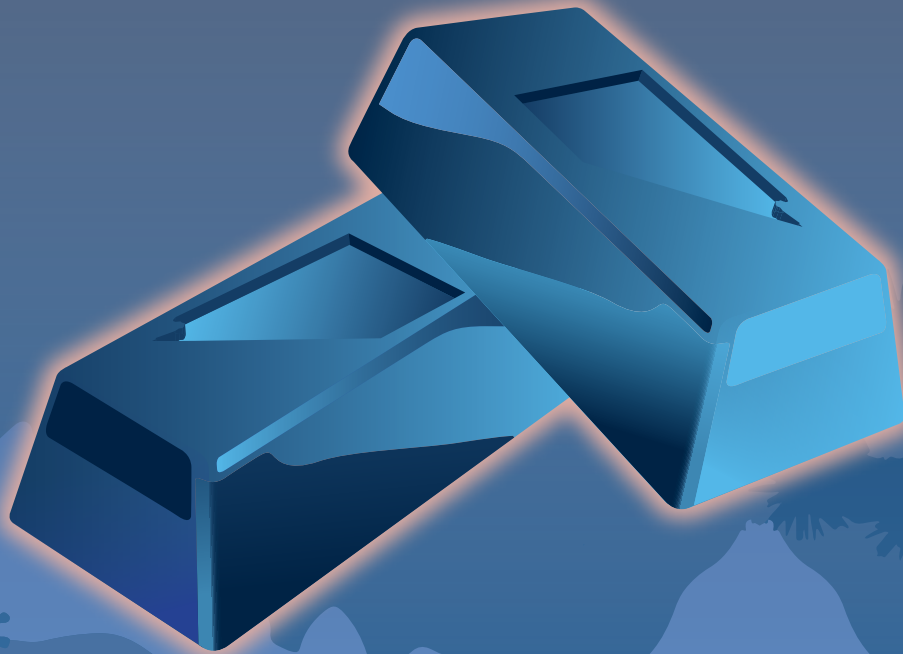


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NEVADA MINING 2022

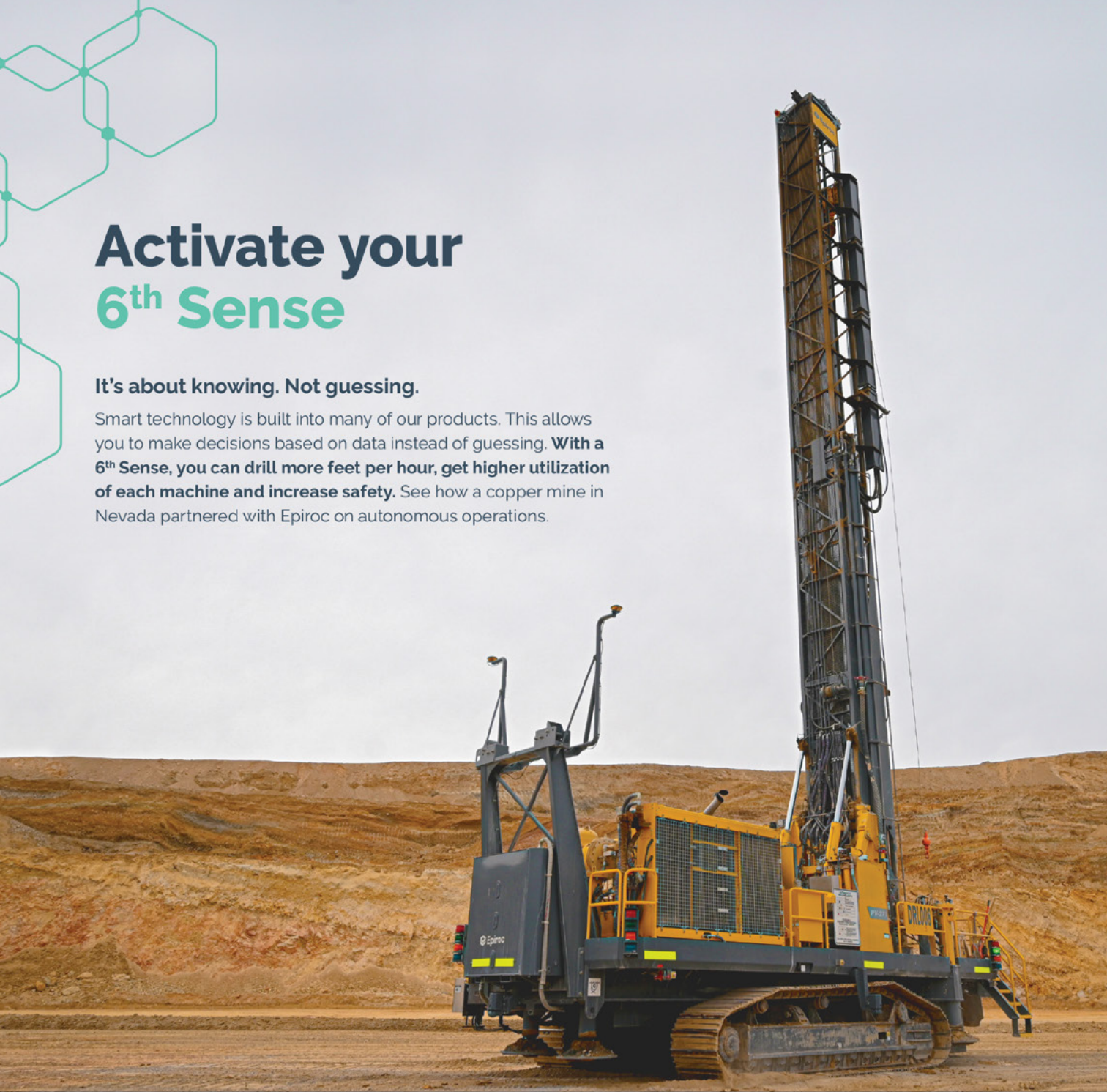


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Dear Reader,

GBR is delighted to be back in Nevada to investigate the latest developments across the mining value chain and provide an in-depth analysis of the companies and themes shaping the industry today.

For years, Nevada has ranked among the top contenders in the Fraser Institute's annual survey of the world's most attractive mining destinations according to investors. In 2020, it finally earned the top position.

Thanks to an outstanding geological potential combined with mining-friendly policies, Nevada today hosts a wide pool of industry players, from majors to intermediate producers, explorers and service providers. In 2019, Nevada Gold Mines was established, creating the world's largest gold mining complex and assuring the state's prominent mining position in the years to come.

Over the last two years, the pandemic has transformed Nevada's mining landscape. Economic uncertainty pushed up the price of precious metals, creating new opportunities for the local industry. Covid also raised the importance of securing supply chains of critical minerals for the country's development. In the following pages, we not only explore Nevada's precious metals opportunities, but also its potential to become an important domestic source of critical minerals such as lithium, vanadium and copper, which are vital to the expansion of renewable sources of energy and emerging energy storage technologies.

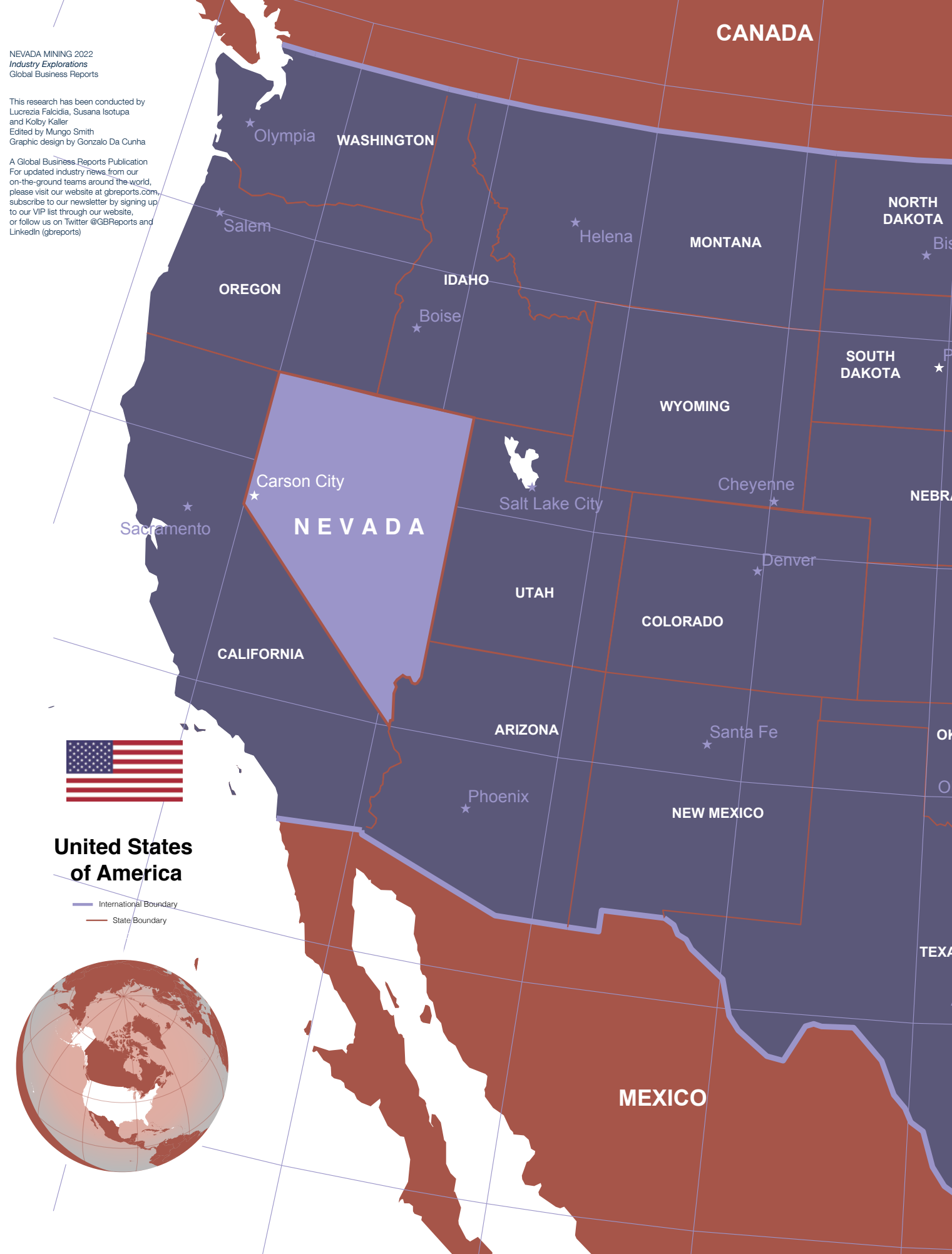
We thank each of our 70 interviewees who have taken the time to provide their insights into the market, and we sincerely hope you enjoy the read.



Alfonso Tejerina
General Manager and Director,
Global Business Reports
(GBR)

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Nevada has become hub for mining engineers and consultancies as a result of the large number of mining operations in the state

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“Mining in Nevada is roughly a US\$9 billion industry, and most of its revenue comes from the production of gold, silver, copper, and lithium; four essential metals for green technology. The state is also a pioneer in modern environmental standards for mining.”

– Tyre Gray,
President,
Nevada Mining Association

INTRODUCTION TO NEVADA

Introduction to Nevada Mining



Many people still believe that mining involves pickaxes and drilling holes in the ground, but this could not be further from the truth. The mining industry in Nevada is very technologically advanced with strict environmental laws. In fact, mine operators must reclaim the land they have mined to a state that is safe, stable and suitable for productive post-mining use, according to the state's reclamation law.

A prolific mining jurisdiction



- Richard D. Perkins, Founder and CEO, Business Council of Canada and Nevada

Since the discovery of the Comstock Lode in the 1850s, mining has become integral to Nevada, playing a vital role in the state's economy and culture. Today, mining in Nevada is roughly a US\$9 billion industry and represents 6% of the state's GDP, accounting for 37,000 jobs throughout the supply chain.

Though Nevada has traditionally been known as the 'Silver State' because of the abundance of silver, gold has progressively stolen the spotlight. According to the US Geological Survey,

if Nevada were a country, it would be the world's fifth largest gold producer, behind China, Australia, Russia and Canada, representing 4.4% of the world's production (2020). The state accounted for 75.8% of US gold production in 2020.

Nevada's mineral endowment is not limited to precious metals. There are over 20 minerals being mined in the state, including lithium and vanadium, which are essential to the expansion of renewable sources of energy and emerging energy storage technologies, as well as copper, iron, molybdenum, gypsum, limestone, sand and gravel.

As far as prolific mining jurisdictions go, it does not get much better than Nevada. The state is regularly among the top contenders in the Fraser Institute's ranking of the world's most attractive mining destinations and, in the most recent survey, Nevada finally earned the title as the world's top mining jurisdiction. Among the reasons for its competitive edge are the state's remarkable geological potential and a very mining-friendly bureaucracy, with a clear permitting process and a favorable industry tax rate. Over the course of its mining industry history, Nevada has also built up world-class mining infrastructure throughout the state, and is home to a strong mining workforce of experienced professionals.



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INVESTMENT ATTRACTIVENESS INDEX

Source: Fraser Institute. Annual Survey of Mining Companies (2020)

JURISDICTION	SCORE
Nevada	91,05
Arizona	90,45
Saskatchewan	89,38
Western Australia	88,82
Alaska	88,06
Québec	85,97
South Australia	85,64
Newfoundland & Labrador	85,17
Idaho	85,00
Finland	82,75

Working through challenges

While Nevada's mining industry appears to be on solid ground, it is also working through some challenges. For several years now, the industry has struggled to mine a specific element that is fundamental to its success: new workers. As highlighted by the president of the Nevada Mining Association (NVMA) Tyre Gray: "The mining industry's largest challenge is workforce development, as it is currently about 500-1,000 jobs under where it should be".

At nearly every level of exploration and mining companies, as well as the service industries that support them, personnel challenges prevail, and the shortage of drillers and laboratory workers in particular is causing significant delays. This is particularly remarkable considering the industry's average salary is US\$95,000 per year, making it one of the highest paying industries in the state.

What are the reasons behind the current shortage of workers? Many attribute it to the generous unemployment benefits that the government provided to help workers that had been laid off due to Covid-19, which have discouraged them from returning to the labor market. However, Nevada is also missing certain basic elements to attract new workers, especially in the northern part of the state: "A poor education system and a lack of affordable healthcare, internet and day-care facilities make it hard to attract quality employees,

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which is why we have over 500 job vacancies within our company currently, of which 200 are professionals," expressed Greg Walker, executive managing director at Nevada Gold Mines (NGM).

In addition, the state faces the perennial struggle of a strong anti-mining sentiment. Today, the industry is a far cry from the days of pickaxes, dangerous working conditions and little concern for the environment, but it still seems unable to shake off its old-fashioned image. The sector is thus making huge efforts to overcome its negative public perception and to expose people to what modern mining looks like in Nevada. "We have one of the best environmental standards in the world and are a technologically advanced STEM industry that thrives on our scientific progressions," stated Tyre Gray of NVMA.

Nevada has also been facing some challenges on its tax front. In May 2021, after agitated negotiations involving lawmakers, mining lobbyists and the state's largest teachers

union, the Nevada Senate and Assembly approved a proposal to impose an additional tax on mines that will gross more than US\$20 million annually. The new tax method preserves the state's Net Proceeds on Minerals Tax structure, which requires companies to be taxed at less than 5% of net proceeds – which are profits minus deductions. It adds an excise tax of 0.75% on mines that report gross revenue of US\$20 million to US\$150 million, and 1.1% on mines that report any higher. It contains requirements that the revenue be directed to schools.

Attracting and retaining a skilled labor force

The tight labor market is creating headaches for the mining industry as it seeks to capitalize on strong prices for gold, silver and copper, as well as growing interest in minerals such as lithium. Companies across the value chain are coming up with new ways of attracting and retaining employees. Many are paying higher salaries than ever before, while others are rewarding employees with sign-on bonuses, engaging with employment agencies, or partnering with universities to attract skilled graduates. The industry is also making efforts to ensure a more balanced work-family life and provide growth opportunities for employees.

"We need to change our approach to attracting new employees. There are many people who have worked in mining their whole career and have good skills developed in operational management, IT, and procurement learned in mining environments, but they choose to work for companies in other industries such as Amazon or Google that offer much more attractive employment conditions rather than just salary incentives," argued Ben Howard, COO of the drilling supply specialist American Mining Services.

On a larger scale, both companies and associations in the sector are making substantial investments to develop their surrounding communities to make them more attractive places to live in. A shining example of this is the I-80 Fund, created by NGM and sponsored by companies such as Cyanco, Small Mine Development and Sandvik, which provides small businesses and start-ups the opportunity to secure low interest loans in an effort to develop north-eastern Nevada. In sum, Nevada's mining industry holds great potential and today, favorable precious metals prices and the strong desire to secure the domestic supply of critical minerals are creating new opportunities and dynamics within in the sector. The following pages will explore how the state's mining industry has accelerated exploration and production activities in order to make the most of the current boom, and analyze in depth how it is overcoming the present challenges. ■

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Tyre Gray

President
NEVADA MINING ASSOCIATION

Can you provide an overview of the NVMA's scope and mandate?

The NVMA is the public voice of Nevada's mining industry. We represent every link of the mining supply chain, from exploration companies to mine operators. We currently have 600 member companies, either with a direct or an indirect interest in mining. Our role is to advocate and educate on the importance of mining, since people often do not make the connection between mining and daily-use objects such as cars or cell phones. It is our directive to expose people to what modern mining looks like in Nevada; we have one of the best environmental standards in the world and are a technologically advanced STEM industry that thrives on our scientific progressions.

Could you share some key facts of Nevada's mining industry?

Mining in Nevada is roughly a US\$9 billion industry, and most of its revenue comes from the production of gold, silver, copper and lithium: four essential metals for green technology. The state is also a pioneer in modern environmental standards for mining. A key aspect of this is the reclamation process and the "smart from the start" approach. It requires companies in Nevada to plan not only for the mine life, but also for the mine's closure, before mining operations commence. Before a single shovel hits the ground, a bond is paid to return the land back to its original state. Nevada also has a very robust abandoned mines program that is funded by the mine operators and comes at no cost to the state. It has been a huge success and is being replicated federally and in other countries.

Our role is to advocate and educate on the importance of mining, since people often do not make the connection between mining and daily-use objects such as cars or cell phones.

Nevada was recently ranked as the top jurisdiction for mining investment by the Fraser Institute. What makes it such an attractive destination?

Nevada is blessed with resources and has a very rich mining history. The state, like the rest of the US, has a relatively stable tax basis, which is predictable and provides security for investors. Nevada also has a very low corporate tax basis, where mining pays the same taxes as every other business plus two industry-specific taxes, including a 5% tax on the net proceeds and the recently approved mining education tax. Nevada also has one of the best-defined regulatory structures in the world.

What are the main challenges the mining industry currently faces?

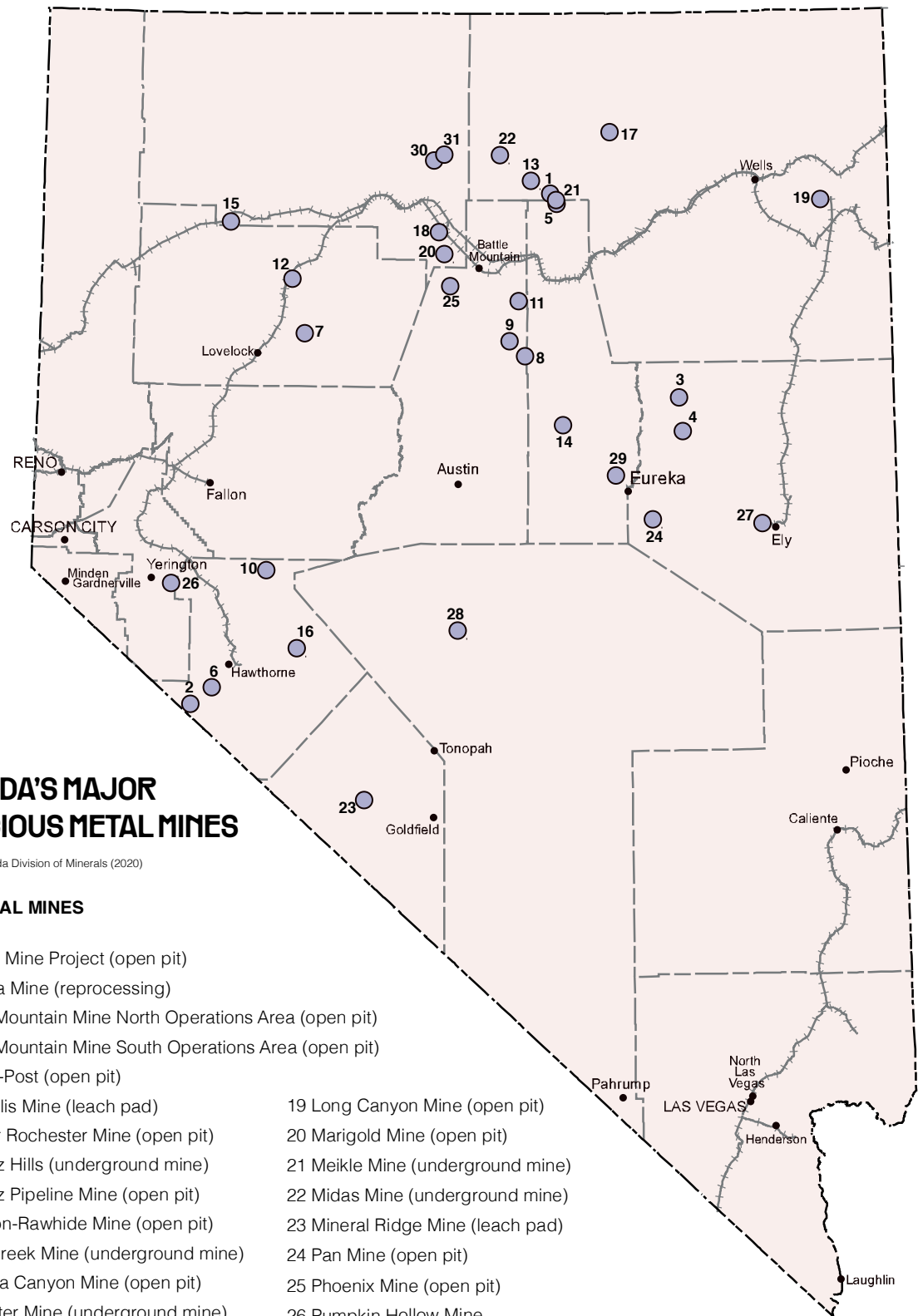
The largest challenge is workforce development, as it is currently about 500-1,000 jobs under where it should be. To tackle this, the NVMA has implemented the Mining Vegas for Talent project to attract a diverse workforce, culturally and gender-wise. From a regulatory perspective, it would be great to streamline the permitting process by running certain pieces of the process concurrently, since it currently takes 7-10 years.

Can you highlight some socioeconomic impacts of Nevada's mining industry?

Mining companies' most important contribution is placing people in high paying jobs where they can become their own revenue generators. Nevada's mining industry employs around 37,000 people throughout the supply chain, with an average salary of US\$95,000 per year. Philanthropy is another essential contribution. The mining industry was the largest contributor to the state's Covid-19 task force and is extremely active in community involvement. The NVMA earmarks 3-5% of its budget annually to contribute to other non-profit organizations. For example, we recently concluded our 6th annual Hope for Heat campaign. It involves donating to After-School All-Stars Las Vegas each day the temperature reaches 100 degrees F in Las Vegas to support after-school programs. Similarly, each day temperatures hit 90 degrees F in Northern Nevada, we contribute to both the Eddy House in Reno and the Boys & Girls Club of Elko.

How do you see the Nevada's mining industry evolving in the medium-term?

The outlook for Nevada's mining industry for the next decade is very bright. Mining is the first link in the green supply chain, and through our public outreach campaigns, we aim to make people aware of its positive contribution. Also, there is increasing recognition at the political level of the necessity to mine critical minerals in America. The mining industry has the duty to extract minerals in a sustainable way. Not wanting mining in Nevada implicitly condones mining to jurisdictions that do not have the same strict environmental and human rights standards. We want to ensure that wherever mining is taking place, it is being done in the right way. ■

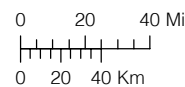


NEVADA'S MAJOR PRECIOUS METAL MINES

Source: Nevada Division of Minerals (2020)

METAL MINES

- 1 Arturo Mine Project (open pit)
- 2 Aurora Mine (reprocessing)
- 3 Bald Mountain Mine North Operations Area (open pit)
- 4 Bald Mountain Mine South Operations Area (open pit)
- 5 Betze-Post (open pit)
- 6 Borealis Mine (leach pad)
- 7 Coeur Rochester Mine (open pit)
- 8 Cortez Hills (underground mine)
- 9 Cortez Pipeline Mine (open pit)
- 10 Denton-Rawhide Mine (open pit)
- 11 Fire Creek Mine (underground mine)
- 12 Florida Canyon Mine (open pit)
- 13 Hollister Mine (underground mine)
- 14 Gold Bar Mine (open pit)
- 15 Hycroft Mine (open pit)
- 16 Isabella Pearl Mine (open pit)
- 17 Jerritt Canyon Mine (underground mine)
- 18 Lone Tree Complex (leach pad)
- 19 Long Canyon Mine (open pit)
- 20 Marigold Mine (open pit)
- 21 Meikle Mine (underground mine)
- 22 Midas Mine (underground mine)
- 23 Mineral Ridge Mine (leach pad)
- 24 Pan Mine (open pit)
- 25 Phoenix Mine (open pit)
- 26 Pumpkin Hollow Mine
- 27 Robinson Mine (open pit)
- 28 Round Mountain Mine (open pit)
- 29 Ruby Hill Mine (leach pad)
- 30 Turquoise Ridge Joint Venture
- 31 Twin Creeks Mine (open pit, underground mine)



Can you introduce the National Mining Association?

The NMA is primarily an advocacy organization, which acts as the voice of mining in the US. We are located in Washington D.C., where we advocate on pro-mining policies with the US government, members of Congress and the regulatory agencies. We are a staff of professionals that manage and leverage the advocacy platforms of the association, such as direct lobbying, media relations and grassroots advocacy at the state and local levels. Our more than 250 members include producers, equipment manufacturers and service providers.

What makes the US an attractive mining investment destination?

The US offers a stable operational base for mining companies due to its solid governance structure and consistent policies. The country also offers robust environmental and labor standards that ensure that all the stakeholders are protected. Our role as the NMA is to ensure transparency, fairness and timeliness throughout this system, and that there is a path for decisions to be made to permit or expand existing and new mines.

How would you describe Nevada's mining industry?

Mining is central to Nevada's economy as the fourth largest producer of gold in the world, but it also holds vast quantities of silver, copper, lithium, iron and molybdenum. Nevada is a particularly attractive mining investment destination in the US due to its skilled labor force, the ease in moving goods and products, the availability of services, and the support by Nevada's communities. In Nevada, around 90% of the land is public and owned by the federal government. This facilitates the access to land where hard rock minerals can be found.

What socio-economic impact does the mining industry have in Nevada?

According to our most recent data, the state's mining industry directly employs nearly 50,000 people. The industry also contributes US\$11.4 billion to the state's GDP.



Rich Nolan

President and CEO
NATIONAL MINING ASSOCIATION (NMA)

By working with the administration and the Congress, the NMA has incentivized actions to try to promote the reshoring of the mineral and metal supply chain in this country.

How do you see the prospects for funding mining projects?

Our stability attracts international capital. We are witnessing an exponential increase in the demand for Nevada's minerals including copper, nickel, gold, silver and lithium as the economy moves towards electrification and with the transformation of our energy sector. The demand for these minerals will also boom as the world recovers from the pandemic, infrastructure projects take off, along with the manufacturing of technologically advanced machinery and equipment that rely on these metals. The market is aware of that, which is why we are currently witnessing a race to find these deposits and to develop them as quickly as possible.

Do you think the US has the potential to become a significant player in the critical minerals value chain?

The demand for all minerals – not just so-called critical minerals – is so great that we cannot have an "us versus them" narrative. Every country has a role to play. Certainly, Canada and Australia have fantastic deposits that they are developing quickly, and we need to be the same in the US, which is part of the mission of the NMA.

While there are certainly minerals that are currently dominating the headlines

and drawing the most attention – chief among them those involved in energy and battery technologies – that focus overlooks co-location of minerals and the production of minerals as byproducts of processing or refining of other minerals. Much of the world's cobalt is accessed through copper production. We have a member company that is working to recover tellurium used in solar panels as byproduct of copper refining. A planned gold project in the US could provide 35% of the nation's antimony needs. And yet neither copper nor gold are listed as critical minerals. I would also add that advancements in battery power – so essential to electric vehicles and the electricity grid of the future – continues to evolve and will inevitably involve a wide range of battery types in the near future, with each requiring different minerals.

To promote these ideas in the US, we have a campaign underway called Minerals Make Life. It seeks to raise awareness on the importance of a wide range of minerals for society and on the need to source them in the US. By working with the administration and the Congress, the NMA has incentivized actions to try to promote the reshoring of the mineral and metal supply chain in this country. Nevada has a significant role to play in that. ■

Environmental Protection

Nevada: A pioneer in modern environmental standards



Image courtesy of Newrange Gold Corp.

Mining activities in the US have changed dramatically in the past 30 years. In the western part of the nation, mining started in the mid-1800s and was completely unregulated for over a century. Congress did not enact the country's first environmental laws until the 1970s, and most states did not start to pass environmental laws until the 1970s and 1980s. During this era of unregulated mining, environmental protection simply was not under anyone's radar and little attention was paid to the long-term consequences of mining activities. Miners typically deposited mine wastes, including mill tailings, waste rocks, and smelter slags, directly on the ground in the nearest valley or low area. Once the ore was exhausted or falling metal prices made mining unprofitable, miners commonly moved on to the next prospect and abandoned the old one, giving no thought to reclaiming the land. The mining landscape in the US – and particularly in Nevada – looks radically different today. In 1989, the Nevada legislature approved laws that established a comprehensive regulatory process governing the reclamation of mined and explored lands. This process included the development of a reclamation plan and the posting of financial assurance that the work would be completed. "Before any mining or exploration company can initiate any surface disturbance on public lands in the state, they must put forth a financial instrument to cover the total cost needed by a federal or state regulating agency to perform all the required reclamation that would result from their proposed project," explained Mike Visher, administrator at the Nevada Division of Minerals (NDOM). Through a formal agreement with federal land management agencies, the NDOM holds these assurances, which are in-

tended to reclaim mining disturbance if the mining company, for whatever reason, cannot or does not do it. However, not all reclamation activities must wait until a mine has closed. Many companies include concurrent reclamation efforts within their plans of operation or expansion. For example, a company will reclaim a waste rock facility or a portion of the mine that is no longer productive. With careful contouring of the land and nurturing of native plants, the reclaimed area soon blends with nearby undisturbed acreage, so that often, the casual observer cannot tell the difference between a place that has been reclaimed and a place that has never been mined.

Excellence in mine reclamation

Since the reclamation laws were introduced in Nevada, the mining industry has worked hard to meet – and often exceed – these requirements. In recognition of the good work being done throughout the state, the NDOM began presenting its Excellence in Mine Reclamation Awards in 1991. According to NDOM, the purpose of the program is to recognize and share examples of successes in the areas of reclamation, closure, planning and wild-life protection and enhancement in Nevada. In 2020, KGHM's Robinson copper mine received the Nevada Excellence in Mine Reclamation Award in the category of Legacy Waste Rock Remediation for reclamation of its Lane City Waste Rock Facility. "As a legacy site, I am proud to say our company has invested significant funds on reclamation activities and remediating historical issues that predate

modern mining laws," commented Amanda Hilton, general manager of the Robinson mine. Mining at the Robinson mine, which is located in White Pine County, dates back to the mid-1860s. Numerous former operators had employed various methods of extracting copper and other metals, generating Waste Rock Facilities (WRF), such as the Lane City WRF, with the potential to negatively impact the environment. Reclamation of the Lane City WRF involved the regrading of slopes and the addition of limestone as a buffering agent, followed by covering the crown and other surfaces with growth media and seed. A new storm water drainage system was constructed that prevents contact with natural water at the site. According to KGHM, this method of reclamation not only secures the facility in terms of its stability, but also protects the state's water, which is one of the primary goals of environmental protection in Nevada. The changes are clearly evident to the naked eye, as re-seeding has enabled the terrain to return to its natural state.

Abandoned mine lands

As a result of the pre-regulated mining era, Nevada, like many other states in western US, has been left with numerous abandoned mines and shafts scattered throughout its territory. While these mines played a fundamental role in the development of the west, many of them left behind serious environmental problems and today constitute considerable safety hazards. To tackle this issue, the NDOM set up the Abandoned Mine Lands (AML) program to address the physical hazards represented by historical legacy mines across the state. "We estimate 250,000-350,000 historic mine features in Nevada, and believe that approximately 50,000 of them are hazardous," stated Visher of NDOM. The program involves taking inventory of inactive mining features, ranking their degree of hazard, and securing them. If there is an owner or claimant, that entity is responsible for safeguarding it from the public. Otherwise, the feature is considered an orphan and the NDOM carries out activities to secure the site. The agency has made great progress in addressing the historic legacy mine issue, as today, 80% of them have been tracked as secured. "The AML program is setting the standard for our country. Part of its success derives from the fact that the funding comes from mining claimants themselves, unlike in many other states," Visher explained. Indeed, Nevada's strong legislation for mine reclamation and robust AML program are two key aspects that have made Nevada a pioneer and a model that other jurisdictions seek to replicate in terms of environmental protection and reclamation standards. Not only is Nevada making great efforts to minimize the adverse environmental effects of surface mining and ensuring that mined lands are returned to a beneficial end use, but it is also striving to fix past "mistakes" from the unregulated mining era. ■

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↘↘

In Nevada, the BLM is responsible for managing approximately 48 million acres of public lands.

↙↙

Justin Abernathy

Deputy State Director for Energy and Minerals
BUREAU OF LAND MANAGEMENT (BLM)

Can you provide a brief overview of the BLM's role in the Nevada mining industry?

In Nevada, the BLM is responsible for managing approximately 48 million acres of public lands, as well as several hundred thousand acres of "split estate" lands (non-Federal surface estate and Federal sub-surface mineral estate), which constitutes over two-thirds of the land in the state. These lands are managed for a variety of uses, including the production of solid mineral resources. Consequently, a majority of mining and other solid mineral projects permitted in the state involve BLM-managed lands and minerals.

The BLM Nevada's solid minerals program is the largest in the Bureau and can be divided into three general categories – locatable minerals, saleable minerals (also called mineral materials), and non-energy solid leasable minerals. We approve plans of operations for the exploration and mining of locatable minerals; sales contracts and free use permits for the disposal of mineral materials; and prospecting permits and leases for non-energy solid leasable minerals that involve Federal lands and minerals. Our solid minerals program also has responsibilities and adjudicative duties associated with the location and maintenance of mining claims, mineral surveys and patents, mineral validity reports, and the use and occupancy of the

surface of public lands pursuant to Federal mining and surface use laws.

How has the number of mining claims on BLM-managed lands in Nevada evolved in recent years?

In recent years, we have seen a significant upswing in the number of mining claims attributable to increases in mineral commodity prices, along with a growing recognition of the importance of domestic sources of critical minerals, such as lithium and vanadium. As of December 1, 2021, there were approximately 235,000 active mining claims on BLM-managed lands in Nevada. This is a 30% increase over the number of active mining claims on BLM-managed lands in Nevada only four years ago.

What makes Nevada's reclamation process so effective and what role does the BLM play in it?

Nevada has been a pioneer and model that other jurisdictions seek to replicate in terms of its environmental protection and reclamation standards for mining operations. Two key factors are Nevada's "smart from the start" approach to permitting and reclamation of mining operations, and close and effective coordination between the BLM and State of Nevada agencies, such as the Nevada Division of Environmental Protection (NDEP). The

BLM and NDEP have a memorandum of understanding concerning reclamation, bonding, and ensuring that Federal and state regulations and oversight are consistent and coordinated. Both NDEP and the BLM jointly review and agree on the reclamation bonding requirements before issuing a decision. We also have procedures for conducting regular and as needed inspections of existing mining operations to ensure consistency with approved operations and standards and to identify and address any instances of non-compliance at any early stage.

How has the permitting process for exploration projects or mines evolved in recent years?

In recent years, BLM and members of the mining industry have placed greater emphasis on front-loading the various baseline studies and other information collection aspects associated with the environmental review and permitting processes for mining projects. This approach has been effective in producing project proposals that are more effectively planned and timelier and more predictable in their permitting processes.

What do you think makes Nevada an attractive exploration and mining jurisdiction? Are there any challenges that should be addressed?

Nevada is the US' most mountainous state with a very active geology, which has created a favorable environment for several different types of mineral deposits. It is also a leading source for critical minerals. Nevada is the 7th largest state and 33rd most populous. This, combined with desirable geology, allows mining to occur well outside areas of urban interface, which helps reduce potential conflicts. Nevada also has well-defined regulatory frameworks and effective coordination between Federal, State and local regulatory bodies with respect to mining operations.

Land and water are finite resources and multiple users are competing for them. Balancing the use of public lands and environments for mining along with other potential uses and resources on the land and doing so while ensuring appropriate protections for natural, cultural and historic values is inherently complex and challenging. ■



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The Nevada Division of Minerals assists in the responsible exploration and production of minerals, oil, gas and geothermal energy.

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Michael Visher

Administrator
NEVADA DIVISION OF MINERALS

What is the role of the Nevada Division of Minerals?

The Nevada Division of Minerals assists in the responsible exploration and production of minerals, oil, gas and geothermal energy. The agency is entrusted with providing information to the public and to entities interested in exploring and developing mines in the state. We are increasingly doing so through our Open Data Platform, which makes publicly available data downloadable and user-friendly. We also regulate fluid minerals (oil, gas and geothermal) as well as dissolved mineral resource exploration (lithium brine). Our mining registry tracks all mineral production in the state, as well as the status of exploration and mining. We also operate the Reclamation Performance Bond Pool and address the physical safety side of the historic legacy mine issue in Nevada. Finally, through our education and outreach component, we educate the citizens of Nevada about the importance of mining to modern society.

How is the Nevada Division of Minerals addressing the challenges posed by abandoned mines in the state?

The Abandoned Mine Lands (AML) program was established to address the physical hazards represented by the abandoned mines and shafts that are

located throughout Nevada. Through this program, we inventory inactive mining features, rank their degree of hazard, and secure them. If there is an owner or claimant, that entity is responsible for safeguarding it from the public. Otherwise, the feature is considered an orphan and the Division carries out activities to secure the site. We estimate 250,000-350,000 historic mine features in Nevada and believe that approximately 50,000 of them are hazardous. We are currently tracking 80% of them as secured. In addition, we work closely with land management agencies to carry our permanent closures. The AML program is setting the standard for our country; part of its success derives from the fact that the funding comes from mining claimants themselves, unlike in many other states.

Could you tell us about the Nevada Reclamation Performance Bond Pool administered by the Nevada Division of Minerals?

Before any mining or exploration company can initiate any surface disturbance on public lands in Nevada, they must put forth a financial instrument to cover the total cost needed by a federal or state regulating agency to perform all the required reclamation that would result from their proposed project.

On average, the total cost for a bond is approximately US\$6,000 per acre of proposed disturbance at small exploration projects. Companies can put the money forth with the Bureau of Land Management (BLM), which can take several weeks to adjudicate the bond, or through our Bond Pool. We have established a US\$2.5 million statewide bond with the BLM, which allows the State of Nevada to act as the co-principal on new project obligations. We receive the full amount that the BLM has determined is necessary to do the reclamation and charge a 2% annual administrative fee. Upon receipt, a bond rider adding the obligation amount is submitted to the BLM and the proponent can immediately move forward with their project. This program is also designed to reduce the financial burden and the timeframe for obtaining a plan-level reclamation bond for small companies that may not have a robust credit history. We currently do around 1/3 of the reclamation bonds for notice-level projects in the state, while the BLM does the remaining 2/3.

How does the mine permitting process in Nevada compare to that of other states in the US?

The Mining Law of 1872 established the ability for anybody, regardless of age, sex or nationality, to locate a claim on lands open to mineral entry, providing the exclusive right to explore and extract mineral material. In Western States, especially Nevada, there is a large amount of federal land which is open to mineral entry. This represents a huge opportunity, but it can also be an additional burden in the sense that companies have to permit both with the Nevada Division of Environmental Protection (NDEP) and with the federal regulator, BLM or US Forest Service. The permitting process can therefore be quite involved and lengthy, but fortunately, the agencies communicate well with each other and reach a consensus on the bond amount. Nevada is a mining-friendly state, with a permitting process that is clear and stable. Companies will usually not face unexpected permitting requirements, as long as they communicate often with all the regulatory agencies. ■

Educating the public is key to preserving Nevada's mining sector

By **Jeff Parshley**,
Corporate Consultant,
SRK Consulting



US reliance on critical minerals has doubled from 1995 to today, with 17 minerals being entirely sourced from overseas.



Nevada's fortunes have been tied to mining since its inception. The discovery of silver at the Comstock Lode in 1859 led to an economic and population boom that became the catalyst for Nevada's creation and, ultimately, admission to the Union in 1864. Nevada's official slogan, the 'Silver State', recognizes the importance of the metal to its history and economy.

Mining is still Nevada's second-most important industry (after gambling, of course) and a major driver for rural economies. Nevada currently has 26 producing mines and is the number one mineral producer in the US, accounting for more than 11% of the total value of nonfuel mineral production in the country in 2020. It is the sole producer of lithium carbonate in the US, accounts for approximately 75% of US gold production, and is also a leading producer of silver, copper, molybdenum and other important raw materials. The success of Nevada's mining sector has been built on the state's vast mineral wealth and the longstanding support of state politicians, regulators, and local communities. Nevada has competent, professional and apolitical regulators who are knowledgeable about mining and willing to work in good faith with operators. If a mine developer follows all the rules, presents all the data required, and prepares a strong environmental impact analysis, it can be reasonably confident of receiving a permit to operate.

It is therefore no surprise that Nevada was ranked the top jurisdiction for investment by the latest Fraser Institute Annual Survey of Mining Companies and fifth in the survey's policy perception index, be-

hind only Idaho, Wyoming, Finland and Ireland.

One threat to Nevada's mining sector - and the US mining sector as a whole - comes from Washington, D.C. The Biden administration is pushing trillions of dollars into green infrastructure investments that will require enormous amounts of mined raw materials, while simultaneously taking steps likely to weaken the domestic mining sector. There does not appear to be any focus on how the US can satisfy its mineral needs domestically while maintaining high environmental and social standards. The US has sufficient domestic reserves of many of the 35 mineral commodities deemed critical by the federal government, but these are not being exploited because it is either too expensive or too difficult. According to the US Geological Survey, US reliance on critical minerals has doubled from 1995 to today, with 17 minerals being entirely sourced from overseas. Adding red tape - as the current administration is attempting - will drive even more of our mineral supply overseas. When it sources minerals from other countries, the U.S. generally adds to global environmental issues rather than fixing them. The well-established American environmental, health, safety and human rights protection levels are among the best in the world, particularly in mining jurisdictions such as Nevada.

Many decision makers are unaware of the extent to which minerals are essential to achieving the very policy goals they are pursuing. Most importantly, initiatives from Washington that could increase the

federal government's authority to limit or prevent mining on federal lands, would affect 28% of the land surface in the US, including most major mining districts.

In Nevada, the federal government owns 85% of the land, by far the most of any state (Utah is second with 65%). Given that Nevada is the number one mineral producer in the country and the state with the highest percentage of federal lands, there is no reason to believe that projects in the Silver State will not become targets of federal government mining bans as mining projects in other states have been. Soon after taking office, the Biden Administration announced a goal to conserve at least 30% of US lands, freshwater and ocean areas by 2030, in an initiative known as 30x30. Polling by various environmental groups has shown that a majority of Americans are in favor of the plan. While environmental protection is something we can all support, there has to be a balance between conservation on the one hand and acknowledgment of the irreplaceable contribution of mining to the Nevadan and American economies and to the achievement of environmental and infrastructure policy goals.

The only way to combat ignorance about the importance of minerals in our lives is through education. We each need to educate the public - our families, friends, neighbors and, yes, even elected officials - to an informed understanding based on facts and not on controversy or misinformation. We must strive to make sure that the American public understands the many ways in which mining serves their individual and national interests. ■



Our Applied Technology team works with mines to enhance safety and performance related to dissolving, detox and optimization of the entire cyanide circuit.



Steve Cochrane

U.S. Sales Manager
CYANCO

Can you give a brief introduction to Cyanco?

Cyanco is the world leader in production, distribution and safe handling of high-quality solution and solid sodium cyanide, a critical reagent in the recovery of gold and silver. The company was founded 30 years ago with its first manufacturing plant in Winnemucca, Nevada, as that region is a core location for US precious metal mining recovery and growth. In addition to our Nevada facility, we operate manufacturing and distribution facilities in Texas, Wyoming and Québec.

Can you elaborate on your production capacities and highlight some of your recent investments?

In the early 1990s, Cyanco built a liquid sodium cyanide plant in Winnemucca, the first of its kind in the US. Before that, gold and silver mines used a dry (solid) form of sodium cyanide that was imported. This traditional supply chain model meant that mines had to store large quantities of sodium cyanide on-site. In an effort to improve efficiency, safety and security of supply for mines, Cyanco wanted to make cyanide in a form that could be used on-site as a liquid - a sodium cyanide solution - without the need to handle and dissolve the sodium cyanide directly. As Cyanco grew, we built a second solution plant in 1997.

This was followed by several production capacity increases over the next ten years. In 2013, we built a solid sodium cyanide plant in Houston, facilitating our entry into global markets. In 2020, we further increased solid production in Winnemucca to serve Canada and Mexico. Today, we operate five independent production lines and produce sodium cyanide in two locations.

What measures are taken to ensure that cyanide is manufactured and transported safely?

It is crucial to engineer systems to ensure safe use of the chemical and then implement policies and procedures for the employees operating the systems. Personal protective equipment on-site is also essential. In addition to the stringent safety measures we have in place throughout our production and transportation functions, Cyanco also has a dedicated Health, Safety and Environment (HSE) department responsible for training our customers and the public on the chemical properties of cyanide and how to use it safely.

How does Cyanco ensure that the environmental impact of cyanide is minimal?

Cyanide is an ideal chemical for the mining industry because it breaks down easily once it is exposed to air, heat, and

oxygen, such as in a leaching environment at a mine. Cyanide is composed of carbon and nitrogen, and when it breaks down it does not retain any toxic properties.

That said, we have implemented strict controls throughout the product's life-cycle to minimize environmental impact, beginning with the design, engineering and construction of our production facilities. We are a zero water emissions discharge facility. Cyanco also has monitors in place to verify that those standards are always met. When the product is used at a mine site or in heap leach operations, similar monitors are in place. Through our Applied Technology and Technical Sales teams, we conduct regular audits with our mine customers to assure their cyanide circuits are operating properly and at the highest standard.

How does Cyanco differentiate itself in the market?

Cyanco is different from other suppliers in that we take a complete product life cycle approach with our product and our customers. Our Applied Technology team works with mines to enhance safety and performance related to dissolving, detox and optimization of the entire cyanide circuit. We work with mines to help them recover more gold from cyanide, whether it is in their mills or heaps. We also work with mines so they consume less cyanide through collaborative continuous improvement projects. For Nevada mines, our local presence is a differentiating factor. Since we manufacture sodium cyanide locally, we have created a very short distribution chain. This allows us to respond to customer needs better and faster.

Can you share some of Cyanco's social initiatives?

We have a proud heritage of supporting our local communities, including non-profits, school districts and economic/infrastructure development efforts. For example, Nevada Gold Mines implemented a special fund during Covid-19 called the I-80 Fund. Cyanco was the first company to partner with them as a supplier and made a significant donation to this fund. ■

Can you give an overview of Solenis?

BG: Solenis is a global specialty chemical manufacturer and one of three water treatment companies with a truly global footprint. Mining is one of our core focus industries. We have a dedicated mining R&D team and a dedicated mining technical applications team. Our mining commercial teams are strategically located around the world in North America, South America, Europe, Africa, Asia, the Middle East and Australia.

Could you elaborate on your products and services for mining and mineral processing?

BG: We focus on three categories for the mining and mineral processing industry. One of those is the chemical products that we manufacture such as flocculants, antiscalants and water treatment chemicals. The second is unique digitization solutions that we pair with our chemistries, such as our proprietary monitoring and control systems. The final and potentially most important category is the people on our mining team that service and support our chemical and digitization programs. Many on our team are experienced metallurgists and experienced mineral processing operations and maintenance leaders.

What are Solenis' chemical production capabilities and recent investments?

BG: Solenis has 47 primary manufacturing facilities strategically located around the world, which makes for convenient logistics for our global customers. Nevada is supplied from our production plants in the US. In terms of new investments, we have a new powder flocculant production facility located in the US that we have recently commissioned. We plan to continue investing in increased manufacturing capacity both domestically and globally.

LD: Our plants are in advantageous locations, which is particularly important today as shipping is facing constant delays and putting customers at risk. Customers rely on us for asset availability and it is imperative to maintain inventories of critical consumables such as specialty chemicals.

What demand trends have you experienced for your products over the last two years?

BG: We have experienced an increased overall demand for mining and mineral



LeRoy Danks & Brady Greifzu

LD: Manager West Region Mining
 BG: Global Corporate Sales Executive
SOLENIS

processing specialty chemicals in recent years. We have also experienced an increased focus by mine operators on the reliability of supply, particularly related to availability of raw materials, manufacturing of finished goods and logistics. Many mine operators are seeking partnerships with actual primary manufacturers such as Solenis rather than resellers in an effort to manage risk and improve asset reliability. The recent global supply chain disruptions have put a greater emphasis on domestic manufacturing capabilities. The pandemic has created a demand on local resources for site service and support rather than travelers from out of state. Inflation is motivating the creation of more strategic contractual partnerships to manage inflationary costs. There is also a demand for new high-performance chemistries and digitalization technologies to enhance operational efficiencies.

Can you provide examples of Solenis' latest innovations to improve safety and efficiency?

LD: Mines are currently experiencing important bottlenecks, so we are working on digitization and optimization. Therefore, we let an algorithm control operations, as opposed to just relying on a human decision. We are also working on improvements on our OnGuard online digitization control methodology used on

leach pads. We recently implemented a digitization program on a leach pad at a mine in Nevada, which resulted in a reduction in chemistry consumption and an improvement of over 10% in recovered ounces off those leach pads. Solenis is leading the way in partnering up with mining operations going forward in this digitization area. We also offer an OnGuard Online data management service, which is a tool that allows both us and our customers to see the performance of the chemistry on mobile devices using cloud-based data. This platform is being upgraded for 2022.

BG: Mining and mineral processing inherently has fluctuating demand for specialty chemicals based on variable minerology and processing plant operating conditions. We can help enhance efficiency by automatically matching our chemical feed rates with varying process demand. Solenis achieves unique efficiencies for our customers due to our proprietary combination of feed forward and feedback automation and control capabilities. For example, a Solenis OnGuard controller can constantly adjust our antiscalant chemical feed to the optimal rate based on computational analysis of feed forward process data from online sensors and analyzers combined with feedback data from an OnGuard 3S online scale monitor. ■

Amidst an industry-wide labor shortage, how can companies attract and retain talent?



"To be successful in the consulting business, it is essential to stay in touch with various sources of workers. For instance, we maintain close relationships with universities and assist students with training, mock interviews, and resumé workshops. We also carry out panel discussions with students to increase their understanding of the mining industry and attract them into the sector. Apart from focusing on college-level students who have already chosen their field, I believe the sector should participate in STEM programs for younger students to attract them to engineering, sciences and mining from very early on."

– Randy Miller, Vice President and Principal Engineer, Broadbent & Associates



"Our success comes from building our team from within. We maintain fair wages and bonuses. We also recognize the importance of having great medical plans, which we have been told are the best in the industry. In addition, our strength and size help retain skilled workers as they can see themselves making a career with Major Drilling. We have very little turnover of qualified positions within our company. In fact, our top 40 managers in the company have over 1,000 years of combined experience in the industry."

– Kelly Johnson, Senior Vice President of Operations – North America and Africa, Major Drilling



"Our use of automated rod-handling systems is attracting more women to our drilling teams, since operators do not have to directly handle heavy rods. This is a win-win situation, as it contributes to a more diverse workforce and allows us to draw on a much larger pool of workers. Today, we have approximately 40 female drillers worldwide, predominantly in Latin America, and our number of female drillers in the US is growing rapidly."

– Jeff Olsen, CEO, Boart Longyear



"A decade ago, Epiroc realized that finding drilling talent was going to become increasingly challenging. We thus committed completely to autonomous capabilities, and what we have achieved with this regard is incredible. We also work hard on our culture and creating a favorable working environment for our employees so that it is their choice to stay with the company for their entire career. From a diversity and inclusion standpoint, we are committed to being a company anyone can work for and loves to work for."

– Jon Torpy, President and General Manager – US, Epiroc



"The industry needs to have a serious conversation about how to get young people excited about mining. The lithium exploration industry has a responsibility not just to educate regulators and the public, but also to demonstrate all the rewarding careers available. So many people in the world right now are passionate about renewable energy, and this space has the capability to get young people more involved."

– Emily Hersh, CEO, Luna Lithium



"At Rangefront, we provide unparalleled geology and mining staffing services. Our in-house recruiters rely on a high-grade, multi-step recruiting system to filter candidates, which allows us to find the best fit for the needs of each company."

– Brian Goss, President, Rangefront Mining Services



PRODUCTION

"The mining industry can be the catalyst for change in our society as long as we collaborate with the government, communities, and private partners."

– Greg Walker,
Executive Managing Director,
Nevada Gold Mines

Precious metals production

Fighting a declining trend since the 1990s

While many countries around the globe suffered drops in metals production in 2020, Nevada's mining industry was relatively immune to the pandemic, since Governor Steve Sisolak designated it as an essential industry. Companies in Nevada started to witness the rapid expansion of Covid-19 in February 2020 and began reacting to the virus' spread in early March. "Favorable metals prices meant that the sector did not want production to drop, so it had to find alternative ways of working and enabling the industry to continue operating without disruptions," explained Jeff Parshley, corporate consultant at SRK Consulting.



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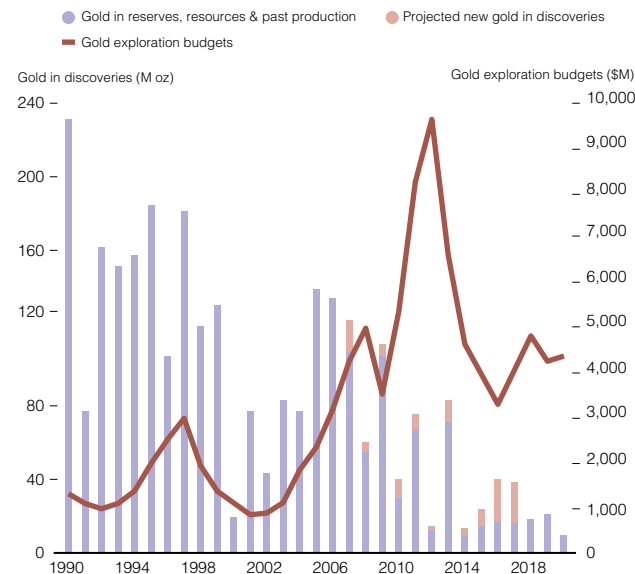
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DOWNWARD TREND IN GOLD DISCOVERIES

Source: S&P Global Market Intelligence (2021)



Having an infrastructure that has grown resilient to market volatility and the fact that mining operations have a particularly high level of health and safety awareness culture facilitated the way mining companies managed the health crisis. In addition, the global nature of the mining industry meant that some companies already had experience in dealing with other health crises such as Ebola, which they were able to apply to the management of Covid-19.

According to data from the Nevada Division of Minerals, gold production in 2020 was 4.63 million oz, which only represented a 5% decrease relative to 2019. Similarly, silver production in 2020 was 6.13 million oz, representing a 2.5% decrease compared to the previous year.

However, Nevada's gold and silver production has been steadily decreasing over the past years. Both precious metals reached their peak production in the late 1990s and have been trending downward ever since. This is not exclusive to Nevada; the fact is that major gold companies worldwide are running out of reserves and the grades have progressively become lower. While the state's geological potential is still enormous, all of the easy, low-hanging fruit has already been picked. New deposits are becoming increasingly costlier to discover because they are in remote or difficult locations, in orebodies that are technically very challenging such as deep underground veins or refractory ore, or are so far off the beaten path as to require the building of new infrastructure from scratch at great expense.

Mergers, acquisitions and asset exchanges

With declining reserves and ore grades, it is not surprising that precious metals producers, in order to grow, need to join forces or eat each other up. Mega mergers and joint ventures have marked Nevada's mining industry in recent years.

What was the rationale behind the creation of NGM?

In late 2018, merger discussions were held which led to the combination of Barrick and Newmont Nevada assets. The companies had six mines operating in very close proximity in Nevada, with a 'fence line' joining Carlin and Goldstrike. They decided to remove this barrier and establish a single management structure across the whole complex.

This JV generated real synergies, including the reduction of administrative costs, the maximization of ore processing and the possibility to access exploration opportunities from the opposite side of the lease. Before the JV, Newmont had significant processing capacity but was running out of ore, while Barrick had abundant ore, but was short on processing capacity. This new structure allowed to move the Cortez ore to Gold Quarry and the Leeville ore to Goldstrike, significantly reducing haulage costs. Overall, this agreement has extended the life of mine and has brought additional ounces into the plants, reducing costs and improving efficiencies.

What have been NGM's main milestones in the 2020-2021 period?

We have focused on establishing the JV and unifying two different business cultures. We have made substantial efforts to understand the regional geology and we now have a very successful plan to expand our assets. We expect to see good results, particularly from the North Leeville area, which is the extension of the current Leeville underground operations. We are also exploring the geological connection between two Tier One deposits in Turquoise Ridge. Finally, we have identified great growth potential for the Goldrush-Fourmile project. We have also optimized the roaster at Gold Quarry, and to support Barrick and Newmont's vision to reduce greenhouse gas emissions, we have converted our coal power plant into a gas power station and introduced 100 MW of solar power. Another milestone has been the merge of the two companies' reporting processes and financial packages under SAP.



Greg Walker

Executive Managing Director
NEVADA GOLD MINES (NGM)



Before the JV, Newmont had significant processing capacity but was running out of ore, while Barrick had abundant ore, but was short on processing capacity.



Can you elaborate on the exploration opportunities for NGM in Nevada?

Barrick's Goldrush, found about five years ago, is a world-class Tier One asset that will produce over 10 million oz. This asset was only a few miles north of Cortez, another huge gold-producing asset. A few miles further north, Fourmile will be an extension of Goldrush, with the potential to be another Tier One gold asset producing over 10 million oz.

There is great potential between Cortez and Phoenix through the Shoshone Range area, between the two Tier One deposits in Turquoise Ridge, and in the extension from Leeville up towards Goldstrike. Processing, however, will be challenging since the gold is underground and refractory. From a greenfield perspective, Barrick has a very active exploration team in Nevada. We are also very proactive in establishing partnerships with junior companies, where we usually function as the operating party.

What are the main pros and cons of operating in Nevada, and can you highlight some of NGM's social initiatives?

Nevada is a stable environment, both politically and socially. However, the

infrastructure is not at the standard it should be, especially in northern Nevada. A poor education system and a lack of affordable healthcare, internet and day-care facilities make it hard to attract quality employees, which is why we have over 500 job vacancies within NGM currently, of which 200 are professionals.

We believe that the mining industry can be the catalyst for change in our society as long as we collaborate with the government, communities and private partners. To address some of the challenges, NGM has donated US\$3 million to the Boys & Girls Club to construct day-care facilities in Elko and Spring Creek (our local communities). We have also invested in the Discovery Education Experience, an online learning tool to assist parents, teachers and students with remote learning. To date, 100% of schools in Nevada have utilized the Discovery Education resource. Another measure involved lending US\$30 million to an internet provider to set up high-speed broadband services throughout Elko and Spring Creek. We also invested US\$5 million to start the I-80 Fund, which provides small businesses and start-ups the opportunity to secure low interest loans in an effort to build north-eastern Nevada. ■



Mark Bristow

President and CEO
BARRICK GOLD



If we have a challenging next seven years, like we had from 1992 to 1999, Barrick will still do well because we are fundamentally profitable.



What did Barrick's Q3 2021 results show you about progress made since the Randgold merger?

A lot has happened since January 2019. After the Barrick/Randgold merger, Nevada Gold Mines (NGM) was established, we took Acacia private, and sold Sabodala to Teranga (before the Endeavour merger). From the initial discussions with John Thornton in 2015 we had a strategic plan based upon flattening the structure and focusing on the Randgold model whereby the operations own the orebodies, have a responsibility to unlock their value, and importantly, are able to respond quickly to changes.

Barrick's Q3 results show that we have been able to deliver on our strategy of focusing on the best assets, fixing the balance sheet and ensuring our social license to operate, even though the environment changed around us. I honestly believe we are going into an unprecedented and critical time for the global economy. If we have a challenging next seven years, like we had from 1992 to 1999, Barrick will still do well because we are fundamentally profitable. We run our business on US\$1,200/oz gold and have a significant amount of net cash. This makes us independent of the market and means the responsibility of creating value sits with management.

Another key aspect highlighted in Q3 was Barrick's focus on exploration. We replaced more than 70% of the gold we have mined in the last two years, and in 2021 we will replace all the gold we mined. Our pipeline, whether it's the work we are doing in the Veladero Pascua-Lama region, advancing Donlin Gold in Alaska, or the various frontiers that we have opened such as Egypt, Japan and Guyana, means the company's future is in good shape.

How has the Nevada Gold Mines (NGM) joint venture between Barrick and Newmont developed?

The trajectory was downwards for both companies in Nevada before the merger. Newmont had very little resource potential left, but had infrastructure which was significant for Barrick because it was geographically in the right place. Barrick had high quality assets,

but infrastructure in the wrong place. By establishing NGM, we turned it into a genuine, long term, value creating mining enterprise. It is a sustainably profitable business that has become Barrick's value foundation.

One thing that Nevada didn't lack was asset quality. Carlin, the biggest gold mining operation in the world at around 1.7 million oz/y, has measured resources of over 9 million oz, or 25 million tonnes at 7.5 to 12 g/t. The North Leeville area is showing great exploration potential, up towards Goldstrike. We are upgrading the Gold Quarry roaster, we have invigorated Robertson, and we have linked the future of Cortez with Goldrush and Fourmile. We also had another look at some of the other assets, such as Turquoise Ridge, which was previously constrained as a high-grade mine with a contractual bottleneck dictating what it could feed the processing facility. Before the JV, it was mining small volumes at high cost, but now we are seeing the benefit of removing the boundaries and unleashing the mine's potential. Seeing this transformation brought home to me the mindless egos that stop the ability to unlock value in the mining industry, and is a clear example of why the sector needs consolidation.

Which educational initiatives has Barrick established in Nevada to increase participation in the sector?

I am a great believer in recognizing your host country as your core stakeholder, and investing in a young, local workforce is a big part of Barrick's strategy. When we created NGM, one of the first things we noted was the wrong age profile of the workforce. We had also noticed a big gap for reaching the children who wanted to have technical careers. At the start of the Covid pandemic, we began a program to enable every single teacher in Nevada to teach virtually, and sponsored an educational program with the Discovery Channel for schools in the state. We are now working with the College of Southern Nevada and Great Basin College in Elko, linking the technical colleges from the last two years of high school to the beginning of university. Barrick was the only mining company in the US that continued its student programs throughout Covid. ■



Tom Palmer

President and CEO
NEWMONT



NGM is the flagship example of how the gold industry can look for opportunities to consolidate within a region.



How has Newmont's joint venture with Barrick to establish Nevada Gold Mines (NGM) progressed?

Newmont has been operating in Nevada for over 60 years. We developed the technology to be able to release gold from the very fine, low-grade oxide ore in Nevada 60 years ago, which opened up the region. Then Nevada moved through processing of oxide ore to double refractory ore which needs more complex facilities to release the metal, such as roasters.

Roll the clock forward to 2019, both Newmont and Barrick had been operating in Nevada for a long period of time, with maturing operations that sat alongside each other. The reality was that production profiles were coming off and costs were going up as processing facilities that were built 30 years ago were constrained for the ore bodies being mined today. There were also some boundaries between ore bodies that were set up historically that were constraining both companies.

The opportunity that came with NGM was to combine processing facilities and deposits, which gives you many more options in terms of how you blend different ores together within the constraints of processing plants, particularly through the Carlin trend, out west at Turquoise Ridge and Twin Creeks, and also because a lot of ore from the Cortez mine gets sent through to Carlin. Through this optionality, operational life can be extended, costs can be reduced, and shareholders of both companies get the benefit.

NGM is the flagship example of how the gold industry can look for opportunities to consolidate within a region. The industry needs to consolidate, as mining at scale is required to fund the technology needed for decarbonization, and NGM presents a pathway for what that looks like.

Can you elaborate on Newmont's decarbonization initiatives?

In 2020, Newmont led the gold industry to set targets for 2030 for the reduction of scope 1, 2 and 3 greenhouse gas emissions. We are committed to reducing our scope 1 and 2 emissions by more than 30%, and our scope 3 emissions by 30% by 2030, with the ultimate goal of

being net zero by 2050. Newmont will have those targets signed off by the Science-Based Target Initiative (SBTI), and we are committing US\$500 million over the next five years to support these targets.

In the decarbonization effort we are working on three main areas. First of all, continuous improvement; we have a program called Full Potential which has been in place for over eight years and delivered more than US\$4 billion of value across our operations. It is predicated upon all 12 of Newmont's managed operations having a set of improvement projects which include carbon reduction initiatives in their business plans. When you reduce carbon intensity you are almost certainly improving efficiencies. The second big area is renewable energy where we can use wind and solar to replace other forms of electricity generation around our business. This will be the key step change for Newmont as the decade progresses. The third area is how to introduce and support new technologies such as bringing in hydrogen or battery electric to replace diesel.

What role do you think gold will play in a transition economy?

Gold has been a store of value for millennia and will be a store of value for a long time to come. Then you have to look at what role gold plays in society and what role it can play in the decarbonization effort. Newmont's purpose as a company is to create value and improve lives through responsible, sustainable mining. Looking at the locations in which we operate, gold mining by reputable companies plays a huge role in creating wealth and improving the lives of local communities. As the world's largest gold mining company, we look to set a standard that others can follow, and this is why the ESG piece is so important.

When it comes to decarbonization, as gold operations are developed, you will see more copper-gold mines coming online, such as Yanacocha or our projects in British Columbia. Newmont will always remain a gold miner, but copper and gold produced together will go hand in hand as a very important metal for decarbonization, along with a very important metal in terms of a store of wealth that improves lives. ■

The most prominent example of M&A activity was the creation of Nevada Gold Mines (NGM) in 2019, the joint venture between Barrick (61.5%) and Newmont (38.5%). The two giants decided to combine their assets to create the world's largest gold producing complex. Mark Bristow, president and CEO of Barrick Gold, explained the rationale behind the joint venture's creation: "The trajectory was downwards for both companies in Nevada before the merger. Newmont had very little resource potential left but had infrastructure which was significant for Barrick because it was geographically in the right place. Barrick had high quality assets, but infrastructure in the wrong place. By establishing NGM, we turned it into a genuine, long term, value creating mining enterprise."

"Overall, this agreement has extended the life of mine and has brought additional ounces into the plants, reducing costs and improving efficiencies," added Greg Walker, executive managing director of NGM.

The giant complex produced 2.1 million oz Au in 2020 and expects to yield between 2.1 and 2.25 million oz in 2021.

The creation of the NGM complex has not been the only milestone on Nevada's M&A front. In January 2022, Calibre Mining completed the acquisition of Fiore Gold. As a result of this arrangement, Calibre acquired a 100% interest in Fiore's operating Pan Gold Mine, adjacent advanced-stage Gold



Gold Bar is located in northeastern Nevada on the Cortez trend about 25 miles south of Nevada Gold Mines' large Cortez Hills mine and currently has a six-year mine life. Production started in 2019, and we faced some challenges in 2020. Those issues have been resolved and for the past two quarters production has been meeting production guidance. Production cost/oz have been falling and expected to continue lower going forward.



**– Rob McEwen,
Chairman and Chief Owner,
McEwen Mining**



Rock Project and the past producing Illipah Gold Project in Nevada, as well as the Golden Eagle project in Washington State. With this transaction, the Pan heap leach gold mine will bring an immediate increase to Calibre's production and cash flow and provide significant exploration potential.

Nevada's landscape has also changed considerably thanks to US-focused gold miner i-80 Gold Corp. In October 2021, the company completed an asset exchange agreement with NGM, as part of their comprehensive plan to create a major mining complex in Nevada. Under the agreement, i-80 Gold acquired the Lone Tree and Buffalo Mountain gold deposits from NGM, as well as certain processing infrastructure, including an autoclave. In exchange, they gave NGM its 40% equity in the South Arturo property and the assigned option to acquire the adjacent Rodeo Creek exploration property.

The company also signed a definitive membership interest purchase to acquire Ruby Hill mine from affiliates of Waterton Global Resource Management for US\$150 million in cash and shares. Commenting on these transactions, i-80's CEO Ewan Downie said: "These deals will position the company as one of the biggest gold producers in Nevada with the capacity to process refractory and oxide mineralization."

At present, NGM and First Majestic are the only companies in the state with this type of processing capacity.

Krebs, CEO of Chicago-based Coeur Mining, the company has greatly accelerated its level of investment in exploration over the past five years. "In 2021, we spent close to US\$70 million because we recognize that in the mining business if you are not exploring you are going to shrink", he commented.

Coeur Mining's Rochester mine, located in northern Nevada, is currently undergoing a transformational project; the infrastructure is being expanded to twice its current capacity. "Production levels of silver will go from 4 million oz/y to 8 million oz/y, and gold from 35,000 oz/y to 80,000 oz/y," Krebs revealed.

Coeur Mining recently invested US\$500 million in building a new leach pad, processing plant and a crusher circuit that will be completed by mid 2023.

In conclusion, even though prospects for precious metals worldwide have become challenging, Nevada still remains one of the most competitive places to look for gold and silver. Faced with the increasing difficulty of finding new deposits, producers and explorers in Nevada today are looking differently at the geology and applying innovative exploration techniques to make the most of the favorable precious metals prices. The state's mining industry has shown great resilience to the pandemic, and despite having been a notable mining region for 150 years, still holds remarkable potential. ■

Growth through exploration

Encouraged by favorable metals prices, companies in Nevada are currently placing huge emphasis on growth through brownfield and greenfield exploration to expand their resource base and life of mine.

It did not take long for NGM to find exploration success on its home turf. In addition to the JV's three Tier 1 assets, Barrick hit a discovery hole just north of its Fourmile project. The new orebody opened the potential for adding one more Tier 1 asset to the three already wrapped into the NGM partnership – Goldstrike/Carline, Cortez and Turquoise Ridge/Twin Creeks – by combining Fourmile with the nearby Goldrush development.

While NGM's exploration potential is certainly enormous, the company expects to face some obstacles ahead. "Processing will be challenging since the gold is underground and refractory," Walker warned.

The state's second largest gold producer, Vancouver-based SSR Mining, has also been focusing on extending the mine-life at the Marigold mine in Valmy. To that end, in 2020 the company invested US\$22 million to acquire 8,900 hectares contiguous to its Marigold mine, increasing its land position to 19,800 hectares. The acquisition of the Trenton Canyon and Buffalo Valley properties is expected to increase SSR's gold resources and add multiple zones of mineralization proximate to the Marigold mine infrastructure. The company's exploration plans aim to upgrade and expand known mineralization to potentially extend mine-life and access higher margin zones. Similarly, other producers in the state are dedicating large parts of their budgets to exploration. According to Mitchell

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Walker Lane Mineral Belt, Nevada

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Jason Reid

CEO, President & Director
FORTITUDE GOLD



We engineered Fortitude Gold to have a very tight capital structure, to be a high margin operation and to return a substantial amount of that margin to shareholders in cash dividends.



Can you tell us about the origins of Fortitude Gold and its unique business model?

Fortitude Gold was spun out of Gold Resource Corporation on December 31st, 2020. Prior to the spin-out, Gold Resource operated a Mexico mining unit and a Nevada mining unit, and achieved a decade of gold production and profitability, even during the brutal bear market years. We returned US\$116 million in dividends to our shareholders at Gold Resource, and when I left the company, we had a very tight capital structure with approximately 70 million shares outstanding. This experience taught us the business plan that we are pursuing today with Fortitude Gold, whereby we target gold equity and yield valuations.

We spun out the Nevada mining unit into Fortitude Gold, with the aim of not only producing gold, but creating greater shareholder value, the likes of which we could not do under Gold Resource if we kept both our mining units together. We wanted to transcend being a gold mining company and tap into a pool of capital much bigger than the gold investment space, which chases

dividends and yield. Therefore, we engineered Fortitude Gold to have a very tight capital structure, to be a high margin operation and to return a substantial amount of that margin to shareholders in cash dividends. In fact, we announced our initial dividend in April of 2021 and raised it three times during the year. Because of this yield focused strategy, we were one of the best performing gold stocks during 2021 when compared with our industry peers in the Junior Gold Miners ETF (GDXJ).

What have been the latest updates at Isabella Pearl and what are the future production targets?

Our flagship Isabella Pearl mine reached first gold production in 2019, 10 months from project groundbreaking. The mine has overperformed, allowing us to pay a higher dividend than we initially expected. We have hit very high-grade gold pockets in the mine, one of which was 100 g/t Au. We targeted an annual production range of 36,000-40,000 oz, but we have increased it to 40,000-45,000 oz as a function of the deposit overperforming. On balance, our mine is over 2 g/t average, which is exciting given that

many open pits in Nevada have an average gold grade closer to 0.5 g/t. Our current goal is to maintain an average annual production rate of 40,000 oz. While it would be possible to mine the entire Isabella Pearl deposit much faster, we decided to stretch production out to have enough time to get other mines into production.

Can you provide some insight into your ongoing exploration activities?

We have acquired over 10 km of prospective mineralized trend at the Isabella Pearl property and expect to identify and explore many targets along this trend. More specifically, we have hit some high-grade at our Scarlet target nearby Isabella Pearl, and we are currently delineating it.

Golden Mile is our next most advanced property. We recently announced an initial resource at Golden Mile of 78,500 indicated ounces and 84,500 inferred ounces. We have completed metallurgical test work, the environmental background studies and are advancing towards a production decision.

Looking at a bigger picture, a likely place to find a big deposit is at our East Camp Douglas property. It has a large district size land position where several mining companies have drilled high grade veins at the north end. We are observing a lithocap associated with high-grade gold on the south end of the property that we believe has not been explored as such. This may indicate proximity to an intrusive center and the potential to host a significant gold deposit. We have completed the first round of drilling to look for structure and have already found mineral.

How will you leverage the synergies created between the different projects within the Nevada mining unit?

With our synergistic approach, we hope to utilize the operating Isabella Pearl ADR process plant. We envision future gold projects taking gold to the carbon phase only, then trucking the loaded carbon to the Isabella Pearl's ADR processing facility for finalize gold dore production. This should greatly lower the capex of future projects we pursue and should shorten permit timing and construction time frames. ■



Joseph Kemp

Operations Manager – Round Mountain
KINROSS GOLD CORPORATION

Can you provide an overview of Kinross' global portfolio and elaborate on the company's strategy to acquire its assets?

We are a global company with a diversified portfolio of mines and development projects. Our two operating mines in Nevada are called Bald Mountain and Round Mountain. We also have an operating mine in Alaska called Fort Knox, together with a development project called Manh Choh which will soon become its own mine. In Russia, we have a large operating mine called Kupol-Dvoynoye and we recently purchased another property called Udinsk which is under development. In addition, we have an underground mine in Ghana called Chirano and a large deposit in Mauritania called Tasiast. Finally, we have two development projects in Chile: La Coipa and Lobo-Marte.

We have managed to be quite successful in all our jurisdictions, and a large part of that can be attributed to the good relationship we have with the local governments and regulatory agencies. Within our diversified portfolio, Nevada is very stable from a geopolitical standpoint, and we can draw on a large and experienced workforce.

How have your Nevada assets performed in the last year?

Our Nevada projects have grown considerably within the last year, and both have been quite successful in terms of produc-

tion. A couple of years ago, the Phase W project was approved for Round Mountain, which had the aim of extending mining by five years and increasing life-of-mine production by 1.5 million ounces of gold. The expansion has been progressing at a good pace, and we have recently been working on getting through some of our major stripping years and getting into the heart of the ore body on the recent mine expansions. In early 2021, we identified movement in our north wall, and we were able to adjust our plan and develop appropriate mitigation steps to get that movement behind background levels. We have also been identifying areas of improvement, from an operating efficiency standpoint and how we deploy the overall mining fleet.

At Bald Mountain, we have been wrapping up the Vantage Complex project, which was another expansion of the mine site. It has been quite successful in adding mine life to the property. We have made multiple operational improvements in mining rates and lowered overall operating costs.

Could you elaborate on Kinross' exploration strategy?

In both properties, there is substantial interest to continue with exploration investment, which stems from the favorable jurisdiction we are located in and the quality of our assets, which have produced numerous ounces of gold over the years. We are constantly searching for

new projects for our life of mine planning, so it is an ongoing strategy. At the moment, we are looking at multiple projects at Round Mountain that have a high likelihood of coming into the mine plan with positive economics.

What new technologies are being implemented at Kinross' properties in Nevada to optimize production and improve efficiency?

At Kinross, we have a large passion for new technologies. As an example, we have implemented one of the first autonomous dozers on the Round Mountain property and are starting to train operators on how to use it.

What initiatives does Kinross have to reduce the environmental impact of its mines?

An important part of our culture at Kinross in Nevada is to complete reclamation as we mine. Bald Mountain has actually won a couple of awards around concurrent reclamation. There is a large mule, deer, and elk migration area close to this property, so it is important that as we mine, we pay attention to the areas that can be returned to better habitats. Kinross has also made a commitment to the market to reduce overall greenhouse emissions, and we have already started introducing these initiatives in Nevada. We are taking this commitment very seriously from a mining fleet standpoint, finding ways to reduce our diesel consumption and improving operational efficiencies to limit our overall footprint.

How do you view the regulatory framework for mining companies in Nevada?

In Nevada, we are fortunate to have a good relationship with the BLM, which is the main agency that we work with since we are mining predominantly on public lands. We understand the various processes that we need to go through at the BLM to get to our next mine expansion. For mining companies in the US, the most challenging part is the lengthy permitting process and the investment required to move a project forward. The permitting process is becoming increasingly challenging; it is requiring larger investments and longer waiting times, which can limit the number of projects that can be economical. ■



We have the expansion plans at Rochester, but we have also consolidated and more than doubled our land position surrounding the mine to increase growth.



Mitchell Krebs

President & CEO
COEUR MINING

Can you share some of Coeur Mining's key milestones in recent years?

Over the past decade, Coeur Mining has undergone a series of changes in terms of organization and composition of assets. The company has undertaken strategic decisions to de-risk the business. First, we have expanded our gold production to help offset the volatility of the silver market. Second, we have condensed our geographical footprint. We used to operate in Latin America and have exploration offices in Tanzania, but now we operate entirely within North America with a focus on the US. We are increasingly committed to our work in Nevada, which has been part of the company since the mid 1980s and which we expect will continue to become more of a focal point in the future.

What is Coeur Mining's exploration strategy?

Coeur Mining has greatly accelerated its level of investment in exploration over the past five years. Within an extractive industry, every day that you mine you deplete your asset base. Unless you invest in replacing what you mine, by definition you are shrinking your business. We invest not only to replace what we mine but also to

expand our resource base to drive a longer mine life. When a company has invested hundreds of millions of dollars into mining infrastructure and worked to create a good climate within the local economy, it is advantageous to build upon this base rather than start anew. We believe the best way to do so is by continuing to drill around existing infrastructure, and we allocate 85% of our exploration investment into the areas surrounding our existing operations.

What expansion efforts has Coeur Mining undertaken at Rochester?

The Rochester mine, located in northern Nevada, is in the middle of a transformational project. Originally a gold and silver mine in the mid-1980s, we are expanding the infrastructure to twice its current capacity to increase growth. By combining our commitment to exploration with larger infrastructure that enables us to capture the economies of scale, we are seeking stronger business outcomes. At Rochester, production levels of silver are expected to go from 4 million oz/y to 8 million oz/y and gold from 35,000 oz/y to 80,000 oz/y. We are investing approximately US\$500 million to build a new leach pad, processing plant and

crusher circuit. Once completed, we predict the mine will have a cash flow of around US\$100 million per year.

How do you think investors are reacting to the current cycle in minerals prices?

There is currently a disconnect between where metals prices are and how mining company share prices are trading, and I believe there are a few explanations. First, the broader economy has seen such a bull market that investors continue to chase returns elsewhere. Second, there is a lack of conviction among investors in the sustainability of these prices. Third, there is a larger question of relevance from the perspective of investors seeking exposure to precious metals. Whereas 15 years ago, one of the most efficient ways to gain this exposure was to buy the shares of a gold or silver mining company, nowadays there are other options with different risk profiles for investors. As an industry we need to reinvent ourselves into becoming more investable, attractive businesses. For example, Coeur Mining sees exploration as a huge differentiator because your shares of an ETF or your bar of gold will not grow overnight by themselves, but we can drill holes in the ground and create new ounces through our exploration efforts to create significant value for our stockholders.

What is Coeur going to look like 10 years from now?

Coeur Mining will continue to focus on the US and Canada, with a particular emphasis on Nevada. We have the expansion plans at Rochester, but we have also consolidated and more than doubled our land position surrounding the mine to increase growth. We believe the northern part of the state will continue to be the cornerstone of our business. In the south of Nevada, we have an exploration property called Crown, that we acquired in late 2018, located within a strategic position in the heart of one of the most dynamic exploration districts in the state. I believe we will eventually have a second operation in southern Nevada in addition to Rochester. ■



A company's ability to operate in Nevada for the long term will depend on having processing facilities.



Ewan Downie

CEO
I-80 GOLD CORP

Can you briefly introduce i-80 Gold Corp?

i-80 Gold Corp is a gold producer and developer with a wide portfolio of advanced-stage gold projects in Nevada. The company was created as a spin-out of Premier Gold Mines Limited's US assets in connection with the transaction whereby Equinox Gold acquired Premier in 2021. We currently trade on the Toronto Stock Exchange and our goal is to also trade on the New York Stock Exchange.

Could you tell us about i-80 Gold Corp's recent asset exchange with Nevada Gold Mines (NGM) and other recent acquisitions?

In early September 2021, we announced that we had entered into definitive agreements with NGM to acquire the Lone Tree gold deposit, placed under care and maintenance by NGM, and the nearby Buffalo Mountain gold deposit, which is currently being permitted by NGM. Lone Tree was a producing mine, hosting substantial processing infrastructure such as Nevada's only fully permitted idle, under care and maintenance autoclave. Therefore, it was an important acquisition for us in our effort to become a standalone producer in the state, as

most deposits are transitioning to liberate gold from the oxide mineralization into sulphides. NGM and First Majestic are the only companies in Nevada with that type of processing infrastructure. In exchange for these properties, NGM would receive the remaining 40% ownership from our joint venture in our South Arturo property, where they already owned 60%. This would consolidate 100% ownership of South Arturo in NGM, providing them with flexibility to pursue potential operational synergies with their other properties.

In addition, we have entered into a definitive agreement to acquire the Ruby Hill project from Waterton Global Resource Management. It is an operating open pit gold mine with substantial high grade underground potential, particularly since we are in the process of acquiring our own refract reward processing facility.

Can you elaborate on i-80 Gold Corp's underground test mining program at Granite Creek?

We recently embarked on an underground test mining program at our Granite Creek operation. Rehabilitation work was carried out on much of the underground workings. We are currently performing underground sur-

face drilling and preparing it for what we hope is a production decision late 2021 or early 2022. Part of the arrangement with NGM states that until we get the laundry facility operational, they will grant us capacity at their existing facilities for our existing projects so we can start advancing our current portfolio.

What is i-80 Gold Corp's financing strategy to develop its portfolio?

i-80 possesses a strong balance sheet, reflected in the fact that we ended Q2 with over US\$70 million in cash. NGM, as part of our whole arrangement, has agreed to take part in private placements, so they will own 9.9% interest in our company at closing, making them a fairly significant shareholder in i-80 Gold Corp. Therefore, they will contribute approximately US\$15 million in cash. We also entered into a term sheet arrangement with New York-based Orion Mine Finance for an initial US\$125 million in capital through mezzanine-type financing with an accordion feature that would allow us to take another US\$100 million. This puts us in an excellent position to develop our projects.

What will be i-80 Gold Corp's key priorities in the next year and do you have a final message?

i-80 is unique in Nevada because, following the deal closing with NGM in mid-October 2021, we became one of only three companies with processing capabilities for refractory ore types. A company's ability to operate in Nevada for the long term will depend on having processing facilities. It will also become more difficult to get the permits to build processing facilities as ESG conditions become stricter. Therefore, having these facilities grants us a competitive advantage in the state.

We are aggressively drilling on multiple projects, and we have a growth profile through our existing and mostly fully permitted assets. In our peer group, we offer the best growth profile that you will find from a small company with the potential to become a significant mid-tier producer. Our goal is to become the second-biggest producer in Nevada, after NGM. ■

Green Metals: Lithium and Copper Production

Global push for renewables brings momentum to the state's critical minerals

For now, oil remains the king of the energy sector, but there is a line of contenders poised to claim the crown. The first one is copper, which Goldman Sachs recently declared as 'the new oil', since it will play a key role in replacing internal combustion engine vehicles (ICEVs) with electric vehicles (EVs). Lithium has also been nominated as a leader in the energy world. This metal, which is an essential ingredient in batteries, was named as 'the white petroleum' several years ago in the first wave of enthusiasm for EVs.

Today, Nevada is one of the leading producers in the USA for both metals. Amanda Hilton, general manager of copper producer Robinson Nevada Mining Company, commented on a distinctive element of the state: "Nevada is unique in that our economy supports both ends of the value chain for electric cars. Not only copper and lithium are mined in Nevada, but additionally Tesla has large factories in the state."

Nevada indeed hosts the Tesla Gigafactory 1 east of Reno, a gigantic battery production facility supporting Tesla's battery-powered vehicles, which is significantly driving the demand for both metals.

Meeting lithium demand

Given the increasing emphasis on renewable energies, the mining industry is looking towards developing lithium reserves in the US, and Nevada has become the mecca of the new lithium boom. Currently, the state is home to Albemarle's Silver Peak mine, the only operating lithium mine in the US.

The US' entire lithium production currently comes from Nevada, but the US accounts for a very small portion of global lithium production. In 2020, global lithium production was overwhelmingly dominated by Australia, Chile and China, which collectively made up 88% of global lithium production, while the US only accounted for approximately 1%. Interestingly, the US is the world's largest consumer of lithium, which makes it heavily reliant on other countries for its supply - in fact, over half of the US domestic lithium consumption relies on imports.

The US' excessive dependence on countries such as China for its lithium supply was made evident with the supply chain disruptions during the pandemic. After mining, the lithium supply chain involves refining, processing and packaging the lithium into batteries - and the majority of this occurs in China. Considering that lithium demand is expected to grow rapidly in the coming years, the US has become aware of the need to encourage domestic production for national security. In February 2021, President Joe Biden signed an executive order aiming to build secure supply chains for lithium and other strategic minerals.

To face this growing demand, Albemarle is seeking to increase the Silver Peak mine's production capabilities. The mine, which is located in Esmeralda County, roughly halfway between Las Vegas and Reno, has been operating since 1967 and has historically produced 3,000-3,500 mt/y of lithium carbonate from evaporation ponds. In January 2021, Albemarle announced its intent to double Silver Peak's produc-

tion capabilities. "Albemarle is making a significant investment to double recent wellfield capacity to reach a sustainable production of approximately 7,500 mt/y of lithium carbonate equivalent, which if used to make batteries could support approximately 100,000 EVs," announced Glen Merfeld, vice president and chief technology officer for lithium at Albemarle.

However, this will still be a drop in the ocean, considering that the US will need approximately 100,000 mt/y of lithium by 2024-2025 and 300,000-400,000 mt/y by the end of the decade. Despite the surge of numerous lithium exploration projects and several advanced-stage development projects in Nevada, it remains unclear whether the US will be able to keep pace with its own demand. Companies seeking to develop lithium reserves on Nevada's public lands are often faced with stringent permitting requirements and opposition from stakeholders.

Nevada's copper potential

The US is among the world's five largest copper producing countries, and the nation's champion copper mining jurisdictions can be found in the Southwest. Leading the region and the country is Arizona, followed by New Mexico, Utah and Nevada. In 2020, Nevada's copper production accounted for 5.8% of the US total production, with 69,073.5 mt produced, according to data from the Nevada Mining Association (NVMA). In 2020, copper production in Nevada was dominated by the Robinson copper-gold-molybdenum mine, currently

operated by Poland-based KGHM International. The mine has a long history in Nevada, with origins tracing back to the 1860s. It is comprised of three large open pits. The ore is extracted using conventional surface methods and is then processed into a copper-gold concentrate and a molybdenum concentrate in a concentrating plant. The mine is the largest private employer within White Pine County, directly employing 15% of the community's workforce.

Since 2012, Robinson has undergone several mine-life extensions. In 2020, life of mine was extended for five years, and the company has continued delineation drilling within current pits. "In 2021, we commenced with a near mine exploration program in Lane Valley, just northwest of the Robinson mine, which will be completed in the coming years," general manager Amanda Hilton explained.

Copper was also produced at Nevada Gold Mines' Phoenix mine near Battle Mountain, where the 13,873 mt Cu produced represented about 34.5% of the value of the mine's gold production in 2020.

However, the latest newcomer to the copper market has the potential to become the biggest copper operation in Nevada. In December 2019, Nevada Copper's Pumpkin Hollow became the first new commercial copper mine in the state since Robinson. Pumpkin Hollow encompasses a high-grade underground mine and processing facility that is now in production, and a large-scale open-pit project that is fully permitted and advancing towards feasibility. Nevada Copper expects to reach steady-state production of 4,500-5,000 mt/d, originally scheduled for 2020, in mid-2022. The ramp up to 5,000 mt/d has been taking longer than anticipated due to slower than expected development rates through the water bearing dike structure and delays incurred in underground infrastructure development, including due to Covid-19 related labor and supply chain challenges.

A limitation that Nevada's mining industry has been facing with regards to copper production is the lack of downstream smelting and refining ca-



Image courtesy of Newrange Gold Corp.

capacity. This means that copper mines have to export copper concentrate to other states or countries, increasing transport costs, and therefore, overall production costs. For example, Nevada Gold Mines' Phoenix operation exports concentrate to Glencore's Horne smelter in Québec as well as to Asia. Similarly, a portion of Robinson's concentrate is processed at Kennecott in Utah, but the majority is exported to Asia.

In brief, over the past decade, copper demand has been rising as it is required for both the construction industry and

the new green energy economy. However, supply has not caught up over time. The underinvestment in 'the new oil' over the past 10 years has resulted in muted growth in project pipelines. This trend is now beginning to change with more and more capital finding its way toward incremental copper production. With higher copper prices and projected increasing demand across industries, mining companies in Nevada are aligning capital strategies to strike a balance between business competitiveness and increasing reserve bases by investment in exploration activity. ■



KGHM has been proactive in investing in Robinson, ensuring that the site has the necessary tools to remain an economically value-generating mine.



Amanda Hilton

General Manager
ROBINSON NEVADA MINING COMPANY
(KGHM)

Can you give an overview of the Robinson mine and the property's extensive history?

The Robinson mine is a historic property with gold and silver mining operations starting in the 1860s. By the early 1900s, mining in the area transitioned from precious metals to almost exclusively on copper. The Robinson mine started with open pit copper mining operations in 1906, which continued off and on based on copper prices under various owners until 2004 when Quadra Mining bought Robinson. It reopened the mine later that year with the site being in continuous operation since then. In 2012, QuadraFNX was acquired by KGHM, who is still the owner today.

Can you underline some of KGHM's recent investments at the Robinson mine?

KGHM has been proactive in investing in Robinson, ensuring that the site has the necessary tools to remain an economically value-generating mine. Since 2012, there have been several life of mine extensions which required investments into infrastructure such as equipment and our tailings storage facility. As a legacy site, our company has invested significant funds on reclamation activities and re-mediating historical issues that predate modern mining laws. In the last three years, we have won two separate reclamation awards from our governmental

entities for the reclamation work of these legacy sites.

What have been the key operational and production highlights at Robinson over the last two years?

We prioritized the health and safety of the Robinson team and the community while maintaining and exceeding production targets. Our mine life was extended for five years, and we have also invested in new equipment during this challenging time. We continued delineation drilling within our current pits, and we have plans for more drilling in the future. In 2021, we also commenced with a near mine exploration program in Lane Valley, just northwest of the Robinson mine, which will be completed in the coming years.

In addition, we recently received a new approved environmental impact statement (EIS) from the Bureau of Land Management. We were able to accomplish this permitting action in only eighteen months due to the strong community support we received during the process.

Can you tell us about the new technologies that have been implemented at the Robinson mine?

KGHM has always been an adopter of proven technology to advance our operations. To that end, we have commissioned an autonomous drill and are in the process of perfecting the function-

ality of the equipment. We are also in the process of commissioning a hybrid shovel which will not only provide costs savings, but also help us to achieve emission reduction targets. In addition, we have a telemetry system at our tailings storage facility and an innovative water pumping system to improve our water management efficiencies through digital monitoring.

What socio-economic impact does the Robinson mine have in White Pine County?

Robinson mine is the largest private employer within White Pine County and we directly employ 15% of the community's workforce. During the pandemic, the unemployment rate in White Pine County remained very low at approximately 3% due to mining being deemed essential. The mining industry pays the most property taxes in the County and we also pay Nevada net proceeds, of which a significant amount stays within the County, supporting schools, hospitals and other governmental services. We donate considerable amounts to local organizations and we also offer 12 hours paid volunteer time per year to our employees where they can volunteer at a local community organization of their choosing.

What are the company's main goals for the next three years?

Robinson has a strong track record and we intend to continue the good momentum by maintaining safe operations and exceeding the expectations of our stakeholders. In the next three years, we will continue to work to extend our life of mine plans as we convert resources to reserves within our district. We will focus on workforce development and the recruiting and retention of employees. One of the pillars of our strategy is the education of children within our community – we will continue supporting everything from geology units in third grade classrooms to professional welders supporting the welding classes in the high school and financial support of the Diesel Mechanic program at Great Basin College. Mining is our future, and we are energized by our responsibility of educating the next generation about the importance of mining and the great careers in the industry. ■



Albemarle is making a significant investment to double recent wellfield capacity to reach a sustainable production of approximately 7,500 metric tons per year of lithium carbonate equivalent.



Glen Merfeld

Vice President & Chief Technology Officer
ALBEMARLE

What do operations look like at Albemarle's Silver Peak plant?

The Silver Peak plant is one of the stand-out resources of the US. In Nevada, there are natural brines that have dissolved lithium out of sedimentary rocks and volcanic ash over tens of thousands of years, and there is a natural basin in which the dissolved lithium has concentrated. We pump the salty brine from below the surface into ponds, using a natural process to further concentrate and purify the lithium. By the time the lithium is processed through our pond system, it can be up to fifty times more concentrated. This is a very sustainable production approach as it relies on solar power without the need for other chemicals or additional energy. Lastly, we convert the lithium into lithium carbonate on site. Silver Peak was in operation to produce lithium carbonate back in the 1960s, as it is now.

What is the current level of production at Silver Peak?

Silver Peak was in operation to produce lithium carbonate back in the 1960s, as it is now.

Historically, Albemarle has produced around 3,000-3,500 metric tons of lithium carbonate per year. Albemarle is making a significant investment to double recent wellfield capacity to reach a sustainable production of approximately 7,500 metric tons per year of lithium carbonate equivalent, which if used to make batteries could support approximately 100,000 electric vehicles.

How do you see the applications of lithium evolving?

The headline news when it comes to lithium is its application in the electrification of transportation. For example, it can be used in fully electric or hybrid vehicles, e-bikes, and electrified buses. Yet its applications can be used on a larger scale in enhanced electric power grids. Introducing bulk energy storage batteries to the grid system can help stabilize fluctuations in conventional power generation as well as accelerate the adoption of renewable electricity generation.

Even deeper within the application space is the Internet of Things. Increasingly, we all enjoy having untethered devices in our homes and businesses that run on batteries. That said, the full extent of ap-

plications of lithium batteries is unknown, as its transformational power may lie in tools and sensors that have not yet been invented. With an emerging industry like batteries, as the supply chains become more efficient and prices fall, things we have not thought of today will be enabled by lithium-ion batteries that sell for less than \$100 per kilowatt-hour — a target we will achieve on an industrial scale within the next few years.

How does the domestic lithium supply compare to the rest of the world?

Albemarle submitted a white paper to the US Department of Energy, outlining our view that the US is far behind Asia in terms of lithium, cathode active materials, and battery production. The US lacks an integrated supply chain that allows for a complete lithium ecosystem from minerals to market. As a country, we must catch up to our competitors by constructing our own ecosystem with a localized value chain. Albemarle is in a strong position to help, given our expansion plans at Silver Peak, and we hope to see more local investment. There is an incubator effect that occurs when you bring the elements together to create a localized market; it not only accelerates adoption, it also provokes invention and seeds potential industry disruption. The lithium-ion battery

market is in its early days, so leaders today will shape how the industry advances.

How does Albemarle think about the carbon footprint of the lithium industry?

Studies indicate that although the upfront emissions associated with manufacturing electronic vehicles are higher than combustion engine vehicles, the benefits of avoided emissions are many times greater over the use life. It is important that as an industry and society we are asking these questions about sustainability now, rather than waiting to react in the future. It is worth highlighting the annualized benefits of producing lithium to enable electric vehicles: for every ton of greenhouse gas generated in the production of lithium, tailpipe emissions are reduced by 50 tons. It is a tradeoff that as a society we must consider seriously.

Sustainability is foundational to Albemarle, and the company is investing in technologies to use water more efficiently and transitioning to cleaner forms of energy. Furthermore, our goal is to increase the recovery of lithium for the same amount of energy and chemistry used. Getting better at maximizing our lithium recovery makes both good environmental and business sense -- using less money and energy to do more.. ■



With the growing demand for minerals, the need to source these minerals in a responsible manner, and the desire to tackle global climate change, there is a growing recognition that we cannot export our mining needs. A strong national mining industry is essential, and this starts with exploration.”

– Mark Compton,
Executive Director,
American Exploration & Mining Association

EXPLORATION AND DEVELOPMENT

A vibrant exploration industry

Explorers capitalize on favorable commodity prices

Exploration and financing, both in Nevada and globally, had a shaky first half in 2020 due to Covid-19. Though mining was declared an essential industry and was allowed to continue operating, widespread uncertainty, coupled with restrictions to cross country boundaries and difficulties to mobilize exploration teams, caused a slowdown in exploration activity during the first months of the year.

However, the industry soon recovered from the initial shock. Numerous junior companies managed to raise large amounts of capital in 2020, in a context of rising metals prices and improving financing conditions. Gold reached an all-time high in July 2020 trading at US\$2,076/oz, silver approached the US\$30/oz mark for the first time in eight years, and copper reached an all-time high in May 2021, trading over US\$4.75/lb.

In the first half of 2021, Nevada saw multiple IPOs, with Summa Silver (TSXV: SSVR) going public in January, followed by American Eagle Gold (TSXV: AE), Millennial Precious Metals (TSXV: MPM), and Nevada Silver Corporation (TSXV: NSC) in May, and Infield Minerals (TSXV: INFD) and NevGold (TSXV: NAU) in June.

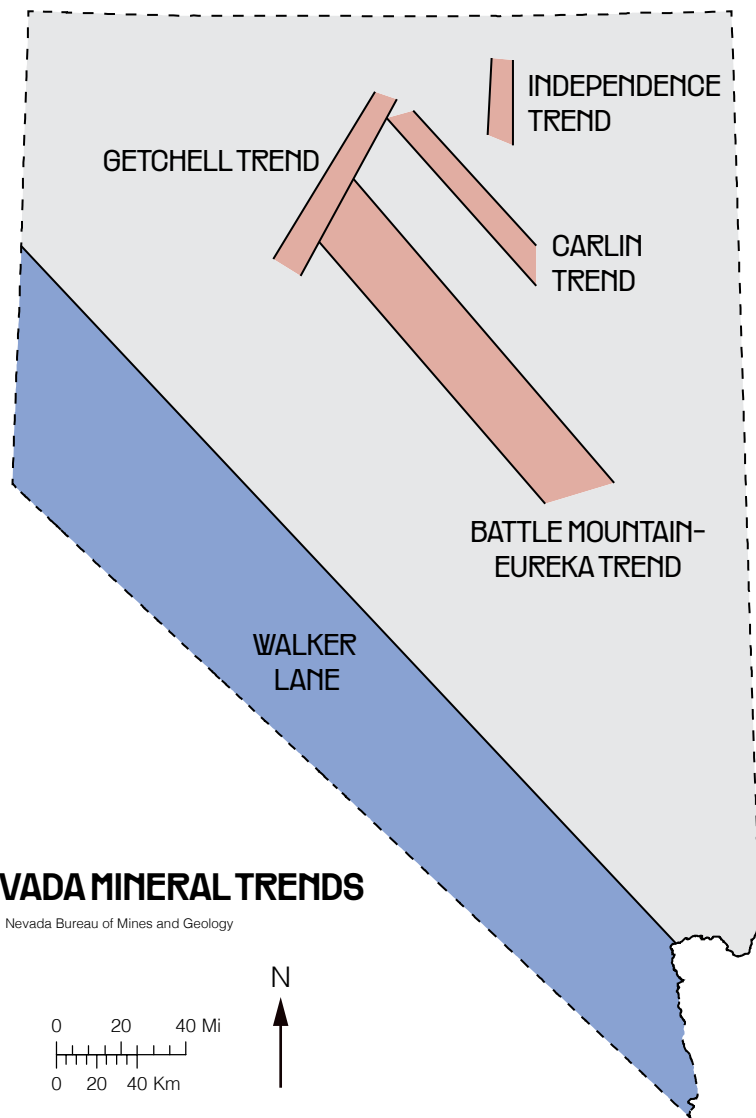
As a result of the huge amounts of capital raised in 2020, 2021 was characterized by an exploration boom. This was evidenced by an increase of US\$345.2 million in the US' mining exploration budget in 2021 compared to the previous year, according to data from Statista. In addition, there was a considerable increase in applications for mineral claims; as of December 1, 2021, there were approximately 235,000 active mining claims on BLM-managed lands in Nevada, representing a 30% increase over the number of active mining claims on BLM-managed lands in Nevada only four years ago.

"We are also seeing evidence of this on the ground, with the lack of drill rigs and

experienced personnel and delays in getting assays out of the lab all pointing to a very robust exploration environment," stated Gary Lewis, group CEO of US-based explorer Nevada Silver Corporation.

David Shaddrick, president of the Nevada Mineral Exploration Coalition, described the current increasing exploration activity as a "multiple commodity boom". "In addition to gold, there are numerous silver, copper and lithium projects underway as well as zinc, vanadium, fluorspar and other less well-known projects," he commented.

Nevertheless, the huge amounts of capital that flew into junior companies operating in Nevada in the second half



of 2020 and first half of 2021 were not matched in the second half of 2021. The competition to attract capital in the junior mining market has become fierce, making it difficult for companies to stand out from the crowd with so many options for investors. "It is no secret that the small-cap mining market has been challenging over the last several months, with a lot of companies down 50%+ from their summer highs," explained Colin Moore, president of Vancouver-based Westward Gold (CSE:WG). In the second half of 2021, precious metal prices trended lower, reflecting declining investor sentiment and soft physical demand. Gold prices have been relatively more resilient and seem to have found a new base level above US\$1,700/oz but were weighed down by outflows from gold-backed exchange-traded funds and slowing central bank purchases. Meanwhile, silver prices slumped on waning industrial demand. In 2022, precious metal prices are anticipated to ease, but there continues to be high uncertainty arising from the Omicron variant and monetary policy stances.

Streamlining the mine permitting process

For many years, Nevada has been the crown jewel of US mining and has constituted one of the most attractive destinations worldwide for exploration companies. "Nevada presents all the right ingredients for exploration projects to succeed," expressed Evandra Nakano, CEO of the newly created gold explorer Infield Minerals (TSXV:INFD), when speaking about the factors that led to the company's acquisition of the M1 and Desperado projects in Nevada.

The state has unparalleled geological potential, and even though it has undergone several cycles of exploration and development since the mid-1800s, explorers still see potential for more ore to be found, especially at depth. Exploration companies in the "Silver State" can benefit from excellent infrastructure, an abundance of professional services, and a skilled and educated workforce, with thousands of workers between the towns of Reno and Elko who are spe-

cialists at mining in Nevada. The state also has a climate and topography that allows for year-round exploration and mining.

Another characteristic that makes Nevada particularly attractive is that there is a large amount of federal land which is open to mineral entry. The Mining Law of 1872 established the ability for anybody, regardless of age, sex, or nationality, to locate a claim on lands open to mineral entry, providing the exclusive right to explore and extract mineral material.

This represents a great opportunity for explorers, but it can also be an additional burden in the sense that companies have to permit both with the Nevada Division of Environmental Protection (NDEP) and with the federal regulator, BLM, or US Forest Services. The permitting process can therefore be quite involved and lengthy.

Like in the rest of the US, it currently takes on average seven to 10 years to secure the permits needed to commence operations in Nevada. To put

that into perspective, in Canada and Australia, which have similarly stringent environmental regulations, the average permitting period is two years. According to a survey conducted by the Nevada Bureau of Mines and Geology, the time and cost of permitting is currently the largest negative impacting factor on companies' exploration activities. This is because the higher costs and increased risk that often arise from a prolonged permitting process can significantly reduce the expected value of a mine before production even begins and can even lead to mining projects becoming altogether financially unviable.

Therefore, while Nevada enjoys one of the best environments for exploration in the world, there are areas to be improved. Many agree that streamlining the minerals mining permitting process is paramount to allow companies to take full advantage of booming commodity prices, to maintain the state's competitiveness in the global sphere, and to decrease US reliance on foreign sources of minerals. ■

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DISCOVERING NORTH AMERICA'S NEXT MULTI MILLION OUNCE GOLD RESOURCE THROUGH FOCUSED EXPLORATION ACTIVITIES

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TSXV: NVX OTCQB: NVGLF FSE: 8NV
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David Shaddrick

President and Director
NEVADA MINERAL
EXPLORATION COALITION

Can you provide an overview of the Nevada Mineral Exploration Coalition's mission and goals?

The Nevada Mineral Exploration Coalition (NMEC) is a non-profit, non-partisan advocacy group, whose mission is to preserve and promote Nevada's mineral exploration

industry. The NMEC monitors legislative and regulatory issues at all levels of government. Our actions include such things as testifying to committees, submitting written comments, and meeting with legislators and regulators to educate them about mineral exploration. Where possible the NMEC cooperates closely with larger organization such as the Nevada Mining Association as well as other stakeholders. Our promotional activities include highlighting our members companies and projects at different events such as PDAC, AME Roundup and the AEMA Convention. Today, we have about 175 members which include small businesses and individuals engaged in, or in support of, mineral exploration and development activities in the state.

What do you think of the current regulatory framework for exploration companies in Nevada?

Nevada has a sound regulatory framework for mineral exploration which compares favorably to that of most other jurisdictions. The time and cost to obtain exploration or operating permits are favorable as well.

Our state has better reclamation rules and structure than many other jurisdictions and mine closure planning is part of the initial permitting process.

How do you see the availability of skills and contractors for exploration in Nevada?

The current exploration boom has greatly strained all exploration related services, and it has become incredibly challenging to recruit skilled workers in Nevada. Drill rigs are fully booked, assay labs are buried, and there are many available jobs for geologists as well as all the other specialties involved in mineral exploration. To solve this problem, many companies are paying higher wages, and some of them are even offering sign-on bonuses.

How do you see the exploration segment evolving in the coming years?

Exploration will continue to expand over the years with the usual ups and downs. If one of the numerous projects currently in the development stage becomes a major discovery, exploration activity will further expand. ■

What are the main challenges currently affecting mining and exploration?

One of the great challenges is making the general public aware of the connection between mining and people's lifestyles. The industry is also often considered old-fashioned and detrimental to the environment, which could not be further from the truth.

Another important challenge involves ensuring access to mineral deposits, as today, there is legislation that could severely inhibit the ability to access public lands for exploration. Nevada, specifically, is a large public lands state, and approximately half of all federal public lands are either off-limits or severely restricted to mining. It is important to maintain public land access for mineral exploration and development. Therefore, a major focus of our association is creating a more efficient permitting system to improve the competitiveness of the domestic mining industry. Doing so will spur job creation and decrease our reliance on foreign sources of the minerals. ■

the National Mining Association and have many of the same members which include large producing mining companies. However, what distinguishes us is that our heart and soul is the exploration and development sector of the industry. An important focus of our association is maintaining access to public lands for responsible mineral resource development.

What role can Nevada play in building a domestic supply chain for critical minerals?

Nevada has fantastic potential to secure the domestic supply chain of critical minerals in the US because it has an unmatched mineral endowment and is composed overwhelmingly by public lands. The demand for critical minerals to accomplish some of the current administration's objectives are astounding, so it will be necessary to look at areas where those mineral resources can be responsibly developed. With the worker protection laws and the environmental regulations that exist in the US, we can mine more responsibly than anywhere in the world.



Mark Compton

Executive Director
AMERICAN EXPLORATION &
MINING ASSOCIATION

Can you introduce the American Exploration & Mining Association?

The American Exploration & Mining Association (AEMA) is a national industry trade association representing the hard rock mining industry. We work closely with

Precious Metals Exploration and Development

Exploring around the old trends

Precious metal exploration in Nevada has traditionally been concentrated around three primary trends: the Carlin Trend, the Battle Mountain-Eureka-Cortez Trend, and the Walker Lane Trend. Together, these three trends have contributed to the nearly 170 million ounces of gold produced in Nevada between 1835 and 2018 and have given rise to some of the world's most important mining districts. Though Nevada hosts a variety of deposit types, including porphyry and skarn, most of the state's gold production comes from low-sulfidation epithermal gold and sediment-hosted Carlin-type deposits.

The presence of Carlin-type deposits is one of the main appeals for explorers in Nevada. These are large sedimentary rock-hosted disseminated gold deposits which often occur near-surface and in clusters, with one large "elephant" deposit surrounded by a group of smaller satellite deposits with similar geology.

Finding more gold and silver in Nevada

Exploration spending in Nevada since 2011 has been directly linked to commodity prices. It has been gradually increasing for four consecutive years, yet this has not translated into more production. "Despite explorers spending more money over the last decades than ever before, discovery and production rates have declined steadily since the late 1990s," expressed James Buskard, president of Nevada Exploration.

This can be attributed to the fact that most of the low hanging fruit, the shallow, multi-million-ounce oxide deposits, have been discovered and mined out, so the new discoveries are coming from deeper deposits that are more difficult to find. New discoveries, such as Nevada Gold Mine's recent discovery of the huge 15 million-ounce Goldrush deposit, tend to result from rethinking the geology of previously mined areas and drilling underneath the near surface mineralization. Therefore, many explorers in Nevada are currently going deeper to find high-grade, refractory deposits. There are also companies focusing in underexplored areas of Nevada in hopes of finding the next major discovery, which is the case of Nevada Exploration. "Nevada Exploration was founded with the sole focus of looking for Nevada's next large Carlin-type gold district in the 50% of the state where the bedrock is covered by sand and gravel beneath large desert valleys. These valley basins have been under-explored due to an historic lack of specialized under-cover exploration tools," Buskard explained.

For Chad Peters, president, CEO and director of Ridgeline Minerals, there are other factors that play an important role apart from

technology. "In the last 10 years, the discoveries made have relied on good teams, layering the data together, and testing concepts," he argued.

Carlin Trend

Millennial Precious Metals (MPM) has become one of the protagonists around Nevada's Carlin Trend and the Battle Mountain Eureka Trend. In 2021, the company started a phased 15,000-20,000 m drill program across its three key assets. It began its exploration campaign by drilling approximately 2,300 m at Red Canyon, a Carlin-style, sediment-hosted gold project, which revealed some encouraging results. "Widths and grades are 54 m to 22 m, ranging from 0.5 g/t to 4.5 g/t oxide Au. It is important to note that the average grade in the Great Basin is significantly lower, about 0.38 g/t Au, which is why our asset is receiving significant attention in the market," stated president, CEO, and director Jason Kosec. MPM has also started drilling over 7,000 m at Mountain View and 4,000 m at Wildcat located in the Carlin Trend.

Battle Mountain - Eureka Trend

Between the Carlin and Battle Mountain trends, Nevada-focused junior gold and silver explorer Ridgeline Minerals has become one of the largest landholders of any junior in the state, with four projects comprising 154 km².

TSXV: NSC
OTCQB: NVDSF
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nevada
SILVER

An advanced-stage exploration company located in one of the most highly-endowed Ag-Au districts in the world's #1 mining jurisdiction

CORCORAN SILVER, NEVADA (100% NSC)
Surface silver-gold deposit with excellent upside – open along trend and depth

- NI 43-101 resource 33.5Moz AgEq
- Grades to 6769 g/t Ag and 8.4 g/t Au
- 328 contiguous mineral claims cover resource, expansion and exploration targets along a 10km alteration zone

BELMONT SILVER, NEVADA (100% NSC)
Includes historic Belmont silver mine, among the richest silver mining camps in the Tonopah district, with average silver ore head grade 25oz/t Ag

The company completed an IPO in August 2020 and achieved a huge milestone in the company's short history in September 2021, when it executed an earn-in agreement with NGM with respect to its Swift project, located in the Cortez district of the Battle Mountain – Eureka Trend. NGM committed to spend US\$20 million over the next five years (US\$4 million of which is guaranteed) to earn an initial 60% interest in the project and they will have further options to increase their interest to 75% by completing additional work commitment milestones and electing to cover Ridgeline's portion of future mine development costs. "This is a substantial commitment even for NGM, which speaks to the confidence they have in Swift and the potential for this asset as a world-class exploration target," expressed Chad Peters.

Adjacent to NGM's operating Phoenix-Fortitude mine lies Golden Independence's Independence project. In December 2021, the company released a PEA outlining production of 195,443 oz gold 1.3 million oz silver over a 6.1 year mine life. The PEA estimates an after-tax NPV5 of US\$35 million and IRR of 18% using US\$1,700/oz gold and US\$24/oz silver. To advance the Independence project towards a production decision, the company announced in December 2021 the creation of a joint venture with Americas Gold Exploration Inc. "The project has world class potential that we need help unlocking, but also has the potential for near term cash flow from the heap leach project," commented Christos Doulis, CEO of Golden Independence.

On the tail end of the Cortez Trend, sits American Eagle Gold's (AEG) Golden Trend asset. What made the project so appealing to

AEG is its position just south of Goldrush. In September 2021, AEG started an initial drill program of 3-4 holes totalling approximately 3,000 m. Exploration is focusing on intersecting lower plate rocks, structures and alteration indicating the presence of a Carlin-type system.

The newest gold explorer at the Battle Mountain - Eureka Trend is Westward Gold, which has assembled a 3,000-hectare land package comprising the Toiyabe project and the Turquoise Canyon project. Since the summer of 2021, the company has used hyperspectral imaging to analyze the old core from the historic operators. They also did a hyperspectral fixed-wing airborne survey and completed a 17-km induced polarization survey across both properties. All the data collected is being incorporated into a new 3D model. The company started 2022 by announcing its listing on the OTCQB Venture Market.

Walker Lane Trend

Nevada's Walker Lane gold trend offers significantly higher grades. Explorer Newrange Gold is targeting the potential near-surface oxide gold resource located at its Pamlico project.

Vancouver-based explorer Gold79 Mines is also developing a trio of properties in the Walker Lane trend. The company is working to leverage an existing database of historical information generated on Gold Chain, its flagship project – located 7.5 km from Kinross Gold's Round Mountain mine. Gold79 Mines is also developing the Tip Top gold project, which, after the new staking to cover the large alteration footprint, now comprises 139 unpatented mining claims including several low-sulfidation oxide-gold-silver epithermal veins located in the Walker Lane gold trend.

In addition to gold, the Walker Lane Trend also offers significant silver potential, and Nevada Silver Corporation is poised to take advantage of this opportunity. The company started trading on the TSXV in May 2021, listing via a reverse takeover. Its flagship Corcoran Silver project, a silver plus gold project, presents mineralization near surface, is open in all directions and has a NI 43-101 inferred mineral resource of 33.5 million silver-equivalent ounces. "We are the first company in a long while that is adequately skilled and funded to give the project a real opportunity for success," stated Gary Lewis, group CEO.

Away from the trends

Gold Spring Resource is targeting the eastern edge of the prolific Great Basin, an area between Nevada and Utah. "This area had been neglected through the different exploration booms," explained Randall Moore, executive vice president of exploration. In 2020, the company updated the PEA of its single project Gold Springs including an IRR of 40% and an NPV of US\$180 million, considering the US\$1,800/oz at that time. It also showed a low capex, technically simple, heap leach operation. "We plan to achieve a multi-million-ounce resource base, which we are setting up today with our 27,000 m drill program," stated president and CEO Antonio Canton.

Nevada's exploration companies are relying on experienced teams, new exploration technologies, and rethinking the geology of previously mined areas to try to reverse the downward trend in discoveries that has been affecting Nevada since the 1990s. ■

THE ONE TO WATCH IN NEVADA IN 2022
Rapid Advancement of a Major Gold Asset
2022 Drill Program at High-Grade Copper-Gold-Silver Project



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Jason Kosec

President, CEO & Director
MILLENNIAL PRECIOUS METALS

Can you introduce Millennial Precious Metals (TSX.V:MPPM) and the company's portfolio in Nevada?

Millennial Precious Metals is an exploration and development company focused on developing near-surface, heap leachable gold and silver ounces in Nevada and Arizona, two of the top mining jurisdictions in the world. Between myself, Ruben Padilla and Terry Harbort, we have discovered over 59 million oz Au across seven projects, five of which are currently in construction or production. This speaks to the quality of the assets that we discovered. Millennial has a well diversified portfolio of assets, the flagship projects being Mountain View and Wildcat, which are at the development stage and hold a combined 1.2 million ounces of oxide gold.

Millennial also has an exciting drillbit story on the Battle Mountain Eureka Trend called Red Canyon, located 35 km south of Barrick's Cortez complex, where the first phase of drilling was completed in 2021. Drill results from the first phase include widths of 54 m to 22 m, with grades ranging from 0.5 g/t to 4.5 g/t oxide Au. It is important to note that the average grade in the Great Basin is significantly lower, about 0.38 g/t Au, which is why Red Canyon is receiving significant attention in the market. Millennial also has four grassroots development stage assets that provide the company with a solid organic growth pipeline. In August 2021 Millennial acquired an option on a high-grade silver asset located in Arizona called Cerro Colorado.

Millennial went public in H1 of 2021. How has the company been received in the market?

The gold equity market was slightly stronger when we went public in May 2021. Since going public, we initiated an aggressive drill program, and have since significantly de-risked our key assets. A key value proposition that Millennial presents to its shareholders is that we have the highest effective grade (gold grade divided by strip ratio) open pit oxide development gold project in Nevada. From a valuation perspective Millennial currently trades at ~US\$35/oz Au compared to our peer group in Nevada which trade closer to US\$50/oz Au.

What are some of your ongoing exploration campaigns and what have the results shown so far?

In 2021 - 2022, we will carry out a phased 15,000 - 20,000 m drill program across our three key assets, Mountain View, Wildcat and Red Canyon. We began our exploration campaign by drilling ~2,300m at Red Canyon, which is a Carlin-style, sediment-hosted gold project, presenting some of the most significant intercepts in Nevada. Currently, we are drilling over 7,000 m at Mountain View, with our first drill holes returning 20 m at 2.3 g/t oxide Au and 128 m of 1.73 g/t oxide Au and 275 m of ~0.5 g/t oxide Au. The evidence we are collecting from the ongoing drill program indicates that the core holes are yielding significantly higher grade than what was predicted in the block model, which is a potential game changer for the project. At Wildcat, we plan to drill over 4,000 m beginning in Q1 2022. Wildcat is a large low sulphidation epithermal system which we are developing a geologic model for in order to better understand its size and depth.

With the current metal prices, how do you see the appetite for exploration in Nevada?

Companies in Nevada tend to focus on the main trends, such as Battle Mountain - Eureka, or the Carlin. Most exploration models are based on drilling through the upper plate which typically presents alternation signatures with the hopes of intersecting a mineralized lower plate. This is not a financially feasible model for juniors. We see an opportunity in exploration off the main trends into the basins within the epithermal belts, which is where new discoveries will likely occur in the upcoming years.

What should we expect from Millennial over the next few months?

The next 12 - 18 months for us will be centered around our aggressive drilling program, which will feed an updated resource at Wildcat and Mountain View in H1 2022. The updated resource will support the joint PEA for Wildcat and Mountain View which we expect to publish in H2 2022. ■



Millennial has a well diversified portfolio of assets, the flagship projects being Mountain View and Wildcat, which are at the development stage and hold a combined 1.2 million ounces of oxide gold.





↘↘
In Nevada, we hope to expand the Pamlico project to include a copper environment in addition to gold.
 ↙↙

Robert Archer

President & CEO
NEWRANGE GOLD CORP.

How has Newrange Gold Corp gone about acquiring its current portfolio of assets?

Newrange Gold Corp was originally incorporated as Colombian Mines Corp. to explore in Colombia in 2006. In 2016, however, it changed its name to Newrange Gold Corp and transitioned its focus to the US, acquiring the Pamlico project in Nevada. Robert Carrington, a co-founder of the company, had actually worked on the Pamlico project before and was familiar with the site. This project focuses on a past-producing historic gold mine that we have since been exploring. Newrange also acquired two projects in Ontario and will begin working on those in February 2022.

Can you tell us about the historical exploration conducted at the Pamlico gold project?

Discovery of gold at the Pamlico site dates back to the 1880s. The mine was put into production in 1896 by a family who mined it until the 1920s. It was then sold to a different family followed by a third one from whom we ultimately purchased it. Despite its early days of production, the site has seen little in terms

of modern exploration. Two other junior companies were there in the late 1990s and early 2000s when the price of gold was relatively low. We have picked up on their work and conducted our own exploration to better understand the gold mineralization that was mined in the past.

What have you learnt about the type of mineralization present at Pamlico?

At Pamlico, high-grade gold mineralization occurs in fractures and quartz veinlets as well as in lower-grade disseminations in the wall rocks. In the old days, miners focused on high-grade gold that they were able to see. The fine gold we currently have in Nevada would not have been economic or even known to miners in the 1800s. At Pamlico, we have high-grade veins and fractures adjacent to low grade material. Another important factor at Pamlico is the depth of oxidation, which at some points reaches 300 m. This presents a strong metallurgical response in the sense that recoveries are up to 97% from some of the preliminary testing we have done, with mineralization right at the surface. Not only is it easy to access, it would also be very

cheap to mine and process on a standard leach pad. With this in mind, we have tried to target our drilling to better understand the mineralizing system and how to trace it out.

In 2021, we also expanded our geophysics beyond the gold zone and discovered several strong induced polarization anomalies. Based on these findings, we more than doubled the size of the property, to more than 5,700 hectares that is largely unexplored. Here, we are finding strong signs of copper mineralization ranging from 1% to 5.5%. We see potential for a porphyry copper deposit. We are in the early days of discovery, and it is exciting.

What was the decision-making process towards acquiring the Argosy gold mine in Ontario?

In the early 2000s, I was the CEO of a different exploration company that had the opportunity to acquire the Argosy gold mine. We drilled several holes and saw great potential, but at the time it was difficult to attract investor attention to narrow-vein, high grade deposits in Canada as the focus was largely on Mexico. In 2015, my previous company Great Panther acquired Cangold, which gave us control of the Argosy project. However, Great Panther was focused on Latin America and viewed the mine as a non-core asset. When I joined Newrange, I negotiated the acquisition of Argosy from Great Panther, presenting a win-win deal because Newrange obtained a project I have a lot of knowledge on in an area we are already involved in. At the same time, Great Panther will participate in any successes at the project via its shares in Newrange, as they are now one of our larger shareholders.

Can you highlight some of the company's key priorities for the coming months?

In 2022, the company will initially focus on its gold projects in Canada while grooming Pamlico for additional drilling. We can drill in Ontario in January to March then switch back to Nevada once those programs are finished. In Nevada, we hope to expand the Pamlico project to include a copper environment in addition to gold. Overall, 2022 will be a very exciting year for the company. ■



Gary Lewis

Group CEO
NEVADA SILVER CORPORATION

Can you introduce Nevada Silver Corporation (NSC) and provide an overview of your portfolio?

NSC is an exploration and mineral development company with two advanced stage projects in the US: our flagship Corcoran silver project in Nevada, and the Emily manganese project in Minnesota. Our primary focus, as reflected in our name, is in Nevada exploring for silver. We started trading on the TSXV in May 2021, listing via a reverse takeover. Our intention is to focus solely on silver and monetize the manganese project to the benefit of our shareholders.

The Corcoran silver project has several compelling features; it is silver plus gold, with mineralization from surface, and we are in Nevada, the world's best mining jurisdiction according to the Fraser Institute, and in a district renown for multi-million-ounce silver and gold production. Corcoran has been explored since the 1980s, but never reached its full potential. We are the first company in a long while that is adequately skilled and funded to give the project a real opportunity for success.

What attracted you to the Toquima caldera complex where the Corcoran project is located?

The Toquima caldera complex is a well-endowed historic mining district with world-class assets in close proximity. It is less 'cluttered' than some of the other districts in Nevada, such as the Carlin and Battle Mountain Belts. Corcoran is the largest underdeveloped project within the Toquima complex, and the historical exploration, 18,000 meters of drilling, has provided a great starting point.

Can you tell us about the current resource estimate for the Corcoran property?

We published our maiden resource in October 2020, the goal being to draw a line under the historic drilling, from which we can then build the resource and the project. Corcoran has an inferred mineral resource of 33.5 million silver-equivalent ounces, including approximately 24 million oz silver and 250,000 oz gold. Based on historic data, the grade can appear low, averaging 30 g/t silver equivalent, but we believe the published grade understates the potential of the deposit, for several reasons. For example, much of the

drilling was percussion and undertaken more than 30 years ago and could not accurately define the high-grade zones. Further, the high-grade intersections were capped, which also may understate the contained grade of the resource. Finally, assaying of samples 40 years ago tended to lose some of the silver in solution, again adversely impacting on grade. We believe we can increase the grade and tonnes significantly and see the current resource estimate as an excellent starting point.

Can you provide some insights into the ongoing drill campaign?

We embarked on an initial diamond drill program in September 2021, commencing with verification drilling within the main (Silver Reef) resource area. The program then moved on to test for extensions to the Silver Reef mineralization, with the intent to provide considerable infill data. This drilling is expected to extend the area of known mineralization and will form both the basis for an updated NI 43-101-compliant resource estimate as well as material for metallurgy and mineralogy studies.

17 holes for 3,040 meters were completed in the current program and assays have been received for three. These first results are very positive with wide intersections of up to 142 m from close to surface with silver and gold averaging 42 g/t AgEq. Numerous thinner intervals of high-grade silver and gold ranging to 1.33 m of 2,310 g/t Ag 2.6 g/t Au were intersected in each. The results are very encouraging.

Can you highlight some of Nevada Silver Corp's key priorities for the future?

Our priority is to establish ourselves amongst a well-established peer group in Nevada and bring our company and our projects to forefront of all stakeholders. This can only come through our results and our actions. Our focus now is to continue drilling at Corcoran, and we have a multi-phase drilling program for 2021 and 2022 to build grade and tons, expand our footprint in Nevada and advance our test work. Our ultimate goal is to build a mine, which is why we are also looking at other acquisitions in Nevada. Underpinning all of the above is a commitment to sustainable exploration and mining practices, regenerating once we are done and operating in a humane and ethical manner. ■



Mike Sieb

President
GETCHELL GOLD CORP

↘↘
In 2022, we will be doubling the drilling activity conducted in 2020 at Fondaway Canyon with two dedicated rigs. Leaping from that, we will arrive at a resource estimate and subsequently, a PEA.



Can you tell us about the origins of Getchell Gold and provide an overview of the company's assets?

Getchell Gold Corp. was born in 2019 from the merger between two active exploration companies. The company, which focuses strictly on gold and copper in Nevada, has a basket of four projects in the northeast and east of Reno, in the main mining and exploration belt that has witnessed the production of millions of ounces of gold over the past decades. Our flagship property, called the Fondaway Canyon gold project, was acquired at the end of 2019 at a very opportune time just prior to a major resurgence in the price of gold. The project had experienced 40 years of historic exploration and presented a substantial historic gold resource with mineralization beginning right at surface. However, what really stood out was its upside potential.

What results have you obtained from the 2020 and 2021 drilling campaigns at Fondaway Canyon?

We initiated our drill program at Fondaway Canyon in 2020, and we stepped out from the known historic results to test our concept. The program covered 2,000 m, and all the holes in the Central

Area hit substantial zones of mineralization. The successful 2020 drill program made the 2021 campaign very easy to plan, since it left ample targets. The beauty of the Fondaway Canyon project is that mineralization is open in all directions. It starts at surface, and according to our current model of the target zone, it extends for 800 m down depth from surface. The mineralization body that we have been intersecting is considerably thick, with zones which are 100 m thick of good grade. Rather than increasing in depth per se relative to the surface topography, the gold mineralization parallels the slope of the hill slide. This is a very beneficial attribute as we work towards a new resource, and eventually a PEA and a mine model. We had a very successful 2021 drill program, where we drilled approximately 4,000 m, and we have the benefit of incorporating three additional drill campaigns, since the publishing of the historic resource estimate, into the new resource. In 2022, we will be doubling the drilling activity conducted in 2020 with two dedicated rigs. Leaping from that, we will arrive at a resource estimate and subsequently, a PEA.

Are you satisfied with the exposure

you are receiving from your listing in the CSE?

The CSE has evolved from being a fledgling exchange to being completely bonified. We are satisfied with the exposure we are obtaining, since it currently provides access to as much funds as the TSXV. However, the exposure that we are receiving can be more attributed to the meteoric rise we have experienced in the last two years and to our company's merits. The value of our share price has increased significantly, and we are currently well funded. A substantial number of warrants will shortly be converted, and this will also provide us with a steady stream of funding. These factors allow us to be relatively opportunistic, but naturally, we still need to plan for additional funding to be able to support the marked increase in activity that we are planning for 2022 and beyond.

How are you benefitting from your listing on the OTCQC?

I believe that it is critical for any company involved in Nevada or in the US to have an allowance open for US investors to invest in the company. Sitting on just one exchange significantly restricts the funnel access point of who can invest in the company. Being listed both on the CSE and the OTCQC allows us to spread our message and expand access as broadly as possible, currently reflected in Getchell's substantial US-based investor base.

What can we expect from Getchell Gold Corp. in the coming years, and do you have a final message?

Nevada is a land of elephants, and we have only scratched the surface, as we still have not seen the bottom to the mineralization at Fondaway Canyon. Therefore, we will continue drilling and defining the mineralization to determine exactly what we are sitting on. Our goal is to make Getchell Gold Corp. one of the most active junior explorers in Nevada. Our project has been extremely positively received in the marketplace and we expect this to continue. Investors should carefully pick the right eggs to put in their investment basket and Getchell Gold Corp should be one of them. ■



John E. Watson

Chairman & CEO
NV GOLD CORPORATION

↘↘
NV Gold looks for deposits that have not been explored in the traditional sense of soil sampling and geologic mapping at surface outcrops.



Can you introduce NV Gold and provide an overview of the company's assets?

NV Gold is a pure gold exploration company focused on Nevada. The company's board of directors and advisors have a combined 150 years working experience, almost entirely in Nevada and the Great Basin. Our portfolio of projects can be divided into two broad groups. We have our high priority projects that we approach on a sole risk basis. These projects are field active, and we prioritize sites where we have done reconnaissance work or first stage drilling and are in the pipeline for the next stage. NV Gold has six projects ready for drilling in the next 6-9 months, and we have a drill currently active. Our second group of projects are lower priority, as we have already tested our ideas and are looking for partners with new ideas. We offer these for lease or joint venture. Today, there are 22 projects in our portfolio. In general, we focus on obscured targets. Much exploration has been done in Nevada over the past 40 years, especially on mountain ranges. However, about half the state is obscured because its valleys have gravel cover, and logically there should be an equal num-

ber of deposits to be found here. NV Gold looks for deposits that have not been explored in the traditional sense of soil sampling and geologic mapping at surface outcrops. We use more sensitive techniques that we hope will enable us to be involved in one of the next big discoveries.

What have been the latest milestones at the Sandy gold project?

In early 2021, NV Gold undertook a significant drilling program at Sandy. We drilled 17 reverse circulation holes in the first quarter of 2021 and saw very encouraging results, with gold intercepts in 12 of the holes, outlining a mineralized zone of 2 km long and 600 m wide. We followed up the drilling with an induced potential resistivity geophysical program. Through this, we identified a very strong target that will be a high priority for NV Gold in the first quarter of 2022, and we will likely undertake a drilling program of 2-4 core holes.

How are advancements coming along at the Slumber gold project?

NV Gold has completed two drilling programs at Slumber over the past few years, and there is a current program

underway. The site is completely obscured by gravel cover which makes progress challenging. In addition to drilling, we covered the area with a CSAMT geophysical survey which produced new targets. We combined the 3D work with the 3D aspect of our drilling, and the result was a great model of the geology.

There are different targets present at Slumber. First, there is an epithermal vein target which could be present. We are also looking at volcanic breccia. Additionally, we will further narrow our focus on the sleeper-type bonanza target. We have completed five holes in this program and have encountered a much larger mineralized zone with a higher degree of silicification and alteration than we have seen elsewhere on the property.

In April 2021, the company announced it had signed an option agreement with Hochschild Mining on the SW Pipe gold project. What attracted Hochschild specifically to that asset?

Hochschild is looking for mega-deposits. The SW Pipe gold project, located in elephant country around 4 miles from the Pipeline mine, has great alteration at surface and is large enough to be of interest to a big company. SW Pipe has a small resource cloud of low-grade mineralization at the surface, possibly related to a potentially deeper, larger, higher-grade deposit. Hochschild has completed some deep geophysics to provide targeting, and I anticipate there will be a few deep core holes in 2022 to test potential.

How does NV Gold think about account strategy?

New discoveries are truly rare and valuable commodities that are made through creative thinking, good geology, and hard work. NV Gold's mindset is to let our shareholders reap the benefits of this success rather than another company. We are more of an exploration company than a classic prospect generator in the sense that our primary emphasis is to test our own ideas first and work on our own account. If we do not succeed with our best ideas, then we will venture out a project. ■

Insights from the explorers



“The Battle Mountain – Eureka Trend is one of the most prolific and well-endowed gold trends in Nevada. As the adage goes, the best place to start hunting for new discoveries is near other large deposits - and we are only 10 km away from Cortez Hills, one of the most significant gold mines in the world. Nevada also has excellent access to infrastructure and skilled labor. From a regulatory and political standpoint, Nevada remains the best jurisdiction to operate in, as evidenced in the most recent Fraser Institute Report on top mining jurisdictions. Early-stage exploration is an inherently high-risk business, so operating in a mining-friendly jurisdiction like Nevada helps mitigate additional outside risks.”

- Colin Moore, President, Westward Gold



“Juniors are currently facing some challenges regarding market support. However, I think that the fundamentals are strong in the near term and beyond for higher gold prices and for a stronger junior market overall. There are few companies in prolific and supportive operating states, and at the same time, within underexplored regions. Realistically, it is becoming increasingly harder to find resources and reserves for intermediates, seniors and the industry as a whole. We believe that, as the market improves for juniors, we will be able to take advantage of our strong position in a well-developed jurisdiction.”

- Evandra Nakano, CEO & Director, Infield Minerals



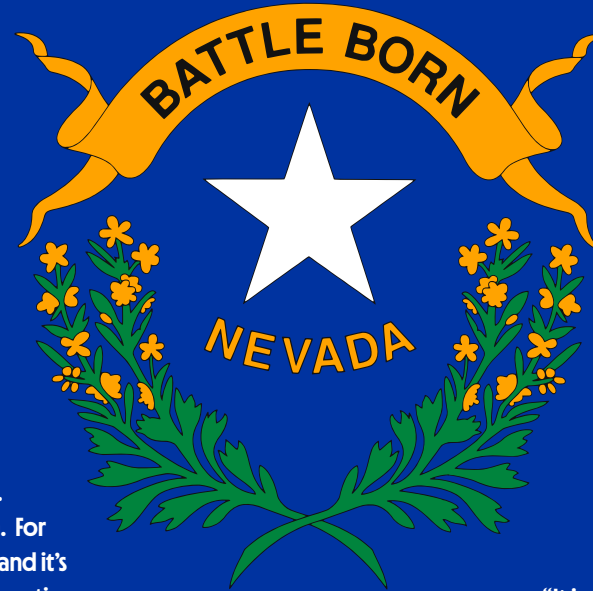
“Like other mature districts around the world, the future of Nevada’s mining industry unquestionably depends on successfully navigating the transition from exploring in yesterday’s near-surface search spaces to exploring in tomorrow’s undercover search spaces. Nevada’s three main Carlin camps share remarkable similarities and we know a lot about them. For each camp sticking out of the ground, there is likely another waiting to be found undercover, and it’s our belief that this residual 200-million-ounce endowment of Carlin gold is the biggest prize in our entire industry.”

- James Buskard, President, Nevada Exploration



“Nevada is probably the best jurisdiction in the world to be in for a junior exploration company thanks to its stable regulatory environment and rich mineral endowment. Within Nevada, we are fortunate to be in the Tonopah mining district, located only 20 minutes away from the nearest town. Besides having excellent infrastructure and a trained workforce, Nevada is a great place to find professional services, which helps keep our costs down. In addition, federal and state regulators in Nevada are well paid and educated about mining. However, at the same time, the competition for resources in the state is fierce.”

- James Hesketh, CEO, Viva Gold Corp



“Following the gold price run, numerous junior companies raised huge amounts of capital in 2020. This led to an exploration boom in 2021, which priced services at a premium and made it hard to find both drills and geologists. However, market sentiment in the junior gold space has decreased recently, so over the next 12 months we expect to see a significant slowdown in exploration for the juniors and some of those companies will struggle to raise capital. We see this as an opportunity to pick up distressed assets and we are always looking to add quality projects to our portfolio whenever possible.”

- Chad Peters, President, CEO & Director, Ridgeline Minerals



“Historic districts that have not seen modern exploration offer attractive acquisition opportunities, which Tonopah fits the criteria for. In my experience as a geologist, I realized that historic producing areas that have not witnessed modern exploration technology and techniques more often than not hold substantial potential. As they say, the best place to find a new mine is next to the old mine. We are simply replicating a model that others have executed successfully before.”

- Galen McNamara, CEO & Director, Summa Silver



“Nevada has always been an extremely popular jurisdiction for gold exploration and development. We were particularly interested in the Independence Project as it has two development paths – one being the near surface heap leach component, which we have focused on for the past year, and the other a much higher-grade skarn at depth. The high-grade skarn target will take much more capital to unlock relative to the heap leach asset, but we believe it is a big prize and of potential interest to our neighbor NGM or other major mining companies active in Nevada. The project has world class potential that we will need help unlocking, but also has the potential for near term cash flow from the heap leach project.”

- Christos Doulis, CEO, Golden Independence Mining Corp.



“It is evident that Nevada’s mining industry is going to continue to experience strong M&A activity. There are currently too many companies in Nevada, so consolidation needs to occur. The consolidation process began with the creation of Nevada Gold Mines, and we keep seeing continuous M&A announcements, such as AngloGold Ashanti’s acquisition of Corvus Gold and Calibre Mining’s acquisition of Fiore Gold. This pattern will continue, and we intend to be a part of this process, either as predator or prey, depending on how we advance in the next 12-24 months.”

- Brandon Bonifacio, CEO, NevGold Corp.



“Our next phase of activity will include furthering exploration to expand the resource base as well as put the Bell Mountain project into production. According to our estimations, we should be putting a small heap leach into production by the end of 2022.”

- Ron Netolitzky, President, CEO & Director, Eros Resources



Lithium Exploration and Development

Nevada lithium to secure US supply chains

Not only is Nevada home to the only lithium producer in the US, but the state has also seen a massive increase in “white oil” exploration in the past few years. As societies move towards electric vehicles (EVs) and the US government seeks to secure the domestic supply chain of critical minerals, exploration in this sphere is booming. According to the Nevada Division of Minerals, as of December 1st, 2021, an estimated 10,989 active placer claims had been located in Nevada, presumably for lithium brine in 18 different hydrographic basins.

Nevada currently hosts two of the most advanced pre-production lithium projects in the US. Not far away to the west of Albemarle’s Silver Peak mine, ioneer’s Rhyolite Ridge Lithium-Boron project is expected to start production in late 2024. A definitive feasibility study (DFS) was completed in April 2020, which confirmed Rhyolite Ridge as a world-class lithium and boron project that is expected to become a globally significant, long-life, low-cost source of lithium and boron vital to a sustainable future. “The DFS confirmed our ability to produce approximately 22,000 mt/y of lithium carbonate or lithium hydroxide, and 174,000 mt/y of boric acid, for 26 years,” explained Bernard Rowe, managing director of ioneer.

Rhyolite Ridge will be an open pit mine, which will extract both lithium and boron from sedimentary rock using sulphuric acid. According to Rowe, the project will become the lowest-cost lithium mine in the world; this is because boron will account for about 30% of the project’s revenue and cover approximately 70% of the costs.

If everything goes according to plan, ioneer will start construction in the second half of 2022. Then, it will undergo a two-year build period, in which the company will effectively transition from a developer to a producer, starting to contribute to the growing lithium demands of the country. “While our project will quadruple lithium production in the US from 5,000 to 27,000 mt and make a substantial contribution, we will still need 20 projects like this one to reach the expected demand,” Rowe pointed out.

Near the Oregon border, the Canada-based Lithium Americas also expects to transition from developer to producer soon. The company’s Thacker Pass, an advanced-stage lithium development project, received a Record of Decision in January 2021 from the US Department of the Interior Bureau of Land Management (BLM) and by the end of the first half of 2022, expects to have all permits and appeals cleared, news on the partnering and financing process, and engineering work completed.

In October 2021, Lithium Americas updated Thacker Pass’ measured and indicated resource, which was close to 14 million mt. “This is the largest resource in North America by far at this point,” expressed Jonathan Evans, president, and CEO of Lithium Americas.

The project’s production capacity is designed to reach 60,000 mt/y of battery-quality lithium carbonate and a 46-year mine life.

Another company that is progressively gaining terrain in Nevada’s lithium arena is American Lithium, which is advancing its Tonopah Lithium Claims (TLC) project, located near the town of

Tonopah in Nevada, in the same geological environment as Albemarle’s Silver Peak lithium mine.

In 2020, the company announced a large initial resource estimate, including 5.37 million mt lithium carbonate equivalent (LCE) in the measured and indicated category as well as 1.76 million LCE in the inferred category. In January 2022, American Lithium reached a major milestone when it received the approved Plan of Operations and reclamation permit approvals to commence drilling at TLC, enabling the launch of a major development program. “Our near-term goal is to engage a firm to carry out a PEA in the first quarter of 2022. We have started evaluating in-depth recovery methods, and since we have multiple economical extraction options, we are in the process of deciding which one is the best,” stated Michael Kobler, CEO.

Addressing environmental concerns

As the US aims to encourage domestic production of lithium and other critical minerals, companies seeking to develop lithium reserves on public lands are often faced with permitting challenges and opposition from stakeholders. In Nevada, plans to establish lithium mines have often encountered a surge of resistance from tribes, ranchers, residents and activists who argue that the repercussions of lithium mines will outweigh lithium’s contributions to the nation’s transition to less-polluting energy sources than fossil fuels.

This has been one of the major setbacks for Lithium America’s Thacker Pass. For almost eight months, environmental and tribal activists have been protesting against the construction of the mine, significantly delaying the company’s plans. Opposition stemmed from the project’s expedited approval, which opponents argue did not include a thorough enough environmental impact statement and minimized its environmental consequences.

Companies looking to establish lithium mines in Nevada are therefore designing their projects in a way that can minimize their environmental footprint. ioneer, for example, decided to take



Image courtesy of ioneer

a different approach to most lithium brine operations which use evaporation ponds. To concentrate the lithium, the company will leach the lithium out of the rock and then concentrate it in sealed tanks by heating and evaporating the water. “As the steam comes off, we will capture this steam and condense it back into water. This way, about 50% of all our water will be re-circulated,” Rowe explained.

ioneer will also power the entire operation through a sulphuric acid plant, eliminating the need of connecting the mine to the grid, gas pipeline, or other energy sources. The plant will convert

sulphur into commercial grade sulphuric acid, used to leach lithium and boron from the crushed rock. The heat released in the process will be recovered to produce steam for electricity, resulting in zero CO2 emissions.

Similarly, Lithium Americas has identified ways to reduce water consumption by approximately 50% through extensive recycling. The company has also proposed a heat recovery system designed to turn waste heat into carbon-free electricity, generating power for the mine and chemical processing facility. In the long term, Lithium Americas’ goal is to achieve carbon neutral



When you compare the lithium market to the gold or oil market, it is still relatively small despite unprecedented growth. The fundamentals underlying the lithium narrative have coalesced recently in a short period of time, however, which is exciting for the future.

– Emily Hersh,
CEO,
Luna Lithium



operations at Thacker Pass. “In terms of air emissions, we utilize the best available control technology that allows us to emit less than 50 tons per year, making us one of the best plants in the US,” stated Jonathan Evans, president and CEO.

Despite innovative measures to reduce the negative environmental impact of lithium extraction, the ongoing litigation and protests at the Thacker Pass illustrate the debate surrounding lithium operations in Nevada and future proponents can anticipate similar challenges. In addition, Nevada’s permitting process is lengthy and raises a multitude of issues with water, air, wildlife and cultural resources, which means it takes many years to put lithium mines into production. Though Nevada has a remarkable lithium potential, these issues raise serious questions about the ability of the US to keep up with its growing lithium demand and electric dreams. ■

Could you provide an overview of Lithium Americas and its project portfolio?

Lithium Americas is an advanced stage developer focused on bringing lithium projects to production. We have projects in both the USA and Argentina that offer various types of lithium resources. We have a joint venture for our Cauchari-Olaroz project in the Jujuy province of Argentina that is expected to be in production in 2022. We also recently acquired the Pastos Grandes project in Argentina. In Nevada, Lithium Americas owns 100% of the Thacker Pass project, which contains the largest known lithium deposit in North America and has a Record of Decision in hand. The asset is an unconventional source of lithium from a sedimentary deposit, which is basically a lithium-rich clay. Here, we have successfully put together a pilot plant that extracts the lithium from the underlying ore before converting it to lithium carbonate or lithium hydroxide. We have started discussions regarding financing Thacker Pass and are awaiting state-level permit clearances. By the end of the first half of 2022, we plan to have all permits and appeals cleared and updates on our partnering and financing process.

What is the current mineral resource estimate for Thacker Pass?

In October 2021, we updated Thacker Pass' measured and indicated resource, which was close to 14 million tonnes, the largest in North America by far at this point. That only included a portion of the property, and we will continue to conduct exploration. The potential scale of the project allows for a long mine life and high levels of production for decades.

Can you tell us about the capabilities of your integrated pilot plant?

We built a pilot plant in 2019 that has been operating continuously since. We have made tons of lithium sulfate, the intermediary product before processing lithium carbonate or hydroxide. As we prepare to formally apply for Department of Energy grants for our novel deposit and extraction techniques, our plan is to place the entire processing circuit under one roof. We have leased a new facility in Reno and are currently in the process of moving the existing pilot



Jonathan Evans

President & CEO
LITHIUM AMERICAS

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In Nevada, Lithium Americas owns 100% of the Thacker Pass project, which contains the largest known lithium deposit in North America and has a Record of Decision in hand.
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plant over, as well as transporting equipment from our vendors to the site. This will allow us to continually optimize the process and train operators during the construction phase.

What extraction techniques will you use at Thacker Pass?

The geology is unique in that it lends itself to off-the-shelf conversion technology. The material was originally formed as sediment at the bottom of an ancient volcanic lake, and we are returning it to its natural state by putting it back in a solution. We then put it through a hydro cyclone, and via particle-size separation, we can take the cut containing the highest concentration of lithium, with no crushing or calcining required in the process.

How does Lithium Americas incorporate the theme of sustainability into its operations?

First, we will not develop anything in the mountainous area of our Nevada property and will only conduct operations where the environment is a poor habitat for wildlife. In terms of operations, our open pit is shallow at 300 feet, and during the

course of the mine we will conduct concurrent reclamation. At any point, only 35% of the pit will be open. Basically, we take the material out, sift it, then put it back into the ground. This whole supply chain process occurs on-site, including a co-located sulfuric acid plant that naturally generates considerable heat, to provide enough power for most of our needs. We will get supplemental power from hydro or geothermal sources, with the goal that power used at Thacker Pass will be carbon neutral. Additionally, we minimize our water usage through recycling and reuse. We use around 100 liters of processed water per second, which is less water intensive than comparable operations. In terms of air emissions, we utilize the best available control technology that allows us to emit less than 50 mt/y, making us one of the best plants in the US. Lithium Americas has gone beyond regulatory requirements to minimize our footprint. We even considered how to minimize the impact of the design and color of our buildings on the natural landscape. We take the same approach to engaging with the local community — looking to invest into sustainable growth that attracts people to stay long-term. ■

Can you provide a brief overview of your Rhyolite Ridge project?

Ioneer owns the Rhyolite Ridge lithium-boron project, located in Esmeralda County in Nevada. We are the most advanced pre-production lithium project in the US and will soon become the lowest cost lithium producer in the world. This will be made possible because the boron will account for about 30% of the project's revenue and cover approximately 70% of the costs.

What were the main findings of the Definitive Feasibility Study (DFS) completed in 2020?

The DFS concluded that we would develop an open pit mine operation. We have a hard rock deposit, and we will use conventional mining methods to extract the rock. That rock will be processed on-site to extract the lithium and boron from it. Then, these will be refined and processed to make the end-product lithium chemicals at the site, which is very unique among hard-rock operations around the world. The DFS also confirmed our ability to produce approximately 22,000 mt/y of lithium carbonate or lithium hydroxide, and 174,000 mt/y of boric acid for 26 years.

How did Ioneer's pilot plant help to understand the most effective way of processing the boron-lithium ore?

We constructed a full simulation pilot plant, where we reproduced each part of the process from the rock to the end product. Rather than using new technology, we adopted technologies from existing copper, lithium and boron mining operations, bringing them together in one process plant to suit our unique deposit. We decided to use a large-scale pilot plant instead of working with small samples in a lab because this allowed us to observe how things will behave more precisely at commercial scale, without large variations.

What measures have you taken to reduce the environmental impact of the mine?

Considering we will produce over 20,000 mt/y of lithium chemicals, we have achieved an extremely small mine footprint through several initiatives. Firstly, with regards to water, we de-



Bernard Rowe

Managing Director
IONEER

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We are the most advanced pre-production lithium project in the US and will soon become the lowest cost lithium producer in the world.
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cidated to take a different approach to most lithium brine operations which use evaporation ponds; to concentrate the lithium, we will leach the lithium out of the rock and then concentrate it in sealed tanks by heating and evaporating the water. As the steam comes off, we will capture this steam and condense it back into water. This way, about 50% of all our water will be recirculated. Secondly, we will power the entire operation through a sulphuric acid plant. The plant will convert sulphur into commercial grade sulphuric acid, used to leach lithium and boron from the crushed rock. The heat released in the process will be recovered to produce steam for electricity, resulting in zero CO2 emissions. Finally, our operation will not need tailings dams since our residue material is suitable for dry-stack storage.

Ioneer recently reached an agreement to establish a joint venture with Sibanye-Stillwater. What does this arrangement entail?

Rhyolite Ridge will be a sizeable project with a long mine life, a large capex and ongoing capital requirements. Therefore, our board decided to bring in a strategic partner. Sibanye-Stillwater will contribute US\$490 million for a 50% in-

terest in the JV, while Ioneer will maintain a 50% interest and retain operatorship. The US\$490 million represents about 60% of the capital required to build the project and the balance will be funded through debt. Separate to the joint venture, Sibanye has invested US\$70 million directly into Ioneer by way of a share placement. This partnership essentially de-risks the funding required to build this project.

What can we expect from Ioneer in the coming months?

Over the next 6-12 months, we will finalize permitting and the detailed engineering. Our offtake agreement on the boron has already been completed, so we will work on finalizing the offtake agreements for lithium. We currently have a binding lithium offtake supply agreement with EcoPro Innovation for about a third of our production. EcoPro is one of the largest cathode manufacturers in the world and is planning to have production facilities in the US, Europe and Korea. We will continue building our team and expect to commence construction in H2 of 2022. Then, there will be a two-year build period, in which Ioneer will transition from a developer to a producer, with the first production beginning in late 2024. ■



“In the 1970s, low grade was considered 3g/t. Even 7-8 years ago, low grade was 1.5g/t. Today, there are many mines working at 0.5g/t. Therefore, continuing technological innovation is needed in process design, in hardware to more inexpensively process the ore, and in software to ensure efficient process control.”

– Daniel W. Kappes,
President and CEO, Kappes,
Cassiday & Associates

ENGINEERING AND MINING CONTRACTORS

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Image courtesy of Coeur Mining

A Hub for Mining Engineers

Water and the environment

Water is an especially precious commodity to the driest State in the US. Operators have to be mindful of not simply the amount of water they use but also where that water goes — mine drainage of metal-rich water can contaminate drinking water, harm regional plant and animal life, and create acid runoff strong enough to corrode infrastructure. As the industry at large strives to alter its public image to being a steward of the environment, water usage plays a critical role in the transformation. Environmental consulting firm Broadbent & Associates operates in Nevada to help mining companies comply with State regulations regarding the protection of groundwater. “Mine sites need to obtain water pollution control permits, which are focused on the protection of the water resource,” explained VP and principal engineer Randy Miller.



An important challenge that the industry will face going forward is the allocation of water. How to share and maintain available water to keep the industry growing will become a very strong component in the decision-making processes.



– Scott G. Britton,
Manager – US,
Mining Plus



The company assists in sampling and testing in addition to remediation work on contaminated water or cleanup projects to help with closure of legacy mines.

Tierra Group’s hydrologists, hydrogeologists and hydrochemists are adept at dealing with the balance, storage, distribution and treatment of water in Nevada, and specializes in the construction of tailings to ensure toxic waste does not contaminate water supplies. Founder and principal engineer Pete Kowalewski

explained the case of mine closures: “Often, when dealing with a tailings facility or water storage facility the closure is two-fold. You have to go through the actual closure process with the environmental regulatory body in the State of Nevada, NDEP, as well as the division of water resources. There, you have to do a dam decommissioning project to ensure that the facility is no longer able to impound water.” Forsgren Associates applies its 60 years of civil infrastructure experience to designing mines, including water plans. “Mines are typically remote, and like cities, require their own infrastructure for drinking water, wastewater processing, and storm water management,” explained VP and director of mining services Alan Driscoll. “Nevada is fairly dry, and the water does not behave well — it is usually not present where you need it, present where you do not want it. Additionally, mines are dynamic in nature. As a result, strategies for managing water at a given site are constantly in flux,” he continued.

Heap leaching

Heap leaching has become a popular processing method as its lower cost can boost the economic viability of a project. While it requires less energy, heap leaching raises certain environmental concerns as the release of toxic fluids into the surrounding environment can cause devastating effects. Kappes, Cassiday & Associates (KCA) is a pioneer in precious metals heap leaching. According to CEO Daniel Kappes, the Bureau of Mines in Reno developed the process in the late 1960s, and KCA built its own technologies based off those developments. Today, KCA works primarily with exploration companies, providing laboratory testing and feasibility studies in addition to its engineering services. “Heap leaching sounds like a simple process, and people tend to think it simply involves piling rock up on a pad, sprinkling it, and waiting for the gold or silver to magically come out. In practice, the process is much more complex,” he said. “The key to heap leaching is the heap itself, so essentially, we advise our clients on how to prepare the ore and construct the heap so it stays uniformly permeable,” said Kappes. As mines expand, producers will sometimes invest in upgrading their heap leach facilities as a means to boost production capacity. As a demonstration of magnitude, Coeur Mining awarded Canadian-based SNC-Lavalin a US\$30 million contract to provide construction management at its Rochester mine. The plan calls for more than doubling the site’s annual crusher throughput to over 28 million tons, making it not only Coeur’s largest mine but also its biggest expansion project. A key component of the scale up is engineering a new heap leach pad. As operations continue to expand, it is expected that heap leaching facilities will only continue to grow.

Technological innovations drive growth

As mining techniques become more complex, engineering and consulting companies are implementing innovations to maximize efficiency. International mining consultancy firm SRK Consulting’s corporate consultant Jeff Parshley describes the company’s most demanded services “involve helping clients with the necessary technical and scientific studies to support permitting or design.”

SRK Consulting uses 3D modeling software along with statistical and geostatistical methods to look at the structural setting and commodity distribution of ore deposits. In using datasets to better pinpoint targets, the company is able to improve the accuracy of operations and allows producers to make their operations more airtight. Kappes of KCA sees a need to improve gold recovery in order to make lower grade ores economically viable. He pointed to the need for innovation not only in hardware that makes it more expensive to process ore, but also in software that ensures efficient process control. “For instance, in mining pits, blast hole locations are set by computers which then employ GPS technology to accurately position the drill, and the explosives are carefully tailored so that the rock does not spread very far,” he explained. Mining Plus is another global mining services provider that believes that its utilization of technology is a differentiating factor: “One of the biggest added values of Mining Plus is that we focus primarily on design and engineering work through our extensive experience with computer modeling and our ability to efficiently evaluate these computer models for mine designs,” offered manager – US, Scott Britton. The company has its own in-house Mining Knowledge Database that it implements in conjunction with its geological and geotechnical engineering skills to provide tailored results based on a project’s specific needs. ■

KCA
Kappes, Cassiday & Associates

EVERY HEAP IS DIFFERENT.

We’ve designed and built heap leach projects since heap leaching was first developed in the early 1970’s.

There are still a lot of failures – due to permeability, heap stability, or lack of respect for the topography – KCA can ensure that your heap starts up quickly, and works as designed. We are not just design engineers – we acted as EPCM contractors on the heaps in these photos – if you want experience and innovation on your side, call us for your next project.

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Could you introduce KCA and provide an overview of its main mining services?

KCA has been providing metallurgical services to the mining industry since 1972. Our 65-person staff in Reno provides laboratory testing, feasibility studies, and engineering services. We design process plants and provide construction management or turnkey construction. On our largest project, we had a contract for US\$140 million to design and manage construction of a 4,500 mt/d gold leaching plant. Our primary clients are exploration companies, which usually request our services about halfway through their exploration programs. We run laboratory tests to determine what kind of treatment to use on their orebodies and work with them to guide the exploration program to develop the tons and grade of ore that can make an economically successful project.

Can you tell us about KCA's extensive expertise in heap leaching?

In the late 1960s, the Bureau of Mines in Reno developed this process. We learned from them and developed numerous techniques of our own, and today, we are primarily known for our expertise in this field.

Heap leaching sounds like a simple process, and people tend to think it simply involves piling rock up on a pad, sprinkling it, and waiting for the gold or silver to magically come out. In practice, the process is much more complex. A heap leach is a mill, and the ore must be processed in such a way that the target return on investment is achieved. The key to heap leaching is the heap itself, so essentially, we advise our clients on how to prepare the ore and construct the heap so it stays uniformly permeable.

How are different technologies improving gold recovery in a context of scarce gold worldwide and high gold prices?

In the 1970s, low grade was considered 3 g/t. Even 7-8 years ago, low grade was 1.5 g/t. However, today, there are many mines working at 0.5 g/t. Therefore, continuing technological innovation is needed in process design, in hardware



Daniel W. Kappes

President & CEO
KAPPES, CASSIDAY & ASSOCIATES
(KCA)



Most of our current Nevada activities involve preparing feasibility studies for clients or advising them on how to improve their existing operations.



to more inexpensively process the ore, and in software to ensure efficient process control. For instance, in mining pits, blasthole locations are set by computers which then employ GPS technology to accurately position the drill, and the explosives are carefully tailored so that the rock does not spread very far.

KCA recently developed an innovative piece of equipment called the KCA Carbon Converter. What was the motivation behind its creation?

Companies often use activated carbon as part of the gold recovery process, and create a lot of dirty, gold-bearing fine carbon. Often it contains mercury and so it is risky and expensive to ship it off site for processing. We saw a strong need for equipment that could process this material. We developed the Carbon Converter, which we believe can increase recovery at many mines by up to 2% at very little additional cost. It is a modular, self-contained unit, which burns the fines very slowly and completely. Dirty-wet carbon fines are fed directly into the roasting chamber, and the resulting ash is fully captured as a dry product. A three-stage exhaust scrubbing system fully captures mercury. This allows the recovery of up to 99% of gold and silver. To date, we have installed four of these plants commer-

cially in Argentina, Armenia, Nevada and Mexico.

Could you elaborate on KCA's expertise in silver processing?

In terms of silver processing, we are experts in heap leaches and agitated plants. Many of the large plants we have built for Mexican operations contain 50:1 silver:gold ratio. We have built and operated a very complex hot chloride leach for a silver ore in Bolivia, and developed a very innovative flowsheet to recover silver, copper and manganese from an orebody in Peru.

What type of projects are you currently working on in Nevada?

Most of our current Nevada activities involve preparing feasibility studies for clients or advising them on how to improve their existing operations. We have recently built and installed two modular laboratories, and we have been providing several operations with laboratory and engineering support. We also tend to work on a couple of lithium projects at any given time. One of the more interesting projects involved testing for Ioneer's Rhyolite Ridge lithium-boron project, which has a rather unique type of ore, and which should develop into a very successful operation. ■



PS



RD

Patrick Sikka & Ryan Dutrisac

PS: Vice President and General Manager, North America, Mining and Metallurgy
RD: Project Director
SNC-LAVALIN

Can you introduce SNC-Lavalin and explain how the company entered the Nevada market?

PS: SNC-Lavalin's Mining and Metallurgy group works across five key markets – Canada, US, Québec, Peru, and Brazil. The type of projects we undertake range from small studies through to full EPCM projects. We are very active in plant engineering and assisting clients with upgrades and expansions of their existing facilities across North America. In addition, our specialized Sustainable Mining Group works on projects related to tailings management, water treatment and mine reclamation. We also perform a significant amount of front-end study work to help clients develop projects.

The mining industry in Nevada has seen tremendous growth, most notably in commodities such as gold and silver. We currently have two ongoing projects in the region – the Rochester POA11 project for Coeur Mining and the Rhyolite Ridge lithium-boron project for Ioneer. Nevada is an important region for us, and we aim to continuously expand our business within the state and throughout the southwest.

Can you elaborate on SNC-Lavalin's role at the Rochester POA11 project?

RD: We started working on the Roch-

ester POA11 project in 2019 when we were awarded a gap analysis mandate. The gap analysis integrated the engineering performed by the various appointed service providers under one set of specifications, procurement policies, standards, systems, and procedures. In Q2 2019, we started with detailed engineering. One of our key strategies was to substantially complete engineering and award all equipment packages prior to starting construction. Early construction began in August 2020, and we were awarded a full EPCM contract two months later. Today, construction continues at the site with heavy earthworks and concrete activities.

Another key strategy for us on this project was to engage local vendors and service providers.

How did the pandemic impact SNC-Lavalin's operations?

PS: Most of the engineering work for the Rochester POA11 project was performed during the pandemic and we had to quickly adapt to working remotely as of March 2020. I am proud to say that our team adjusted very well, performing the engineering on schedule and on budget. Our 3D integrated engineering platform, SmartPlant, offers a live environment to work in, whether in the office or at home. Everyone has re-

al-time access to engineering progress and can interact in a live 3D model with various engineering disciplines, making it easy for us to adapt to a remote working environment. We also had daily virtual meetings with staff and teams to check that everything was progressing according to our engineering schedule. RD: In the past, when we ordered equipment, we would send our engineers to the vendors' factories and shops to inspect equipment. This was not possible during the pandemic due to mobility restrictions, but we mitigated this challenge with Go Pro cameras where the vendor would video-record the equipment for us, and we could perform virtual inspections. Many of our vendors have set up virtual platforms for inspections and testing, which is a great advantage because more of our engineers can participate instead of only one engineer being sent to the factory.

SNC-Lavalin was recently awarded an engineering and design contract for the sulfuric acid plant at Ioneer's Rhyolite Ridge boron-lithium project. Can you tell us about this project?

PS: The sulfuric acid plant SNC-Lavalin is designing for Ioneer is based on industry leading MECS sulphuric acid plant technology from DuPont Clean Technologies, with whom we have a long working relationship. This project will be one of the largest producers of lithium in the US; a resource that is extremely important to the battery market. We are providing engineering and procurement services for a 3,500 mt/d sulphuric acid plant that provides acid for the vat leaching process. We are proud to be supporting Ioneer on this project and to be implementing a world-class sulphuric acid plant that focuses on long-term sustainability.

What is SNC-Lavalin's growth strategy in the US?

PS: The market has great areas of growth opportunities in a variety of commodities, specifically those that support the EV battery market. We are also becoming increasingly involved in projects that include emission reduction and recyclable material feeds; we can help our clients reach their environmental and sustainability goals. ■



It is essential to use technologies in new ways to make operations safer and more efficient.



Dagny Odell

Owner
PRACTICAL MINING LLC

What was your vision behind the creation of Practical Mining?

After having worked for several different mining companies in Nevada and in Colorado, I started Practical Mining in 2005. Practical Mining was founded to provide geologic and mine engineering services with the goal of maximizing the value of mineral resources and mineral reserves. The company has two full time employees plus numerous professionals that we have worked with in the past and can draw on if the project requires their area of technical expertise.

Could you elaborate on Practical Mining's geologic and engineering services?

We do a considerable amount of mineral resource work, especially geologic modeling and mine planning. NI 43-101 and SK-1300 reports make up a large percentage of our work. We also perform a lot of scoping study type work, either on the geology or the mine engineering side. Mine planning work includes both underground and surface methods.

Can you tell us about the company's expertise in underground mining and comment on the main trends you are observing in Nevada?

In the 1980s and 1990s, explorers were searching for open-pit oxide heap leachable deposits, and most of them did not drill beyond 500-feet. Below 500-feet the mineralization transitions

to refractory and extensive dewatering is nearly always required. Today's mines are reaching below that level and geologic modelling and mine planning need to take both of these into consideration. Mining in Nevada, at any depth, has always had to deal with poor ground conditions. Practical Mining has years of experience dealing with these conditions and can incorporate methods to safely manage them into the selection of mining methods, detailed mine planning and accurate cost estimates.

Can you provide an example of Practical Mining's technologies to improve safety and efficiency underground?

I believe the key to survival in the mining industry is innovation. With increasing regulations and technical difficulty, it is essential to use technologies in new ways to make operations safer and more efficient. At Practical Mining, we have purchased LIDAR scanning technology from the Australian company Hovermap. It can be deployed as handheld, mounted on a vehicle and on a robotic drone. The drone can fly into inaccessible underground excavations, out of line of sight and communication range and automatically return to the home point. It continuously maps its location and recalculates the path to return home.

What are some of your recent projects in Nevada?

We have worked with Premier Gold

Mines and i-80 Gold on the McCoy-Cove project for nearly eight years helping them to advance the project from a Resource Estimate to the pre-feasibility stage. We have produced 43-101 technical reports on the McCoy-Cove and South Arturo projects. We are also supporting clients with due diligence work when considering mergers and acquisitions.

Recently, we have been doing a lot of work for Small Mine Development and First Majestic Silver at the Jerritt Canyon mines where we have been exploring new ways of using our LIDAR scanning equipment. Jerritt Canyon requires a large amount of RC drilling to define the resource prior to mining. Using LIDAR scanning, we are able not only to map the collar location, but it can see up to 10-feet down the hole allowing us to measure the bearing and plunge as well. We have scanned several hundred holes in half a shift. This used to require two surveyors and a lift to reach the holes in the back. Using the LIDAR saves time, is safer and more accurate.

Can you tell us about your approach to safety?

Safety in mining starts early in the design stage and continues through reclamation. We incorporate safety considerations in our design work, selecting the most efficient and safest mining methods. Usually, that translates into the most cost-effective method as well.

What makes Practical Mining stand out in the competitive sphere?

We are a small company, which allows us to provide personalized service to our clients. The majority of our clients are repeat customers whom we have worked with on multiple projects over the years. Our reputation is everything and new clients come to us through recommendations from our existing client base.

What are Practical Mining's priorities moving forward?

We will continue to provide quality work on a timely basis to our clients and keep looking for ways to improve our work. We need to find ways to apply technology to make mines more efficient and safer. ■



Alan Driscoll

VP, Director of Mining Services
FORSGREN ASSOCIATES

Could you provide a brief introduction to Forsgren Associates?

Forsgren Associates is a consulting firm that provides engineering, environmental, construction and management services. Within the mining industry, we

primarily help with civil infrastructure projects. Mines are typically remote and require their own infrastructure for drinking water, wastewater processing and storm water management, along with roads, bridges, and other facilities. This is where Forsgren comes in.

What do Forsgren's activities in Nevada's mining industry look like?

We recently helped a Nevada gold mine improve the efficiency of its water management by providing engineering and permitting support to consolidate the operations and compliance for previously separate systems at two mines. We helped another gold mine with a major de-watering project by developing a simplified design with cost-effective materials and methods to keep costs down while still meeting the project goals. As a final example, we helped another gold mine with design and permitting of their water system as they ramped up for operation.

Forsgren has invested considerable time and effort into understanding the regulatory requirements and processes for

mining in Nevada, and consequently. As a result, we excel at helping operators plan, design, build, and permit their infrastructure projects efficiently and cost-effectively.

In terms of water management, what are the main challenges present in Nevada? How does Forsgren help overcome them?

Nevada is fairly dry and the water does not behave well — it is usually not present where you need it, present where you do not want it, and very difficult and expensive to move from one place to the other. Additionally, mines are dynamic in nature. As a result, strategies for managing water at a given site are constantly in flux.

What services does Forsgren offer for mine reclamation?

Forsgren's reclamation work ranges from GIS work for calculating bonds, to environmental and engineering work for remediation of historic hydraulic mining sites, to construction services for habitat restoration work. ■



Pete Kowalewski

P.E. Founder & Principal Engineer
TIERRA GROUP INTERNATIONAL

Can you introduce Tierra Group?

Tierra Group offers highly focused engineering services, specializing in mine waste management and water management. Our primary focus is tailings, but

we also do work on heap leach facilities, waste rock management facilities, and more traditional water storage facilities. We have three offices in the US – Colorado, Utah and Nevada – and an office in Lima.

What is Tierra Group's expertise related to water resources?

Most of the work Tierra Group has done is related to developing overall water management plans, including developing water balances for tailings facilities as well as providing surface water management designs. We have prepared large diversion project designs and the company has also designed lined ponds for water management.

Could you point to some of the projects Tierra Group is currently working on in Nevada?

Tierra Group works with a number of clients in Nevada, including Nevada Gold Mines, Hecla-Klondex, Fortitude Gold, National Oilwell Varco, and Florida Canyon Mining.

Can you elaborate on Tierra Group's expertise in mine closure and reclamation?

We have provided closure services for a wide range of clients in Nevada, for waste rock facilities, heap leach facilities, and tailings facilities requiring closure. Often, when dealing with a tailings facility or water storage facility, the closure is two-fold in that you have to go through the actual closure process with the environmental regulatory body in the state of Nevada, NDEP, as well as the division of water resources where you have to do a dam decommissioning project to ensure that the facility is no longer able to impound water. We also provide services for closure cover design over the tailings as well as surface water management to ensure meteoric water is effectively and efficiently removed from the facility, providing a physically and geochemically stable facility in the long term. This includes the engineering design and monitoring plans to ensure long term performance. ■

Underground Contractors

Out of sight, not out of mind

Underground hard-rock mining accounts for 40% of the world's mining activities, but only 12% of run-of-mine production, according to consulting management firm McKinsey & Company. The majority of surface-level ores have already been mined, so forward-focused jurisdictions like Nevada are increasingly investing in underground mining methods with the hopes of improving productivity and costs associated with the processes.

Deep rock mass can be categorized by its high in situ stress, high temperature, and high water pressure. Additional technical and safety considerations are required to help prevent the risk of disasters like rock-bursts, squeezing and creeping rocks, and redistributed stresses. Importantly, each mine also has its own distinct geographical considerations that largely determine extraction methods. For these reasons, selecting the right underground contractor to provide the necessary technical acumen is of paramount importance to keep an underground mine safe and economically viable.

New technology makes underground drilling more attractive

In Nevada, underground contractors are partnering with mining companies to develop more efficient ways of mining deeper. Nevada Copper brought on mining contractor Redpath USA for a long-term contract to help with the ramp-up strategy at Pumpkin Hollow. The copper mine, which also yields gold, silver and iron, utilizes a mechanized transverse longhole mining method to help simplify stope sequencing along with cemented paste fill (CPF) methods. With its processing facility now in production, Pumpkin Hollow is expected to reach 3,000 mt/d by the end of the second quarter of 2022.

Small Mine Development (SMD) has carved a name for itself in Nevada's underground

drilling sector. SMD has partnered with Nevada Gold Mines on several of their underground operations. SMD helped establish the requisite infrastructure at the Leeville mine, a gold mine that is part of the Carlin Complex, by installing bulkheads and long-term ground support. The Carlin Complex is also home to the Goldstrike and Portal underground mines, and all three use drift and fill, long-hole stoping, or both.

SMD's work with Nevada Gold Mines expands to its operations at the Turquoise Ridge Complex in the Potosi Mining District. Here, the complex includes the Turquoise Ridge and Vista underground mines as well as surface pit operations. As the holder of the largest gold assets in the country, Nevada Gold Mines is setting the pace for its competitors to follow suit in conducting operations deeper underground.

The popularity of SMD's services proves just how desirable underground mining is becoming in Nevada. Within recent years, the underground contractor has worked with a variety of other companies including First Majestic at its SSX and Smith mines, i-80

Gold Corp, Sabre Gold, and Jervois. The contracting company's general manager Keith Jones attributes this activity largely to the cost of gold, but sees broader potential applications of Small Mine Development's services in the region: "Underground mining services are currently a significant revenue generator since there is considerable expansion in the gold sector due to the favorable prices. We also see nearby growth prospects for battery metals."

Jones believes that in the present day, innovations for underground mining will increasingly be related to automation and electrification of operating machines. Redpath is undertaking a project to do just that — working on automating both the drill and blast processes of conventional shaft sinking. Being tested in Germany, the technology has the potential to eliminate workers at the shaft bottom as well as increase sinking performance. As the method of extraction gains more popularity, it is likely that more investment will go into improving electrification and automation of underground mining equipment. ■

SMD UNDERGROUND MINING CONTRACTORS

BUILDING AND OPERATING AMERICA'S UNDERGROUND MINES

<p>MINE DEVELOPMENT:</p> <ul style="list-style-type: none"> Portal/Highwall Construction Exploration and Development Ramps Underground Infrastructure Shotcrete High capacity ground support installation Reverse Circulation Definition Drilling 	<p>PRODUCTION MINING:</p> <ul style="list-style-type: none"> Longhole and Drifting Mining Methods Conventional Mining Methods With and Without Backfill Longhole Drilling Cellular Backfill Capability
<p>TECHNICAL SERVICES:</p> <ul style="list-style-type: none"> Mine Design & Engineering Underground Grade Control and Surveying Permitting Assistance 	

Contact: Keith Jones | kjones@undergroundmining.com | +1 775-635-8356
 Nevada contractor's license: NV 0048016
www.undergroundmining.com



The majority of our prime fleet runs on diesel particulate filters, which reduce emissions by 70% or more.



Keith Jones

General Manager
SMALL MINE DEVELOPMENT (SMD)

What is SMD's history in the mining industry?

SMD was founded in 1982 by Ron Guill, who had a strong vision for mechanized underground mining. Since then, our focus has always been on mechanized, lateral mining. A group of senior managers purchased the company from Ron in 2011. We recently embarked on our third chapter of ownership by creating a 100% ESOP, which means that SMD is currently employee-owned.

Can you provide some insight into SMD's service offering?

Our mission is to be the leader in safe, productive and innovative mining solutions, specializing in underground, hard rock mining. We carry out underground work in support of exploration efforts since companies sometimes require underground platforms for exploration drilling. Following exploration, our services are also relevant in the development phase as we create the various ramps and accesses to facilitate production mining. We also offer production mining including drift and fill, longhole open stoping and other mining methods for full-scale production. Finally, we maintain engineering, geology, and surveying capabilities in the company so we can assist with those disciplines as required. Underground mining services are currently a significant revenue generator

since there is considerable expansion in the gold sector encouraged by favorable prices. We also see nearby growth prospects for battery metals.

What are some of the current projects you are working on in Nevada?

One of our main clients is Nevada Gold Mines, who we work with on several operations, including Leeville and the Meikle-Rodeo complex, Turquoise Ridge, and the Vista underground mines, which are part of the Twin Creeks complex. We also have two operations with First Majestic, at the SSX and Smith mines. Some of our smaller clients include i-80 Gold Corp at Granite Creek, and Sabre Gold's Copperstone mine in Arizona. Finally, we are also starting up the Idaho Cobalt Operation with Jervois.

Cemented backfill was first used by SMD in 1984 and is now standard practice in Nevada. Can you elaborate on this method?

The cemented backfill method is particularly widespread in areas where ground conditions are not ideal. Consolidated rockfill allows us the flexibility to mine challenging areas from a ground support standpoint. It allows typically 100% extraction of the resource, assuming the resource is of sufficient value to support that. It is currently a standard practice in northern Nevada.

Can you share some of SMD's initiatives to minimize diesel particulate emissions (DPM)?

In 2007, we pioneered the use of diesel particulate filters in Nevada on our prime fleet. The majority of our prime fleet runs on these filters, which reduces emissions by 70% or more. As Tier 4 emission standards have been implemented, the use of bio-diesel has decreased dramatically. However, in certain instances, it can be a very effective way to reduce DPM.

We also have a DPM program as part of our preventative maintenance. The program involves using exhaust gas analyzers and measuring specific engine performance parameters. If certain indicators are out of compliance, we can then troubleshoot the machines, fix the specific problem, and get them back into compliance. We see this program reducing emissions substantially.

Additionally, we do operator training to ensure operational practices reduce DPM. This includes things like proper operation of the equipment to prevent lugging the engines or shutting them down when not in use to reduce idle time.

How do you see the future of underground mining?

Underground mining will continue to increase as surface resources become harder to find and companies drill deeper on the hunt for higher grades. This will be complemented with innovations in equipment and automation. Operating machines autonomously underground from the surface will rise. However, I do not think we will be able to completely remove personnel from the underground environment, because machines break down and they need monitoring. There are also jobs underground that simply cannot be performed from a remote area.

Electrification is another trend that will continue to gain traction. There have been some issues in implementation of battery technology since the energy density required for certain applications is very high. Petroleum is extremely energy-dense, and it has some inherent advantages with our energy intensive industry. Over time, as technologies evolve, electrification will continue to develop. There are areas where its application will make commercial and economic sense, but others where it will be more difficult to implement. ■



“There is an increasing demand and interest for automation and digitalization solutions in Nevada, although the adoption rate is still slightly slower compared to other parts in the world.”

– Jon Torpy,
President and General Manager – US,
Epiroc

EQUIPMENT, TECHNOLOGY & SERVICES

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Image courtesy of Epiroc

Equipment and Technology

Innovations reshape industry trends

A far cry from the days of sifting with a gold pan, today's mining equipment sector is increasingly technologically driven as companies strive to increase efficiency, lower costs and boost operational safety. As the industry advances, trends toward automation and digitization allow operators to maximize their productivity and safety while heightened environmental awareness drives efficiencies to lower carbon emissions. Within the Nevada mining community, the demand for more modern equipment has skyrocketed over the past few years. As Cashman Equipment president Mike Pack noted: "Technology is making a huge difference. About five years ago, our machines would sell themselves and they would sometimes be accompanied with technology. Today, we use technology to sell the machines. If technology is not incorporated, it does not matter how good the equipment is."

Automation and digitization take hold

The US mining industry did not embrace the shift towards automation with the same force as its counterparts in other countries such as Australia or certain parts of South America. While Nevada still lags behind other mining jurisdictions in the adoption of digitized solutions, renewed interest in the safety and efficiency potential of automated tools has spurred growth for equipment providers in the region.

After decades of operations, Nevada-based Caterpillar dealer Cashman Equipment has seen a shift in demand, with its autonomous and semi-autonomous solutions now serving as the company's most sought after equipment. The company's president attributes the rise in popularity to a variety of factors: "The vehicles never go off the road, they never get tired or crash, the fuel efficiency is phenomenal, and the availability of the trucks normally increases by 4-5% since they do not have the same stops as drivers. Today, America is seeing the results of these autonomous solutions and how they can lower operating costs."

In addition to vehicles, automation is redefining drilling operations by allowing companies to increase production while simultaneously lowering operating costs. KGHM's Robinson mine invested in Epiroc's Pit Viper 271 blast hole drill rig, part of the Swedish manufacturing company's broader line of automated drills designed to operate in extreme conditions. The Robinson mine saw a 34% increase in production capacity as well as heightened safety as the drill can be operated at nearly all hours of the day from a remote command center. Epiroc is also currently collaborating with Nevada Gold Mines to test how to best employ autonomous equipment within an existing mine environment. The future of digitally focused innovation within Nevada's mining industry will center around the strategic use of data. As many mines in the state have a wealth of information about their geo-



We are seeing an increase in interest for automated equipment, particularly amongst our senior clients. We like to consider ourselves the leader in this arena, especially with automated rod handling tools. Major Drilling has offered this type of machinery for nearly 20 years.

**- Kelly Johnson,
Senior Vice President of
Operations,
Major Drilling**



Can you provide an overview of Epiroc's presence in Nevada?

Epiroc has been present in Nevada for many years – our legacy goes back to companies such as Atlas Copco and Ingersoll Rand. The surface mining business used to be handled through a distributor and the underground business directly by us, however, we acquired the distributor a few years ago and today all the business in Nevada is transacted directly through an Epiroc company. The greatest demand in the region is for our equipment and consumables sales as well as support services, and we primarily service the gold and copper mines.

Can you tell us about Epiroc's new Exploration Competency Center in Elko?

Together with Fordia, an Epiroc company well known for exploration drilling tools, Epiroc opened an Exploration Competency Center in Elko in May 2021 to improve the customer experience for the US exploration market. The new center provides more flexibility and customer focus over the entire sales and service process. By bringing all exploration products and applications together, customers can expect a one-stop exploration solution for all products, parts and aftermarket service needs with greater efficiency and shorter lead times.

What are Epiroc's best-selling and fastest growing products in Nevada?

Epiroc sells both surface and underground mining equipment. On the surface side, we sell drilling equipment such as the Pit Viper drills, which have been part of the Nevada surface mining landscape for a long time. These drills have seen a great evolution in performance thanks to years of development and investment in the Pit Viper platform, and now we are exploring what we can do in terms of automation, digitization, and connecting these pieces together. Our Pit Viper range has fully autonomous capabilities and we have also ventured into automated hands-free bit changing. For the underground business, Epiroc has a complete range of drilling, loading and hauling equipment, with the same opportunities in terms of automation, connectivity, and systems integration.

We pride ourselves in having the availability of parts and services to take care



Jon Torpy

President and General Manager US,
EPIROC



We expect to start seeing more continuous mining methods in hard rock mining moving forward.



of our installed base in Nevada, ensuring that our clients can continue to operate at the high levels of utilization they require despite the current supply chain challenges. In addition, we have competency as application specialists to be a partner to our customers.

How do you see the rate of adoption of automation and digitalization technologies in Nevada's mining industry?

There is an increasing demand and interest for automation and digitalization solutions in Nevada, although the adoption rate is still slightly slower compared to other parts in the world. Epiroc has projects with Nevada Gold Mines and Robinson Nevada Mining Company where we are testing autonomous equipment and experimenting with the best ways to deploy these technologies in their operations. We have a continuous proof of autonomous projects contributing to productivity increase, but the key is to set it up for success in an existing mining environment so that it becomes the standard way of working rather than a special way of working within a standard operation.

Can you share details about Epiroc's battery powered equipment and how it can reduce the environmental footprint of mines?

When taking diesel underground, you must have an extensive ventilation plan, which becomes an inherently important part of the underground operation. Battery powered equipment changes this landscape, how you approach your equipment, and the overall design of your mine. Battery equipment is a cleaner solution and significantly impacts on how mines are designed from a ventilation point of view. From the safety perspective, the new electrics mitigate the risk of fire and overheating while reducing ventilation needs.

Do you believe that we will start seeing continuous mining methods in hard rock mining, or will the industry continue using "drill and blast" methodologies?

We expect to start seeing more continuous mining methods in hard rock mining moving forward. Epiroc has a continuous miner and has successfully implemented it in a few regions globally and will be running more trials in the US. The mine needs to be designed to accommodate a continuous mining setup, and our aim is to establish how we can make this method fit in an existing mining operation while ensuring the same or better efficiency and cost that would be relevant to a standard drill and blast method. ■

Cashman Equipment is celebrating its 90th anniversary in 2021. Can you provide an overview of the company's history?

Cashman Equipment was founded by "Big Jim" Cashman in 1931. At the time, Big Jim was an automobile dealer and was involved in the building of the Boulder (now Hoover) Dam. The story goes that he sold six Cat Model 60 Tractors to the project even though he was not a Caterpillar dealer. He then went to Caterpillar, based in California at the time, and asked the company if they would hire him as a dealer if he was able to sell their largest tractor order to date. That is how he landed the position. In 1961, his successor Jim II acquired a dealership in Reno called Crooks Brothers. When mining took off in Nevada in the late 1960s, Cashman Equipment took off with it, and we opened our Elko operation.

Today, the company is owned by MaryKaye Cashman and has 1,000 employees. Our four major locations include Elko, Winnemucca, Reno and Henderson, but we also have smaller operations throughout the state. While we work in several industries including the power and construction businesses, most of our revenue comes from mining activities.

What are Cashman Equipment's fastest-growing products and solutions at the moment?

The largest demand at the moment is for our autonomous and semi-autonomous solutions. We also see numerous requests for electrification and cleaner running machines. We are now ready to offer an UG electric solution in the next 12 months or sooner. In terms of surface mining, our clients are focused on reaching zero emissions.

Can you elaborate on Cashman's autonomous and semi-autonomous offering?

We offer remote controlled dozers which are excellent for slide-type or hazardous situations. In addition, our underground machines are semi-autonomous, meaning that they can be operated through a control board above the ground and even from another part of the world. It also allows operators to



Mike Pack

President
CASHMAN EQUIPMENT

↘↘
The largest demand at the moment is for our autonomous and semi-autonomous solutions.
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handle multiple LHDs at the same time. That technology will soon be fully autonomous, for both the LHDs and the trucks.

On the surface, we currently offer many safety enhancements. One of our standout solutions is the Driver Safety System, which allows machines to stop before collision occurs. We have not reached autonomy yet in Nevada, but we have a few pieces of equipment with strong potential.

How do you see the extent in the adoption of autonomous mining solutions in Nevada?

The US is not as far along in the autonomous path as countries such as Australia or certain parts of South America, but it is coming along well. Originally, many people thought that you needed to have a very high-cost operator to offset the cost of autonomy. For instance, a truck driver in a remote and rural mining project in Australia could easily cost US\$250,000 per year, which is why autonomous took off primarily in this type of place. In America, and especially in Nevada, autonomy did not seem to make as much sense since there are towns near the mines and the cost of labor is significantly lower.

However, once autonomy started to take off, mines began to realize the payback not only from offsetting the cost

of hiring a driver but also from the complete safety and efficiency the technology provides. The vehicles never go off the road, they never get tired or crash, the fuel efficiency is phenomenal, and the availability of the trucks normally increases by 4-5% since they do not have the same stops as drivers. Today, America is seeing the results of these autonomous solutions and how they can lower operating costs. The main challenge now is that OEMs have limited capacity and capability in this field, and they are encountering a huge demand, so they must prioritize.

What are Cashman's priorities moving forward?

We will continue to take care of our customers by listening to them, understanding their goals, and helping them lower their cost per tonne or their desired metric. In fact, we have a Continuous Improvement team that works for our customers. Nevada is in a strong position for future growth through lithium, boron, molybdenum and rare earths.

Additionally, Cashman Equipment will continue to be a very charitable organization. We will keep donating heavily to multiple Boys & Girls Clubs throughout the entire state, since one of our primary goals is the development of our youth. ■

Image courtesy of Barrick Nevada



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We are starting to again see more requests for site visits, but I expect this demand to never return to pre-pandemic levels due to digitization and virtual technologies available to us today.

- Cameron Barton,
President,
CGS Mining



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graphical holdings, global commercial manager of Hexagon, Lance McGinn, poses the query: "Most Nevada operations are already sitting on mountains of data, which raises the question – are we leveraging this information to its fullest extent?"

The mining software company is working on its comprehensive Power of One program that uses a cloud platform to integrate applications dealing with all aspects of the mine life, from claims and surveying to drill and blast operations, fleet management, and collision avoidance. McGinn sees digitization as the answer to many of the industry's current problems, stating: "Mines these days face enormous challenges, including volatile commodity prices and increasing pressures to be safer and more sustainable, with greater scrutiny from the authorities and stakeholders. Digital transformation is well accepted as an answer to these challenges."

Sharing the vision of a data-driven mining landscape, Komatsu is investing in its Mining Technology Solutions team to speed up its technological advancements. Notably, the company's Modular Mining subsidiary includes a product

line specialized in optimizing mine safety and efficiency through tracking data on equipment and operational productivity. Within the portfolio is Intellimine Synergy, an open-technology platform meant to serve as a single source of real-time information that can assist in optimizing decisions.

Lowering emissions for a greener future

As global attention increasingly shifts to environmental and sustainability concerns, many mining companies looking to minimize their carbon footprint are turning towards equipment that produce lower emissions. Equipment providers, in turn, are offering increasingly robust electronic and battery-powered product upgrades to essential mining machinery.

A recent study by the management consulting firm McKinsey & Company found that emissions from mining operations and related power consumption reach between 1.9 and 5.1 gigaton of carbon dioxide equivalent of greenhouse gases annually. While the bulk is generated from underground operations at coal mines, general power consumption from the extraction and refinery of metals is also a contributor. As industry stakeholders and multina-

tional coalitions increasingly pressure mining executives to respond, Nevada operators are taking stock. The Robinson mine purchased several electric drive trucks from Komatsu, as well as a 2650CX hybrid shovel which incorporates switched-reluctance technology that reduces fuel consumption and overall emissions, as part of its strategy for improving its environmental impact. Other equipment companies operating in Nevada are working to expand their electric-powered product lines. Sandvik provides a variety of electric and battery-electric vehicles to the region, particularly drill rigs and bolters, underground loaders, and mechanical cutting equipment including bolter miners, continuous miners, and roadheaders for hard rock. Cashman Equipment hopes to offer products for the electrification of underground mines within the next few years.

Finally, CGS Mining provides environmental efficiencies of a different kind — in providing more effective solutions for precious metals recovery. Its heater skid, for example, incorporates energy saving technologies in order to run on less. "Our teams' extensive experience and knowledge has led us to produce equipment that uses less carbon, consumes less acid and cyanide, and decreases energy requirements," explained president Cameron Barton. ■



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The Elko service center is one of the first combined operations between the Komatsu and Joy Global entities under Komatsu.

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Jason Ashby

General Sales Manager Mining
KOMATSU

Can you provide an overview of Komatsu's presence in Nevada?

In Nevada, Komatsu is present both in mining and construction, with the mining industry representing a major portion of our business. We have numerous electric drive haul trucks and electric shovels at the larger Nevada mines along with various mining size machines such as the mechanical drive haul trucks, HEX shovels, wheel loaders and dozers. Komatsu also has various construction size machines at several of our Nevada mining customer sites including with mining contractors and smaller construction type companies.

In February 2020, Komatsu opened its largest service center of North America in Elko. Could you give us some details about this new facility?

The Elko service center is one of the first combined operations between the Komatsu and the Joy Global entities under Komatsu. We decided to establish this facility in Nevada considering the state's rich mineral endowment. The purpose of this 150,000 square foot state-of-the-art facility is to serve Northern Nevada with all levels of service and parts support on the largest to the smallest of Komatsu machines. We anticipate to construct an additional warehouse facility in the coming years if we are able to obtain the necessary capital funding. That would potentially encompass additional 45,000 square feet of warehouse, increasing the total square feet of our facility to 190,000-195,000.

What are Komatsu's fastest-growing products in Nevada?

Our HD785 haul truck (100 ton) and WA800 and WA900 are becoming a popular combination for the smaller mining operations and mining contractors. Technology products are also in demand as mining operations want to be more efficient along with helping them to reduce their overall greenhouse gases.

Can you tell us about Komatsu's new Mining Technology Solutions team and provide some insight into the company's latest technologies?

In August 2021, we announced the creation of the Mining Technology Solutions (MTS) team, which brings together experts from across our businesses to focus on rapid technology advancement. This new business unit includes the Modular Mining brand, a Komatsu technology brand focused on real-time digital offerings that are compatible with all makes of equipment. For example, the MTS has been developing our new Intellimine Synergy open-technology platform. Its goal is to collect, integrate and process data in real time, offering customers a single source of actionable insights through an open-technology platform that brings together data from all relevant Komatsu, Modular Mining, and third-party machines, mining processes, systems, and technology applications. This solution seeks to provide a single source of real-time information that can assist, automate, and help optimize the

important decisions customers make every day.

In addition, Komatsu and several of its customers recently formed the Komatsu Greenhouse Gas (GHG) Alliance. The founding members of the alliance are Rio Tinto, BHP, Codelco, and Boliden. We will actively collaborate on product planning, development, testing, and deployment of the next generation of zero-emission mining equipment and infrastructure. The alliance's initial target is advancing Komatsu's power agnostic truck concept for a haulage vehicle that can run on a variety of power sources including diesel electric, electric, trolley (wired), battery power, and even hydrogen fuel cells.

How are customers in Nevada responding to Komatsu's technologies?

Customers in Nevada have been responding very well to our technologies. Our technology systems are used to track both maintenance and production data remotely along with assisting in operator performance. We also have customers requesting information on our autonomous haulage systems technology for their future mine plan outlooks.

Can you give us an overview of Komatsu's autonomous and semiautonomous machinery?

We have designed an automation roadmap to enable mines to progress from fully manual to autonomous operation. This can happen by leveraging an open supervisory system that communicates with all machines, makes, and models, allowing for mixed fleets and for staffed equipment to operate alongside unstaffed equipment. The progression starts with manual operation, with a human operator fully responsible for all functions. The roadmap moves in stages through increasing levels of autonomy until it reaches the fully autonomous state.

We are currently finishing the development of our semi-autonomous PC7000-11, a 700-ton-class hydraulic excavator with teleoperation, and we plan to trial the concept machine at a customer site in 2022. We also have several products related with autonomous haulage, autonomous water trucks, autonomous drilling solutions, underground soft rock automation, and automated cutting. ■



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90% of our customers are now looking to transition to digital solutions.

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Victor Tapia

Vice President Sales Area USA
SANDVIK

Could you provide a brief overview of Sandvik's presence in Nevada?

In the US, Sandvik focuses on mining and construction. For the mining industry, our main branch is located in Elko, Nevada, because of the potential customer base that exists and the commodities that are mined in the area.

What are Sandvik's best-selling and fastest growing products in Nevada?

The majority of Sandvik's operations in Nevada are related to underground equipment, including drilling equipment, loaders, and trucks. In 2019, we signed a collaboration agreement with Nevada Gold Mines that we have been able to successfully execute. This agreement has significantly grown our presence in the underground equipment market in Nevada. Now, we are expanding our presence on the surface with other types of products.

How has Sandvik been improving its battery-driven equipment for underground mining?

Sandvik has some of the most advanced technology for underground operations because we are not simply trying to replace engines with batteries, but we are actually designing completely new products to support the new battery-related technology. The main advantage this method provides is superior productivity, and we have around 400 patents for it. Currently, we are collaborating with Barrick at one of their mines

in Nevada by testing our C50 truck, perhaps the largest truck that exists on the global market.

Can you tell us about Sandvik's underground digital offerings, including the Remote Monitoring Service?

We are currently in the process of rolling out globally our Remote Monitoring Service, a robust solution that analyzes underground mining equipment data to identify abnormalities and develop predictive solutions to increase uptime and reduce operating costs. We have already installed a Remote Monitoring Service Center in Elko, Nevada, from where we are connecting our equipment in the USA.

With our customer Barrick, for example, we have connected the machinery and are now trying to provide advice not only about possible future problems with their equipment but also about how to optimize this technology. This space is growing very fast, as all OEMs have been pushing to develop similar technology. Today, customers can see clear positive results, and I anticipate this will continue to grow quickly in the months to come.

Could you provide an update on the trend towards autonomous equipment in Nevada and what role, if any, Covid-19 has played?

Autonomous equipment heightens safety and efficiency. From a safety perspective, less people in the mines

lessens certain risks. From an efficiency perspective, less people also translates to lower costs. Plus, the equipment has the potential to be more productive in general.

The pandemic has accelerated the trend towards autonomous equipment, as 90% of our customers are now looking to transition to digital solutions. That said, we cannot make this transition quickly. Autonomous solutions require certain preconditions, as mines must be prepared with specific infrastructure. Sandvik currently has the capacity to provide these types of solutions for underground operations, and we are trialing this technology in some mines in Nevada. We cannot trial this with any customer because we have to have to make sure these conditions are met.

What was the rationale for Sandvik's acquisition of DSI Underground in 2020, and what will this mean for the Nevada market?

Sandvik is one of the leaders in underground drilling operations, and DSI is the global leader in underground support. There was a clear synergy in partnering our operations to pair our drilling equipment with DSI's reinforcing capabilities. One of the first actions we took was to unite both teams of engineers to work on more efficient solutions we can offer our customers. Additionally, our market share in underground support was previously not very big. With this acquisition, Sandvik will be able to grow quickly in this regard. DSI will also benefit from our current sales structure, as they did not have the same footprint in the mining industry as Sandvik does.

To conclude, what are Sandvik's main goals for the next three years?

Sandvik is in growth mode, both organically and through acquisitions. We want to keep our strong position in underground operations, and we aim to grow quickly in the surface mining space, where we already have strong existing customer relations. Here, we are investing not just in people, but also on our physical structure in Elko. We are doubling our capacity, so we will need to keep this in line with our regional growth. ■



Lance McGinn

Global Commercial Manager
Mining Division,
HEXAGON

Can you provide a brief overview of Hexagon's role in the mining industry and its presence in Nevada?

Our role at Hexagon is to integrate measurement solutions with proven technolo-

gies for planning, operations and safety. This way, we can make our customers safer and more productive, and make sense of their data. Hexagon has been present in Nevada since 2015.

Hexagon recently introduced the Power of One to connect all parts of a mine. Can you tell us about this solution?

Essentially, the Power of One is a single platform that enables all solutions across the life of mine and can grow as your operations grow. We have one sensor platform which connects planning, drill and blast operations, safety, and FMS with a single GPS/GNSS, LTE, Wi-Fi, networked sensor, as well as a similar user interface across the platform for familiarity. A cloud platform integrates all these different suites into one manageable area that allows the applications to communicate effortlessly with each other. Then, all the different pieces monitor and pull in data together from the machine control, monitoring, fleet management, and collision avoidance.

Can you elaborate on Hexagon's Mine-Measure solution and how it can improve drill and blast processes?

It is a tailored portfolio for drill and blast which combines blast design software, high-precision drills, blast movement monitoring, fragmentation analysis and enterprise analytics.

Imagine a drill and blast ecosystem that has seamless data collection at every step, enabling machine learning and AI to automate blast designs and optimize the blast outcome.

How do you see the extent of digitalization and autonomy of mines in Nevada?

Incremental digitalization has assisted many of the Nevada mines in becoming more efficient and productive.

The precursor to autonomy involves identifying and processing the right data at the right time to make the right decision with the proper feedback, and this is where many Nevada mines are now. At Hexagon, we can provide clients with a vision of what their mine could be. ■



Ron White

President
3D-P

Can you provide a brief overview of 3D-P?

3D-P is a Canadian-based wireless technology integrator which focuses primarily on mining. We have a three-

tiered approach to the market. First, we are a radio-agnostic wireless integrator; our focus is to find the right solution for each mine, and this may include elements from multiple different wireless OEMs - LTE, WiFi, or WiFi Mesh, or a combination of the above. Second, we manufacture some of the hardware. We found that much of the off-the-shelf hardware available in the market is not rugged enough to survive in a mining environment. Finally, our software engineering team writes software that runs specifically on each box, facilitating deployment and installation.

3D-P was recently acquired by Epiroc. What synergies have been created between both companies?

As Epiroc moves into the realm of autonomy and remote controls, one of their biggest challenges is related to wireless networking. Our expertise allows us to figure out exactly what needs to be done to augment networks or to deploy a specific network for the

autonomous drills to make them work properly in the mine.

Simultaneously, Epiroc can greatly expand our geographical footprint.

How have you seen the demand trends for your technologies evolve in recent years?

In Australia, LTE has been a big part of the wireless solution in mining for 5-7 years, because they have spectrum available for the mines to use. In the US, that spectrum traditionally has not been available because it is exclusively used for consumer devices such as cell-phones. So, we have been focusing on solving the challenges that come with the LTE deployments primarily in Australia, as far as the ruggedization and communication enhancements that can happen just from using the proper clients on an LTE network.

More and more customers are becoming interested in what LTE can bring, and where there is spectrum available, we are able to help them take advantage of it. ■

Drilling



As a drilling supply company, we help customers implement drill systems from the "Top Head to Down". We provide tools for water wells and exploration, as well as equipment for different types of drilling such as hammer drilling, down-the-hole drilling, RC drilling, and many more.

– Steve Antonini,
General Manager,
Jentech Drilling Supply



Demand outpaces supply

Drilling services play a crucial role in the exploration process and as more companies race to join the exploration boom in Nevada, the demand for these services has skyrocketed.

As an example, the Utah-based drilling company Boart Longyear has noticed an uptick across its various offerings, from surface coring to underground drilling and large rotary drilling. The company's CEO Jeff Olsen acknowledged: "RC drilling is one of the first types of drilling to see increasing demand when the market picks up, and we are currently fully employed within this area in our Nevada operations."

Drilling companies that have been working to expand their reach into the Nevada in recent years currently face challenges in finding a sufficient labor force to meet the demand. So too have Nevada-based companies like Jentech Drilling Supply, whose business development manager Clint Welsh said: "There are many drilling companies that despite having rigs available, cannot utilize them due to a shortage of staff."

With the largest obstacle currently impacting the drilling sector being the inability to meet soaring demand, drilling activity is operating at maximum capacity. Certain trends in technology are helping companies keep the pace and improving safety conditions, while new exploration strategies present novel challenges for drilling services.

Technology to drill better, safer

As equipment providers incorporate increasingly sophisticated technology into their product designs, companies specializing in drilling services are no excep-

tion. In particular, the trend towards data optimization has extended to the sector. Boart Longyear is working on its Geological Data Services (GDS) with the vision of creating a suite of tools that can collect and unite drilling data into a single body of knowledge. GDS products include Tru-Core for core orientation, as well as its down-hole survey technologies, TruGyro

and TruShot. "Ultimately, once all the data is collected from these tools, we will be able to develop a unified ore body of knowledge," explained CEO Jeff Olsen. "This will be a huge milestone because all the datasets are currently kept separate in the industry."

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has brought to Nevada a reporting system the company previously implemented in Australia. With the system, COO Ben Howard says: "The company is able to analyze data in order to track the performance and cost analysis for every tool used in mining environments and utilize digital capabilities to increase productivity."

As more drilling companies adopt their own digital solutions, drilling in Nevada continues to become increasingly efficient.

As one of the most popular new technologies in the industry, automated rod-handling systems are reshaping how drilling companies operate. Layne's team of engineers designed their automated rod manipulator (ARM) system so that, relying on a hydraulic motor and gear system, the machinery is able to perform complex motions remotely, liberating drillers from the potentially harmful task of rod handling directly.

National EWP helped introduce the technology to Nevada for core, RC, and large de-watering rigs. Today, all of the company's rigs have automatic capabilities to reduce hand-related injuries. In addition to safety, the innovative hands-free technology has generated the unforeseen benefit of promoting workforce diversity. Boart Longyear found that after implementing its own automated rod-handling systems, more women joined the company's drilling teams as operators no longer have to directly handle heavy rods. "Today, we have approximately 40 female drillers worldwide, predominantly in Latin America," acknowledged Olsen. "Our number of female drillers in the US is growing rapidly."



We are in an industry where the wind is blowing in the right direction currently, and we have our sails up. But right when people become confident that this period will never end is the exact moment to check which way the wind is blowing and to prepare for leaner times. Alford Drilling plans to take advantage of this prosperous moment without becoming too nearsighted about the long-term future.



**- Steve Alford,
President and Owner,
Alford Drilling**



Geological hurdles

Despite being the top mining jurisdiction, Nevada can be a tricky place to operate when it comes to drilling. "From a driller's perspective, it can be the crummiest, lousiest drilling imaginable," said Steve Alford, president and owner of Elko-based Alford Drilling.

Given the unique geology, Alford acknowledged it can be challenging to sink holes to their target depth or to generate recovery where it has been historically impossible. Mining in Nevada often takes place in remote and fairly harsh environments, where each hole and each site has its quirks. With such variation, drilling companies must approach each project with specialized equipment and preparation.

Nonetheless, Alford believes the difficult nature of the terrain may be contributing to Nevada's mining prosperity. He said: "The poor conditions are "probably why there is so much exploration going on — a geologist might say that the lousier the drilling is, the more fractured or difficult for recovery, the higher the likelihood is of encountering gold intercepts."

Likewise, global company Major Drilling specializes in difficult geology, taking on jobs in locations like the Andes or the Arctic. As such, Nevada's challenges present an opportunity for the company. "We are deep hole directional specialists, which we take advantage of often in Nevada," explained Kelly Johnson, senior vice president of operations - North America and Africa. "We pride ourselves in our ability to meet the various challenges caused by the state's unique geology."

As the Nevada attracts more companies seeking to reap the benefits of operating in the top mining jurisdiction, drilling contractors will have to continue to take on unique geological challenges as a means of expanding not only their footprint, but the industry's at large. ■

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Nevada is becoming a favorable location for the implementation of our new technologies to address the state's unique geology.



Jeff Olsen

**CEO
BOART LONGYEAR**

Can you provide an overview of Boart Longyear's presence in Nevada?

Boart Longyear has been present in Nevada for a long time, and part of the reason why we are headquartered in Salt Lake City is its proximity to this state. We have a wide range of clients, including producers like Nevada Gold Mines, Robinson Nevada Mining Company, and Coeur Rochester, as well as exploration companies such as Allegiant Gold and Scorpio Gold. We provide all kinds of drilling services, from rotary to surface coring and underground work. We also have a small distribution center for our products in Elko to serve our clients. Increasingly, Nevada is becoming a favorable location for the implementation of our new technologies to address the state's unique geology.

How have you seen the demand for your drilling products and services evolve?

We have experienced a significant increase in the demand for our services. RC is one of the first types of drilling to see increasing demand when the market picks up, and we are currently fully employed within this area in our Nevada operations. We are also observing an immense uptick in surface coring and underground drilling. Lastly, we have seen increased demand for our large rotary drilling, which is very efficient in dealing with water management in Nevada mines.

Can you tell us about your Geological Data Services (GDS) and how they are being implemented in Nevada?

Our GDS are focused on redefining the future of mineral exploration through innovative and emerging technologies. Within GDS, we have developed TruCore for core orientation, as well as down-hole survey technologies including TruShot and TruGyro. We are also introducing the TruSub Drilling System, which measures the drilling parameters on rigs and provides real-time information to understand drilling behavior and contribute to future automation. In addition, we have a suite of tools and services called TruScan, designed to provide same-day continuous analysis of drill core or chips and quickly provide non-destructive, accurate, high-density

elemental concentration data. We are currently in conversation with some of our customers in Nevada to implement this technology.

Ultimately, once all the data is collected from these tools, we will be able to combine it and develop a unified body of knowledge. This will be a huge milestone because all these datasets are currently kept separate in the industry.

Can you elaborate on Boart Longyear's culture of safety?

Many of the technologies we have implemented, including TruScan, dramatically reduce the number of people on a drill site, providing clear advantages in a Covid environment. In addition, we have multiple new tools and products that improve rod handling and automated drilling, which simultaneously improve safety and productivity. In the future, we expect to see fully automated drilling and core handling.

How is the company dealing with the current shortage of skilled workers?

Our use of automated rod-handling systems is attracting more women to our drilling teams, since operators do not have to directly handle heavy rods. This is a win-win situation, as it contributes to a more diverse workforce and allows us to draw on a much larger pool of workers. Today, we have approximately 40 female drillers worldwide, predominant-

ly in Latin America. Our number of female drillers in the US is growing rapidly.

Can you tell us about Boart Longyear's workforce training initiatives?

Boart Longyear is the world's largest drilling company, and how we train our people definitely contributes to this success. We have subject matter expert training where workers must go through several safety courses. We also partner with the University of Utah to provide leadership training for our employees worldwide through different modules. Having good leaders allows us to have numerous long service employees, and the more workers we can retain, the less people we have to hire and develop. That said, we have a cross-functional team dedicated to understanding the issues of attracting, retaining and developing new people in the workforce.

What were the reasons behind Boart Longyear's recent recapitalization plan?

For a long time, we had an overleveraged balance sheet due to the industry's downturn. We decided to undertake a recapitalization plan to substantially reduce our debt, strengthen the balance sheet, and enhance liquidity to support our operations and future growth. This has put us in a strong financial position just as we are getting some favorable tailwinds from the industry. ■



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Layne created an automated rod manipulator (ARM) system, which is a way to feed rods to the machine in a hands-free way on the coring side.
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Michael Magnin

General Manager of US Minerals
LAYNE

What synergies were created by Granite's acquisition of Layne in the fall of 2018?

When Granite purchased Layne and its subsidiaries to increase its presence in the mining sector, the union made for a great fit thanks to shared values. Granite's structured equipment management helped Layne manage our equipment as an asset and focus on the return-on-investment. We have also done some drilling work for some of Granite's aggregate sites in Nevada, Arizona and California.

Can you tell us about Layne's Mineral Services and the demand trends over the past year?

Layne's Mineral Services headquarters is located in Chandler, Arizona, however, in 2019, we opened an office in Elko, Nevada, committing to our local presence and hiring people from the Elko community. We wanted to officially become part of this region instead of just coming in and drilling when the prices of minerals are high and leaving when times are tough.

Traditionally, we have drilled a lot in the copper market. When the copper market is low, Layne historically turns towards gold in Nevada. Both metals are doing well now, providing us with

a better balance, which is why we are trying to be a key player in Nevada. Layne still has equipment for iron, which is ramping up after the impacts of the pandemic. The recent increase in metals prices have led to a substantial increase in the demand for our services. The challenges are finding a labor force to meet the demand and handling the supply chain disruptions.

What occurs at Layne's Drilling Technology Center (DTC)?

Layne's Drilling Technology Center is located near Houston, Texas, in an area rich in drilling history and expertise. If our drillers find an issue with no solution already present on the market, we will bring this to our engineers at the DTC. Once they determine a solution, we work with a manufacturing company to fabricate the tool or part that will ultimately save time, injuries, or create efficiencies.

For example, Layne created an automated rod manipulator (ARM) system, which is a way to feed rods to the machine in a hands-free way on the coring side. The ARM was designed through collaboration between our engineering team and our drillers. While working on a better way to break drill col-

lars with our existing rigs, we ended up building wrenches that work on three different styles of rigs, and everything is hands-free so that no pipe wrenches are involved. Two of these wrenches are in engineering labs, and one is already built and on rigs.

Have you noticed an increase in the adoption of automated technology for drilling services?

We have not seen a large trend towards automated technology. We operate in remote and often harsh environments, though every hole and every site are a bit different. With so many variables, it is almost counterproductive to turn to automation. The industry could get there one day, but right now, the only real automated technology I have seen take off is rod-handling systems.

Since coming to Nevada, what clients has Layne served?

NGM is now one of our main customers, and we have worked at their Phoenix Mine and Long Canyon Mine, to name a few locations. We have also worked extensively with Kinross at Round Mountain. During the pandemic, we carried out some directional drilling for Coeur Mining's Rochester mine.

How does Layne factor safety considerations into its operations?

Safety is Layne's main focus. We have a strong health and safety team, including a committed member in Nevada. Our managers, supervisors, and health and safety representatives frequently visit crews onsite. Everybody has an app for conducting and logging site inspections, and we take the time to correct any negatives that arise. A safe company is a profitable company, so it pays dividends to focus on safety.

As Layne continues to grow, where will it focus its attention?

Layne's vision is to build responsibly. Right now, there is significant demand for our services, but we will not rush this growth as we take the time to hire qualified people and train them in-house. We have enough equipment, so it really is about responsibly building up our workforce. Layne continues to strive to be professional and safe at all times. ■



↘↘
AMS was established in Salt Lake City in August 2017 to provide both drilling tools and technical expertise to suit any specific drilling projects needs.
 ↙↙

Ben Howard

COO
AMERICAN MINING SERVICES (AMS)

Could you provide a brief introduction to AMS?

AMS was established in Salt Lake City in August 2017 to provide both drilling tools and technical expertise to suit any specific drilling projects needs. The company was created as an expansion of the business in Australia called Australasian Mining Services, as we saw the US as the next logical step in our internationalization process and great growth opportunities in Nevada's mining industry. We secured a large four-year contract with Rio Tinto to supply all their drilling consumables at their Kennecott copper mine. Salt Lake City has become a central point for us, from where we service Nevada, Colorado, Arizona, South Dakota and Montana. We currently do a lot of work related with exploration and construction in Nevada.

Can you provide an overview of your drilling and blasting products?

AMS offers a comprehensive range of products manufactured by Shareate Tools Ltd. These include DTH hammers and bits, tricones drill bits, drill string products, top hammer drilling consumables and many exploration and water well drilling products such as diamond coring bits and hammers. We utilize manufacturing capabilities in Australia, China and the US.

Can you highlight some of AMS' latest innovations to improve the safety and performance of its tools?

Many of our product innovations are bought from Australia, which is extremely safety orientated. We have a lot of limitations on what we are allowed to lift, where we are allowed to stand, and noise limits. Therefore, we have identified some very useful products, especially around manual handling, and introduced them in the US market.

In addition, we are working to reduce the weight of historically heavy tooling. For example, deck bushes normally weigh 150-200 pounds, and we are reducing it to 50-80 pounds so that they can be manually handled. We also bring out numerous light weightlifting tools made of aluminum. The fact that the tools are used to lift something heavy does not mean they should be heavy and cumbersome as well.

We also implement a monthly reporting system to our customers to track the production and cost performance for every tool used in the Drill & Blast function to identify opportunities for research and development or operator training.

What are some of AMS' standout projects and clients in Nevada's mining industry?

Some of our main clients in Nevada include Hycroft Mining, Borealis Mine Operation, I80 Business Park, Q&D Construction Quarries, and we also work extensively with all the drill and blast contractors in Nevada.

What makes AMS stand out in the competitive sphere?

In our industry, we have to compete with companies much bigger than ours, and the service we provide is our key differentiator. Anybody can supply a drill bit, but what really adds value to clients is our people on the ground. That is why we hire subject matter experts rather than salespeople. Our philosophy is to hire people with extensive mining and exploration experience and then teach them about sales, rather than the other way around. This is to ensure our people can provide real support to clients while onsite and can identify the risks that go

with the mining and drilling environment. We are a small company which keeps us very customer focused. Everyone in our business from senior management to accounts contribute to all aspects and duties of delivering a service that is valued by our customers.

How do you see the growth potential for the company?

We are constantly looking for expansion opportunities. The challenge with expansion is always finding quality people, which is why we have engaged some employment agencies that are specific to the mining industry. This is costly in the short term, but in the long run you get quality candidates and a lower turnover. We also need to change our approach to attracting new employees. There are many people who have worked in mining their whole career and have good skills developed in operational management, IT, and procurement learnt in mining environments, but they choose to work for companies in other industries such as Amazon or Google that offer much more attractive employment conditions rather than just salary incentives. Our quality drilling consumables supported by highly motivated engaged people will ensure we continue the growth we have achieved in the last five years. ■

Concluding Remarks



“Nevada has seen the creation of a very healthy partnership between the government, the mining industry and the citizens, to ensure safe and environmentally friendly mine operations. While the fuel for this is the precious metals industry, rare earths are emerging and there is also a very active and dynamic industry for sand and gravel, industrial minerals, limestone and cements. The state, which is extremely rich in terms of geologic diversity, still has numerous areas that have yet to be explored and properly catalogued.”

**– Scott G. Britton,
Manager – US,
Mining Plus**



“Gold is a primary commodity in Nevada, and it is still desired as a hedge against inflation. However, I see the future of the mining industry in the green energy minerals. The International Energy Agency’s Net Zero by 2050 report recently estimated a sevenfold increase by 2030 for critical minerals such as copper, cobalt, manganese, and rare earth elements. In addition, President Biden wants half of all vehicles sold in America to be fully electric by 2030. S&P expects automakers to invest approximately US\$500 billion by 2030 in green energy minerals and estimates a global revenue of US\$1.9 trillion in the next five years. These levels of financial investment will encourage finding more mineral resources.”

**– Jeff Parshley,
Corporate Consultant,
SRK Consulting**



“Mining has been an integral part of Nevada’s past and it will undoubtedly be an important part of Nevada’s future. Nevada possesses world-class mineral deposits, and Federal and state agencies will continue to work collaboratively to produce regulatory frameworks and working relationships that are well-defined, and the lead the way in terms of balancing extractive industries with environmental responsibility and sustainability.”

**– Justin Abernathy,
Deputy State Director for Energy and Minerals,
Bureau of Land Management**

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