Guidelines for the Management and Rehabilitation of Basic Raw Material Pits

Department of Environment and Conservation

2008

Department of
Environment and Conservation

Inside Cover

Initial clearing (Jeremy Chick)

A well laid out topsoil and debris heaps (Jeremy Chick)

Stockpiling resource prior to use (Carl Cicchini)

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TABLE OF CONTENTS

1 Background

1.1 Purpose

The aim of this document is to establish consistent standards for the management and rehabilitation of areas quarried for basic raw materials (BRM) on lands managed by the Department of Environment and Conservation (DEC).

These requirements replace those specified in *Guidelines for the Management and Rehabilitation of Gravel Pits (South West Forest Areas)* (1992).

1.2 Scope

This document is to be used for all DEC operations, Local Government and Main Roads WA operations and is to be included as contract conditions for DEC and FPC contractors.

This document applies to State forest, timber reserves managed by the Department of Environment and Conservation (DEC) and freehold land held in the name of the Department's Chief Executive Officer.

This document applies to all activities unless the activity is covered by an authority that overrides the *Conservation and Land Management Act 1984* or the *Forest Management Plan (FMP) 2004-2013*.

1.3 Custodianship and management of this document

The custodian of this document is the Manager of the Environmental Management Branch of the Nature Conservation Division in the Department of Environment and Conservation. The document will be reviewed in 2011 but may be reviewed earlier if information becomes available that warrants it.

2 Definition of key terms

Basic Raw Materials The generic term used to describe a range of minerals (including gravel, shale, sand, clay, limestone and rock) that are extracted for agricultural, pastoral, household, road making and building uses from lands managed by DEC.

Brushing Natural material such as understorey shrubs or leaves and branches from tree crowns that is used to cover a disturbed area to reduce soil erosion and to assist with the capture and germination of seed for rehabilitation. It is particularly useful in assisting with the stabilisation of disturbed areas of sand.

Overburden **S**ubsoil material that is below the topsoil but is not to be used in the road building process.

Pit boundary The area within which all the activities associated with the clearing, stockpiling and mining of the basic raw material is contained.

PDWSA **P**ublic **D**rinking **W**ater **S**ource **A**rea. These includes all underground water pollution control areas, catchment areas and water reserves constituted under the *Metropolitan Water Supply Sewerage and Drainage Act 1909* and the *Country Areas Water Supply Act 1947*.

Rehabilitation A process of treatment of a disturbed site to achieve:

- The resumption of ecological processes;
- The re -establishment of natural contours and soil profile in areas where this has been disturbed, or the creation of a suitable contour where this is not possible;
- The protection of retained trees within or adjacent to the disturbed area, during rehabilitation earthwork; and
- The minimization of the risk of soil erosion following the rehabilitation earthworks: and
- The successful establishment and growth of indigenous understorey vegetation on all sites, and the successful establishment and growth of indigenous overstorey species on specified sites.

Ripping Mechanical penetration and shattering of soil, generally beneath the topsoil, for the purpose of breaking up compacted soil to facilitate penetration of plant roots and water.

Risk period Risk periods (Low, Medium, Medium to high, and High) are as defined in Appendix 6 (following review) of the Forest Management Plan.

RPZ **R**eservoir **P**rotection **Z**one. This means:

a) that part of a catchment area which lies upstream of a reservoir and is within 2 kilometres of the top water level; or
b) that area adjacent to a reservoir, the extent of which is identified on the plans; and
c) includes the reservoir.

Scarification Loosening of the soil surface to assist germination and establishment of seedlings.

3 Site Selection and Planning

3.1 Lead Times

Ideally, 3 months lead time is required prior to the approval for clearing and establishing a new BRM pit to allow the completion of environmental checks and timber salvage from the site.

3.2 Sensitive Management

Relevant checks need to be conducted to ensure that important environmental values and sensitivities of the proposed site and surrounds are not threatened by the establishment of the pit. The DEC Pre-operations Checklist is recommended to ensure all relevant checks are completed. Sensitivities must be identified before approval will be granted to establish a new pit.

The following sections outline some of the key sensitivities identified in the Pre-operations Checklist and details of any special requirements for these aspects.

3.2.1 Protection of Informal Reserves

Appendix 3 of the FMP identifies a number of informal reserve types which must be protected during forest management activities. These are:

- Old-growth forest;
- Areas previously classified as old growth forest;
- River and stream zones;
- Travel route zones;
- Diverse ecotype zones (DEZ);
- Less well reserved vegetation complexes;
- Poorly reserved forest ecosystem; and
- Regional Forest Agreement accredited linkage zones.

The extraction of BRM is not permitted in these reserves. In the case of existing sites in informal reserves, these can continue to be used (subject to the preparation of a Pit Management Plan) where it is not reasonable or practical for them to be closed and rehabilitated.

3.2.2 Flora / Fauna Conservation Values

All sites are to be checked by the proponent for Declared Rare Flora (DRF), priority flora, and threatened and priority fauna species before any operation proceeds. Field surveys should be scheduled for the most suitable time to locate the target species.

Should populations of these species be found the proposed operation should be reviewed to avoid, minimise and mitigate disturbance to these populations. Mitigation may involve post-operational work such as the creation of den sites, replacement of habitat logs etc.

Disturbance to DRF will require a “Permit to Take” approved by the Minister for the Environment. In the case of P1 and P2 taxa approval is required by Manager Species and Communities Branch and for P3 and P4 taxa approval is required by the Regional Manager.

3.2.3 Weeds

The proposed site should be checked for the presence of weeds, and strategies developed to address existing weed infestations, and to prevent the introduction of weeds during or after the operation of the pit. BRM from weed infested pits should not be used where there is the potential to spread weeds along road verges and establish new infestations.

3.2.4 Heritage Values

All sites are to be checked by the proponent for indigenous and non-indigenous heritage values. Field surveys may be required and sufficient lead time should be available to allow these to be undertaken.

Should material of heritage interest be found during clearing or BRM winning / mining activities then the work should cease and the pit manager **must** advise the relevant DEC District Manager.

3.2.5 Water Conservation

Undisturbed filter strips below pits are to be maintained on all watercourses to at least the specified width of the stream reserve (see Table 1) and sediment control structures may be required to further reduce the risk of turbidity in streams from the pit. Contour drains to slow water speed, and allow sediment to settle and disperse water over a larger area (preferably into litter) are desirable. Structures to achieve this may be earthen banks or formed using reject logs, stones or branches. Pit layout and access should be designed to prevent water accumulation and erosion.

Sites in areas that are seasonally inundated, or are likely to have a shallow groundwater table should be avoided, as they are likely to cause problems for drainage, earthworks and vegetation survival during rehabilitation.

Additional turbidity precautions are taken in public drinking water source areas (PDWSA). The Department of Water must be notified of any disturbance proposed in a PDWSA and will require the following:

- Stream reserves as indicted in Table 1;
- Pits will not be permitted within reservoir protection zones (RPZ) i.e. 2km from reservoirs; and
- Any surface waters flowing from the pit should pass through effective settling pits designed to minimize turbidity. The settling pits should be designed and maintained to provide a minimum of 2 hours run-off storage resulting from a 10 year return frequency storm event, when calculated in accordance with the Institution of Engineers current version of Australian Rainfall and Runoff. The settling pits should be operated with a surface scum trapping system which prevents discharge of floating matter.

Table 1 Minimum distance to streams[1] below BRM pits

	Within PDWSA	Outside PDWSA[2]
Stream order	**Outside RPZ**	
1	20 m	20 m
2	30 m	20 m
3	30 m	20 m
4	75 m	50 m
5+	200 m	100 m

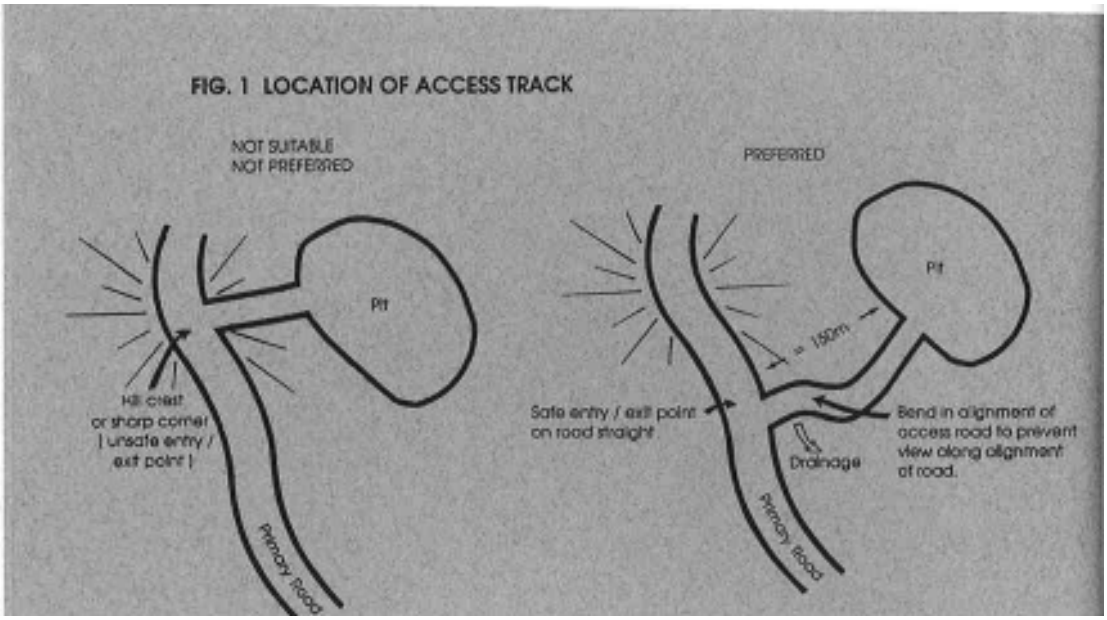
1 Measured from the pit boundary.
2 Minimum widths as specified in the Forest Management Plan (2004 -2013).

3.2.6 Landscape Values

Actions are necessary to reduce the visual impact of BRM pits. Adoption of the following aspects will minimise impact:

- Provision of adequate screening from public roads i.e. leaving a 150 m buffer from the road. A 200 m buffer is required for Level 1 travel routes and the Bibbulmun Track;
- Restricting views directly into the pit area i.e. dog legging the access roads;
- Avoidance of sites in view of prominent observation points;
- Confining disturbance to within the pit boundary and access road alignment; and
- Ensuring general tidiness of operations.

Figure 1 Location of access track



3.3 Prospecting

The identification of suitable BRM resources will often involve prospecting of potential areas. Testing should be done in a systematic manner during dry soil conditions, and subject to a Hygiene Management Plan.

- Initial investigation with hand tools (if promising, mark boundary with tape).
- Identify potential sources of BRM whilst minimising the disturbance to vegetation.
- If machine exploration is required then a backhoe is the preferred machine, as this will enable the disturbed area to be minimised in comparison to using loaders or bulldozers. Approval must be obtained, and the minimum requirements are:
    - DEC Pre-operations Checklist approval;
    - Rare flora survey;
    - Phytophthora cinnamomi (P.c) Occurrence survey; and
    - Hygiene Management Plan (consider the high value of P.c-free material - don't waste it).
- Backfill and / or cap all sample holes once exploration is completed.
- Replace topsoil and debris last.

3.4 Alternative Sources

Sites with low natural values should be utilised in preference to undisturbed ecosystems, e.g. power-line easements, cleared private property etc. Final site selection may need to be justified in these terms.

3.5 BRM Requirements

As part of the planning process the proponent must determine the total BRM requirement for the project, and the hygiene status of the products that are required. Planning should also consider options to minimise the area cleared and to maximise the effective use of the resources by:

- Avoiding shallow resources. A suggested minimum depth of utilizable gravel is one metre. Resources less than 1 metre in depth of recoverable BRM will require special approval by the District Manager before they can be developed;

- Crushing of cap-rock and laterite floaters in the pit to supplement gravel resource; and
- Maximise resource by utilising alternative BRM materials (shale / coarse sand) as a base in boggy soil conditions.

The intended use of a gravel crusher should be determined prior to the commencement or early in the life of the pit, as it is not possible to convert stockpiled rock into good quality gravel, unless it can be mixed with clay and fine material, which allow it to be compacted.

The crusher can be fed with all material that is below the topsoil, and above the clay layer or water table. Crushers can produce 5000 – 6500 m^3 of stockpiled product per day. This is likely to increase the gravel yield by about 1/3 from the same area when compared with conventional gravel mining, and result in a better quality product, quicker production, assist to maintain hygiene status of the product and facilitate easier and earlier rehabilitation.

The use of a gravel crusher is most suited to pits where:
- the proposed pit area is greater than 2 ha;
- a large volume of BRM is required (>25,000 m^3);
- the pit has a high rock component in the natural gravel; or
- pits where rapid rehabilitation is required or desirable.

3.6 Dieback Status

The dieback status of the pit must be ascertained before any work commences. A minimum of three years lead time without fire may be necessary to allow expression of dieback symptoms if P.c–free gravel is required.

P.c-free gravel is a valuable resource.

Table 2 Hygiene status compatibility

Gravel Source	Gravel Destination
P.c-free Gravel	Uninfested (P.c-free) Uninterpretable
P.c Gravel	Infested (P.c) Unprotectable

Outside DEC-managed estate, P.c-free gravel from the DEC-managed estate should only be used for high value, protectable locations.

3.7 Safety

The contractor is responsible for managing safety within the workplace, which will be recognised as the area within the pit boundary and access road.

The location of the pit access road must be planned to cater for safety of other road users. The basic principles to be used are:
- Ensure any roadwork complies with relevant legislation (Road Traffic Act (1974), Road Traffic Code);
- Position the access road junction on a straight section of road, and avoid junctions on crests or curves;
- Have the Main Roads Department / Local Government Authority approve the intersection or crossing configuration on public roads;
- Ensure that the sight distance either side is sufficient for the expected speed of the traffic; and
- Design a relatively level junction to enable quick merging of trucks with through traffic.

3.8 Pit Management Plans

For each pit, the proponent must prepare a pit management plan. The pit management plan will include:

- Alternatives examined;
- BRM requirements and disease status;
- Management of sensitivities identified;
- Pit / access road demarcation;
- Pit access;
- Dieback management;
- Timber recovery plan;
- Topsoil management;
- Fire management;
- Management of mining / removal of BRM;
- Pit drainage;
- Safety;
- Rehabilitation prescription and timing (Checklist B);
- Revegetation plan;
- Weed management; and
- Monitoring pit management.

Maps diagrams and plans are required to address the following in the pit management plan:

- Extent of viable resource and intended pit boundary; (include GPS coordinates)
- Location of hygiene boundaries;
- Contour map including location of ridgelines and direction of slope;
- Intended set-backs from roads and riparian zones;
- Proposed access point/s;
- Location of debris stockpile (if required) Figure 2 (a);
- Location of topsoil stockpiles Figure 2 (b);
- Direction and stages and sequence of BRM extraction Figure 2 (c) and Figure 3;
- Contour banks with direction of intended water flow; and
- Location of any proposed management barriers.

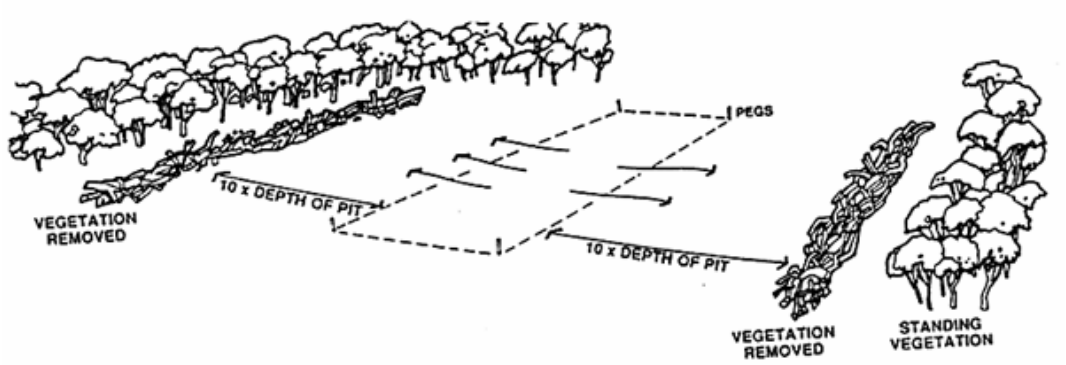
3.9 Other Planning Requirements

No more than 2 hectares is to be cleared at any one time without the approval of the Regional Manager.

For all pits and access roads, the following conditions will apply in addition to the approval:

- DEC will require operator of the pit to fully fund the rehabilitation to departmental specifications;
- DEC will require operator of the pit to provide a 'Bank Guaranteed Performance Bond' calculated on 50% of the expected cost of rehabilitation of the pit and road;
- The 'Bank Guaranteed Performance Bond' for rehabilitation will be based on the area calculated from the area of the pit defined in the "Pit Management Plan" plus length of road and nominal clearing width in the approved access road; and
- In the event that the operator of the pit default on rehabilitation of a pit or road within the required time period, then the future 'Bank Guaranteed Performance Bond' for rehabilitation will increase to 100% of rehabilitation costs.

Figure 2 (a) Vegetation Stockpile



To allow sufficient area for stockpiling of vegetation (to be used and not burnt), topsoil and overburden and pit activities, the vegetation should be stockpiled within the pit boundary at a distance of at least 10 (preferably 20) times the proposed depth of the BRM resource.

Figure 2 (b) Topsoil Stockpile

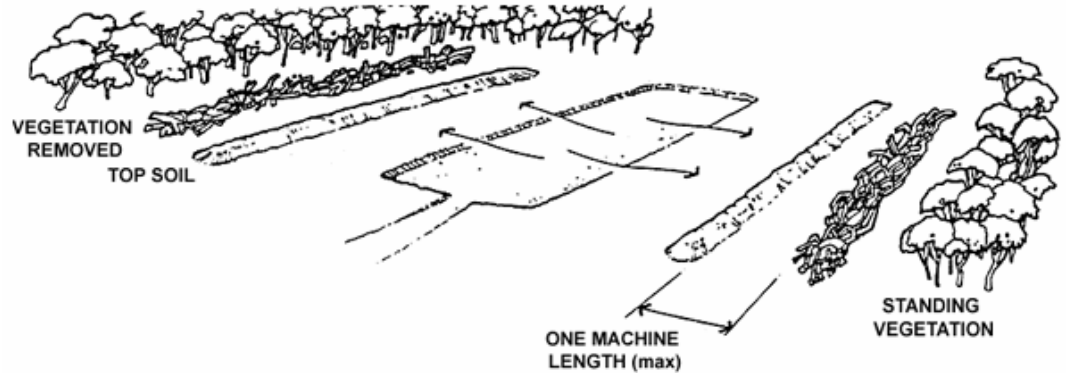


Figure 2 (c) Stylised Pit Layout

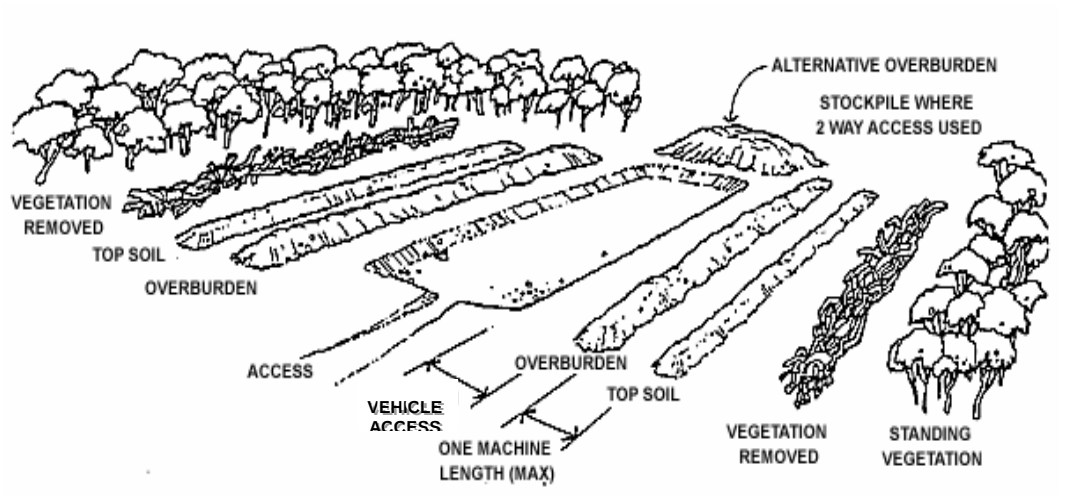


Figure 3 Idealised Mine Plan

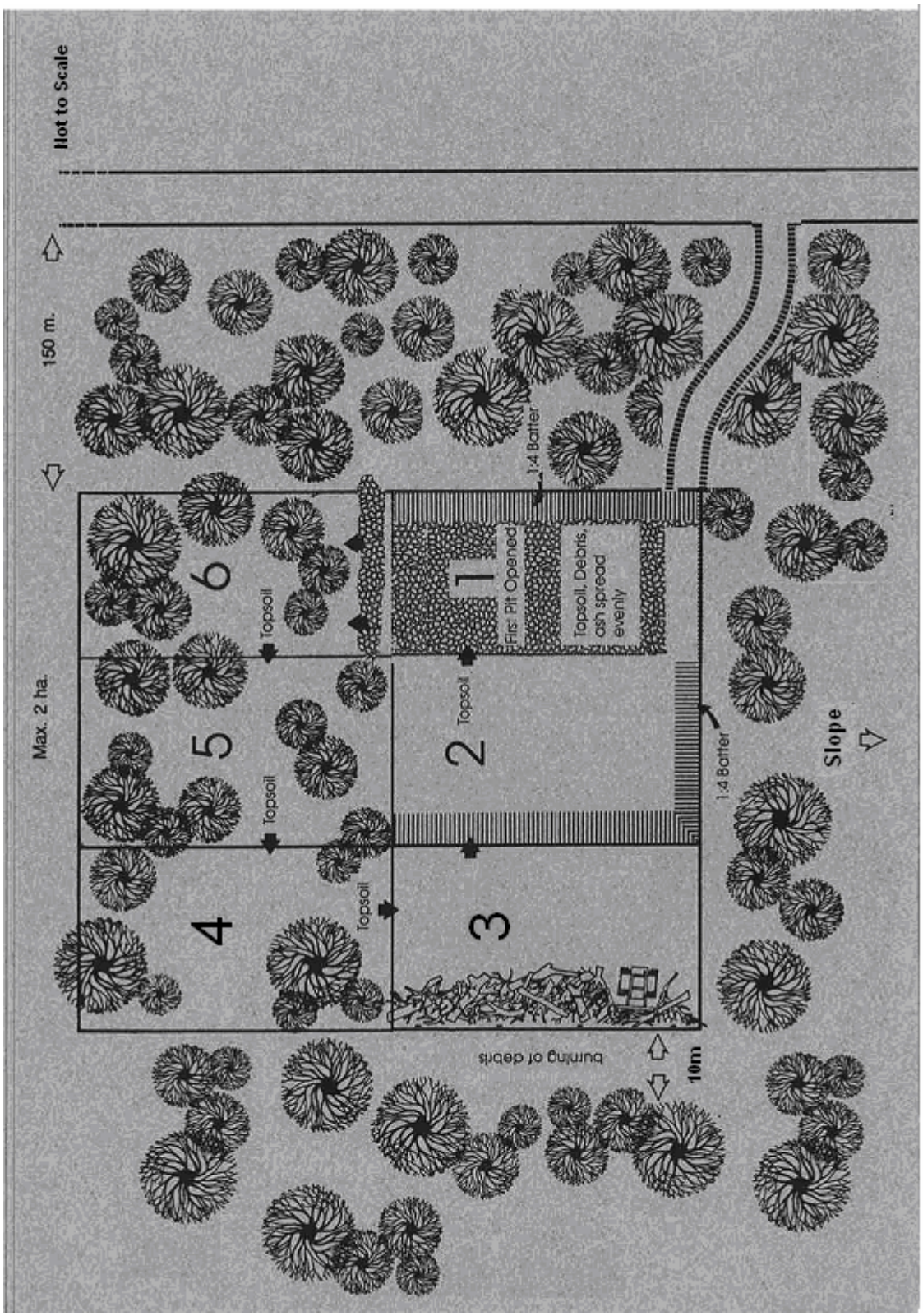


Figure 3 (a) Idealised Mine Plan Sequence

Pit Area No.	Location of debris for retention	Location of debris for burning	Placement of topsoil / subsoil	Topsoil for rehabilitation	Seed / fertilizer requirements /ha
Area 1	Stack inside Area 1 approximately one machine length from standing timber.	Stack inside Area 1 >10m from standing timber and burn (as required by DEC).	Stack each type separately on the edge of Area 6.	From Area 2	100 000 seeds and 250kg of fertilizer.
Area 2	Stack inside Area 2 as above	Stack inside Area 2 >10m from standing timber and burn (as required by DEC).	Spread over Area 1.	From Area 3	100 000 seeds and 250kg of fertilizer.
Area 3	Stack inside Area 3 as above.	Stack inside Area 3 >10m from standing timber and burn (as required by DEC).	Spread over Area 2.	From Area 4	100 000 seeds and 250kg of fertilizer.
Area 4	Stack inside Area 4 as above.	Stack inside Area 4 >10m from standing timber and burn (as required by DEC).	Spread over Area 3.	From Area 5	100 000 seeds and 250kg of fertilizer.
Area 5	Stack inside Area 5 as above.	Stack inside Area 5 >10m from standing timber and burn (as required by DEC).	Spread over Area 4.	From Area 6	100 000 seeds and 250kg of fertilizer.
Area 6	Stack inside Area 6 as above.	Stack inside Area 6 >10m from standing timber and burn (as required by DEC).	Spread over Area 5.	From Area 1 and additionally from topsoil/subsoil and BRM under stockpiles.	200 000 seeds and 400 kg fertiliser if topsoil is stockpiled greater than 2m height and / or for longer than 12months duration

4 Operational Procedures

4.1 Clearing

Prior to clearing, pit boundaries are to be demarcated as follows:

- Marked with white paint crosses facing the area to be cleared; and
- In non-forest situations the boundary must be pegged with prominent white painted pegs flagged with white tape.

NB. All pit operations and activities must be contained within the demarcated boundary.

As part of the clearing operation all commercial forest produce must be:

- Harvested and removed from the pit and access road; or
- Harvested and stockpiled within the pit boundary, in a position that can be accessed without compromising hygiene, and not behind topsoil or gravel stockpiles; and
- When less than 3 months notice is given to the District, the harvesting may be carried out at the proponent's expense.

Following removal of commercial products, debris must be cleared into heaps or windrows (which must be free of topsoil) at a distance no closer than 10 m from standing trees, so that it can be burnt within the confines of pit boundary. Some debris (logs, stumps rocks) can be used for fauna habitat at the rate of 4 habitat mounds per hectare, and this material should be retained for later scattering over the rehabilitated pit after topsoil has been spread over the pit surface. It should be neatly stockpiled within the pit area, in a location that will allow it to be recovered after rehabilitation earthworks are completed.

4.2 P.c Hygiene Management

- Locate the entrance to pit at the down slope end of the pit.
- All earthmoving machinery must be clean of all dirt and root material to the satisfaction of the District Manager before entering or leaving the pit.
- Access to the pit must be properly formed and free draining. Ensure pit does not drain down access track or drainage from roads does not enter the pit.
- P.c-free pits and uninterpretable pits must be closed to unauthorised access whilst open but not in use. This should consist of a physical, immovable barrier or a gate.
- All vehicles entering a P.c-free pit must be clean of soil and root material. This may require the establishment of a suitably located clean down (brush, blow or wash-down) facility in the field.
- P.c-free pits should be worked under dry soil conditions.

4.3 Stripping Topsoil

Topsoil management is of critical importance. This is the only effective means of re-establishing a diverse vegetation community on the site, and will be managed according to the following criteria:

- A nominal 100 to 150 mm of topsoil is to be immediately re-spread on pre-prepared pit or stockpiled;
    - Topsoil stock piles should not exceed 2 metres in height; and
    - Topsoil should not be left standing for more than 12 months.

- Overburden or subsoil below 150 mm should be removed if necessary and stored separately;
- Immediate topsoil use should be encouraged by sequential operations if the pit is ongoing (See figure 3);
- Topsoil from newly cleared area should be used for rehabilitation of the previously mined area; and
- Topsoil from road alignments may be used to assist with rehabilitation of BRM pits with DEC approval, providing that the soil has a suitable disease status, and is not required for rehabilitation of the road.

4.4 Winning Resource

- Working in a general uphill pattern, gravel should be won from the front of the pit first and progress to the back of the pit if possible. If material quality is patchy, mixing from various sites will be necessary.
- To increase pit life basement clay can be mixed with the surface gravel and crushed laterite rock.
- Do not leave islands of material, work on a front during winning operation and use all the resource from one section before moving to the next.
- Gravel winning should be carried out by a bulldozer fitted with rippers in preference to a wheeled loader. The dozer should push up sufficient gravel and basement clay to allow mixing at the loading phase.
- Rock crushing to improve utilisation should be encouraged.
- In P.c-free and uninterpretable pits the winning operation must be separated from the loading out operation by a physical hygiene barrier.

4.5 Pit Drainage

During the establishment and use of BRM pits it is important to plan for the management of water. This will involve attention to the movement of water in relation to the pit itself, and the access road. This can include:

- Selection of the pit location (water gaining or water shedding), and issues relating to hygiene management;
- Construction of drains to encourage water to drain off the pit, and reduce the potential for significant ponding in the pit;
- Installation of surface water management structures above the pit, to ensure that water is dispersed into vegetation or debris, and does not drain into the pit; and
- Orientation of drains so that water is directed outside the curve of any access road to reduce the likelihood of the effluent water being re-collected on the road.

Pits should be inspected for potential ponding or erosion issues in winter to determine if the surface water management has been effective. Urgent remedial action to correct ineffective drainage and/or repair erosion must be completed immediately, and non-urgent remedial action completed as soon as hygiene or soil conditions permit.

4.6 Pollutants / Rubbish

Specify management requirements for on-site fuel / chemical storage i.e. bunded areas.

- No oil changes in the pit.
- Ensure advice to DEC in the event of fuel or chemical spills.

- Remove soil contaminated by spilt oil and fuel.
- Remove all rubbish to an authorised waste disposal site.

4.7 Weed Management

The site is regularly inspected and maintained free from introduced weeds both agricultural and environmental. Spraying weeds using recommended herbicides at prescribed rates should be undertaken as required.

Equipment and trucks should be cleaned and inspected for potential sources of weeds, in conjunction with P.c hygiene management prior to the commencement of clearing, carting or rehabilitation operations.

5 Rehabilitation Earthworks

The sequence of events recommended for rehabilitation of BRM pits and access roads are detailed below. This sequence is also summarised in the Pit Rehabilitation Flow Chart and Checklist B must be used to record completion of the rehabilitation phases outlined.

5.1 BRM Pits

- At the completion of BRM extraction and prior to rehabilitation earthworks:
  - Remove all litter;
  - Clean up any oil or fuel spills by removing contaminated soil and disposing of this in an approved manner;
  - Remove any potentially saleable log material from the pit;
  - Neatly stack on the pit all unmerchantable log material, debris and bark that is to be burnt; and
  - Stacks are to be no closer than 10 m from any crop or habitat trees or other vegetation marked for retention;
- Complete landscaping earthworks so that:
  - Batters are no greater than 1 vertical to 4 horizontal (14^{o});
  - Pit floors should have at least 1:100 fall, and effective dispersal from the pit to prevent ponding and dieback intensification;
  - Drainage should be constructed to avoid disease spread on a broad front downhill from the pit;
  - Laterite floaters must be cracked, removed or buried in the batters; and
  - Rock piles may only be established with approval from the appropriate DEC District Manager.

- All rehabilitation earthworks must be carried out in a way that is consistent with the requirements of the "Hygiene Management Plan" for the area;
- Once pit debris and log off-cuts have been burnt away to the satisfaction of the DEC officer, then the rehabilitation earthworks can be carried out (see Figure 4);
- Examine the soil contour and peg a reference line at approximately 0.5% off the natural contour;
- Rip lines should be constructed primarily to alleviate compaction, secondly to promote infiltration and thirdly to assist to divert water off the pit floor without causing erosion;
- Ripping will be carried out using a dozer with a minimum flywheel 110 hp, fitted with a rake blade and preferably a winged-tyne ripper capable of ripping to a depth of 0.8 m, and is to be undertaken in Low or Medium risk period in the wetting up phase of the year to achieve shattering of compacted subsoil;
- Rip the pit floor across the contour to at least 0.8 m depth with a winged-tyne ripper, at 1 m spacing. Check the soil condition against the required specifications. If the ripping results in excessive clods, then these are to be broken down by scarification;
- Scarification may be carried out with any suitable implement that will loosen the soil surface to a minimum depth of 100 mm, spaced at approximately 250 mm centres, and should be undertaken during the Low or Medium risk period;
- Ash from the burnt logs and debris must be evenly spread over the pit;

- Cross rip the pit floor with the contour to at least 0.8 m depth with preferably a winged-tyne ripper, at 1 m spacing;
- Following cross-ripping scarification may be necessary if large clods are evident or there is minimal top soil available;
- Spread the stockpiled topsoil evenly over the pit floor after second ripping and scarification;
- Once the ripping, replacement of topsoil and surface scarification have been completed then the pit should have surface water management structures installed;
- Provide fauna protection by creating rock heaps, or replacing stumps or logs at the rate of 4 per hectare;
- Seeding and planting will be undertaken as specified in Section 6;
- Pits and drainage areas down slope of the pit should be inspected for potential ponding or erosion issues as appropriate, until they have been signed off as completed by a DEC Officer as part of the completion criteria; and
- Remedial action will be required to correct ineffective drainage and repair erosion (this may be required following the first winter).

5.2 Pit Access Roads

The requirements and expected sequence of events for the closure and rehabilitation of roads will be as follows:

- At each junction or crossing with an open road, ensure road closure to the satisfaction of the District Manager using an approved technique including blocking the alignment with either:
    - Logs greater than 1 m diameter;
    - Earth bund to be 1 m high and faced with rock greater than 300 mm diameter; or
    - Rocks greater that 1 m in diameter;
- Undertake the removal of road hardware such as pipes, posts and signs;
- Reshape the road alignment and drainage features to the natural contour;
- Rip the alignment at 1 m spacing to at least 0.8 m depth with preferably a winged-tyne ripper. The ripping tyne must be lifted every 20 m for a distance of 1 m to reduce the potential for soil erosion;
- Surface scarification of the alignment to a minimum depth of 100 mm and a maximum of 200 mm at approximately 250 mm centres, to enable restoration of soil porosity and create a seed-bed will be required;
- Install suitable surface water management structures to prevent erosion according to the requirements specified in Section 6 of this document;
- Seed and plant the alignment as specified in Section 6 of this document;
- Ensure ongoing compliance with the "Hygiene Management Plan" requirements until vegetation is sufficiently large to effectively close the road; and
- At the completion of the rehabilitation earthworks ensure DEC is advised so that the corporate database can be updated to reflect any change in road inventory or point items e.g. road signs.

5.3 Success criteria

The outcomes that must be achieved to ensure successful rehabilitation of BRM pits and access roads are dependent on the phase of the rehabilitation process as described below. In all cases where the rehabilitation criteria have not been achieved, then the proponent will be advised and will need to have the work completed to the required standard.

- The log and debris cleanup phase:
  - All heaped material has burnt away as required.
- The ripping phase:
  - The area has been reshaped to the natural contour (if required);
  - Ash from burnt debris heaps has been roughly spread out;
  - Ripping has not resulted in avoidable mixing of the topsoil and subsoil layers;
  - Rip lines in the pit are aligned within 0.5% of the natural contour; and
  - An 8 mm rod can be pushed by hand to a depth of at least 0.8 m at 80 per cent of test points in the rip lines (based on 30-50 points / ha in the pit and across the pit, and a point every 5-10 m along access roads).
- The scarification and soil surface preparation phase:
  - Stored overburden and topsoil has been evenly spread over the ripped area;
  - Scarification has not resulted in avoidable mixing of the topsoil and subsoil layers;
  - Clods of compacted soil are less than 100 mm in diameter;
  - Topsoil is generally loose and friable to a minimum depth of 100 mm (and a maximum of 200 mm) at approximately 250 mm centres; and
  - An 8 mm rod can be pushed by hand to a depth of 100 mm over 80 per cent of test points off the rip lines (based on 30-50 points / ha in the pit and across the pit, and a point every 5-10 m along access roads).
- Rehabilitation earthworks phase:
  - The pit and access road has been reshaped to the natural contours;
  - Ripping and / or scarifying has been completed to the required standard;
  - Stored topsoil has been respread uniformly across the pit or road alignment; and
  - Rehabilitation operations have not resulted in major erosion, deposition or ponding;
- The rehabilitation operations:
  - The requirements for the preceding phases have been met;
  - Seedlings and regeneration achieve the stocking and survival rate specified in the Revegetation plan; and
  - The rehabilitated area is stabilised without ongoing major erosion, deposition or ponding of water.

Figure 4 Idealised Pit Rehabilitation

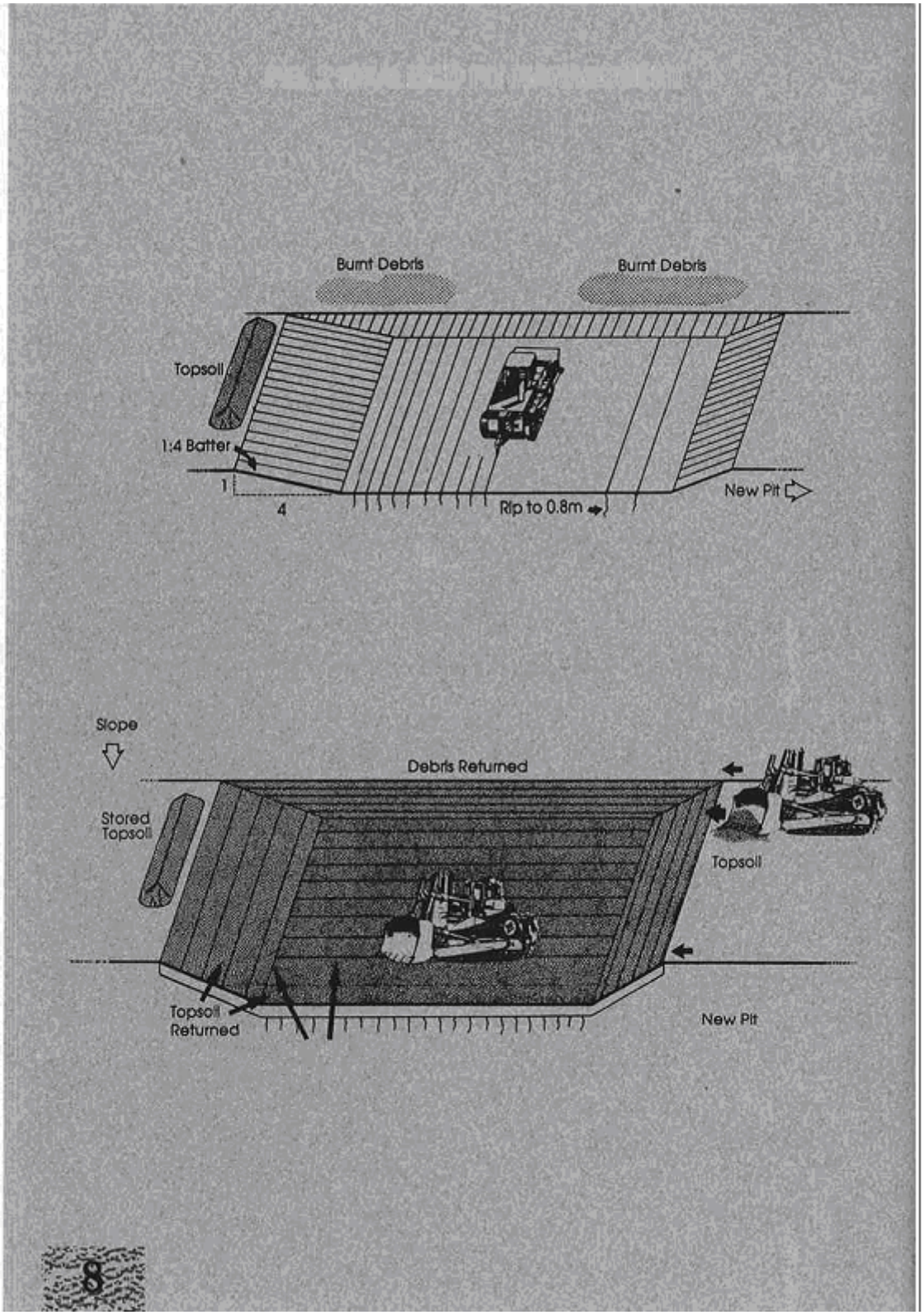
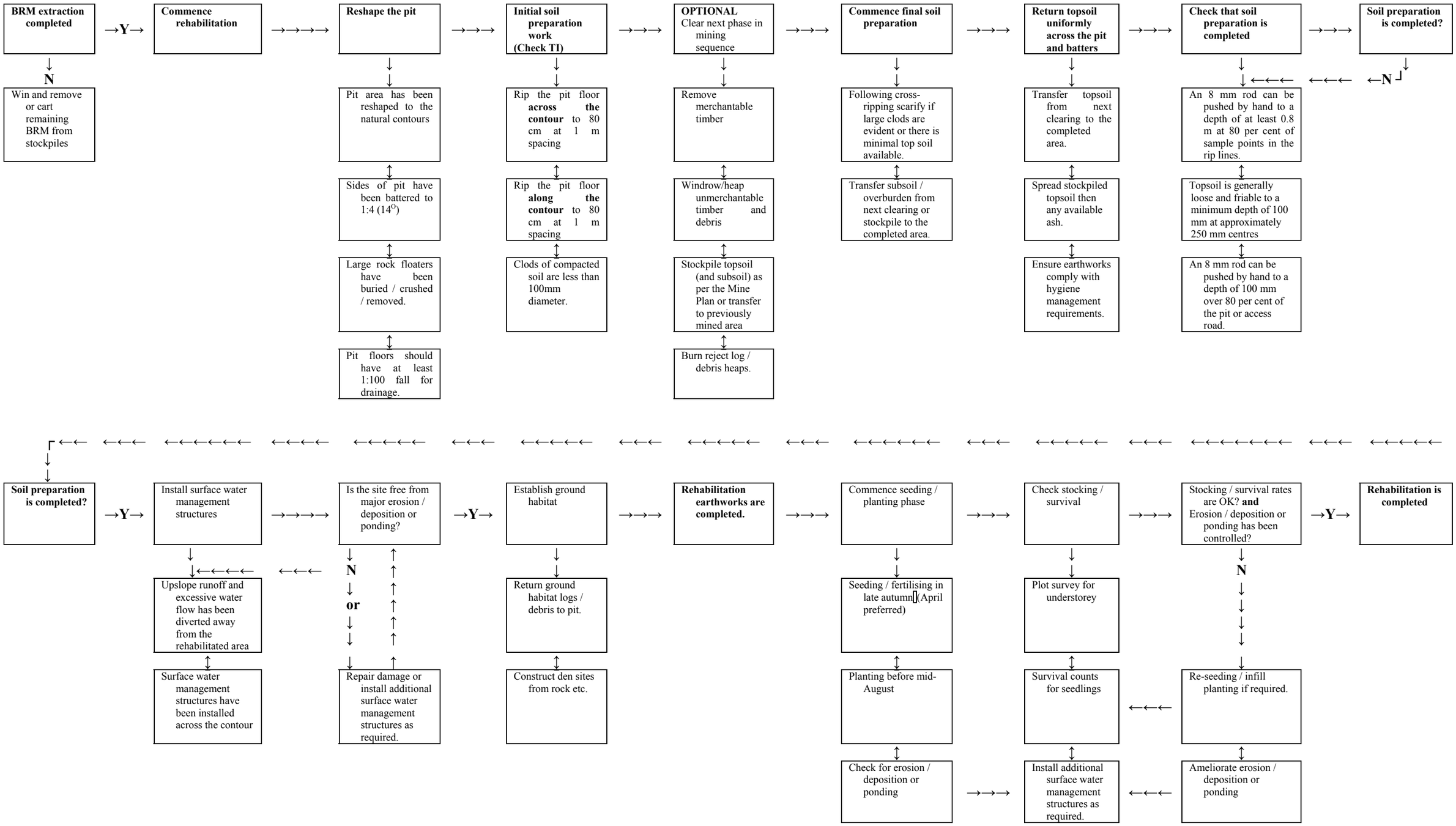


Figure 5 Pit Rehabilitation Flowchart



6 Revegetation Requirements

The following general requirements apply to seeding and planting activities associated with rehabilitation. The Pit Management Plan will define whether rehabilitation will be undertaken using seeding only or a mixture of seeding and planting.

6.1 Seeding

- BRM pits, banks, batters and access roads will be seeded with an approved seed mix and fertilised according to the following standards:
    - Seed mixes relevant to the surrounding forest type are to be utilised and must be sourced from the seed zones appropriate to the site;
    - Seed supplied for the rehabilitation must be tested and certified as viable;
    - Prior to broadcast, seed should be pre-treated using recognised seed dormancy breaking procedures; to break seed dormancy and improve germination rates;
    - Seed mix is to be applied to recently rehabilitated pits and access roads in autumn, before the first winter rains. Heavy rain prior to sowing may compact the surface soil and reduce germination success;
    - Seed mix is to be evenly spread over proposed area for rehabilitation;
    - At least 100 000 seeds per hectare are to be applied if topsoil has been stored for less than 12 months prior to spread on the pit;
    - At least 200 000 seeds per hectare are to be applied on roads or on the pit if topsoil has been stored for more than 12 months, has been stockpiled at a height of greater than 2 m, or is available in insufficient quantity to adequately cover the pit;
    - Seed mixes will be approved for each pit by the DEC Senior Silviculturist or the DEC Nature Conservation Leader for the area. The seed mixes will generally include species that are nitrogen fixers or likely to accumulate organic matter quickly, with the aim of ensuring that the reseeding re-establishes nutrient cycling in the soil by contributing to the carbon and nitrogen cycles;
    - Fertilise with 250 kg/ha of granulated fertilizer (with N – 16.1%, P – 9.1%, K – 0%, S – 14.3%) or an equivalent rate of an approved fertiliser when fresh topsoil is available to spread over the pit;
    - Fertilise with 400 kg/ha of granulated fertilizer (with N – 16.1%, P – 9.1%, K – 0%, S – 14.3%) or an equivalent rate of an approved fertiliser on roads or if topsoil has been stored for more than 12 months, is insufficient or of low fertility;
    - It is expected that the sowing will be supplemented by natural seed dispersal from adjacent vegetation or from soil stored seed to provide establishment of other local species; and
    - Seed bearing brush may be used to assist regeneration.

6.2 Planting

Where required in the Revegetation Plan, BRM pits and access roads will be planted with seedlings and fertilised according to the following standards:

- Use plants propagated from seed sourced from the appropriate seed zone;
- Planting will generally be by means of a potti putki planting spear;
- All plants will meet the standards outlined in Table 3 (below);
- Plants must be broken out of plant trays carefully to avoid damage to roots or shoots; and
- Plant trays and liners are to be handled carefully and stacked neatly at the plant dump for later pickup.

Table 3 Seedling standards for hand planting

Species	Height (mm)	Diameter at soil level (mm)	Stem characteristics	Root characteristics	Unacceptable defects*
Jarrah, Marri, Wandoo	100 - 200	2	Single erect stem	Well-developed root ball, which allows seedling to be removed from the tray with soil mass intact.	Multiple leaders Unthrifty (dehydrated, partially dead, root-bound, with mildew or fungus attack).
Karri	150 - 300	2	Single erect stem	Well-developed root ball, which allows seedling to be removed from the tray with soil mass intact.	Multiple leaders Unthrifty (dehydrated, partially dead, root-bound, with mildew or fungus attack).

* Seedlings exhibiting these defects are to be discarded.

During the planting of seedlings the following requirements must be adhered to:

- Planters should use random spacing and pattern or alternatively rows should not be visible from adjacent roads;
- Aim to position plants immediately on the edges of rip lines where possible;
- Plants must not be planted closer than 1 metre to logs and stumps;
- Do not plant beneath the crowns of retained trees;
- Planting lines must not commence within 3 metres of the edge of any road;
- Plants must be planted between 10 mm and 20 mm deeper than the nursery level;
- Plants are to be heeled or toed in to remove air pockets from around roots and to ensure they are firmly positioned. (Plants should not be able to be removed from the soil when held firmly by the stem and a gentle lifting motion applied.);
- The stem of planted seedlings must be vertical or near vertical;
- Regular checks of planting stocking rates must be completed. This must be done at least twice daily on each planting site using a random point sampling method;
- Spacing will be altered as necessary to ensure the correct stocking is achieved;
- All roads subject to rehabilitation in addition to seeding will have tree seedlings planted in rip lines on the road surface and on rehabilitated banks and batters;
- Planting of overstorey species is required in the first year according to the following standards:
    - Plant 1000 trees/ha.
    - Apply 100g pellets of fertilizer (with N – 17.5%, P – 20.0%, K – 0%, S – 1.2%) or an equivalent rate of an approved fertiliser is to be buried within 150 mm and down hill of each seedling at the time of planting.

6.3 Monitoring Survival

Rehabilitated areas will be monitored by the proponent for regeneration success and seedling survival no sooner than the end of the first summer following rehabilitation using the relevant Departmental guideline. To be considered successful 85% of the sample points are required to meet the following success criteria:

- Overstorey: 625 seedlings/ ha
- Understorey: 2500 legume plants/ha and
  2500 non-legume plants/ha

Unless otherwise specified second year planting of trees and shrubs is required if a success criterion of at least 25 x legume and 25 x non-legume shrubs and 7 x trees per 100 m^2 (10 m x 10 m) is not achieved by year 2.

Areas of 0.5 hectares or greater not meeting the success criteria will be reseeded or replanted until the area is successfully rehabilitated. Areas that receive additional seeding will be re-monitored the following year and reported to DEC.

In the event that the person monitoring the rehabilitation is unsure what remedial action to use, this can be resolved by referring to the Senior Silviculturist from DEC;

6.4 Weed Control

Weed infestation of rehabilitated sites should be assessed in conjunction with survival assessments, and where necessary weed control should be carried out in year 2. The intention is that weed populations should not exceed the weed populations on the original site or be no greater than that of surrounding vegetated areas.

7 Completion Criteria

The rehabilitation process will be considered complete when DEC is satisfied that:

- All requirements of Checklist B have been satisfactorily completed;
- Regeneration surveys indicate that the regeneration requirements have been achieved (at least one summer following rehabilitation);
- Rehabilitated area is stabilised without ongoing erosion, deposition or ponding of water;
- Areas down slope of the rehabilitated area are not negatively affected by pit effluent; and
- The rehabilitated site does not have weed infestations that exceed the weed populations on the original site or are greater than that of surrounding vegetated areas.

Once all of these criteria are achieved, then DEC should return the "Bank Guarantee Rehabilitation Bond" to the pit operator, and the DEC records should be updated to record that the rehabilitation has been completed.

8 Reporting

The Forest Management Plan 2004-2013 - Action 19.1.2 requires that instances where local seed has not been used for regeneration and rehabilitation are reported to the Conservation Commission of WA.

The Forest Management Plan 2004-2013 - Action 29.4 requires the DEC and FPC to maintain a database of areas from which BRM have been extracted and will progressively develop plans and works programmes for the rehabilitation of these areas. To ensure compliance with this each proponent or pit operator will provide DEC with the location and extent of all pits, and will advise DEC once completion criteria have been achieved and pits have been rehabilitated.

9 Useful reading

Department of Conservation and Land Management (2004), *Forest Management Plan 2004-2013*. Department of Conservation and Land Management, Perth.

Department of Environment and Conservation (2007), *Use of Basic Raw Materials for the Construction and Maintenance of Harvesting Roads,* Department of Environment and Conservation, Sustainable Forest Management Series, SFM Advisory Note (Draft).

CHECKLIST A - PIT MANAGEMENT PLAN

BRM Site Number: _____

DEC District: _____ DEC Region: _____

Roading Contractor: _____ Contract No._____

BRM Type: Estimated Volume available: _____

BRM supply for - FPC - Native forest harvesting / Plantation harvesting

FMS - Strategic access / Burn boundary construction or maintenance / Other

PVS - Roads, tracks or trails / Recreation site construction or maintenance / Other

NC Monitoring / Species management / Feral animal or weed control / Other

SFM – Monitoring / Survey / Other

Other Agencies (List)_____

Access to - _____ (Insert coupe / plantation or location name)

Road Name - _____

PLANNING	ACTION / COMMENTS
ALTERNATIVES EXAMINED - Use existing pits; - Use utility corridors; - Obtain from private property.	
BRM REQUIREMENTS AND DISEASE STATUS - Disease status of BRM required; - Disease status of the pit; - Volume of BRM required.	
MANAGEMENT OF HERITAGE - Indigenous heritage; and - Non-indigenous heritage.	
FLORA, FAUNA & OTHER CONSERVATION VALUES - Flora survey of BRM pits and access roads - Flora survey of off-shoot drain alignment and outflow area; - Fauna management; - Management of existing weeds.	
PROTECTION OF INFORMAL RESERVES - Check FMP - Appendix 3 for compatible activities; - Use buffer width specified in FMP – Appendix 3.	
PROTECTION OF WATER VALUES - Ensure buffer widths proposed are appropriate; - Consult with Department of Water in PDWSA / RPZ; and - Specify sediment control structures type and location.	
VLM MANAGEMENT - Avoid sites in view of prominent observation points; - Adequate screening from public roads (150 m buffer); - Restrict disturbance to within pit boundary / access road alignment; - Dog legging the access roads	
PIT / ACCESS ROAD DEMARCATION - Boundary location; or - Method of demarcation; - Area of the pit; - Length and area of clearing for access road; - Access road standard (width etc); - Topsoil storage; and - Road drainage.	

PLANNING	ACTION / COMMENTS
PIT ACCESS - Highways / public road to be used; - Intersection points - Road hardware / signage requirements; and - Management of public access (barriers etc).	
DIEBACK MANAGEMENT - P.c Occurrence Map (ID No.) Hygiene Management Plan (ID No.) - Current for entire operational period? - Management of pit hygiene / drainage.	
TIMBER RECOVERY PLAN - Removal / Sale of Merchantable Timber - Removal / Disposal of Other timber / debris - Planned lead time	
TOPSOIL MANAGEMENT - Topsoil removal and storage; - Subsoil removal and storage; and - Priorities for topsoil return.	
FIRE MANAGEMENT - Burning of debris; - Shutdown periods; and - Fire extinguishers / fire fighting equipment.	
MANAGEMENT OF MINING / REMOVAL OF BRM - Winning; - Mixing (use of clay / subsoil); - Dealing with cap-rock / floaters: - Crushing; - Managing stockpiles; - Access to pit when not in use and - New weed infestations	
PIT DRAINAGE - Pit floor; and - Sumps / silt traps.	
SAFETY - Identify work hazards; and - Specify workplace safety provisions.	
REHABILITATION PRESCRIPTION AND TIMING - Rehabilitation earthworks; - Seeding prescription (Revegetation plan attached); - Fertiliser prescription (Revegetation plan attached); and - Planting prescription (Revegetation plan attached).	
WEED MANAGEMENT - Ensure equipment and vehicles are free of weeds before commencing work; - Monitor and treat population of existing weeds; - Monitor and treat populations of new weeds.	
MONITORING PIT MANAGEMENT - Nominated Pit Manager	
PIT MANAGEMENT MAP (Attach)	

Signed: (Operator) Date:

DEC Use:
Does the information provided satisfactorily address the sensitivities identified? Y/N
If "Yes" Provide "initial" approval for the work; or
If "No" Return the Plan and map to the roading contractor and advise of areas of concern
APPROVAL IS NOW GIVEN TO CLEAR …. ha. AS PROPOSED IN THE ATTACHED PLAN AND DEMARCATED IN THE FIELD.

DEC Officer: Name Signature: Date:

PIT MANAGEMENT MAP

BRM Site Number: _____

Checklist -:

The map shows the following aspects			
Location of hygiene boundaries	Y/N	Location of topsoil stockpiles	Y/N
Location of ridgelines	Y/N	Location of merchantable timber stockpiles	Y/N
Direction of slope	Y/N	Location of debris stockpiles	Y/N
Extent of viable resource and intended pit boundary	Y/N	Direction and stages and sequence of BRM extraction	Y/N
Intended buffers for roads and riparian zones	Y/N	Location of contour banks with direction of intended water flow	Y/N
Proposed access point/s	Y/N	Location of any proposed management barriers	Y/N

MAP: Minimum standard: 1:10,000 or larger scale showing the full extent of the work.

Scale:

CHECKLIST B - PIT REHABILITATION

	PHASE	DATE	COMMENTS
PIT MANAGEMENT	BRM REMOVAL HAS BEEN COMPLETED - Confirm removal of BRM from current operational area is completed; and - Plan transition to next phase (if required).		
INITIAL EARTHWORKS	RESIDUE LOGS - The removal of the log material is satisfactory; - Location / amount or type of residue remaining after burning or physical removal will not cause subsequent problems for DEC.		
	RESHAPING WORK HAS BEEN COMPLETED - Large floaters have been buried / crushed / removed; - Pit area has been reshaped to the natural contours; - Sides have been battered to 1:4; and - Pit floors should have at least 1:100 fall.		
	INITIAL SOIL PREPARATION HAS BEEN COMPLETED - Pit floor has been ripped across the contour to 0.8m at 1m spacing; - Rip along the contour to 0.8m at 1m spacing; - Clods of compacted soil are less than 100mm diameter; and - An 8mm rod can be pushed by hand to a depth of at least 0.8m at 80 per cent of sample points in the rip lines (up to 20% below standard is not located in one area).		
FINAL EARTHWORKS	SOIL PREPARATION HAS BEEN COMPLETED - Topsoil and ash has been respread uniformly across the pit or access road; - Topsoil is generally loose and friable to a minimum depth of 100 mm at approximately 250 mm centres; - An 8 mm rod can be pushed by hand to a depth of 100 mm over 80 per cent of the pit or access road.		
	WATER MANAGEMENT STRUCTURES ARE INSTALLED - Upslope runoff and excessive water flow has been diverted away from the rehabilitated area; - Surface water management structures have been installed across the contour (0.5%); - Pit floors should have at least 1:100 fall, and effective water dispersal to prevent ponding and dieback intensification.		
REVEGETATION WORKS	SEEDING - Completed before May; - Approved seed mix of local seed used; - Fertilised with approved type and quantity of fertiliser.		
	PLANTING - Completed before mid - August; - Stocking is 1000 seedlings / ha and seedlings are properly planted; - Fertilised with approved type and quantity of fertiliser.		
	DRAINAGE - Rehabilitated area is stabilised without ongoing erosion, deposition or ponding of water.		

Signed: (Operator) (District Manager)
Date:

Inside back page

← A crushing unit operating in Mowen Road gravel pit (Jeremy Chick)

Gravel recovery from stockpile on Carbanup Road (Deirdre Maher)→

← Loading gravel – Frosty Road (Bob Hagan)

Completed rehabilitation earthworks - Frosty Road (Wolf Tiedemann)→

Back page

Unacceptable Outcome

Poor rehabilitation showing rough surface and little seedling growth.

Understorey and tree growth on an un-rehabilitated pit approximately 4 years after completion of mining.

Results of rehabilitation without topsoil replacement at approximately 20 years since establishment.

Acceptable outcome

Seedling and understorey regeneration approximately 6 months after establishment.

Understorey and tree growth in a properly rehabilitated pit approximately 4 years after establishment.

Subsequent regeneration of a similar site approximately 9 years after topsoil replacement and replanting.

Last updated: 8th August 2008
Custodian: Manager, Environmental Management Branch
Approved by: Manager Environmental Management Branch