Oceana Gold (NZ) Ltd Macraes Gold Project

Macraes Phase III

Avifauna and Herpetofauna Assessments

prepared by

Ryder Consulting

April 2011

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Oceana Gold (NZ) Ltd Macraes Gold Project

Macraes Phase III

Avifauna and Herpetofauna Assessments

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Cover: McCann's Skink on rock outcrop (Marcia Dale).

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Table of Contents

1. Executive Summary

Oceana Gold (NZ) Limited (OceanaGold) is proposing an expansion of the consented mine at the Macraes Gold Project, the Macraes Phase III Project, including new pits, waste rock stacks, tailings dam and a freshwater dam. This report presents ecological assessments for each of the proposed developments in relation to avifauna and herpetofauna, including possible mitigation options for any potential adverse effects identified.

The Macraes Phase III Project is located within the Macraes Ecological District, which contains high reptile diversity and is a stronghold for the 'Threatened - Nationally Vulnerable' New Zealand falcon. If the project goes ahead as planned it will have significant adverse effects on several threatened species and/or the habitats that support them. These effects include flooding or infill from waste rocks of the habitat of threatened lizards, flooding of hunting grounds of NZ falcon, removal of mature trees resulting in loss of nesting and roosting habitat and removal of tussock grassland pipit habitat.

As avoidance is not feasible for the bulk of the area affected, mitigation is considered appropriate to offset the adverse effects of the project. Recommended mitigation includes restoration of tussock grassland and wetlands, predator control, replanting of trees and translocation of lizards.

If all mitigation is carried out successfully it will reduce the effects of the project from significant adverse effects to minor adverse effects.

2. Introduction

2.1 Background

Oceana Gold (NZ) Limited (OceanaGold) own and operate an open pit and underground gold mine in the Macraes Flat area of East Otago. The company is proposing an expansion and extension to the consented life of the Macraes Gold Project, the Macraes Phase III Project (the Project). Ryder Consulting Limited was engaged by OceanaGold to provide an ecological assessment of the different components of the Project.

The proposed developments included in this report are:

Macraes-Dunback Road realignment
Golden Bar Road realignment
Camp Creek Freshwater Dam
Back Road Waste Rock Stack
Top Tipperary Tailings Storage Facility
Frasers North Waste Rock Stack
Frasers South Waste Rock Stack
Round Hill Extension
Round Hill – Southern Pit Extension
Innes Mills Stage V
Frasers Stage VI

This report presents ecological assessments for each of these proposed developments in relation to avifauna and herpetofauna, including possible mitigation options for any potential adverse effects identified. Site-specific assessments are presented in speparate sections followed by a generic section that addresses potential adverse effects and recommended mitigation relating to all developments. Figure 1 outlines the locations of proposed mining extensions.

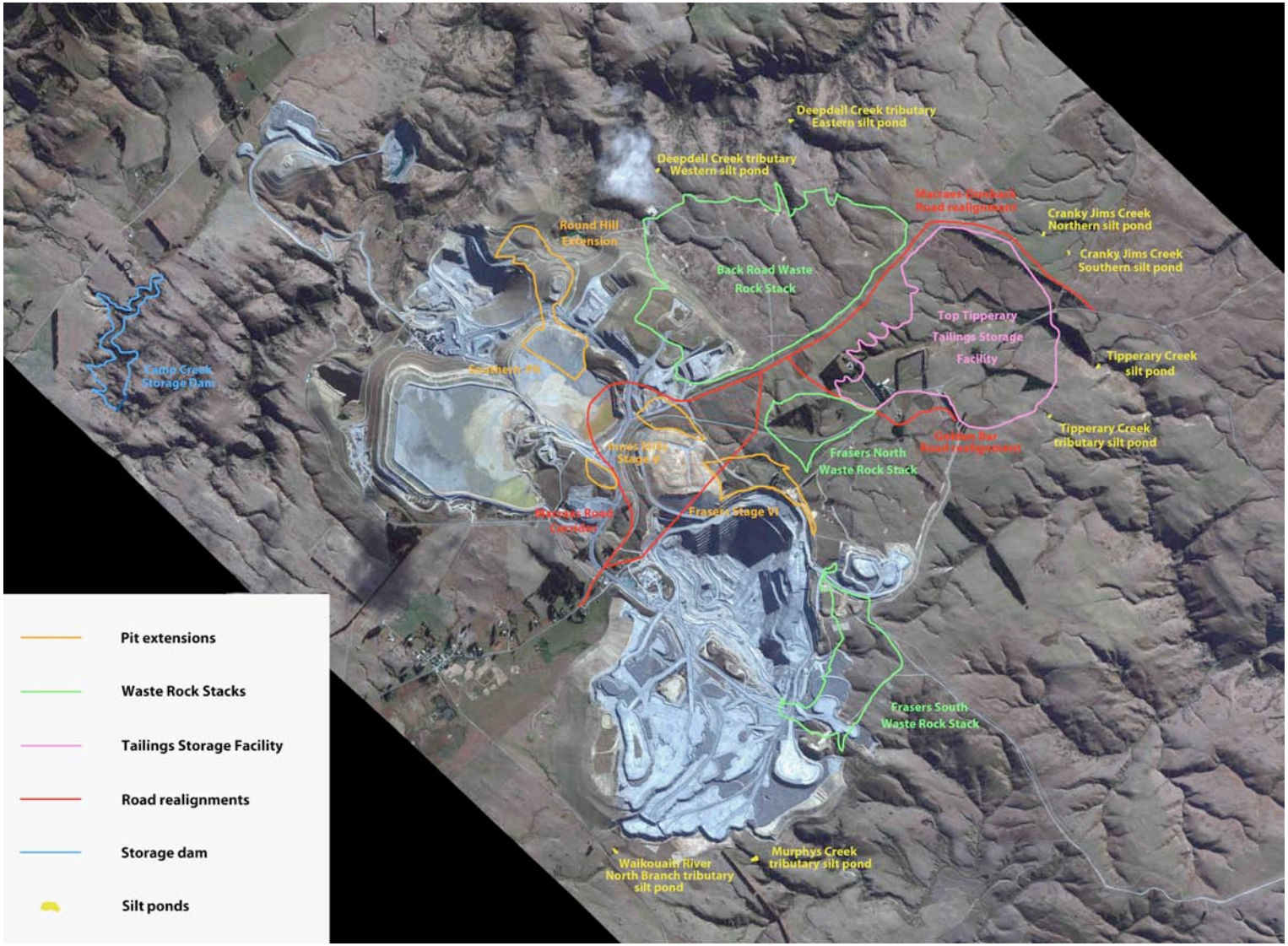

Figure 1 *Map showing locations of proposed mining extensions.*

2.2 Existing information

2.2.1 Methods

Existing information on the birdlife of the Macraes mining area was sourced from Otago Regional Council publications, the Department of Conservation (DoC) publications and field observations, the New Zealand Biodiversity Strategy (2000), published and unpublished reports, University of Otago Science library searches and wider internet searches. Publications such as the OSNZ Atlas of Bird Distribution in New Zealand (Robertson *et al.* 2007), Heather and Robertson's Field Guide to the Birds of New Zealand (2000) and Jewell and Morris's A Photographic Guide to Reptiles and Amphibians of New Zealand (2008) were also utilised. The faunal surveys of the area undertaken by Whitaker (1986, 1987a, 1991, 1992, 1996a, 1996b) and Bibby (1997) were reviewed.

The Ornithological Society of New Zealand (OSNZ) carried out several (7 to 12+) bird surveys from 1999 to 2004 within two 10km^2 areas overlapping Macraes Flat and environs (Robertson *et al*. 2007). A map of the grid squares is shown in Appendix One. A total of thirty-seven bird species were found within the grid squares (Appendix Two). Not included in the OSNZ list were sixteen other bird species, nine of which were observed by Whitaker during the field surveys carried out between 1986 and 1996. The Department of Conservation has observed three other species, fernbird (*Bowdleria punctata punctata*), bittern (*Botaurus poiciloptilus*) and rook (*Corvus frugilegus*). Bibby (1997) contributed three more species to the total (brown creeper (*Mohoua novaeseelandiae*), Canada goose (*Branta canadensis*) and red-billed gull (*Larus novaehollandiae*)) and the distinctive call of the California quail (*Callipepla californica*) was heard during the 2010 surveys.

2.2.2 Fauna groups

Of the fifty-three species of birds recorded from Macraes Flat and the surrounding area, thirty-two are indigenous and the remaining twenty-one are introduced. Seven species are listed as 'Threatened' and a further five are 'At Risk', based on the New Zealand threat classifications (Miskelly *et al.* 2008). The black fronted tern (*Chlidonias albostriatus*), black-billed gull (*Larus bulleri*), bittern and the banded dotterel (*Charadrius bicinctus bicinctus*) are all ranked as 'Threatened – Nationally Endangered' (Miskelly *et al.* 2008), and are at risk from introduced predators, human disturbance of colonies and the spread of exotic plants within their breeding areas (Heather and Robertson 2000). For reasons

not entirely understood, black-billed gull numbers have crashed in the South Island since the 1970s (Heather and Robertson 2000). Black fronted terns have been seen on dredge ponds near Macraes Flat township, as have banded dotterels, which are also known to breed in the area (Whitaker 1986). Bitterns have been observed in nearby Emerald Creek by Department of Conservation staff. The New Zealand falcon (*Falco novaeseelandiae "eastern"*), ranked 'Threatened - Nationally Vulnerable' is relatively numerous in the Macraes Ecological District (Whitaker 1996a) and the area is considered a stronghold for the species (Bibby 1997). Also listed as 'Threatened - Nationally Vulnerable' is the red-billed gull (*Larus novaehollandiae*) (Miskelly *et al.* 2008). Red-billed gulls are rarely found inland in the South Island (Robertson *et al.* 2007) so it is probable that the individuals observed at Macraes Flat were merely passing through whilst undertaking their regular seasonal movement between breeding sites and wintering sites (Heather and Robertson 2000). Species listed as 'At Risk – Declining' are fernbirdNew Zealand pipit (*Anthus novaeseelandiae*), pied stilt (*Himantopus himantopus*), and South Island pied oystercatcher (*Haematopus ostralegus*) and 'At Risk – Naturally Uncommon' are black shag (*Phalacrocorax carbo*) and little shag (*Phalacrocorax melanoleucos*) (Miskelly *et al.* 2008).

Seven species of lizards occur within Macraes Flat and environs (Whitaker *et al*. 2002) (Table 1). Macraes Flat is notable for its high diversity of lizards, with the highest number of *Oligosoma* species (6) occurring sympatrically[1] (Whitaker *et al*. 2002). Two notable species are the Otago skink (*Oligosoma otagense*) and grand skink (*Oligosoma grande*), which are currently ranked as 'Threatened - Nationally Critical' (Hitchmough *et al*. 2010). The Macraes Ecological District is the last remaining stronghold of these threatened species (Whitaker 1996b). Both species occur within rocky bluffs and outcrops, with only grand skinks extending to ridge-tops in more exposed sites (Towns 1985). Both the green skink (*Oligosoma chloronoton*) and the Otago Large gecko (*Hoplodactylus* sp. 'Otago large') are listed as 'At Risk – Declining' (Hitchmough *et al*. 2010). Green skinks tend to be localized and in dense vegetation can be difficult to detect (Department of Conservation 2010). The Otago Large gecko, the only gecko known from the Macraes Flat area (Whitaker *et al.* 2002), is thought to be declining due to habitat loss and predation (Department of Conservation 2010). It is also known as 'Korero gecko' (Jewell 2008).

[1] Occupying the same or overlapping geographic areas without interbreeding. Often used in reference to populations of closely related species.

Table 1 *The lizard fauna of Macraes Flat and environs.*

Common name	Species name	NZ threat classification
Otago skink	*Oligosoma otagense*	Threatened –Nationally Critical
Grand skink	*Oligosoma grande*	Threatened –Nationally Critical
Green skink	*Oligosoma chloronoton*	At Risk - Declining
McCann's skink	*Oligosoma maccanni*	Not Threatened
Common skink	*Oligosoma polychroma*	Not Threatened
Cryptic skink	*Oligosoma inconspicuum*	Not Threatened
Otago Large gecko	*Hoplodactylus* sp. 'Otago large'	At Risk - Declining

2.3 Terrestrial faunal survey

Bird and lizard communities within the Macraes area were surveyed between 7th October and 1st November 2010. The survey included all sites designated for development in the Macraes Phase III project. The weather during the field survey was predominantly fine and warm, with occasional light breezes.

The birdlife was assessed during walk-over surveys and identification was by both visual and vocal characteristics. Birds observed in areas immediately adjacent to sites were also included.

Lizards were searched for in all major rock outcrops within each site. Each outcrop was scanned with binoculars from 20m - 40m, and then examined from a closer distance. Deep cracks were searched with a focusing torch (MagLite). Loose stones were lifted, particularly to search for geckos. Sign such as shed skin and large droppings were searched for amongst outcrops. Surveys were only carried out during the warmest parts of the days to facilitate easier observation of basking lizards.

Particular attention was focused on finding signs of the Otago skink and grand skink. Despite weather conditions being conducive to observing lizards, no Otago skinks or grand skinks were observed at any of the sites and no evidence of their presence was detected.

3. Statutory Assessment

3.1 The Resource Management Act

The Resource Management Act (RMA) was released in 1991. Part Two of the RMA states that the purpose of the act is to promote the sustainable management of natural and physical resources. Section 6(c) states:

6 Matters of national importance

In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall recognise and provide for the following matters of national importance:

(a) the preservation of the natural character of the coastal environment (including the coastal marine area), wet- lands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:

(c) the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna:

3.2 The New Zealand Biodiversity Strategy

The New Zealand Biodiversity Strategy was released in 2000 as a response to the state of decline in New Zealand's indigenous biodiversity. Four goals were established for conserving and sustainably managing New Zealand's biodiversity. 'Goal Three: Halt the decline in New Zealand's indigenous biodiversity' is relevant to this proposal and is expressed in the following way:

Maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production and urban environments and do what else is necessary to maintain and restore viable populations of all indigenous species and subspecies across their natural range and maintain their genetic diversity. (Department of Conservation and Ministry for the Environment, 2000).

Goal Three recognises that most of New Zealand's habitats have been modified to some extent and that ecosystems in production landscapes are important for maintaining indigenous biodiversity.

3.3 The Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land

The Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land was developed by the Ministry for the Environment in 2007. Four National Priorities were developed with the intention of focusing conservation efforts on the protection of some of our most rare and threatened ecosystems and species found on private land. The National Priorities are used to support and inform councils' biodiversity responsibilities under the Resource Management Act, and provide a framework for determining whether values on private property are significant and require protection. The National Priorities of relevance to the faunal habitat aspects of the Macraes Flat Phase III Project are:

National Priority 2:
To protect indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity.

National Priority 4: To protect habitats of acutely and chronically threatened indigenous species.

A proposed National Policy Statement on Indigenous Biodiversity (NPS) is currently being developed by the Government, with public submissions closing on 2nd May 2011. The proposed NPS contains a list of criteria for identifying areas of significant indigenous vegetation and habitats of indigenous animals that are rare or threatened at a national level. The proposed NPS requires district and relevant regional plans to identify these areas of significant biodiversity within five years of the NPS taking effect. Local authorities would be required to manage the effects of activities through district and regional plans and resource consent decisions (or be satisfied that effects are managed by other methods) to ensure there is no net loss of significant biodiversity.

4. Macraes-Dunback Road realignment

4.1 General

Macraes-Dunback Road will be realigned in three stages. The first realignment has been dealt with in a separate application and will not be discussed here. The second and third realignments are predominantly over land previously mined. OceanaGold is proposing to realign 5.12km of the existing road. The proposed new route will be 5.8km long.

Second realignment of Macraes-Dunback Road

The second realignment is to be undertaken where the Macraes-Dunback Road currently traverses the backfilled Innes Mills Pit. Prior to removal of this section of the road, a new section of temporary road will be constructed to the south of the existing road. This temporary road is to allow mining of the northern portion of the proposed Innes Mills Pit. The realignment will be formed using mine waste rock as the base. This second realignment is shown in Figure 2. The second realignment will affect about 0.5km of road and will reduce the road length by a minimal amount (25m). It will be undertaken prior to the removal of the existing road and is provisionally planned for 2016.

Third realignment of Macraes-Dunback Road

The third and final realignment is to be undertaken where the Macraes-Dunback Road currently traverses the backfilled Innes Mills Pit. Once mining has been completed to the north of the road the pit will be backfilled and the final road realignment will be constructed to allow Innes Mills to be mined to completion. Prior to removal of this section of the road a new section of road will be constructed to the north of the existing road. The realignment will be formed using mine waste rock as the base. This third and final realignment is shown in Figure 2. The final realignment will add an additional 0.3km to the road length making the entire road 0.8km longer than the currently existing road. It is provisionally planned for late 2016.

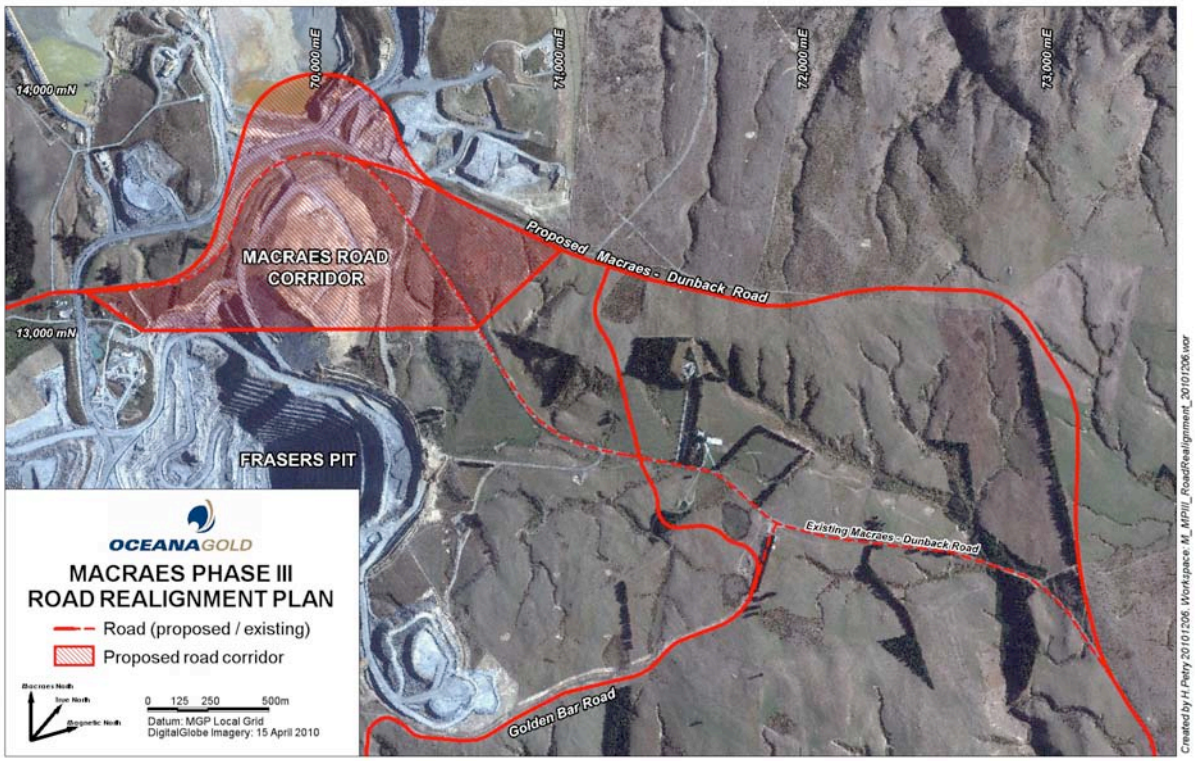

Figure 2 *Map showing location of proposed second and third road realignment stages of the Macraes-Dunback Road and proposed first and second road realignment stages of Golden Bar Road.*

4.2 Avifauna

The dominant habitat in the proposed road realignment area is improved pasture, although there is also a small section of native tussock. The improved pasture habitat provides a short grass sward in which various bird species feed, such as paradise shelduck, spur-winged plover, Southern black-backed gull, feral pigeon, Australian magpie and starling (Whitaker 1987). Large flocks of small passerines (e.g., goldfinches, greenfinches, redpolls) will also use this habitat for feeding (Whitaker 1987). Yellowhammers and skylarks were particularly abundant throughout this habitat. Australasian harrier hawks were observed flying over this area, in search of prey or carrion. A white-faced heron (*Ardea novaehollandiae*) was seen feeding amongst the tussock.

4.3 Herpetofauna

The improved pasture habitat that covers the bulk of the proposed road realignment route does not support any substantial lizard populations due to the lack of cover for retreats. However, a small number of McCann's skinks were seen basking in the spoil mounds

alongside the haul road margin. Common skinks may also be present amongst the pasture grasses and tussocks. The presence of rare or threatened lizards species is unlikely due to the unsuitability of the habitat.

4.4 Potential adverse effects and recommended mitigation

4.4.1 Terrestrial fauna

Given the small size of the Macraes-Dunback Road realignment area and the limited habitat available, the loss of habitat is considered a less than minor impact. As disturbance increases within the site, resident lizards should be able to freely disperse into adjoining areas. Impacts on avifauna are considered to be less than minor.

5. Golden Bar Road realignment

5.1 General

Golden Bar Road will be realigned in two stages. 1.65km of Golden Bar Road is being realigned compared to the existing length of 0.24km. Both stages of the realignment are situated predominantly over previously farmed land.

First Realignment of Golden Bar Road

The northern section of the existing Golden Bar Road is planned to be realigned in a north western direction to join with the existing Macraes-Dunback Road. A connection between the existing and realigned Macraes-Dunback Road will be made as shown in Figure 2. This realignment and connection is provisionally planned for 2014. The realigned section of Golden Bar Road will run along the northern face of Frasers East Waste Rock Stack within the current consented footprint before connecting with the existing Macraes-Dunback Road. The connection between the existing and realigned section of Macraes-Dunback Road is over land previously used for farming.

Second Realignment of Golden Bar Road

The second realignment is required for the Frasers North Waste Rock Stack to be constructed to the proposed extent. The realigned section of road would run from the face of the Frasers East Waste Rock Stack up the ridge west of the Top Tipperary Tailings Storage Facility abutment and rejoin the realigned Macraes-Dunback Road. This second realignment is provisionally planned for 2017.

5.2 Avifauna

The proposed Golden Bar first and second road realignments occur along improved pastureland and border two medium sized wetlands. The improved pasture habitat provides a short grass sward in which various bird species feed, such as paradise shelduck, spur-winged plover, Southern black-backed gull, feral pigeon, Australian magpie and starling (Whitaker 1987). Large flocks of small passerines (e.g., goldfinches, greenfinches, redpolls) will also use this habitat for feeding (Whitaker 1987). Yellowhammers and skylarks were particularly abundant throughout this habitat. Australasian harrier hawks were observed flying over this area, in search of prey or carrion.

The proposed Golden Bar first road realignment skirts the edge of a pond with associated

wetland vegetation at NZTM E1402569 N4973489. Various species of waterfowl were observed in this wetland, including grey teal, New Zealand shoveler, paradise shelduck, mallard duck and grey duck/mallard duck hybrids.

The proposed Golden Bar second road realignment skirts the edge of a ridge top swamp at NZTM E1401602 N4973760. South Island pied oystercatcher and paradise shelduck were observed utilising this wetland and juveniles of both species were present. This wetland may be important during the breeding stages of these species. Other species such as white-faced heron and the New Zealand pipit may use this area for foraging. Both the South Island pied oystercatcher and the New Zealand pipit are listed as 'At Risk – Declining' (Miskelly *et al*. 2008).

5.3 Herpetofauna

The improved pasture habitat that covers the bulk of the proposed road realignment route does not support any substantial lizard populations due to the lack of cover for retreats. However, there are likely to be low numbers of McCann's skinks and common skinks present in the grassland, as well as in and around the rock stacks at the northern edge of the proposed Frasers North Waste Rock Stack, adjacent to the proposed Golden Bar second road realignment. The presence of rare or threatened lizards species is unlikely due to the unsuitability of the habitat.

5.4 Potential adverse effects and recommended mitigation

5.4.1 Avifauna

In a landscape where areas of standing water are scarce, the wetland at NZTM E1402569 N4973489 is a significant feature and is an important habitat for waterfowl species. Although the proposed Golden Bar Road realignment is set to avoid the wetland, the new Frasers East Waste Rock Stack now borders the southern edge of this wetland (Figure 3) so unless the road is to be constructed on top of the waste rock stack is it difficult to see how the wetland is to be avoided. It is therefore recommended that the proposed stage one Golden Bar Road realignment be altered slightly so that it skirts the northern edge of this wetland. This would be in accordance with Policy 2, Section C of the proposed National Policy Statement on Indigenous Biodiversity, treating habitats associated with wetlands as significant indigenous vegetation. Care will be required to minimise any edge effects from the road construction and sediment runoff into the wetland,

Figure 3 *Photo showing wetland at NZTM E1402569 N4973489 with Frasers East Waste Rock Stack bordering southern edge.*

5.4.2 Herpetofauna

There will be a less than minor impact on lizard communities in the road realignment area due to the lack of suitable lizard habitat.

6. Camp Creek Storage Dam

6.1 General

Camp Creek is a major tributary of Deepdell Creek, situated upstream of the Macraes mining operation. The headwaters of Camp Creek are in the vicinity of the Sister Peaks, at an elevation of 737m above sea level. The catchment drains steep slopes and the creek flows in a southeasterly direction to a plateau at approximately 500m elevation near Horse Flat Road. Below Horse Flat Road the creek enters a 3km long gorge before entering Deepdell Creek on its true left. The proposed Camp Creek Storage Dam would create a reservoir of 1,400,000 m^3 covering an area of approximately 14.3 hectares (Figure 4).

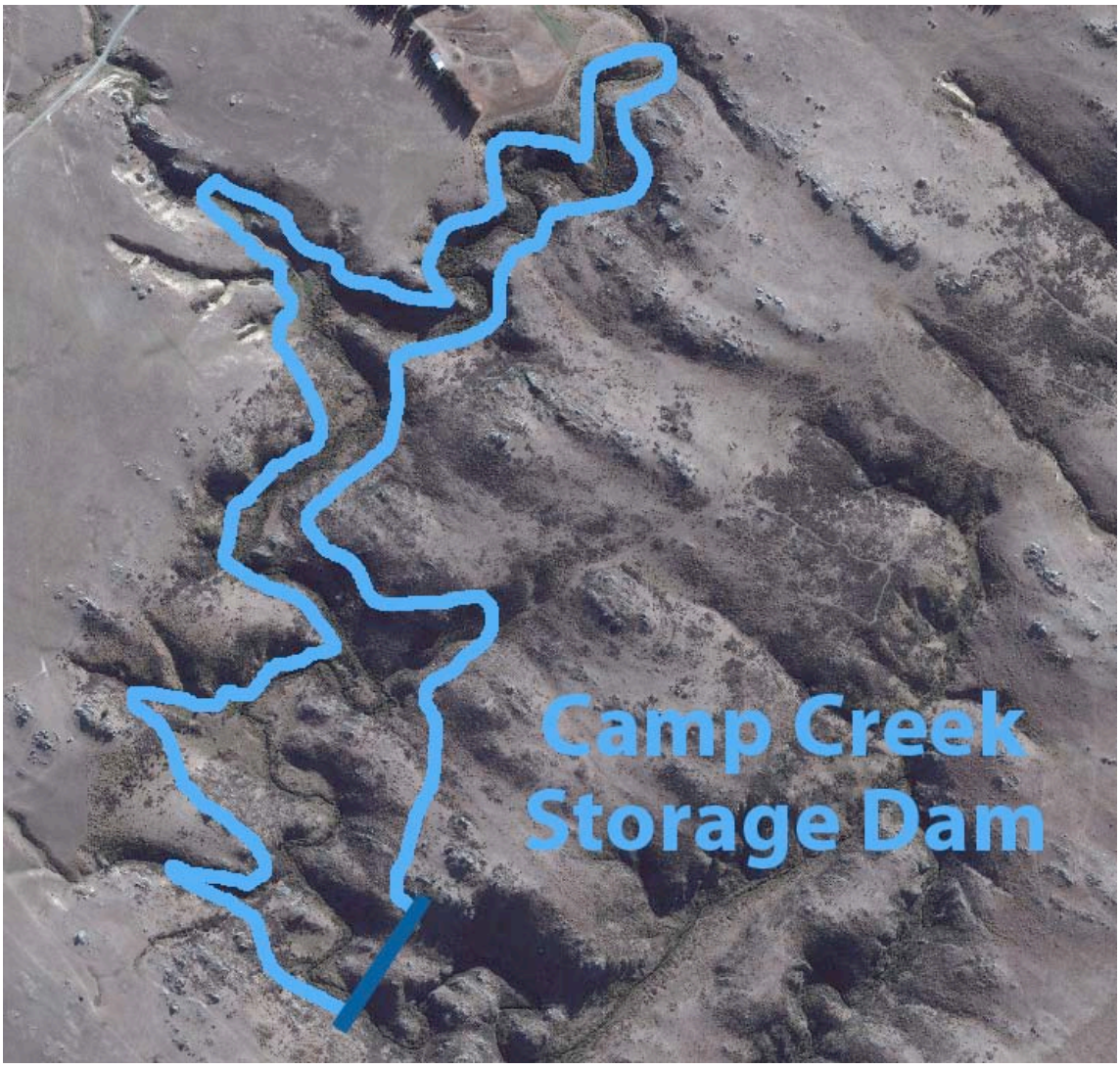

Figure 4 *Extent of reservoir area that will be created by construction of the Camp Creek Storage Dam.*

6.2 Avifauna

Bird diversity is high in Camp Creek, with twenty species observed during the 2010 survey of the area upstream of the proposed dam location, plus an additional two species observed by Whitaker in his survey of 1986. The majority of these species were introduced passerines such as blackbirds, dunnocks, song thrushes and assorted finches, all of which are common and non-threatened. However, eight native species were observed, including the New Zealand falcon (*Falco novaeseelandiae* "eastern"), which is listed as 'Threatened – Nationally Vulnerable' (Miskelly *et al.* 2008). The New Zealand falcon was observed twice during the survey, once carrying prey towards Deepdell Creek and once hunting over the Camp Creek area. The New Zealand falcon is a generalist predator, but the main component of its diet is birds (Fox 1977). The resident pair are likely to be nesting in the Deepdell Creek gorge, as the surrounding bluffs provide the most suitable nesting habitat in the area, so the proximity of Camp Creek to the nesting area means a faster turnaround when hunting prey to feed to chicks. Falcons are territorial and although their home range may be as large as 1,500ha (Whitaker 1995), their foraging activities are likely to be concentrated in the gullies and associated outcrops (Whitaker 1987a). Therefore, given the high diversity of bird species present, Camp Creek is likely to be a significant hunting area for the resident falcons.

The scrub cover within the gully of Camp Creek provides roosting, feeding and nesting sites for a variety of passerines, such as the introduced redpoll, house sparrow, yellowhammer and the native grey warbler (Figure 5). California quail were heard amongst the scrub and Australian magpies were heard in the large macrocarpa trees bordering the gully. It is likely that fantails and silvereyes also use this habitat, as they are found nearby in Deepdell Creek.

Southern black-backed gulls, skylarks and starlings were observed foraging in the rough pasture within the gully. Both spur-winged plovers and South Island pied oystercatchers were seen with juveniles present. South Island pied oystercatchers are listed as "At Risk – Declining' (Miskelly *et al.* 2008), although unusually for a native species, they have benefited from the conversion of tussock grassland to pasture (Heather and Robertson 2000).

Feral pigeons were seen roosting in a large rocky bluff. Outcrops provide nest sites for feral pigeons, house sparrows, starlings and also falcons (Whitaker 1987). Falcons often

utilise rock outcrops by perching in a prominent location and scanning the surrounding area for prey (Whitaker 1987).

Paradise shelduck and mallard duck were present within the stream itself. Black shags are known from the Deepdell Creek (Whitaker 1986) and may also utilise Camp Creek as a feeding habitat. Black shags are listed as 'At Risk – Naturally Uncommon' (Miskelly *et al.* 2008).

Banded dotterels were not seen during the 2010 survey, but are known to breed on pasture habitat in the surrounding area (Whitaker 1986). Banded dotterels are listed as 'Threatened – Nationally Vulnerable' (Miskelly *et al.* 2008), and are threatened by introduced mammalian predators (Heather and Robertson 2000).

Figure 5 *Left: Habitat within upstream area of proposed Camp Creek reservoir. Right: Area immediately upstream of proposed Camp Creek dam.*

6.3 Herpetofauna

Camp Creek contains a large amount of suitable lizard habitat, with numerous rock outcrops surrounded by indigenous scrubland, tussock grassland and pasture. Although the weather conditions were not ideal, with a cool breeze blowing, many McCann's skinks and a number of common skinks were observed basking either on rocks or within vegetation. No geckos were observed, but a large lizard dropping was found on a rock outcrop at NZTM E1396187 N4973863 that may have been from an Otago Large gecko. Green skinks were found less than 2km to the north of the proposed Camp Creek storage dam (Whitaker 1986), so there is a possibility that they are also resident within the site. Green skinks are listed as 'At Risk – Declining' (Hitchmough *et al.* 2010), and are

threatened by introduced predators, habitat modification and tussock grassland fires (Whitaker *et al.* 2002, Patterson 1985). Camp Creek provides ideal habitat for green skinks as they are most often found in damp sites with plentiful loose rocks and dense herbaceous vegetation (Whitaker 1987a). Green skinks are elusive and usually only single animals are found (Whitaker 1987a), which makes it difficult to confirm their presence.

6.4 Potential adverse effects and recommended mitigation

6.4.1 Avifauna

With the creation of the Camp Creek dam, the resulting reservoir will flood approximately 14.3 hectares of land upstream of the dam, creating a lake with a volume of approximately 1,400,000 m^3. This will remove a large area of scrub utilised by a diverse assemblage of bird species for feeding, roosting and nesting. The majority of these species are introduced and common, but have some ecological value as a prey item for the New Zealand falcon. The native grey warbler also occurs here.

The main concern with the flooding of the gully is that it will remove a significant hunting ground for the endangered New Zealand falcon. It is recommended that mitigation be in the form of enhancement of the lake shore. Enhancement of the lake shore would help to replace habitat for the common species of birds that help make up the diet of the New Zealand falcon and would be beneficial to six of the seven threatened bird species in the area. Black-fronted tern, black-billed gull, red-billed gull, fernbird, bittern and banded dotterel all utilise lakes or lake margins for feeding and/or nesting (Heather and Robertson, 2000). As lakes are scarce in the district (Whitaker 1986) the creation of the Camp Creek reservoir could provide important habitat for avifauna and act as a staging area for birds moving between the coast and inland areas. Enhancement of the lake shore would also tie in with the mitigation for lizards. Ground contouring may be needed to create lake edges suitable for feeding grounds. In conjunction with ground contouring, indigenous lake shore vegetation should be planted to enhance natural values. Plants may include *Juncus* and *Carex* species, as well as plants such as *Leptinella maniototo* and *Ranunculus glabrifolius.* Scrub species such as *Melicytus alpinus, Corokia cotoneaster, Aristotelia fruticosa* and *Dracophyllum* sp. could be planted above the lake shore. The lake and surrounding vegetation should be fenced off from stock to allow revegetation.

6.4.2 Herpetofauna

As the reservoir fills with water, lizards will be forced to higher ground. The majority of the resident lizards will move up the sides of the gully of their own accord, but are likely to move into areas already occupied by other lizards. To ensure that sufficient habitat will remain above the water line to support the resident population of lizards as well as the individuals forced higher by the rising water, the area above the water line should be enhanced by planting. To prevent the loss of a substantial number of fruit bearing indigenous plants, selected specimens could be dug up and removed from below the water line and transplanted on higher ground within the Camp Creek gully.

It is recommended that, prior to construction, an experienced herpetologist thoroughly search the area for green skink and Otago Large gecko. This may require several visits to the site and the use of pit fall traps or artificial cover objects. If individuals are found then arrangements will need to be made to transfer the lizards to a suitable alternative location. Prior consultation with the Department of Conservation is recommended to assess the best location to release captured lizards. Note that any lizard transfers will require approval from the Department of Conservation under the Wildlife Act. It is possible that the relocation site will require some protection and enhancement, for instance fencing off from stock, predator control and replanting with fruit bearing indigenous plants such as *Melicytus alpinus*, *Coprosma propinqua* and *Leucopogon fraseri*.

7. Back Road Waste Rock Stack

7.1 General

The proposed Back Road Waste Rock Stack (BRWRS) is located on slopes draining into Deepdell Creek downstream of the current Macraes mining operation (Figure 6). The area covers approximately 210 hectares and is dominated by tussock grasslands, with scrub and some pasture in the gorges.

Figure 6 *Area proposed for the Back Road Waste Rock Stack site.*

7.2 Avifauna

The open tussock grassland of the BRWRS (Figure 7) supports relatively low numbers of birds, the most abundant being the introduced skylark and yellowhammer, with smaller numbers of New Zealand pipits. Whitaker (1987a) found that the only resident birds in tussock grassland were skylarks and pipits. The New Zealand pipit is listed as 'At Risk – Declining' (Miskelly *et al.* 2008). Pipits are scarce in very dry parts of the South Island and declines have been linked with conversion of tussock grassland to areas of intensive agriculture (Heather and Robertson 2000). Other small passerines such as dunnock, chaffinch, greenfinch and starling were seen feeding in the tussock, whilst Australasian

harrier hawks were commonly seen hunting over the area. The falcon is also known to hunt over tussock grassland (Whitaker 1987a).

Figure 7 *Tussock grassland of the Back Road Waste Rock Stack site.*

Scrub within the gullies provides habitat for a more diverse assemblage of bird species than in the open areas. The gullies all drain into the Deepdell Creek and species richness within the gullies appeared to increase with proximity to Deepdell Creek. Fantails, silvereyes and grey warblers were frequently seen or heard in the lower reaches of the gullies, where there is a good cover of indigenous vegetation including numerous kowhai trees. Paradise ducks appeared to be breeding in the lower gullies, with a male behaving defensively and the female unseen, presumably incubating. Welcome swallows were also present within the lower gullies. It is likely that the pair seen may have had a nest site in the rocky bluffs of the gully, as rock outcrops are the welcome swallow's second choice of nesting site after manmade structures (Heather and Robertson 2000). Introduced passerines were abundant throughout the gullies, with observed species including blackbird, Australian magpie, dunnock and redpoll.

The southern edge of the BRWRS crosses an area of tussock grassland with scattered ephemeral wetlands. A number of these wetlands fall outside of the proposed BRWRS, but two ephemeral wetlands occur within the footprint at NZTM E1401506 N4973964 and E1402039 N4974411. South Island pied oystercatcher and paradise shelduck were observed utilising these wetlands and both species had juveniles present. These wetlands may be important during the breeding stages of these species. Southern black-backed gulls were observed feeding in the rough pasture near the wetlands. Other species such as white-faced heron and the New Zealand pipit may also use this area for foraging.

7.3 Herpetofauna

The gullies within the BRWRS provide very good habitat for various species of lizards. McCann's skinks were abundant throughout the rock outcrops along the gully edges, whilst common skinks were found in both rocky habitat and grassland. Large amounts of lizard droppings were observed throughout the area on rock outcrops. Otago Large geckos (*Hoplodactylus* sp. 'Otago Large') (Figure 8) were seen at various locations, including the gully running along the northeast boundary of the BRWRS (NZTM E1401891 N4975090 to E1402304 N4974930). Otago Large geckos are 'At Risk', with a current ranking of 'Declining' (Hitchmough *et al.* 2010).

Green skinks were not found during the 2010 survey, but were thought to occur at NZTM E1402234 N4974949 in the same gully running along the northeast boundary of the BRWRS in which the Otago Large geckos were found (Whitaker 1986).

Figure 8 *Otago Large gecko found in gully at NZTM E1401978 N4975083.*

7.4 Potential adverse effects and recommended mitigation

7.4.1 Avifauna

The construction of the BRWRS will envelop all existing avifaunal habitat within its footprint. There is potential for some disturbance to avifauna during the construction period of the BRWRS, but the majority of species will move into the adjoining habitat. However, the loss of a large area of tussock grassland (approximately 67 hectares) will have a significant impact on the resident New Zealand pipit population. It is recommended that as mitigation for this loss of habitat an area of land be retired from

farming and restored as tussock grassland. Details on tussock grassland restoration will be outlined in section 15 of this report.

The ephemeral wetlands at the southern edge of the BRWRS will be completely eliminated by the proposed development. Between the BRWRS and the consented Frasers East Waste Rock Stack there is potential for the loss of up to forty-five percent of this habitat type in the vicinity. It is recommended that either the footprint of the BRWRS is changed to avoid the wetland or the remaining wetlands in the area that are not designated for development are protected and enhanced by fencing off from stock and planting with locally sourced vegetation. This should help to offset the habitat removal and enhance avifaunal values in the area.

The proposed silt ponds are likely to be beneficial to a number of native bird species in the area. For instance, welcome swallow habitat will be enhanced by areas of standing water, allowing them to feed on invertebrates on the surface of the water. Ponds will also enhance breeding areas and feeding sites for paradise shelduck.

7.4.2 Herpetofauna

Due to the nature of the disturbance, lizards would be unlikely to make their own way out of the impact zone and therefore would have a high likelihood of being crushed by waste rocks. Given the presence within the BRWRS footprint of an 'At Risk' species, the Otago Large gecko, it is recommended that an experienced herpetologist search for and translocate resident lizards. Prior consultation with the Department of Conservation is recommended to assess the best location to release the captured lizards. Note that any lizard transfers will require approval from the Department of Conservation under the Wildlife Act. The chosen location should be far enough away from the proposed BRWRS to prevent homing behaviour in the translocated lizards. It may eventuate that the chosen location will require some protection and enhancement, for instance fencing off from stock, creating refuges, predator control and replanting with fruit bearing indigenous plants such as *Melicytus alpinus, Coprosma propinqua* and *Leucopogon fraseri*.

The gully running along the northeast boundary of the BRWRS is home to at least three species of lizard, the common skink, McCann's skink and Otago Large gecko. Green skinks may also occur here. Given the diversity of species present, and the 'At Risk' status of at least one species, this gully is of significance. Clearly, if this gully is included

in the BRWRS, the habitat values will be destroyed. Two mitigation options are presented here, with the former being the preferred choice;

Option 1: Shift the boundary of the BRWRS further west to avoid the northeast gully. Figure 9 shows the recommended new boundary. Provided the areas outside the BRWRS are not impacted during the construction phase and subsequent maintenance, this boundary shift should protect the rock outcrops and fruiting plants required by the resident lizards.

Option 2: If the boundary cannot be moved then it is recommended that an experienced herpetologist be engaged to locate and remove lizards to a suitable relocation area.

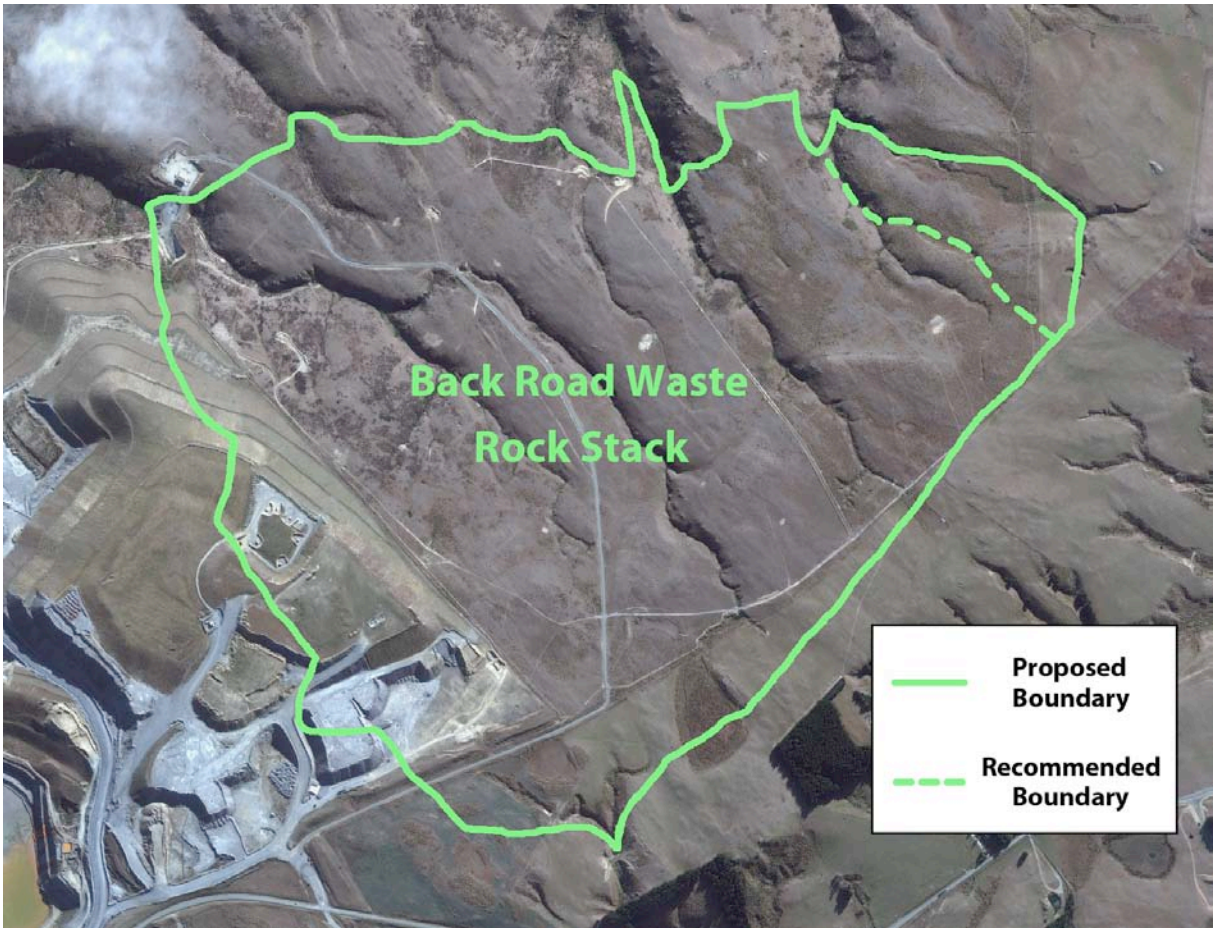

Figure 9 *Recommended boundary change to the Back Road Waste Rock Stack.*

8. Top Tipperary Tailings Storage Facility

8.1 General

The proposed Top Tipperary Tailings Storage Facility (TTTSF) is located at the head of the Tipperary/McCormicks Creek catchment (Figure 10). The head of this catchment is dominated by farmland, with pasture grasses and areas of tussock grasslands and scrub in some gullies. Small stands of exotic plantations or shelterbelts are located throughout the site.

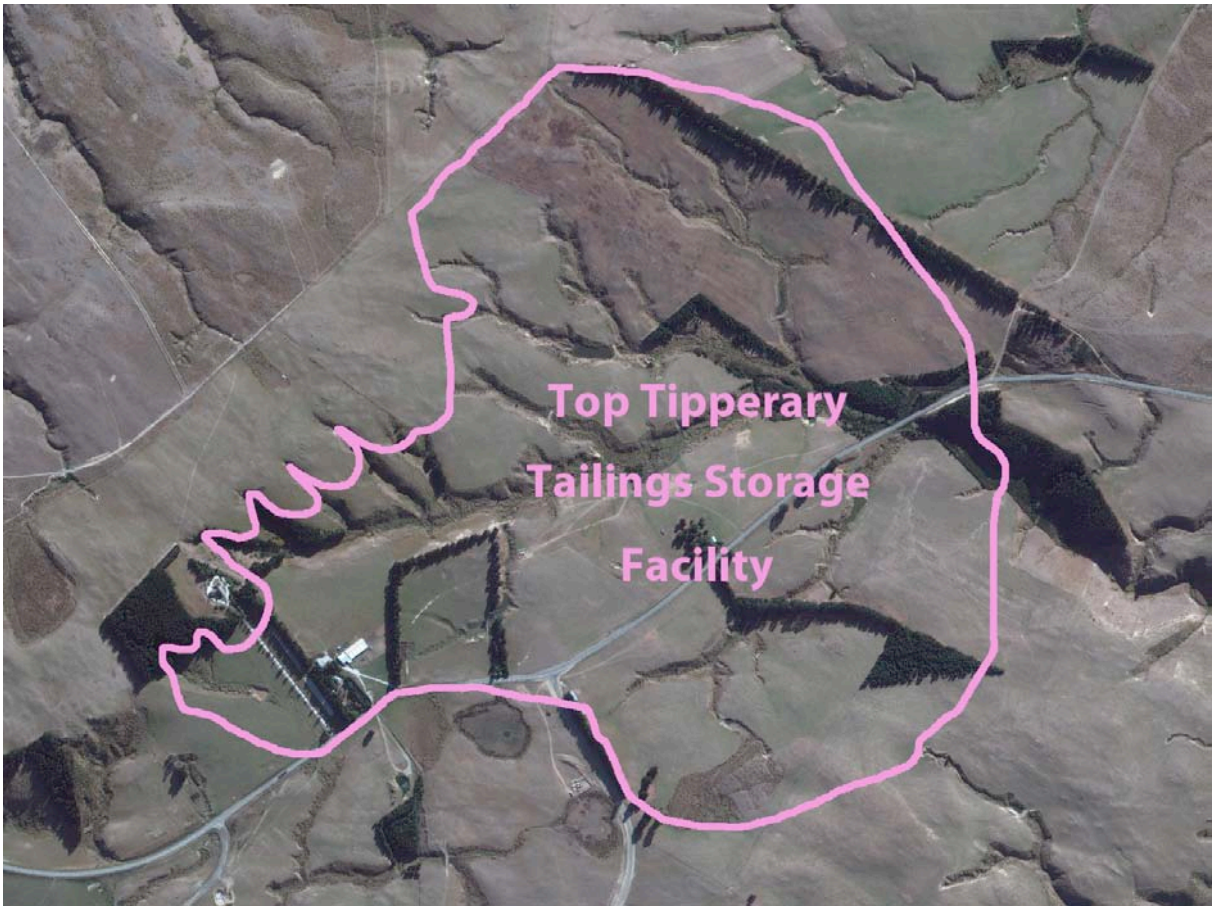

Figure 10 *Area proposed for the Top Tipperary Tailings Storage Facility.*

8.2 Avifauna

The modified farmland of the TTTSF provides habitat for roosting and feeding, in particular for introduced and native passerines, and grazing for several waterfowl species (Figure 11). The dominant habitat of the proposed TTTSF is improved pasture. This provides a short grass sward in which various bird species feed, such as paradise shelduck, spur-winged plover, Southern black-backed gull, feral pigeon, Australian magpie and starling (Whitaker 1987). Large flocks of small passerines (e.g.,

yellowhammer, greenfinch, redpoll) also use this habitat for feeding, as does the South Island pied oystercatcher, which is listed as 'At Risk – Declining' (Miskelly *et al.* 2008). Australasian harrier hawks were observed hunting over the open areas. Skylarks were abundant throughout the site.

In an area largely devoid of indigenous trees, the exotic plantations within the TTTSF provide roosting and nesting habitat, mostly for introduced passerines such as house sparrows, goldfinches and chaffinches and also native species such as grey warblers and silvereyes. Exotic trees planted around an old homestead site provide roosts and fruit for blackbirds, song thrushes, and dunnocks.

Figure 11 *Left: Modified farmland of the Top Tipperary Tailings Storage Facility. Right: Wetland at NZTM E1402569 N4973489.*

Many farm ponds exist in the area and these provide habitat for waterfowl, with a number of ponds being utilised by paradise shelducks with ducklings in tow. Welcome swallows were also observed foraging for insects over farm ponds. No ponds were present in the area designated for Tipperary Creek silt pond, but paradise ducks were observed within the creek.

The western edge of the TTTSF skirts the edge of a pond with associated wetland vegetation (NZTM E1402569 N4973489) (Figure 11). The proposed Golden Bar Road realignment and the consented Frasers East Rock Stack skirt the opposite side of the wetland, effectively hemming it in from the surrounding landscape. Various species of waterfowl were observed in this wetland, including grey teal, New Zealand shoveler, paradise shelduck, mallard duck and grey duck/mallard duck hybrids.

8.3 Herpetofauna

Grand skinks and Otago skinks occur at several sites within a ten kilometre radius of the TTTSF (Whitaker 1996b). Large skinks were reported from the headwaters of McCormick Creek in the mid eighties, but there have been no recent sightings (Whitaker 1996b). Whitaker (1996b) states that "*the outcrops and bluffs on the true left of Tipperary Creek might be suitable habitat for Otago and Grand, but the level of habitat modification means it is unlikely there is a resident population there now*". No sign of Otago or grand skinks was found along these bluffs, nor was there any sign found of the more common species of lizards. Elsewhere in the TTTSF, habitat is not ideal for lizards due to the modified nature of the area and the lack of rock outcrops. Common skinks are occasionally found around the edges of plantations (Whitaker 1987a), so they may be present in small numbers.

8.4 Potential adverse effects and recommended mitigation

8.4.1 Avifauna

The construction of a Tailings Storage Facility will remove all existing avifaunal habitat from the proposed TTTSF. However, the current values are low due to the already modified nature of the farmland. All bird species resident within the TTTSF are expected to relocate to adjacent areas.

In a landscape where areas of standing water are scarce, the wetland at NZTM E1402569 N4973489 is a significant feature and is an important habitat for waterfowl species. Although the TTTSF is positioned to avoid the wetland, care will be required to minimise any edge effects from construction and sediment runoff. The construction of silt ponds will have no adverse effect on avifauna.

There will be a loss of approximately 14 hectares of mature stands of trees, mostly shelterbelts, once the TTTSF is constructed. Large trees are important for providing roosting and nesting habitat and also acting as ecological corridors, but are sparse within the Macraes mining area. It is recommended that as mitigation for the loss of this habitat, trees are planted outside of the mining footprint. Trees could be planted along existing fence lines to work in conjunction with grazing needs, so as to not take up large areas of improved pasture and to act as shelterbelts for stock. A suitable mixture of tree species could include fast growing eucalypts or pines to quickly provide nesting and roosting

sites (as well as shade for stock) and native species such as kowhai (*Sophora microphylla*), broadleaf (*Griselinia littoralis*) and flax (*Phormium cookianum*) to provide seeds and nectar. See Appendix Three for other suitable planting species.

8.4.2 Herpetofauna

The construction of a Tailings Storage Facility will remove all existing or potential reptile habitat from the proposed TTTSF. However, the current values are low due to the already modified nature of the farmland and the lack of suitable cover for retreats. Lizard populations are considered to be low in density and not significant.

9. Frasers North Waste Rock Stack

9.1 General

The proposed Frasers North Waste Rock Stack (FNWRS) covers approximately 23 hectares of land within the upper Waikouaiti River North Branch catchment (Figure 12). The Macraes-Dunback Road bisects the site, with improved pasture to the south of the road and a mixture of pasture, tussock grassland and pine plantation to the north of the road. Rocky outcrops are present in the higher areas of the site.

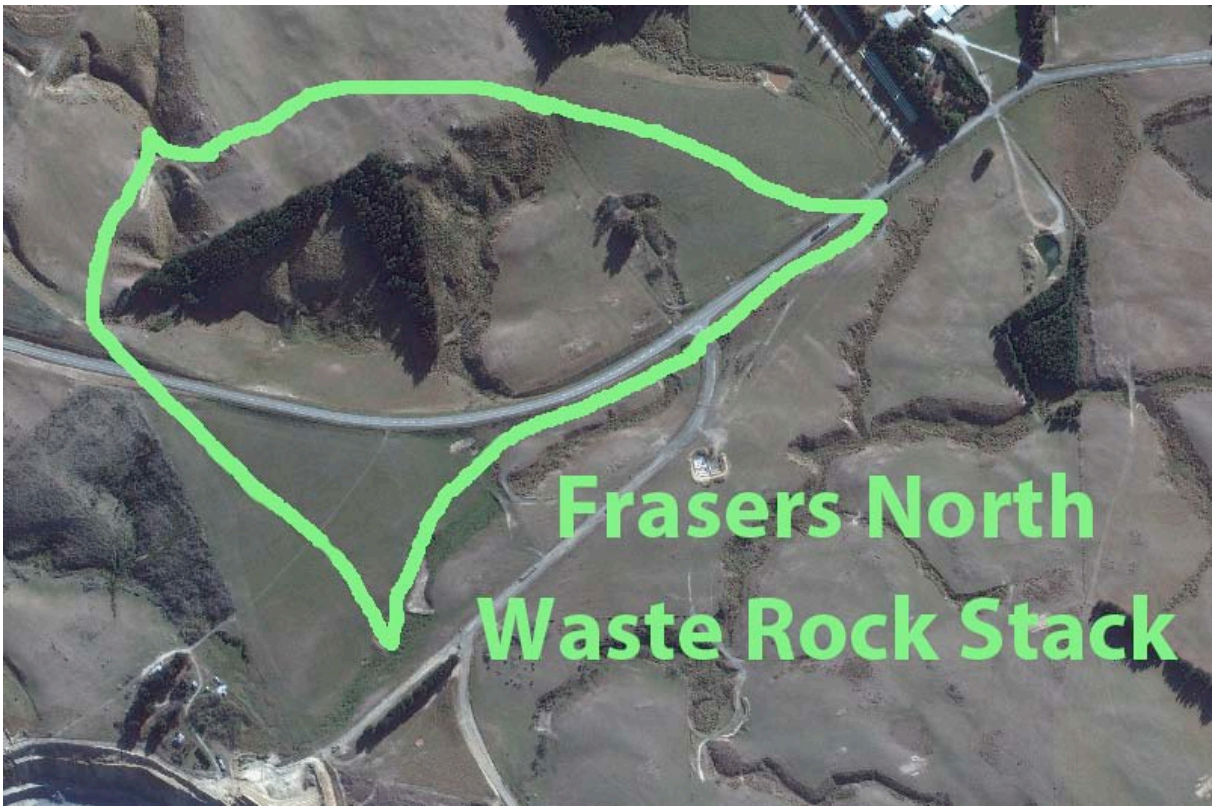

Figure 12 *Area proposed for the Frasers North Waste Rock Stack site.*

9.2 Avifauna

The plantation of mature radiata pines provides roosting habitat for a variety of passerines, including goldfinches, greenfinches, chaffinches, blackbirds and the native grey warbler. Paradise shelducks were seen utilising the farm pond below the plantation. The improved pasture within the site was being used as a foraging ground by spur-winged plovers. Yellowhammers, redpolls and other introduced passerines were seen foraging amongst the tussock grassland. Australasian harrier hawks were observed flying over this area, in search of prey or carrion.

9.3 Herpetofauna

Within the FNWRS there are two areas of suitable lizard habitat (Figure 13). The first is on the crest of the hill in the northeast section of the FNWRS where a small number of rock outcrops provide good refuges and are surrounded by fruiting plants. McCann's skinks were observed on the rock outcrops and a large lizard dropping was found at NZTM E1401670 N4973443 that could have been from an Otago Large gecko. However, the area is grazed and the number of lizards that could be supported would be relatively small. The second area is within the tussock grassland between the lines of exotic plantation, which forms a 'v' shape. Rock outcrops are scattered throughout the tussock and numerous McCann's skinks were observed basking in the area.

Figure 13 *Left: Rock outcrop where large lizard dropping was found. Right: Photograph showing the three main habitats of the FNWRS; exotic plantation, tussock grassland and improved pasture.*

9.4 Potential adverse effects and recommended mitigation

9.4.1 Avifauna

The FNWRS would envelop all existing avifaunal habitat within its footprint, including a loss of approximately two hectares of mature radiata pine plantation. However, due to the relatively small size and modified nature of the area, the species and avifaunal habitats present are not considered significant.

9.4.2 Herpetofauna

The FNWRS would envelop all existing reptile habitat within its footprint. Aside from

the two areas where suitable lizard habitat is found, the loss of habitat will be insignificant. It is recommended that an experienced herpetologist search the area, in particular the rock outcrop at which the large lizard dropping was found (NZTM E1401670 N4973443). Any lizards found could be removed to a suitable location, the whereabouts of which can be decided by prior consultation with the Department of Conservation.

10. Frasers South Waste Rock Stack

10.1 General

The proposed Frasers South Waste Rock Stack (FSWRS) covers approximately 53 hectares of land within the upper Waikouaiti River North Branch catchment (Figure 14). The site is dominated by pasture grasses, with areas of tussock grassland and scrub in some gullies.

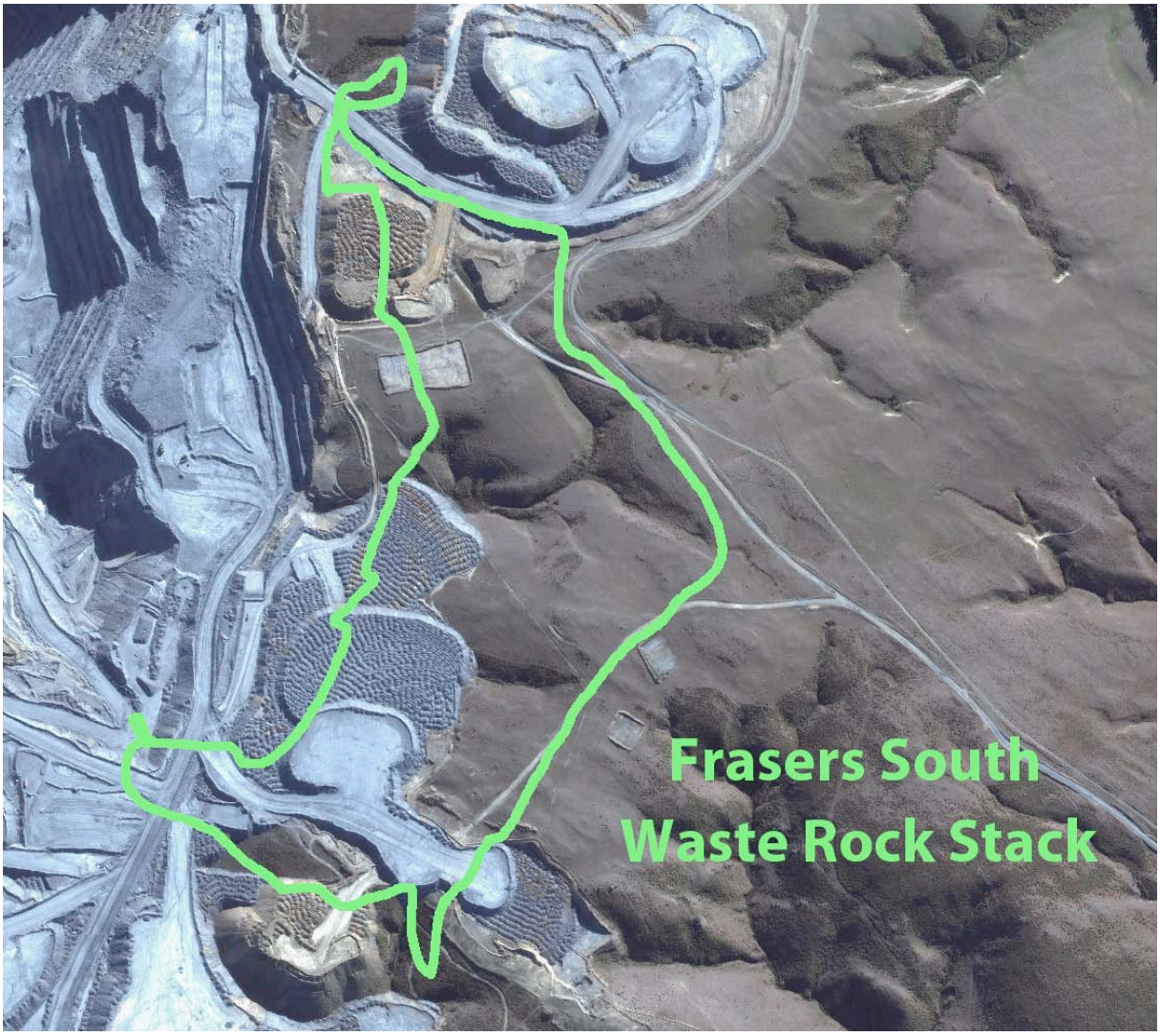

Figure 14 *Area proposed for the Frasers South Waste Rock Stack site.*

10.2 Avifauna

The improved pasture of the FSWRS supported a variety of introduced passerines such as skylarks, yellowhammers, starlings and redpolls (Figure 15). Spur-winged plovers and pied oystercatchers were observed foraging in the improved pasture. Tussock was

scattered throughout the site, with higher concentrations within the gullies. New Zealand pipits were seen utilising these tussock grassland areas. A number of ponds are within the FSWRS and two species of ducks were observed feeding in them, paradise shelduck and grey duck/mallard duck hybrids. Other species such as New Zealand shoveler, grey teal and mallard duck are also likely to utilise these ponds. Australasian harrier hawks and Australian magpies were observed flying above the site.

Figure 15 *Improved pasture and tussock gullies of the Frasers South Waste Rock Stack site.*

10.3 Herpetofauna

Lizard habitat in the FSWRS footprint is limited due to a lack of rock outcrops. Whilst a number of fruiting species palatable to lizards are present (eg. *Coprosma propinqua* and *Gaultheria* spp.), they occur in low densities. No lizards or evidence of lizard sign were encountered during the 2010 survey, although common skinks are likely to occur there within the grassland.

10.4 Potential adverse effects and recommended mitigation

10.4.1 Avifauna

The conversion of the FSWRS area into a waste rock stack will eliminate all avifaunal habitat currently found there. The loss of modified farmland habitat is not regarded as having a significant adverse effect on the avifaunal values. Whilst the habitat is highly modified, it does support at least one species that is listed as 'At Risk', the South Island pied oystercatcher.

There is a pond immediately to the east of the FSWRS area situated between Golden Bar Road and the haul road running adjacent to it (NZTM E1400326 N4972150). Grey

duck/mallard duck hybrids were observed on this pond, and the associated vegetation surrounding it was in relatively good condition. This pond could be fenced off as a mitigation measure to enhance avifaunal values and protect remaining waterfowl habitat. Section 15 of this report discusses mitigation relating to wetland restoration.

10.4.2 Herpetofauna

The conversion of the FSWRS area into a waste rock stack will eliminate all lizard habitat currently found there. However, due to the modified nature of the area and the lack of cover for retreats the lizard habitat values within the FSWRS are low. No mitigation is required for resident lizard populations.

11. Round Hill Extension

11.1 General

The proposed Round Hill Extension (RHE) site encompasses approximately 20 hectares of rehabilitated waste rock stacks (Figure 16). The area is heavily modified from its natural state and the majority of vegetated areas have been sown with improved pasture grasses.

Figure 16 *Area proposed for the Round Hill Extension site.*

11.2 Avifauna

Due to the already modified nature of the RHE area, the existing avifaunal values are low (Figure 17). The majority of birds seen were flying over the site, very few individuals were observed utilising the area. Of those that were seen feeding amongst the pasture grasses all were common introduced passerines such as yellowhammers and redpolls. Paradise shelducks were observed in the Northern Gully silt pond directly below the RHE site, but changes to the RHE should have minimal impact on this habitat.

Figure 17 *Modified environment of the Round Hill Extension site.*

11.3 Herpetofauna

McCann's skinks were observed in the re-sown pasture grass of the rehabilitated rock stack within the RHE (Figure 18). Approximately 16 hectares of such habitat occurs within the RHE and McCann's skinks are likely to be present throughout. Common skinks may also be present amongst the re-sown pasture grasses.

Figure 18 *McCann's skink in re-sown pasture grass of rehabilitated rock stack.*

11.4 Potential adverse effects and recommended mitigation

11.4.1 Terrestrial fauna

The conversion of the RHE area into an open cast pit will eliminate all bird and lizard habitat currently found there. However, due to the modified nature of this area and the amount of similar habitat immediately adjacent to this site, this loss of habitat is not considered significant. As disturbance increases within the site, resident lizards should be able to freely disperse into adjoining areas. Impacts on avifauna are considered to be less than minor.

12. Round Hill - Southern Pit Extension

12.1 General

The proposed Round Hill - Southern Pit Extension (RHSPE) is located within an existing tailings dam (Figure 19). The area covers approximately 15 hectares. Vegetation is limited to a few straggly weeds near the perimeter.

Figure 19 *Area proposed for the Round Hill - Southern Pit Extension site.*

12.2 Avifauna

As the RHSPE is situated within a tailings dam (Figure 20), the avifaunal values are very low. Introduced passerines such as chaffinches, yellowhammers and skylarks were observed flying above the site or perching on rocks at the edge of the tailings dam, though no birds were seen utilising the area for foraging. The odour emanating from the tailings waste was a likely deterrent to bird species.

Figure 20 *Habitat of the Round Hill - Southern Pit Extension site.*

12.3 Herpetofauna

Despite an abundance of rocky retreats in the form of spoil mounds, it is unlikely that lizards are present due to the lack of suitable vegetation.

12.4 Potential adverse effects and recommended mitigation

The RHSPE site does not support significant faunal values, therefore the loss of this habitat will have no effect on birds and lizards.

13. Innes Mills Stage V

13.1 General

The proposed pit extensions of Innes Mills Stage V (IMSV) are located in two separate areas, a western site to the west of the current Macraes-Dunback Road and an eastern site which is bisected by the Macraes-Dunback Road (Figure 21). The western site covers approximately three hectares and is situated atop a plateau dominated by rough pasture. The eastern site covers approximately seven hectares and is a mixture of improved pasture and tussock grassland.

Figure 21 *Area proposed for Innes Mills Stage V extension sites.*

13.2 Avifauna

The IMSV extension contains only a small amount of habitat suitable for birdlife. The IMSV covers approximately eleven hectares, of which, approximately four hectares is

road or waste rock within the mine site. The remainder is mostly rough pasture, although there is a small section of native tussock. A white-faced heron (*Ardea novaehollandiae*) was seen feeding amongst the tussock. Species observed foraging in the rough pasture included yellowhammer, skylark and starling. Southern black-backed gull, spur-winged plover and Australasian harrier hawk were all seen flying over the site.

13.3 Herpetofauna

McCann's skinks were seen basking in the spoil mounds alongside the haul road margin (Figure 22). Common skinks may also be present amongst the pasture grasses and tussocks.

Figure 22 *Left: Spoil mounds within the Innes Mills Stage V extension site.*
Right: Tussock and rough pasture within the Innes Mills Stage V extension site.

13.4 Potential adverse effects and recommended mitigation

The conversion of the IMSV area into an open cast pit will eliminate all bird and lizard habitat currently found there. However, given the small size of the area and the limited habitat available, the loss of habitat is not considered significant. As disturbance increases within the site, resident lizards should be able to freely disperse into adjoining areas. Impacts on avifauna are considered to be less than minor.

14. Frasers Stage VI

14.1 General

The proposed Frasers Stage VI pit extension is situated at the northern edge of the existing Frasers Pit (Figure 23). The area covers approximately sixteen hectares of farmland, with an area of tussock grassland and exotic trees planted around an old homestead. Headwaters of the Waikouaiti River North Branch bisect the site, with scrub as riparian vegetation.

Figure 23 *Area proposed for the Frasers Stage VI pit extension site.*

14.2 Avifauna

The bird community of Frasers Stage VI pit extension was comprised almost entirely of introduced passerines such as skylarks, chaffinches, dunnocks and redpolls. The pine trees in the south west of the site were utilised by a flock of starlings and the scrub beneath the trees contained many yellowhammers. Only three native species were observed, the Australasian harrier hawk and the southern black-backed gull flying overhead and spur-winged plovers foraging in pasture grasses.

14.3 Herpetofauna

McCann's skinks were seen throughout the site, with most observed basking on the spoil mounds alongside the haul road margin (Figure 24). Beside the spoil mounds is a small area of tussock grassland, which provides a foraging ground for the resident lizards.

Figure 24 *Spoil mounds within the Frasers Stage VI pit extension site.*

14.4 Potential adverse effects and recommended mitigation

The conversion of the Frasers Stage VI pit extension area into an open cast pit will eliminate all bird and lizard habitat currently found there. However, the faunal habitat values within the area are not significant, nor are the species that are resident there. Similar habitat is found elsewhere, and resident lizards should be able to freely disperse into adjoining areas.

15. Potential adverse effects and recommended mitigation

15.1 Loss of habitat

The most noticeable effect of the proposed development on faunal values will be the complete removal of habitat from within the development footprint (Table 2). Whilst each separate section of the proposed development may have only small areas of high value land, the cumulative effects of habitat removal will be major, as one of the key threats to indigenous terrestrial species is insufficient and fragmented habitat (Department of Conservation and Ministry for the Environment 2000). The removal of approximately 155 hectares of indigenous habitat will have an adverse effect on significant biodiversity values.

Table 2 *Table showing potential loss (in hectares) of vegetation/habitat types within the proposed Macraes Phase III development area.*

Vegetation/habitat type	Area (ha)
Exotic pasture	262.5
Tall tussock grassland	78.4
Mine/Road	75.8
Indigenous scrub	32.2
Short tussock grassland	29.7
Exotic pasture with scattered tussock	29.0
Exotic trees	17.0
Exotic scrub	7.9
Indigenous scrub/Tall tussock grassland	7.2
Rock outcrop	4.1
Carex/Juncus	1.4
Cleared scrub	0.7
Farm pond	0.7
Wetland	0.5
Total	**547**

The proposed development areas are predominantly farmland. Removal of this habitat will mostly impact introduced bird species such as finches, starlings, blackbirds and magpies. These bird species are likely to disperse into surrounding farmland habitat, so disruption should be temporary and less than minor. The majority of these species are introduced and common, but have some ecological value as a prey item for the New Zealand falcon. Native species such as paradise ducks and South Island pied oystercatcher that utilise farmland for feeding will likewise disperse to adjoining

farmland to forage. However, pockets of high value land are located throughout the proposed development areas, and fall broadly into three faunal habitat categories; tussock grassland, wetlands and scrub. A fourth category is exotic plantation, which in an area where trees are scarce, becomes a locally important habitat.

The implementation of the Macraes Phase III Project will result in the removal of significant areas of rocky outcrop habitat and areas of fruit bearing indigenous plants, an important source of food for lizards. The largest lizard assemblages in Otago occur in the Macraes Flat area, making this a significant area for lizard conservation (Whitaker *et al.* 2002). Three species of lizard are confirmed from within the development areas, including the 'At Risk – Declining' Otago Large gecko. Two more species possibly occur within the development areas, the 'At Risk – Declining' green skink and the cryptic skink. The presence of the 'Threatened - Nationally Critical' Otago skink and grand skink is unlikely within the development areas. Mitigation will be required to compensate for the loss of lizard habitat and the loss of lizard individuals that do not make it safely out of the development areas.

15.1.1 Tussock grassland

If all consents for the Macraes Phase III Project are granted, approximately 108 hectares of tussock grassland will be eliminated from the consented areas, including approximately 67 hectares from the BRWRS alone. The loss of a large area of tussock grassland will reduce the quality of faunal habitats in the vicinity for the majority of terrestrial fauna and will have a particular impact on the threatened New Zealand pipit. Given the Statement of National Priority focus on protecting habitats of threatened indigenous species, and the Biodiversity Strategy's goal to halt the decline in New Zealand's biodiversity, it is recommended that, as mitigation for this loss of habitat, an area of land be retired from grazing and restored as tussock grassland as habitat for New Zealand pipit. Two options are recommended for establishing a tussock grassland reserve;

Option one (preferred)

A site outside of the mining footprint is selected based on three criteria; that it contains a pre-existing representative native tussock grassland, that it is unlikely to be encroached upon by future mining activities and that it is feasible to fence the area off from stock. A site with an area of 108 hectares should be aimed for to compensate for the approximately

108 hectares of tussock grassland that will be lost. The site should be fenced off to allow protection from stock trampling and grazing, and weed species controlled within the site. This is the preferred option because, depending on the site selected, it may be possible to combine the mitigation suggested for other threatened species which are also adversely impacted by this development. For instance, the selected site may be an appropriate habitat for trans-located lizards from the BRWRS. It may prove cost effective to focus mitigation efforts onto one site that can deal with the habitat requirements of various threatened species.

Option two
One or more sites are selected from areas within the mining footprint designated for pasture grass rehabilitation. Tussock is already being planted in selected areas on waste rock stacks, but more information is required on whether or not conditions are conducive to permanent tussock establishment. The site(s) should be fenced off to allow protection from stock trampling and grazing. Establishing a tussock grassland from scratch is likely to prove more costly and labour intensive than protecting a pre-existing tussock grassland, and allows less options for combining mitigation with other threatened species.

Consideration should be given to the following measures when implementing a tussock grassland restoration plan:

- It can be difficult for transplanted tussock to re-establish in different soil (Lowther 2002), therefore it may be beneficial to use large diggers to transplant specimens of tussock from the impact zone to the restoration area, taking care to remove tussock with the surrounding soil and root systems intact.

- Nitrogen should be either applied as fertiliser to the restoration area or built up in the soil by legumes. This has the potential to provide a cost effective means of improving tussock growth (Lowther 2002).

- Rehabilitated tussock grasslands should incorporate all the different species of tussock that will be lost. Red tussock and narrow-leaved snow tussock are of particular note. Red tussock is predominantly found in wetter gully floors.

- Indigenous intertussock vegetation needs to be established along with tussock

restoration, which will require weed control of pest plant species.

- The transplantation of tussock should ideally take place outside of pipit breeding season (August to February) to avoid destroying nests and causing disruption to breeding. Pipit numbers should be monitored prior to development to establish a baseline size of population.
- Monitoring of tussock establishment and subsequent pipit colonisation should be carried out to ascertain whether mitigation outcomes have been met.

- Legal protection should be considered for the land that is chosen for tussock rehabilitation.

15.1.2 Wetlands

A number of small wetland areas will be either removed completely or have the potential to be disturbed by the Macraes Phase III Project. Wetlands support the greatest concentrations of bird life of any habitat in New Zealand and are of particular importance in the Macraes area due to the relative scarcity of standing water. Given the Statement of National Priority focus on the retention and enhancement of wetlands it is recommended that wetlands outside of the development area are protected and enhanced. Specific wetlands proposed for protection include, but are not limited to, the following:

- Ridge top swamp at NZTM E1401602 N4973760, described by Whitaker (1995) as a site of potential biological interest, having the potential to harbour rare or unusual wetland plants (Figure 9, number 4).

- Wetland at NZTM E1402569 N4973489 between TTTSF and the proposed Golden Bar Road realignment (Figure 9, number 7).

- Ephemeral wetlands in the area of the proposed Macraes-Dunback Road realignment and the southern edge of the BRWRS (Figure 9, numbers 1, 2, 3, 5 and 6).

- Wetland to the east of the FSWRS between Golden Bar Road and the haul road running adjacent to it at NZTM E1400326 N4972150.

- Wetlands in the headwaters of Cranky Jims Creek shown in Figure 29.

Wetlands should be fenced off to exclude stock and to limit disturbance from vehicles. Where applicable, weed species should be removed and native species planted to enhance the wetland value. Tall exotic species should be controlled so that they cannot overshade the smaller native species. The condition and changes within the wetlands should be monitored by an experienced ecologist to determine the effectiveness of the mitigation. Guidelines for restoring wetlands have been adapted from the Greater Wellington Regional Council and can be found in Appendix Four.

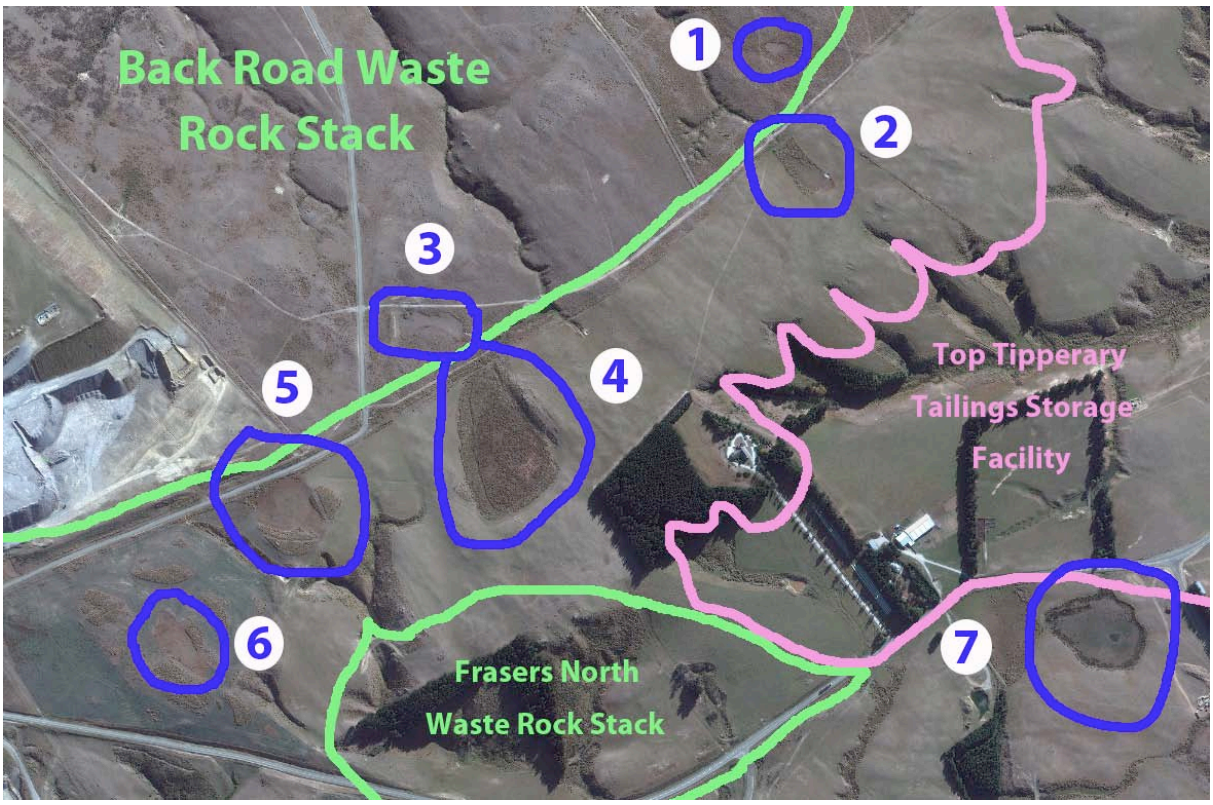

Figure 25 *Wetlands in the area of the proposed Macraes-Dunback Road realignment and the southern edge of the BRWRS.*

15.1.3 Scrub

There will be a loss of approximately 40 hectares of scrub if all proposals for development go ahead. Scrub habitat is important for providing feeding and nesting habitat for a large variety of bird species, some of which are important prey species for the New Zealand falcon. The Waitaki District Plan states that 'It is the myriad of small and fragmented areas of "common" vegetation types that are under greatest threat and are of the most debated value". It is recommended that as mitigation for the loss of this

habitat, an area of indigenous scrub is protected outside of the mining footprint.

15.1.4 Tall trees

There will be a loss of approximately 16 hectares of mature stands of trees once the TTTSF and FNWRS are constructed. These stands of trees are in the form of shelterbelts, small exotic pine plantations and homestead plantings. Large trees are important for providing roosting and nesting habitat and also acting as ecological corridors, but are sparse within the Macraes mining area. It is recommended that as mitigation for the loss of this habitat, trees are planted outside of the mining footprint. Three options are recommended for tree plantings;

Option one – exotic shelterbelts

Trees could be planted along existing fence lines to work in conjunction with grazing needs, so as to not take up large areas of improved pasture and to act as shelterbelts for stock. Tree species could include fast growing eucalypts or pines to quickly provide nesting and roosting sites (as well as shade for stock). This will be replacing like with like, so plantings should cover approximately 16 hectares. This will offset the loss of shelterbelts and plantations and will be cost effective, but will not add any additional ecological benefits.

Option two – mixed shelterbelts

As per option one, trees could be planted along existing fence lines to work in conjunction with grazing needs, so as to not take up large areas of improved pasture and to act as shelterbelts for stock. A suitable mixture of tree species could include fast growing eucalypts or pines to quickly provide nesting and roosting sites (as well as shade for stock) and also native species such as kowhai (*Sophora microphylla*), broadleaf (*Griselinia littoralis*) and flax (*Phormium cookianum*) to provide seeds and nectar. The exotic species will provide good nesting sites relatively quickly, and the native species will enhance ecological values by providing an important food source. Because of the enhanced ecological values, the replacement plantings would need to only cover at least 10 hectares, which would make the cost effectiveness comparable to option one.

Option three – native riparian planting

Native tree species such as kowhai and broadleaf could be planted alongside stream edges to not only provide nesting and roosting for birds, but to significantly enhance aquatic

values. If this is combined with fencing the replacement plantings would need to only cover at least 5 hectares. Due to the requirement for fencing this is likely to be the most expensive option, but it would significantly enhance both terrestrial and aquatic values in the area.

15.2 Construction of Camp Creek Storage Dam

15.2.1 Avifauna

With the creation of the Camp Creek dam, the resulting reservoir will flood approximately 13.7 hectares of land upstream of the dam. This will remove a large area of scrub utilised by a diverse assemblage of bird species for feeding, roosting and nesting and remove a significant hunting ground for the endangered New Zealand falcon. It is recommended that mitigation be in the form of enhancement of the lake shore. Enhancement of the lake shore would help to replace habitat for the common species of birds that help make up the diet of the New Zealand falcon and would be beneficial to six of the seven threatened bird species in the area. Black-fronted tern, black-billed gull, red-billed gull, fernbird, bittern and banded dotterel all utilise lakes or lake margins for feeding and/or nesting (Heather and Robertson, 2000). Enhancement of the lake shore would also tie in with the mitigation for lizards. Ground contouring may be needed to create lake edges suitable for feeding grounds. In conjunction with ground contouring, indigenous lake shore vegetation should be planted to enhance natural values. Plants may include *Juncus* and *Carex* species, as well as plants such as *Leptinella maniototo* and *Ranunculus glabrifolius*. Scrub species such as *Melicytus alpinus, Corokia cotoneaster, Aristotelia fruticosa* and *Dracophyllum* sp. could be planted above the lake shore. The lake and surrounding vegetation should be fenced off from stock to allow revegetation.

15.2.2 Herpetofauna

As the reservoir fills with water, lizards will be forced to higher ground. The majority of the resident lizards will move up the sides of the gully of their own accord, but are likely to move into areas already occupied by other lizards. To ensure that sufficient habitat will remain above the water line to support the resident population of lizards as well as the individuals forced higher by the rising water, the area above the water line should be enhanced by planting. To prevent the loss of a substantial number of fruit bearing indigenous plants, selected specimens could be dug up and removed from below the water line and transplanted on higher ground within the Camp Creek gully.

15.3 Translocation of lizards

The Macraes Phase III Project will remove all lizard habitat from within the development area. Although there is some potential for lizards to move out of development areas of their own accord, many individuals within the resident lizard populations will be killed during the construction phase if they are not removed prior to works beginning. It is recommended that an experienced herpetologist search the development area for resident lizards. Particular attention should be paid to Camp Creek, BRWRS and FNWRS as there is a higher likelihood of 'At Risk' species being found at these sites. Searches will focus on finding green skink and Otago Large gecko, but other common lizard species should also be relocated. This may require several visits to the site and the use of pit fall traps or artificial cover objects. Note that any lizard transfers will require approval from the Department of Conservation under the Wildlife Act.

Arrangements will need to be made to translocate the lizards to a suitable new location. Prior consultation with the Department of Conservation is recommended to assess the best location to release the captured lizards. It may eventuate that the chosen location will require some protection and enhancement, for instance fencing off from stock and planting with fruit bearing indigenous plants such as *Melicytus alpinus*, *Coprosma propinqua* and *Leucopogon fraseri*. Care must be taken to choose a location that is not already at carrying capacity. Appropriate monitoring of potential sites to assess population density will need to be carried out before a translocation occurs. Following relocation, monitoring should be undertaken within the new site. The purpose of this monitoring would be to establish if the relocation was successful.

15.4 Potential sites for mitigation

15.4.1 Cranky Jims

A preliminary survey to identify potential sites for mitigation has been completed. This has identified some good examples of vegetation/habitat sites that could potentially be included as mitigation. The areas identified have been described below. OceanaGold has agreed in principle to the mitigation concept proposed but further work is required to confirm these areas and to define final boundaries. In the headwaters of Cranky Jims Creek is an area of high value native bush (Figures 26 and 27). As this is an extremely rare habitat type within the Macraes Ecological District, we recommend that the area is set aside as a mitigation site of at least 28 hectares (Figure 29 and Table 3). We recommend that this area is fenced off from stock and enhanced by weed control, in particular wilding pine control. At risk species found within the bush include *Gingidia grisea* and *Celmisia hookeri*. We recommend that this area be given legal protection in the form of a covenant. Above the Cranky Jims Bush is an area of indigenous tussock grassland (Figure 28). The dominant species is narrow-leaved snow tussock (*Chionochloa rigida* subsp. *rigida*) with areas of red tussock (*Chionochloa rubra* subsp. *cuprea*) and short tussock. We recommend that the area is set aside as a mitigation site of at least 75 hectares (Figure 29 and Table 3).

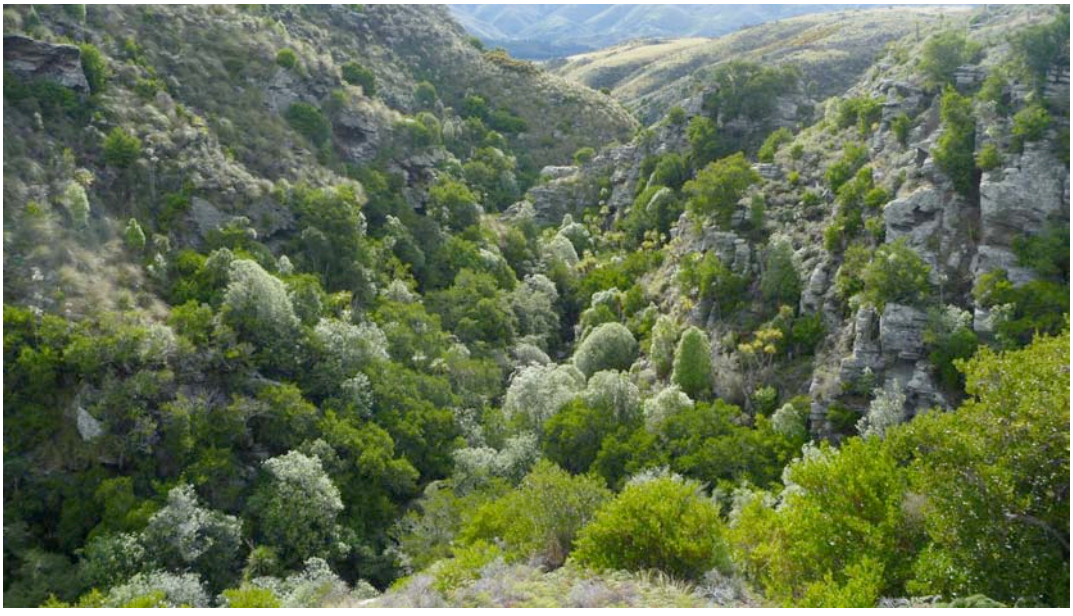

Figure 26 *Photo showing bush habitat in Cranky Jims Creek at property boundary of Oceana Gold Macraes.*

We recommend that this area is fenced off from stock and enhanced by weed control. Various wetlands and ephemeral ponds exist in the vicinity of Cranky Jims Creek headwaters (Figure 29 and Table 3). We recommend these wetlands are examined by an experienced botanist and any areas with high value are set aside as mitigation sites. Wetlands may require fencing off from stock and weed control.

Figure 27 *Photo showing bush habitat understorey in Cranky Jims Creek.*

Figure 28 *Photo showing tussock grassland habitat above Cranky Jims Bush.*

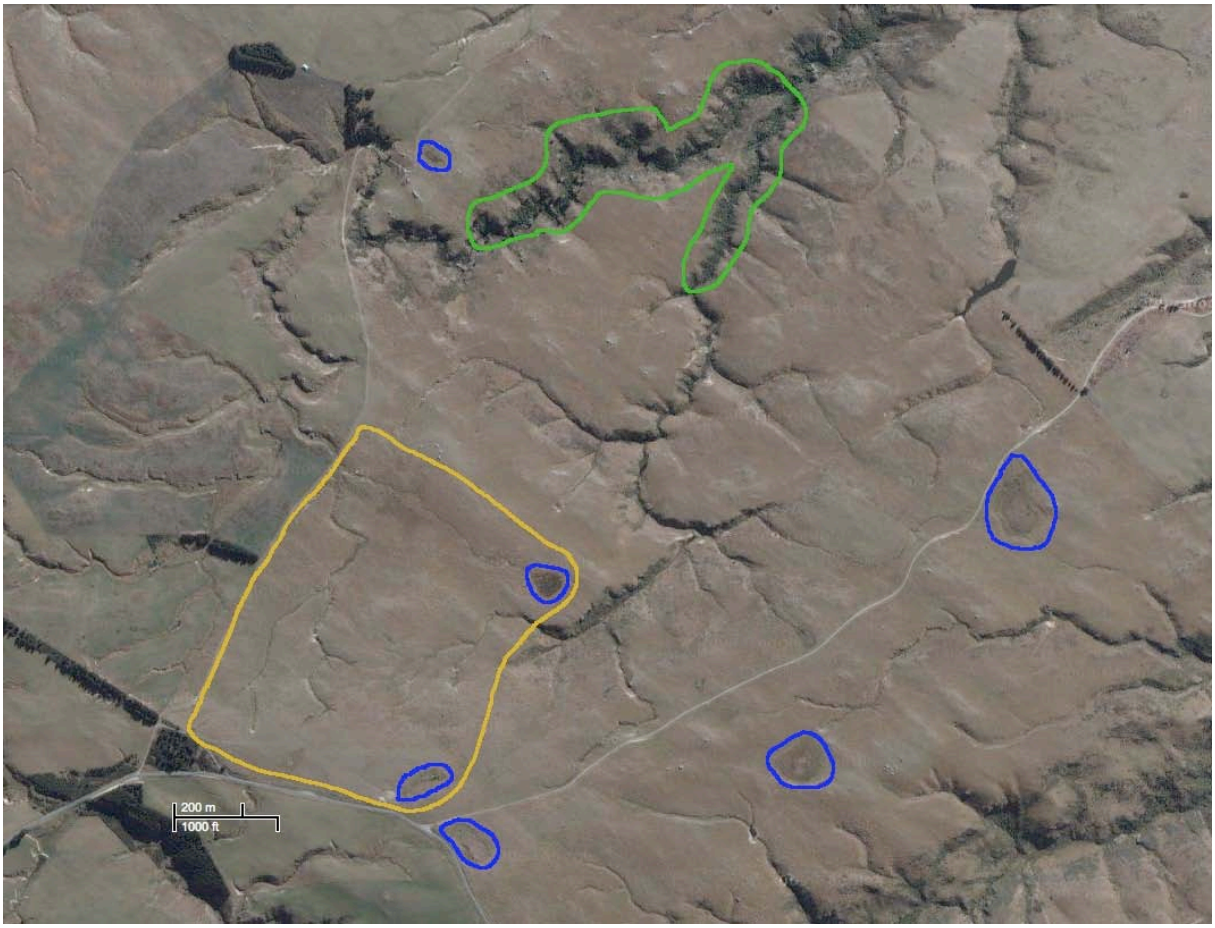

Figure 29 *Aerial photograph showing locations of potential mitigation sites. Core area of bush habitat shown in green, core area of tussock grassland shown in yellow, wetlands shown in blue.*

Table 3 *Area table for Figure 29.*

Colour	Type	Area in hectares
Green	Core area of bush habitat	28
Yellow	Core area of tussock grassland	75
Blue	Wetland	6

15.4.2 Highlay Creek

OceanaGold is considering setting aside an area of Highlay Creek due to the presence of an historical site (Figure 30). As the historical site is within a gully dominated by indigenous scrub (Figure 31), we recommend that the historical mitigation site be tied in with a scrub mitigation site of approximately 10 hectares. We recommend that this area is fenced off from stock and enhanced by weed control and planting of indigenous scrub vegetation. Some small areas of scrub may need to be removed to enhance historical values, this can be offset by new plantings of species such as *Melicytus alpinus, Corokia*

cotoneaster, Aristotelia fruticosa and *Dracophyllum* sp.

Figure 30 *Aerial photograph showing location of potential mitigation site in Highlay Creek. Core area of scrub shown in green.*

Figure 31 *Photo showing scrub vegetation in Highlay Creek, immediately upstream of historical site.*

16. Summary and Conclusion

The Macraes Phase III Project is located within the Macraes Ecological District, which contains high reptile diversity and is a stronghold for the 'Threatened - Nationally Vulnerable' New Zealand falcon. If the project goes ahead as planned it will have significant adverse effects on several threatened species and/or the habitats that support them. These effects include flooding or infill from waste rocks of the habitat of threatened lizards, flooding of hunting grounds of NZ falcon, removal of mature trees resulting in loss of nesting and roosting habitat and removal of tussock grassland pipit habitat.

As avoidance is not feasible for the bulk of the area affected, mitigation is considered appropriate to offset the adverse effects of the project. Recommended mitigation includes restoration of tussock grassland, native bush, indigenous scrub and wetlands, replanting of trees and translocation of lizards.

If all mitigation is carried out successfully it will reduce the effects of the project from significant adverse effects to no more than minor adverse effects.

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Appendix One

Map of 10km^2 bird survey grids overlaying Macraes Flat

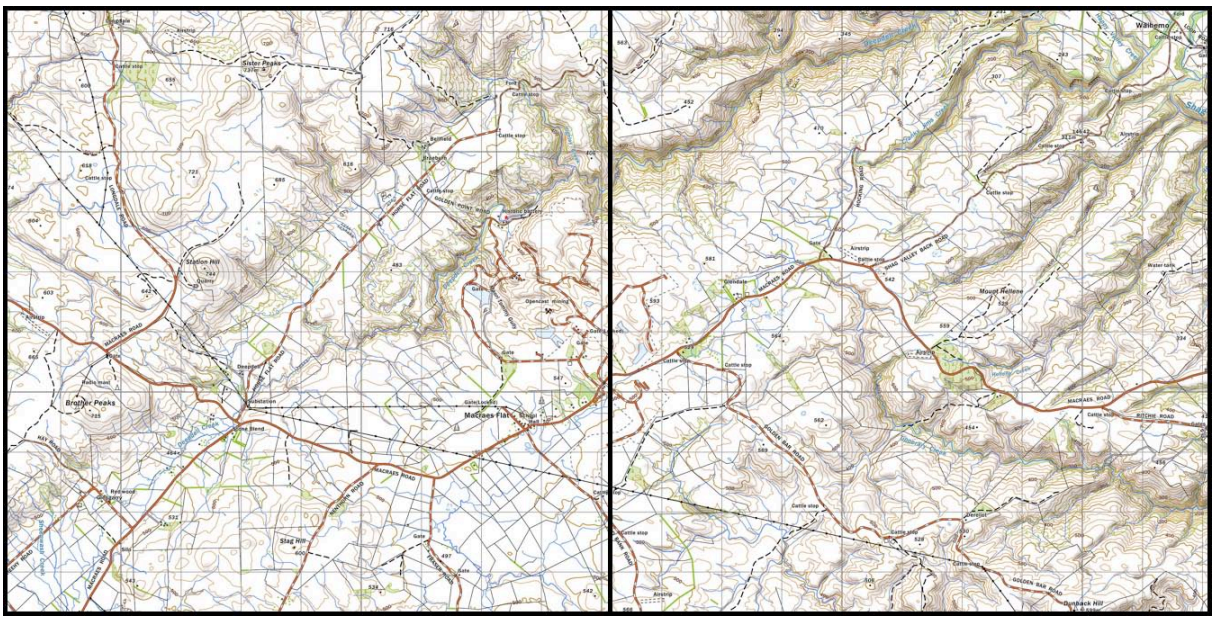

Figure 1.1 *Map of 10km^2 bird survey grids overlaying Macraes Flat (Robertson et al. 2007).*

Appendix Two

Avifauna identified in the Macraes Flat mining area

Table 2.1. *Avifauna identified in the Macraes Flat mining area.*

Common name	Scientific name	Distribution[1]	NZ threat classification[2]	Source[3]
Australasian Harrier	*Circus approximans*	Native	Not threatened	A,B,C,D
Australian Magpie	*Gymnorhina tibicen*	Introduced	Naturalised	A,B,C,D
Banded Dotterel	*Charadrius bicinctus bicinctus*	Endemic	Threatened - Nationally Vulnerable	A
Bellbird	*Anthornis melanura*	Endemic	Not threatened	A,B,C
Bittern	*Botaurus poiciloptilus*	Native	Threatened - Nationally Endangered	E
Black Fronted Tern	*Chlidonias albostriatus*	Endemic	Threatened - Nationally Endangered	A
Black Shag	*Phalacrocorax carbo*	Native	At Risk - Naturally Uncommon	A,C
Black Swan	*Cygnus atratus*	Introduced	Not threatened	B,C
Black-billed Gull	*Larus bulleri*	Endemic	Threatened - Nationally Endangered	A
Blackbird	*Turdus merula*	Introduced	Naturalised	A,B,C,D
Brown Creeper	*Mohoua novaeseelandiae*	Endemic	Not threatened	B
California Quail	*Callipepla californica*	Introduced	Naturalised	D
Canada Goose	*Branta canadensis*	Introduced	Naturalised	B
Chaffinch	*Fringilla coelebs*	Introduced	Naturalised	A,C,D
Dunnock	*Prunella modularis*	Introduced	Naturalised	A,C,D
Falcon	*Falco novaeseelandiae "*eastern*"*	Endemic	Threatened - Nationally Vulnerable	A,B,C,D
Fantail	*Rhipidura fulginosa*	Native	Not threatened	A,B,C,D
Feral Goose	*Anser anser*	Introduced	Naturalised	A
Feral Pigeon	*Columba livia*	Introduced	Naturalised	A,C,D
Feral Turkey	*Meleagris gallopava*	Introduced	Naturalised	C
Fernbird	*Bowdleria punctata punctata*	Endemic	At Risk - Declining	E
Goldfinch	*Carduelis carduelis*	Introduced	Naturalised	A,C,D
Greenfinch	*Carduelis chloris*	Introduced	Naturalised	A,C,D
Grey Duck x Mallard Duck hybrid	*Anas superciliosa superciliosa* x. *Anas platyrhynchos*	Native/Introduced	Unknown	A,D
Grey Teal	*Anas gibberifrons*	Native	Not threatened	A,C,D
Grey Warbler	*Gerygone igata*	Endemic	Not threatened	A,B,C,D
House Sparrow	*Passer domesticus*	Introduced	Naturalised	A,C,D
Kereru	*Hemiphaga novaeseelandiae*	Endemic	Not threatened	A
Kingfisher	*Halcyon sancta*	Native	Not threatened	A
Little Owl	*Athene noctua*	Introduced	Naturalised	A
Little Shag	*Phalacrocorax melanoleucos*	Endemic	At Risk - Naturally Uncommon	A,C
Mallard	*Anas platyrhynchos*	Introduced	Naturalised	A,B,C,D
New Zealand Pipit	*Anthus novaeseelandiae*	Endemic	At Risk - Declining	A,C,D
New Zealand Shoveler	*Anas rhynchotis*	Endemic	Not threatened	A,C,D
Paradise Shelduck	*Tadorna variegata*	Endemic	Not threatened	A,B,C,D
Pied Stilt	*Himantopus himantopus*	Native	At Risk - Declining	A,C
Pukeko	*Porphyrio porphyrio*	Native	Not threatened	B,C,D
Red-billed gull	*Larus novaehollandiae*	Native	Threatened - Nationally Vulnerable	B
Redpoll	*Carduelis flammea*	Introduced	Naturalised	A,C,D
Rook	*Corvus frugilegus*	Introduced	Naturalised	E
Scaup	*Aythya novaeseelandiae*	Endemic	Not threatened	C,D
Shining Cuckoo	*Chrysococcyx lucidus*	Native	Not threatened	C
Silvereye	*Zosterops lateralis*	Native	Not threatened	A,B,C,D
Skylark	*Alauda arvensis*	Introduced	Naturalised	A,C,D
Song Thrush	*Turdus philomelos*	Introduced	Naturalised	A,C,D
South Island Pied Oystercatcher	*Haematopus ostralegus*	Native	At Risk - Declining	A,B,C,D
Southern Black-backed Gull	*Larus dominicanus*	Native	Not threatened	A,B,C,D
Spur-winged Plover	*Vanellus miles*	Native	Not threatened	A,C,D
Starling	*Sturnus vulgaris*	Introduced	Naturalised	A,C,D
Tomtit	*Petroica macrocephala*	Endemic	Not threatened	A,B
Welcome Swallow	*Hirundo tahitica*	Native	Not threatened	A,C,D
White-faced Heron	*Ardea novaehollandiae*	Native	Not threatened	A,B,C,D
Yellowhammer	*Emberiza citrinella*	Introduced	Naturalised	A,C,D

Note: 1. Distribution from Heather and Robertson, 2000.

2. NZ Threat Classification from Miskelly *et al.* 2008.
3 Sources: A = Whitaker reports (1986, 1987a, 1992, 1995, 1996a, 1996b), B = Bibby 1997, C = Robertson *et al.* 2007, D = Ryder Consulting Oct/Nov 2010 field surveys. E = Department of Conservation observations.

Appendix Three

Suitable Planting Species for Shelterbelts

Common name	Scientific name	Distribution
Broadleaf	*Griselinia littoralis*	Native
Flax	*Phormium cookianum*	Native
Gum	*Eucalyptus* spp.	Introduced
Kanuka	*Kunzea ericoides*	Native
Kohukohu	*Pittosporum tenuifolium*	Native
Kowhai	*Sophora microphylla*	Native
Mountain toatoa	*Phyllocladus alpinus*	Native
Mountain totara	*Podocarpus cunninghamii*	Native
Radiata pine	*Pinus radiata*	Introduced
Tarata	*Pittosporum eugenioides*	Native

Appendix Four

Guidelines for Wetland Restoration – Adapted from Greater Wellington Regional Council (2009)

Guidelines for Restoring Wetlands

The steps that follow are a general guide that focus on swamps (estuaries and peat bogs will have different management needs). Each wetland is unique, so some steps may not be necessary in your situation. We recommend you seek professional help for detailed information and advice.

Larger wetlands may contain several different types of plant and animal communities, and all wetlands change with time as environmental conditions change.

Look, learn and plan.

Investigate the wetland's water supply.

Keep stock out, particularly at critical times of the year.

Consider providing 'extras' for wetland wildlife.

Control animal pests.

Tackle weeds.

Plant in and around your wetland.

Maintain the area with weeding and pest control.

Monitor your progress.

Protect your investment.

Look, learn and plan

Consider the wetland type, what you want to achieve and what suits your situation. Seek advice and take your time. No two wetlands are alike – how they look and the plants and animals they contain will vary with local conditions (eg, soils, climate and water flow).

Before you start restoring your wetland, develop a site plan and ask yourself:

What's there now? Plan to protect and encourage any desirable plants first.

What was there originally? What would you like to see in the future?

What are your aims? Erosion control? Wildlife? A water source?

How much time and what resources do you have?

What effect will your activities have on neighbouring properties, both upstream and down?

Could you work with neighbours? Seek advice and help

Investigate the water supply

Wetlands are covered or soaked for at least part, and often all, of the year. They depend on a natural supply of water – from tidal flows, streams, flooding rivers, connections with

groundwater, rainfall or a combination of these. The water level in your wetland, and how much it fluctuates, will determine the plants and animals it can support.
If water levels and flows need changing, this will be your first step. (You may need a resource consent). Before you even lift a spade, spend some time monitoring the source and amount of water, especially over the seasons. Use a 'depth marker' (such as a wooden post) to mark water levels at different times of the year, and use stakes to mark the edges of the winter water levels and summer water levels. This will help you decide if the water levels need restoring, and what to plant and where.
A number of things can damage a wetland's natural cycle of flooding and drying. They happen at two key places:

At the 'wetland' level the cycle can be affected by drainage (including the construction of drainage ditches) and filling and levelling low-lying areas.
At the 'catchment' level (ie. the source of the wetland's water) the cycle can be affected by fewer floods than normal (if rivers are stopbanked), overusing water in streams and groundwater, and the drainage of nearby wetlands.

If your wetland has been partially drained, you'll probably need to increase its water levels by filling in or blocking ditches or drains. If there have been changes within the catchment you may need to increase water levels by building a low bund, weir or dam, or other earthworks. Before you make any changes to water levels or undertake any earthworks, contact your local council for information about resource consents.

It's generally not a good idea to create areas of open water by excavating material out of existing wetlands or creating dams. Areas of open water can be difficult to keep free of weed and algae in summer, and dams can block fish access – and most native birds prefer swampy rushes and flax rather than deep, open water.
Avoid damming or excavating wetlands that have not been previously disturbed and that support native plants and animals. If you want to create open water, choose degraded wetland areas that have been partly drained and are covered in weeds. And make sure you create gently sloping, irregular shorelines. This allows birds, particularly waders, chicks and ducklings, easy access to and from the water and will extend the belt of reeds and rushes growing around the edge.

Keep stock out

Stock that venture into wetland areas are likely to increase the soil's nutrient levels, pug the soil, cause erosion, disturb the wildlife and eat and trample wetland plants. Cattle in particular tend to gather near water and wade into it.

Fencing stock out will encourage plants to regenerate from natural seed sources, prevent stock getting trapped, and in some areas may reduce the incidence of liver fluke. If you can, aim to exclude not just the wetland itself, but a buffer strip around it.

If you don't wish to keep stock out for the whole year – for example, if you want to keep surrounding plants cropped short for feeding waterfowl and pied stilt – it's better to graze a small number of sheep as they are less likely to enter water, pug soil or ring-bark trees. The best time is mid-summer to mid-autumn, as your wetland will be drier and most bird breeding will be over.

Provide 'extras' for wildlife

Extras for birds

As well as providing the basics for birds (water and shelter), you can provide a number of 'extras' that will make your wetland a highly desirable home:

Provide logs and trees in the water as well as the banks for perching sites and shelter.

During the breeding season (September to December for most species) either stop or significantly reduce grazing and other activities - birds are particularly sensitive to disturbance at this time.

If your wetland is near a block of native bush or another wetland, consider linking them with a 'green corridor' of native plants.

Extras for fish

If your wetland is connected to a stream (or streams) at least 10 centimetres deep – it should be accessible to most native freshwater fish. Long stretches of fast-flowing or polluted water and overhanging culverts can act as impassable barriers and stop fish getting to your wetland.

Native fish also need streams with fairly clear water, shading and cover. Muddy water limits their vision and reduces their food supply of aquatic insects.

Help fish find your wetland using the tips below:

Plant overhanging species like flax and sedges for shelter and to keep the water cool.

A hay bale placed at the head of a ditch entering your wetland will act as a simple silt

trap.

When clearing drains, leave one side or parts of it untouched until plants have grown back.

If using culverts in streams, set them low in the stream bed.

Rough up the smooth bottom of culverts with cement or rocks to slow water flow.

Control animal pests

A number of animals pose significant risks to wetland bird and plant life, for example:

possums, hedgehogs, stoats, weasels, ferrets, cats and rats all take birds' eggs, and most will also eat chicks and adult birds,

magpies are territorial and aggressive to other birds, rabbits, hares and possums eat wetland plants,

dogs may harass wetland birds (note: high-tensile net fencing will discourage dogs from entering the wetland and provide more incentive for birds to nest).

Pukeko can also pose a problem. Although a native to New Zealand and a natural part of a wetland ecosystem, they can nibble on and uproot newly planted seedlings. To deter them, use large and heavy potted plants. Alternatively, try placing a hedge of short sticks around the plants, or use plant protectors.

Animal pest control will enhance bird life in your wetland and protect young plants. Contact local council for practical advice and fact sheets on the best animal pest control methods for your situation.

Control the weeds

Weeds are one of the greatest threats to wetlands and, in many cases, weed control will be the most important thing you can do in restoring yours. If you're planning any planting, you must control weed species in and around the area first – and continue weed control once your planting is complete.

The first step is a weed audit, in which you use a map of the wetland to locate and identify weed infestations. The next step is to gather information on how to control the weed species. You can then decide where to start the weed control, and when – and remember, it may take several seasons to control a serious weed infestation.

You may find you need help from a specialist qualified to use herbicides in wetlands.

Wandering willows

Willows were introduced to New Zealand for bank stability, shelterbelts and fodder. However, their dense growth can block stream flow and shade out native species. Crack willow and grey willow are particularly invasive – their broken branches take root easily in muddy soils, and grey willows have tiny, windblown seeds. Willows can be controlled in a number of ways – we recommend you first seek specialist advice from local council.

Helpful hints on weed control

When working with spades and machinery in weedy areas, wash them down before using them elsewhere to prevent weed spread.

Fence out stock to reduce the spread of weeds.

Barley straw reputedly inhibits algal growth and boosts aquatic insect life in slow-moving water. Two bales should keep around half a hectare of shallow, open water free of algae for six months. Either spread it out or anchor it in one position – eventually it will sink and decompose.

Start planting

Prepare a planting plan

When you're ready to plant your wetland, divide it into three plant zones:

Moist soils that flood infrequently.

Wet soils, with temporary flooding.

Standing water/water margin.

Identify any desirable plants you already have in each zone, and list the plants you can use in each, taking into account wind and drainage.

Table C.1 includes a small sample of potential species. Not all will be suitable for your area or situation – coastal and upland areas, in particular, have their own species associations.

It's a good idea to buy your plants from nurseries that source plants from your district. This will ensure they're suited to your climate and soils.

You may also be able to grow some of the plants you need from seeds or cuttings taken from neighbouring wetlands, with permission. Keep use of cuttings to a minimum and take them from a large number of parent plants, to ensure a good genetic mix and that you have male and female plants.

Table 4.1 *Planting zones and plant examples for wetland planting*

Zone 1: Moist soils **Flood infrequently**	**Zone 2: Wet soils** **Temporary flooding**	**Zone 3: Water margin** **Standing water**
Mingimingi (*Coprosma propinqua*) Good erosion control with fibrous roots, bird- distributed seeds. Can be used as a nurse crop. Grown from seed or cuttings.	Toetoe (*Austroderia richardii*) (not to be confused with pampas) Pioneer. Suitable for damp and dry soils – can grow on poor soils. Rats and stoats can inhabit dense stands.	Marsh Clubrush (*Bolboschoenus fluviatilis*) Grows in fertile water up to 0.8 metres deep, tolerates salt water. Wildlife shelter. Best grown from division although will also grow from seed.
Kanuka (*Kunzea ericoides*) Fast-growing, hardy pioneer, useful as a nurse crop. Good erosion control, can grow on a wide range of soils. Grow from seed.	Flax (*Phormium cookianum*) Fast-growing, hardy plant. Withstands five centimetres of water, flooding and dry soils. Unpalatable to possums. Easily split into small fans or grown from seed. Attracts tui.	Pukio (*Carex secta*) Grows in shallow water, boggy margins and dry soil. Shelter and nesting for ground birds. Can be split or grown from seed.
Mountain totara (*Podocarpus nivalis*) Prostrate shrub. Good in exposed places. Good erosion control.	Cabbage tree (*Cordyline australis*) Tolerates wet and dry soils. Rabbits eat young plants. Can be grown from seed. Hardy. Good erosion control.	Uncinia sinclairii Grows in boggy soils. Easily grown but slow to establish. Fresh seed germinates easily and plants can be grown by division.

Timing

In wet areas, around the water's edge and in shallow water, plant in summer when water levels are low and the water is warm.

Otherwise, plant hardy, frost-tolerant species in autumn and frost- sensitive species in spring. Plants that need shelter or shade can be planted one to two years later, once cover has developed.

Site preparation

Clear a one-metre circle around each planting spot with a spade or a herbicide to prevent competition from grass and weeds. This will make sure your plants get enough light and nutrients.

Planting

Remember, native plants don't tolerate grazing by stock – protect your investment by keeping stock out.

When planting:

choose sites suitable to each plant's growing requirements, leaving space for them to grow. Ferns, rushes and small sedges can be planted three per square metre. Larger plants need more room,

dig a hole twice the size of the plant container, leaving some soft soil at the bottom. Set the plant in the hole and gradually fill in the soil, compacting it to remove air gaps,

if you're planting on dry sites around the edge of your wetland, form a hollow around the plant's base to trap rainfall,

give the plants and surrounding soil a good watering. Water young plants over dry spells.

Staking the plants at this stage will make them easier to find later. Tall, thin bamboo stakes highlighted with spray paint are ideal.

Looking after your plants

Weeds can overwhelm your plants in the first one to three years. Smothering by tall grass is the most common cause of planting failure.

It's important to maintain your plants during this time by clearing the weeds around them. You can weed by hand or with a grubber or herbicide – and save further weeding by using mats (eg, non- rubberised carpet underlay) that eventually decompose. Pests such as rabbits and possums should also be controlled, particularly during the plants' seedling stage.

Once the plants have grown tall enough, they will begin to shade out grasses and aquatic weeds and will no longer need weed control. After three years, your plants should take care of themselves.

Herbicides

You can greatly reduce the need for manual weeding if you use glyphosate herbicide (we don't recommend long-lasting residual herbicides, as they remain toxic to plants three to four months after application).

The best time to spray is late summer when water levels are low and most nesting and flowering have taken place. Chemicals are transported rapidly through water, making wetlands more sensitive to pollution and herbicides.

You can get more information on suitable herbicides and suggested application rates from plant pest officers at your local council.

Note: If you want to apply herbicide to weeds that are in the water, you will need a resource consent.

More planting tips

The best time to plant in zones 2 and 3 is in summer when the water levels are at their lowest. To ensure your plants have the highest as possible a chance of survival, use larger potted plants. They are also less likely to be uprooted by pukeko.

When planting the dry edges of wetlands, use a mulch at least 10cm deep. This can be untreated wood chips, compost, cardboard, old carpet underlay or rotted hay. It will help to conserve water from evaporation, keep weeds down and add nutrients. Alternatively, leave a low grass cover around the plants for the first summer (until March) to help conserve water.

Use fast-growing species such as manuka as nurse plants to provide shade for seedlings underneath.

Monitor your progress

Make sure you maintain an ongoing programme of weed and pest control. Keep a photographic record and a diary of progress. It will help you to learn what works and what doesn't and make changes as necessary. It will also be a record to show you how much you have achieved.

Protect your investment

You can protect your investment of time and energy by placing a covenant on the site. This means you or subsequent owners retain ownership and control, but the wetland is protected forever.