


Implementing Rehabilitation to Pasture

This fact sheet gives an overview of the methods used to rehabilitate farm land during mining operations. The first step is to identify the on-site resources that can be salvaged and used for rehabilitation (Fact Sheet 5). The second step is to agree rehabilitation outcomes (Fact Sheet 6). Creating a post-mining landform with slopes that give adequate drainage (and height above water table) is key to success. Salvaged topsoils and/or sands and fine gravels are then spread over the new landform to form a pasture growth medium. High fertiliser applications are needed to establish vigorous , dense pastures. Early weed control is needed during establishment. More detailed information on pasture rehabilitation methods is available from www.landcareresearch.co.nz *(keyword: mining factsheets)*.

1. Identify rehabilitation resources and constraints

- Calculate approximate volumes of suitable materials available and volumes needed **(Fact Sheet 5)**
- Identify resources that can be produced Run of Mine, e.g. boulders, fines for root zone, gravels for surfacing races

HINT: ROM (Run of Mine) materials may be more cost-effective than separately stockpiling during stripping, especially where stockpile area is limited, haul distances or handling can be reduced

2. Strip

- Identify, mark, and protect riparian zones and agreed no go zones , e.g. remnant forests, wetlands, buildings
- Survey weeds and ID weedy areas; decide on management , e.g. spraying, separate stripping and stockpiling or disposal
- Fell/remove trees and direct transfer; remove and salvage fences, troughs, etc.
- Identify stockpiling areas and prepare these areas with access., firm bases, cut-off drains, sediment control and fences
- Reduce pasture mass by intensive, close, grazing immediately prior to stripping, or herbicide 2–3 weeks earlier
- Preferably use low ground-pressure machinery to strip topsoil separately from subsoil
- Strip and stockpile free-draining materials that will be used in root zone separate from general backfill
- Remove poorly-drained or hostile subsoil and overburden. Dispose in suitable backfill areas below root zone

HINT: Placing stockpiles adjacent to areas that will be rehabilitated may reduce or eliminate haulage

HINT: The cost of double handling is avoided by managing the mining schedule to allow direct placement of soil and rock from stripped area s to rehabilitated area s

3. Stockpile and conserve root zone

- Separately stockpile topsoil, subsoil, and other materials for rehabilitation in accessible areas
- No surface water should enter stockpiles ; reduce 'dirty water' needing treatment by diverting clean water away from stockpiles
- Create soil stockpiles by back-dumping to minimise compacting the soil . Do not drive over stockpiles
- If stockpiles will be unused for > 3 months, sow with grasses or legumes to conserve quality

HINT: Keep track of topsoils and root zone volumes needed and used or stored; many mines run out of suitable root zone material. An inadequate root zone increases costs and the risk of poor plant growth

4. Reinstate landform or create modified landform

- Place overburden to minimise the amount of reshaping (bulldozing) and re-handling required
- Identify and mark watercourses and water detention areas; confirm flood capacity is adequate;
- Reinforce flood zones and water-courses with rock armouring if necessary; install culverts and crossings
- Check site safety : remove steep drops and dangerous areas , e.g., soft, deep sediment or mitigate hazards, e.g. excluding vehicle access using boulders, fenced ditches or other contouring

HINT: Check compliance:
- with land-owner access agreement,
- with WCRC requirements and relevant bond release conditions

HINT: Ensure treatment of permanent water-courses (e.g. streams) is consistent with WCRC 2004 'Clean Streams' Guide and WCRC stock crossing policy

5. Create root zone

- For pasture: Create a free-draining root zone of minimum 300 mm depth over compacted gravels or overburden. The root zone should include at least 100 mm topsoil, unless fine sands and silts are substituted (silts increase risk of surface sealing)
- Trees (shelter belts & native plantings) grow best in a 1 m root zone depth to ensure stability and reduce stress
- Minimise compaction of topsoil by avoiding handling in wet periods and using light or low ground-pressure tractors
- Soil tests will confirm initial (capital) fertiliser and lime recommendation for good pasture growth

HINT: Wet and pond margins also need soil. Protect this from wave erosion using a sheeting of gravel, placing logs in the water parallel to the edge, and/or using diggers to remove and place buckets of rushes/raupo /flax into pre-dug holes or offshore islands

6. Establish pasture, re-vegetate

- Stone pick or rake, remove metal or concrete and other stock and vehicle hazards as necessary
- Decide if a pre-sowing spray of weeds is needed
- Apply fertiliser (lime/gypsum, phosphate, nitrogen, etc.)
- Minimise compaction of topsoil by combining fertilising, harrowing, sowing operations during drier periods
- Minimise erosion by cultivating with the contour
- Best results (germination and growth) are in spring and autumn
- See native vegetation establishment flowchart for TREE and SHRUB establishment

HINT: Keep records of what root zone, pasture sowing rates and fertiliser were used and when. Mark the areas on a map. This helps identify best methods for your site

7. Monitor pasture outcome

- After first storm and/or 3–6 weeks after planting
- For each rehabilitation area

HINT: This is a good time to establish permanent photo points to show rehabilitation progress

Check and Control Weeds

- Identify source of weeds and why weeds are dominant
- Decide weed control method (including grazing

Check Pasture Vigour

- Will pasture resist grazing?
- If grass is yellow check soil drainage, then nitrogen deficiency by spot fertilising

Check Pasture Cover

- Successful if >90% cover after three months
- Find causes of poor cover (weather, soil, erosion, pests) and do remedial work

Check Erosion*

- Check land surface , watercourses , cut-off drains
- Identify cause of erosion, then do remedial work
- Amend rehabilitation method (slope, surface roughness, timing) unless erosion is caused by an unusual rainfall

Decide if the area is ready for grazing or topping

8. Prepare for grazing or topping/mowing

- Is the area stock-proof (permanent or temporary fences in place) and watercourses excluded from grazing?
- Can stock get to and from the area to be grazed without impacting mining?
- Is the ground surface safe for stock or mowing (no wire, concrete, etc.)? Is an adequate water supply present (not a unfenced stream or drain)?
- Are wet areas present that are likely to be pugged (damaged)?
- Walkover with grazing manager/ farmer and confirm objectives: short duration with light stock under dry conditions leaving adequate pasture height

Grazing / Topping

Record the duration, and weather (e.g. rain)

9. Monitoring after grazing

- Pasture health and density (was pasture pulled out by roots, is residual pasture adequate for rapid regrowth or has it been over-grazed with bare soil evident?). Grass/legume balance (high legume cover indicates nitrogen stress)
- Weed species and cover (was grazing effective in controlling weeds?)
- Erosion or pugging, damage or runoff from grazed areas to watercourses
- Check fences remain stockproof

Feedback with farmer/ manager

- Did grazing go to plan?
- Review access, fencing, stock health, pasture health
- Does grazing intensity, timing or duration need to be altered?

10. Maintain and complete rehabilitation

- Post-grazing fertilisation, weed and pest control as needed
- Annual maintenance fertiliser as needed (phosphate, potassium, nitrogen, trace elements as needed)
- Complete permanent fencing, races, water troughs, shelter, etc. as agreed
- If soil fertility levels are part of agreement, soil test and fertilise as indicated by results

HINT: This is a good time to photograph permanent photopoints and identify the best rehabilitation method for this site

11. Closure assessment for hand-over to landowner and Bond Release *(part/whole)*

- Confirm agreed outcomes with land manager/owner and administrator

This fact sheet is part of a series relating to a framework for predicting and managing the environment impacts of mining.
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