GUIDELINES FOR EFFECTIVE REHABILITATION OF BORROW PITS IN THE TOP END

R.J. APPLEGATE
DECEMBER 1983

CONSERVATION COMMISSION OF THE NORTHERN TERRITORY
DARWIN N.T.
3.0 OPERATION

3.1 Clearing

3.1.1. Only vegetation within the 1 hectare perimeter of each pit should be cleared. A further area 5-10 m wide can be cleared on the longitudinal sides of the pit to stockpile topsoil if quantities dictate the need.

3.1.2. Felled timber should be windrowed longitudinally down the middle of the pit area. As little topsoil as possible should be incorporated with the timber. The use of a root rake rather than a blade on a bulldozer is the most efficient and effective method of achieving these aims.

Fig 2. Clearing

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![Diagram showing clearing process]
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ACKNOWLEDGEMENTS

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The co-operation of Henry and Walker Pty Ltd in adopting these guidelines during their inception stage and proving their effectiveness is very much appreciated.
1.0 INTRODUCTION

These guidelines have been compiled to encourage the effective rehabilitation of borrow pits by extractive operators.

The guidelines have been designed to reduce the visual impact of borrow operations, make rehabilitation an integral part of the operation and reduce problems of soil erosion often associated with unrehabilitated and disused borrow pits.

The method has been used very successfully by extractive operators, construction companies and mining companies in the Top End of the Northern Territory and all have found that not only is the method effective it is also efficient with very little being added to the overall cost of the extraction operation.

Where pits are operated and rehabilitated in one season the cost of rehabilitation has been reduced since the revegetation relies on native seed in the respread topsoil and introduced seed and fertilizer is not necessary.

There are hundreds of disused borrow pits adjacent to Territory roads. Most are in varying degrees of self revegetation but all have acted as source areas of sediment through wet season erosion and all could have been more rapidly rehabilitated if the guidelines denoted in this bulletin had been used.

It is hoped that this technical bulletin will act as a guide for all persons concerned with extractive operations and that awareness of sound soil conservation practices will be promoted.

The guidelines should only be used in conjunction with soil, gravel and sand extraction. They do not apply to sand mining or dredging operations from stable river, creek and drainage lines.
2.0 PREPARATION

2.1 Apply to the Department of Mines and Energy for an Extractive Mineral Permit or necessary Authority.

2.2 Prepare a pit plan, showing location of pit in relation to drainage lines, natural topography, roads and buildings.

2.3 Locate pits at least 50 m away from natural drainage lines. This is to reduce the likelihood of the pits filling with water from the flooded drainage line in the wet season and possibly altering the course of the drainage line.
2.4 A minimum vegetative screen of 150 m should be used to separate the pits from roadways.

2.5 Exploration test pits and costeins should be backfilled if located in unsuitable sites. Access tracks to test pits should be ripped with a grader if the tracks were initially cleared and graded.

2.6 On slopes greater than 1% (1 m fall in 100 m) pits should be located with the longitudinal access parallel with the contours of the natural topography.

2.7 Area of each pit should be restricted to a maximum of 1 hectare. The pit should be in the shape of a rectangle with maximum dimensions of 200 m x 50 m.

Fig 1. Pit Plan
2.8 Access to the borrow area should be via a single road except where safety or machine requirements necessitate separate entry and exit roads. The access roads should be constructed to suit the expected usage. Formed all-weather roads with adequate side and cross drainage should be constructed if the pits will be operated for longer than one year.

2.9 A screen of uncleared vegetation of at least 30 m should be left between adjacent pits. This area acts as a seed source for natural revegetation of the pits following cessation of extractive operations.

Plate 2. Borrow pits following extraction.
Note: Vegetation screen between adjacent pits
Single access track to pits.
3.1.3. The piled timber should be burnt once it is dry. Therefore, the actual clearing operation should precede the extractive operation by sufficient time to allow for the burning.

3.2 Topsoil Stockpiling

3.2.1. Following the burn, the topsoil is removed by pushing from the middle of the pit to the longitudinal sides, where topsoil is to be stockpiled. Any burnt timber and ash can be pushed with the topsoil and incorporated in the stockpile.

3.2.2. Stripping of the top 10-15 cm of soil will suffice for rehabilitation purposes as this topsoil contains the seed and nutrient reserves for future rehabilitation.

3.2.3. Where scrapers are being used for the extractive operation, the topsoil should still be placed in the designated stockpile area.

3.2.4. In a large borrow operation where scrapers are employed there is great potential for progressive rehabilitation minimising stockpiling and double handling of the topsoil.

Topsoil is stockpiled from the first pit in the normal manner but the topsoil stripped by scraper from the second pit is transported directly and spread on the first pit after extraction has been completed. This ensures progressive rehabilitation of each pit. When extraction is completed from the final pit the topsoil stockpiled on the perimeter of the first pit is picked up and spread over the final pit to effect rehabilitation.
3.2.5. If the pit is unlikely to be rehabilitated before the wet season the topsoil stockpile should have batters no steeper than 3H:1V.

3.2.6. It is recommended that the depth of extraction does not exceed 1.5 m. The depth of extraction will depend on the depth of gravel or sand in situ but where the pit is deeper than 1.5 m, successful rehabilitation is hindered because the pits pond water in the wet and it is difficult to ensure their self draining.
The ease of ensuring self draining pits increases with the slope of the land where the pits are located. Pits can be extracted to greater depths if located on steeper ground, where cut trenches can ensure the pits drain efficiently and don't pond water.

3.2.7. Pits should be operated on a progressive basis. No more than three pits should be cleared at once. This enables the first pit to be extracted whilst topsoil stockpiling is carried out on the second pit and timber burning is going on in the third pit. When the first pit's extraction is completed it is rehabilitated prior to extraction commencing on the second pit or a fourth pit being cleared.

Fig 4. Sequence of Pit Operation

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Topsoil stockpile

Pit 1
Gravel extraction

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Pit 2
Stockpile topsoil

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Pit 3
Clearing and burning

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Pit 4
To be cleared

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9
4.0 REHABILITATION

4.1 Following completion of extraction the pit floor should be left in a neat and tidy manner with unused stockpiled gravel being respread over the pit floor. The removal or crushing and burial of drums and other equipment discarded during the operation should be completed at this stage.

4.2 The floor of the pit should be deep ripped with a 1 m tyne, to improve infiltration. Rip lines should be spaced about 3 m or the width of the dozer's tracks.

4.3 The batters of the pit's walls should be at least 3H:1V which is adequate for pits with a depth of 1 m. With pits deeper than 1 m the pit walls should be battered back to 6H:IV during operations.

4.4 Topsoil should be respread by pushing from behind the topsoil stockpiles towards the middle of the pit. Topsoil removed from the access road should also be respread over the road.
4.5 The surface can be lightly tyned during the grader operation and the tyning should be carried out along the contour. The access road should also be tyned with the grader.
4.6 Erosion control diversion banks or bunds may be necessary to divide the catchment of the borrow pit or divert run-on water from above if the slope and size of the catchment warrants it. Advice from soil conservation authorities should be sought where an erosion problem is likely to exist.

4.7 If the borrow operation is completed during the dry season inside a year, the seed reserves in the respread topsoil should be sufficient to generate natural revegetation during the wet season.

4.8 However, if the topsoil has been stockpiled over a wet season the surface seed will have germinated and subsequent flowering of the species will have only seeded the surface of the stockpiles. After a year of stockpiling a lot of the seed within the stockpile may be dead.
4.9 In such a case the respread rehabilitated pit may require introduced seeding and fertilisation prior to the wet season to ensure good ground cover in the first wet.

4.10 Revegetation using introduced seeds and fertiliser should be done at the commencement of the Wet following ripping, topsoil resspreading and tyning. Combinations of fast growing grasses and legumes are useful species to introduce. Suitable species certified weed free should be used. Within the Northern Territory, only some of the species are approved for use in National Parks. If mining is in a National Park, permission to use any of the species should be obtained from the Park Superintendent.

The initial stabilisation with such introduced species creates a favourable habitat for other natural species and invasion by these is usually rapid and successful in subsequent years.

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>COMMON NAME</th>
<th>ANNUAL RAINFALL RANGE (mm)</th>
<th>SOWING RATE kg ha(^{-1})</th>
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<tr>
<td>Brachiaria decumbens</td>
<td>Signal grass</td>
<td>&gt; 1200</td>
<td>5</td>
</tr>
<tr>
<td>Cenchrus ciliaris</td>
<td>Buffel grass</td>
<td>300 - 1000</td>
<td>5</td>
</tr>
<tr>
<td>Chloris gayana</td>
<td>Rhodes grass</td>
<td>600 - 1500</td>
<td>5</td>
</tr>
<tr>
<td>Cynodon dactylon</td>
<td>Green couch</td>
<td>500 - 1500</td>
<td>5</td>
</tr>
<tr>
<td>Paspalum notatum</td>
<td>Bahia grass</td>
<td>900 - 1600</td>
<td>10</td>
</tr>
<tr>
<td>Urochloa mosambicensis</td>
<td>Sabi grass</td>
<td>400 - 1100</td>
<td>5</td>
</tr>
<tr>
<td>Stylosanthes humilis</td>
<td>Townsville stylo</td>
<td>500 - 1500</td>
<td>5</td>
</tr>
<tr>
<td>Stylosanthes hamata</td>
<td>Verano stylo</td>
<td>500 - 1500</td>
<td>5</td>
</tr>
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A shot-gun mix of seed at a rate of 20 kg ha\(^{-1}\) should be applied using a combination of Stylo and other grass species.

Table 1. Introduced Pasture Species useful for Revegetation
4.11 Fertiliser should be applied at a similar rate of 400 kg ha\(^{-1}\) of a Nitrogen, Phosphorous, Potassium mix fertiliser in proportion 10N:9P:7K for initial establishment.

Such reseeding and fertilising can be conducted by broadcast spreading or by a drill-seeder implement.

4.12 Reintroduction of seed and fertiliser adds costs to the borrow pit rehabilitation and it is recommended that borrow pits be operated in the dry and rehabilitated prior to the wet season to take advantage of the natural seed source in the topsoil.

Plate 8. Revegetated Borrow Pit following first wet season. Note: native trees and grasses.
Plate 9. Aerial view of successfully rehabilitated Borrow Pit after its second wet season.