



**BENEATH YOUR FEET:
A WOODLAND OWNER'S GUIDE TO
MINERAL AND GEOLOGICAL RESOURCES**

Lesson 5: Mineral Exploration and Mining

Overview

Understanding mineral rights is important if your woodland is located in an area where mineral exploration or mining may be pursued, by yourself or others. This Lesson will help you understand mineral rights and the main activities associated with mineral development, such as staking claims, mineral exploration and mining. Landowner rights, interests and concerns in the mineral development process will also be discussed.

Industrial Minerals

As discussed earlier, minerals can be owned by the Crown or by private landowners, but discovery, evaluation and development of industrial minerals is independent of ownership.

Many non-aggregate, industrial minerals in the province are also rock types such as limestone, gypsum, salt, slate and building stone. The distribution of these materials in Nova Scotia is fairly well known from geological mapping and historical mining.

Some deposits of industrial minerals are relatively easy to find. Because deposits of salt, gypsum and limestone form under similar conditions, they are often found in similar geological settings. Geological units that host these particular rock types are primarily found in central Nova Scotia and in Cape Breton.

Building stone suited to construction can be sourced from a variety of rock types. Other industrial minerals such as graphite, kaolinite (a type of clay), and silica sand are discovered and evaluated in a manner similar to metallic minerals.

Metallic Minerals

Although we can often see evidence of industrial mineral deposits and may be relatively confident of their underground quantities, it is rare to have this certainty with metallic minerals. Often incidental information must be used to look for these types of deposits. This information includes the geology, geological features, mineral occurrences and exploration data which may be available for an area. Because metallic minerals have a close association with specific rock types and geological processes, searches can be narrowed to sites of likely occurrences.

Geological information is most commonly presented in the form of maps. Geology maps depict a range of information such as rock types and relationships between geological units. Maps also illustrate geological features, including the orientation of rocks. Whether rocks are lying flat, or are tilted, folded or faulted are important factors in the formation and location of mineral deposits. As an example, most gold deposits in southern Nova Scotia are associated with large fold structures.



Figure 46. Folded gold bearing vein in the Ovens Gold District.

Other types of metallic mineral deposits are associated with the formation of igneous rocks or geological structures such as folds or faults. The Nova Scotia online Prospector's Education Program contains an informative module on the formation of gold deposits and other types of mineral deposits in the province.

The link to the online program is:
novascotia.ca/natr/meb/prospector-videos/video-list2.asp

The presence of mineral occurrences in an area is often a good indicator of unique geological conditions required to form an economic size metallic mineral ore deposit.

A mineral occurrence is a documented location where a mineral or metal has been found.

These may include minerals of economic significance, or other minerals which are often found in association with mineral deposits of economic significance. Using

gold as an example, other minerals which are known to co-exist with gold are often used as a starting point in gold exploration. The rarity of gold dictates that looking directly for gold metal itself would be very time-consuming and costly.

As an example, most of the gold deposits found in southern Nova Scotia are associated with arsenopyrite and quartz veins. If you find quartz veins and arsenopyrite mineralization on your property in this area of the province they are good indicators that you are in an area where you should look for gold.

The Nova Scotia Department of Natural Resources manages a Mineral Occurrence Database which catalogues thousands of mineral occurrences. By viewing the diversity of mineral occurrences across the province, we can visualize the exciting potential for new mineral discoveries in Nova Scotia.

Among other information examined in the search for metallic minerals is a review of work performed on the exploration license such as drilling and sampling. This information is filed and stored with the Department of Natural Resources, and is made available to the public two years after a company or prospector submits the information. A more detailed discussion of this subject can be found in the Accessing Information module of the online Prospector's Education program at:
novascotia.ca/natr/meb/prospector-videos

Mineral Rights and Landowner Rights

As discussed earlier, all minerals belong to the Crown. This includes minerals as defined by the *Mineral Resources Act*, which may exist on or under the ground. Ownership of minerals has remained with the province because of the view that all people benefit from shared resources. To underline this principle, companies must pay the province a royalty fee when minerals are sold.

Mineral exploration rights can be transferred to a company or individual by application to the Nova Scotia government for an exploration licence. To begin mining, a mineral lease is required. “Staking a claim” is the same as applying for an exploration licence, which allows the holder of the licence to explore for minerals in a designated area.

Obtaining an exploration licence does not require permission from a landowner. Permission is necessary, however, to physically explore for minerals on private property or Crown land. The *Mineral Resources Act* gives the Minister of the Department of Natural Resources the right or ability to allow a company or person to cross (access) privately owned land for the purposes of mineral exploration. This section of the *Act* has been rarely used in the past. Companies normally work directly with landowners to avoid any potential conflicts.

A land access agreement between an exploration company and a landowner is often used to clearly describe the company's exploration plans. The

agreement usually outlines the mutually agreed conditions for the company to access a parcel of land. These conditions can include the commencement and termination dates for exploration, and potential financial compensation to the landowner. The agreement describes the kinds of exploration activities to take place, and may include remediation measures for property damage, such as the replacement of trees or repair to woodland roads. These agreements protect both the landowner and the exploration company.

Staking a Claim

The term “staking a claim” may be an old expression, but it is still in use today. Historically, the phrase defined the symbolic staking of ground to mark a piece of government land an individual claimed as his/her own. Both the term and practice were carried forward to be used in mineral exploration jargon.

In time, the physical staking of a claim in Nova Scotia was replaced by paper or map staking, in which claims were recorded on special Claims Reference Maps. More recently, map staking has been replaced by staking over the internet. The Nova Scotia Department of Natural Resources, Registry of Minerals and Petroleum Titles manage the records and regulation of mineral licences in the province through the NovaROC (Nova Scotia's Registry of Claims) system.

A claim is the basic unit for the acquisition of a mineral right. The entire province is sectioned into claims measuring approximately 400 m x 400 m (16 hectares in area).



Figure 47. Sample diagram of a claim.

An exploration licence can include a single claim, or up to eighty adjacent claims, in one licence. The NovaROC online system is open to the public and anyone can view all mineral licences (and leases) in the province.

The Nova Scotia Prospector’s Online Education Program has a module which describes the process for obtaining a mineral licence in more detail.

novascotia.ca/natr/meb/prospector-videos/video-12A.asp

MINERAL EXPLORATION

Determining whether minerals can be mined economically while protecting the environment and nearby communities, is a laborious process. The mining cycle or sequence includes mineral exploration, project evaluation, mine development, production, site closure and reclamation.

Mineral exploration begins before anyone even sets foot on the ground. Companies and individuals study geological maps, reports, government databases and previous exploration surveys to choose areas which they might wish to explore. However, mineral exploration does not

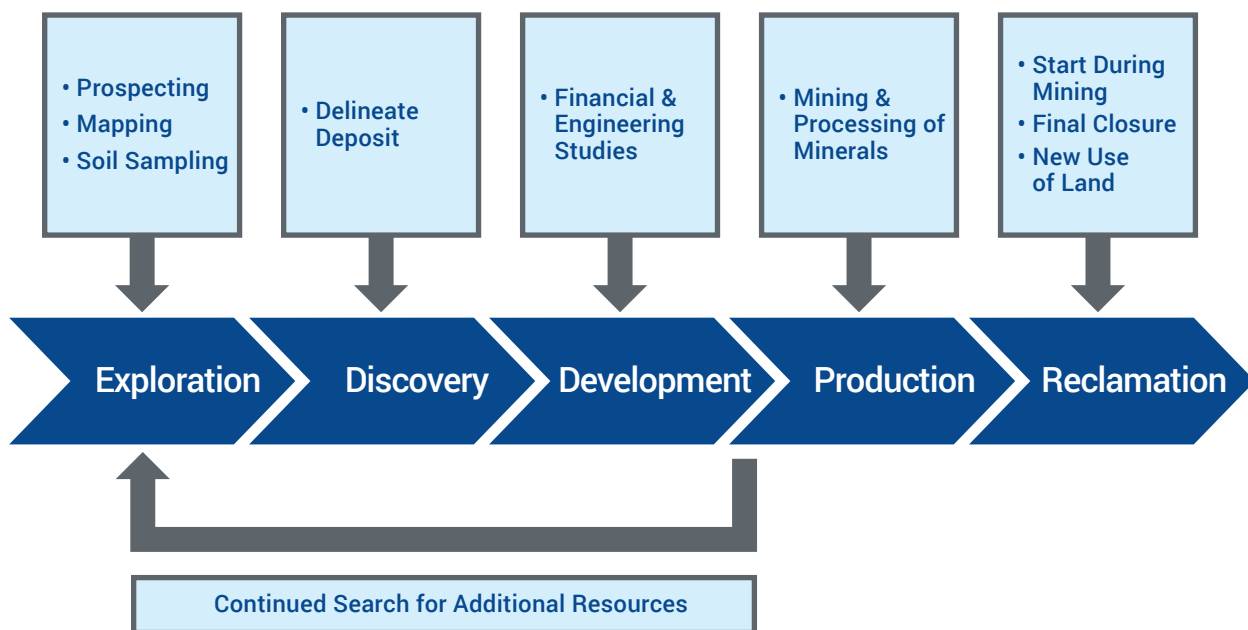


Figure 48. Diagram of mining sequence and activities.

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commence until there is a market demand for a mineral commodity or commodities.

As an example, society is demanding alternative energy products and high tech equipment such as cell phones and computers. All of these products contain rare earth elements (REE's) so a global demand for these products recently created a huge global exploration search for REE deposits in which billions of dollars were spent exploring for these minerals.

It is common to conduct rapid searches over large areas. This is called prospecting. It can be carried out by individuals (prospectors) or companies employing prospectors and geologists in which they will walk across land and along streams looking for evidence of minerals in soil, boulders and bedrock. Samples may be collected from boulders, exposed bedrock or from small holes dug into the soil or till.



Figure 49. Soil sample (paper bag) and till sample (plastic bag).

Prospecting is essentially equivalent to a hiker, fisherman or hunter walking over a block of land. The only difference is the prospector might collect rock or till samples

by hand or carry a piece of geophysical equipment to conduct a survey while they walk. There is no ground disturbance. In most cases the only sign a land owner might see that a prospector has walked their property is a piece of flagging tape with a sample number written on it to mark the sample location in case the prospector needs to return to the location. With the development of accurate GPS technology most prospectors will not even flag the sample location. They can use the stored sample location in their GPS unit to guide them back to the site.



Figure 50. A prospector in the field.

Prospecting does not require a mineral licence but prospectors must obtain landowner permission to enter land, including Crown land. In addition,

prospectors are not permitted to prospect areas where mineral licences have already been issued.

If prospecting proved successful, the next stage of exploration is a shift to systematic grid-based surveys of mineral licenses.

Exploration companies often begin examining large areas of land, then focusing their efforts on smaller areas to better locate the perimeter of a potential mineral deposit. Mineral exploration across large areas is termed regional exploration.

Geological mapping consists of a geologist walking streams, roads, shorelines and cross-country traverses looking for bedrock and surficial geology exposures that can be observed and described. Geological data collected from these exposures is then used to produce bedrock and surficial geology maps.

Other people will traverse the same mineral license and collect a variety of sample media, including rocks, soils, stream sediments, twigs, bark, or possibly lake bottom samples. These samples are sent to laboratories for geochemical analyses of the minerals the company is seeking. This sample collection and analyses are collectively called geochemical surveys.

Glacial deposits, which cover much of the province, create a challenge when mapping the underlying hidden bedrock. To overcome this problem the mineral industry has developed specialized tools called geophysical equipment which can see through the surficial sediments and map characteristic properties of certain rock types and/or mineral deposits. As an

example, some rocks contain magnetic minerals such as magnetite. An instrument called a magnetometer can be used to map the locations of these rocks and trace their presence in areas covered by surficial deposits to areas where the bedrock is exposed. Many of the geophysical surveys can be flown in fixed wing aircraft or helicopters over large areas, or can be done by a person walking on the ground.

There is typically no land disturbance involved with these three types of surveys. Since the introduction of GPS technology, surveys merely involve people walking over the ground surface collecting samples and data. In some instances, 1 m wide lines are cut through densely forested areas to provide a clear line of sight between survey stations.

Data collected through various survey methods is compiled and used to identify areas of concentrated metals. Once these areas are identified the company may decide to decrease the grid spacing to better delineate a target for follow-up or they may decide to trench or drill the target.

An excavator is used to trench the target when the mineralization is expected to be near the surface with shallow surficial material cover. If the target is expected to be deep, companies will employ a drilling rig to drill into the bedrock. The most commonly used drill is a diamond-drill rig. A diamond impregnated bit is rotated to cut a cylindrical piece of rock that is pulled to the surface for mapping and geochemical sampling. These types of surveys are the first to require land disturbance. In the early stages of exploration trenches and

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drillholes are widespread so there is little impact to woodlands.

If drilling or trenching is planned, a notification must be made to the Registrar of Mineral and Petroleum Titles, whether on privately-owned or Crown land. As an exploration target is outlined, survey line grid spacing for the three ground survey types – plus trenching and drillhole spacing – decreases. Advanced exploration programs require tightly-patterned drilling surveys. There is considerable impact to woodlands once the exploration reaches this advanced stage.



Figure 51. An exploration access road and bridge.

Prior to initiating trenching or drilling surveys, exploration companies will negotiate property access agreements with landowners. In some cases this work can be beneficial to landowners, such as the construction of new forestry access roads.

If companies are interested in creating and maintaining good working relationships

locally they should ensure that landowners and communities are kept up-to-date with exploration plans. This includes openly discussing planned activities and encouraging dialogue with landowners.



Figure 52. A diamond drill rig at work.

Should exploration reveal a mineral deposit, next steps would determine whether the deposit could be mined profitably. This evaluation, or feasibility, stage involves viewing all aspects of a potential mining project, including:

- Costs associated with mining the ore;
- Costs associated with milling the ore;
- Development of a reclamation plan for use when the mine closes, and costing of the plan for use in government reclamation bonding;
- Development and implementation of a community engagement plan;
- Proponent engagement with the Mi'kmaq community;
- Environmental baseline data collection plans and implementation, and preparation and submission of an environmental assessment document;

- Negotiations with surface rights landowners to purchase or lease impacted lands;
- A mineral lease application is prepared and submitted.

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If feasibility studies indicate that a project is profitable, will meet environmental standards, is accepted by people and

groups that may be affected by mining and all necessary permits and leases are obtained, mine construction is initiated. Activities include road building, site clearing and construction of mill and mine waste facilities.

Companies usually purchase or lease all property required to mine and process waste, called tailings.



Figure 53. Aerial view of the Dufferin Mine site, near Sheet Harbour, N.S.

WORKING WITH LANDOWNERS

For development of a mine to proceed, a company must prove they own the land or have written permission from the landowner.

Exploration activities take place over several years. Landowners usually have time to decide whether they wish potential development to take place should workable deposits be found. In some instances, a landowner may not wish to allow

exploration or mine development on their property. As discussed earlier, the Minister of Natural Resources may grant surface access through the *Mineral Resources Act*.

When a mine is found and appears to be profitable, is accepted by the local community and other interested people, and meets all environmental requirements, the *Mineral Resources Act* provides a company the ability to obtain a mineral lease to extract (mine) the minerals.

Quiz 5

- 1 Landowners own any gold found in tailings. True False
- 2 A claim is a mineral licence. True False
- 3 Prospectors do not need landowner permission to prospect. True False
- 4 Landowner permission is needed to conduct mineral exploration. True False
- 5 Surface land access can be granted by the Minister of Natural Resources if a landowner denies land access for mineral exploration. True False
- 6 The names of people or companies who acquire mineral licences are kept confidential. True False
- 7 Most mineral deposits that are discovered never become mines. True False
- 8 Drilling requires a notification to be filed with the Registrar but trenching does not. True False
- 9 In a case where a landowner does not wish to sell their property for mine development, a company can apply to have surface property rights transferred to the company. True False
- 10 A royalty is a fee a company paid to the government for staking claims. True False

Case Study – Part 4

Mattie agreed to sign an agreement giving permission to the exploration company to search her property. If they found something, they could cross that issue at a later time.

The summer passed quickly, and Thomas had spent much of it on the woodland. He had used his Forest Ecosystem Classification training to re-map the forest stands in their forest stewardship plan. To his delight, Thomas found that the training helped him choose the right trees to harvest in the uneven-aged management work he was completing in several hardwood stands.

One day, Thomas met Sam while he was walking on his woodlot uphill. Sam stopped now and then to tap a rock with his geologist's hammer. He had a backpack, which contained small chunks of rock. He showed them to Thomas. They were mostly pieces of white quartz with dark grey lines and blotches through them.

Sam took his pocket magnifier from his vest and passed it to Thomas. "It's pretty hard to see, but there is a wee bit of colour in one of these samples," Sam indicated. Thomas peered at the chunk he held in his hand, but could see nothing but quartz. Then he saw it – a speck of yellow which caught the sunlight.

"We won't know if there is enough gold here to be commercially viable until we explore the area thoroughly," Sam said.

Just before Thanksgiving weekend, Sam called Mattie at her home. "I'd like to meet with you," Sam said.

Sam arrived early the next day carrying a roll of maps under one arm which he unrolled on the kitchen table.

Sam said "we would like to drill some test holes in these areas" as he pointed to the map. He also had a document with him to give permission for the company to conduct drilling on their land.

The first phase of drilling we want to undertake is five holes on your property. We may want to follow up with additional drilling in the future if this program proves successful. "To accommodate the heavy equipment, we will need to construct an access road on your property.

Sam produced a document which outlined the responsibilities of North Star and the landowner, including financial compensation for the use of their land for the duration of the exploration work. He carefully explained each clause in the agreement to Mattie and Thomas. One clause in the agreement stated that any access roads constructed by North Star could be used by the landowner, and that the company will work together with Mattie and Thomas regarding the optimal location of access road to suit both their needs.

Mattie and Thomas discussed North Star's proposal for several days. In the end, they signed the agreement to allow

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North Star to drill test holes. Sam was pleased to hear this, and indicated he would flag the centerline of the agreed upon road location. Thomas could cut and sell whatever wood was present along the proposed road location.

Three weeks later, the road had been cut and a bulldozer and excavator had begun the work road construction. The road was then allowed to “set up” for several months before the heavy trucks transporting the drilling equipment arrived.

Scenario 1

Two years had passed since the first drilling program, and Mattie wondered what was happening. She decided to call Sam to see if the company still held the claims and was planning on returning to her property. Sam was happy to hear from Mattie. He explained that since drilling ended the price of gold dropped. The decrease in the price of gold was the reason for North Star’s abrupt cessation of activities. Sam said that until prices moved up a lot they would put their plans for exploration on hold.

Thomas was pleased to have the new access roads, which he would use to manage the woodland he was so passionate about. There was little damage to the woodland from the drilling activities, and Thomas was secretly hoping to manage the woodland in a way that Mattie could someday be nominated for the NSDNR Woodland Owner of the Year Award.

Now *that* was something to work towards!

Case Study – Part 4 (Scenario 2)

The new road had been holding up well under the pressure of heavy trucks and equipment. After the first round of drilling Sam and North Star were quite keen to conduct a lot more drilling over a larger area than the first drilling program. Mattie and Thomas figured that North Star obviously found something of great interest to increase and expand their drilling efforts. Time passed and there had been a lot of activity on Mattie's property over the years. Sam always kept Mattie and Thomas up to date with what they were doing and always seemed very excited about the exploration.

Over this time Thomas had continued working on the woodland, which was now much more accessible because of the road construction. He had also met several interesting people, including biologists and hydrologists, who were collecting information for North Star's environmental monitoring program.

Thomas learned a good deal more about the wildlife and water resources on the property from these people. He found that, in addition to greatly adding to his store of knowledge from the *Forest Biodiversity Stewardship Guide*, he was able to use some of this new information in his woodland activities. For example, he learned that those small pesky wet sites which he used to consider a nuisance when operating his tractor, were actually rich hardwood seeps, and were valuable habitat for amphibians and reptiles. Thomas now avoided working near those sites to protect them from damage.

Sam called one day and asked Mattie if he and an executive with the company - Tony, could come by to visit. Mattie knew they

wanted to talk about something important. Sam and Tony arrived the next morning.

After Tony was introduced; he indicated that the geological and economic information could support mine development. He also said that they that they would like to purchase their property.

Mattie explained that the property has been in the family for over 75 years, and Thomas likes to work on the hardwood hill above the cabin. "I will have to think about this."

Tony did not seem surprised by Mattie's decision. "Why not think about it for a few days, and we can discuss it again?" suggested Tony.

A week later, Sam again dropped by the house.

"I don't blame you if you did not want to sell," he said. "That's a nice property, and your son has put a lot of work into the woodland. So we might be able to reach some kind of compromise here. We could arrange the purchase of about half your property, if you are willing. That would allow

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you to keep the cabin and the hardwood hill, and give North Star access to the area of most interests to us. If gold prices rise and the company needs to expand their holdings, they could discuss that with you in the future.”

Mattie agreed to the new sale conditions, which also allowed Thomas to use the access roads for the management of the 61 hectares (150 acres) of woodland which she would continue to own.