An Investigation of Terrestrial Ecosystems for the L&M Coal Ltd Escarpment Mine Project:

Avifauna and *Powelliphanta* snails

Prepared for

Resource and Environmental Management (Nelson) Ltd

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Cover photo: Artificial lake (Brazil's Dam) east of Escarpment Mine Road

Figure 1 Coal-measure tableland and taller vegetation toward Mt Rochfort, central part of proposed mine area (R.B)

EXECUTIVE SUMMARY

Brief

L&M Coal Ltd (L&M) via Resource and Environmental Management Nelson Ltd (REM) have requested a technical report describing avifauna, kiwi and *Powelliphanta* snails within and adjacent to the currently disused Whareatea and Escarpment coalmines located on the southern edge of the Denniston Plateau and above the headwaters of Cascade Creek and Whareatea River, Buller.

The technical report for terrestrial fauna involved:

- Collecting baseline information on *Powelliphanta* land snails, kiwi and other birds within and near the proposed mine area and access road to assist with mine design and the preparation of the Assessment of Environmental Effects (AEE).
- Evaluation of potential adverse effects on terrestrial fauna as above and faunal habitat caused by mining development and activities.
- Recommending measures to avoid, remedy or mitigate these potential effects.

Proposed Development

L&M propose to extract coal from an open cast mine within an approximate area of 148 ha at the abovementioned location. At this stage the actual mine location and area involved is indicative but is at or near the location of two former underground coalmines: Whareatea Extended and Escarpment.

Overview of Fauna

Considerable information is known of the flora and fauna in the general area of the Denniston and Stockton plateaux and surrounding forest areas, mainly from ecological surveys carried out in association with coal mining and other industries. A review of this information is provided in this report.

The Stockton and Denniston Plateau contains a diverse assemblage of habitats and fauna including nationally threatened species, some endemic to the area. A substantial proportion of the proposed development area is coal-measure habitat that is becoming rare in its natural state. However, past coal mining, roads and other developments have modified much of this area.

Fauna of most conservation importance in the Stockton and Denniston Plateau area are great spotted kiwi and *Powelliphanta* "patrickensis", which are patchily distributed in the proposed mine area. Kiwi are concentrated in taller vegetation while *P.* "patrickensis" are mainly found in coal-measure scrubland. Other threatened fauna include western weka (low numbers throughout), fernbirds (locally common), kaka and kereru (both seasonal). Threatened lizards likely to be present include the West Coast green gecko and speckled skink (both known from the Denniston area). Long-tailed bats have been recorded at Happy valley, upper Waimangaroa valley in 1997.

Objectives

- Evaluating the presence, distribution and relative abundance of kiwi, avifauna in general, and *Powelliphanta* land snails in and around the proposed mine area;
- Evaluating the potential adverse effects on the above caused by mining development and associated activities;
- Recommending potential measures (including reinstatement and rehabilitation methods) to avoid, remedy or mitigate such effects where practical.

Field Methodology

The survey followed standard methods for determining the presence, distribution and relative abundance of kiwi (nocturnal call survey), and *Powelliphanta* snails (surface shell collection), and also involved five-minute bird counts and "snapshot" counts for diurnal birds. The survey was carried out over the entire proposed mine site as well as along the part of the Denniston to Mt Rochfort Road that would be widened to provide access to the proposed mine.

Richard Nichol, MBC Contracting staff and the author carried out the field survey during late June and early July 2008.

Results

A total of 17 indigenous and six introduced birds were recorded within the proposed mine area and surroundings, including five threatened species: great spotted kiwi, black shag, western weka, South Island rifleman and South Island fernbird.

Signs of great spotted kiwi (calls, footprints and droppings) were found west of Escarpment Mine Road with the population concentrated in taller vegetation areas to the south and west of the proposed mine site. A pair of kiwi and 4-5 females were heard calling at night, and additional signs found during the day indicated at least six kiwi occupy the proposed mine area or immediate vicinity.

Weka and fernbirds were patchily distributed mainly in coal-measure vegetation and roadside scrub. A few riflemen were encountered in tall forest to the extreme southwest of the proposed mine area.

Powelliphanta "patrickensis" shells were found in relatively low numbers in coal-measure habitat on the tableland between Escarpment Mine Road and Trent Stream. One live snail was found near the head of V40 Stream, near the edge of the proposed mine. No sign of *Powelliphanta* was found between the Escarpment Mine Road and V8 Creek (eastern part of the survey area). Nearly all shells found were damaged and many were old. Nearly half showed sign of damage by weka, while the proportion showing damage from introduced predators was low.

No especially distinctive terrestrial faunal habitats were found within the survey area. The four main faunal habitats identified within the area, tall forest, dense scrub/low forest, manuka-wire rush rushland and wetland are not particularly distinctive and are well represented outside this area.

General Discussion

The time of year (June/July) when this field survey was carried out is the least favourable season to survey for birds and other fauna, thus absences or low numbers of records of species should be treated with caution. No attempt was made to search for bats, carry out a comprehensive fauna survey of terrestrial wetland fauna (at the dam) or search for live snails due to the season being inappropriate for these activities.

The high incidence of damage to *Powelliphanta* shells by weka may indicate a switch of weka diet as favoured foods became depleted or that snails have become easier to find due to habitat degradation. The low percentage of shells damaged by introduced mammalian predators implies that the harsh environment and/or paucity of food have limited their numbers. In contrast, rat damage sign was found on 50% of shells collected at lower altitude on coastal slopes outside the mining footprint near the Whareatea Gorge in March 2008.

Significance of fauna and faunal habitats within the proposed mine area

The area L&M propose to mine contains areas of significant habitats for indigenous fauna as defined principally by the threat status of a number of species present in the area, the relative intactness of parts of the area and the size of the area. The main areas of significance are the coal-measure scrubland where the Nationally Endangered *Powelliphanta* "patrickensis" is found, and the forested parts to the south and west where great spotted kiwi are concentrated.

However, all fauna found within the survey area are also found outside this area, and no "core" populations of any species was found within the proposed mine area. In addition, no especially distinctive terrestrial faunal habitats were found within the survey area. Past mining, fires, roads, spread of weeds, etc have modified much of the area, thus reducing the overall importance of the area to wildlife. The proposed mine area lies just outside the Mt Rochfort Recommended Area for Protection (RAP).

Kiwi and *Powelliphanta* snails are likely to represent the main ecological concerns associated with the proposed development. An opencast mine would have adverse effects on populations of these (and other) fauna, though most effects could be reduced if appropriate mitigation, rehabilitation or avoidance is incorporated into the mine design and operation.

Predicted impacts of the proposed coalmine on terrestrial fauna

The primary adverse effect on fauna by an opencast coal mine is habitat destruction over the areas that are mined. Secondary effects include those associated with roading, mine infrastructure, downstream and offsite effects, effects of dust, noise and light and possible increase in weeds and pests. Coalmining (particularly underground mining if carried out) potentially increases the risk of fire destroying large areas of offsite habitat, which has occurred in other parts of the Denniston and Stockton plateaux. However, the propensity for combustion is low and modern mining methods further reduce the risk of fire.

Total removal of *Powelliphanta* habitat within the proposed mine area would affect approximately 1-1.5% of the *Powelliphanta* "patrickensis" distribution range but probably a lesser proportion of the *P.* "patrickensis" population would be affected because of the apparently low densities of snails within the proposed mine footprint compared to core areas.

A much lesser percentage (probably <0.1%) of the national great spotted kiwi population would be affected, though the loss of any kiwi as a result of industry would be considered unacceptable to ecologists and probably most New Zealanders. Kiwi would be most affected if the forested area to the south and west of the proposed mine area is stripped. Mining and associated activities would expose kiwi to hazards not normally faced in undisturbed habitat. The overall effects will result in lowered mean survival rates, disruption of pair bonds, reduction in productivity and stresses and loss from social disruptions in the surrounding areas.

Adverse effects on weka and fernbird would be similar though these species would be more likely to re-colonize rehabilitated mine surfaces as they are more generalist than kiwi, and occupy coal-measure scrubland which regenerates much faster than forest.

Impacts on fauna from habitat fragmentation, dust, noise and light, offsite effects and predators are discussed in the report.

General Recommendations

- Given the inappropriate timing of this survey further surveys are recommended during spring or summer when species of fauna are more likely to be present, more active, and/or more conspicuous;
- Surveys for lizards, and invertebrates other than *Powelliphanta* snails are recommended given the interesting distributions known in the general area, and gaps of knowledge for these fauna; and
- Prior to mining if this occurs, more detailed surveys of *Powelliphanta*, great spotted kiwi, fernbird and other fauna will be required for both mitigation and monitoring purposes.

Mitigation

- Subject to mine design requirements, either avoid development or carry out underground mining in forested areas to the south and west as these areas contain the densest kiwi populations and highest numbers of birds in general;
- Similarly, avoid development or carry out underground mining if possible in the coal-measure scrubby tableland area between Trent Stream and the Whareatea headwaters, as this area is where *Powelliphanta* snails are concentrated;
- Ensure a comprehensive fire risk contingency plan is in place;
- Construction or modification of access roads, building sites etc should avoid where practical the kiwi breeding season (June to January);

- Retaining where possible pockets of taller vegetation (e.g. in gullies) and large trees (>60 cm dbh) as these provide important habitat or microhabitat for some species of fauna;
- Retaining a natural forest edge (or rehabilitating it) as this edge often provides favoured habitat to fauna such as weka and fernbird;
- Reducing effects of dust, noise and light on fauna;
- Prohibiting dogs, as dogs can be a serious predator of kiwi, weka and other birds; and
- Reducing the event of road kills (e.g. on kiwi and weka) by imposing speed restrictions, road signs, and appropriately inducting staff.

If avoidance of development, or appropriate mine design is not possible in sensitive fauna areas, mitigation and remediation will be required. This mitigation will require:

- Translocating kiwi and *Powelliphanta* snails to a protected site prior to mining;
- Ensuring a comprehensive vegetation rehabilitation plan is in place, based on an appropriate method tested and proven in the harsh environment of the proposed mine site; and
- Carrying out off-site restoration to help compensate for losses in fauna. This will involve a comprehensive and integrated predator control regime following best practice protocol developed by the Department of Conservation.

These options for mitigation are discussed in more detail in the report (Section 11).

Monitoring

Monitoring based on a detailed monitoring plan will be required if access agreement and consents allow the proposed mine to proceed. Monitoring specific terrestrial fauna is carried out to quantitatively evaluate:

- Relative densities or territories of specific fauna before development;
- The efficiency of the predator control programme or other mitigation programmes;
- Changes in faunal habitat after rehabilitation; and
- The re-establishment of fauna in rehabilitating habitat.

Options of monitoring fauna of particular conservation importance are outlined in the report.

Conclusion

The area proposed for an opencast coalmine has significant values for fauna, particularly great spotted kiwi and *Powelliphanta* “patrickensis”. However these species, and others, are also found widely outside the proposed mine and no “core” populations of fauna are known to live within the proposed mine area.

Past mining, fires, roads, bulldozed tracks and spread of weeds etc has modified and degraded much of the area, thus reducing its overall importance to wildlife. However,

natural vegetation cover is extensive within this area, particularly to the south and west, providing important habitat for kiwi and other birds, and *Powelliphanta* snails. The proposed mine area lies just outside the Mt Rochfort RAP, which comprises overall a better representation of fauna and fauna habitats.

Providing the recommended mitigation measures are undertaken, the overall adverse effects of the proposed coalmine are considered to be minimal for reasons stated above, and that the loss of fauna can be largely offset through remedial action for threatened species, best-practice predator control and habitat rehabilitation.

Figure 2 Forest hugging the steep escarpment above Cascade Creek to the south of the proposed mine area (R.B.)

1. Introduction

L&M Coal Ltd (L&M) via Resource and Environmental Management Nelson Ltd (REM) has requested a technical report describing avifauna, kiwi and *Powelliphanta* snails within a 148 ha area known as the Escarpment Mine located on the southern edge of the Denniston Plateau and above the headwaters of Cascade Creek and Whareatea River, Buller (Map 1). This is part of a number of requests for technical information in preparation for obtaining necessary Access Agreements to extract coal from an open cast mine. The area proposed for mining is Crown owned, and administered by the Department of Conservation (DoC).

The technical report for terrestrial fauna involved:

- Collecting baseline information on the presence, distribution and relative abundance of *Powelliphanta* land snails, kiwi and other avifauna within and near the proposed mine area (hereafter also called "the survey area") to assist with mine design and in the preparation of the Assessment of Environmental Effects (AEE);
- Evaluation of potential adverse effects on terrestrial fauna as above and faunal habitat caused by mining development and activities; and
- Recommending measures to avoid, remedy or mitigate these potential effects.

It should be noted that the time of survey (June/July) and the time available for field survey to meet report deadlines have placed some limitations on this assessment. Mid winter is probably the least appropriate time of year to detect and evaluate relative abundances of many species of fauna due to their inactivity, inconspicuousness or absence at that time of year (e.g. migratory/seasonal birds). Furthermore, light snow covering parts of the survey area in early July impeded the search for *Powelliphanta* snail shells.

2. Background

2.1. Area Location and Physical Description

The currently disused Escarpment Mine is located about 16 km east of Westport, 5 km southwest of Denniston and lies within the Ngakawau Ecological District. The proposed mine area (148 ha) lies south of the disused Whareatea Mine on the southern part of the Denniston Plateau, extending south to a ridgeline above Cascade Creek, a tributary of the Buller River (Map 1). The topography of the area is generally gentle in slope with a few incised headwaters of small streams (Figure 1). Slopes drop dramatically off this plateau to the south into Cascade Creek (Figure 2).

2.1.1. Vegetation

The proposed mine area consists largely of low-canopy forest and coal-measures scrub comprising silver and mountain beech (*Nothofagus* spp.), rimu (*Dacrydium cupressinum*), yellow-silver pine (*Lepidothamnus intermedius*), pink pine

(*Halocarpus biformis*), mountain toatoa (*Phyllocladus alpinus*), manuka (*Leptospermum scoparium*), *Dracophyllum* spp., mountain flax (*Phormium cookianum*) etc, and rushland comprising wire rush (*Empodisma minus*), tangle fern (*Gleichenia* spp. and snow tussock (*Chionochloa* spp) etc (Figure 1). Taller vegetation is patchily distributed in the gullies while scrub and tall forest forms a consistent cover to the south and west of the area and on slopes within the Cascade Creek catchment (Figures 2 & 3).

While largely natural vegetation covers approximately 80-90% of the survey area it has been extensively modified by past mining, fires, roads, spread of weeds, or more subtle forms of modification (Nichol & Overmars 2008). Modification is particularly noted in the Whareatea Mine, Escarpment Mine and Lake Brazil area.

Details of the flora and vegetation are presented by Nichol & Overmars (2008).

2.2. Proposed Development

L&M propose to extract coal from an open cast mine within the approximate area defined on Map 1. At this stage the mine location is indicative but is at or near the location of two former underground coalmines: Whareatea Extended and Escarpment.

The coalmining project is subject to approval by the central and local government by way of a mining permit approved under the Crown Minerals Act, an access agreement with the Department of Conservation, and resource consents through the Buller District Council and the West Coast Regional Council.

Figure 3 Lush forest habitat near Escarpment Mine (R.B.)

2.3. Previous Ecological Surveys

Considerable information is known of the flora and fauna in the general area of the Denniston and Stockton plateaux and surrounding forest areas, mainly from ecological surveys carried out in association with coal mining and other industries. Only limited surveys have been carried out specifically within the proposed Escarpment Mine area, including searches for *Powelliphanta* snails carried out by the Department of Conservation c. 2004 as part of completing the distribution mapping for *P*. "patrickensis" (K. Walker *in litt.* 30 June 2008) and monitoring surveys for *Powelliphanta* set up in 2007 (Department of Conservation, Hokitika). Relevant literature is given below. Studies marked with an asterisk include information on fauna relatively close (within 5 km) of the proposed Escarpment Mine area.

- Ecological surveys within the Ngakawau Ecological District (Overmars *et al*. 1998).
- Wildlife assessment carried out in the Te Kuha Coal Prospect (lower Buller River) in February/March 1986 (Garrick 1986).
- Fauna surveys for Solid Energy Ltd (Buckingham 1998a, b & c; Kingett Mitchell & Landcare Research 1997: Thomas & Toft 1997; Thomas *et al*. 1997; Wildlife Surveys 2002, 2005)*.
- Surveys for *Powelliphanta* "patrickensis" carried out by the Department of Conservation (Walker 2003; unpublished information)*.
- Fauna surveys for Restpine Ltd, Whareatea West Exploration Permit, Denniston Plateau in 2002 (Buckingham 2002a)*.
- *Powelliphanta* surveys carried out for Eastern Corporation Ltd at Whareatea Mine in 2005 (Buckingham 2005)*.
- Fauna surveys for Timberlands West Coast Ltd in the Orikaka valley (Buckingham 1999).
- A survey for birds carried out by the Ecology Division, DSIR, at the Ohikanui valley and lower Buller valley in the 1970s (Wilson *et al*. 1988).
- Fauna surveys carried out by New Zealand Wildlife Service in 1979 throughout Buller and the West Coast (Morse 1981).
- A review of lizard distribution in the Buller region (Whitaker & Lyall 2004).
- A recent survey for *Powelliphanta* snails, birds and other fauna carried out between Lake Rochfort and Whareatea River for Kawatiri Energy Ltd (unpublished information)*.

3. Overview of Terrestrial Fauna

The Stockton and Denniston Plateau contains a diverse assemblage of habitats and fauna including nationally threatened species, some endemic to the area (Overmars *et al*. 1998; Thomas *et al*. 1997). A substantial proportion (c. 62%) of the proposed

development area is coal-measure scrub and grassland habitat that is becoming rare in its natural state, though more ecologically valuable areas of this habitat are found outside the proposed mine (e.g. the Mt Rochfort RAP, and upper Waimangaroa valley). Much of this habitat has been modified to various degrees within the Escarpment Mine and Whareatea Mine area.

Typically bird species numbers are relatively low in the general area of the Denniston Plateau but include several threatened species such as great spotted kiwi[1], western weka, kereru, kakariki, fernbird and rifleman. Higher numbers of species and individuals are found in forest than in coal-measure scrub and grassland. A relatively dense kiwi population is known in the nearby Mt William Range and the Orikaka valley (Buckingham 1999; Kingett Mitchell & Landcare Research 1997). Fernbirds are locally common in pakihi and coal-measure scrubland habitat on the plateau. Kaka, kea and falcon have also been recorded in the general area (Overmars *et al.* 1998).

Powelliphanta 'patrickensis', an endemic and nationally endangered land snail (Hitchmough *et al.* 2007) is patchily distributed throughout the Denniston and Stockton Plateau, ranging from St Patrick Stream in the north to Mt Frederick in the west, the Mt William Range in the east and Mt Rochfort in the south (Walker 2003). Although it was anticipated that the area of the proposed mine would likely have scattered populations of this threatened snail, they would be probably on the extremity of their range there (Buckingham 1998a, 2002a).

Long-tailed bats (and also possibly short-tailed bats) may be present in the proposed coalmine area, or visit this area seasonally. Documented records are known in the upper Waimangaroa valley (Thomas *et al.* 1997) and the Orikaka River (Morse 1981), but recent surveys have not confirmed their presence in the general area (Buckingham 1998b, 1999; Wildlife Surveys 2002).

The fauna known to be present in the general area is described in more detail below.

3.1. Mammals

3.1.1. Indigenous mammals (bats)

Bats (presumably long-tailed bats) have been recorded in the Ngakawau Ecological District in the upper Waimangaroa River (Thomas *et al.* 1997) and in the Mokihinui valley (pers obs.). However, bats appear to be uncommon as they are rarely recorded on specialized bat surveys (e.g. Buckingham 1998b, 1999; Wildlife Surveys 2002). During February-March 1998 and February 2002, no bats were detected in a total of 654.5 hours of automatic detection at a range of habitat sites within the upper Waimangaroa valley area or in 262 bat-detector hours on 40 kHz and 123 bat-detector hours on 27 kHz at Orikaka Forest in 1998/1999 (Wildlife Surveys 2002; unpublished information courtesy of Timberlands West Coast Ltd). Nor were bats recorded recently at Lake Rochfort using two Batbox III™ detectors for one night (pers. obs.).

In general, bats appear to be less common in the Ngakawau Ecological District than in other parts of the West Coast (Buckingham 1999, 2002b). In particular, there have

[1] Scientific names of birds are given in Appendix 1

been few recent records of bats between the Mokihinui River gorge and the lower Inangahua River valley, despite reasonably extensive surveillance for bats at different locations and habitats (see above). Short-tailed bats have not been recorded in the Ngakawau Ecological District, the nearest known population being in the Oparara valley near Karamea (Lloyd 2001).

3.1.2. Introduced mammals

Red deer, possums, hares, stoats, feral cats, rats and mice are known to be present in the area (Thomas & Toft 1997; Thomas *et al*. 1997). Chamois were seen recently at Mt Rochfort (M. Bygate, pers. comm., 2008). Localised populations of pigs and goats are also present (Overmars *et al*. 1998; M. Bygate, pers. comm., 2008).

The primary threats to indigenous fauna are possums, stoats and rats. Possums and rats prey on *Powelliphanta* land snails (Bockett 2004; Walker 2003), while stoats (and feral cats) are a threat to young kiwi (McLennan *et al*. 1996) and other birds. From a large collection of *P*. "patrickensis" shells collected in 1998, 31 % of shells in which predator damage could be assessed showed sign of possum damage (Walker 2003). Possums were also found to be a significant threat to *Powelliphanta lignaria johnstoni* at Charming Creek (Walker 2003). In general, possums are the main predator of *Powelliphanta* snails at higher altitudes while rats can be significant predators of snails at lower altitudes (Walker 2003). For example, a high incidence of rat-damaged shells were found recently in populations of the lowland *Powelliphanta lignaria unicolorata* in the Mokihinui valley and also in populations of *P*. "patrickensis" between the Whareatea River and Lake Rochfort (pers. obs.). Stoats are the main threat to kiwi and probably weka, while stoats, possums and rats impact on a wide range of other birds. Rats (and mice) are likely to be present in the Whareatea and Escarpment mine areas (evidence from *Powelliphanta* shell collections) but probably in relatively low numbers at that altitude.

3.2. Birds

Bird abundance and distribution varies considerably throughout the Denniston and Stockton Plateau and surrounding areas due to the range of habitats present (e.g. coastal and subalpine forest, pakihi tussockland, rushland, wetland, coal-measure scrubland and rock-pavement). Numbers of bird species and abundance of individuals are also likely to vary seasonally, with changes in food availability or the presence of visiting migrant species (e.g. shining and long-tailed cuckoo). Highest concentrations of birds are typically found in forest habitat, while coal-measure scrubland and pakihi generally support comparatively few species.

A total of approximately 42 species of birds has been recorded in the wider area from the Mokihinui River, through the Stockton and Denniston Plateaux to Mt Rochfort including 30 indigenous and 12 threatened species (Buckingham 1998c, 2002a & b, 2005; Kingett Mitchell & Landcare Research 1997; Thomas & Toft 1997; Thomas *et al*. 1997; Wildlife Surveys 2002, 2005). Of these threatened species (Table 1), great spotted kiwi, western weka and fernbird are perhaps of most conservation concern regarding the proposed development (in respect of threat status and numbers that would be affected).

Great spotted kiwi are relatively common in nearby areas of the proposed coalmine such as the Mt William Range, Orikaka valley and parts of the western escarpment of the Denniston and Stockton Plateaux (Buckingham 1999, 2002a; Kingett Mitchell & Landcare Research 1997; pers. obs.). Fernbirds are locally common in coal measure scrub and pakihi habitats. However, weka tend to be fairly thinly spread with male-dominated populations on the upland plateau (Buckingham 1998c; Thomas *et al.* 1997).

Other threatened birds that are likely to visit the area seasonally are kaka, kea and kereru. Riflemen have a patchy distribution on the Denniston and Stockton Plateau, tending to be most common in higher-altitude beech-dominant forest areas. Table 1 lists threatened birds and other fauna recorded present, or possibly present in the Escarpment Mine and Mt Rochfort area.

Table 1: Threatened fauna and distribution known or possibly present in the Escarpment Mine and Mt Rochfort area

Common Name	Scientific Name	Distribution	Threat status
Long-tailed bat (Sth Is.)	*Chalinolobus tuberculata*	Widespread	Nationally Endangered
Great spotted kiwi*	*Apteryx haastii*	Regional	Gradual Decline
Black shag*	*Phalacrocorax carbo*	Widespread	Sparse
Grey duck	*Anas superciliosa*	Widespread	Nationally Endangered
NZ falcon (bush)	*Falco novaeseelandiae*	Widespread	Nationally Vulnerable
Western weka*	*Gallirallus a. australis*	Widespread	Serious Decline
Kereru (NZ pigeon)	*Hemiphaga novaeseelandiae*	Widespread	Gradual Decline
South Island kaka	*Nestor m. meridionalis*	Widespread	Nationally Endangered
Kea	*Nestor notabilis*	Widespread	Nationally Endangered
Yellow-crowned Kakariki	*Cyanoramphus auriceps*	Widespread	Gradual Decline
Long-tailed cuckoo	*Eudynamys taitensis*	Widespread	Gradual Decline
Rifleman*	*Acanthisitta c. chloris*	Widespread	Gradual Decline
South Island fernbird*	*Bowdleria p. punctata*	Widespread	Sparse
West Coast green gecko	*Naultinus tuberculatus*	Regional	Sparse
Speckled skink	*Oligosoma infrapunctatum*	Widespread	Gradual Decline
Brown skink	*Oligosoma zelandicum*	Widespread	Sparse
Koura (freshwater crayfish)*	*Paranephrops planifrons*	Widespread	Gradual Decline
Giant land snail*	*Powelliphanta* "patrickensis"	Local & limited	Nationally Endangered

Note: * Recorded June/July 2008 within the proposed mine area.

Threat classification after Hitchmough *et al*. 2007

3.3. Lizards and amphibians

A number of lizard records are known from the Stockton and Denniston Plateaux based on several surveys for lizards over the past 10-12 years (Thomas & Toft 1997; Thomas *et al*. 1997; Waybacks Ltd & Wildlife Surveys Unlimited 2008; Whitaker & Lyall 2004). Among the species known to be present are the speckled skink (*Oligosoma infrapunctatum*), the forest gecko (*Hoplodactylus granulatus*) and the West Coast green gecko (*Naultinus tuberculatus*) (Table 2). The Denniston skink previously described as *Oligosoma* aff. *infrapunctatum* (e.g. Whitaker & Lyall 2004) is no longer regarded as being distinct from *Oligosoma infrapunctatum* (Tony

Whitaker, pers. comm., 2007). Also possibly present in the area are the brown skink (*O. zelandicum*), which is known at several coastal sites north of Westport, and the common gecko (*Hoplodactylus maculatus*), which has been found north of the Mokihinui River (Whitaker & Lyall 2004).

Landcare Research carried out comprehensive surveys for lizards in the upper Waimangaroa valley during 1995-1997 (Thomas & Toft 1997; Thomas *et al*. 1997). These surveys involved a total of 120 lizard pitfall trapping days and more than 45 person-hours of search effort by experienced herpetologists. Despite this effort, few lizards were found indicating low population densities. The only lizard positively identified was a female forest gecko found under a loose thin slab of sandstone on 1 November 1995. West Coast green geckos are also known from the area, and an unidentified brown skink was seen in March 1997 in tussock at Happy valley (Thomas *et al*. 1997).

Recent surveys on the Stockton Plateaux have found the non-threatened forest gecko to be relatively common and widespread (Waybacks Ltd & Wildlife Surveys Unlimited 2008; T. Jewell, pers. comm., 2008; M. Hamilton, pers. comm., 2008). West Coast green geckos are also probably widespread but are less commonly reported.

Table 2 Species of lizards recorded in the general area and their threat status

Common name	Scientific name	Distribution status	Threat status	Local record (Denniston/Stockton Plateau)
West Coast green gecko	*Naultinus tuberculatus*	Regional	Sparse	Confirmed
Forest gecko	*Hoplodactylus granulatus*	Widespread	Not threatened	Confirmed
Common gecko	*Hoplodactylus maculatus*	Widespread	Not threatened	Unconfirmed
Speckled skink	*Oligosoma infrapunctatum*	Widespread	Gradual decline	Confirmed
Brown skink	*Oligosoma zelandicum*	Widespread	Sparse	Unconfirmed

The only frog species known in the area is the introduced tree frog, *Litoria ewingii*, which is moderately common and widespread (Thomas *et al*. 1997; pers. obs). The large introduced green tree frog *L. raniformis* may also be present though it was not found in the upper Waimangaroa valley during a fauna survey in 1997 (Thomas *et al*. 1997) nor on more recent surveys (pers. obs.). Native frogs are unlikely to occur in the area though sub-fossil bones are known from the Oparara caves, some 50 km north (Thomas & Toft 1997).

3.4. Terrestrial invertebrates

Although there have been relatively few surveys for invertebrates other than *Powelliphanta* land snails in the Denniston and Stockton Plateaux area, the surveys do show that parts of the plateau support a rich and diverse invertebrate fauna, including unusual communities normally associated with higher altitudes (Overmars *et al*. 1998; Thomas & Toft 1997; Thomas *et al*. 1997). Because the area is on the periphery of the Northwest zone of endemism (Walker 1987) a high degree of endemism in the invertebrate fauna is possible (Overmars *et al*. 1998).

Other than *Powelliphanta* snails, there is little or no information on the conservation status of invertebrates within the Ngakawau Ecological District (Overmars *et al.* 1998). A limited survey for beetles at various sites on the Denniston and Stockton plateaux and Mt William and Mt Rochfort in 1998 revealed 12 species of carabid and two species of scarabaeid species plus a number of other beetles that were not identified to species level (Overmars *et al*. 1998). Of all the sites sampled, Mt Rochfort was found to have the greatest abundance of ground beetles, and numbers were also high at plots sampled near Whareatea Mine.

Landcare Research carried out a fairly comprehensive invertebrate survey in the upper Waimangaroa valley in 1995 and 1996 (Thomas & Toft 1997; Thomas *et al.* 1997). They found that the invertebrate communities of red tussock and coal-measure vegetation comprised a range of species associated with wetlands, or normally found at higher altitudes. The fauna was typical of north Westland and north-west Nelson with an abundance of tree weta (both *Hemideina crassidens* and *H. broughi*), an undescribed large leaf-veined slug (*Amphikonophora* sp.), and large flightless beetles such as *Zeadelium gratiosum* and *Dorcus helmsi*.

Other species known to be present in the general area are koura (*Paranephrops planifrons*), giant yellow and black dragonflies (*Uropetela carovei*) and alpine grasshoppers (*Alpinacris crassicauda*) (Overmars *et al*. 1998; Thomas *et al*. 1997).

Several surveys for *Powelliphanta* land snails have been carried out in areas within and adjacent to the proposed coalmine (e.g. Buckingham 1998a, 2002a, 2005; Department of Conservation records). The results of these surveys, and other information on *Powelliphanta* found in the general area are described below.

3.4.1. *Powelliphanta* land snails

A patchy distribution of *Powelliphanta* "patrickensis" is recorded in the Whareatea and Escarpment Mine area (Buckingham 1998a, 2002a, 2005; Department of Conservation records). This population appears to represent one of the most southern limits of *P.* "patrickensis" distribution, extending a few kilometres west to Mt Rochfort.

The Department of Conservation established two 10 x 10m standard *Powelliphanta* monitoring plots within the proposed mine area and two others in the proximity in May 2007 (Map 2). Sign of *Powelliphanta* was not found in the plots within the proposed mine area but one shell was found in a plot nearby (data courtesy of the Department of Conservation, Hokitika).

Powelliphanta 'patrickensis' is relatively widespread extending from Mt Rochfort in the south to the headwaters of St Patrick Stream in the north, and from the Mt

William range in the east to Mt Frederick in the west (Walker 2003). The snail occupies a range of scrub and forest habitats, occurring most frequently in coal-measure scrub dominated by stunted manuka, wire rush, tanglefern and flax (Figure 4).

The type locality for *Powelliphanta* 'patrickensis' (formerly *Powelliphanta rossiana patrickensis*) is near St Patricks Dam (Powell 1949). However an earlier record and description of a *Powelliphanta* snail found at Mt Rochfort (Hutton 1899) may have been the first described collected shell of *P.* "patrickensis". *P.* 'patrickensis' is classified as "Nationally Endangered" (Hitchmough *et al.* 2007).

Figure 4 Dense grasses and scrub: typical habitat of *Powelliphanta* "patrickensis" in central north outside of proposed mine area (R.B.)

4. Objectives of fauna assessment

- Evaluating the presence, distribution and relative abundance of kiwi, avifauna in general, and *Powelliphanta* land snails in and around the proposed mine area;
- Evaluating the potential adverse effects on the above caused by mining development and associated activities; and
- Recommending potential measures (including reinstatement and rehabilitation methods) to avoid, remedy or mitigate such effects where practical.

5. Field methodology for fauna

5.1. Powelliphanta snails

The survey followed standard methods for determining the presence, distribution and relative abundance of *Powelliphanta* described in Walker (1997). These methods involved:

- Traversing the survey area systematically along transects approximately 200m apart searching for the presence of snails by the "Surface collection of shells" method (Walker 1997) (Map 3);
- Searching for *Powelliphanta* shells on the ground surface while walking through transects at a slow but steady pace;
- Noting the presence, location and habitat of any live snails found (but not handling them); and
- Recording details of location, number of shells/live snails and habitat.

A search for *Powelliphanta* snails was also carried out at intervals along the access road between Denniston and Mt Rochfort on 9 July 2008 to evaluate the presence of snails in different habitats close to this road (Map 3).

An additional *Powelliphanta* survey was carried out by MBC Contracting Ltd on 17 July 2008, focusing on areas where no evidence of snails was found on the initial transect surveys. These included areas east of the Whareatea-Escarpment Mine road and near Trent Stream and west of it.

A provisional assessment of shell damage was carried out following descriptions of damage in Meads *et al.* (1984). All shells were first cleaned and dried to make assessment easier. As a condition of the Low Impact Research and Collection Permit, all cleaned empty shells were sent to the Department of Conservation (via Kath Walker, Nelson) after the survey.

5.2. Kiwi

A specific search for kiwi was carried out throughout the survey area. The methods of surveying for kiwi included:

5.2.1. Diurnal search

- A search for kiwi sign (footprints, droppings, probe holes and feathers) during diurnal surveys for birds and snails (Map 3);
- Recording GPS coordinates, habitat, and detailed description of sign;

5.2.2. Nocturnal call survey

- A nocturnal survey for kiwi following the standard Department of Conservation's Kiwi Call Scheme (McLennan 1992) was carried out in late June and early July. Monitoring was carried out at five sites (two observers, three nights) that offered excellent listening vantages (Map 4);
- Other animals heard calling and their relative abundance were also recorded;

5.2.3. Nocturnal playback survey

- At the end of the two-hour listening period, recorded calls of great spotted kiwi were played every c. 400m along roads and tracks within the survey area or vicinity (Map 4).

5.3. Other birds

All birds encountered during the survey were recorded. Diurnal bird counts were carried out systematically approximately 200m apart along walking transects (Map 3). The counts, designed to detect bird species presence, distribution and relative abundance, included:

- "Snapshot" counts where all individuals of all species of birds were recorded in exactly one minute; and
- Standard five-minute counts (after Dawson & Bull 1975) carried out in forest habitat, where data from the first minute were recorded separately as for a "snapshot" count.

Birds that were encountered on transects between plots or at plots outside the formal listening period were also noted, and details taken (GPS location, time, gender, group size, activity, etc) of any threatened species or significant finds. All birds heard at night during the kiwi listen surveys were recorded.

5.4. Faunal habitats

A subjective, qualitative assessment of habitats based on threatened species presence, distribution and relative abundance was made. Other habitats offering potential significance for wildlife (such as wetlands or unmodified forest) were also noted. This data was considered in view of the wider area regionally, based on literature, personal

observations and reports of other ecologists. Photographs were taken to illustrate key features of the faunal habitat (Figures 1-5).

5.5. Miscellaneous

The presence and sign of introduced mammals, invertebrate fauna etc were noted, but no specialized search was made for these fauna (other than *Powelliphanta* snails).

5.6. Mt Rochfort and Escarpment Mine roads

In addition to a comprehensive survey within and immediately outside the proposed mine area, a diurnal survey mainly for *Powelliphanta* snails, and a nocturnal survey mainly for kiwi was carried out along the road and roadside habitat from the tarseal end of Mt Rochfort Road to Whareatea Mine, and Escarpment Mine Road (Maps 3 & 4; Figure 5). L&M propose to widen this road in places to accommodate heavy traffic use to and from the proposed mine.

A kiwi call playback method was used along the length of this road, broadcasting calls every 400m or so during the evening of 19th June 2008 (21:00 hrs to midnight) (Map 4). On 9 July 2008, a search for *Powelliphanta* snails was made at approximately 400m intervals (200m where no evidence of snails was found) along roadside habitat (Map 3).

Figure 5 Coal measure tussock and scrubland to the east of the proposed mine area. Escarpment Mine Road visible central foreground and Mt William in background. This is the most disturbed part of the proposed mine area (R.B.)

6. Results

6.1. Powelliphanta land snails

The threatened land snail *Powelliphanta* "patrickensis" was found patchily distributed within the survey area (within and outside the proposed mine area), being concentrated in the central part of the survey area (Map 5). Shells were also found fairly readily along the Mt Rochfort Road from Trent Stream toward Denniston, but were not found in the immediate vicinity of the Whareatea Mine and Escarpment Mine Road. Details of shell and live snail location, size and habitat are given in Appendix 4.

Powelliphanta appear to be in low-moderate numbers in coal-measure scrub and grassland habitat, within damp ground vegetation, on the plateau area west of the Escarpment Mine Road and east of Trent Stream. One live snail was found near the head of V40 Stream, about at the edge of the proposed mine (NZMG 2408234 5936531) at the edge of low-canopy manuka scrub, and 44 empty shells were collected from a number of sites both within and outside the proposed mine area (Map 5).

Only two of these shells were whole and many appeared to be quite old, being severely damaged or fragmented. Of the 42 damaged shells, 47.6% showed sign of weka damage (Figure 6), 23.8% naturally damaged, 19.0% unidentified damage, 4.8% rat, 2.4% possum and 2.4% crushed (probably by humans). Details of snail/shell location, measurements and habitat descriptions are given in Appendix 4.

No sign of *Powelliphanta* was found between the Escarpment Mine Road and V8 Creek (eastern part of the survey area) which was consistent with the results of earlier surveys (Department of Conservation data; K. Walker *in litt*., 30 June 2008). Nor were they found within the proposed mine area west of Trent Stream although they are likely to be present at least in low numbers there as shells have been found nearby toward Mt Rochfort and Conglomerate Stream.

The MBC Contracting snail search team also found no sign of *Powelliphanta* in these areas described above, but they found one shell on the east side near Trent Stream (Appendix 4).

6.2. Birds

Overall bird numbers were notably low, indicating low densities and/or relative inconspicuousness of birds, the latter expected during winter months, especially in cold conditions after the low snowfall in early July. A total of 17 indigenous and six introduced birds were recorded within the proposed mine area and surroundings, including five threatened species (Hitchmough *et al*. 2007): great spotted kiwi, black shag, western weka, South Island rifleman and South Island fernbird (Table 3). An additional two species were recorded outside the area. These were New Zealand scaup seen at a small artificial lake near the tarseal end of Mt Rochfort Road, well away from the area of the proposed mine, and spur-winged plover that were heard at night,

close to the Mt Rochfort road in coal-measure scrub country. A pair of mallard/grey duck[2] was also recorded on this small lake.

Threatened birds not recorded but possibly present include NZ falcon, kereru (NZ pigeon), kaka, kakariki (yellow-crowned parakeet) and long-tailed cuckoo (summer migrant) (Table 1).

Table 3 Threatened species recorded present within the survey area

Species	Threat status	Distribution and abundance
Great spotted kiwi	Gradual decline	Moderate numbers, south and west
Black shag	Sparse	One seen, over artificial lake
Western weka	Serious decline	Occasional throughout
South Island rifleman	Gradual decline	Low numbers, forested areas, south
South Island fernbird	Sparse	Scattered throughout coal-measure scrubland

Note: threat classification after Hitchmough *et al*. 2007

6.2.1. Great spotted kiwi

Sign of kiwi (calls, feeding probe holes, footprints and faeces) was found throughout the survey area, particularly in forested areas to the south of the survey area and at higher altitudes toward Mt Rochfort (Map 6; Appendix 2). One definite pair and 4-5 females were heard calling at night (Table 5b, Appendix 2). The pair and at least one of the females were heard within the proposed mine area while the other kiwi were within about a kilometre of the area. Female kiwi calling alone do not necessarily mean that they are unpaired (e.g. the male may be at the nest during the time of survey). Kiwi sign (probe holes, droppings, footprints) was found scattered throughout the area (Map 6). From the number and location of kiwi heard calling, and sign found through the day, at least six kiwi were estimated to occupy the proposed mine area or immediate vicinity.

No kiwi were heard in the vicinity of the road from near Denniston to the Whareatea Mine, nor along Escarpment Mine Road. The nearest kiwi to this area was a female heard toward the Mt William Range well outside the proposed mine area on the night of 19th June 2008.

Kiwi are relatively numerous at the nearby Mt William Range, and along the Stockton Plateau coastal ridge/escarpment area (Kingett Mitchell & Landcare Research 1997; Wildlife Surveys 2002; pers. obs.). They prefer areas of tall forest or scrub more than open coal-measure habitat, though they forage for food in the latter habitat.

[2] Too dark to identify though distinguishing the species morphologically is problematic

6.2.2. Western weka

Weka were seen or heard throughout the survey area though their presence appeared to be occasional rather than common (Map 7). They were also encountered along the roadside from Denniston to Escarpment Mine. Mainly male weka were heard.

Weka are found throughout the Denniston-Stockton Plateau though are generally not particularly abundant (Buckingham 1998c, 2002a; Thomas & Toft 1997; Thomas *et al.* 1997). They occupy a range of habitats including indigenous forest, exotic forest and shrubland.

6.2.3. South Island fernbird

Fernbirds (Figure 7) were heard occasionally, mainly in coal-measure scrubland within the central part of the survey area, and also in taller, denser scrub along roadsides (including the Mt Rochfort Road outside the proposed mine area) (Map 8; Appendix 3). They are likely to be more common than observed, as they tend to be very quiet and inconspicuous during winter months. They are very common in extensive areas of pakihi scrubland in parts of the Denniston-Stockton Plateau and at the Blackburn Pakihi.

6.2.4. South Island rifleman

A few riflemen were encountered in the taller forest to the south and west of the survey area (Appendix 3). Riflemen have a patchy distribution in forested areas of the Denniston-Stockton Plateau and have been recorded in relatively high densities in parts of the Mt William Range and near Mt Frederick (Buckingham 1998c; Thomas *et al.* 1997; pers. obs).

6.2.5. Black shag

A black shag was seen flying above the artificial lake east of Escarpment Mine Road. Black shags (and little shags) are recorded occasionally in the Denniston-Stockton Plateau area and elsewhere in the Ngakawau Ecological District (Buckingham 1998c; Overmars *et al*. 1998; Thomas *et al.* 1997).

6.2.6. Other birds

The low counts of most birds within forested areas of the survey area are shown in Table 4. Bellbirds were the only species recorded where the mean count was greater than one per count. Most species were only occasionally encountered (<25% of counts). Bird counts were even lower outside forest habitat (Appendix 3).

The most frequently recorded bird overall was bellbird, which was encountered in 19.4% of all one-minute counts and 62.5% of counts in medium-tall forest habitat (Appendix 3). Tomtits and redpolls were both recorded in 11.9% of counts, the former in forest and scrub habitats while the later not recorded in forest (but likely to seasonally visit forest). The only other reasonably frequently encountered species was grey warbler (9% of counts) found in forest and scrub habitats. Robins and brown creepers (each 4.5% of counts) were mainly recorded in scrub and low forest.

There were differences in counts of some species within and outside the proposed mine area (Appendix 3). For example, bellbirds and grey warblers were recorded more frequently outside this area whereas chaffinches, robins, brown creepers,

fernbirds and riflemen were recorded more frequently within. However, caution need be taken interpreting these data as sample size is relatively low and the proportion of different bird habitats within each area varies.

Two paradise shelducks and two introduced mallard ducks were seen on the artificial lake east of the Whareatea-Escarpment Mine road on 17th July 2008 (M. Hamilton, pers. comm.).

Table 4 Results of five-minute bird counts

Species	Mean/count	Standard Deviation	% Occurrence
Bellbird	1.30	0.23	80%
Tomtit	0.45	0.20	25%
Grey warbler	0.35	0.13	30%
Silvereye	0.30	0.15	20%
Robin	0.25	0.10	25%
Brown creeper	0.20	0.09	20%
Chaffinch	0.20	0.12	15%
Goldfinch	0.20	0.20	5%
Fantail	0.10	0.07	10%
Redpoll	0.10	0.07	10%
Rifleman	0.05	0.05	5%

Note: n=20 comprising counts carried out in low-canopy to tall-canopy forest

6.3. Other fauna

Other fauna of interest found was the carcase of a tree weta (*Hemideina* spp., probably *H. crassidens*) found in coal-measure scrubland in the central part of the survey area. Remains of the threatened koura (freshwater crayfish, *Paranephrops planifrons*) were found in wetland areas of the survey area.

The introduced whistling frog was heard in swampland near the Escarpment Mine Road on 19th June 2008. They are likely to be more conspicuous during warmer seasons. Introduced mammal sign, including that of deer, possum and goat was found relatively infrequently.

Figure 6 Presumed weka damage on *Powelliphanta* "patrickensis" found in the survey area (R.B.)

7. General Discussion

The time of year (June/July) when this field survey was carried out is the least favourable season to survey for birds and other fauna because:

- Birds during winter are often quiet and inconspicuous, or absent in the case of summer migrants (e.g. cuckoos) or other visiting birds (e.g. those such as kereru, tui and kaka that feed on seeding or flowering plants between spring and late autumn);
- Great spotted kiwi tend to be most vocal in the middle of summer (McLennan & McCann 1991) and least vocal during winter;
- Bats tend to be sedentary during winter nights when temperatures drop below 5°C; and
- *Powelliphanta* snails are harder to detect as they hibernate over winter, and shells can be difficult or impossible to detect when snow covers the ground. Light snow covered parts of the survey area in early July. A better indication of *Powelliphanta* densities can be obtained during warmer months when ground conditions are more suitable for carrying out plot surveys and relative numbers can be assessed by carrying out nocturnal surveys on appropriate nights (wet, warm and humid).

Despite these constraints, a reasonable knowledge of both kiwi and *Powelliphanta* distribution was obtained during the survey. The results for these fauna were more or less as expected, namely moderate numbers of kiwi in the taller vegetation areas of the survey area, and a southern extension of the known *Powelliphanta* "patrickensis" distribution centred on the coal-measure scrubland tableland in the central part of the proposed mine area and outside this area to the north and west. The results of this survey were consistent with the results of Department of Conservation surveys for *Powelliphanta* snails in the same general area (Department of Conservation data; K. Walker *in litt*., 30 June 2008).

The relatively low proportion of *Powelliphanta* shells showing sign of being killed by introduced mammalian predators perhaps indicates relatively low numbers of these pests in the area. The noted abundance of ground beetles at Mt Rochfort and Whareatea Mine (Overmars *et al*. 1998) is perhaps further indication of relatively low mammalian predator numbers in that area (see also Section 8.1).

The low incidence of mammalian predator damage on shells strongly contrasts that of a recent survey at a lower altitude site in the Whareatea valley where 50% of shells showed sign of being damaged by rats (unpublished information). It is feasible that the harsher climate and/or less palatable vegetation in the part of the survey area where *Powelliphanta* were found are less favourable to possums and rats than warmer and lusher coastal-facing vegetation at lower altitudes. As a general rule, rats are a greater threat to *Powelliphanta* at lowland sites than higher-altitude sites (Walker 2003).

The high incident of weka damage on shells is of interest and may indicate a switch of weka diet as favoured foods became depleted or that snails have become easier to find

due to habitat degradation (Walker 2003). Also it is possible that weka have less competition for *Powelliphanta* due to the paucity of mammalian predators in the area.

Kiwi and *Powelliphanta* snails are likely to represent the main ecological concerns associated with the proposed development. An opencast mine would adversely effect populations of these (and other) fauna, though impacts could be reduced if appropriate mitigation, rehabilitation or avoidance is incorporated into the mine design and operation (see Section 11).

The wetland area to the east of the proposed mine site including the artificial lake [Brazil's Dam] (Cover photo) is of potential significance to aquatic fauna and some species of birds (e.g. ducks, herons, black backed gulls) that may use it from time to time. However, the absence or rarity of fish and the acidic nature of the headwater streams and lakes in this area (especially during dry seasons) implies relatively low aquatic ecosystem values, thus a poor food source for the abovementioned birds (Patrick 2008).

8. Significance of fauna and faunal habitats within the proposed mine area

The area proposed to be mined by L&M contains areas of significant habitats for indigenous fauna as defined principally by the threat status of a number of species present in the area, the relative intactness of parts of the area and the size of the area (Buller District Plan 2005). The main areas of significance are the coal-measure scrubland where the Nationally Endangered *Powelliphanta* "patrickensis" is found (Figures 1 and 4) and the forested parts to the south and west where great spotted kiwi are concentrated (Figures 2 and 3).

In identifying areas of significant habitats of indigenous fauna, guidelines presented in the Buller District Plan (2005) are used: 1. Representativeness, 2. Distinctiveness, 3. Intactness, 4. Size, 5. Protected status, 6. Connectivity, 7. Threat, 8. Migratory habitat, and 9. Scientific or cultural value. The West Coast Regional Council (Policy Statement 9.2) has similar criteria to evaluate significant faunal habitats.

Taking cognisance of these guidelines, the values of the proposed mine area are discussed below (Sections 8.1 to 8.5). The significance of the area for individual species is discussed in Section 8.6.

8.1. Representativeness and Distinctiveness

All fauna found within the survey area are also found outside this area. Core populations of species including *Powelliphanta* "patrickensis", great spotted kiwi and western weka are found outside the proposed mine area, though *P* "patrickensis" has a more restricted distribution than other threatened species found in the area, being endemic to the Stockton-Denniston Plateau and surrounding hill country. It is possible there are species of invertebrates endemic to the Whareatea-Mt Rochfort area given the paucity of information on invertebrates other than *Powelliphanta* snails in the Ngakawau Ecological District (Overmars *et al*. 1998; Thomas *et al*. 1997).

From a limited survey of carabid (ground beetle) fauna at 16 sites within the Stockton and Denniston Plateau in 1986, comparatively high species richness and abundance of

ground beetles was found at Mt Rochfort (4 sites) with also high values west of the Whareatea Mine (3 sites), and lesser numbers elsewhere (Overmars *et al*. 1998). Relatively immobile large-bodied invertebrates such as ground beetles may be more vulnerable to mammalian predators than smaller ones (McGuinness 2001), thus may survive better at higher altitude sites more exposed to weather extremes where densities of predators are likely to be comparatively low. Ground beetles may be an indicator of the abundance and diversity of other invertebrates in the area.

No especially distinctive terrestrial faunal habitats were found within the survey area. The four main faunal habitats identified within the area, tall forest, dense scrub/low forest, manuka-wire rush rushland and wetland are not particularly distinctive and are well represented outside this area.

8.2. Size, Intactness and Connectivity

Being >5 ha and comprising >1 ha of wetlands, the proposed mine area is considered large enough an area to be of potential significance for faunal habitat. Past mining, fires, roads, and spread of weeds, etc have modified much of the area, thus reducing the overall importance of the area to wildlife. In places, roads and disturbed areas have fragmented the natural habitat and this may have influenced the current populations of some fauna such as the more immobile invertebrates (e.g. *Powelliphanta* snails and flightless beetles). However, forest and taller scrub habitat to the south and west is largely unmodified and is contiguous with similar habitat within the Cascade Creek catchment.

8.3. Protected status and threat

The proposed mine area lies just outside and to the east of the Mt Rochfort Recommended Area for Protection (RAP) as described by the New Zealand Protected Natural Areas Programme (Overmars *et al*. 1998). Conglomerate Stream marks the north-east boundary of this area, approximately 500m from the western extremity of the proposed Escarpment Mine area. The Mt Rochfort RAP was chosen as the "…best remaining representation of the coal measures landform and vegetation patterns of the Denniston plateau and its coastal hillslopes, in a full altitudinal sequence…" (Overmars *et al*. 1998, page 83). Significant fauna known to be present in this RAP include great spotted kiwi and *Powelliphanta* "patrickensis", while as mentioned elsewhere, the greatest abundance and comparatively high species richness of ground beetles was found at Mt Rochfort. In general, the Escarpment Mine area is more disturbed with lower fauna habitat values than most of the RAP area. However, the proposed mine site does appear to offer similarly important habitat for great spotted kiwi.

Providing that adequate measures of preventing or reducing offsite adverse effects are in place (particularly regarding fires and potential contamination and disturbance of streams) the proposed mine should have little influence on the ecosystems of this RAP. Acid mine drainage and other potential adverse effects of waterways are dealt with in other documents (e.g. Patrick 2008).

8.4. Migratory habitat

The area is unlikely to have particular importance as migratory habitat for fauna, other than perhaps for visiting waterfowl using Brazil's Dam east of the Escarpment Mine Road, and for the threatened long-tailed cuckoo that is present in New Zealand over summer. The relatively high numbers of brown creeper may attract long-tailed cuckoo, as brown creeper are a host for the nest-parasitic cuckoo.

Because of the location on a relatively low ridgeline separating coastal vegetation with extensive inland forests, the area may be visited seasonally or used as a flight path for a number of mobile species such as long-tailed bat, kereru and tui.

8.5. Wetlands

The relatively low-lying area east of Escarpment Road containing Brazil's Dam was identified as the main wetland area of importance in the proposed mine area. Wetland in this area was identified as having some (but relatively minor) significance for black shags and fernbirds, and relatively minor importance for visiting water birds (observed and potential) such as ducks and black backed gulls. However, further surveys at different times of the year, and specialized surveys for crakes and bitterns would better ascertain species using the wetland and overall values of this habitat to fauna (see Section 10). It is noted that Brazil's Dam is an artificial water body, and thus of low significance from a historical ecological perspective.

8.6. Species of particular conservation importance within the proposed mine area

8.6.1. *Powelliphanta* "patrickensis"

Powelliphanta "patrickensis" is a Nationally Endangered land snail (Hitchmough *et al*. 2007) that is threatened by habitat destruction and predators throughout its range. Within their population there is considerable morphological variation but it is not known whether this variation reflects genetic diversity or different habitats and climatic exposure (Walker 2003). The core area of this snail's occupation lies within the upper Waimangaroa River and Deep Stream (Buckingham 1998a; Walker 2003).

Total removal of *Powelliphanta* habitat within the proposed mine area would affect approximately 1-1.5% of the *Powelliphanta* "patrickensis" distribution using the minimum convex polygon method of estimating a species' range and comparing the number of sub-square grids where shells of this snail were found within the proposed mine area and the total known distribution (Department of Conservation records). Probably a lesser proportion of the *P*. "patrickensis" population would be affected because of the apparently low densities of snails within the proposed mine footprint compared to core areas such as in the upper Waimangaroa valley and Deep Stream. However, due to the patchiness of this snails' distribution and insufficient knowledge of *Powelliphanta* densities over their range, the percentage of population loss due to total removal of habitat within the proposed mine area can only be surmised.

Given the apparent low densities of *Powelliphanta* snails and the high proportion of old shells found in this area, their populations may be declining due perhaps to slowly

degrading habitat and subsequent increased predation by weka. Thus irrespective of whether mining occurs or not (or the option of underground mining taken), steps may have to be made to protect the population, such as moving a proportion of snails from the area prior to mining to an appropriate managed site such as within the Mt Rochfort RAP. Rehabilitating habitat after mining finishes may provide a long-term option for re-establishing the snail population. These aspects of mitigation are addressed in more detail in Section 11.

8.6.2. Great spotted kiwi

Great spotted kiwi are a nationally threatened species ("Gradual Decline") found only in the north-western half of the South Island. The Mt William Range population is considered of national significance, though densities of kiwi are lower there than in stronghold areas of Northwest Nelson (Kingett Mitchell & Landcare Research 1997). Despite midwinter being a usually inappropriate time to survey for great spotted kiwi, numbers heard and signs found during the recent survey indicated similar densities of kiwi at the Escarpment Mine area as the Mt William Range population.

The presence of moderate numbers of kiwi in the survey area is not surprising given the knowledge of their distribution in the general area (Garrick 1986; Kingett Mitchell & Landcare Research 1997; Thomas *et al*. 1997; pers. obs.). Great spotted kiwi are widely but patchily distributed in the region with the montane and subalpine forests of Kahurangi National Park, the Mt William Range/Orikaka River area and the Paparoa Range being their stronghold localities. Although kiwi densities in the nearby Mt William Range are not exceptional compared to core areas in Kahurangi National Park they are above average, therefore of national significance (Kingett Mitchell & Landcare Research 1997).

Great spotted kiwi appear to be found mainly in forested areas to the south and west of the proposed mine area. Furthermore, this kiwi population is likely to be contiguous with a wider population extending to Cascade Creek, western faces of Mt Rochfort, the Mt William Range, and the Orikaka valley. Thus only a very small proportion of this population would be affected by the proposed development. Given a national population of 10,000 to 20,000 birds (Heather & Robertson 1996), only at most 0.1% of the total population of great spotted kiwi would be affected by the proposed mine.

Notwithstanding this, every individual kiwi is of significance given their threatened and New Zealand icon status. The loss of any kiwi as a result of industry would be considered unacceptable to ecologists, conservationists and probably most New Zealanders.

The apparent greater abundance of kiwi in forest habitat at higher altitudes is also consistent with other studies. Great spotted kiwi may not necessarily favour wetter, higher-altitude areas but rather have a higher survival rate there due to lower densities of predators, mainly stoats (Kingett Mitchell & Landcare Research 1997). Because the study area is located within a high-rainfall zone, the kiwi population there is likely to persist for many years.

8.6.3. Western weka

Western weka have a higher threat ranking ("Serious Decline") than great spotted kiwi because weka populations are subject to sudden, dramatic declines that are largely unexplained. For example, numbers of weka have declined to almost extinction in parts of North West Nelson over the past two decades (Beauchamp 1999). Currently, western weka are widely distributed in the Ngakawau Ecological Area, and more generally in the northern and central West Coast region being the stronghold area for this subspecies (Beauchamp 1999, 2000).

Western weka are widely present on the Denniston Plateau, including the proposed mine area but do not appear to be common (Buckingham 1998c, 2002a; Garrick 1986; Thomas *et al*. 1997; Wildlife Surveys 2002). Densities of weka in that area are considerably less than observed in stronghold areas such as between Hokitika and Reefton (Buckingham 2002b; pers. obs.). Weka are found in a variety of habitats including scrubland, forest and pakihi, but seem to prefer dense scrub and forest edges.

Weka are not generally as vocal in winter and spring than in late summer and autumn (Beauchamp 2000). Other surveys (Buckingham 1998c) also found an apparent male-biased weka population, though pairs of weka are occasionally heard and breeding has been recorded (Thomas *et al*. 1997).

8.6.4. Fernbird

Fernbirds are a threatened endemic species classified as "Sparse" (Hitchmough *et al.* 2007). They are threatened locally by habitat modification (e.g. drainage of wetland) and nationally by predators.

Fernbirds are commonly found throughout coal-measure scrubland and pakihi habitat throughout the Stockton and Denniston plateaux, including the proposed coalmine area. During winter, fernbirds can be very quiet, which is likely the reason that comparatively few records were noted on the current survey. Notwithstanding this, the area is unlikely to support the very dense fernbird populations that have been recorded on the Blackburn Pakihi (Buckingham 1998c; Kingett Mitchell & Landcare Research 1997) or near Mangatini and Weka Stream on the Stockton Plateau (pers. obs.) where habitat appears more ideal for fernbird (pakihi with abundant scrubland and fern).

Approximately 92 ha of potential fernbird habitat (excluding edge habitat) is present within the proposed mine area. Using the median territory size (8,110 square metres) of the closest study population (Golden Bay), an estimate of the approximate fernbird population in the proposed mine area can be calculated, noting however that fernbird territory size varies significantly at different habitats and locations (Parker 2002). The number of fernbird territories within the proposed mine site would be c. 113 using this figure. However, fernbird habitat is fairly patchy within the c. 92 ha potential fernbird habitat thus this figure is likely to be an overestimate.

8.6.5. Other birds

It is stressed that the failure to detect species on this survey does not mean that they are absent. Species of fauna can be missed because they are inconspicuous or inactive

during winter months, or because they are absent then but visit during other times of year (e.g. seasonal migrants such as long-tailed cuckoo).

Threatened bird species known to be present within forest habitat in the general area include bush falcon, kaka, kakariki, kereru and long-tailed cuckoo (e.g. Buckingham 1998c; Garrick 1986; Thomas *et al.* 1997). These species are likely to be present at least seasonally, given their presence in nearby localities and the availability of suitable habitats within the survey area. Kaka, kereru and falcon are only recorded occasionally on the Denniston and Stockton plateaux and vicinity (e.g. Buckingham 1998c; Thomas & Toft 1997; Thomas *et al.* 1997) thus they could easily be missed, especially in short, one-off surveys. The migratory long-tailed cuckoo is absent in New Zealand during winter. Kereru occur more commonly in the mixed lowland forests, but are also occasionally recorded in higher-altitude forest in this region.

Overall bird species and numbers tend to be relatively low in coal-measure scrubland in the region (Buckingham 1998c; Garrick 1986; Thomas *et al.* 1997), thus the very low numbers recorded in this habitat during winter was not surprising. Probably the only relatively common threatened species in this habitat are fernbirds (see Section 8.6.4 above).

9. Predicted impacts of the proposed coalmine on terrestrial fauna

9.1. Summary of adverse effects on fauna

The level and extent of adverse effects on fauna will primarily depend on:

- The extent and type of coal mining carried out;
- The location/s where coal mining is carried out;
- The extent of roading and infrastructure required additional to what currently exists; and
- Functions of the mine design and operation to avoid, remedy or mitigate adverse effects.

The largest adverse effect on fauna by an opencast coal mine is habitat destruction over the areas that are mined. Large-scale removal of fauna habitat will result in either fauna being killed directly during the process of removing habitat, or their forced displacement to outside areas. Many of the displaced fauna will likely die due to stress and related reasons such as not being able to compete with existing territory holders. Similar effects on fauna will occur on access roads, overburden dumping sites, building sites and other infrastructure sites associated with the mine.

Fragmentation of habitat is a potential threat to fauna by disrupting dispersal of less mobile fauna (e.g. flightless invertebrates) and creating an increase in edge vegetation, which may lead to changes in fauna composition and possibly increases in predators and invasions of weeds (Moller 1999). Also fragmentation and increased edge effect increases light and wind penetration which could affect species such as *Powelliphanta* snails that rely on damp shaded habitat to protect them from desiccation or freezing in winter. However, roads do have some benefit in allowing cost-effective predator and weed control and these advantages may outweigh any

potential adverse effects of roads such as improving access (if they do) or providing edge habitat for predators.

Underground mining, or high wall mining, which occupies a much smaller footprint, has generally a much lesser impact on fauna and faunal habitat, but is not always technically or economically practicable. However, subsidence caused by underground mining can impose a problem to fauna and faunal habitats, and underground mining presents a higher risk of fires than opencast mining.

Adverse effects from mining also occur outside mining areas, often at some distance from the mine site. Usually the scale of these effects is harder to predict because the areas likely affected are hard to define, and the efficiency of mine design is not always known until put to the test. Problems may also be unforeseeable in the event of a catastrophic event. These types of effects include but are not confined to:

- Downstream effects by acid mine drainage (AMD), silt accumulation, or contamination from accidental spillage of oil, fuels etc (note that processing of coal will be offsite);
- Spread of weeds brought about through removing natural vegetation cover, or seeds carried by humans or vehicles;
- Effects of dust, noise and light on vegetation and fauna; and
- Offsite effects such as caused by subsidence, slumping or changes in hydrology.

Finally, the coal mining industry increases the risk of potentially serious adverse effects such as fire destroying large areas of offsite habitat, or downstream devastation of habitat after a catastrophic event (such as major subsidence or flooding).

Predicted effects on specific fauna and faunal habitat are described below:

9.2. Powelliphanta "patrickensis"

Removal of *Powelliphanta* habitat for opencast mining would impose the greatest threat to *Powelliphanta* in the Escarpment area. Approximately 1-1.5% of the total *Powelliphanta* "patrickensis" habitat would be removed if all of *Powelliphanta* habitat was mined in the area (see Section 8.6.1).

Other potential adverse effects on snails include the general effects discussed in Section 9.1 above. The biggest potential effect on snails is loss of habitat caused by fires. Burning has seriously affected considerable areas of habitat on the Denniston Plateau and fires are listed as one of the major threats facing *P.* "patrickensis" (Walker 2003). However, it should be noted that any increased human use increases the risk of fires, opencast coalmines generally impose less risk of fires than underground mines, and onsite fire control services can greatly help to arrest fires before they spread and cause widespread damage.

General degradation of habitat adjacent to mined areas also negatively effect snail populations. This may be directly though drying out of habitat, or dust effects causing snails to desiccate and die, or indirectly by making snails more vulnerable to predators such as weka and rat. Degradation of habitat may be caused by land subsidence, collapse of high walls, rock falls, drainage effects, dust, spread of weeds

etc. Downstream effects may also adversely affect *Powelliphanta* snails or their habitat through silting of waterways, flooding, or contamination.

9.3. Great spotted kiwi

Kiwi appear to be mainly present in areas dominated by taller vegetation, and highest densities appear to be present in the south and west of the proposed mine area. Thus it is predicted that kiwi would be most adversely affected where mining impacted on this habitat and location. Kiwi like other fauna would be either killed through loss of habitat or displaced to areas outside development where they would have to compete with other kiwi. It is known that kiwi defend their territories vigorously and that some territorial encounters between adults are fatal (Butler & McLennan 1991; McLennan & McCann 1991).

All kiwi with territories entirely within or partly overlapping the proposed mine would be directly affected by the removal of vegetation and dumping of overburden. Neighbouring kiwi would also be disturbed, by noise, blasting, dust etc, or having to compete with kiwi that move out from the area being mined. Given the survey effort to date it would be difficult to estimate the number of kiwi affected other than suspecting that at least eight kiwi live within or close to the proposed mine area.

The chance of kiwi surviving if they escaped out of the affected areas probably depends largely on the density of kiwi populations in neighbouring areas (McLennan 2004). Kiwi densities in the general area of the proposed mine have been found to be relatively high by national standards (Kingett Mitchell & Landcare Research 1997), and the current surveys suggest a similar situation exists in the Escarpment Mine area.

Displaced kiwi, as for other birds, will be exposed to hazards not normally faced in undisturbed habitat. The overall effects will result in lowered mean survival rates, disruption of pair bonds, reduction in productivity, and stresses and loss from social disruptions (McLennan 2004).

Apart from direct disturbance and loss of kiwi habitat from mining and associated development, there are other potential adverse effects on kiwi. For example, increased levels of noise, or strong light may have local effects on kiwi (e.g. on birds that nest close to roads), and increased traffic may result in an increase in road deaths.

9.4. Western weka

The predicted adverse effects on weka by the proposed development are similar to those discussed for great spotted kiwi except effects are likely to be more evenly spread as weka appear to be more widespread, occupying a range of habitats within the proposed mine area. Unlike for kiwi, the impacts on weka are likely to be greater in coal-measure scrub habitat than taller forest.

Weka are not as shy as kiwi regarding some types of disturbance such as noise and human presence. However weka's curious behaviour makes them at times vulnerable to machinery, vehicles or blasting etc in an operating area. Weka are likely to be more adaptable to habitat change than kiwi, and recolonize rehabilitated habitat more readily.

Weka are likely to be victim of more road deaths than other threatened species due to their ground feeding and scavenging habits, use of tracks and open areas as access, and their preference for scrubby edge habitats that are typically present along roadsides in this area.

9.5. Fernbird

Removal and disturbance of fernbird habitat will negatively affect fernbirds in a similar way to kiwi and weka. Based on rough estimates, up to 113 fernbird territories (at most 226 individuals) could be affected if all potential fernbird habitat is mined (see Section 8.6.4). Fernbirds vigorously defend their territories and thus it may be difficult for displaced birds to establish elsewhere. However, fernbirds unlike kiwi are likely to re-establish relatively quickly into rehabilitated vegetation after mining ceases.

Fernbirds are prone to relatively high predation pressure due to their small size and their habits of feeding and nesting close to the ground (Parker 2002). The main predators of fernbirds in the Stockton and Denniston plateaux area are likely to be stoats, rodents and weka. While there is no evidence that mining or roading lead to increases in numbers of predators in New Zealand (Moller 1999) there is a potential risk that fernbirds and other fauna will become more prone to predation from stress caused by disturbance.

Road deaths are another threat to fernbirds, particularly as roadside edges with dense fern, scrubs and gorse are often favoured fernbird habitat. Although fernbirds typically fossick in dense vegetation they occasionally run across open ground or fly across gaps in the vegetation.

9.6. Other birds

Removal of habitat and other disturbances will affect a range of bird species including residents and visiting birds. As a larger range of species live in forest, removal of this habitat will have a disproportionate affect on fauna.

Riflemen are obligate forest-dwellers that are particularly intolerant of disturbance of their habitat and thus will either die or be displaced if forest is removed or modified. As riflemen were found only on the south-western part of the survey area, near the edge of an extensive area of forest, it is unlikely that many individuals would be affected by the proposed mining.

Birds that are likely seasonal visitors to the area include kaka, kakariki and kereru. These species may arrive when specific food such as fruit, seeds and honeydew become available. It is also possible that these species nest in the area. Removal of forest habitat would thus have negative effects for these species, which would then be forced to seek other areas for food and/or nesting. Similarly, seasonal migrants such as long-tailed cuckoo would have to seek other areas for food source.

Robins and brown creepers are non-threatened birds found widely within the Denniston and Stockton plateau area. Brown creepers have a preference for scrubby low-canopy vegetation while robins are found in most habitats. Robins in particular seem to be relatively uncommon, particularly compared to low-altitude forest areas in Buller and Inangahua valleys (Buckingham 1999; pers. obs.). As for other bird

species, both robins and brown creepers would be affected by habitat removal. Brown creepers would probably be relatively quick re-colonizers of rehabilitated habitat while robins may not return to the area in the short and medium term until taller vegetation cover has well established.

Birds occupying wetland habitat (e.g. black shag and paradise shelduck) will be affected if mining removes or greatly modifies wetland habitat, particularly in the vicinity of the artificial reservoir in the eastern part of the proposed mine area. The impact on these species as a whole is considered negligible, particularly as these water bodies are highly acidic, and consequently probably have low value as a food source.

9.7. Bats

Although bats have not recently been detected in the area, and results of surveys within the past 12 years have indicated at most very low numbers of bats between the lower Buller River and Mokihinui River (Buckingham 1998b, 1999, 2002b; Thomas *et al.* 1997), it is possible that low numbers of bats (particularly long-tailed bats) are present in the proposed mine area, or its vicinity.

There is only a relatively small area within the proposed mine site than would provide ideal roosting and nesting habitat for bats, this being in tall forest on and near the southern margin, above Cascade Creek. Bats actively select larger-diameter trees for roosts, and colonies rotate between a number of roost sites (Sedgeley & O'Donnell 1999). Thus although bats if present in the area roost mainly outside the proposed mine area they may have some roosts within this area, and thus be affected by habitat removal.

Long-tailed bats have often been detected more frequently near ponds in lowland forest areas (pers. obs.) presumably as ponds provide a good source of flying insects. However, bats are unlikely to be targeting still water bodies in the proposed mine area due to these tarns and lakes being presumably highly acidic and consequently supporting low densities of aquatic invertebrates, or flying insects associated with these habitats.

10. General Recommendations

General recommendations are listed below. These relate to the requirement of further surveys to address knowledge gaps that need to be addressed, prior to mining or related activity in the proposed Escarpment Mine area.

- As explained elsewhere, baseline fauna surveys carried out solely during winter are not appropriate to provide a full understanding of existing fauna and faunal values in a particular area. Thus to provide a fuller knowledge regarding these matters further surveys are recommended during spring or summer when species of fauna are more likely to be present (e.g. long-tailed cuckoo, kaka and kereru), are more active (e.g. bats and *Powelliphanta* snails), or more conspicuous (e.g. kiwi, weka, fernbird);
- Surveys for lizards and invertebrates other than *Powelliphanta* snails are recommended given the interesting distributions, and gaps of knowledge for these fauna in this area (Overmars *et al*. 1998; Thomas *et al*. 1997; Whitaker & Lyall 2004). These surveys need to be carried out during warmer months;
- A detailed kiwi survey should be carried out during summer involving certified and approved kiwi-tracking dogs and handlers. The survey needs to determine the number of kiwi and their approximate territories within the proposed mine site;
- A detailed survey for *Powelliphanta* snails is recommended to determine their relative densities within the proposed mine area compared to densities outside this area. This survey will involve at least 10 standard 10m x 10m survey plots (after Walker 1997) and nocturnal time-based surveys (Buckingham 2005; Wildlife Surveys 2005). The survey is best timed from early summer to autumn but should avoid times of drought, hot sun or windy weather when snails may be at risk of desiccation, or inactive at night; and
- Specialized surveys in late spring or early summer for cryptic species such as crake and bittern are recommended in wetland areas (specifically the artificial lake and surroundings east of Escarpment Mine road), and further general surveys to ascertain seasonal use of the lake by various species of birds.

11. Mitigation measures and monitoring

In view of avoiding, remedying or mitigating the adverse effects of the proposed coalmine and associated developments on fauna, the following measures should be considered.

- Subject to mine design requirements, either avoid development or carry out underground mining in forested areas to the south and west as these areas contain the densest kiwi populations, and highest numbers of birds in general (Map 9);
- Similarly, avoid development, or carry out underground mining if possible in the coal-measure scrubby tableland area between Trent Stream and the

Whareatea headwaters, as this area is where *Powelliphanta* snails are concentrated (Map 9);

- Ensure a contingency plan is in place to reduce the risk of fires, as fire would be very destructive to fauna in this area, particularly within the *Powelliphanta* habitat;
- Construction or modification of access roads, building sites etc should not be carried out during the kiwi breeding season (June to January) or the peak weka and fernbird breeding season (spring/early summer) as disturbance then would have a disproportionate impact on these fauna;
- Retaining where possible pockets of taller vegetation (e.g. in gullies) and large trees (>60 cm dbh) as these provide important habitat or microhabitat for some species of fauna (e.g. kiwi, kaka, riflemen and bats);
- Retaining a natural forest edge (or rehabilitating it) as this edge often provides favoured habitat to fauna such as weka and fernbird;
- Reducing effects of dust, noise and light on fauna (e.g. dampening roads during dry periods, using modern noise-reduced equipment, reflecting light away from important fauna habitat);
- Prohibiting dogs from the area (by publicity, noticeboards, signs etc), as dogs can be a serious predator of kiwi, weka and other birds;
- Reducing the event of road kills (e.g. on kiwi and weka) by imposing speed restrictions, road signs, and appropriately inducting staff; and
- Retaining any significant wetland areas (see Section 8.5) based mainly on the results of the botanical survey and extended fauna surveys as recommended in Section 10.

If avoidance of development, or appropriate mine design is not possible in sensitive fauna areas, mitigation and remediation will be required. This mitigation will require:

- Translocating kiwi and *Powelliphanta* snails to a protected site prior to mining. Although all affected kiwi will need to be caught and transferred, it is recommended that only a representative proportion of snails (quantified by number of snails and/or person-hour search effort) be moved to an appropriate protected area of similar habitat where they are actively managed;
- Ensuring a comprehensive vegetation rehabilitation plan is in place, based on an appropriate method tested and proven in the harsh environment of the proposed mine site; and
- Carrying out off-site restoration to help compensate for losses in fauna. This will involve a comprehensive and integrated predator control regime following best practice protocol developed by the Department of Conservation.

These options for mitigation are discussed in more detail below.

11.1. Translocation of fauna

Successful translocations of great spotted kiwi, weka, fernbird and *Powelliphanta* snails (the latter mainly unofficially) have been carried out in New Zealand (e.g.

Beauchamp *et al*. 1999; Parker 2002; Paton *et al*. 2007; Walker 2003). All of these species have bred in the re-located site, and in many cases long-term prospects look encouraging.

Translocations of indigenous fauna require consultation with the Department of Conservation and Ngai Tahu, and appropriate permits. Depending on species, possible release sites include predator-free offshore islands and managed "mainland islands" preferably areas known to be within the species former range. Captivity is also an option. The Department of Conservation have the responsibility of deciding transfer methods and release sites.

A suggested area to release and manage *Powelliphanta* snails transferred from the proposed Escarpment Mine area is within the Conglomerate-Sullivan West Mine area a couple of kilometres north of the Escarpment mine area, where *Powelliphanta* "patrickensis" appears to be relatively common but possibly threatened by rats (pers. obs.). If or when rehabilitated areas of the mine site become suitable for re-occupation of *Powelliphanta*, a number of snails could be moved back to their former site.

Great spotted kiwi and western weka could be moved to the Lake Rotoiti Nature Recovery Project area, where ongoing intensive management has produced encouraging results for a number of fauna (Butler *et al*. 2003; Paton *et al*. 2007). There may be other opportunities in the future as other mainland island restoration areas become available.

Prior to any translocations of fauna, the maintenance of genetic diversity should be considered. This matter is particularly important regarding *Powelliphanta* snails where populations tend to be patchy and isolated, and may show marked genetic variations between populations.

11.2. Rehabilitation of habitats for fauna

Rehabilitation of disturbed vegetation areas has positive effects for fauna in a number of ways.

- Increases the potential for the re-colonization of fauna;
- Reduces the extent of habitat fragmentation, allowing corridors linking or buffering areas of undisturbed vegetation;
- Stabilizes the landform thus reducing adverse effects such as erosion, slumping or flooding;
- Improves vegetation cover to protect *Powelliphanta* snails and other invertebrates from desiccation during dry periods or freezing during winter; and
- Rehabilitated cover, if dense enough, may also reduce predation of *Powelliphanta* snails by weka and other predators.

Rehabilitation should not just focus on establishing vegetation cover after mining but be an active and ongoing management practice along all disturbed areas from before mining to many years after mining has ceased. Rehabilitation may involve weed control (e.g. gorse alongside roads and tracks), hydroseeding steep banks, hand-planting shrubs, flax, tussock etc and direct transfer methods (the latter being

preferable in areas that have had vegetation cover entirely removed). For more information on rehabilitation in the proposed mine area refer to Ross (2008).

The time frame to achieve adequate rehabilitation of habitat will vary considerably for different species of fauna, and also be highly dependent on location, geology, soils, climate and other physical factors. It is more challenging to rehabilitate habitats in harsh, exposed environments such as the Mt Rochfort, upper Whareatea River area.

Rehabilitation constraints and requirements for different fauna are briefly described below.

11.2.1. *Powelliphanta* snails

Rehabilitating suitable habitat for *Powelliphanta* snails is likely to be especially problematic within the proposed mine area due to the harsh exposed climate, high-altitude situation and thin, impoverished soils. The key problems envisaged are:

- Establishing dense cover which snails require to prevent desiccation, freezing (in winter) and to give them some protection from predators;
- Establishing adequate litter layers for above reasons and also to maintain food supply for snails;
- Ensuring areas have adequate water retention to prevent habitat from drying out, particularly through drought periods; and
- Ensuring habitat is established so that worms (the dominant food of snails) re-occupy the rehabilitated area.

Trials carried out by Solid Energy (NZ) Limited at Stockton Coalmine in rehabilitating habitat by the direct transfer method (large clumps of soil and vegetation moved intact by machinery and vehicle) has shown that invertebrates (including large flightless beetles) survive using this method (Simcock 2006). In a trial carried out by Landcare Research at Stockton in 1998 the overall invertebrate fauna were not significantly different in direct transfer plots compared to undisturbed plots, though there were differences within groups of invertebrates. However, the method has not yet been proven as a successful means of re-establishing *Powelliphanta* habitat. It is probably unlikely that suitable habitat for *Powelliphanta* providing dense cover and adequate litter layers would be available within 20 or more years at most sites. The time interval may be less where direct transfer of vegetation is possible.

11.2.2. Great spotted kiwi

It is not known whether kiwi would re-occupy rehabilitated mine surfaces, and at best the re-established habitat would take many decades to become suitable for kiwi. Local mitigation measures alone are unlikely to fully protect populations of kiwi in the Escarpment Mine area. Thus to offset adverse effects on kiwi by the proposed mine it is recommended that a predator control program over a treatment area of approximately 1,000 ha at a suitable location in a nearby area is established (see Section 11.3).

11.2.3. Weka and fernbird

There is a reasonable chance that both weka and fernbird would re-occupy rehabilitated mine surfaces within a relatively short term (from 10 years or less after rehabilitation commences). Both species are more adaptable than kiwi, and prefer lower-canopy vegetation, which in some locations should establish relatively quickly. Planting of flax, tussocks, ferns and shrubs, or the direct transfer rehabilitation method are recommended to benefit these species.

11.2.4. Other fauna

Obligate forest birds such as kaka, kakariki, and riflemen are particularly sensitive to forest modification or clearance, thus there is a possibility that these species would not re-occupy rehabilitated areas. The abovementioned species are hole-nesters, and it takes many hundreds of years for suitable trees to establish. Similarly, roost and nesting habitat for bats would take a similar time to re-establish. A predator control program as recommended for great spotted kiwi (Sections 11.2.2 and 11.3) would also have benefits for these species (Elliott & Suggate 2007; Moorhouse *et al*. 2003).

11.3. Offsite mitigation

Predator control is known to increase the productivity of several species of birds such as kiwi and kaka (e.g. Butler *et al*. 2003; Elliott & Suggate 2007; McLennan *et al*. 1996; Moorhouse *et al*. 2003; Paton *et al*. 2007), and reverse the decline of some *Powelliphanta* taxa (Bockett 2004; Walker 2003). There are a number of options available to best manage threatened species, including translocations of species to managed mainland sites, manage in captivity, move to predator-free offshore islands, or carrying out management offsite to compensate for losses onsite (see also Section 11.1). Best practice management based on ongoing research and field trials must be used for any pest management scenario. Liaison with the Department of Conservation is prerequisite as they are responsible for conservation management of indigenous flora and fauna in New Zealand.

An area considered perhaps worth investigating for management of *Powelliphanta* "patrickensis" is discussed in Section 11.1. Given that rats and weka appear to be key predators of *Powelliphanta* in the Whareatea/Rochfort area (Buckingham 2002; pers. obs.), intensive control of rats along with possum control is recommended, and a predator exclusion fence may have to be considered to exclude weka from the management area. Weka may be a relatively recent significant threat for snails due to degrading of habitat (by industry, roading, past fires, recreation, climate change etc) allowing weka to forage for food more easily (Walker 2003) or perhaps the more preferred foods for weka have been depleted by competitors, or other reasons.

The main threat to kiwi in this area is from stoats, possums and dogs. It is recommended that an offsite area in the general vicinity of the Escarpment Mine be established as a management area for kiwi, with predator control targeting stoats and possums. A 1,000 ha area is predicted to benefit approximately 30 pairs of great spotted kiwi as well as benefiting other threatened birds such as western weka, kaka and kakariki (McLennan 2004). A predator exclusion fence set up to protect *Powelliphanta* snails as discussed above would also be useful as a holding area for juvenile kiwi during the period they are most vulnerable to predation (McLennan

2004; McLennan *et al.* 1996). The area enclosed by the fence may be relatively small (e.g. a few hectares) to protect *Powelliphanta* snails but would need to be larger (up to 20 ha) to protect kiwi and snails. There is a risk that kiwi would significantly prey on young *Powelliphanta* and snail eggs so close monitoring would be required if the enclosure is used periodically for kiwi.

11.4. Monitoring

Monitoring specific terrestrial fauna is carried out to quantitatively evaluate:

- Relative densities or territories of specific fauna before development;
- The efficiency of the predator control programme or other mitigation programmes;
- Changes in faunal habitat after rehabilitation; and
- The re-establishment of fauna in rehabilitating habitat.

Monitoring methods are discussed briefly for specific fauna below. Often a "focal species" or "indicator species" approach is used with the assumption that the species being monitored is representative or indicative of a range of other species that are likely to follow similar trends after development or management (Hutcheson *et al.* 1999).

11.4.1. *Powelliphanta* snails

Before any development commences in areas where *Powelliphanta* are found a survey should be carried out to determine their relative abundance within this area (Section 10) and a survey also carried out at similar sites outside the proposed development area for comparative reasons. Preferably one of the sites would be the area proposed for management of *Powelliphanta* "patrickensis" (Section 11.1 and 11.3). Monitoring would then continue on a yearly basis at the paired sites after mining commenced and later at rehabilitated sites after mining (before and after snails are translocated back to these sites if the latter is ever possible).

The most appropriate monitoring technique would involve mark and recapture using transponders, a technique that is currently being used by Solid Energy NZ Ltd in the Stockton and Mt Rochfort areas for *Powelliphanta* "Augustus". Other techniques include standard 10m x 10m plot surveys (after Walker 1997) and nocturnal transect surveys (after Wildlife Surveys 2005).

11.4.2. Great spotted kiwi

Two monitoring programmes are required for great spotted kiwi: the first to evaluate approximate territories (using radio transmitters) within the proposed mine site and the second is to monitor survival and productivity within a predator control area (Section 11.3). Determining the locations and movements of kiwi within the proposed site will need to begin at least two months before mining commences. If the mining is staged, monitoring will need to be carried out on days each area is to be stripped to check whether any tagged kiwi are using that area.

Monitoring kiwi within the predator control area will involve searching for juvenile kiwi by trained dog-handlers every 3-5 years. If the predator control programme is

operating effectively, juveniles should comprise approximately one-quarter to one-third of kiwi present in the treatment area compared with <10% in unmanaged areas (McLennan 2004). If juveniles are not found at expected levels of abundance the predator control may need to be upgraded, or protective rearing will need to be put in place (advised in any case during years after beech mast when stoat numbers peak).

11.4.3. Fernbirds

Methods of monitoring fernbirds are described in Parker (2002). Monitoring fernbirds is relatively inexpensive using a playback technique to map individual territories, though a mark-recapture technique could also be used. Monitoring of fernbirds should be carried out:

- Before and after rehabilitation of mined area. This will require determining fernbird territories in spring prior to mining then re-monitoring from when vegetation has rehabilitated to a stage when it is considered suitable for fernbirds.
- Within the offsite management area for *Powelliphanta* snails to evaluate fernbird response to predator control (or predator exclusion).

12. Conclusion

The area proposed for an opencast coalmine at or in the vicinity of the disused Escarpment Mine and Whareatea Mine, Denniston Plateau, has significant values for fauna, particularly because of the presence of great spotted kiwi and *Powelliphanta* "patrickensis". However these species, and others, are also found widely outside the proposed mine, and no "core" populations of fauna are known to live within the proposed mine area. Populations of *P.* "patrickensis" appear to be low in density compared to stronghold areas such as in the upper Waimangaroa valley. However, kiwi numbers are probably comparable with densities in the nearby Mt William Range, at least in the comparatively small part of the proposed mine where they are concentrated.

Past mining, fires, roads, bulldozed tracks and spread of weeds etc has modified and degraded much of the area, thus reducing its overall importance to wildlife. However, natural vegetation cover is extensive within this area, particularly to the south and west, providing important habitat for kiwi and other birds, and *Powelliphanta* snails. The proposed mine area lies just outside the Mt Rochfort RAP, which comprises overall a better representation of fauna and fauna habitats.

Providing the recommended mitigation measures are undertaken, the overall adverse effects of the proposed coalmine are considered to be minimal for reasons stated above, and that the loss of fauna can be largely offset through remedial action for threatened species, and best-practice predator control and habitat rehabilitation.

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Figure 7 Secretive but curious fernbird near Escarpment Mine (R.B.: Tony Whitaker enhanced using PHOTOSHOP)

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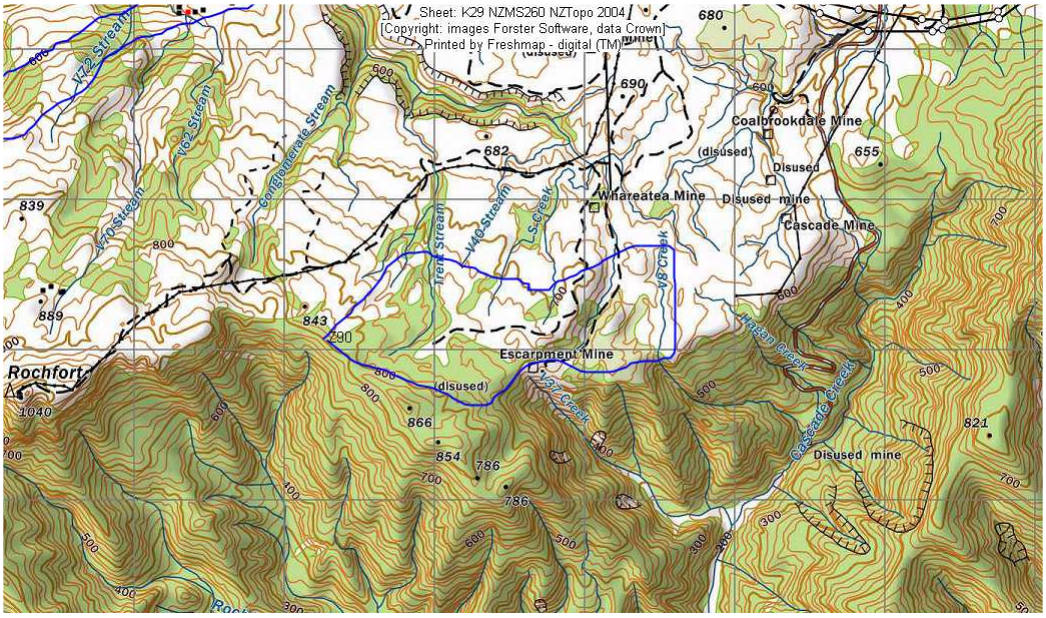
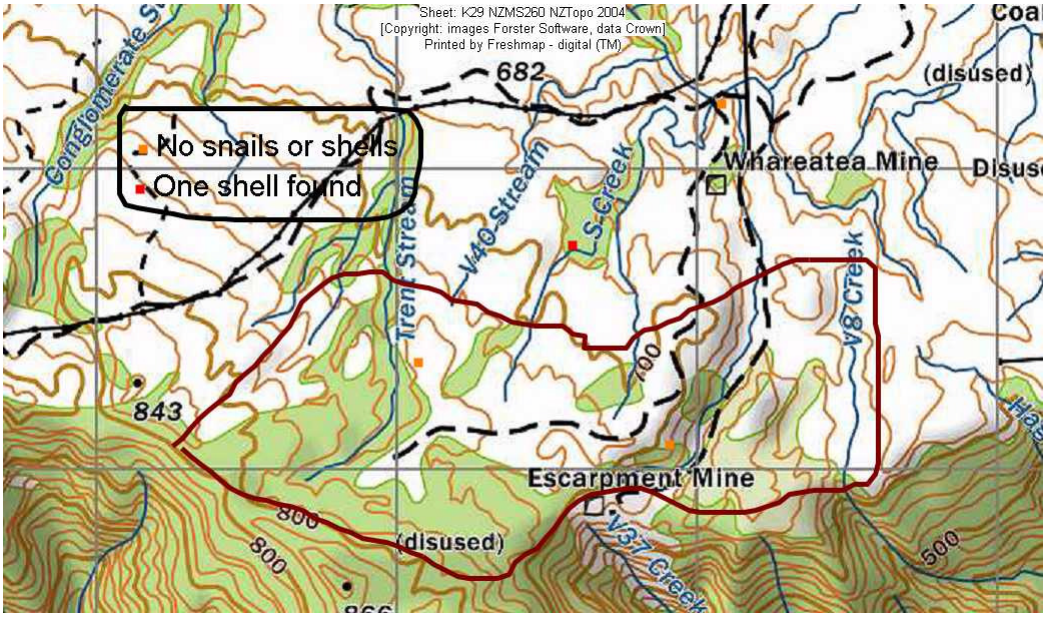
MAPS

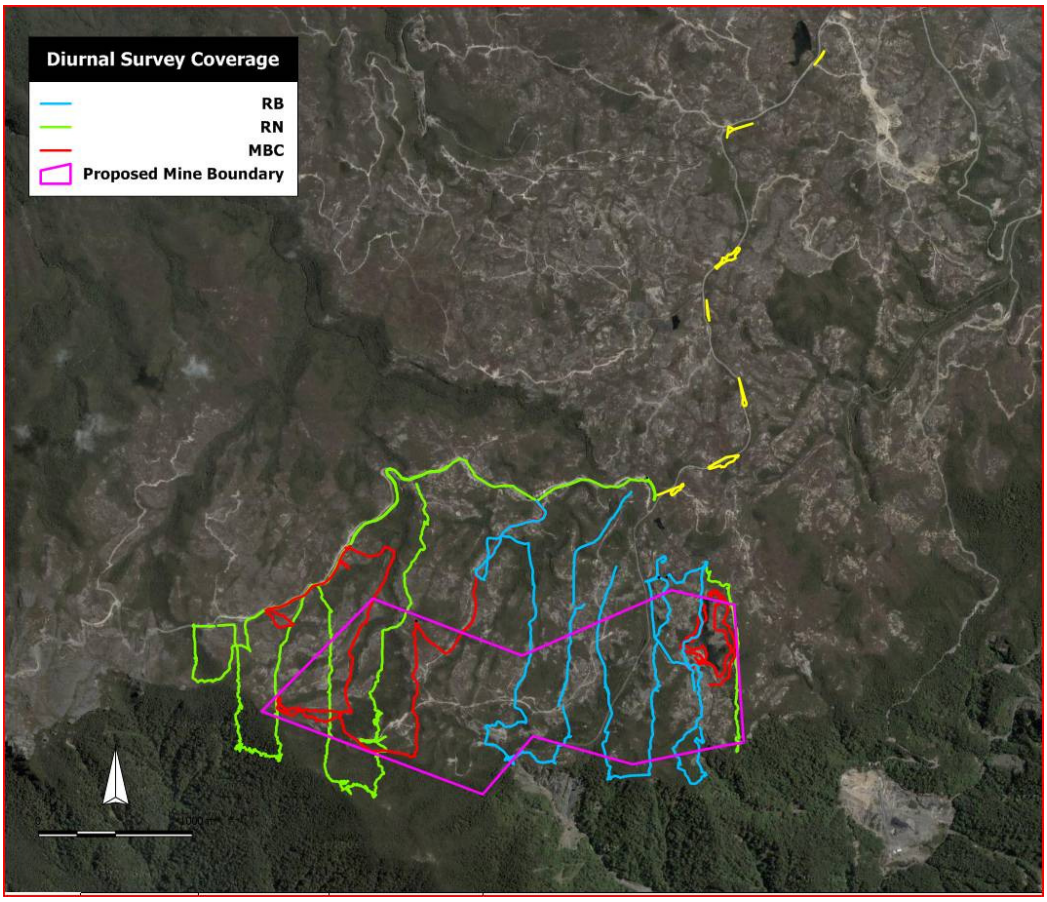


Map 1 Location of proposed Escarpment Coalmine

Note: Demarked area is approximate boundary of proposed mine

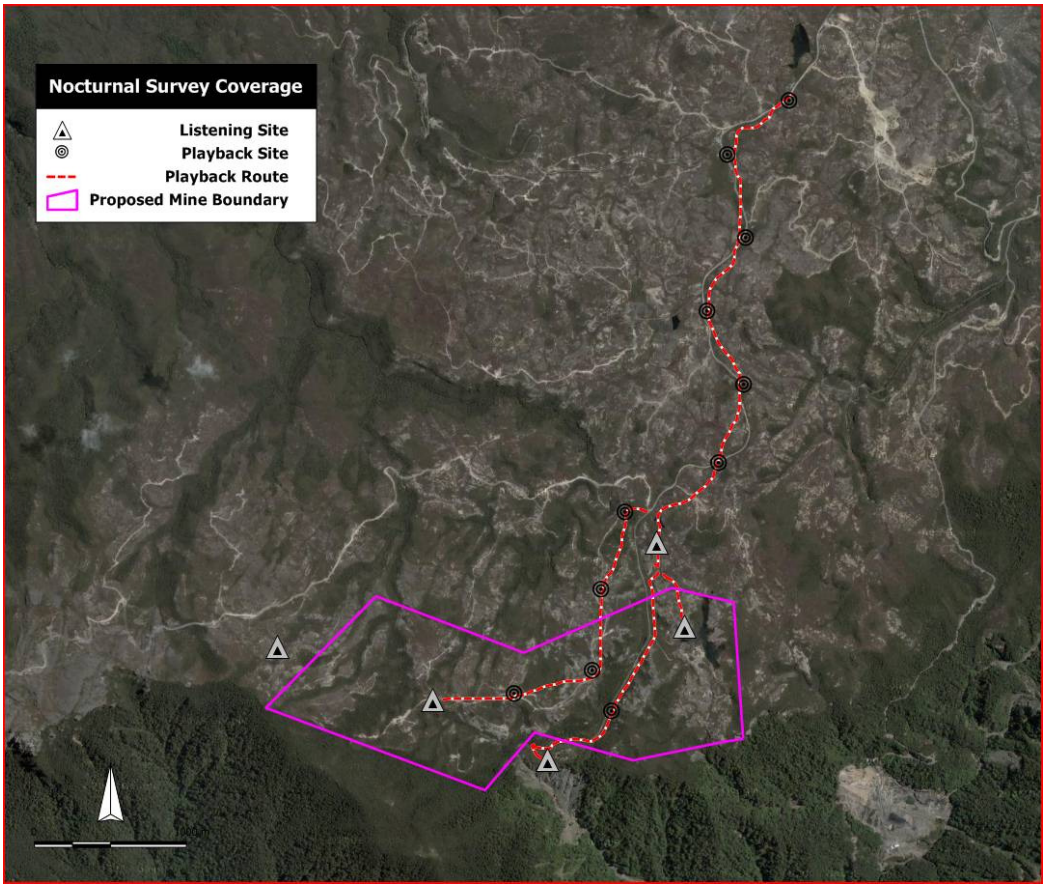


Map 2 Location of Department of Conservation Plots and 2007 results

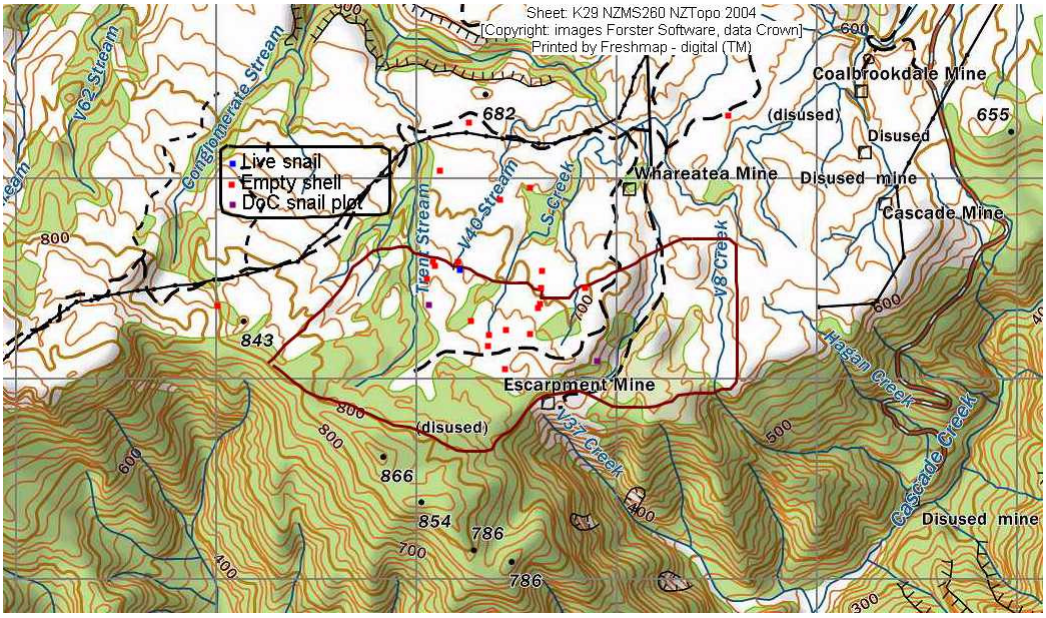


Map 3 Diurnal transect coverage

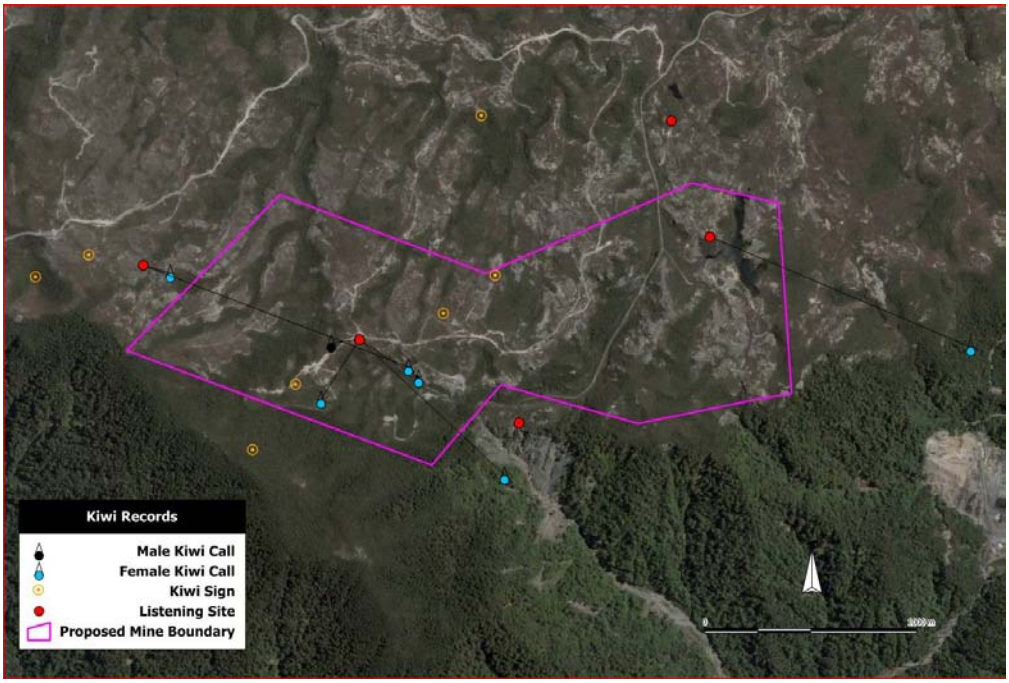
Note: RB—Rhys Buckingham transects; RN—Richard Nichol transects; MBC—MBC Contracting Ltd transects.



Map 4 Nocturnal kiwi coverage

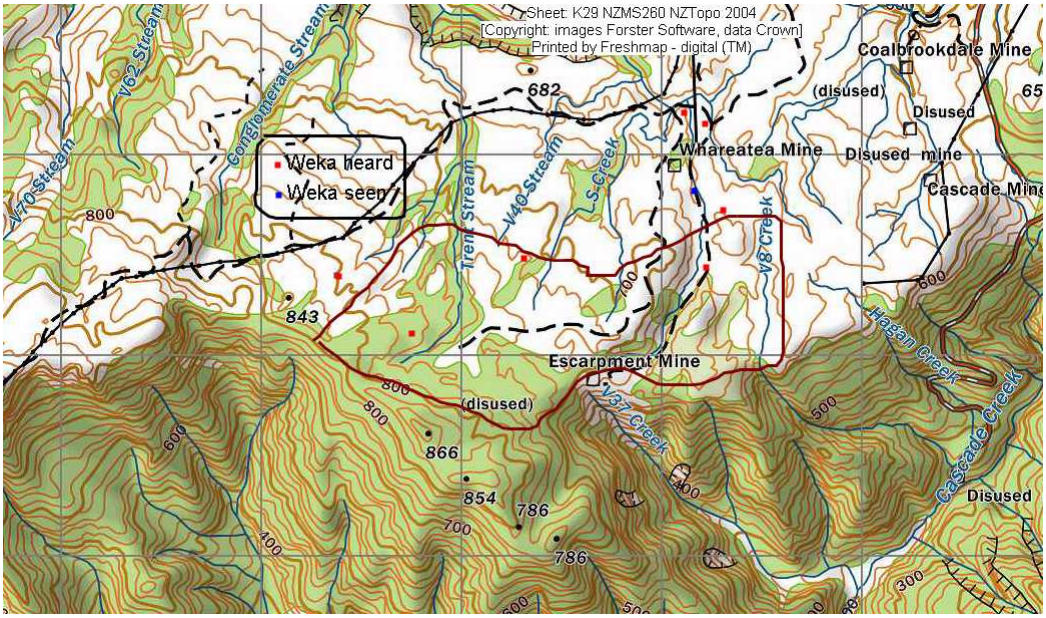


Map 5 Location of *Powelliphanta* "patrickensis" records July 2008

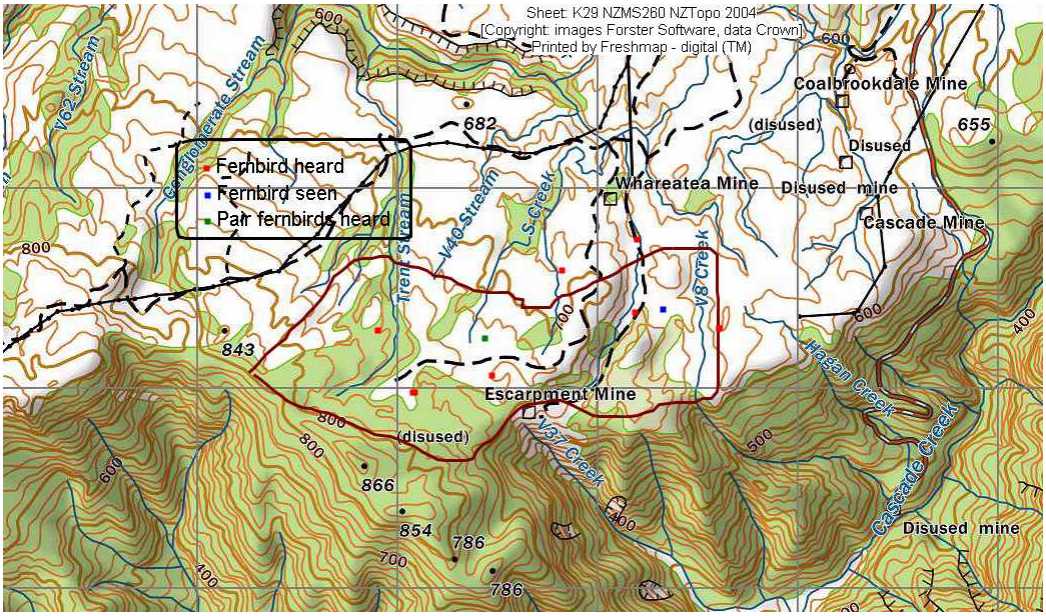


Map 6 Location of kiwi heard and kiwi sign: June/July 2008

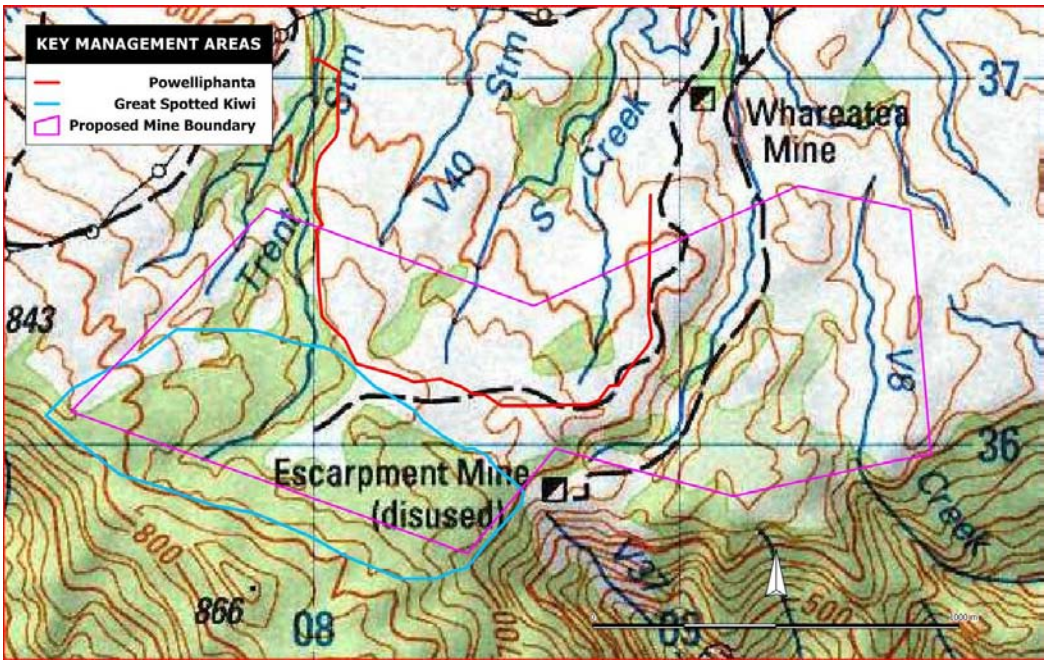
Note: It is possible that the same kiwi may have been recorded more than once on different nights or by different observers stationed at different locations (as almost certainly the two females marked close together in the centre of this map). "Male" and "Female" denote calls heard from nocturnal listening stations, and their locations are plotted from compass bearings and estimated distances, thus inaccuracies are expected.



Map 7 Location of weka records June/July 2008



Map 8 Location of fernbird records June/July 2008



Map 9 Key areas of conservation importance recommended for management or protection

APPENDIX 1

SCIENTIFIC NAMES OF BIRDS RECORDED WITHIN OR NEAR THE PROPOSED MINE SITE OR REFERED TO IN TEXT

Asterisk denotes species recorded on current survey.
(In checklist order after Heather & Robertson 1996)

Great spotted kiwi*	*Apteryx haastii*
Black shag*	*Phalacrocorax carbo*
Paradise shelduck	*Tadorna variegata*
Mallard/grey duck*	*Anas platyrhynchos/Anas superciliosa*
New Zealand scaup*	*Aythya novaeseelandiae*
NZ falcon	*Falco novaeseelandiae*
Western weka*	*Gallirallus australis australis*
Spur-winged plover*	*Vanellus miles novaehollandiae*
Southern black-backed gull	*Larus dominicanus*
Kereru (NZ pigeon)	*Hemiphaga novaeseelandiae*
South Island kaka	*Nestor meridionalis meridionalis*
Kea	*Nestor notabilis*
Yellow-crowned kakariki	*Cyanoramphus auriceps*
Long-tailed cuckoo	*Eudynamys taitensis*
Morepork*	*Ninox novaeseelandiae*
South Island rifleman*	*Acanthisitta chloris chloris*
Welcome swallow*	*Hirundo tahitica*
New Zealand pipit*	*Anthus novaeseelandiae*
Blackbird*	*Turdus merula*
Song thrush*	*Turdus philomelos*
South Island fernbird*	*Bowdleria punctata*
Brown creeper*	*Mohoua novaeseelandiae*
Grey warbler*	*Gerygone igata*
South Island fantail*	*Rhipidura fuliginosa fuliginosa*
South Island tomtit*	*Petroica macrocephala macrocephala*
South Island robin*	*Petroica australis australis*
Silvereye*	*Zosterops lateralis*

Bellbird*	*Anthornis melanura*
Tui*	*Prosthemadera novaeseelandiae*
Chaffinch*	*Fringilla coelebs*
Goldfinch*	*Carduelis carduelis*
Redpoll*	*Carduelis flammea*

APPENDIX 2 KIWI COUNT DATA

Table 5a Count data for kiwi on nocturnal listening surveys

Date	Hour of Listen	Observer	Easting	Northing	Altitude m a.s.l	Habitat description
19/06/08	1	Rhys	2409386	5936519	663	Coal measures, rock, lake
19/06/08	2	Rhys	2409386	5936519	663	Coal measures, rock, lake
19/06/08	1	Richard	2408722	5935856	667	Beech, podocarp forest, disturbed area
19/06/08	2	Richard	2408722	5935856	667	Beech, podocarp forest, disturbed area
20/06/08	1	Rhys	2408155	5936140	758	Coal-measure scrub, rock, forest
20/06/08	2	Rhys	2408155	5936140	758	Coal-measure scrub, rock, forest
20/06/08	1	Richard	2407389	5936389	811	Coal-measure scrub
20/06/08	2	Richard	2407389	5936389	811	Coal-measure scrub
08/07/08	1	Rhys	2409245	5936924	650	Coal-measure scrub, disturbed area
08/07/08	2	Rhys	2409245	5936924	650	Coal-measure scrub, disturbed area
08/07/08	3	Rhys	2409245	5936924	650	Coal-measure scrub, disturbed area

Table 5b Count data records for kiwi on nocturnal listening surveys

Date	Hour	Sunset	Time	Kiwi call records			
	of listen		Start	Time	Sex	Bearing	Distance
						° true	*c*. metres
19/06/08	1	17:09	19:00	19:17	Female	112	1,000
19/06/08	2	17:09	20:00				
19/06/08	1	17:09	19:20				
19/06/08	2	17:09	20:20				
20/06/08	Pre 1	17:08	18:26	18:26	Female	212	250
20/06/08	Pre 1	17:08	18:26	18:26	Male	262	100
20/06/08	1	17:08	18:30				
20/06/08	2	17:08	19:30	19:35	Female	122	250
20/06/08	2	17:08	19:30	19:40	Female	132	700
20/06/08	1	17:08	19:30	19:35	Female	105	100
20/06/08	1	17:08	19:30	19:36	Female*	110	1,000
08/07/08	1	17:16	18:30				
08/07/08	2	17:16	19:30				
08/07/08	3	17:16	20:30				

* Presumed same bird as record above (122°, 250m) by a different observer at different listening station

APPENDIX 3 BIRD COUNT DATA

Table 6 Percentage of occurrence of bird species in one-minute counts

	No. counts	Bellbird	Silvereye	Warbler	Tomtit	Robin	Fantail	Brown creeper	Rifleman	Fernbird	Chaffinch	Redpoll
All counts	67	19.4	1.5	9.0	11.9	4.5	3.0	4.5	1.5	1.5	4.5	11.9
Coal-measure scrub, wetland	30	6.7	0	0	10.0	0	0	3.3	0	0	10.0	10.0
Scrub and low forest	29	20.7	3.4	17.2	13.8	10.3	3.4	6.9	0	3.4	0	17.2
Medium to tall forest	8	62.5	0	12.5	12.5	0	12.5	0	12.5	0	0	0
Within proposed mine	36	13.9	0	5.6	11.1	5.6	2.8	5.6	5.6	2.8	8.3	11.1
Outside proposed mine	31	25.8	3.2	12.9	12.9	3.2	3.2	3.2	0	0	0	12.9

APPENDIX 4 *POWELLIPHANTA* DATA

Table 7 Live snail and empty shell data (date found/collected, shell diameter, habitat descriptions)

	GPS location						
Date	Northing	Easting	Mine area?	No shells/site	Diameter	Canopy	Habitat
7/7/08	2407012	5936339	0	7	35.6	3m	manuka scrubland
7/7/08	2407012	5936339	0		35.9	3m	manuka scrubland
7/7/08	2407012	5936339	0		34.2	3m	manuka scrubland
7/7/08	2407012	5936339	0		—	3m	manuka scrubland
7/7/08	2407012	5936339	0		21.1	3m	manuka scrubland
7/7/08	2407012	5936339	0		—	3m	manuka scrubland
7/7/08	2407012	5936339	0		—	3m	manuka scrubland
7/7/08	2409657	5938574	0	1	37.4	2m	manuka-mixed scrub
7/7/08	2408839	5936439	0	1	38.6	1-2m	manuka-flax-pakihi
7/7/08	2408459	5936039	1	2	30.5	1.5-2m	manuka scrub
7/7/08	2408459	5936039	1		—	1.5-2m	manuka scrub
7/7/08	2408568	5936210	1	2	31.1	≤1.5m	manuka-mixed scrub
7/7/08	2408568	5936210	1		—	≤1.5m	manuka-mixed scrub
8/7/08	2408634	5936366	1	2	38.7	0-1.5m	dense manuka, mixed scrub

8/7/08	2408634	5936366	1		34.1	0-1.5m	dense manuka, mixed scrub
8/7/08	2408642	5936425	1	1	18.8	0	Scree and scrub
8/7/08	2408635	5936447	0	1	34.9	3-4m	manuka scrub
8/7/08	2408633	5936524	0	1	35.5	2-3m	manuka and flax
8/7/08	2408578	5936928	0	1	41.4	≤7m	manuka-ys pine scrub
8/7/08	2408428	5936878	0	1	29.7	0-1m	Scree and scrub
9/7/08	2408218	5936573	0	1	27.6	0.5-2m	Low manuka mixed scrub
9/7/08	2408277	5937276	0	1	30.7	≤0.5m	Coal-measure scrub and tussock, scree
9/7/08	2409554	5937304	0	1	45.5	2m	Dense manuka, shrubs, fern
9/7/08	2409609	5938326	0	1	37.3	<2m	Low manuka, wire rush, bogland
9/7/08	2409593	5938946	0	3	38.8	2m	Dense manuka, open mossy ground
9/7/08	2409593	5938946	0		39.4	2m	Dense manuka, open mossy ground
9/7/08	2409593	5938946	0		32.1	2m	Dense manuka, open mossy ground
10/7/08	2408452	5936231	1	6	38.6	2m	manuka scrub
10/7/08	2408452	5936231	1		31.1	2m	manuka scrub
10/7/08	2408452	5936231	1		37.3	2m	manuka scrub
10/7/08	2408452	5936231	1		31.4	2m	manuka scrub
10/7/08	2408452	5936231	1		31.1	2m	manuka scrub
10/7/08	2408452	5936231	1		36.9	2m	manuka scrub
10/7/08	2408380	5936190	1	3	34.6	2m	manuka scrub
10/7/08	2408380	5936190	1		32.4	2m	manuka scrub

10/7/08	2408380	5936190	1		—	2m	manuka scrub
10/7/08	2408277	5936279	1	2	36.9	2m	manuka scrub
10/7/08	2408277	5936279	1		35.2	2m	manuka scrub
10/7/08	2408234	5936531	1	Live snail		1m	manuka edge
10/7/08	2408100	5936553	1	2	35.7	1-2m	manuka edge
10/7/08	2408100	5936553	1		37.5	1-2m	manuka edge
10/7/08	2408088	5936572	1	2	34.7	1-2m	manuka edge
10/7/08	2408088	5936572	1		c 32	1-2m	manuka edge
10/7/08	2408365	5936155	1	1	38.8	2m	manuka edge
17/7/08	2408071	5936480	1	1	35.7		Manuka scrub