



Case Study

September 2021

The Stockton mine returns to indigenous tussock and shrubland.

Stockton Mine: Returning Stockton to nature

One of New Zealand's largest mines, the Stockton mine, is the scene of large-scale site rehabilitation into indigenous subalpine shrubland typical of the West Coast plateau landscape. Success stems from more than a decade of research into optimum growth medium and planting methods.

Introduction

Coal mining on the Stockton plateau near Westport has been taking place since the late 1800s, where early operations were underground. The site has seen several changes in ownership since that time, most recently Solid Energy until August 2017, and then BT Mining. The 65/35 joint venture of Bathurst Resources and Talley's Energy now produces around 1.2 million tonnes a year of premium-quality export coking coal for steelmaking at this site.

At the site of the Stockton mine, more than 1000 hectares have been disturbed over time, which is a large area as mines go in New Zealand. The plateau is in a harsh climate, at 500 metres to 1100m above sea level, and rainfall of 5-6 metres per year. Bathurst loses 30% of working days on average because of low cloud and



Stockton mine rehabilitation sequence.

fog, reducing visibility on site to less than 60m. This affects site rehabilitation techniques to restore ground cover, and manage acidic runoff into waterways.

Compounding the challenge for the current mine operator is a legacy of decades of mining with little or no regard for environmental effects. The need to blend variable coal quality from different pits to meet client requirements had led to an unsystematic opening up of the site. Mining practices now attend to water quality, indigenous habitat restoration, and off-site conservation programmes.

Bathurst today employs around 250 staff at Stockton, close to all of whom live in Westport or elsewhere in Buller District. The mine has a life of up to a further 10 years.

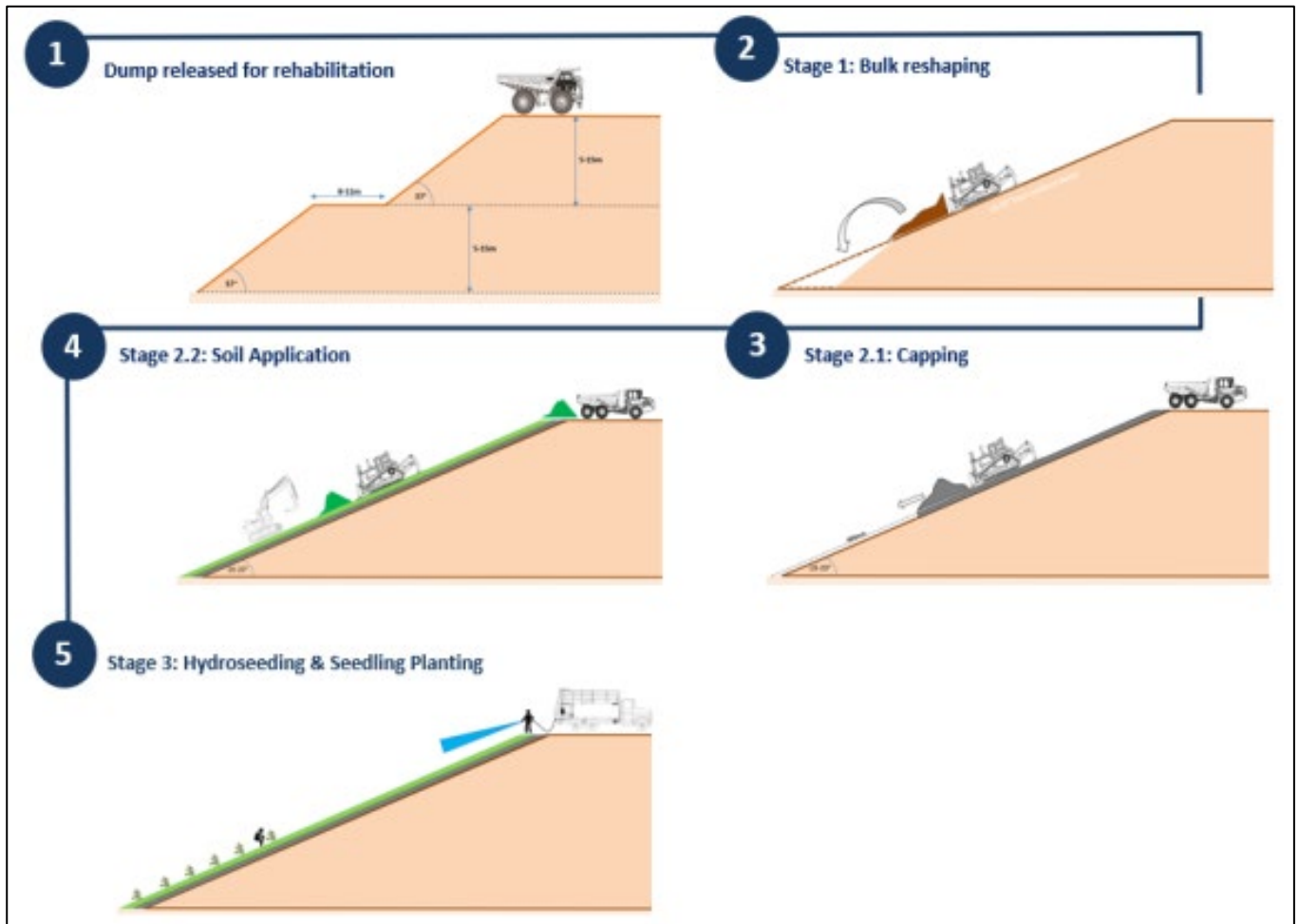
In 2014, the site won a Minerals West Coast environment award for research and practice into fast revegetation of disturbed ground, and in 2020, a Straterra and Freeman Minerals Sector Award for native bird conservation in Kahurangi National Park.

This case study focuses on site rehabilitation. In the year to 30 June 2021, Bathurst rehabilitated 29ha to Stage 1 (see below for a description of stages), 24.6ha to Stage 2, and 28.3 ha to Stage 3.

Research into growing media

A challenge at Stockton has been to achieve large-scale and fast growing ground cover after recontouring mined areas to manage erosion and acid mine drainages (AMD). The breakthrough came more than a decade ago on mixing processed biosolids from Christchurch City Council and stockpiled soil from overburden stripping at the mine. This creates a durable and fertile growth medium to support plantings, as well as improving soil pH (reducing acidity).

Hydroseeding of exotic grass species on this enhanced growth medium produces fast growth, stabilising ground and reducing erosion, and preparing it for planting with indigenous species. The grass eventually dies off, as areas return to 100% indigenous plant cover. Contractors have planted more than 400ha in this way to date, or 36% of the site, with a further 700ha of rehabilitation ahead.



Flow chart of the current process for rehabilitation at Stockton.

The Bromley treatment plant in Christchurch can treat 10 tonnes of sewage a day, and Bathurst uses up to 1400t of biosolids per year at Stockton.

Site rehabilitation sequence

Stage 1: Shape slopes

Overburden dumps start out at slopes of 37 degrees separated by 8-11 metre-wide drainage benches. A dozer operator then recontours these earthworks into smooth slopes of 18-20 degrees. Compaction of material reduces pore space between substrate particles, reducing the presence of oxygen, and slowing the production of AMD.

Stage 2: Cap surface and lay growth medium

Next comes a 400mm-thick layer of weathered granite to seal the substrate, which is then compacted, further reducing the rate of acid-forming reactions. This is key to freshwater management on site.

Dozer and excavator operators then lay a 200mm thickness of growth medium on top of the compacted granite, in a 1:4 to 1:10 ratio of biosolids to soil. The ratio varies, depending on the age and quality of soil from stockpiles of overburden from other mined areas. Biosolids add nutrients to naturally poor-quality soils on the Stockton plateau to boost seedling growth. It is critical to get the mix right because too much biosolids produces too much exotic grass growth, stymying later growth of native vegetation.

Stage 3: Hydro seed grass, and plant seedlings

Hydroseeding is done with a mix of seeds, water, glue and paper to create a pulp sprayed onto the growth medium layer. This stabilises the rehabilitation surface and prevents erosion. The work is carried out early in the rehabilitation process, and the grass grows quickly for large-scale cover.

Bathurst then stages the planting of eco-sourced grasses, trees and shrubs – 25 species in all – so that the natives can take over from the exotic grass cover. Species include rata, beech species, mānuka, flax (harakeke), hebes, astelias, broadleaf, tussock, coprosmas and toetoe. This mix will depend from place to place on altitude, exposure to wind, and sun position.



Mix of native seedlings on a typical rehabilitation slope at Stockton.

Plantings have stepped up over time from 6500 seedlings a hectare to 9000ha, for better ground cover. One contractor can plant upwards of 800 plants a day, depending on weather and terrain.

Other rehabilitation methods

“Vegetation direct transfer” of chunks of native vegetation with soil substrate attached is used at the toe of recontoured sites, at places, to improve the effectiveness of rehabilitation. VDT takes place selectively, in recognition of the up to \$200,000 a hectare cost of this technology. Some areas are left as rock, reflecting the original nature of surrounding undisturbed terrain.

The opening of the Cypress extension to Stockton came with VDT of wetland grass and sedge species, conserved offsite during mining and then returned on completion of mining.

Control of exotic animal pests – principally rats, stoats and possums – includes trapping along the perimeters of areas under rehabilitation, and also around Powelliphanta snail release areas.



Aerial view of Stockton coal mine site rehabilitation - c400 ha to date.

Research underpins good results

Research has been central to site rehabilitation at Stockton throughout the programme, eg, into which indigenous plant species grow best, and techniques for acclimatising plants to the terrain and climate, besides the growth medium research.

In 2016 Bathurst Resources started a new initiative of planting benches (flat, raised terraces) at high walls, to initiate the rehabilitation of areas that cannot be recontoured. The method is to lay up to a 400mm thickness of “slash”, a mixture of growth medium and vegetative matter (branches, logs etc), and plant it in native seedlings. Timing is important: this work has to be done while there is still on-ground access to the high wall, with due attendance to health and safety for workers operating at height. This work at Mt Frederick, where mining has been completed, and at the Cypress extension where mining is continuing, benched slopes are returning to the subalpine shrubland typical of the Stockton plateau.

Variation in native plant growth rates around Stockton reflects natural variation in the physical conditions, and produces a varied ecology that mirrors nature. Placement of old tree stumps and rocks adds to the natural character of rehabilitated sites.

Professor David Norton of the University of Canterbury, and Robyn Simcock of Landcare Research have provided peer review of the rehabilitation work.

Case study sources: Bathurst Resources.