CONTENTS

1. INTRODUCTION

The construction and maintenance of Western Australia's 167 000 km of roads depends heavily on the continued supply of road base materials from quarries and borrow pits. As road construction authorities, Main Roads Western Australia and Local Government Authorities create and operate most of the State's quarries and therefore take responsibility for the impact upon our environment.

Without proper planning in the operation and rehabilitation of borrow pits and quarries, material extraction can cause visual pollution and land degradation.

Responsible road managers will take great care not only to observe the requirements of statutory legislation, but also to embrace community expectations in landcare and conservation values.

The guidelines and principles contained in this publication will apply to most situations.

Other guidelines which can be used in conjunction with this publication include:

- *Environmental Management of Quarries - Development, Operation and Rehabilitation Guidelines,* published by the Department of Mines, Western Australia in march 1991, and
- *Guidelines for the Management and Rehabilitation of Gravel Pits in South West Forest Areas,* published by the Department of Conservation and Land Management.

2. THE PLANNING STAGE

BORROW PIT ASSESSMENT

The environment in and around the proposed borrow pit must be considered before beginning field investigations.

Information on specific matters, such as gazetted threatened flora and sites of Aboriginal significance, should be sought from the Department of Conservation and Land Management and the Western Australian Museum, Department of Aboriginal Sites.

If the pit is to be used and rehabilitated over the course of one project, the environmental assessment should cover all steps, from planning to rehabilitation. Should a pit be required for a series of projects, or as a long-term resource, it is desirable to establish individual assessment and management plans for individual locations.

Where land is managed by the Department of Conservation and Land Management or is on a Mining Lease under the Mining Act (1978-1989), specific clearance requirements are necessary.

Under the Conservation and Land Management Act (1984), and subsequent Government decisions relating to mining in national parks and nature reserves, and the status of conservation Management Priority Areas within State Forest, there are limitations on the extraction of basic raw materials from these areas. Details of Government policy relating to this process must be sought from CALM.

Section 112 of the Mining Act requires the Local Government or Government agency wishing to take material from an existing mining lease to comply with the same conditions placed on the lessee of that lease. It is recommended that a Notice of Intent, including attention to those conditions, be submitted to the Department of Mines when pits are to be established on a Mining Lease. Plans for pit operation and rehabilitation should be approved by the holder of the mining lease and approval to proceed must be received from the State Mining Engineer.

LOCATION

Approval to begin investigations for a borrow pit should be given by the Shire Clerk or his delegated nominee.

Borrow pits should be located to avoid stands of significant vegetation

in any area. In the Wheatbelt and the south-west of Western Australia, all remaining native vegetation is environmentally significant. Areas of cleared land should be fully investigated for the location of suitable material prior to entry into areas of native vegetation, including gravel reserves vested in the Commissioner of Main Roads, Local Government or vacant Crown land. Under no circumstances should land recommended for reservation as a conservation reserve in an EPA System Report (Red Book Recommendation Area) be used as a material source.

Borrow pits should not be located within the road reserve or within 200 metres of a roadway. They should also be placed beyond the sight of the motorist or any casual observer. Placement should utilise screens of vegetation or terrain. If this is not possible, a buffer zone of 200 metres should remain between the proposed pit and the roadway.

Pit shape should be longitudinal along the contour and preferably be operated parallel to any roads to reduce visual impact further.

MANAGEMENT PLANS

The management plan should describe the tenure and existing environment of the site, including hydrological, physical, geological and biological attributes. Further details should be provided on the extent of the site, its possible life span as a pit, the extraction and rehabilitation process and funding of its management.

Borrow pits are located wherever the required material is most readily available and extraction is environmentally acceptable. Before the pit is opened up, careful consideration must be given to:

- the immediate effect of the pit
- the disruption of any aesthetic feature, native flora, effect on surrounding land use, erosion, loss of production and impact on the environment around the pit
- future use of the area

A properly planned pit can become an asset, by either its return to its former plant cover or by its redevelopment for an alternative use, eg. farm dam or water catchment.

Pits should be planned and worked in sections not exceeding one hectare or 200 metres long and 50 metres wide in maximum dimension.

After the necessary clearances have been obtained to enter an area, it is essential to test the extent and quality of material in the entire deposit to determine the total area to be used, the mode of operation of the pit and its likely period of use. Only then can management plans that will detail the techniques to be used for the establishment and rehabilitation of the pit be developed for the area. This planning should identify and describe the method of handling vegetation, top layer material (that which contains the seed plant nutrients and organic material) and overburden removed to expose the desired grades. Methods will generally reflect land use and the natural slope in the area. Costs required to establish and rehabilitate the pit properly should be made clear.

Investigations to establish material location and determination of quality and extent should consider the following:

- entry requirements onto land
- local regulations, eg. disease control
- local problems, eg. declared or pest weeds
- reserve land status and authorisation required to explore material deposits
- advice to land manager of area and scope of exploration
- advice from land holder on preferred access routes, location of livestock, use of water, establishment of camp sites, use of fire and rubbish disposal, locality of significant environmental areas
- all contractors to be informed of precautions and conditions affecting the investigation
- all machines and vehicles to be cleaned down before entry to an area
- curtailment of activities under conditions which may damage property improvements, such as tracks and water quality or storage facilities, or spread plant diseases such as fungal dieback
- informing land managers on equipment movements, installation of any new gates, tracks etc, and discussing their location with the land manager
- compensation for loss of improvements (such as pasture) and use of land during material extractions

ENVIRONMENTAL IMPACTS OF BORROW PITS

Short-term impacts include:

- destruction of vegetation
- temporary loss of use of improved pasture and the resulting loss of income during pit operation
- dust and noise pollution
- stream pollution
- erosion
- aesthetics; landscape modification
- high density of pioneer species in early regeneration phase
- possible long-term impacts
- change of environment due to increased water collection in the pit
- changed structure and composition of native vegetation (return to a totally rehabilitated state may take hundreds of years in forest areas) and resulting changes to native fauna
- changed land use - camping/rest areas; water catchment
- soil salinity through increased recharge of ground water
- increased pasture productivity

ACCESS

Vehicle movement should usually be confined along a single access road to the pit area to avoid additional and unnecessary rehabilitation work. For scraper operation or job safety, it is acceptable to use more than one access. Access tracks should be located to avoid direct lines of sight into the borrow pit from the roadway and should not create unnecessary drainage and erosion problems (see Figure 1). Access tracks should enter pits at a point above the lowest natural ground level of the pit.

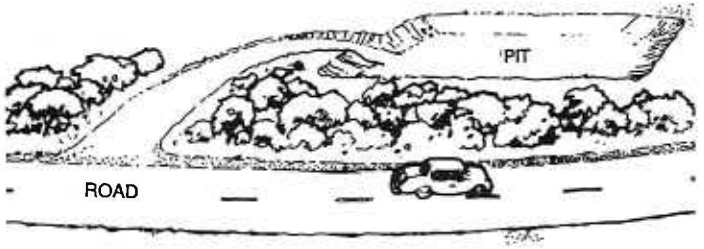


Figure 1 - Access tracks should avoid direct lines of sight

WATER COURSES

Access tracks should not exceed five metres in width for a one-way track and eight metres in width for a two-way track. All aspects of clearing and rehabilitation of borrow pits will apply to access tracks.

If suitably placed, access tracks should utilise the route of existing tracks. This may involve longer haul distances, but will lessen environmental impact by reducing clearing.

Tracks should be restricted in placement, and be rehabilitated after use.

Where a pit contains large quantities of material, or is to be utilised over a prolonged period (years), it should be sectionally developed with each section being separated by a 50 metre buffer of undisturbed ground (see Figure 2), and the dimensions given in the Management Plan Section. This is particularly important in uncleared land.

The sections of 50 metres of undisturbed vegetation may be removed after sections either side have achieved five years' growth of a well-covered regenerating vegetation. This may be dependent on the life of a pit.

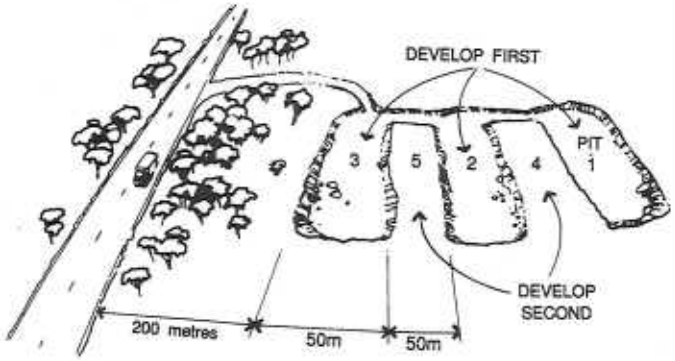


Figure 2 - Borrow Pit Size and Sectional Sequence

Major water courses must be avoided by at least 200 metres to ensure that natural flows are not impeded to any great degree. Exceptions can be made for the extraction of river sands in arid regions, which generally have to come from a major water course. Where drainage lines dissecting the landscape are encountered, they should be avoided and an undisturbed buffer of 10 metres width be left on either side of them (see Figure 3).

If excavation of drainage lines is unavoidable, alternative drainage structures should be constructed from the high side of the pit, around and within the pit, to direct water back to its original water course below the lowest side of the pit (see Figure 3a).

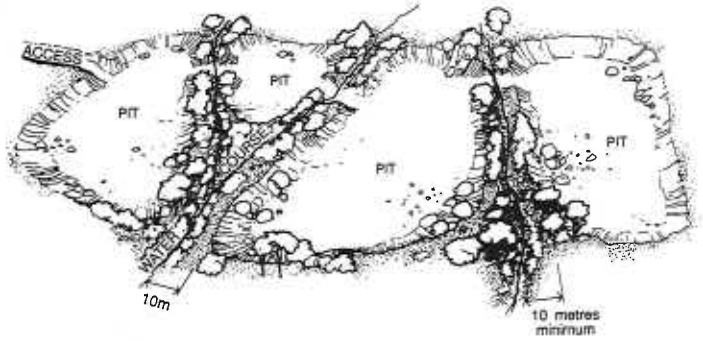


Figure 3 - Water Courses

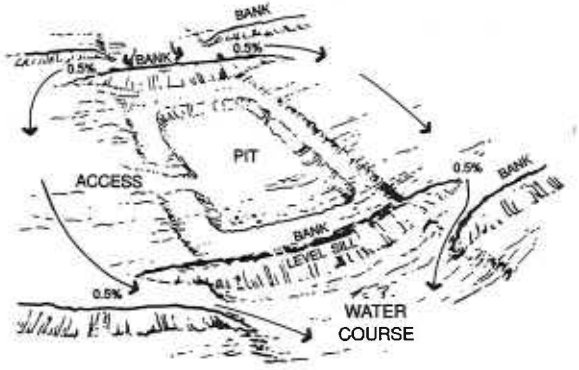


Figure 3a - Movement of Water around a Borrow Pit

SIZE OF BORROW PITS

Alternatively, a pit may be operated as an ongoing operation which will sacrifice some of the environmental advantages of operation on a section-by-section basis (see Figure 2).

When initial investigation and sampling is complete, all backhoe pits and test hole costeans must be backfilled, if no longer needed, or fenced to indicate their presence clearly, if they are to be left open for an extended period. When all investigation is complete, all test pits must be backfilled and the extent of the material available clearly marked.

New tracks should be placed along contours and should not be visible from the road for long distances. Entry from the road should be curved, not straight, to restrict vision along the track from the road (see Figure 4).

Details of the size, location and shape of a material deposit should be available to the Engineer and/or Supervisor to ensure that proper planning for the operation and rehabilitation of a pit can be completed before opening up a pit.

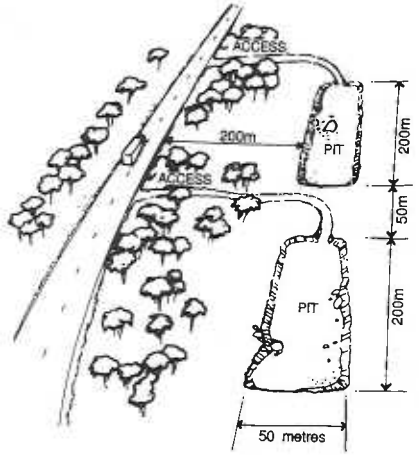


Figure 4 - Size and Position of Borrow Pits

3. OPERATION OF THE PIT

OPENING A BORROW PIT

Some land management authorities (such as CALM and WAWA) have their own guidelines for pit operation and rehabilitation. Liaison should be established with such authorities before opening a pit, to establish the existence of any such guidelines when operating on land managed by other agencies.

Before opening a borrow pit, all vehicles and machines that will enter the area should be cleaned down to limit the spread of weeds and plant or animal diseases.

SETTING OUT THE BORROW PIT

Deposits of naturally occurring material should be pegged to determine their extent. Pegs should also be placed to delineate the pit sections to be used and their placement should indicate the natural contour of each section. Pit sections should not exceed 200 metres in length and 50 metres in width.

CLEARING AND STOCKPILING OF VEGETATION, TOP LAYER AND OVERBURDEN

The vegetation cover should be pushed off to the longitudinal sides of the intended borrow pit section to a distance of at least 10 times the proposed depth of the section and left in a neat windrow. The vegetation removed should not be pushed into standing vegetation at the edge of the pit section. Sufficient cleared area should be left beyond the windrow for a machine to retrieve the windrow for use in future rehabilitation (see Figure 5).

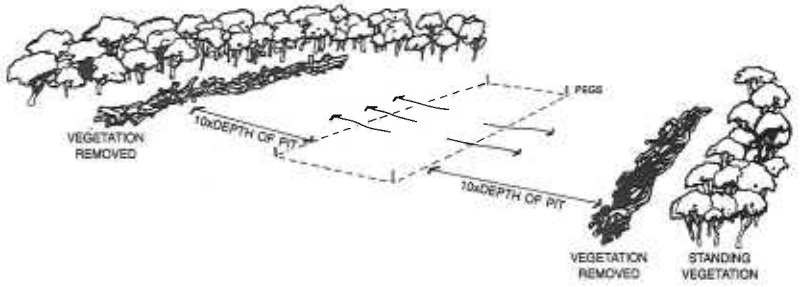


Figure 5 - Vegetation Stockpile

Only machines with front end rakes should be used to push the vegetation into the neat windrow or to retrieve it for use in the rehabilitation process.

These machines minimise any disturbance of the soil profile and do not mix top layer and vegetation, which must be kept separate so they can be used in future rehabilitation.

Vegetation should not be burned unless this is prescribed in the pit management plan. Burning destroys organic material, seed, micro-nutrients and micro-fauna that assist in the rehabilitation process.

The top layer is the layer of soil covered with humus, grass, gibbers or scree, which contains the nutrients and roots that feed on these nutrients. The top layer should be removed and kept in its entirety. Often, it is a different colour to the subsoil, but not always. In sandy areas, the top layer may be up to one metre in depth, while in clayey soils, its depth may be restricted to between 75 and 150 millimetres. The shallower the layer, the more care must be taken with its removal and storage.

When the first pit section is opened up, the top layer should be stockpiled longitudinally in a neat windrow allowing sufficient room beyond the windrow for a machine to operate between the top windrow and the windrow of vegetation (see Figure 6).

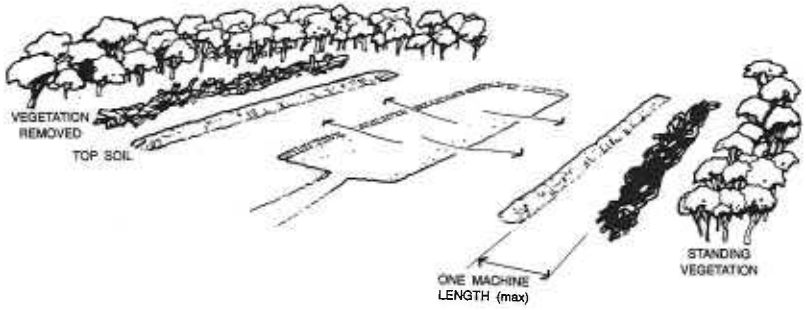


Figure 6 - Top Layer Stockpile

Sufficient space should be left between the windrow and the working face of the pit to batter down the sides of the pit in the rehabilitation process. This should be a distance of at least four times the depth of material. Additional distance may be required where the natural angle of repose is

flatter than four horizontal to one vertical (4H:1V). In farm land pit sections, where flat batters are required, it may be necessary to place top layer windrows a distance of up to 10 times the depth of material beyond the edge of the deposit.

Vegetation and top layer material should be pushed to one side of the access track for use in the final rehabilitation phase of the access track, taking into account comments made when discussing the opening of borrow pit sections in Section 4.

Overburden should be removed from the pit and stockpiled in an area separate from the vegetation and top layer windrows. The overburden is described as that layer below the top layer, but above the layer of material to be used in the road building process. Its placement should take into account the space requirements for effective rehabilitation of the borrow pit section (see Figure 7).

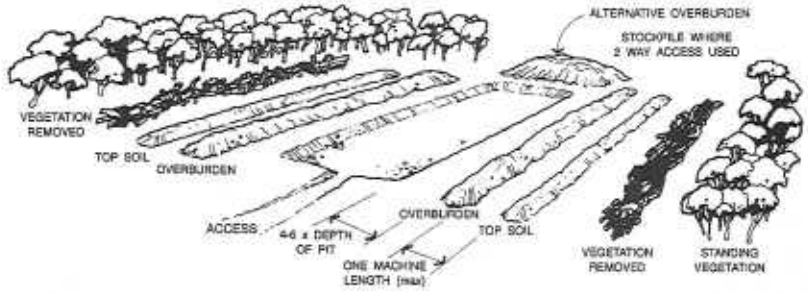


Figure 7 - Overburden Stockpile

STOCKPILING AND REMOVAL OF BORROW MATERIAL

Stockpiling of the borrow material can begin once clearing and stockpiling of material required for rehabilitation are complete. Care must be taken to ensure the borrow pit is worked to the planned depth, and extraction of material does not extend beyond the planned internal pit area.

Where scrapers are used to remove borrow material, the sides of the pit may be step battered to allow removal of material to the base of the overburden windrow (if it exists) or the topsoil windrow. The slope of the batter should be designed to fulfil the criteria as set for the rehabilitated pit.

4. REHABILITATION OF CURRENT PITS

FUTURE USES OF BORROW PITS

NATURAL BUSHLAND OR RANGELAND AREAS

In natural bushland or rangeland areas, the best future use for borrow pits is to return them to their former condition.

FARMLAND BORROW PITS

These are often easiest to rehabilitate by returning them to developed pasture. They do, however, require very flat batters—a vertical depth of one metre requires a 10 to 20 metre horizontal length batter.

Farmland borrow pits can often be developed to provide facilities which may be of more value to the farmer than pastured land. Where the pits exist on flat land, they can be shaped into a spread bank dam (see Figure 8). The cost of this work is often less than the rehabilitation of the pit to pasture. On sloping ground, a conventional earth dam may be constructed in one corner of the pit, with the remainder of the pit being developed as a roaded catchment area. Details on capacity of dams required for such sites are available from local Department of Agriculture staff.

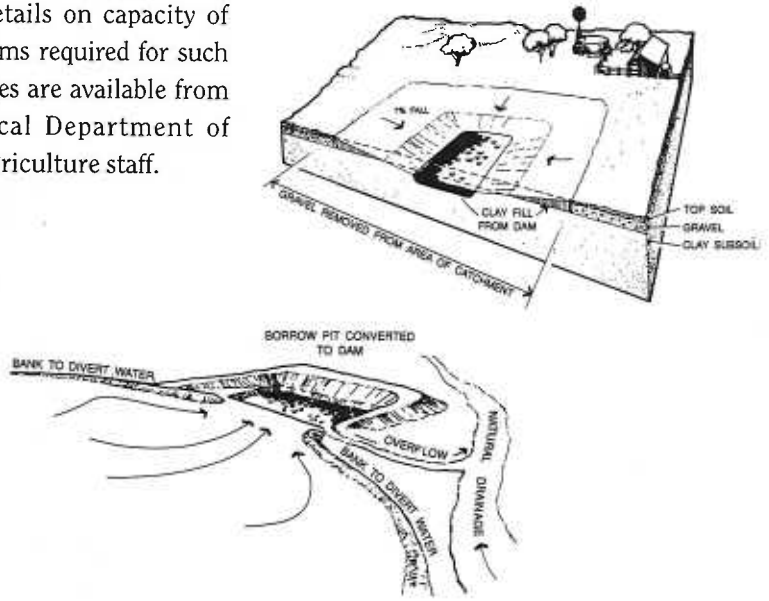


Figure 8 - Typical Dam Types

INDUSTRIAL WASTE

When material extraction is completed in each pit section, waste material present should be removed for proper disposal or deeply buried.

Any heaps of stone should be removed from the pit floor and stockpiled for respreading in the rehabilitation process. Opportunities for rock crushing should be explored. Sometimes this can be cheaper than opening and rehabilitating a new pit.

SHAPING THE PIT

The borrow pit floor should be left smooth with any stockpiles of material being used to fill local depressions in the pit floor. The smooth finish is essential for the even application of top layer over the pit area later in the process.

The sides of the pit should then be battered down to blend closely with the surrounding landscape and match local contour patterns, where possible. Batter slopes should be finished to slopes no steeper than 4H:1V. Secondary filling of batters should be carried out using overburden removed in the pit establishment process, where the overburden is part of the soil profile (see Figure 9).

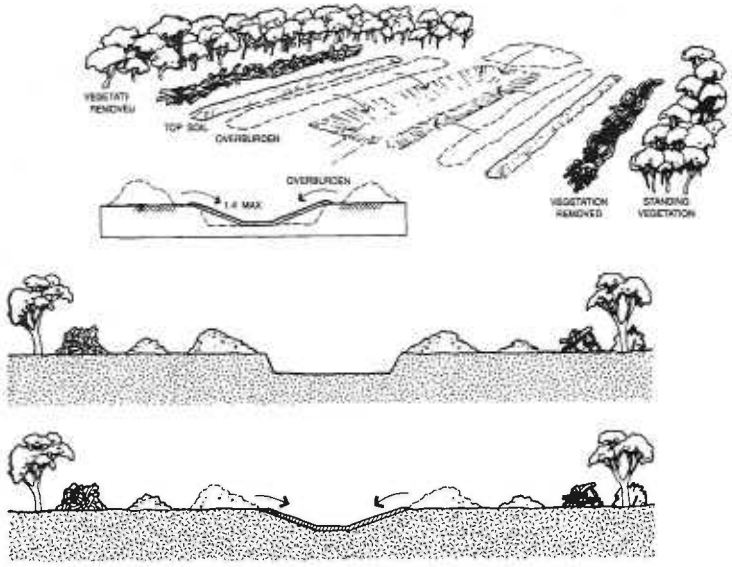
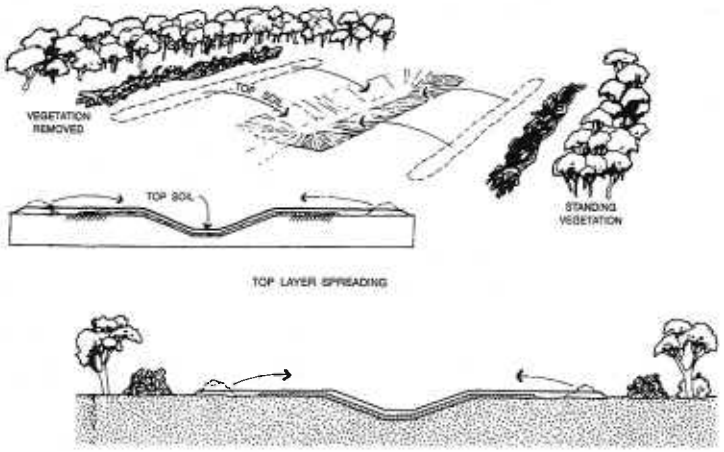


Figure 9 - Pit Reshaping

TOP LAYER SPREADING

Top layer should be spread evenly over the total disturbed area created by pit establishment. Care should be taken not to remove the original top layer from beneath the windrow of stockpiled top layer (see Figure 10).



Figures 10 - Top Layer Spreading

SPREADING CLEARED VEGETATION

Stockpiled vegetation and rocks cleared for the pit are then respread evenly over the top of the top layer, if the pit area is to be returned to its natural state.

EROSION CONTROL MEASURES

As a guide to erosion control structures required within a borrow pit, the following criteria should be used:

BATTER SLOPE	PIT DEPTH (m)	STRUCTURE
less than 1V:50H	<1	None required.
	>1	Absorption drain midway down batter on the high and low side.
1V:50H - 1V:20H	<1	Catch drain on top of batter on the high side.
	>1	As above and absorption drains midway down the batter on high and low side.
1V:20H - 1V:5H	<1	As above and a relief drain from the lowest point in the pit to a level sill outlet 25 metres beyond the pit edge.
	>1	Catch drain at the top of the batter on the high side, two absorption banks placed equidistant down batter and at the base of the batter on the high and low sides and a relief drain from the lowest point in the pit to a level sill outlet 25 metres beyond the pit edge.
greater than 1V:5H		A catch drain on the top of the batter on the highside and absorption drains equidistant across the pit at spacings of not more than 10 metres.

RIPPING OF BORROW PIT

It may be necessary to complete this stage before shaping the pit, as described in the Rehabilitation Section.

Ripping should always be worked to the pit contours to reduce the possibility of erosion, and should be carried out over the entire disturbed area.

Ripping should be carried out to a minimum depth of 500 mm at 500 mm spacings. **As a general rule, the deeper the rip the better.**

Rehabilitation of borrow pits and access tracks is not complete until ripping is carried out.

A windrow should be placed at each entrance of the borrow pit to prevent easy entry.

In pastured sites, only tyning is necessary to provide a smooth finish for future use by the farmer.

DIRECT SEEDING OF PIT

The progress of revegetation in the rehabilitated pit should be monitored and, if necessary, direct seeding of the pit should be carried out. Seed used must be collected from local species in the surrounds of the pit. In agricultural areas, this may be pasture seed with an accompanying fertiliser.

Where seeding is necessary, rehabilitation processes should be assessed and general procedures amended, if required.

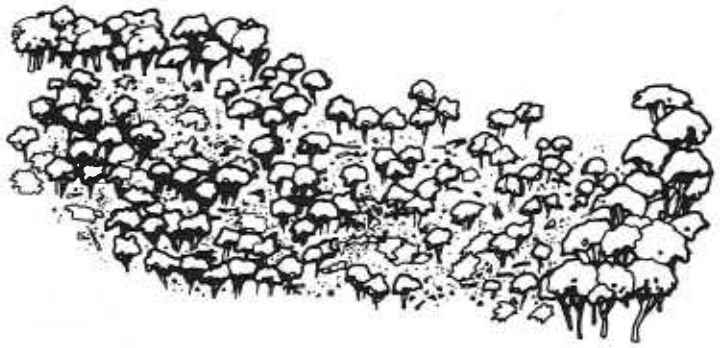


Figure 11 - Borrow Pit Rehabilitation Complete

5. REHABILITATION OF OLD BORROW PITS

In the past, many borrow pits have had material extracted with no attempt to reshape or rehabilitate the pit or pit section. Such pits must be assessed objectively and the rehabilitation process started from the beginning, regardless of vegetation establishment.

While it is desirable to save as much vegetation as possible in the rehabilitation of old borrow pits, it may be more beneficial in the long-term to remove some vegetation, which would only achieve short-term gains if retained.

PIT SHAPING AND REHABILITATION

This may be best achieved by stripping vegetation and top layer beyond the edges of the pit for a distance of at least four times the depth of the pit. Spoil from works should not be used as it invariably contains exotic species.

The pit can then be rehabilitated as described in that section.

OLD ROADS AND DISTURBANCES

Old roads, camp sites, material storage sites, work areas and other areas disturbed in the road construction and maintenance process should be treated using the techniques described in this manual to promote revegetation. This removes the scars created in the works process.

6. MAINTENANCE

Monitoring of borrow pits and other areas disturbed in the works process is important. If initial treatment is unsuccessful three to five years after the work is completed, it may be necessary to re-rip and direct seed the area with local seed collected from the immediate surrounds to revegetate the area successfully. Areas requiring such treatment should be inspected by the Shire Clerk, Engineer and/or Supervisor before treatment, so as to establish the reason for the lack of successful revegetation.

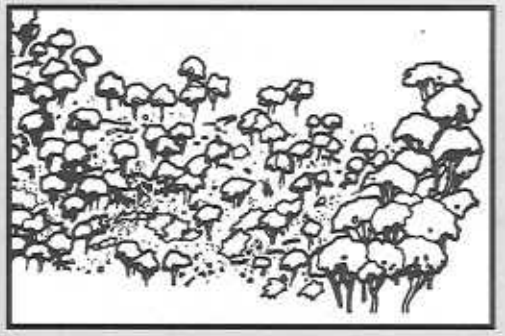
Current technology should determine seeding rates of treatments.

To date, rehabilitation technology does not indicate a need to apply fertilisers where top layer material is present. However, such application may assist pasture establishment in farmland sites.

Water harvesting techniques are applied through ripping on the contour and installation of contour drains and absorption banks.

Department of Conservation and Land Management
1994

Produced by MAIN ROADS Western Australia for the Roadside Conservation Committee



ROADSIDE CONSERVATION COMMITTEE

GUIDELINES FOR PLANNING, OPERATING AND REHABILITATING BORROW PITS

JUNE 1994