Resource | Investing News

Life Cycle of a Gold mine

The focus of the series is on the operational and financial hurdles that exploration companies must overcome in order to develop a successful mine and maximize shareholder value.

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The Life Cycle of a Gold Mine

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Introduction

The Life Cycle of a Gold Mine series educates investors about the distinct phases in successful mine development from finding and outlining a mineral reserve, through mine construction, mining, and post-mining reclamation. The focus of the series is on the operational and financial hurdles that exploration companies must overcome in order to develop a successful mine and maximize shareholder value. The series is divided into separate articles each of which will center on a particular phase of a gold mine's life cycle.

Figure 1 - Beaufor Mine, Richmont Mines (TSX:RIC)

Staking the Claim

The first step in developing a gold mine is selecting an area for prospecting. While this may seem boring and irrelevant to an investor looking into gold miners, this preliminary phase is the very foundation of a successful mining venture. There are dozens of ways in which an error in this crucial time could cause major headaches down the road. A critical misstep by an exploration company could in turn impact share-value. Therefore, it is important for an educated investor to understand the basic process involved in staking a mining claim.

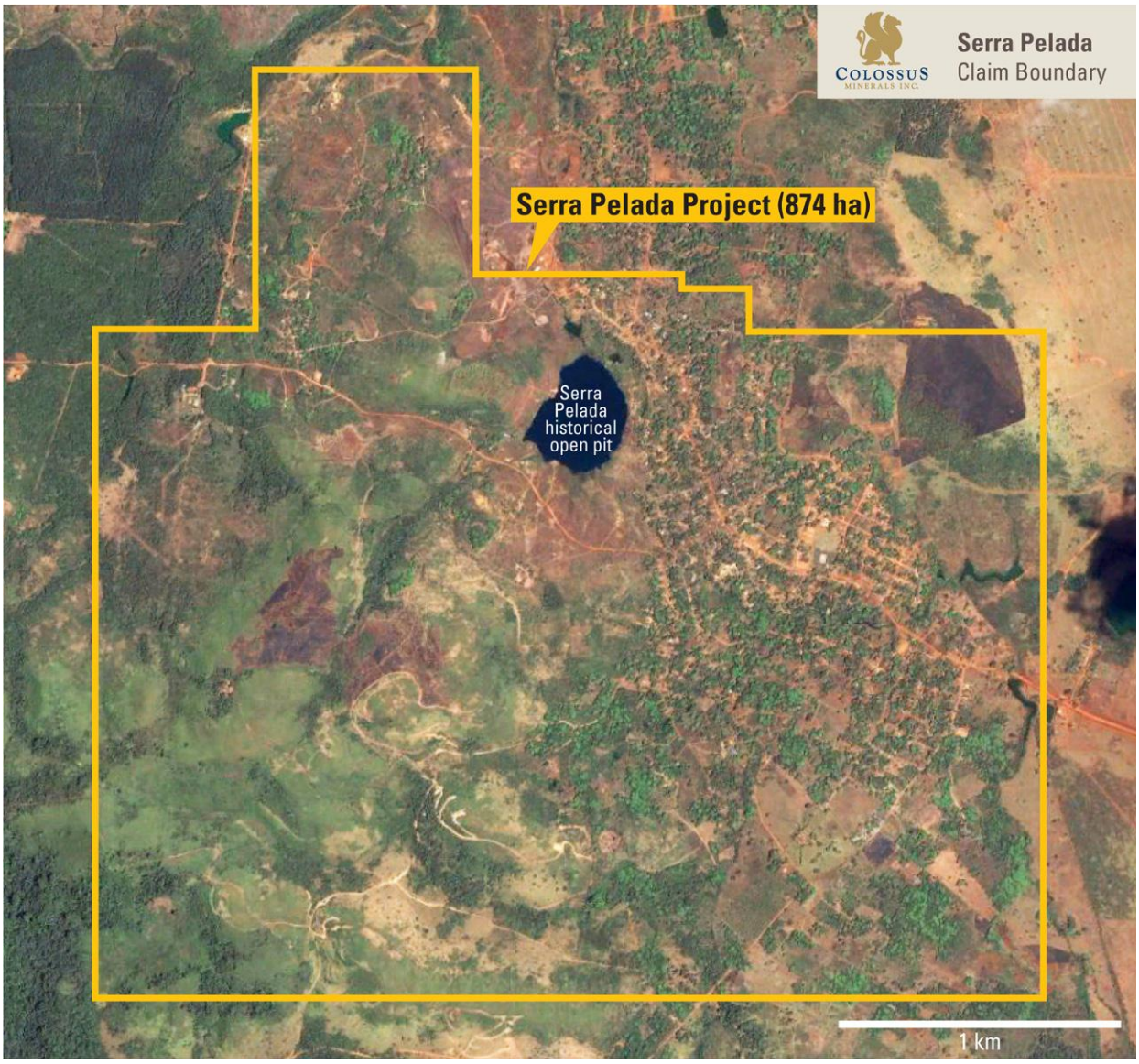

Figure ii - Serra Pelada Project Area - Colossus Minerals Inc (TSX:CSI)

Background research

Before settling on a parcel of land to lease, a mineral exploration company must determine what land is available, and whether it is government or privately owned. Market research is also an important factor in mineral exploration, and different forms of market research are conducted throughout the life cycle of a gold mine. In the beginning stages of developing a mine, market research tools are used to analyze how much gold must be found in order to make a project economically feasible based on projected commodity prices and demand growth. In addition, certain companies are only interested in deposits above a certain size threshold. In the beginning stages of research, miners will also consider other important factors, including local taxes and regulations, and infrastructure.

Leasing politics

How mineral rights are leased depends on what country, and even in what state or province the land of interest is located. In fact, all of the steps involved in mining are generally heavily regulated by the government. Investors should be wary of the political climate of the region where a miner is prospecting.

Many "pro-mining" countries, offer what is called a "split-estate." In a split estate, mineral and surface rights can be held by separate owners. This is a law that was created to encourage mineral prospecting. By only leasing the land, an explorer can save money by not having to pay for the surface ownership, and only paying for the mineral rights, which in many cases are leased and not bought. This separate mineral/land rights ownership not only saves money- it requires a shorter-term commitment. If after leasing land, and conducting exploration, if a miner does not find a viable resource, he can pick up and move on to the next target, without leaving capital tied up in a property.

Choosing a site

The preliminary steps of locating a site to lease may be conducted without physically collecting any surface data, a necessity due to the fact that miners must usually be granted mineral rights before they can have physical access to the land. In some cases, miners may decide to lease areas of land without performing preliminary data collection, for instance in areas that are known exploration hot spots, miners may want to apply for a lease before assessment in order to beat out the competition.

"Investors should be wary of the political climate of the region where a miner is prospecting."

So, how do miners collect data without surface access? They analyze the likelihood of a mineral deposit on the land by looking at the regional geology. Ore genesis is constrained to certain geological environments, therefore, geologists can apply the knowledge of gold deposition environments to narrow down the search area for a potential deposit. Miners may also have access to geological maps. If the explorer is lucky, they may even be able to acquire historical exploration data. Once the explorer comes to the conclusion that there is enough evidence to suggest the possibility of a gold deposit, they will proceed to the next step, applying for a mineral lease.

The lease

Once a mining company has found an area of interest, they will apply for a mineral lease, permit, or license (the terminology varies across regions). Not everyone can apply for a mineral lease right away, for example, in Canada, miners must hold a prospector license before they can apply for a

mineral license. Leases enable explorers to collect physical evidence from the property in question.

"Keep in mind that the entire mineral prospecting process is, at the very least, mediated by the government. This is why it is important to have an understanding of the political stance in the country where a miner/explorer is operating."

When a mineral lease is granted, the exploration company is able to conduct surface exploration. Mineral rights leases vary considerably, they may be for a finite time frame, and they are generally awarded in certain land parcel sizes. For leases from the government, mining companies are usually required to submit proof of exploration activity on order to keep their mineral lease in good standing. This is an important consideration for the prudent investor. Do some research into a mining company's history in terms of upholding claims. If a company is known to lose claims, they may not be the best investment choice. However, companies should not be faulted for leasing a claim, conducting preliminary exploration work, and then making the decision not to proceed. Most often, this decision is based on insufficient geological evidence of a viable gold deposit. It is better that a company picks up and moves on at an early stage rather than pour hundreds of thousands of dollars into a project that may never be brought to market.

Another important consideration in terms of leasing is that not all mineral leases also imply ownership of the mineral reserve, if discovered. Often, mineral leases only award the right to prospect, and if exploration leads to the conclusion that a viable mineral deposit is present, another permitting process must be undertaken. Keep in mind that the entire mineral prospecting process is, at the very least, mediated by the government. This is why it is important to have an understanding of the political stance in the country where a miner/explorer is operating.

Once a mineral exploration company has been granted a lease/license, then the work begins. The next step is exploration. Exploration is often the most interesting part- and where investors can make a great deal of money. This will be addressed in the next part of the series.

Regional Exploration

Once an exploration company has been awarded the proper permits for a parcel of land they are interested in prospecting, the work begins. After "staking the claim" the next phase is the life cycle of a mine is the exploration phase, which is also the longest and riskiest phase. The goal of this phase is to incrementally collect data regarding the potential of a mineral reserve.

Figure 3 - Los Grandules Propery, Unigold Inc. (TSXV:UDG)

The overall exploration phase involves many steps. This piece will focus on the preliminary exploration phase, regional exploration, where a company tries to determine whether or not their property hosts a feasible gold reserve; and if so, where the reserve is most likely located. In the next part of these series we will look at the more advanced part of the exploration phase, where a company is more certain that their property hosts a reserve, and therefore is working to delineate the reserve and start the necessary environmental assessments so that mine construction can kick-off in timely fashion.

Regional analysis

It is important to note that overall, exploration is not a "one size fits all" prescription, and there will be different starting points, and different techniques for different projects. Many properties have a history of exploration work, which a company can leverage. In other cases, they may be starting from scratch. The first goal in preliminary exploration is to narrow down the search area, to determine where a mineral deposit is most likely located. Eventually, the goal is to start drilling. Luckily, long gone are the days where exploration companies would "blind drill." Now, they have a suite of sophisticated exploration techniques that they can employ to locate where a valuable mineral deposit may lie.

Drilling is conducted with the purpose of furthering the knowledge about a mineral deposit, but proper placement of drill cores is essential, because the assay results from drill cores are reported to the public. In an investment climate where sentiment is paramount, reporting "bad"

drill results can be detrimental to share values. On the contrary, investors should take heed when looking at buying into a company that reports one excellent drill core. While gold is a bit finicky because it is so rare, pay attention to average grades, and drill cores that "start and end in mineralization." Please note that nuances of drill cores are beyond the scope of this piece, and will be fully addressed in the next exploration piece.

"The techniques used in gold exploration fit into two broad categories: geophysics and geochemistry."

The techniques used in gold exploration fit into two broad categories: geophysics and geochemistry. Geophysical methods measure variations in physical properties of rocks as a tool to locate mineral deposits. Geophysical methods are paramount, because they enable geologists to actually "see" into the earth itself; to understand the sub-surface structure and where a mineral deposit is most likely located.

At first, regional scale geophysical surveys are employed. Ground geophysics surveys are not as often conducted at the beginning phases of exploration work because they are costly. A variety of geophysical techniques commonly employed in regional analysis include: remote sensing (aeromagnetic surveys, satellite imagery, and sometimes aerial photographs) magnetic surveying (including Induced Polarization).

Geochemistry, which involves assaying, usually follows geophysical data collection, at least when it pertains to "drill cores." However, assaying may be conducted on hand specimens collected from outcrops, or it may be undertaken as a spot check- to verify data collected through geophysical tools. Assays are carefully analyzed, not only for actual gold, but also for importantindicator minerals that suggest the nearby location of a gold reserve.

If the exploration company continues to collect evidence that supports the nearby location of a valuable mineral deposit on their property, then they will continue to collect data to help pin-point the mineral reserve. On the other hand, if the data does not support a resource, then the property may be abandoned- or the exploration company will turn its focus towards other targets identified in the regional analysis.

Financing

The cost of exploration can vary incredibly depending on a number of factors, but can easily run up to about one-quarter of what actually mining costs, when compared on a per ounce basis of mined gold. Unless we are dealing with a major miner with deep pockets, chances are, at some time during the exploration phase, the explorer will try and raise capital. If the company is not already public, you will most likely see the IPO sometime during the exploration phase. If the company is already public, and even once it goes public, you will most likely see multiple financing phases, used to drum up cash to spend on further resource identification. While you don't want a company to dilute shareholder value, you do want it to raise money so that it has the money to properly conduct its exploration initiatives. The exploration phase is also where investing can really pay off. This phase may be riddled with volatile stock swings and speculation, but this is also where the swings may be in an investors favour.

Next up, in the second part of the exploration phase of the life cycle of a mine series we are going to look at the more advanced part of the exploration phase- where drilling, speculation, and proper data collection (for NI 43-101 and JORC compliant resource estimates) come into play.

Resource Definition and The Feasibility Study

After preliminary exploration has been completed, the next step in the life cycle of a gold mine is resource definition. The processes in reserve definition are similar to preliminary exploration, and there is considerable overlap between the two phases. However, in resource definition, the exploration company has reason to believe that their property contains a mineral reserve. Therefore, the company will spend more money on intensive and technical exploration techniques.

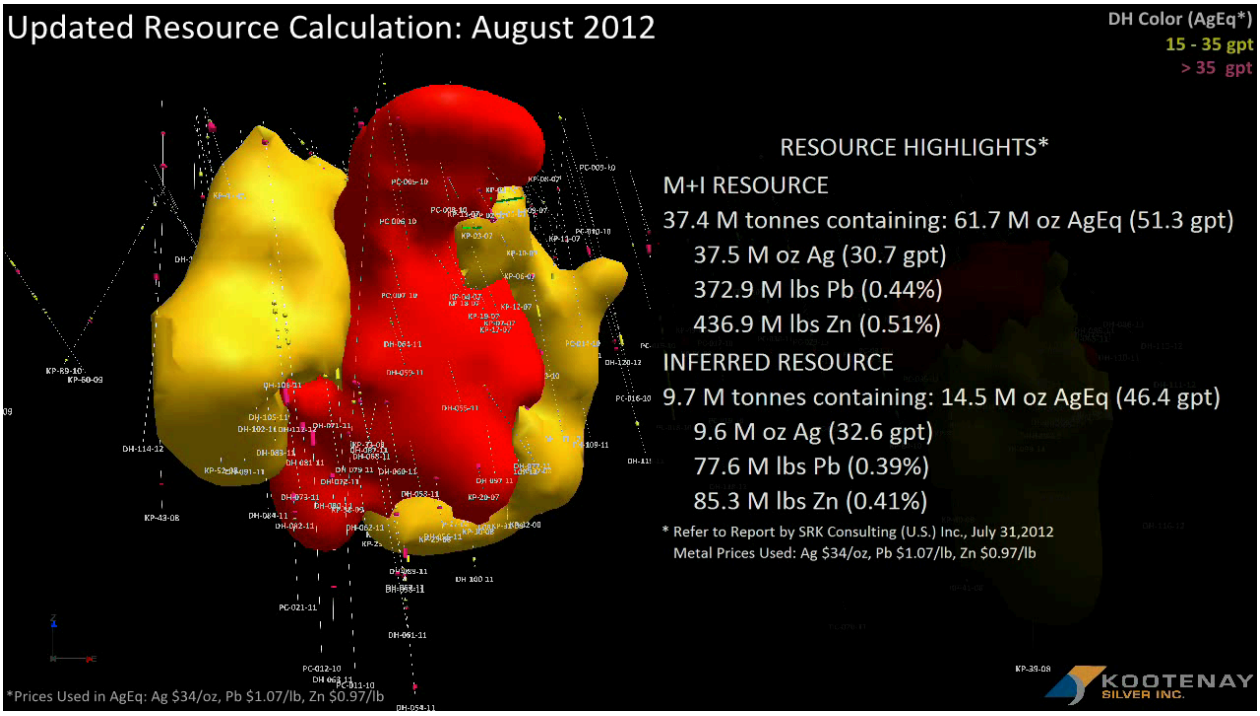

Figure iv - Promontorio Deposit - Kootenay Silver (TSXV:KTN)

The resource definition phase not only involves further analysis of the size and grade of the mineral reserve, but also uses engineering and geotechnical studies to evaluate the mining method and the estimate how much it will cost to extract the ore, given the geology of the deposit. At the end of this process, a feasibility study is published, and the ore deposit may be either deemed uneconomic or economic.

The feasibility study

While the feasibility study is the key development in the advanced exploration phase, in regional exploration companies actually collect a great deal of data that is used in the feasibility study. A feasibility study analyzes the sampling, test work, and engineering analysis conducted throughout the exploration phase to determine whether or not a project has the proper economics to be developed into a mine. During the feasibility study how and what a public company communicates (regarding reserve estimates etc.) is governed by the securities exchange commission in the country where the

company is listed. The rules are meant to prevent a company from releasing misleading information to the public. In Canada, the National Instrument 43-101 Standards of Disclosure for Mineral Projects dictates the rules.

It is recommended that mining companies undergo the feasibility study in a somewhat linear fashion. There are no precise rules governing how a company proceeds in developing a feasibility study, and therefore companies may try and rush through the steps in an attempt to accelerate the process of developing a mine. While data collection is left up to the explorer, the validity of this data is tested by the securities exchange commission guidelines. Miners who rush may find themselves running around in circles collecting data- a waste of time, and money. A proper feasibility study has three key phases: the scoping study, the pre-feasibility study, and the feasibility study. Not all exploration projects make it through all the phases, if at any point it is determined that a project is uneconomical, it should be abandoned.

Scoping study

The scoping study involves analyzing drilling and sampling results to define a resource and analyze the best mining method to extract the resource. Scoping studies are key in the life cycle of a mine because they typically identify technical issues that will require additional examination or test work. Generally, the end result of the study is a description of the general features and parameters of the project and an order of magnitude estimate of capital and operating costs.

Preliminary feasibility

Preliminary feasibility involves the use of engineering and geotechnical studies for a more in-depth look at resource extraction. In addition, the company will examine environmental and permitting issues, and preliminary capital and operating cost estimates. A key importance of the preliminary feasibility study is to identify areas of concern that warrant further investigation. Depending on the level of detail in these studies, and the securities exchange that is involved, reserves can in some cases be declared at this point.

"A proper feasibility study has three key phases: the scoping study, the pre-feasibility study, and the feasibility study. Not all exploration projects make it through all the phases."

Feasibility

The feasibility stage is basically a more comprehensive preliminary feasibility study. However, during the feasibility study, the study into the economics of a potential mine advances to include mine design, production schedule, gold recoveries, plant design, consideration of environmental issues, detailed capital and operating costs estimates, and an economic model of the project. During the feasibility stage gold reserves can be declared. This phase marks the culmination of the years of painstaking research and data collection, where an exploration company will ultimately make the decision whether or not to proceed with mine development.

Bankable feasibility studies

Often the term "bankable" precedes the term feasibility study. This term is often misunderstood to mean that a project is feasible. Adding this term simply means that the level of effort that has been incorporated into the study is sufficient for outside financing provided the project is feasible. Typically "bankable" means an overall accuracy level of plus

or minus 15 percent on the feasibility study. Just like feasibility studies, bankable feasibility studies may also determine that a project is "unfeasible." It is important to be clear that "bankable" only describes the level of accuracy of the analysis and has no relation to project's feasibility.

The importance of the feasibility study

Conducting a thorough feasibility study is essential to a gold mine's successful development. Scoping and prefeasibility are important because they identify potential problems; these problems can either be corrected by collecting more data or, in some cases, suspending the development of the mine. Once a company states they are doing a feasibility study there is pressure to pursue the feasibility to the end, even if at an early stage there is evidence it is not worth pursuing. However, companies who abandon projects due to calculations suggesting that the development of a mine would not be economical should not be looked upon unfavourably. If the economics are not there- they are better off pursuing another project. By pursuing a project for too long, a company will not only lose money, they will also lose out on better opportunities. If a company determines a project is "feasible" the next step is to move forward with the assessment and approval phase.

Assessment and Approval

Figure 5 - Community Meeting - Nevada Copper Corp. (TSX:NCU)

Regardless of how valuable of a resource an exploration company discovers, the resource will never be brought to market unless the company can properly assess and present the total environmental and socio-economic impacts of going from buried resource, to mine, to reclaimed land. The goal of the assessment phase is to thoroughly investigate how mining will impact the environment and communities, and how the miner will mitigate the risks associated with resource extraction. Not only must a miner conduct an accurate assessment of the risks and benefits of mining, they must communicate their assessments to various government agencies, and have these agencies agree that the pros of developing a mine outweigh the cons, before they will be granted permission to develop a mine.

Financial considerations are very important in the assessment phase as environmental preservation and remediation come at a financial cost, and in environmentally sensitive areas the cost of preservation and remediation may render a proposed mine uneconomic. Development must limit impacts to the environment and bring social and economic benefits to the mining company, local communities, and the local economy before a government will approve a mine's development.

Mining is overseen by governments, therefore, the precise steps involved in the assessment phase depend on the government in the country/ state/province where the mine is to be constructed. The assessment phase is extremely complex. Exploration companies can expect to fill out hundreds of pages of paperwork, apply for dozens of permits, and share data collected since preliminary exploration work.

In this piece we will address the basics of the assessment process, as this phase will vary considerable depending on the local government, the type of proposed mine, the location of the mine, etc. The prudent investor should education themselves on the "mining friendliness" of the region where an exploration stage company is interested in mining to see how often proposals are outright objected, or held up by "red tape."

Permitting

The entire life cycle of a mine is laden with permits. Explorers must get permits to explore a piece a land, permits to extract resources from a land, permits to construct a mine, etc. The length of time it takes to obtain the necessary permits to build a mine depends on the country where the proposed mine is to be located. The United States has one of the longest permitting phases; obtaining approval takes an average of seven years. On the other side of the scale, the approval process in Australia takes an average of one to two years. In the permitting phase, the mining company will present to the required agencies a comprehensive document that outlines the proposed impacts, and how these impacts can be mitigated. The nomenclature of this document depends on the

country, but is commonly referred to as an Environmental Impact Study.

The Environmental Impact Study

An Environmental Impact Study (EIS) must be completed before a miner can receive approval to build a mine. The EIS addresses the possible environmental, economic and social impacts, both positive and negative, that would result from mining the discovered gold resource. In the environmental impact assessment, all potential impacts are addressed, including, but not limited to: impacts on wildlife, aquatic and terrestrial habitats, socio-economics (disruptions to local communities including first nations land), noise, air and water pollution, and hydrogeology. In the end, the EIS has to show that the benefits of building the mine outweigh all the possible negatives, or the government is unlikely to grant permission for mine construction. The EIS is disclosed to agencies involved in making decisions on the project. Whether or not a company is granted a permit (a go-ahead) on a project is dependent on the information contained in the EIS. If all or parts of the EIS are rejected, the proposer is usually given a chance to make adjustments, and reapply.

Reclamation

Reclamation is a separate phase in the lifecycle of a mine; however, it is an important consideration during the assessment and approval phase because this is when an exploration company will first start considering the reclamation process. In the process of obtaining approval to build a mine, exploration companies must address how they will reclaim the land after mining has finished. Governments are extremely interested, and therefore pay close attention, to a mining company's reclamation plan. The cost estimate to perform the reclamation is provided by the miner in a Mining and Reclamation Plan. Many governments require a mining company to provide some form of collateral towards reclamation before then can go forward with mining. This collateral may be a cash deposit, a bond, or a letter of credit from a lending institution. It is up to the government what they consider an acceptable deposit. Reclamation will be addressed, more in depth, in a latter part of this life cycle of a mine series.

Financial considerations

In order to build a mine, the mineral deposit must be valuable enough to cover the costs of design and construction (capital costs), mine operation (operating costs), and mine closure and reclamation. In the feasibility study, financial considerations were important to determine if it was "worth" extracting a mineral reserve. In the assessment phase, exploration companies will take a more in depth look at other financial considerations involved in the operating and reclamation phases.

Miners are interested in making money, and governments are interested in ensuring that their mineral resources are utilized in a responsible and sustainable manner for the benefit of the Crown and the people. The assessment phase is an in-depth phase that involves close communication between the miners, government agencies. That all stake holders make sure that their needs and requirements are addressed is imperative during the assessment phase. Mining companies will spend a great deal of money and time determining and communicating the pros and cons of a potential mining development. While the assessment phase may seem tedious to an investor, it also provides a sense of security. When a miner obtains approval to go-ahead, an investor can be more confident that the risks inherent in mine development have been thoroughly addressed.

Mine Construction

Once an exploration company has obtained all of the necessary permits and approvals to develop a mine, the construction phase kicks off. Construction generally takes a few years, depending on the mine location, the size of the development, and the complexity of theregulations and review processes in the region where the mine is being developed. Investors can expect to get updates via press release and shareholder reports that detail the progression of mine development. While an investor may feel that now that the "risky" exploration phase is over they can sit back and relax, they should pay attention to these reports to make sure that the miner is a) not dealing with too many setbacks, and b) is appropriately following regulations.

Figure vi - Mine Shaft Construction - Nevada Copper Corp. (TSX:NCU)

After approval, but before construction of the actual mine, the mine site must be prepared for development. These pre-construction steps include: removing old buildings; developing infrastructure including roadways, bridges and railways; and building camps for workers. Environmental and land management kicks off in the preliminary phases of mine construction. Miners will have to adhere to the guidelines set out in their permits. This may involve the relocation of wildlife and keystone plants, planting vegetation that will be used during remediation and the implementation of erosion prevention and water management practices.

Mine construction

Building a mine can be a huge undertaking, especially when constructing mines located in remote areas. These mines may be more than just mines; they may morph into small cities that include housing for employees, schools, medical facilities, and may even have recreation areas. While a miner may start with camps, permanent structures are eventually needed to house the mine's workers during the operation phase. If a mine is located close to a community, then it may not be necessary to have such a large construction effort and instead only the structures necessary for the actually mining and milling will be built. Some mines may also include processing equipment involved in the transition from mined rock to refined ore. A variety of service and supply facilities necessary to maintain the mine and mining equipment, including electrical, welding and vehicle maintenance shops may also be built.

In terms of the actual gold mine, there are two main types of mines to consider; the open pit (surface) mine and the underground mine, and the framework of the actual mine depends on whether a surface mine or an underground mine is being built. Surface mining is the more common method, and produces approximately 85 percent of minerals. It is important to note that there are other ways to mine for gold, such as dredging, and some mines are even a hybrid open pit/underground mine.

While gaining access to the minerals can be considered a construction phase undertaking, this is a bit of a grey area because some of this overburden that is removed may actually be processed for minerals. To access the ore body in an open pit mine a miner drills holes in the ground and fill them with explosives. Constructing an underground mine involves digging tunnels that will provide access to the minerals. Other tunnels provide proper ventilation and emergency exits. Tunnels are supported via a variety of geotechnical engineering techniques including shotcrete, meshing, and bolting. The nuances of building the tunnels and the open pit will be discussed in further detail in the next part of the Life Cycle of a Gold Mine: Mine Operation.

"In terms of the actual gold mine, there are two main types of mines to consider; the open pit (surface) mine and the underground mine."

Regulation

It is a relief, for both an exploration company and an investor, when construction kicks off, but neither the investor nor the company should be lulled into complacency. There are still pitfalls that could delay, or even halt mine construction. Construction requires a great deal of capital investment, and the sooner production starts, the sooner the company will finally start earning money after having spent millions, and maybe even billions of dollars over years of exploration, planning and permitting. Like all phases of mine development, the construction of a mine is highly regulated, with the regulations varying in different regions. The explorer must strictly adhere to the guidelines set forth in the various assessments and permits that were completed in the permitting and approval process. The miner must be in constant contact with the necessary authorities and is required to provide maps, construction details, and even access to the site. Not only must the miner satisfy the regulating bodies, it must prove to the financiers that due diligence is being followed in order to keep the much needed capital flowing.

A potential threat to the timely development of a mine is protests. Protesters often do not care that a mine has passed the government's approval and

will still object to a mine's development once construction begins. In some cases, the government will hear these objections which at the very least may delay the building of the mine, in other cases the protests turn violent and work is stopped due to safety concerns. There is not too much a miner can do to prepare for protests other than follow sound environmental practices and communicate with the local communities. Certain regions are more subject to environmental protests; however, this may not deter a company from developing a mine in a "high risk" area. Some of the richest mineral reserves are located in politically unstable and environmentally sensitive areas.

Operating the Mine

Operation is a dynamic and exciting phase in the life cycle of a gold mine. After years of hard work and millions of dollars invested, a miner can finally start to see some returns. Though the basics components of the operational phase seem simple (extracting, processing, and selling the ore) calling the process simple is a gross understatement. The operational phase is complex and requires a great deal of management and planning in order to be successful.

Figure vii - Mill at Avino Mine - Avino Silver & Gold Mines Ltd. (TSXV:ASM, NYSE:ASM)

In response to the dynamic economics behind running a profitable mine, the miner puts a great deal of effort into implementing and adjusting key operational strategies when extracting ore. Furthermore, while extracting the ore, the miner may also still be exploring the area surrounding the in hopes of expanding the mine's reserves. Maximizing profits and resource expansion are crucial undertakings inherent in this phase, as is making sound business decisions to mitigate the social and environmental impacts of mining.

They have started mining..... Now what?

Strategy is the backbone of the operating stage. During the operational phase, miners rely on their strategy to determing how successful and profitable the mine will be. Though some aspects of operating strategy, like resource quality, are out of the miner's control, important parameters that the miner must address include: their interest in investing into resource expansion (exploration) ahead of mining, and what the minimum cut-off

grade of gold is that they are willing/able to mine, and the overall macroeconomic picture for gold.

Throughout the mining operation, the strategy has to be routinely revisited and possibly revised as important external economic factors, like gold price and the dollar index influence the economics of the mine. Cut-off grade provides the mechanism by which miners respond to changing metal prices. If prices rise, they can extend mine life by reducing cut-off grade, exploiting previously uneconomic mineralization. This has the effect of extending mine life, while lowering gold output and causing costs to rise.

Profitability

Several factors can influence a mine's profitability that are both controllable and "uncontrollable". The "uncontrollable" factors can be separated into two broad categories: geological and financial. The geological factors include: the grade of the deposit and the depth at which the gold is buried. Due to the geology of some mines, the potential for profit will be greater than others. Financial factors, such as the price for gold, the demand for gold and the exchange rates also influence a mine's profits. Fortunately, gold prices have rallied for the past decade and have no signs of slowing down.

Within a miner's control are the operating costs. Operating costs are dictated by how much waste rock is mined with the ore (i.e. the grade of the reserve), how effectively the resource is recovered, and how costs are managed. No two mines have the same operating costs. Productivity, safety, and the environmental and social impacts of the mine are also factors to be considered.

Generally, a mine with lower operating costs is a better investment than a mine with higher operating costs. In order to determine what a mine's operating costs are, investors should be mindful of the miner's reported gold cash costs (i.e. the cost of production per unit of output) as well as the miner's annual and quarterly earnings reports. The gold cash costs account for operational cash costs at site level. Many gold analysts caution against looking solely at cash costs, because some costs like depreciation, reclamation, and other non-cash costs are omitted from the calculation, making a mine appear more profitable than it actually is.

As an investor, it is important to keep up to date on a miner's operational strategy as well as business developments as they have the potential to impact profits- and therefore share value.

Social and environmental considerations

There is a cost to operating with sound environmental and social practices; however, by following sound environmental and social practices, miners develop a good reputation (important if the miner wants to develop more properties in the future). By not following proper social and environmental regulations, miners risk labour disputes, paying for expensive environmental clean-ups, and perhaps even some pricey lawsuits. In order to be approved to mine- the company had to make certain guarantees to mitigate the social and environmental impact of mining- they must stick to those promises. In the next part of the this series we will talk in depth about the last step in the life cycle of a mine and a key component of a miner's attention to social and environmental considerations: the rehabilitation/reclamation of the mine site.

Rehabilitation

Once the gold reserve at a mine has been exhausted, the owner of the mine must rehabilitate the site. Rehabilitation refers to the process of returning mined land its preexisting condition or to a predetermined post-mining use. Closure plans are devised prior to mine operation but are adjusted during the operational phase to account for various changes in mine operation, including mine lifespan and economics. Rehabilitation is a process that is required by governments and mine is contingent on the miner proposing a feasible rehabilitation program prior mining activities. In addition to proposing a proper rehabilitation plan, most governments require companies to provide financial assurance to cover some or all of the costs of the anticipated rehabilitation program.

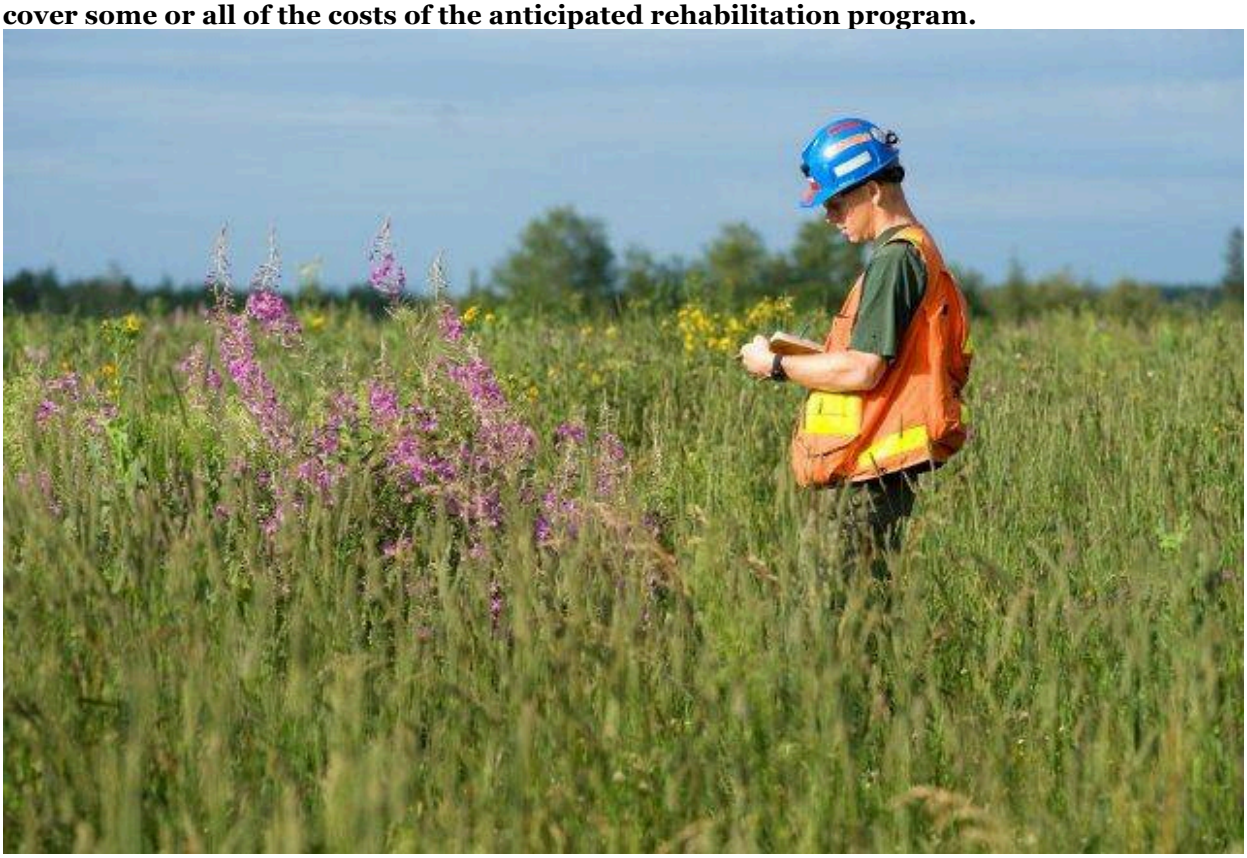

Figure viii - Coniaurum Gold Mine Site - Goldcorp Inc. (TSX:G, NYSE:GG)

A properly laid out rehabilitation program has clearly stated objectives. Broadly, these objectives are: the protecting ensuring public health and safety, minimizing environmental effects, removing wastes and hazardous materials, preserving water quality, stabilizing the land surface to protect against erosion, and establishing new landforms and vegetation. All of these factors will be addressed while at the same time reducing the requirement for long-term monitoring and maintenance.

After a site has been reverted to its rehabilitated state, the miner is responsible for post-rehabilitation monitoring. Site monitoring is to ensure the new surface is stable, the new vegetation is healthy, and that there is no surface and/or groundwater contamination.

The significance of rehabilitation

While rehabilitation process may seem to be irrelevant to the investor, this phase of the life cycle of the mine is far from inconsequential, and can have a huge impact on the future success of a mining company. Rehabilitation is important because a poorly executed rehabilitation program can impact the share value of a public company. Companies that do not follow proper rehabilitation plans could face costly lawsuits. Furthermore, poorly rehabilitated mines leave a negative legacy for their operators. As permission to develop future mines becomes tied to a company's reputation, a company with a history of not following proper rehabilitation procedure may have difficulty obtaining this permission in the future. A poorly planned and executed rehabilitation plan has both negative implications in the future and in the present. Poorly executed rehabilitation can result in skyrocketed costs and eroded profit margins earned through running and operating the mine.

"Regardless of end-use of the land there are a few key procedures undertaken to ensure human/ animal health and safety."

The rehabilitation program: the underground mine

Underground mining results in significantly less surface disturbance than open-pit mining. Even during mining operations the surface of an underground mine may simultaneously be used for other uses such as growing crops, grazing livestock, agriculture etc. Shaping and contouring of spoil piles, replacement of topsoil, seeding with grasses and planting of trees take place on the mined-out areas. Care is taken to relocate streams, wildlife, and other valuable resource. As mining operations are winding down, rehabilitation will be undertaken in tandem with the last phases of mine. When mining is ceases on one section of a surface mine, bulldozers and scrapers reshape the disturbed area. Drainage within and off the site is carefully designed to make the new land surface as stable and resistant to soil erosion as the local environment allows. Based on the soil requirements, the land is suitably fertilized and vegetated. Finally, the underground tunnels are stabilized, and the entrances sealed off.

The open-pit mine

An open-pit mine causes significant surface disruption; therefore, rehabilitation is a much more involved process compared to underground mining. The land's post mining end-use will determine what is done with the open pit. Rehabilitation of the pit may be as simple as fencing it off and allowing it to fill with water. Or it may be filled with rock and soil, and contoured into whatever platform is required for the land's post mining use. Often, material removed in the mining process is used for the backfill. Not all land is returned to resemble a natural state, sometimes mine sites are turned into recreational sites, farms, or garbage dumps.

Regardless of end-use of the land there are a few key procedures undertaken to ensure human/ animal health and safety. Waste piles are flattened out and then stabilized to prevent erosion. Ore containing sulfides is covered with a layer of clay to prevent access of rain and oxygen which can turn the sulfides to toxic sulfuric acid. Tailings dams are left to evaporate, then covered with waste rock or

clay. The land is covered with topsoil, and then landscaped into the predetermined surface form. Surface infrastructure may or may not be removed during the rehabilitation process. Some buildings will have a new use, and in some cases, old mine buildings remain for their historic and cultural value.