

Aggregate Operators Best Management Practices Handbook

PART II

Chapter 4

MINE PLANNING

Table of Contents

Mine Planning	2
Modular Approach to Mine Planning	2
Mine Planning - A Four-Step Process	4
Step 1 - Scope	4
Step 2 - Research	4
Step 3 - Planning	4
Step 4 - Assembly	4
Maps - The Key Planning Tool	7
Common Map Features	7
Site Location / Access Map	9
Local Features Map	9
Mine Plan / Extraction Map	10
Reclamation / Post Extraction Land Use Map	10

Tables and Figures

Image MP - 1: Modules can apply to various portions of a mine plan, and BMPs can be used in a number of modules.	2
Table MP - 2: Mine planning modules and their sections.	3
Table MP - 3: Helpful mine planning information.	5
Table MP - 4: Mine plan activity and module worksheet.	6
Table MP - 5: Basic & other commonly required map elements.	8
Table MP - 6: Common types of aggregate permit application maps.	9

Mine Planning

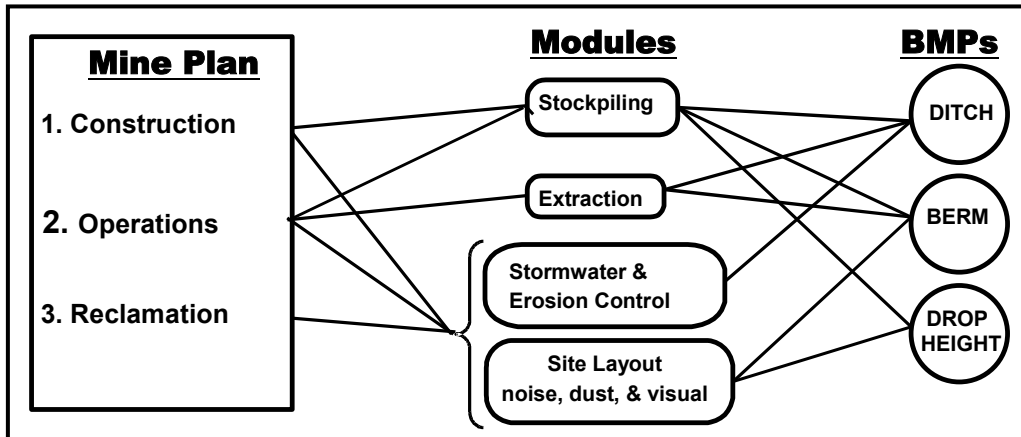
This chapter contains basic advice on mine planning, map preparation and coordination of aggregate production. It also includes non-production related topics such as noise, dust and traffic. It describes in general terms how to use the modules presented in Chapter 5 of this manual, and contains a section on use of maps in planning.

Preparing a mine plan may be a significant undertaking involving engineering reports, market analyses, community consultation and environmental studies. A mine plan may address issues related to:

1. resource identification (exploration)
2. market analysis and business planning
3. access to land
4. environmental management
5. community consultation
6. permitting processes
7. operations
8. reclamation and post extraction land use

Modular Approach to Mine Planning

Figure MP - 1: Illustration of a modular approach to mine planning



The following modules address many aspects of managing an aggregate operation, with each module containing helpful planning and BMP suggestions.

Table MP - 2: Mine planning modules and their sections

MODULES & Sections	Abbreviation
1. EXTRACTION	EM
2. PROCESSING	PM
3. STOCKPILING	SM
4. TRAFFIC	TM
5. STORMWATER & EROSION CONTROL	SECM
6. BY-PRODUCT & WASTE MANAGEMENT	BWM
7. SITE LAYOUT <ul style="list-style-type: none"> • Noise • Dust • Visual Landscape 	SLM
8. RISK MANAGEMENT <ul style="list-style-type: none"> • Emergency And Spill Response • Employee Training • Community Relations • Identifying Potential Environmental Issues 	RMM
9. BMP MONITORING	BMM

Modules can be selected as required by the location, size and complexity of the operation to ensure that priority areas are handled appropriately, and to make the overall mine planning process less daunting.

Each module includes a discussion and planning and BMP suggestions. All modules follow a similar format for ease of use. The general format is:

1. common concerns
2. discussion of the topic
3. suggested planning and BMPs options

Mine Planning - A Four-Step Process

Because every gravel pit and rock quarry is unique, each will have a unique mine plan. Nonetheless, there are four common steps that can be applied to most aggregate operations in preparing formal mine plans or reviewing existing operations.

Step 1 - Scope	<ul style="list-style-type: none">• Define the project.• Set goals.
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A mine plan should be the blue print for an aggregate operation. Scoping out a mine plan involves determining what needs to be done and setting out goals for the operation. Will the product be pit run or high quality screened and washed aggregate? Will a quarry produce riprap or Superpave™ aggregate? There are many factors that will affect the answers to these questions. A mine plan should be flexible, technically competent, business smart and respectful of the community and the environment.

Step 2 - Research	<ul style="list-style-type: none">• Gather information for turning goals into detailed plans.
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Research helps to flesh out the goals into plans. Table MP - 3 lists some helpful types of mine planning information and may be a good starting place for research. The Identifying Potential Environmental Issues component in the [Risk Management Module](#) also has references to numerous information sources. Legal information requirements for formal mine plan applications are laid out in the [Mines Act](#), the [Health, Safety and Reclamation Code for Mines in British Columbia](#), and the *Sand and Gravel and/or Rock Quarry Notice of Work and Reclamation* form. Further information may be required by other Provincial or Federal acts or local government bylaws. Those mining specific documents, other statutes and local government community plans and bylaws set out the information parameters that allow decision makers to assess mine safety and community and environmental impacts.

Step 3 - Planning	<ul style="list-style-type: none">• Plan out the details.
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Mine planning involves making decisions. A good mine plan explores all of the options within various constraints (i.e. economic and technical feasibility, compatibility with adjacent land uses, compliance with legal requirements, etc.) to determine how a mine will be developed and operated. Maps help to visualize a mine plan. They are essential planning tools for developing any aggregate property, and a number are required for a *Mines Act* permit application. Basic advice for constructing plan maps is presented later in this chapter.

Step 4 - Assembly	<ul style="list-style-type: none">• Put all the pieces together.
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The final step in the mine planning process is to assemble the information and concepts in a comprehensive plan. The information could include advice from pertinent modules in this handbook as well as the various documents (engineering reports, environmental and community reports, etc.) submitted in support of a *Mines Act* permit application.

Table MP - 3: Helpful mine planning information

INFORMATION CATEGORY	INFORMATION (examples in brackets)	SOURCES: Where to find detailed requirements or information
Legal	<ul style="list-style-type: none"> • Tenure (property title, lease) • Company name • Site identification (lot numbers) • Jurisdiction (municipal, Crown, etc.) 	<ul style="list-style-type: none"> • Internal / Corporate • Land and Water BC • Local Government • Land Title Office
Administrative	<ul style="list-style-type: none"> • Applicant's name • Contact information (address, phone) • Application type (pit, quarry, new, modified Notice of Work and Reclamation) 	<ul style="list-style-type: none"> • Internal / Corporate • Mines Act • Health, Safety & Reclamation Code
Geological	<ul style="list-style-type: none"> • Type of deposit • Extent of deposit • Grade, quality • Soils requiring conservation • Topography and drainage 	<ul style="list-style-type: none"> • Consultants • Lab results • Market standards (CSA, BCH, ASTM, AASHTO, CalTrans)
Engineering	<ul style="list-style-type: none"> • Slope design • Blasting • Facility equipment (extraction, processing, transportation) 	<ul style="list-style-type: none"> • Internal / Corporate • Equipment vendors • Health, Safety & Reclamation Code
Transportation	<ul style="list-style-type: none"> • Onsite haul roads • Onsite loading requirements • Offsite routes 	<ul style="list-style-type: none"> • Internal / Corporate • Health, Safety & Reclamation Code • Ministry of Transportation • Local governments
Operations	<ul style="list-style-type: none"> • Production rates / scheduling • Products 	<ul style="list-style-type: none"> • Mines Act • Health, Safety & Reclamation Code • Internal / Corporate
Environmental	<ul style="list-style-type: none"> • Habitat <ul style="list-style-type: none"> • Fish and wildlife habitat present • Red & Blue listed species in area • Water <ul style="list-style-type: none"> • Average rainfall • Potential site rainfall volumes • Water supply • Groundwater depth & quality • Creeks, streams and other water bodies and courses • Vegetation <ul style="list-style-type: none"> • Inventory • Air quality 	<ul style="list-style-type: none"> • Ministry of Sustainable Resource Management • BC Conservation Data Centre (CDC) • Fisheries & Oceans Canada • Environmental Atlases • Consultants • Ministry of Water, Land and Air Protection - web pages and regional offices • Land Reserve Commission • Ministry of Agriculture, Food and Fisheries • Local government offices • Mines Act & Health, Safety & Recln Code
Community	<ul style="list-style-type: none"> • Official Community Plans • Zoning, bylaws & other regulations • Adjacent land use, easements, statutory right-of-ways, covenants • Site history • Noise and dust receptor sensitivity 	<ul style="list-style-type: none"> • Local government • BC Heritage • Ministry of Community, Aboriginal and Women's Services
Reclamation	<ul style="list-style-type: none"> • Decommissioning specifications and reclamation standards 	<ul style="list-style-type: none"> • Mines Act • Health, Safety & Reclamation Code • Zoning defined within Official Community Plan or Growth Strategies

Table MP - 4: Mine plan activity and module worksheet

MODULES Activity	EM	PM	SM	TM	SECM	BWM	SLM			RMM					
	Extraction	Processing	Stockpiling	Traffic	Stormwater & Erosion	By-product & Waste	Noise	Dust	Visual Landscape	Risk Management	Emergency & Spill Resp.	Employee Training	Community Relations	ID Environmental Issues	BMP Monitoring
SITE PREPARATION															
Timber clearing / Grubbing			✓		✓	✓	✓		✓		✓	✓		✓	✓
Topsoil / Overburden salvage			✓		✓	✓	✓	✓	✓		✓	✓		✓	✓
Construction/Utilities/Services					✓	✓				✓	✓	✓			✓
Sediment Control	✓				✓							✓		✓	
OPERATIONS/EXTRACTION															
Haul roads	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓			✓
Extraction	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Drilling and blasting	✓	✓					✓	✓		✓	✓	✓		✓	✓
H/C storage, handling, disposal	✓	✓			✓	✓				✓	✓	✓		✓	✓
Mobile equipment operations	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓
Waste management	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓
Site entrance / Exit		✓	✓	✓	✓			✓	✓				✓		✓
Safety & security	✓			✓						✓		✓	✓	✓	✓
Stormwater / Erosion control	✓		✓		✓	✓						✓			✓
Settling ponds	✓	✓			✓	✓					✓	✓			✓
Water exfiltration/Discharge	✓	✓			✓	✓					✓	✓		✓	✓
PROCESSING & HANDLING															
Screening / Crushing		✓				✓	✓	✓	✓			✓			✓
Washing		✓			✓	✓			✓		✓	✓			✓
Material separation / Blending		✓	✓				✓	✓				✓			✓
Conveyor operations		✓	✓				✓	✓	✓		✓	✓			✓
Stockpiling / Material handling		✓	✓		✓	✓		✓	✓			✓			✓
Loading		✓	✓	✓			✓	✓	✓		✓	✓			✓
RECLAMATION															
Decommissioning	✓				✓	✓			✓		✓	✓	✓	✓	✓
Grading / Drainage alteration	✓				✓	✓		✓				✓	✓	✓	✓
Re-vegetation	✓				✓	✓			✓			✓	✓	✓	✓
OFF SITE IMPACTS															
Traffic		✓		✓			✓	✓					✓		✓
Dust	✓			✓				✓	✓			✓	✓	✓	✓
Noise	✓	✓		✓			✓					✓	✓	✓	✓
Viewscapes	✓	✓	✓	✓	✓				✓				✓		✓

Maps - The Key Planning Tool

Maps are the key tool for developing a mine plan. In order to clearly illustrate an operation, they should be of appropriate size and scale. Maps can range from pen and ink annotations on pre-printed government topographic maps, to digital products on customized and surveyed base maps. Basic information that is commonly required on maps is illustrated in Table MP - 5.

Maps can be drawn to show almost any aspect of an aggregate operation and are specifically recommended in several of the modules in this handbook. The scale, complexity and location of an aggregate operation will determine how many, and what types of maps should be prepared. Depending upon the detail required, some maps may be combined. Table MP - 6 lists some common types of aggregate mine maps.

The Ministry of Energy and Mines' Sand and Gravel / Quarry Notice of Work and Reclamation Program form outlines the Ministry's specific map requirements. Applications for other necessary permits or authorizations may also have specific map requirements.

Common Map Features

Some common features that should be present on all aggregate permit application maps are:

- Boundaries of the requested permit area,
- Elevations and contours,
- Drainage patterns and names,
- Jurisdictional boundaries and names of local governments,
- Property boundaries, dimensions and lot numbers,
- Roads, access points, railroads, utility lines, right-of-ways and easements with complete names,
- Current land uses including buildings and structures, locations of wells, park lands, and other artificial features,
- Boundaries and dimensions of the areas to be disturbed and mined,
- Environmentally sensitive areas such as streams, lakes, wetlands, coastlines, coastal bluffs, older forests, riparian vegetation and woodlands (Note: some local governments have Environmentally Sensitive Areas Atlases available to the public), and
- Adjacent land uses.

Table MP - 5: Basic and other commonly required map elements

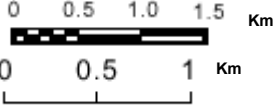
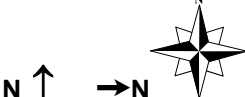
Map Element	Description	Examples
Basic Map Elements		
Map Scale	Scale tells you the relationship between the size of features on the map and their actual size on the ground. Applications generally tell you what scales are required for each map.	<p style="text-align: center;">Common Scales</p> <ul style="list-style-type: none"> • Location maps - 1:250,000 / 1:50,000 • Local features map - 1:20,000 (TRIM) • Site map - 1:500 to 1:1,000 <p>Note: Cross sections should have the same vertical and horizontal scales.</p>
Graphic Bar Scale	Graphic scales are like a ruler that can be used to measure the size of features on the map, and will remain accurate even if the map is reduced or enlarged.	
North Arrow	All maps must show the direction of north. A north arrow helps to orient the map during field use.	
Legend	Defines all symbols and patterns used on the map.	
Title Block	May contain information such as: <ul style="list-style-type: none"> • Title of Map • Permit/Application Number • Name & Address of Permittee • Signature of Engineer • Map Number • Date of Map 	
Topographic Contours	Lines of equal elevation, illustrating the topography or the lay of the land for the map area.	<ul style="list-style-type: none"> • Contour intervals are determined by scale and detail required. • State contour interval in legend.
Boundaries	<ul style="list-style-type: none"> • Permit area boundary • Mining boundary • Local govt. boundaries • Property lines, etc. • Dimensions 	
Other commonly required map elements		
Watercourses, Ponds and Wetlands	All streams, rivers, wetlands and ponds should be indicated on the maps.	
Environmental Features	<ul style="list-style-type: none"> • coastlines & coastal bluffs • old growth forests 	Note: Some local governments have Environmentally Sensitive Areas atlases available to the public.

Table MP - 6: Common types of aggregate permit application maps

<i>Common Types of Maps in a Mine Plan</i>	<i>Notice of Work and Reclamation Map*</i>
Site Location/Access Map	Schedule A1*
Local Features Map	Schedule A2*
Land Title Map	Schedule A3*
Mineral Tenure Map	Schedule A4
Terrain/Geology and Terrain Stability Map	Schedule A5
Mine Plan/Extraction Map	Schedule A6*
Cross Section of Proposed Development	Schedule A6*
Reclamation/Post Extraction Land Use Map	
Module Maps (Dust, Noise, etc.)	

* Indicates required by Notice of work and Reclamation Program

Site Location/Access Map

A Site Location/Access Map shows the regional setting of the site and how to reach the site by road. This type of map is commonly presented on a letter size page. Some Site Location/Access Maps also incorporate copies or overlays of air photos to give a bird's eye view of the regional setting.

Local Features Map

A Local Features Map shows background information for the site, such as the lay of the land before extraction begins. Land use, archaeological or environmental features could also be illustrated on this map. Similarly to the Site Location/Access Map, air photos can be combined with contours to convey the relationship between the features of the property with the surrounding area.

Additional local features:

- water wells
- archaeological sites
- environmental features
- test pit & test drill locations
- vegetation

Mine Plan/Extraction Map

Mine Plan/Extraction Maps show how the deposit will be mined. Applicants may choose to produce one for each phase of extraction or one for each stage of completion (e.g., at 25%, 50%, 75% and 100%). Alternatively, they may choose to illustrate all phases on a single map. Mine plan/extraction maps should be accompanied by cross sections showing water table information and, in the case of quarry plans, geological structure details.

Additional Mine Plan/Extraction Map features:

- 2 metre contours
- Permanent boundary markers
- Proposed access roads
- Setbacks and berms
- BMPs (note codes in top left hand corner of BMPs for this use)
- Stockpile areas
- Primary crusher and processing plant
- Stormwater and erosion control features (i.e., ditches, settling ponds, etc.)

Reclamation/Post-Extraction Land Use Map

Sand and gravel pits and rock quarries in British Columbia may be reclaimed for agriculture, forestry, wildlife habitat, fish habitat, recreational, residential or industrial uses. Post-extraction land use may be determined by an official community plan (see [Risk Management Module](#)). An appropriate map should be prepared showing the configuration of the site upon completion of mining and reclamation.

The key element of this map, which should include a cross section, is the proposed post-mining lay of the land, or grade. For ease of reference, the map should be of the same scale as the Local Features Map, or at a scale convenient for the post-extraction use of the site. For some situations, this map could also be the final mining stage or the 100% mine plan/extraction map. For reclamation details, refer to the *Reclamation and Environmental Protection Handbook for Sand, Gravel and Quarry Operations in British Columbia*. It is currently available from the [Ministry of Transportation](#).

Additional reclamation/post-extraction land use features:

- Reclaimed drainage patterns
- Depth of replaced overburden, rock, and topsoil
- Revegetation plans, if applicable