



Department of
**Primary
Industries**

**Guidelines for
Environmental
Management in
Exploration
and Mining**

1

EXPLORATION
& REHABILITATION OF EXPLORATION SITES

Minerals and Petroleum Division

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1. PREAMBLE

1.1 BACKGROUND

(1) Exploration is the search for economic mineral deposits by a variety of methods, most of which have a low impact on the environment. Exploration is usually undertaken within Exploration Licences, granted under the *Mineral Resources Development Act 1990* ("the Act").

(2) The Guidelines for Exploration and Rehabilitation of Exploration Sites ("the Guidelines") apply to all exploration carried out under the Act. They do not cover mining, which is the commercial extraction of minerals. However, they do apply to exploration activities carried out on Mining Licences.

(3) The Act requires that a licensee must rehabilitate the land in accordance with the conditions of the licence. The Guidelines refer to "standard licence conditions" for exploration and a number of statutory regulations which must be complied with. The "standard licence conditions" are those which are applied routinely to Exploration Licences. However, they may be varied for a particular Exploration Licence and may be incorporated, in full or in part, in Mining Licences. In all cases, the licensee should check the licence to establish the conditions which apply. In addition, advice is provided in the Guidelines on environmental and rehabilitation practices which should be adopted by licensees.

(4) Conditions imposed on licences, or on consents granted under provisions of the Act, or operational requirements imposed under legislation, may require more stringent measures than those recommended in the Guidelines. In such instances, those provisions take precedence over the Guidelines.

(5) A separate publication entitled *Guidelines for Abandonment of Mineral Drillholes* should be referred to for advice on the sub-surface abandonment of drillholes.

(6) Reference to "the Department" means, unless otherwise stated, the Department responsible for the administration of the Act. This is currently the Department of Primary Industries (DPI). Reference to the "land manager" means the division of the Department of Sustainability and Environment (DSE) or agency responsible for management of the relevant Crown land, usually Forest Services division, Crown Land Management division or Parks Victoria.

(7) It is recognised that some of the activities referred to in the Guidelines may be covered by compensation agreements entered into under Part 8 of the Act.

1.2 DEFINITIONS

Words marked with an asterisk (*) are defined in the Appendix to the Guidelines. Reference should also be made to the definitions contained in section 4 of the Act.

1.3 PURPOSE OF THE GUIDELINES

(1) The purpose of the Guidelines is to assist licensees to ensure that exploration in Victoria is carried out in an effective and responsible manner with the least environmental disturbance reasonably practicable, and that areas of land disturbed during exploration activities are rehabilitated to an acceptable standard.

(2) It is recommended that licensees require that staff and contractors and their employees be familiar with and observe the Guidelines.

2. GENERAL PRINCIPLES

The general principles, as detailed in this part of the Guidelines, apply to all exploration under a licence.

2.1 CO-ORDINATION

(1) To facilitate communication between the licensee, owners and other interested parties, standard licence conditions require that the licensee notify in writing the Manager - Minerals & Petroleum Tenements, Melbourne office, and the relevant Regional Mining Engineer of the name, telephone number and location of a contact person for exploration and rehabilitation activities carried out on the licence.

(2) Standard licence conditions require that the licensee inform the chief executive of the municipalities within the licence area of the proposed work program and its duration, prior to commencing work and provide further information as appropriate during the term of the licence. It is not the intention of this clause to substitute for the legal responsibilities of the licensee to notify various authorities.

(3) Standard conditions for all work plan approvals require notification of the land manager, usually a division of the Department of Sustainability and Environment (DSE), prior to commencement of any program of work on Crown Land.

2.2 PLANNING

In order to minimise environmental impact and facilitate effective rehabilitation of disturbed areas, activities carried out on a licence should, as far as reasonably possible, be planned in advance.

2.3 SOIL

(1) Standard licence conditions require that soil disturbance be kept to a minimum. Where soil is significantly disturbed, topsoil* is to be removed and stockpiled as near as reasonably practicable to the working area, together with all leaf and plant litter. Where subsoil* is disturbed, this is also to be stockpiled as near as practicable to the working area, but separately to the topsoil.

(2) Standard licence conditions require that soil be replaced as soon as is practicable, in order that the microbial activity, seed viability and soil fertility are maintained. Soil is to be replaced such that the subsoil is replaced first, and the topsoil is replaced last.

(3) When refilling trenches and holes, soil should be compacted into the trench or hole to minimise settlement in the future. Such openings should be initially refilled to above the natural ground level to allow for subsequent settlement. However, this should not normally exceed 150mm above the natural ground level.

(4) The licensee should undertake follow-up surveys of trenches and holes so that areas which may have settled below the natural ground surface can be topped up with the soil remaining from the original operation. Follow-up surveys should be conducted at appropriate intervals of time following backfilling.

2.4 VEGETATION

(1) Before removing vegetation on Crown Land, the licensee should consult with the land manager, usually a division of DSE, regarding restrictions which may apply under legislation other than the Act. In areas of Crown Land, a royalty may be payable on the value of the timber cut down during operations.

(2) Before removing vegetation on private land, the licensee should seek advice from the owner unless provision for vegetation removal has been made in the compensation agreement.

(3) Standard licence conditions require that vegetation removal be kept to a minimum. Where possible, locate vehicle access tracks at a reasonable distance, normally at least 2m, from trees greater than 150mm in diameter. Minimal tree trimming to gain access for vehicles is preferable to felling. Where trees have to be removed, timber should be cut and moved to one side of the track to allow salvage. Trees should be cut at the base at a height equal to the diameter of the tree rather than uprooted, to allow coppicing*.

(4) Clearing of vegetation between survey markers should be kept to a minimum. Greater numbers of markers should be used in preference to clearing vegetation between markers. Survey lines requiring only foot access should be cleared by hand.

(5) Standard licence conditions require that rehabilitation of disturbed areas be undertaken to achieve final revegetation with species consistent with the surrounding vegetation.

(6) Where rehabilitation back to a cover of native vegetation is to be undertaken, species native to the local area should be used. Gathering of seed and planting methods should be discussed with Minerals and Petroleum Regulation Branch environmental officers.

(7) Follow-up surveys at appropriate intervals should be undertaken after planting to ensure that successful revegetation has been achieved.

(8) Standard licence conditions do not permit the blazing or permanent marking of trees.

2.5 PLANT DISEASES AND WEEDS

(1) Licensees should be aware of the problems associated with vehicles and equipment carrying noxious weeds and plant and livestock diseases. Care should be exercised to ensure that the spread of such weeds and diseases is minimised. This may require regular and thorough cleaning of vehicles and equipment.

(2) Cleaning should include all types of equipment, particularly those types where soil and vegetation is likely to become lodged. Equipment size is not a criteria for cleaning, as soil is just as likely to be carried on work boots as on a drilling rig.

(3) When removing equipment from an area, thoroughly remove all soil and other organic matter from vehicles and equipment prior to departure. The undersides of vehicles require particular attention.

(4) When equipment is moved to Victoria from interstate, or from one part of Victoria to another, it may also be necessary to disinfect that equipment, depending on the existence of diseases and noxious weeds in the area from where the equipment has come. For example, the root pathogen *Phytophthora cinnamomi* (Cinnamon Fungus) causes dieback and death to many native plant species. Equipment coming from areas where the fungus exists in the soil would need to be disinfected with sodium hypochlorite or ABF-42 prior to use. (Note: disinfectants should not be applied in the vicinity of streams.)

(5) Licensees should seek advice from the land manager (or the land-owner) and Agriculture Victoria regarding any special noxious weed or disease conditions which prevail in the intended area of operation, and the best method of minimising the risk of spreading the weed or disease.

2.6 STREAMS AND WATER QUALITY

(1) Standard licence conditions require that exploration work be conducted away from stream and drainage lines as much as reasonably possible to ensure that the water quality of streams and dams is maintained. Except in the case of geological surveying and geochemical surveying, work areas are to be sited so that a sufficient buffer is maintained to ensure that runoff does not enter directly into streams. Minimum buffer widths should normally be 20m.

(2) Standard licence conditions require that all reasonable steps be taken to ensure that possible sources of contamination such as fuel, lubricants and drilling additives, are sited away from streams and drainage lines, and are properly contained and stored.

2.7 NOISE AND DUST

(1) Permitted noise limits are set by the Environment Protection Authority. Standard licence conditions require compliance with these limits. Standard licence conditions also require that mufflers be fitted to mechanical equipment where appropriate, and that the operation of mechanical equipment and the detonation of explosive charges are, whenever reasonably possible, restricted to such times as will not unduly annoy or disturb others in the area. Obviously, the operating times and noise level of operations will in part be dependent upon the circumstances. Near dwellings and towns, operations may be restricted to daylight hours by special conditions on the licence, while in more remote areas, it may be possible to operate for longer periods.

(2) Licensees should consult with the Department in order to determine whether noise emanating from proposed operations is likely to cause significant disturbance to native fauna during critical periods such as breeding seasons. The licensee should take all reasonable measures to avoid disturbance to native fauna during such periods.

(3) Dust generated as a result of exploration activities should be kept to a minimum and, if it exceeds reasonable levels, controlled using water sprays, tankers, or other dust-control systems.

2.8 TRACKS

(1) Vehicular access to areas should, as far as practicable, utilise existing tracks rather than cutting new ones. If the use of a vehicle involves no marked disturbance to the land surface, the requirement to rehabilitate does not apply.

(2) Where it is necessary to cut a new track, this should be planned in advance to avoid, if possible, areas where track construction is likely to be difficult or environmentally damaging. Where a new track is to be constructed by the licensee to gain access to Crown Land, an Impact Statement may be required under section 41A of the Act. Licensees should consult with the relevant Department to determine whether such a requirement may apply

(3) Measures should be taken to minimise soil erosion and deterioration of water quality in the vicinity of tracks constructed by the licensee. Tracks should not follow the course of streams or drainage lines.

(4) Track routes should also seek to minimise any impact on landscape values. Account should be taken of areas likely to be visible from public vantage points, towns, cities or highways. Tracks should be planned as much as reasonably possible, to blend into the terrain and maintain landscape values. This may not always be the shortest or most direct route.

(5) Standard licence conditions require that the construction of new tracks on Crown land be carried out in consultation with the land manager, in relation to standards of construction. Tracks should be designed and constructed to a standard consistent with their intended use.

Tracks to be used for drill pad access by heavy drilling equipment will require a higher standard of design and construction than a track intended for light vehicle access.

(6) When using or constructing tracks, trimming should only be carried out to remove actual obstructions to vehicles. The trimming of overhanging timber should be kept to a minimum (also see 2.4).

(7) Avoid disturbance to streams and riparian vegetation* by siting crossing points so as to minimize the entry of sidecast* material and ensure that road surface runoff does not discharge directly into streams. Tracks should not be constructed within 30m of a stream other than at a crossing point.

(8) Standard licence conditions require that tracks constructed by the licensee are in accordance with the Forest Code of Practice and are properly formed, consolidated and drained to ensure that the impact of runoff on water quality is minimised.

(9) A properly constructed crossing should be established and maintained if a stream crossing is likely to be used more than a few times.

(10) Tracks should be located to minimize earthworks and, as far as is practicable, avoid steep and unstable slopes, areas prone to landslip, and damp southern aspects.

(11) Batter slopes* adjacent to tracks should be stable. On highly erodible soils, revegetation or stepping may be necessary. In extreme cases, the use of retaining walls, wire gabions*, etc. may be required.

(12) Rehabilitation of embankments and fills should be undertaken at the time of construction of the track. Fills and embankments may require consolidation. If tracks are to be retained for a significant time, faces and slopes requiring stabilisation and drainage should be seeded with grasses or other species consistent with the surrounding vegetation to establish protective ground cover. It may be necessary to respread topsoil on embankments to assist in plant establishment.

(13) Standard licence conditions require that tracks and forest roads only be constructed, used and rehabilitated when weather conditions permit. Construction and use of tracks during wet weather may result in unacceptable erosion, loss of water quality, track damage and difficulties in rehabilitation.

(14) The licensee should seek advice from the owner or land manager as to whether any of the tracks constructed by the licensee will be required for other purposes. Tracks required for future use as part of the State track network or by the land-owner should be left in a serviceable condition when the track is no longer required by the licensee.

(15) Standard licence conditions require that upon completion of exploration operations, tracks constructed by the licensee and not required as part of the State track network, or by the land-owner, are reinstated to natural surface wherever practicable. Licensees should consult with the Department if some other form of rehabilitation is proposed

(16) Minimum requirements under standard licence conditions are that tracks be breached and barred to redirect water flow from the track onto undisturbed areas. In areas where the rehabilitated track may still be accessible to vehicles, the licensee should install a suitable barrier at the intersection with a permanent track. This can be in the form of an earthen barrier, heavy log, or similar obstacle for preventing access..

(17) Tracks should be rehabilitated by seeding with species consistent with the surrounding vegetation, unless other requirements are specified by the landowner.

(18) Follow-up surveys at appropriate intervals should be undertaken after planting to ensure successful regeneration.

2.9 RUBBISH AND WASTE

(1) Standard licence conditions require that rubbish material be removed from a work site or survey area at the completion of works. Where site occupation is prolonged, periodic removal of rubbish may also be required. Rubbish should be disposed of at an appropriate rubbish disposal site. Redundant equipment should also be removed from the licence area.

(2) Work sites should be provided with a rubbish receptacle to facilitate rubbish removal at the completion of an operation.

(3) Portable self-contained toilet facilities should be provided at work sites, such as drill sites. Toilet waste from portable toilets should be removed from the site periodically, and disposed of at a site appropriate for such waste.

(4) During the course of a survey, particularly one requiring foot access by field parties (such as a soil sampling survey), personnel should ensure that any rubbish generated by them is not discarded in the survey area, but brought back and disposed of in the proper manner. During surveys of this type, solid toilet wastes should be buried.

2.10 SURVEY MARKERS

(1) There are a wide variety of markers available for survey purposes. These include wooden pegs, steel pegs, plastic pegs, coloured tape, aluminium tags and paint used to indicate grid lines, sample sites, etc.

(2) Marker pegs, should be removed at the completion of a survey, unless the area is to be accessed again during the term of the licence. Any remaining marker pegs should be removed at the termination of the licence, except where the permission of the Inspector has been given, in writing, to leave base-line markers.

(3) Standard licence conditions require that tape used to mark sites of interest be of the biodegradable type. The quantity of tape used should be kept to a minimum. Tape markers should be removed where practicable at the termination of the survey or licence.

2.11 ARCHAEOLOGICAL AND HISTORIC SITES

Licensees should be conversant with their obligations regarding archaeological and historic sites and areas, as provided for under sections 6(c) and (d), and section 45 of the Act.

2.12 STOCK AND CROP DISTURBANCE

(1) Exploration activities, particularly those involving vehicles, should, where reasonably practicable, be timed to minimise disturbance to stock and/or crops.

(2) Standard licence conditions require that licensees instruct exploration crews to leave gates as found. If any damage to fencing or gates results from exploration activities, the owner or occupier is to be informed and repairs undertaken immediately.

(3) Licensees should take all reasonable steps to inform the land-owner of matters relating to the possible disturbance to livestock and their protection from potential hazards associated with exploration activities.

(4) Domestic animals, particularly dogs and cats, and firearms, should not be taken onto licences areas.

2.13 FIRE PRECAUTIONS

(1) Standard licence conditions require that adequate fire precautions are to be exercised by licensees at all times. Local fire hazard conditions or fire susceptibility, particularly during declared fire danger periods, are to be checked with the local Country Fire Authority Fire (CFA) officer or the land manager before commencing, and periodically during, exploration activities.

(2) Standard licence conditions require that operations involving mechanised equipment are to be provided with appropriate fire fighting equipment. Equipment such as drill rigs is to be provided with approved knap-sack sprays and rake-hoes in addition to fire extinguishers.

(3) Standard licence conditions require that all fire bans, regulations and directions from CFA officers and the relevant Department be observed. It is the responsibility of the licensee to be aware when fire bans and associated conditions are in force. The relevant regulations to be observed when conducting operations on Crown land are the Fire Protection Regulations 1992.

(4) Standard licence conditions require that all internal combustion engines are to be fitted with exhaust pipes, mufflers and spark arresters in accordance with the Fire Protection Regulations 1992. Such devices should be checked regularly and kept in proper working order.

(5) Vegetation can be caught by underbody guards of vehicles, dry out and then catch fire. The undersides of vehicles should be periodically freed of all vegetation debris.

(6) Vehicles which use unleaded fuel are equipped with a catalytic converter. These operate at temperatures which may be high enough to initiate fires in long grass and other vegetation when conditions are dry. Licensees should ensure that such vehicles are not used during dry periods in areas where the vegetation is long enough to come in contact with, or become lodged around, the converter.

2.14 CAMPING AND CAMP SITES

(1) Licensees should be aware that camping on both private and Crown land may be restricted. Some areas of Crown Land preclude camping or restrict it to certain specified areas. Standard licence conditions require that camp sites only be established in areas where camping is permitted and that camping and the lighting of camp-fires on private land only be undertaken with the consent of the owner. Information regarding on camping restrictions which may apply to areas of Crown Land can be obtained from the land manager.

(2) Where permission to camp is obtained, standard licence conditions require that the licensee ensure that the requirements of the owner are complied with.

(3) Where camp fires are used, standing dead timber and living timber not be cut for fire wood. Wood used for fires should be collected from fallen dead timber. The collection of firewood may be restricted or prohibited in some areas. Licensees should consult with the owner or land manager regarding possible restrictions on firewood collection.

2.15 FUEL AND LUBRICANTS

(1) Standard licence conditions require that the transportation and storage of fuel and lubricants be in properly constructed containers, and that the storage of fuel and lubricants at sites, where practicable, be within an impervious bunded* area, with the volume of the bunded area equal to at least 125% of the volume of the fuel and lubricants stored. The impervious lining may be hydrocarbon resistant plastic sheeting, compacted clay or other approved impervious lining. Spills of even a minor nature should be contained and treated with absorbent material. If a spill occurs, standard licence conditions require that the

contaminated soil and used absorbent material be treated as waste and disposed of at a site approved for such disposal.

(2) Standard licence conditions require that fuel and lubricant storage areas no longer required be rehabilitated by removing the liner of the bunded area and recycling it or disposing of it at an appropriate site, levelling the bund walls, and, when necessary, ripping and revegetating.

(3) Extreme care should be exercised when refuelling vehicles and equipment in the field. Activities such as this should be conducted away from streams and drainage lines, and proper containers and funnels used for the transfer.

(4) Routine maintenance and servicing of mechanical equipment should not normally be carried out on the licence. There will be times when equipment such as a drill rig will require maintenance while it is being used on the licence. Maintenance may be carried out under such circumstances, provided that it is done in accordance with the following provisions.

(5) Where emergency repairs and maintenance are required, standard licence conditions require that such activities be carried out so that all fuel and lubricants are contained and not able to spill on to the ground.

(6) Standard licence conditions require that waste fuel, oil and lubricants be retained and disposed of at a site approved for such disposal.

3. REHABILITATION PRINCIPLES FOR SPECIFIC EXPLORATION TECHNIQUES

(1) The following rehabilitation principles for specific exploration techniques should be applied in conjunction with the general principles set out in Part 2.

(2) The rehabilitation principles for each exploration technique consist of:

- a brief description of the technique;
- a statement regarding the level of impact of the technique; and
- principles relating to the operation of the technique and the rehabilitation of areas disturbed by it.

3.1 GEOLOGICAL MAPPING

(1) Geological mapping involves the search for and examination of rock outcrops and exposures within the licence area. It is usually carried out on foot, and may involve taking small rock samples using a geological hammer. Sample sites or sites of interest may be tagged using coloured tape or other means. Access to the mapping area is usually by conventional two- or four- wheel drive vehicle along pre-existing roads and tracks.

(2) This form of exploration activity normally has an extremely low impact. Unless the actual mapping team is encountered, generally the only evidence for this activity is site markers.

(3) Licensees should restrict the use of marker tape to a minimum. Markers should be removed from the area at the completion of the survey, as set out in 2.10.

3.2 GEOCHEMICAL SAMPLING

Geochemical sampling may be divided into two categories: surveys where samples are collected from intervals in a regular grid* pattern, and surveys where samples are taken in an irregular pattern, such as in stream sampling. Small samples are taken using a variety of hand tools, including hand augers.

3.2.1 Regular Grid Surveys

(1) Surveys involving a regular grid usually utilise a system of marker pegs or other means of identifying grid positions. As they are regularly spaced, the markers are often visible, particularly looking along grid lines. Minor vegetation trimming or removal may be required.

(2) Surveys usually involve a survey team to lay out the grid, and may involve a second team to collect the samples. Access to the area is generally by conventional two- or four-wheel drive vehicle using pre-existing tracks.

(3) Sampling usually involves taking small soil samples from locations on the grid, using hand tools such as a shovel or small diameter hand auger. The impact of sampling is normally very small, and the sample sites are usually difficult to find after the sample has been taken, except for the existence of the marker tape or peg.

(4) To minimise the impact, licensees should restrict the use of grid markers to the minimum required to conduct the survey. Sample points should be rehabilitated after the sample is taken by refilling the hole with soil from the immediate area, and covering with leaf or ground litter.

(5) Markers should be removed from the area at the completion of the survey, as set out in 2.10.

3.2.2 Irregular Sampling Surveys

(1) Irregular sampling surveys, usually involve sampling of stream sediments and the taking small samples from the stream bed, by one or two persons on foot. Sample size is usually about 1kg. Access to the area is by vehicle, usually using pre-existing tracks, and impact on the area is minimal. Marker tape may be used to indicate where a sample was taken, and is usually attached to vegetation on the adjacent stream bank.

(2) Care should be taken when accessing and sampling a stream to minimise disturbance to banks, riparian* and aquatic vegetation, and the stream bed.

3.3 GEOPHYSICAL SURVEYS

Geophysical surveys are carried out to measure physical properties of subsurface rocks using various types of electronic equipment. Geophysical surveys can be either airborne or ground surveys. In most cases, geophysical ground surveys will also involve placing marker pegs in a grid pattern.

3.3.1 Airborne Surveys

Airborne surveys include aerial photography and aerial geophysical surveys. These activities may cause short-term annoyance through the use of low flying aircraft. Prior to the commencement of surveys, licensees should contact municipalities and owners, either in person or by way of advertisement in the local newspaper, in the intended area of flying. The information provided should include details of the proposed work program and its likely duration.

3.3.2 Gravity and Magnetic Surveys

Gravity surveys are carried out using a gravimeter, while magnetic surveys use a magnetometer. These are usually small readily portable instruments. Surveys are usually carried out by a team of up to three persons who take readings across a grid. The impact of such surveys is generally negligible.

3.3.3 Resistivity, Induced Polarization and Electromagnetic Surveys

(1) These surveys are carried out using equipment with interconnecting cable arrays. Electricity is required and is supplied by a generator which is sometimes vehicle mounted. Surveys are carried out on a grid pattern, and may require the excavation of shallow holes up to 500mm deep and 1m square, though usually much smaller, or the temporary insertion of metal probes. Aluminium foil is sometimes used to line the holes.

(2) The impact of such surveys is generally small, and temporary.

(3) Care should be taken when laying out and retrieving cables so that damage to vegetation is kept to a minimum.

(4) When conducting surveys involving cables which carry high currents, standard licence conditions require that all reasonable measures be taken to prevent harm to people, livestock and wildlife. This may include the provision of warning signs in appropriate positions.

(5) Standard licence conditions require that all excavations be rehabilitated by refilling with topsoil and subsoil, and that metal foil and cables be removed from the area.

3.3.4 Seismic Surveys

(1) Seismic surveys involve the laying out of an array of geophones connected by cable to measuring instruments mounted in a vehicle. Either a small explosive charge detonated below ground, a hand-held mechanical hammer or a vehicle-mounted weight is used to generate shock waves in the ground. The time delay for the waves to reach the geophones is measured. This type of survey may require the drilling of shallow auger holes, usually with a hand-held power auger, and access for light vehicles.

(2) Seismic surveys typically involve several people and a small number of light vehicles. The geophones are placed directly on the ground, and do not require any excavation. When required, the auger hole for the explosive is typically only a few metres in depth.

(3) The impact of such surveys, although generally small, may involve some noise and minor ground vibration resulting from the sub-surface detonation of small explosive charges.

(4) When explosives are used, standard licence conditions require that charge sizes be kept to the minimum necessary, and that the transport, handling, loading and detonation of explosives be in accordance with the relevant Regulations (Dangerous Goods (Explosives) Regulations 1988 and Mineral Resources (Health and Safety) Regulations 1991 Part 5 - Explosives).

(5) Standard licence conditions require that the detonation of explosive charges, whenever reasonably possible, be restricted to such times as will not unduly annoy or disturb others in the area (see 2.7).

(6) Standard licence conditions require that auger and detonation holes be rehabilitated and made safe by refilling with topsoil and subsoil as soon as practicable after the shot is fired.

3.4 DRILLING

(1) Drillers, including contract drillers, should be made aware of these Guidelines and the *Guidelines* for Abandonment of Mineral Drillholes*, which cover the subsurface sealing of drillholes* .

(2) Drilling is the process of subsurface sampling to determine the nature and structure of the material below the surface. There are a variety of drilling methods, most of which utilise equipment which is vehicle mounted. In general terms, the size of the equipment will vary, and the larger the drill rig, the greater will be its environmental disturbance. Drilling is relatively expensive, and is not usually undertaken unless there are encouraging results from other, less expensive methods. In some cases, existing tracks will need to be upgraded, or new tracks constructed in order to gain access for the drill rig.

(3) Possible environmental impacts arise from drill pad construction, access to the drill site, sump construction, temporary noise, and intersection of groundwater* .

(4) Standard licence conditions require that drill sites be confined to the smallest area in which it is reasonably practicable to conduct operations.

(5) In all methods of drilling, licensees should ensure that samples taken from the drillhole are either placed back down the drillhole, removed from the site or blended in with the topsoil in the vicinity of the drillhole.

(6) In order to gain more information from a drillhole, the drillhole is sometimes profiled using special electronic equipment. This is known as "downhole logging", and is carried out by lowering a probe into the drillhole. Some methods use a low emission radiation source

housed in the probe. Standard licence conditions require that licensees comply with statutory regulations covering the use, handling and transport of radiation sources (Health (Radiation Safety) Regulations 1984).

(7) Standard licence conditions require that, in the case of a radiation source becoming lost down a drillhole, the licensee take all reasonable steps to ensure that the source is recovered. Where the licensee believes that recovery is impracticable, the source may be sealed down the drillhole with the permission of the Chief Mining Inspector after consultation with the Department of Health and the Rural Water Corporation.

(8) Drillholes should be abandoned in accordance with the *Guidelines for Abandonment of Mineral Drillholes*.

(9) Rehabilitation of the drill pad may require ripping where the ground has become compacted during operations. On cleared land, further tillage may also be required. In areas supporting native vegetation, tillage and seeding with species native to the area may be needed. Re-contouring may also be required, to return the land as near as practicable to the original topography.

(10) Where a drillhole intersects an aquifer or stratigraphic layer containing significant groundwater, standard licence conditions require that the licensee notify the Minister administering the *Water Act* 1989 of the existence of, and depth to the groundwater layer.

(11) If substantial quantities of groundwater are encountered and the flow of water cannot be contained within the rig circulatory system, standard licence conditions require that drilling cease until arrangements are made for a suitable disposal method as approved by the Inspector of Mines in consultation with the relevant authorities.

(12) Standard licence conditions require that where topsoil is removed during drill pad preparation, this be stockpiled for use when rehabilitating the site. At the completion of drilling, the topsoil is to be respread and, where appropriate, the area revegetated with species consistent with the surrounding vegetation.

3.4.1 Auger

This is usually restricted to shallow drilling, using either a hand-held power auger or a rig mounted on a small vehicle. Support vehicles are not normally required, and the impact is generally small.

3.4.2 Open Hole Percussion, Reverse Circulation and Rotary Air Blast

(1) These drilling methods usually involve a truck-mounted rig, and at least one support vehicle. A compressor is required to supply compressed air for some methods of drilling and sample recovery. The noise of such drilling may be high in the immediate vicinity of the rig. Some dust may also be generated by this drilling method. There is usually little evidence that the drillhole has been drilled after the rig has left, and the drillhole filled in.

(2) In instances where groundwater is encountered, or where water needs to be injected down the drillhole to recover the samples, the sample collecting container should be of sufficient size to allow decanting of the water while retaining the sample, rock chips etc.

3.4.3 Diamond Drilling

(1) This method involves the extraction of a continuous cylindrical core of rock. It is usually the slowest, and most expensive form of drilling. It often requires some site preparation, a supply of water and sumps for mixing and recovering drilling muds or

fluids. The method generally requires the use of a vehicle-mounted drilling rig and support vehicle.

(2) Where reasonably possible, portable, self-contained sumps should be used. Where this is not practicable, a sump may need to be excavated. Standard licence conditions require that the excavated sump be of sufficient size to contain drilling fluids, well constructed, and lined with a suitable impermeable membrane such as plastic.

(3) Standard licence conditions require that topsoil be stockpiled separate from the subsoil, adjacent to the sump excavation. At the completion of drilling, the sump is to be drained, the liner removed and the sump excavation filled in, with the subsoil replaced first and the topsoil replaced last.

(4) Standard licence conditions require that liners and sump contents be disposed of at a site approved for the disposal of such waste.

3.4.4 Rotary Mud

(1) Rotary mud drilling is most commonly used for deep stratigraphic investigation and petroleum exploration drilling. The method involves circulation of thick drilling muds for drillhole stability and recovery of samples. It uses substantial quantities of mud, and requires water and sumps. The rigs used for this type of drilling are mounted on a truck or trailer, and often require a support vehicle.

(2) For standard licence conditions applying to rotary mud drilling see 3.4.3.

3.4.5 Wide Diameter Drilling

(1) Wide diameter drilling is most commonly used in the sampling of shallow alluvial deposits, from which large samples are needed to give a reliable estimate of ore reserves.

(2) The method utilizes bucket auger (or Calweld) drilling equipment, which is usually truck mounted. Drillhole sizes are commonly up to 1.2m diameter and up to 30m deep. The boring bucket is a cylindrical bit into which the sample is forced as the bit rotates. When full, the bucket is hoisted from the drillhole and the sample dumped on the surface. Drilling is usually conducted without drilling fluids, though water or drilling mud may be added to stabilize the drillhole.

(3) Standard licence conditions require that drillholes be backfilled and samples removed from the surface at the completion of drilling. Samples which are not required should be used as backfill. Supplementary backfill material, from off-site, may be needed to completely fill the drillhole.

3.5 TRENCHING AND BULK SAMPLING

3.5.1 Costeaning and Trenching

(1) These exploration techniques involve the mechanical excavation of trenches (also known as costeans) to expose ground for the observation of geological features and for sampling. Trench dimensions can vary from as small as 150mm in width to as large as the available earth moving equipment.

(2) Very narrow and shallow trenches are often excavated using a rapid trenching machine or ditchwitcher. Ditchwitch trenching distributes the excavated material along each side of the trench, from where it can be sampled. (The method is similar to that commonly used in laying telephone cables.)

(3) Larger trenches are usually made using an excavator or backhoe. This method accommodates separation of topsoil more easily than the ditchwitch method but disturbs a larger area.

(4) The possible impacts of trenching are erosion on steeper slopes, damage to vegetation through excavation or clearing for equipment access and mixing of topsoil with the subsoil.

(5) Unnecessary removal of vegetation should be avoided. Where it is necessary to remove vegetation, trees should be cut rather than removed (see 2.4). Trenches should be sited to minimize damage to the roots of large trees (as a rule of thumb the roots can be assumed to extend as far laterally as the crown).

(6) Standard licence conditions require that trenching not be carried out on slopes greater than 10° without prior written approval of the Inspector of Mines.

(7) Standard licence conditions require that for trenches, other than ditchwitch trenches, excavated topsoil and subsoil be stockpiled separately (see 2.3).

(8) Standard licence conditions require that trenches be refilled and compacted. This should be undertaken as soon as practicable after excavation and preferably within 24 hours. Licence conditions may specify that trenches be refilled within a particular time after excavation.

(9) Where trenches are left open for longer than 24 hours and the safety of the public is at risk, temporary fencing should be erected. Standard licence conditions provide that the Regional Mining Engineer (RME) may direct that such fencing be erected.

(10) Where trenches are left open for longer than 24 hours, one end should be gently sloped to allow trapped animals to escape.

(11) Trenches should initially be refilled to above the natural ground level to allow for settlement. Standard licence conditions require that trenches be refilled such that subsoil is replaced first and the topsoil is replaced last (see 2.3), and that rehabilitation be undertaken to achieve final revegetation with species consistent with the surrounding vegetation (see 2.4).

(12) As refilled trenches have a tendency to settle over time, trenches should be checked and maintained regularly during the term of the licence. Additional topsoil may be required to top up the level in trenches which have settled to below the natural ground surface.

3.5.2 Surface Bulk Sampling

(1) Surface bulk sampling is distinguished from other forms of exploration by the removal of significant quantities of material from the site. Large scale trenching, such as that involving a bulldozer, would also be regarded as bulk sampling.

(2) Where bulk sampling is proposed, an Impact Statement may be required under section 41A of the Act.

(3) Standard licence conditions require that excavated topsoil and subsoil be stockpiled separately (see 2.3).

(4) Where excavations are left open for longer than 24 hours and the safety of the public is at risk, temporary fencing should be erected. Standard licence conditions provide that the RME may direct that such fencing be erected.

(5) Where excavations are left open for longer than 24 hours, one end should be gently sloped to allow trapped animals to escape.

(6) The removal of material from bulk sampling sites will often result in insufficient material to completely refill the excavation. Wherever possible excavations should be backfilled to surface. This can be achieved by importing clean fill from elsewhere on the site or from a location convenient for back-loading of trucks. Where backfilling is not possible, standard licence conditions require that rehabilitated excavations be battered to slopes not exceeding 1v:3h. Wherever possible unfilled excavations should be self draining.

(7) Where complete or partial refilling is required using local or imported fill material, excavations should initially be refilled to above the natural ground level to allow for settlement.

(8) Standard licence conditions require that excavations be refilled such that subsoil is replaced first and the topsoil is replaced last (see 2.3), and that rehabilitation be undertaken to obtain final revegetation with species consistent with the surrounding vegetation (see 2.4).

(9) Where there is potential for erosion, as on steeper slopes, erosion control measures such as cut-off drains and silt traps should be constructed.

(10) As refilled excavations have a tendency to settle over time, they should be checked and maintained regularly during the term of the licence. Additional topsoil may be required to top up the level in excavations which have settled to below the natural ground surface.

3.6 UNDERGROUND EXPLORATION AND DEVELOPMENT

(1) Underground exploration and development includes underground sampling, drilling and mine construction, as well as associated surface works. It does not include commercial mining.

(2) Standard licence conditions require that on completion of underground exploration and development works surface access (shaft, adit or decline), if no longer required, be permanently closed off and the site made safe for the public. Access points may be capped and/or backfilled.

(3) Standard licence conditions require that surface facilities associated with underground works, if no longer required, be removed and the disturbed surface area rehabilitated. The general rehabilitation principles described in Part 2 of the Guidelines should be applied.

Definition of Terms

- **Batter slope:** the slope of the bank of cut earth or soil fill on either side of a constructed road, track or levelled area, such as a drill pad.
- **Bund; Bunded:** a low wall, usually earthen, used to surround a works or storage area.
- **Coppice; Coppicing:** regrowth from stems originating from dormant buds on a stump or the base of the trunk of a damaged eucalypt.
- **Drillhole:** hole drilled by a drilling rig or similar equipment, not including other excavations such as backhoe pits, shafts and drives.
- **Grid:** a set of evenly spaced parallel lines marked out at right angles to a base line used to identify accurately ground locations by a system of co-ordinates. (The lines are usually marked by wooden pegs set at regular intervals of up to 200m)
- **Groundwater:** all water occurring beneath the earth's surface.
- **Riparian vegetation:** vegetation that requires free water or conditions that are moist, along the margins of streams, drainage lines and lakes.
- **Sidecast material:** the soil and rock debris that accumulates adjacent to road and track construction operations conducted across moderate to steep side-slopes.
- **Subsoil:** the soil and weathered material located below the topsoil.
- **Topsoil:** the soil or other material from the surface to the subsoil, generally conforming to the A₀ soil horizon. This may vary in depth dependent on soil-forming factors but, for the purposes of the Guidelines, is not considered to be greater than 300mm in depth from the natural surface.
- **Wire gabion:** a cuboid made of wire netting, which is filled with materials such as gravel or rocks, and used for engineering purposes.

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