



Planning and Agreeing Rehabilitation to Pasture

Planning and agreeing the post-mining outcomes before starting rehabilitation reduces uncertainty for miner and land-owner or manager. This fact sheet gives an overview of how this can occur and should be read with Fact Sheets 5 and 7. More detailed information available from www.landcareresearch.co.nz (keyword: mining factsheets).

1. Decide what is possible at the site

A. Site assessment

What are current site conditions?
Land-use capability measures versatility (e.g. cropping potential and the main limitations to farm production). Current productivity is a useful guide (stock units/ha, Dry Matter/ha/year), seasonality of growth may be important. Consider trees, shelter belts, ponds, drains, watercourses and their values and farm infrastructure: fences, races, sheds, reticulated water, silage pits and stand-off areas.

C. What resources are available?

The mine machinery and equipment influences what resources can be salvaged and separated, e.g. size of fines, ability to access slopes.
See **Fact Sheet 5**.

Is any mine infrastructure useful to retain after mining? E.g. access roads (races), power supply, dredge pond (with reshaped batters), culverts and bridges, sheds.
Are farm resources useful? E.g., seeding equipment, light stock for grazing new pasture, dairy shed effluent, hay bales for erosion control.

B. Site assessment

What are current site limitations? These may be reduced or removed in rehabilitation:

- Poor drainage due to perched water table (iron pan) -> mining breaks this pan
- Poor drainage due to flat site with slowly-permeable soils (pakihi) -> mining can create humps and hollows
Floods frequently -> deeper gravel mining may raise the land
- Chemical infertility and low-producing pasture species -> rehabilitation can establish high-producing pasture
- Gorse and weeds -> heavily-infested soils may be replaced if adequate alternatives and moderate to high fertiliser rates are used

D. How does the mine plan influence resource availability and use?

When will areas be available to separately stockpile resources for rehabilitation?
What areas are likely to be rehabilitated each year, and when? (This can help farm operations.)

HINT: Using aerial photos or farm map to mark key features helps clarify discussions

HINT: Access, bridges, and culverts may need to be upgraded to support mining equipment, and can add value to the farm

2. Agree general and specific success criteria to guide rehabilitation

General criteria are needed to allow mine flexibility and guide decisions when mine plans need to change. Farm/landscape-scale criteria and paddock-scale criteria should be developed.

A. Farm-scale criteria

- Location of mine access, mine infrastructure, general location of ex-pit stockpiles or overburden dumps
- General location of farm races, gates, stand-off areas/feed-pads after mining
- General location and width of shelter belts, water courses (with riparian buffers) and crossings
- Specific location of areas that are not to be mined

B. Paddock-scale criteria

- General paddock sizes and shapes
- General land contour (minimum and maximum slopes and lengths, especially if hump and hollowing)
- General water reticulation density and capacity
- Standards for temporary, electric, permanent fences
- Treatment of high-wear areas such as gateways and troughs (may use gravels, not topsoil in these areas)

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

3. Agree administrative and health and safety criteria

- Treatment of high-walls and ponds (sediment ponds, dredge ponds, new amenity ponds) to make them safe
- Agreement on access and exclusion times for shared areas (e.g. during milk tanker or school bus runs), or places
- Agreement on access and exclusion times or places in mining areas (e.g. operational zones, water treatment areas)
- Identify responsibility for security of fences and gates
- Agreement on any assistance with rehabilitation, pasture management, e.g. stock or machinery for pre-stripping grass removal or post-rehabilitation grazing. Post rehabilitation grazing needs to be done by light stock for short periods
- Agreement on signoff for first grazing (stock & vehicle safety) and closure signoff
- Agreement on process to resolve disputes, e.g. contracting an independent farm advisor

HINT: It is often better to use contractors to establish grass and carry out weed control. This decreases the risk to the miner of poor pasture establishment or grazing outcomes related to poor timing and provide useful feedback

4. Define the standard root zone (or zones)

The standard needs to be flexible enough to adapt to site experience and changing resource availability, e.g. include minimum, target (optimum) and maximum values.

A typical standard root zone for pasture has:

- 300 mm rooting depth (free-drained, uncompacted) of which 100 mm is topsoil
- pH >5.5 and Olsen Phosphorus 20–30 ug/g for dairy pasture, >10 ug/g for sheep pasture

When topsoil is thin:

- the underlying root zone needs to be sandy rather than gravels to improve water and nutrient supply
- nitrogen fertiliser needs will be higher until organic levels build up

It is helpful to identify remedial options for any areas that do not meet the standard.

Monitoring is most effective if it identifies poorly performing areas early. This is important for remediation options that require earthmoving.

HINT: Trees, whether in shelter belts of plantations, need a greater rooting depth than pasture to be stable and healthy but trees often grow adequately in lower-fertility soils if drainage is adequate. Flax shelter belts are suited to wetter, lower sites. Flax provides nectar for tui and bellbirds. Poplars can provide additional stock food in dry periods. Both grow rapidly and grow well together

HINT: If topsoil or root zone materials are short, construct areas that do not need soil (ponds, feed pads)

5. Define acceptable pasture quality

The standard may include specifying:

- pasture species
- acceptable weed cover and
- acceptable pasture production

If soil physical conditions and pasture establishment are acceptable, pasture production and composition is influenced by fertilisers, and grazing or mowing frequency and severity.

When drainage is improved pasture production may be higher in spring and lower in drier months.

HINT: Photographs of 'good' outcomes (acceptable standard of pasture, races, etc.) may be useful, as are photos of the land before mining

HINT: Criteria may be supported by specific conditions that reinforce outcomes wanted, e.g. large native trees may be identified as a landscape feature. Because they are impossible to replace in the lifetime of the land owner, they may be given a \$ value that encourages mining to avoid them

6. Agree specific rehabilitation criteria for bond release

This may include specific criteria for rehabilitated farm infrastructure, e.g. races (width, fencing, water-table, surfacing - ideally refer to an example from the farm, or cross-section), fencing standards and gate standards.

It may be useful to agree to post-closure .

Check site safety for steep drops, vehicle trafficability and dangerous areas (sediment ponds with soft sludges). Eliminate hazards, e.g. fill in sediment ponds, recontour steep drops, especially drops into water, or mitigate hazards, e.g. excluding vehicle access using boulders, fenced ditches or other contouring.

HINT: Progressive bond release can be beneficial for both farmers and miners and incentivises faster rehabilitation, especially for larger, multi-year sites

7. Agree success criteria (closure criteria)

These are measurement or descriptions that when met, mean the area is handed back to the land-owner or manager. At this stage the owner is responsible for maintaining the rehabilitated areas.

EXAMPLE: 'Typical' overall criteria may be a dense cover of ryegrass/clover pasture with no visible gorse after 12 months, a reticulated water supply to each paddock; post and batten fencing 5 m from streams and along the boundary; 2-wire internal electric fences. No stock injury during grazing

8. Agree bond or compensation

Compensation may include 'in kind' parts, i.e. upgraded access, races, culverts, water supply, and/or riparian protection.

Linking compensation to the length of time land is removed from production incentivises effective rehabilitation.

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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