

# MINERAL EXPLORATION LIFE CYCLE

## AVAILABLE LAND RESOURCES

A large area of land is required to find rare, valuable and hidden minerals.



## PROSPECTING & EARLY EXPLORATION

Prospectors and geoscientists look in the rocks for useful minerals and clues to where a mineable deposit may be hidden.



## RESTORATION AND RECLAMATION

Caring for the environment and restoring land is an ongoing process throughout the mineral exploration life cycle.



## INTERMEDIATE EXPLORATION

Looking deeper into the earth, often using drilling, helps geoscientists better understand where and what types of minerals are hidden beneath the surface.

## MINERAL DEVELOPMENT

There is a particular focus on mine planning including engagement and consultation.



## ADVANCED EXPLORATION

Definition drilling results in many rock samples being taken. Companies think about the design of a mine project.



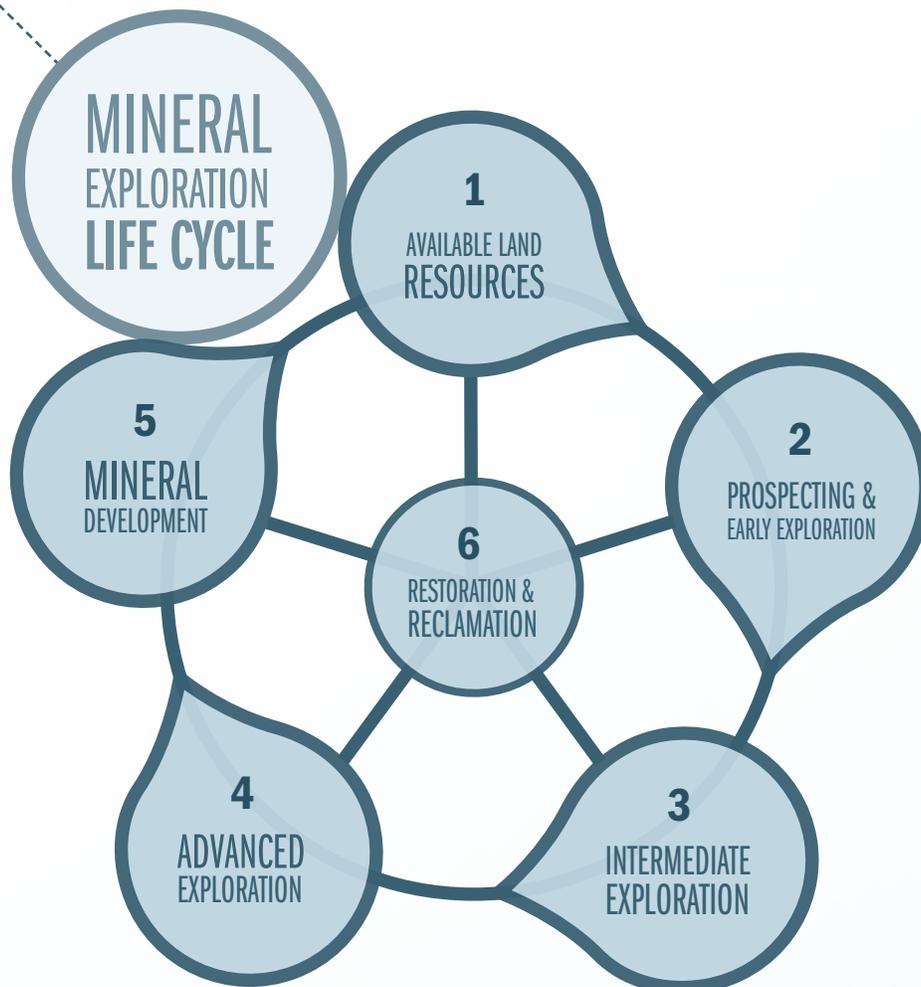
# MINERAL EXPLORATION IS IMPORTANT TO EVERYONE

Mineral exploration rarely results in a mine being developed, but it does create significant benefits including jobs on exploration projects as well as for many people who provide the needed supplies and services. In addition to economic benefits, exploration builds on existing geoscience knowledge and expands the opportunities to find mineral deposits in the future.

Minerals provide resources for life. These important minerals keep us healthy and happy. They are the raw materials needed to build, care for and sustain our world. Whether it is by car, bus, or bicycle, minerals help us get to school and work and play. Everyday household items like tools, electrical wire, refrigerators, ovens and counter tops, even

toothpaste and water filters, all come from mineral development. Minerals are also critical for use in advanced technologies such as cell phones, wind turbines, pacemakers and hip and knee replacements.

The process of finding a concentration of minerals is called mineral exploration. This is the detective work that finds clues in the rocks and land around us to see if there is a mineral deposit. Mineral exploration can be complex and has many stages; it is often easier to think of it as a life cycle. Just as treasure hunters don't always find treasures, mineral explorers often do not discover a mineable deposit. For this reason many exploration programs do not make it through all the stages of the cycle.

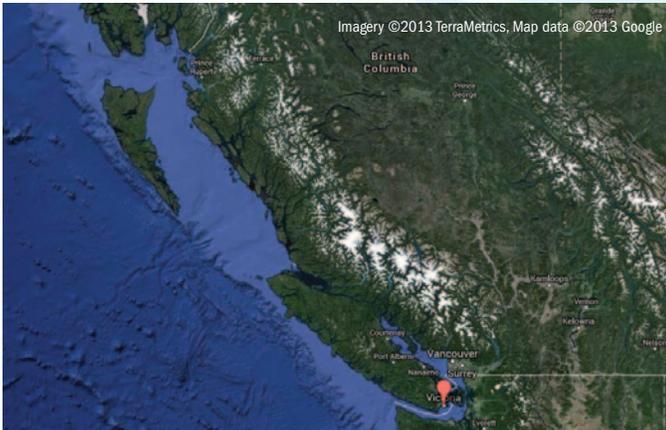


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## AVAILABLE LAND RESOURCES

**LAND ACCESS:** Mineral exploration is a temporary use of the land. It requires looking for clues over a large area to find rare, valuable and hidden minerals – you never know where the clues will lead. Whether the search is for metals, gemstones, coal or building materials, the ability to explore large areas of land over time is essential to making a discovery. The search for hidden minerals is like searching for a needle in a haystack; but we need to be able to search through as much of the haystack as possible.

Mineral projects can be located on both public (Crown) and private lands, and access is highly regulated by governments at many levels.



### 1 AVAILABLE LAND RESOURCES

Mineral development activities have disturbed less than half of one per cent of BC's land – about the size of Greater Victoria – with half of that already reclaimed. From this small footprint come great benefits to the economy and society.



### 2 PROSPECTING AND EARLY EXPLORATION

Mineral exploration is vital to a healthy and sustainable future.



### 2 PROSPECTING AND EARLY EXPLORATION

Early exploration involves very little ground disturbance. Using hand tools such as rock hammers, mineral explorers take very small samples of rock, earth and water for analysis and make maps of geology and other features.

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## PROSPECTING & EARLY EXPLORATION

**EXPLORERS:** In the early stages of mineral exploration, explorers are often called prospectors, people who look in the rocks for useful minerals and other clues to where a deposit may be hidden. Prospectors work together with scientists, including geoscientists, who study the earth's features and history.

Collecting and analyzing this information is called geoscience. Exploration in a certain area changes over time as explorers use different approaches and technologies to examine the clues and as demand for certain minerals evolves. Explorers, who are often early adopters of technology, are innovative, optimistic and persistent.

Mineral development potential, the possibility that a mineable deposit can be developed, may change over time. Evolving geoscience, access to the deposit by land, water and air, hydroelectric infrastructure, commodity markets and extraction technologies may all affect an area's mineral development potential.

**ON THE GROUND:** In the search for minerals, prospectors and geoscientists explore large areas on foot, identifying and mapping locations they have visited, taking small samples of rocks, soils, water, and sometimes vegetation, to be analyzed for clues that could lead to the discovery of a deposit of useful minerals. What they find may also help us understand fault zones and other geohazards such as landslides to assist with earthquake and emergency planning.



### 2 PROSPECTING AND EARLY EXPLORATION

Collecting and analyzing information about the earth's feature and history is called geoscience.

**FROM SPACE AND IN THE AIR:** Mineral explorers often use planes or helicopters to view large areas efficiently. Aeromagnetic surveys, satellite photos, air photos and detailed maps help with decisions on the best places to explore on Earth.

**TOOLS, TECHNOLOGY & SCIENCE:** Rock, water, dirt and vegetation samples collected by prospectors and geoscientists can either be tested on site or in laboratories called assay labs.

**OPENING A DIALOGUE:** Modern mineral exploration includes developing relationships and keeping local communities aware of exploration activities. All parties benefit from open dialogue at the local level.

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## INTERMEDIATE EXPLORATION

**ENGAGEMENT:** Companies proposing mineral exploration engage many different groups including Aboriginal peoples, local and regional communities, and governments. Engagement and consultation help companies obtain input, identify potential financial, social and environmental impacts of mineral exploration and ensure that the needs and requirements of those affected are properly addressed. For example, in BC, First Nations are consulted before any mechanized work can take place on a mineral exploration project.



### 3 INTERMEDIATE EXPLORATION

Drilling under the surface gives us core samples. Examining these samples, as shown above, help us better understand the value and location of mineral resources that may support development of a mine.

**DRILLING & TRENCHING:** Looking deeper into the earth helps geoscientists better understand what is hidden from view and estimate the quantity and value of resources, as well as develop a 3D picture of where different rocks and minerals may be located under the ground. Like any good detective, mineral explorers are always looking for more hidden information.

**COVERING THE COST:** Mineral exploration is expensive and does not generate revenue. Companies that conduct exploration and develop mineral deposits require money – often millions of dollars - to complete their work. Companies usually sell shares on the public stock market to raise money to explore and develop projects. Sometimes large companies can use revenue from existing operations to finance the search for new mineable deposits. Investors in exploration include private individuals and companies.

**ENVIRONMENTAL PLANNING:** Mineral exploration at this stage follows comprehensive guidelines and regulations to minimize any adverse impacts. Scientific inventories and baseline studies may begin at this stage, depending on the location and size of the exploration project.

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## ADVANCED EXPLORATION

**DEFINITION DRILLING AND BULK SAMPLING:** Definition drilling results in many rock samples being taken. Bulk sampling takes a large amount of rock out of the ground. The assay lab to test the samples may be either on-site or at a specialized facility off-site.

**PROJECT DEVELOPMENT DESIGN:** Companies begin thinking about designing the mineral development project. They begin to make plans to extract the rock, process it and handle by-products. This development project planning includes discussions with local communities about the potential benefits developing a mineral deposit can bring and also the concerns to be addressed.

**ENVIRONMENTAL STUDIES:** Using science, inventories are done to identify any rare species, important animal migrations, water quality and flow, wind and other local environmental conditions. Water, soil composition and plant life in the project area are tested to have a baseline understanding of what the project area's environment is like before development begins. Mine design addresses how surrounding ecosystems will be protected during and after mineral development.



### 4 ADVANCED EXPLORATION

Definition drilling results in many rock samples being taken; these may be tested on-site or transported off-site, as at the Brucejack project (above).

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## MINERAL DEVELOPMENT

**PLANS:** Planning occurs at all stages of the mineral exploration life cycle but is a particular focus during the development stage, which focuses on formal plans for project construction, operation and, finally, closure and reclamation, as part of the required environmental assessment and subsequent permitting processes. Environmental assessments consider physical impacts to the environment and mitigation measures as well as social and economic implications. Planning also considers the potential benefits of the project to the local communities, the province and the proponent. Permitting requirements are also part of planning, as they will affect things like mine design, cost of development and site rehabilitation. The value of the rock to be mined (called ore), is estimated at this stage as is the cost of designing, constructing, operating, closing and rehabilitating the proposed mine site.

**ENGAGEMENT AND CONSULTATION:** Engagement and consultation are an important part of the mineral exploration life cycle. Companies proposing mines engage with many different groups including aboriginal peoples, local and regional communities and provincial governments to explain their project. Formal consultation, which is undertaken by the government, helps companies obtain input, identify potential financial, social and environmental impacts of the project and ensure that the concerns of those affected by mining projects are properly considered.

**AGREEMENTS:** Formal agreements are developed with government, aboriginal communities and key stakeholders to provide a framework for understanding key commitments for mineral development, operation, benefit sharing and caring for and restoring the environment. These may be part of the final government approval process for mine development.

**SITE DEVELOPMENT:** Construction proceeds after government approval and can take several years to complete depending on the scope and location of the project. Mineral exploration continues during this phase and through production until the mineral deposit is mined out.



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## RESTORATION AND RECLAMATION

Today's regulations ensure that all exploration sites will be returned as near as possible to their previous conditions. This means that most equipment, buildings and facilities will be removed and any affected land reclaimed and restored. Some necessary monitoring equipment, buildings and facilities may remain.

Planting and other site treatments are used to restore grasses, plants and trees on rock piles and disturbed surface areas. Reclamation occurs at every stage of the mineral exploration life cycle.



5 MINERAL DEVELOPMENT

Engagement and consultation are an important part of the mineral exploration life cycle.



6 RESTORATION AND RECLAMATION: DURING RECLAMATION (LEFT) AFTER RECLAMATION (RIGHT)

Scientists and engineers have learned new techniques to restore disturbed areas on exploration sites such as at Miner Mountain, pictured above. Modern methods mean that these sites can be restored to provide clean water and healthy ecosystems for grasses, plants and trees and natural habitats for birds, fish and wildlife and allow for other land uses in the future.



  
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Looking deeper into the earth through diamond drilling helps geoscientists better understand what is hidden from view.