ioneer’s Rhyolite Ridge Project

Project overview

A searlesite resource that is different to other sedimentary lithium deposits - it is suitable for a simple acid leach process

- Total Resource¹ of 4.1 million tonnes lithium carbonate & 10.9 million tonnes boric acid
- Including 121 million tonnes of lithium-boron ore containing:
  - 1.1 million tonnes lithium carbonate
  - 8.6 million tonnes boric acid
- Lithium only clay mineralisation to be stockpiled
American Lithium – TLC Project

- Measured and indicated resource of 5.4 Mt lithium carbonate equivalent
- Lithium ore at the surface
- Preliminary metallurgical tests indicate >90% recovery in <10 minutes using sulfuric acid leach
- Large drilling program permitted and economic analysis is underway
Lithium Exploration Activity

➢ > 40 companies in various stages of exploration; ~30,000 mining claims (~13% of total mining claims in NV)
➢ ~30 companies involved in Clayton Valley alone, with numerous joint ventures/agreements
➢ ~12 lithium in clay projects (open pit)
➢ >30 lithium brine projects (DLE), none are considering solar evaporation concentration process
➢ NeoLith Energy (Schlumberger Energy) has permitted the Clayton Valley Pilot Plant to evaluate their DLE technology ($15M invested to date) and has a collaboration agreement with Panasonic Energy to optimize process for battery-grade feed
➢ 24 approved DMRE Notices
➢ 14 Approved DMRE well Permits
➢ ~11 different playas have been drilled for lithium brine under DMRE regulations
➢ Advancements in DLE are critical to future of lithium brine production
Dissolved Mineral Resource Exploration (DMRE)

Assembly Bill 52 of the 2017 session was signed into law in June, 2017. The purpose of this legislation is to define a permitting path for dissolved mineral exploration, including lithium brines, and to develop regulations to ensure exploration drilling for dissolved minerals is protective of groundwater, as well as oil and geothermal resources. The legislation authorizes regulation by the Division beginning on January 1, 2018. The Division of Minerals is now accepting applications for Dissolved Mineral Resource Exploration (DMRE) wells and notices of intent for DMRE exploration boreholes. All forms for the program are located below, can be picked up at the Division office, or mailed to the public upon request.

- NRS 534B
- NAC 534B (codified)
- Response to Summary Comments on Proposed Regulations, April 25, 2018
- Oil, Gas, and Geothermal Resources and Groundwater Basins with High Temperature Gradients - Areas with Limitations Map 01/15/2020
- NDEP – BMRR Permitting Requirements for Lithium Exploration and Extraction Activities (2019 edit)

Areas with Limitations Interactive Map

This map is to be utilized in order to determine if a proposed dissolved mineral exploration project will be located within an area with limitations.