Mediating Risk of Acid Generation by Translocating Intact Vegetation with Soil

Robyn Simcock[1], Craig Ross[2], James Pope[3]

[1]Manaaki Whenua Landcare Research – Auckland, New Zealand,
[2]Retired Research Associate Manaaki Whenua Landcare Research – Palmerston North, New Zealand,
[3]Verum Group – Christchurch, New Zealand

Abstract

Vegetation direct transfer (VDT) is a West Coast NZ rehabilitation method in which sods of soil with roots and living plants are removed and placed on rehabilitated areas to retain their structural integrity. VDT probably helps mediate acid drainage by (1) reducing erosion (2) reducing air and water permeability into overburden by acting as 'sponges' that retain saturated- to near-saturated conditions (3) ponding free water in gaps between sods due to low lateral permeability. Sharp textural interfaces between the finer VDT topsoil and coarser underlying compacted overburden rock help restrict unsaturated water percolation and key to maintain natural wetland vegetation.

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Vegetation direct transfer (VDT) is the premier rehabilitation method at mines on the West Coast of New Zealand that impact native vegetation. The method removes ~2 to 6 m2 intact sods of soil with most of the typically shallow root system and living attached vegetation in a way that retains their structural integrity (Figure 1). A single layer of stripped sods is transported on conventional dump trucks fitted with tray inserts that lengthen the deck to maximise area and yield. Typically, matched, reverse-attached excavator buckets with a cutting edge and flat base are used to strip, load and unload sods that are typically 300 to 500 mm deep and carefully placed close-together on areas ready for rehabilitation. Direct transfer is mostly valued for its efficacy in conserving whole ecosystems, particularly a wide diversity of plant species (given only a fraction of native plants are readily available in nurseries) and invertebrate fauna, especially flightless, slowly dispersing species such as earthworms which can survive within sods. However, direct transfer probably also has an under-recognised role in mediating the risks of acid drainage. This paper to illustrate the ways such risks are mediated using mines on the Stockton and Dennison Plateaux, where VDT was trialled in 1998/99 and used extensively since 2006. These mechanisms include:

- An immediate reduction in erosion risk, protecting cap integrity. The DVT sods with high cover of living and dead vegetation physically protect the underlying cap while the DVT soils are bound with roots. Both features reduce erosion vulnerability to the high-intensity rainfall typical of these mines (a >200 mm/24 hr rain event occurs approximately monthly). The sods largely remove the temporal gap that typically occurs during vegetation establishment and in a medium-sized event (60-80 mm in 24 hours) are as effective as straw mulching in the short term, as measured by Total Suspended Solids concentration in runoff. Sods may be deployed across a whole area on slopes with high-erosion risk, or placed in strips adjacent to vulnerable areas (such as remnant ecosystems or watercourses) to intercept and filter runoff.
- Low vertical and lateral permeability. Permeability into these fine-textured and organic-enriched soils is lower than stripped soils because DVT avoids mixing topsoils with rocky subsoils.

- Higher soil moisture content/and fewer days with low moisture content due to a) higher water-filled pore volumes in undisturbed soils due to higher organic matter contents and lower stone content, b) ponded free water retained in gaps between sods due to low lateral permeability and layout of sods that minimises creation of interconnected drainage channels, c) low evapotranspiration rates of VDT dominated by the native jointed rush Empodisma minus. This rush forms peat as it slowly decomposes, helping maintain high water holding capacity in the soils.
- A probable initial flush of Dissolved Organic Carbon when sods are placed due to soil disturbance and death of some roots.
- Living plants and soil microbial systems using soil oxygen, reducing dissolved oxygen content in water leaving the soils and entering the overburden.

At Stockton and Denniston, VDT is particularly effective at reducing air and water permeability into overburden as the peaty, sandy loam topsoils have high water holding capacities, so act as 'sponges' for retaining saturated or near-saturated conditions. Sharp textural interfaces between the finer VDT topsoil and coarser underlying compacted overburden rock help restrict unsaturated water percolation. This benefits wetland VDT by helping retain saturated or near-saturated soil conditions suitable for the wetland vegetation that occurs on the Plateaux. Another key contributing factor is a climate that delivers excess rain over evapotranspiration on average in all months.

***Figure 1** Specialised VDT stripping head reverse-attached to an excavator bucket. Photo by D Rodgers.*