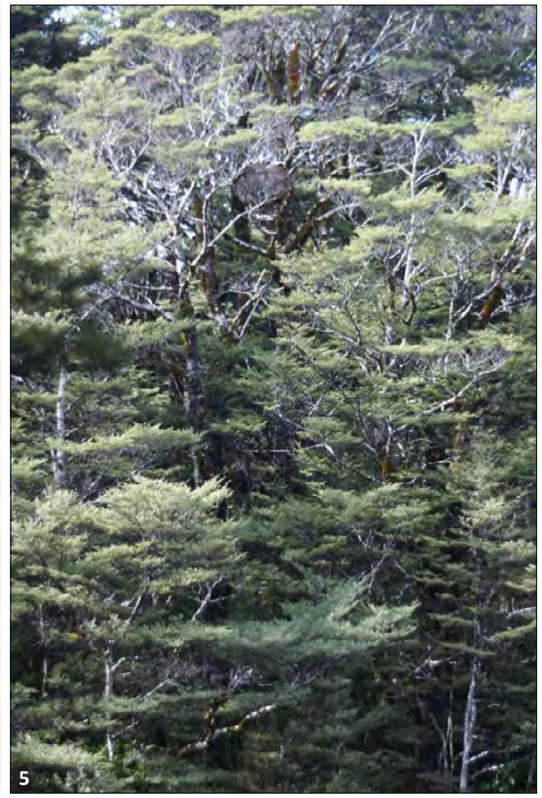
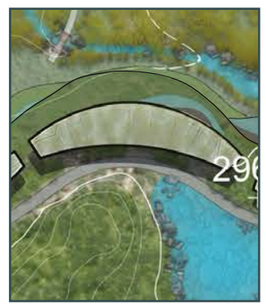
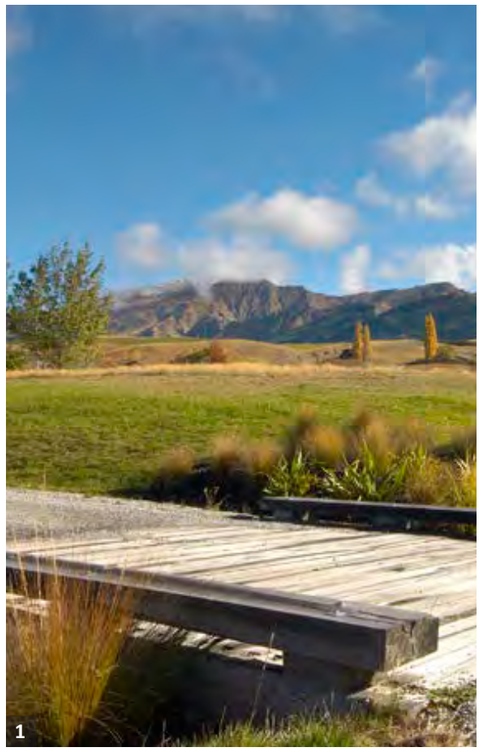


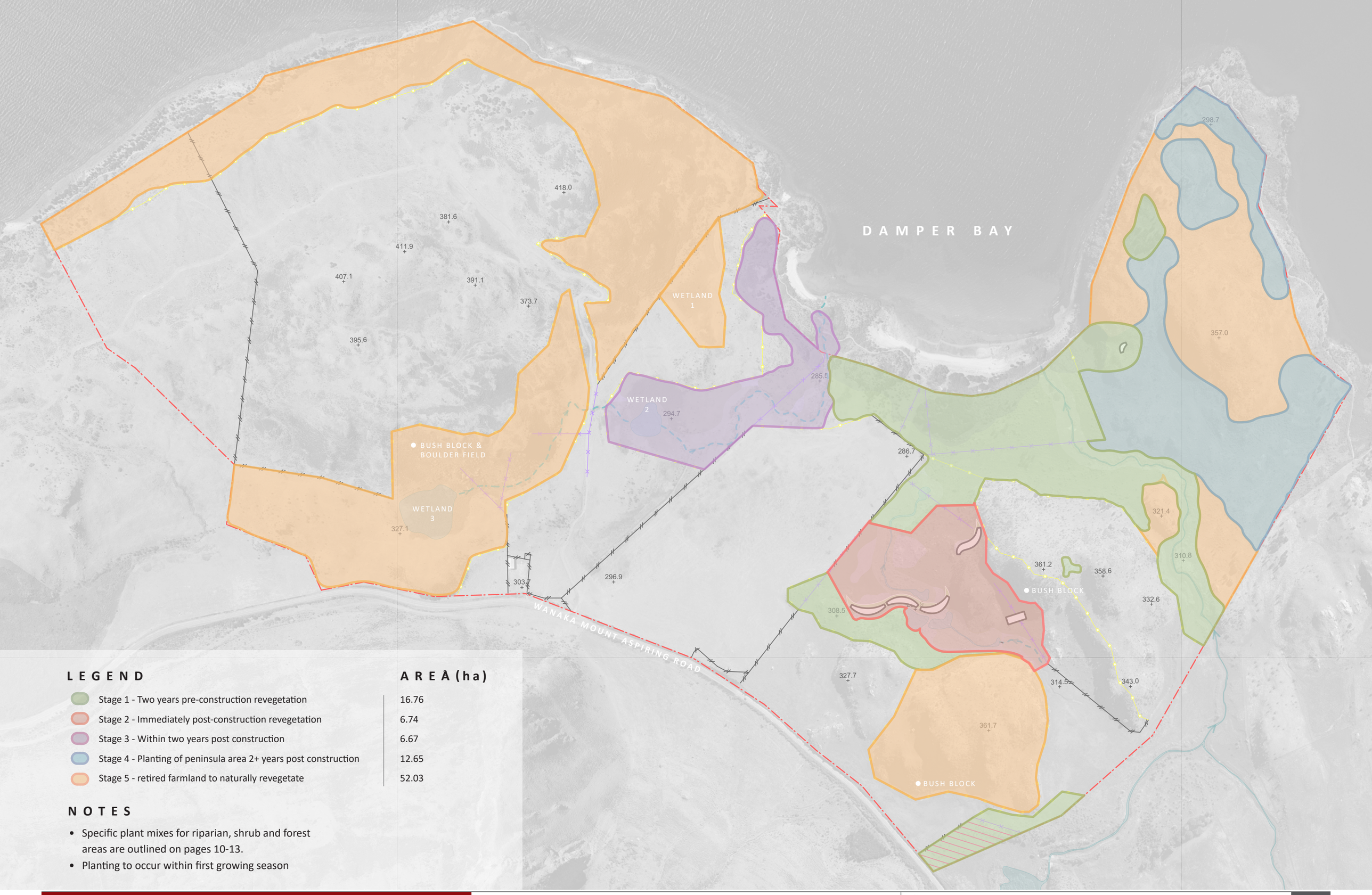
1 Mysine divaricata | Weeping Matipo
2 Podoacrpus laetus | Hall's Totara
3 Kunzea serotina | Kanuka
4 Nothofagus menziesii | Silver Beech
5 Fuscospora cliffortioides | Mountain Beech

1 Muehlenbeckia complexa | Creeping Wire Vine
2 Festuca novae-zelandiae | Hard Tussock
3 Helichrysum lanceolatum | Niniao
4 Poa cita | Silver Tussock
5 Acaena microphylla | Bidibid
6 Libertia peregrinans | Mikoikoi
7 Coprosma acerosa ‘Hawera’ | Hawera Coprosma
8 Coprosma propinqua | Mingimingi
9 Discaria toumatou | Matagouri





1 Silvering timber bridge exemplar
2 Corten steel detail
3 Cluden schist surface
4 Vitex timber
5 Feature schist boulders
6 Schist edge details
7 Flagstone detials
8 Natural shapes, colours and textures
9 Exposed aggregate
10 Architectural ponds



LEGEND

	AREA (ha)
Stage 1 - Two years pre-construction revegetation	16.76
Stage 2 - Immediately post-construction revegetation	6.74
Stage 3 - Within two years post construction	6.67
Stage 4 - Planting of peninsula area 2+ years post construction	12.65
Stage 5 - retired farmland to naturally revegetate	52.03

NOTES

- Specific plant mixes for riparian, shrub and forest areas are outlined on pages 10-13.
- Planting to occur within first growing season

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Ecological Staging Plan

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

SHEET 29

LEGEND

- Site Boundary
- Proposed Building Layout
- # Viewpoint Location
- # Viewpoint Location and Visual Simulation Location

N.B. All distances measured from viewpoint to Pod A unless stated otherwise

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Viewpoint Location Map

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

SHEET 30

Viewpoint 1: Looking east towards site from Wanaka Mt Aspiring Road at a distance of 720m from Pod D
Date: 02 February 2021 **Time:** Between 10:00am and 3:00pm

Viewpoint 2: Looking east towards site from Wanaka Mt Aspiring Road
Date: 02 February 2021 **Time:** Between 10:00am and 3:00pm

Viewpoint 3: Looking north towards site from Roys Peak Track at a distance of 1.20km
Date: 02 February 2021 **Time:** Between 10:00am and 3:00pm

Viewpoint 04 - Existing

Viewpoint 04 - Proposed - 5 Years

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 367868.958
Northing: 808750.62
Elevation : 296.903m
Height of Camera : 1.5m
Orientation of View : SE
Date of Photography : 12 July 2021
Time of Photography : 11:59am

DAMPER BAY

Viewpoint 04 - Looking South East Mt Roy Track

Distance to site: 806m

NOTES: The Proposed - 5 Years is a 3D photo simulation.
All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were supplied by JEA Surveyors.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 18-08-2021

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Viewpoint 4 Visual Simulations - Existing & Proposed View

Camera: Canon 5Dmk2 **Focal Length:** 50mm **Print Size:** A3

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

SHEET 33

Viewpoint 04a - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 367868.958
Northing: 808750.62
Elevation : 296.903m
Height of Camera : 1.5m
Orientation of View : SE
Date of Photography : 12 July 2021
Time of Photography : 11:59am

DAMPER BAY

Viewpoint 04a - Looking South East Mt Roy Track

Distance to site: 806m

NOTES: The Proposed - 5 Years is a 3D photo simulation.
All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were supplied by JEA Surveyors.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 18-08-2021

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Viewpoint 4a - Existing View

Camera: Canon 5Dmk2 **Focal Length:** 50mm **Print Size:** A3

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

SHEET 34

Viewpoint 04a - Proposed - 5 Years

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 367868.958
Northing: 808750.62
Elevation : 296.903m
Height of Camera : 1.5m
Orientation of View : SE
Date of Photography : 12 July 2021
Time of Photography : 11:59am

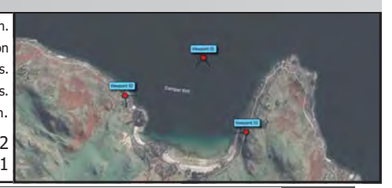
DAMPER BAY

Viewpoint 04a - Looking South East Mt Roy Track

Distance to site: 806m

NOTES: The Proposed - 5 Years is a 3D photo simulation.
All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were supplied by JEA Surveyors.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 18-08-2021



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Viewpoint 4a Visual Simulation - Proposed View

Camera: Canon 5Dmk2 **Focal Length:** 50mm **Print Size:** A3

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

SHEET 35

Viewpoint 04b - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 367868.958
Northing: 808750.62
Elevation : 296.903m
Height of Camera : 1.5m
Orientation of View : SE
Date of Photography : 12 July 2021
Time of Photography : 11:59am

DAMPER BAY

Viewpoint 04b - Looking South East Mt Roy Track

Distance to site: 806m

NOTES: The Proposed - 5 Years is a 3D photo simulation.
All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were supplied by JEA Surveyors.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 18-08-2021

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Viewpoint 4b - Existing View

Camera: Canon 5Dmk2 **Focal Length:** 50mm **Print Size:** A3

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

SHEET 36

Viewpoint 04b - Proposed - 5 Years

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 367868.958
Northing: 808750.62
Elevation : 296.903m
Height of Camera : 1.5m
Orientation of View : SE
Date of Photography : 12 July 2021
Time of Photography : 11:59am

DAMPER BAY

Viewpoint 04b - Looking South East Mt Roy Track

Distance to site: 806m

NOTES: The Proposed - 5 Years is a 3D photo simulation.
All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were supplied by JEA Surveyors.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 18-08-2021

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Viewpoint 4b Visual Simulation - Proposed View

Camera: Canon 5Dmk2 **Focal Length:** 50mm **Print Size:** A3

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

SHEET 37

Viewpoint 5: Looking south-east towards site from Wanaka-Glendhu Bay Track at a distance of 714m
Date: 19 May 2021 **Time:** Between 10:00am and 3:00pm

Viewpoint 6: Looking south-east towards site from sandpit at a distance of 655m
Date: 17 May 2021 **Time:** Between 10:00am and 3:00pm

Viewpoint 7a: Looking east towards site from Wanaka-Glendu Bay track at a distance of 460m from Pod M
Date: 14 July 2021 **Time:** Between 10:00am and 3:00pm

Viewpoint 7b: Looking east to site from Wanaka-Glendhu Bay Track at a distance of 452m from Pod M
Date: 19 May 2021 **Time:** Between 10:00am and 3:00pm

Viewpoint 8: Looking south towards site from Wanaka-Glendhu Bay Track and track at a distance of 418m
Date: 02 February 2021 **Time:** Between 10:00am and 3:00pm

Viewpoint 9: Looking east towards Pod M from Wanaka-Glendhu Bay Track and track at a distance of 136.5m
Date: 27 August 2021 **Time:** 3:00pm

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Viewpoint 8 and 9

VP 9 Camera: Cellphone
VP 8 Camera: Canon EOS 7D Mark II **Focal Length:** 50mm **Print Size:** A3

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

SHEET 40

Viewpoint 10: Looking south-west towards site from Wanaka-Glendhu Bay Track at a distance of 1.03km
Date: 02 February 2021 **Time:** Between 10:00am and 3:00pm

Viewpoint 11: Looking south-west towards site from Wanaka-Glendhu Bay Track at a distance of 930m
Date: 02 February 2021 **Time:** Between 10:00am and 3:00pm

Viewpoint 12: Looking south-west towards site from Wanaka-Glendhu Bay Track at a distance of 862m
Date: 02 February 2021 **Time:** Between 10:00am and 3:00pm

Viewpoint 13 - Existing

Viewpoint 13 - Proposed - 5 Years

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 368494.8
Northing: 808584.61
Elevation : 304.201m
Height of Camera : 1.5m
Orientation of View : SW
Date of Photography : 12 July 2021
Time of Photography : 12:46pm

DAMPER BAY

Viewpoint 13 - Looking South West Mt Roy Track

Distance to site: 759m

NOTES: The Proposed - 5 Years is a 3D photo simulation.
All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were supplied by JEA Surveyors.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 18-08-2021

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Viewpoint 13 Visual Simulations - Existing & Proposed View
Camera: Canon 5Dmk2 **Focal Length:** 50mm **Print Size:** A3

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

SHEET 43

Viewpoint 13 - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 368494.8
Northing: 808584.61
Elevation : 304.201m
Height of Camera : 1.5m
Orientation of View : SW
Date of Photography : 12 July 2021
Time of Photography : 12:46pm

DAMPER BAY

Viewpoint 13 - Looking South West Mt Roy Track

Distance to site: 759m

NOTES: The Proposed - 5 Years is a 3D photo simulation.
All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were supplied by JEA Surveyors.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 18-08-2021

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Viewpoint 13 - Existing View

Camera: Canon 5Dmk2 **Focal Length:** 50mm **Print Size:** A3

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

Viewpoint 13 - Proposed - 5 Years

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 368494.8
Northing: 808584.61
Elevation : 304.201m
Height of Camera : 1.5m
Orientation of View : SW
Date of Photography : 12 July 2021
Time of Photography : 12:46pm

DAMPER BAY

Viewpoint 13 - Looking South West Mt Roy Track

Distance to site: 759m

NOTES: The Proposed - 5 Years is a 3D photo simulation.
All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were supplied by JEA Surveyors.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 18-08-2021

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Viewpoint 13 Visual Simulation - Proposed View

Camera: Canon 5Dmk2 **Focal Length:** 50mm **Print Size:** A3

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

Viewpoint 14: Looking south-east towards site from lake at a distance of 1.2km
Date: 14 July 2021 **Time:** Between 10:00am and 3:00pm

Viewpoint 15 - Existing

Viewpoint 15 - Proposed - 5 Years

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 368240.347
Northing: 808969.480
Elevation : 277.376m
Height of Camera : 1.5m
Orientation of View : S
Date of Photography : 12 July 2021
Time of Photography : 11:28am

DAMPER BAY

Viewpoint 15 - Looking South Lake Wanaka

Distance to site: 1.05km

NOTES: The Proposed - 5 Years is a 3D photo simulation.
All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were supplied by JEA Surveyors.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 18-08-2021

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Viewpoint 15 Visual Simulations - Existing & Proposed View

Camera: Canon 5Dmk2 **Focal Length:** 50mm **Print Size:** A3

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

SHEET 47

Viewpoint 15 - Existing

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 368240.347
Northing: 808969.480
Elevation : 277.376m
Height of Camera : 1.5m
Orientation of View : S
Date of Photography : 12 July 2021
Time of Photography : 11:28am

DAMPER BAY

Viewpoint 15 - Looking South Lake Wanaka

Distance to site: 1.05km

NOTES: The Proposed - 5 Years is a 3D photo simulation.
All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were supplied by JEA Surveyors.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 18-08-2021

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Viewpoint 15 - Existing View

Camera: Canon 5Dmk2 **Focal Length:** 50mm **Print Size:** A3

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

SHEET 48

Viewpoint 15 - Proposed - 5 Years

IMAGE TO BE VIEWED AT 50cm FROM EYE FOR CORRECT VIEWING SCALE WHEN PRINTED AT A3

VIRTUALVIEW
3D VISUALISATION SPECIALISTS

Easting: 368240.347
Northing: 808969.480
Elevation : 277.376m
Height of Camera : 1.5m
Orientation of View : S
Date of Photography : 12 July 2021
Time of Photography : 11:28am

DAMPER BAY

Viewpoint 15 - Looking South Lake Wanaka

Distance to site: 1.05km

NOTES: The Proposed - 5 Years is a 3D photo simulation.
All photos were taken by Virtual View with a Canon 5Dmk2 and a 50mm lens.
Photo positions were supplied by JEA Surveyors.
Dashed white line indicates cropped viewpoint portion.

Version info: 0002
Date Printed: 18-08-2021

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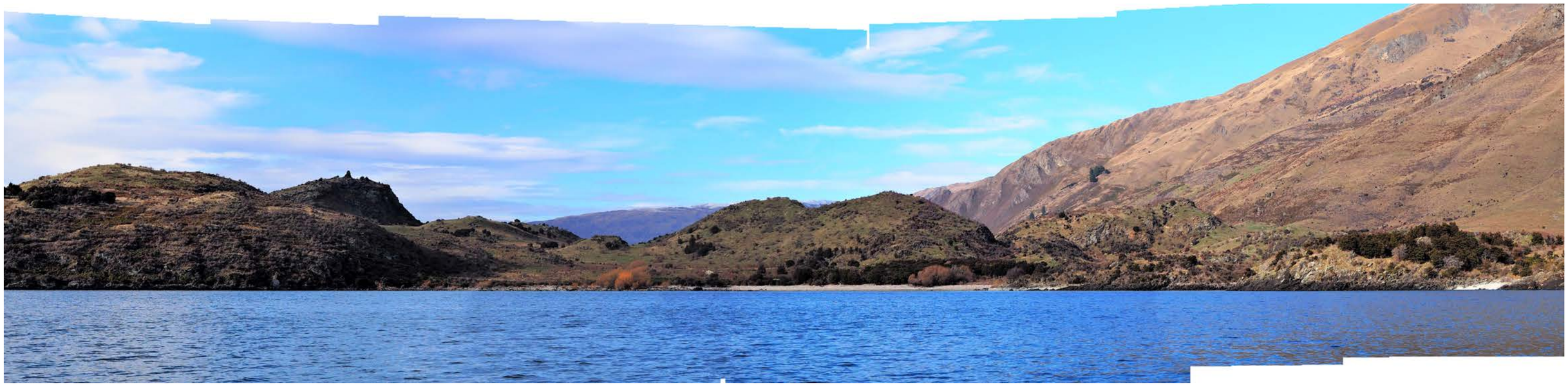
Viewpoint 15 Visual Simulation - Proposed View

Camera: Canon 5Dmk2 **Focal Length:** 50mm **Print Size:** A3

Proposed Development, Damper Bay, Wanaka - Mt Aspiring Road, Wanaka
August 2021

SHEET 49



Viewpoint 16: Looking south-east towards site from lake at a distance of 1.062km
Date: 14 July 2021 **Time:** Between 10:00am and 3:00pm.

Viewpoint 17: Looking south towards site from lake at a distance of 743m
Date: 14 July 2021 **Time:** Between 10:00am and 3:00pm.

Viewpoint 18: Looking south towards site from lake at a distance of 726m
Date: 14 July 2021 **Time:** Between 10:00am and 3:00pm.

Damper Bay.
Ecological Assessment

Prepared for John Edmond & Associates Limited.

Background

A preliminary assessment was made of the water courses and water bodies on the Damper Bay property to describe their general ecological values. The property boundary is shown in sheet 6 “Site Aerial” Rough & Milne 2021. Once these values and the associated habitat limitations were identified opportunities for enhancement and restoration were described.

The potential to support a new wetland habitat complex to provide amenity and natural values in association with the main buildings was briefly considered. Evaluation of other sites in terms of their enhancement potential, such as an area of remnant kanuka forest and grey shrublands draws on an ecological assessment undertaken by Boffa Miskell in 2010 and documented in a report titled Damper Bay Ecology.

There is a degree of crossover between terrestrial and aquatic habitats especially around wetlands and riparian zones. The Boffa-Miskell Report 2010 (‘BM Report’) should be referred to for the in-depth details of terrestrial ecology- this report can be found at Appendix 2. Other sources of information were the New Zealand Freshwater Fish Database, The Rough & Milne Landscape Report and JEA Ltd. briefs on landscape, building locations and design.

The property has historically supported sheep and beef farming but rocky topography has limited the opportunity to cultivate the land so that has been restricted to surrounding flatter paddocks. The vegetation shows the classic central Otago “drying off” as plants respond to the lack of water in the shallow soils close to the rocky outcrops and up the hillsides over summer. On the steeper slopes, especially on the colder faces, remnants of once, more common, bush and scrub vegetation are still present. These areas have provided limited refuge from fire and agriculture for this suite of vegetation.

Methods of Assessment.

I visited the site in March 2021 when I sampled fish and water quality in the NE Stream, and assessed the aquatic values of the ephemeral watercourse near the building site areas. In the March survey I inspected scrublands and identified significant trees and shrubs particularly in the riparian zone. I inspected the scrublands to the NW and the wetlands and identified restoration options in July. I also collected additional water quality data on the July visit and inspected the ephemeral watercourse and NE stream to check for seasonal differences.

The water courses and wetlands were checked for flow and pathways of drainage noted. Significant points were recorded on a GPS. Vegetation was checked for aquatic species, in particular the western water course (ephemeral stream), where building sites have been located.

The north eastern (NE) Stream was electro-fished at two sites (Fish 1 and Fish 2, figure 1) to check fish species present and habitat characteristics were recorded. Invertebrates were sampled at the 2 fish survey sites using a kick sampler to give baseline data on species present and the consequent indication of water quality. Two 50m reaches in the less modified section were selected for the fish sampling, approximately 200 and 400m from the lake shore.

At other noted locations water quality was assessed. Areas of native vegetation (Scrub Blocks, figure 1) that are possible sources of nursery plants and that would benefit from protection from rabbits and farm stock were recorded. Suggestions for enhanced fencing were noted.

Wetland dimensions, water sources that feed the wetlands, and options for restoration were recorded.

Observations on the effects of grazing, where grazing can be helpful as a management tool, and where grazing might be avoided are included below.

Comments on the value of changing the emphasis from farming to enhance general biodiversity and compliment wildlife corridors are listed below.

Figure 1, ecological and survey sites of Damper Bay, bush, wetlands 1, 2 & 3. Water quality sites 1, 2, 3, & 4. Fish survey sites 1 & 2.

Existing Environment

The BM Report (2010) describes the Damper Bay landform as a central fan with "distinctive roche moutonnee "sheepback" landforms to the east and west". These landforms are created by the passing of a glacier. The "Glossary of Glacial Terms" published in 2013 by the U.S. Geological Survey (USGS), defines *roche moutonnée* , as "an elongated, rounded, asymmetrical, bedrock knob produced by glacier erosion. It has a gentle slope on its up-glacier side and a steep to vertical face on the down-glacier side.". The Damper Bay property is a glaciated landscape highly modified by human activities that have substantially altered the vegetation. Leathwick et al 2004, in the BM Report, records the previous suite of vegetation as "tussock grassland, scrub and shrublands with areas of matai, kahikatea, totara forest near the shore and silver beech on elevated areas". Remnants of the shrublands remain but various human activities and continued grazing have changed the vegetation landscape markedly. However what remains provides ample opportunity for restoration and rehabilitation and is a seed source for such a program.

Site Features

As referred to on the Figure 1 above, the following watercourses and other features were mapped on the site:

Table 1, GPS locations of specific habitats and sampling locations, WQ=water quality.

Feature	**E**	**N**	**Parameter**
Ephemeral water course (a)	1288263	5046961	Visual survey
Ephemeral water course (b)	1288137	5047170	Visual survey
NE Stream (a)	1288630	5046997	Fish/WQ/Photo
NE Stream (b)	1288522	5046629	Fish/WQ/Photo
Wetland 1	1287751	5047589	Photo, dimensions
Wetland 2	1287636	5047300	Photo, dimensions
Wetland 3	1287246	5047097	Photo, dimensions
Kanuka Grove	1288197	5047322	location
NW shrublands	1287359	5047911	location

Ephemeral Water Course

This western water course has historically been channelized to facilitate drainage of pasture and cropping land to the east. It is a dry channel for most of the year and although there is some jointed rush and *carex* along the margins the channel is mostly grassed. There was no surface water or damp locations indicating where water may have recently lain (March 2021). In some sections, the channel was green grass but in others the grass had died off as the soil was progressively dehydrated in the Central Otago summer sunshine.

A further inspection in July noted evidence of water flow in the channel from a recent heavy rain event but there was no surface water. There are no aquatic or wetland values in this water course, it is simply a storm water course and therefore does not provide a reliable water supply to maintain any aquatic or wetland values. The establishment of water features around the proposed development is likely to provide opportunities to establish wetland habitat in this drainage.

NE Stream

The catchment area for this stream begins on the N slopes of Mt Roy, travels NE and then NW through neighbouring properties. It continues NW through the Damper Bay property to discharge into Damper Bay on the Lake Wanaka southern shoreline. This Mt Roy tributary is the main tributary supplying water to the NE Stream on the Damper Bay property. A wetland, heavily infested with raupo, *(Typha orientalis)* (not threatened) forms another tributary of this drainage system. There are current attempts to replant much of this wetland, most of which is on the neighbouring property, with native plants. From the wetland, the stream flows in a heavily channelised section to meet the main tributary near the eastern edge of the Damper Bay property. Both tributary catchments are through cultivated pasture land and finally through rough pasture.

There is extensive evidence of cattle damage and channelization to the NE Stream but where the pasture is less productive and therefore cattle grazing less intense, the stream still has a meandering form in a well-defined channel and has the potential to provide good habitat.

There is a large amount of fine sediment/soil clogging the main channel at the most upstream end of this stream, at the eastern property boundary, photograph in appendix 1. The removal of this fine sediment loading would greatly enhance habitat quality and carrying capacity of this stream for aquatic life.

The stream riparian vegetation is largely pasture grasses but with a few willows in the lower reaches and matagouri and Rose hip characteristic of the surrounding hillsides in the upper sections. There is an abundance of *carex* and rushes scattered along the stream margins. In the upper reaches, long exposure to cattle grazing (and channelization) has lead to trampling of the banks and the creation of a broad shallow floodway. The form of the lower reaches is much less modified and has all the characteristics of tumbling small stream and the associated noises of flowing water. The channel is much more deeply incised between grassy banks with many twists and turns as it makes its way to the lake.

The stream in general would benefit from measures to restrict the supply of fine sediment from upstream and stock access to the banks. With the vegetation present the habitat should quickly respond to these measures and improve substantially.

Flow from the stream at a point about 300m from Lake Wanaka, was in the order of 15L/s on the day of fish survey, March 2021. Evidence from the debris line from the flood in July show it can reach much higher flows.

This stream has abundant potential to be enhanced with some restorative works and could support a greater density of fish than at present.

Wetlands

Two wetlands in varying degrees of modification are located on the eastern side of the western roche moutonnée. The stream draining these wetlands is referred to as an ephemeral stream in the Boffa-Miskell 2010 report. An additional wetland is at the south end of this roche moutonnée in an elevated basin, it does not have a surface drainage.

This sequence of 3 wetlands is about 1km from the wetland on the neighbouring property to the east, 700m from the wetland to the west and is therefore an important component in establishing a corridor of wetland habitat which will further support wildlife in the area.

A wetland restoration plan would maximise benefits to wetland fauna and flora. Restoration of degraded wetlands is allowed for in the NES, National Environmental Standards of the RMA. There are conditions related to preserving wetland vegetation but the Damper Bay remnant wetlands are definitely retrievable and a good recovery is to be expected as wetland plant species are still present and would be a seed source once wetland habitat was restored.

Wetland 1

This wetland has open water as observed in July 2021, it is orientated roughly NW-SE, and is on the eastern slopes at the north end of the western roche moutonnee. It measures 90x20m. There has historically been a connection with an adjacent wetland area 45m to the south, this extra wetland measures approximately 50x50m. This wetland complex (potentially 4300m^2) has been partially drained and wetland values severely restricted but is still dominated by wetland plants. Restoration would be relatively simple and the existing flora would respond well given improved habitat, enhanced water retention and protection from grazing. There are several spring water sources from the steep hill to the west. Restoration would involve blocking the constructed outlet channel, excavation to improve connection between the two arms of the wetland, and excavation to create some more open water.

Wetland 2

Wetland 2 is 350m SSW of Wetland 1 and approximately east of the midpoint of the western roche moutonnée. This wetland presently holds no open water as excavated drainage ditches have been successful in draining all water emanating from the hillsides to the west. The wetland is defined by the distribution of remnant wetland plants over an area approximately 140x70m (9800m^2). To restore it, blockage of the outlet channel and excavation around existing wetland vegetation to create open water will be required. Wetland fauna will quickly utilize such new habitat and wetland plants flourish with protection from livestock.

Wetland 3

This wetland is situated in an elevated basin on the southern end of the western roche moutonnée. It measures 140x120m, (16800m^2) in extent. It is approximately 10% open water and the rest is dense wetland vegetation mostly of carex species. It is approximately 360m SW of wetland 2 and 700m east of a major wetland to the west. The significance of that is in the creation of wildlife corridors that allow wetland bird species for example to make short flights between pockets of desirable habitat that support their life history strategies.

Little is required here in the way of restoration but minor improvements can be made by restricting grazing. It does not appear that attempts have been made to drain this wetland and stock damage is much less evident and vegetation consequently in much better condition and more abundant. The boulderfield referred to in the Boffa-Miskell terrestrial ecology report is on the northern boundary of this wetland.

Fish Species

Three species of fish (2 native and 1 sports-fish) were captured, brown trout *(salmo trutta),* common bully *(gobiomorphus cotidianus),* and Koaro (*galaxias brevipinnis*), Table 3. These fish were captured from 2 sites in the NE Stream, figure 1. The bullies and galaxiids represent breeding populations as evidenced by the range in sizes from juvenile to adult. The single trout may be a transient rather part of a permanent population. At 123mm it is likely to be 2 years old. For the distance surveyed (100m) these are relatively low numbers but

sufficient to allow for population expansion as habitat and therefore carrying capacity improves.

Table 3, fish species and size range (mm)

Species	Size Range (mm)	Length(mm)
Brown trout		123
Common bully	37-60	51,59,51,37,56,60,47,51,52,59,48
Koaro	63-92	81,63,73,83, 92

Invertebrates

The aquatic invertebrate population was sparse reflecting the capability of the habitat to support invertebrates. There is little exposed gravel that would normally provide a substrate for algae to grow on and then which invertebrates can graze. Habitat can be expected to improve as, for example, grazing is restricted, cattle kept from waterways, and sediment and nutrient inputs reduced.

The invertebrate MCI (macroinvertebrate community index) scores are listed for the species present, Table 4. This system of scoring allows water quality to be assessed using species tolerance to enrichment. A high score represents a low tolerance to enrichment and their absence may indicate degraded aquatic habitat. The highest scoring species present (in this case mayfly) indicate that water quality is high enough to support a species with a low tolerance to enrichment indicating opportunity for habitat restoration. No formal MCI calculation was made but the low density of invertebrates observed highlights habitat shortfalls. Other habitat features also play an important role here, such as the high sediment loading and consequent lack of exposed gravels.

Table 4, invertebrate species, their MCI score, and relative abundance.

Species	Scientific name	MCI Score	Abundance Rank
Worms	*Annelids*	1	high
Mayfly	*Deleatidium sp*	8	low
Caddis	*Pyncnocentrodes sp*	5	common

Macrophytes of NE Stream.

Macrophytes were visually assessed during the stream survey, Table 5. Macrophytes cover about 90% of the streambed where water cress and sweet grass dominate. A flood in July washed out much of the water cress and exposed the large quantities of accumulated top soil that has built up in the streambed, figure p15, Appendix 1. This build-up of sediment has completely overlain the gravel substrate and greatly reduced habitat quality in the NE Stream. A program of clearing sediment would greatly improve habitat quality and the life supporting capacity of this ecosystem.

Rushes and *carex* are occasionally found along the riparian zone but these are sporadic and could also be greatly enhanced.

Table 5, Main macrophytes in the north-eastern stream with relative abundance.

Species	Scientific name	Abundance Rank
Sweet grass	*Glyceria sp*	High
Water cress	*Nasturtium officinale*	High
Rush	*Juncus sp*	High
	Carex secta	Common

Water Quality.

A simple assessment of water quality using a hand-held meter (YSI brand) was made. Conductivity, Total dissolved solids, and salinity were unusually high for a freshwater resource, Table 6. Samples were assessed at four locations, initially at the fish sample site in the NE Stream (summer sample) but then upstream in order to check on the source of high values. The water being sourced from the planted wetland on the SE boundary is about half the values for conductivity, salinity, and total dissolved solids and are "more normal" levels.

The "Roys Peak" sample (upstream of WQ4 in figure 1) is from the small stream crossing the road near the Roys Peak Car Park, it is a short distance from this site to where the water falls off the hillside. The winter sampling is comparable between sites. The blue highlighted record is a late summer sample, the others are July 2021, winter sample and comparable as they were all taken within a few days of each other.

Table 6, water quality parameters for the un-named stream summer and winter, the stream draining the wetland and the stream tributary where it crosses the road at the Roys peak carpark. Temperature compensated conductivity (microseimens @ ^{o}C), Salinity (ppm), Total Dissolved Solids, TDS (ppm). Summer April, winter July 14th.

Parameter	NE Stream Summer	NE Stream Winter	Confluence	Roys Peak	Wetland stream
Conductivity	*301.6*	*261.8*	*268.1*	257.0	*141.8*
Temp-Conductivity	*384.1 @ 13.8 ^{o}C*	*405.4 @ 6.0 ^{o}C*	*413.6 @6.6^{o}C*	*329.0 @ 7.0 ^{o}C*	*219.4 @ 6.4 ^{o}C*
Temperature	*13.8*	*6.0*	*6.6*	7.0	*6.4*
Salinity	0.2	0.2	0.2	0.2	0.1
Total Dissolved Solids	0.2498	.2637	.2688	.2139	.1422

Indigenous Terrestrial Vegetation Communities

The main indigenous terrestrial vegetation communities as identified in the BM report are:

- Bracken fernland;
- Coprosma-matagouri (grey) scrub and shrubland;
- Rock bluffs and boulderfields;
- Kanuka shrubland/scrub; and
- Kanuka forest.

The following descriptions are extracted from the BM report.

Bracken fernland

Bracken fernland occurs in dense patches in open grassland on many of the hillslopes and amongst the boulderfields and under bluffs. Bracken is often present in frequently burnt areas.

Matagouri-Coprosma-Sweet Briar Scrub and Shrubland

These communities are dominated by matagouri, *Coprosma propinqua* and sweet briar and occur on the steeper slopes on the property and particularly on south and south east aspects which are cooler and damper. The scrub and shrubland communities also support *Coprosma rigida*, *C. rugosa*, *Coprosma* sp., *C. virescens, Olearia lineata* and occasional bush lawyer (*Rubus schmideliodes*) and small leaved pohuehue (*Muehlenbeckia complexa*). Of note is the presence of *Olearia lineata* which is classified as "At Risk-Declining".

BM report that the scrub and shrublands are in a degraded stock with no ground cover or understorey as they have been used by stock for shelter and shade and grazed by sheep and rabbits.

Rock Bluffs and Boulder-fields

BM reports the rock bluffs and outcrops as being a feature of the steeper areas of the property supporting exotic grass species and bracken and other native species such as blue tussock, *Helichrysum lanceolatum*, *Olearia arborescens*, *Melicytus alpinus* and several fern species. A boulderfield located under a south facing bluff is cited by BM as an ecological feature of note as it is dominated by native species, including lowland flax, a tree fucshia (*Fucshia excorticata*), awineberry (*Aristotelia serrata*), *Coprosma propinqua*, bush lawyer, tutu (*Coriaria sarmentosa*) and a variety of ferns.

Kanuka scrub and shrubland

BM describe small areas of kanuka shrubland and scrub present on dry north and west facing slopes, particularly near the lake.

Kanuka forest

A single small patch of 10-22 m high kanuka (*Kunzea robusta*) encompassing an area of 0.6 ha occurs near the shoreline in the centre of Damper Bay. BM note that despite its small size, it is one of the larger, more mature areas of lowland indigenous vegetation within the wider area. BM add that as with the shrubland and scrub communities, this community is almost totally devoid of any ground cover or understorey due to stock and rabbit access.

Bird Species

Twenty species of bird have been recorded on the Damper Bay property from casual visits. It is possible that more secretive species such as fernbird are present in the wetlands but such species require more specific surveys to have a chance of locating them.

Table 6, composite of BM Table 1, April 2010 and survey visits in March and July 2021

Common Name	**Threat Status**
Bellbird	Not threatened
Blackbird	Introduced and naturalised
California quail	Introduced and naturalised
Goldfinch	Introduced and naturalised
Greenfinch	Introduced and naturalised
Grey warbler	Not threatened
Hedge sparrow	Introduced and naturalised
Redpoll	Introduced and naturalised
Silvereye	Not threatened
Skylark	Introduced and naturalised
Song thrush	Introduced and naturalised
South Island fantail	Not threatened
Starling	Introduced and naturalised
Welcome swallow	Not threatened
Yellowhammer	Introduced and naturalised
Pied Oystercatcher	Not threatened
Paradise shelduck	Not threatened
Mallard Duck	Introduced and naturalised
Spur winged Plover	Introduced and naturalised
Harrier Hawk	Introduced and naturalised

Lizards.

A survey of lizards present on the property will be required in late spring/summer. There are likely to be skinks and geckos present, including possibly, threatened species such as Southern grass skink.

Proposed Restoration Measures

Rationale

Restoration of wetland habitats and retiring various blocks from farming would greatly restore habitat for native fauna and flora. There are existing protected areas on neighbouring properties to the east and west and restoration of habitats on this property would help create and consolidate a corridor of wetland and scrub-shrubland habitats along this shoreline of Lake Wanaka.

As shown in the results the western water course (ephemeral stream) is simply a stormwater drainage system previously mechanically enhanced to improve drainage of agricultural land. It is completely dry almost all of the time. It has no aquatic values and judging by the vegetation there have not been any in recent years. The general area has been subject to some large-scale drainage operations in the past.

Similar drainage work in the catchment upstream of the property has resulted in historic high sediment loadings in the NE Stream. These works have resulted in a soft bed, very fine substrate, and therefore little macroinvertebrate habitat in the stream on the eastern side of the property. Water is easily discoloured if bed disturbed. Large volumes of "mud" clog the streambed and destroy "free stone" invertebrate habitat. A flood in early July removed much of the water cress and exposed the accumulate mud deposits that have overwhelmed the streambed, photo in Appendix 1. There are still the basic elements of quality stream habitat present and therefore options for restoration of stream environment.

We recorded unusually high conductivity, salinity, and total dissolved solids in the stream. In most freshwater habitats away from intensive agriculture, salinity is zero, conductivity in the order of 130, and TDS 0.1. The elevated levels are likely to be a result of some agricultural inputs and local geology. The level of macrophyte growth is noticeably less in the tributary draining the restored wetland and a reflection of lower levels of nutrient in that water way as it's catchment area is less intensively farmed.

As agricultural impacts decline on the Damper Bay property habitat can be expected to improve and there are opportunities to enhance the NE Stream habitat.

There are plans to retire some areas of the property from farming, these include the N and NW slopes of the hill on the western side of the property and the peninsula hill to the NE. Benefits accruing from this will include less nutrient and soil lost downhill to the lake. The nutrient status of some New Zealand lakes has been a focus in recent years with historic agricultural impacts threatening eutrophication. This has resulted in nuisance algal blooms and compromising of intrinsic values of the lakes. There are well documented programs of water quality restoration around Lakes Taupo and Rotorua involving retirement of farmland. There are currently concerns about water quality in Lake Wanaka with the recording of algal blooms in recent years. Agricultural land continues to be developed around lakes Wanaka and Hawea with its attendant threats to water quality.

Retiring some land from farming in the Damper Bay Block is a positive contribution to maintaining Lake Wanaka's water quality and reducing threats posed by elevated nutrient and runoff inputs.

Restoration of plants species that were controlled by grazing, creation of habitat for native insects and animals such as lizards, and restoration of wetlands and wildlife habitat, are all important components of developing balanced biodiversity at this Damper Bay property. An outline of fencing and replanting is shown in sheet 18-23, appendix 2, from the Rough & Milne, 2021 Landscape Assessment.

The development as proposed for this site will have major positive effects especially for local wetlands but also scrubland and freshwater habitats. Weed control, rabbit control, revegetation, habitat restoration, retiring marginal land from farming, are all part of the proposal.

The benefits to the ecology of the Damper Bay property will be substantial. All the current limitations on habitat and risks to local water quality for example, result from use of the property primarily for farming. Wetlands have been drained and streams compromised by stock access and nutrient enrichment from fertiliser and animal waste. Native vegetation is restricted and compromised by stock access. Retiring farmland and the restoration strategies outlined that change the emphasis from farming to habitat protection will greatly enhance ecological values, local biodiversity, and improve habitat corridors along the southern shore of Lake Wanaka.

As well as being important components of habitats, the taller tree species are potential screening mechanisms. Enhancing vegetation will have positive spin offs for enhancing native birdlife as well as contributing to a healthy riparian zone where plantings are associated with the stream margins.

The buildings themselves, which are designed for minimal visual and environmental impacts, provide the positive effects indirectly by changing the land-use priority.

Specific Restoration and Enhancement Measures

The following specific ecological and biodiversity enhancements are proposed on the site:

1. Restoration of wetlands 1 and 2 and exclusion of stock on all 3 wetlands
2. Riparian protection and planting on the NE Stream
3. Protection of the “Kanuka Forest”
4. Extension of scrub and shrubland cover with plantings
5. Creation of ponds and water features around the building complex
6. Retiring farmland and limiting grazing regime
7. Fencing off waterways and other sensitive areas and establishing alternative stock water troughs
8. Rabbit control on the property

Wetland and Stream Enhancement and Riparian Protection

There are considerable opportunities to enhance the stream and wetland habitat. Removing fine sediment from the stream and enhancing riparian vegetation would restore aquatic habitat and support a greater density of fish. Severely degraded wetlands, (Wetland 1 and 2 Figure 1) can be re-established, through reversing drainage patterns, some excavation, and denying animal access to them. Remnant wetland plant communities present should flourish and recolonise such newly restored habitat. There are good water sources from the hill side to the west that will supply the two wetlands in need of restoration (1 and 2), shown in Figure 1.

Fish populations may be expected to expand in the NE Stream and wetland species of birds increase in numbers. There is also the possibility that species such as, Spotless crake (*Porzana tabuensis tabuensis),* Marsh crake (*Porzana pusilla affinis)*, and fern-bird (*Bowdleria punctata punctata)*, all of which have an "at Risk" conservation status, will take up residence as the new corridor allows for dispersal to new and enhanced habitats.

Some exotic species, such as willow plantings could provide rapid shelter/screening and be used as nursery species to establish slower growing natives along the stream margins.

Protection of Kanuka Forest

It is proposed to increase the size of the forest to approximately 60,000 m^2, (a 10 fold increase) pers comm JEA Ltd. The proposed planting program in combination with protection against animal browse will allows for understorey development improving habitat quality for indigenous fauna. It will also be aesthetically pleasing.

Some planned Beech plantings will help re-establish a species that was likely a significant habitat component in the past and provide an additional tier of forest strata that is important for NZ native bird fauna.

Grey scrub and Shrub-land Communities

There are plans to retire the faces above the lake on the north-western edge of the property from grazing. This will benefit the shrub-lands allowing for natural regeneration to occur and over time leading to an improvement in habitat quality and water quality of adjacent inshore areas of Lake Wanaka.

Fencing.

The development project at Damper Bay will see a substantial revision of existing fencing arrangements. There is a need to align some fencing, including perimeter fencing of existing pockets of indigenous vegetation such as the Kanuka Forest and areas of grey scrub and shrubland shown in Figure 1, as they are currently threatened by stock grazing. These patches demonstrate what will grow successfully in this specific micro-climate and are a potential source of seeds and seedlings for enhancing forest and scrub-shrubland cover. Fencing (and active rabbit control) will also protect this vegetation.

Existing trees and shrubs would benefit from protection against grazing by stock. In particular fencing off of the "Kanuka forest" and the scrub-shrubland communities shown in Figure 1.

The water ways are proposed to be protected from cattle grazing and much more so the effects of trampling through fencing. Heavy animals can wreak havoc with soft riparian soils,

collapsing banks and introducing sediment, which smothers the streambed and compromises fish and aquatic insect habitat.

Grazing Regime

The present landscape is a consequence of traditional farming and the open grassland appearance dotted with small trees and shrubs has been maintained by grazing. Some light grazing (sheep only) would maintain this general appearance without further compromising shrubs and small trees. Changing the emphasis from farming being the priority, to using light grazing to maintain landscape characteristics, would result in positive benefits all round to biodiversity and provide an eco-friendly method of weed control.

Controlling Rabbits.

Rabbit control will be a critical component of the planting programs planned for Damper Bay. It will require a variety of methods and strategies to have a chance of success. Rabbit control is particularly important for new plantings and protection of existing vegetation. Splitting the area into separate blocks by denying free range over the whole property is critical. Good rabbit habitat can be provided in part by heavy grazing that keeps vegetation short thus providing ideal conditions for rabbit breeding. Where the emphasis was changed from farming productivity in the marginal grazing areas, to "maintaining landscape" a heavier vegetation cover could be maintained that would degrade rabbit habitat. When coupled with shooting and limited and highly strategic poisoning, if required, these methods can successfully control rabbits on individual properties.

Adding rabbit proof mesh to some existing fences would provide valued protection and be an important feature of any rabbit control program.

Potential Ecological Effects

No significant adverse effects are anticipated from this proposal. The BM report of 2010 also did not anticipate any adverse effects from the proposal at that time either as long as standard construction mitigation methods were adhered to.

Building sites are largely restricted to a dry catchment with little or no native vegetation cover so potential impacts will not affect existing streams, wetlands, or native bush/scrublands. Storm water from winter-time construction can be contained in the catchment of the ephemeral water course and therefore discharged to dry land on the flats below the building sites. This potential impact will be minor or non-existent during the summer months. As a precaution sediment filters can be installed below construction platforms with a substantial buffer to the Lake. The scale of the building platforms relative to the total area is minor further reducing potential adverse effects.

The locations of building sites correspond to grassland and briar vegetation neither of which are of particular ecological value at the building sites, or in short supply. Revegetation programs post building will more than compensate for the disturbance during construction. Grass and shrubs will be easily re-established around the buildings.

Building sites will require some earthworks and the exposure of soil surface may present some dust issues (that can be controlled) and opportunities for weed establishment, that can also be controlled. The project involves a low density accommodation style facility with a

strong emphasis on appreciation of the local ecology. Adverse effects from building the facility can be easily identified and therefore controlled. As a low density accommodation style facility, during normal use, waste water should be easily managed according to modern best practice, and in volume likely be far less than that from grazing farm animals from which there is no containment or treatment and currently direct connection to Lake Wanaka.

Where works involve stream crossings there are standard construction practises to minimise potential adverse effects.

Conclusions

Ecological values at Damper Bay are significant and include wetlands, freshwater, grey scrub and shrubland and kanuka forest remnants, rocky outcrops and boulder-fields.

This proposal embraces a wide range of restoration measures that will address long standing environmental short comings associated with common land-use activities. The sorry state of our freshwater resources is well documented. The scrub, shrublands and forest communities are remnants of what was once extensive indigenous vegetation communities across the property. Wetlands are still present but in varying stages degradation. Fish and wildlife populations are correspondingly compromised but are still present to the extent they can provide a foundation for recolonising as habitat is repaired and restored.

Few development proposals seek to enhance and protect the range and extent of ecological resources to the degree this one does. This approach is to be encouraged as it provides an example of what can be achieved. It will also contribute substantially to regional habitat by creating corridors to adjacent habitats which, when isolated, support less secure populations of fauna and flora. Regional biodiversity is likely to benefit significantly.

The Damper Bay proposal holds a major promise for regional indigenous faunal and floral community welfare.

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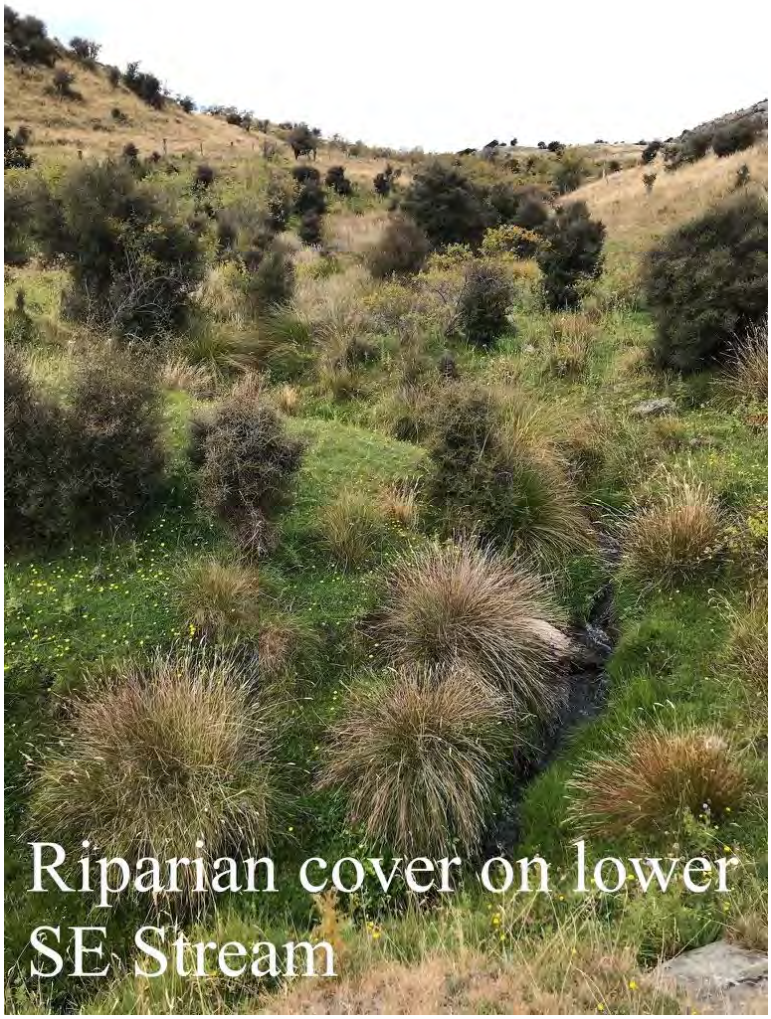
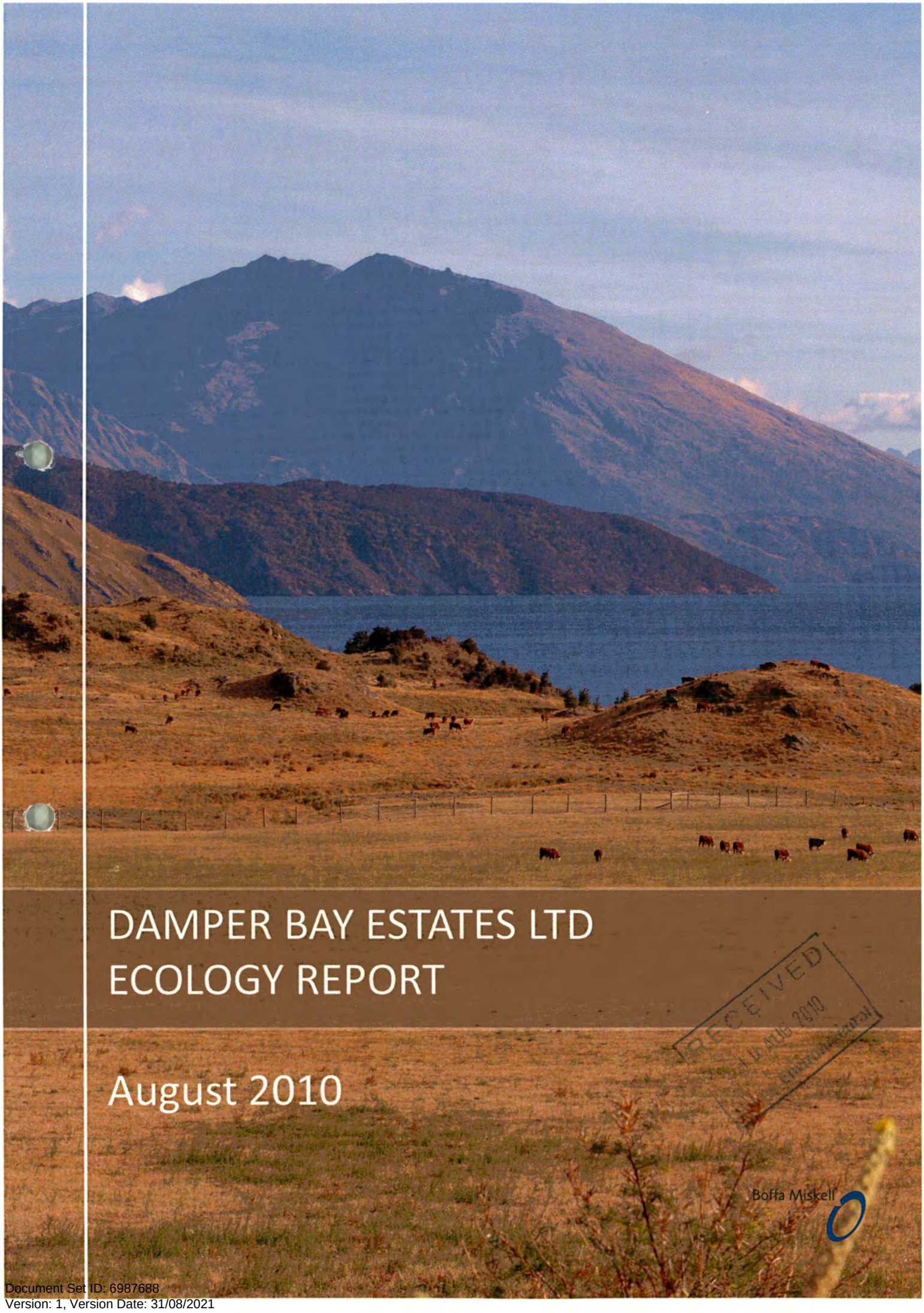
Ross Dungey August 2021

Appendix 1- Site Photographs



The two tributaries feeding into NE Stream from the SE, main Tributary, and S secondary Tributary, from the wetland

Appendix 2- Boffa Miskell Ecological Report 2010



DAMPER BAY ESTATES LTD
ECOLOGY REPORT

August 2010

Boffa Miskell

Damper Bay

ECOLOGY REPORT

Prepared for

Damper Bay Estates Ltd

by

Boffa Miskell Limited

Boffa Miskell

May 2010

Contents

1 Introduction

1.1 Background

In September 2004 Damper Bay Estates Limited (DBEL) purchased a 194 ha property (Lot 1, DP 33719) at Damper Bay, Wanaka from Alpha Burn Station. The site is located on the southern shoreline of Lake Wanaka approximately 8 km east of Wanaka and 3.5 km west of Glendhu Bay (Appendix 1).

DBEL is proposing to subdivide the property into 3 separate lots and erect a primary dwelling and guest house on each lot. The plan of the proposal is shown in Appendix 2. Resource consent is required to undertake this development.

DBEL commissioned BML to undertake an ecological investigation to assess the ecological values of the site, the potential effects of the proposed development on these values, and to make recommendations to guide the subsequent management of the property. This report will form part of the consent application.

1.2 Scope of this report

Boffa Miskell Ltd was engaged by Damper Bay Estates Limited to:

- describe the existing ecological values of the site;
- assess the potential effects of the proposal on those ecological values; and
- recommend mitigation options and appropriate land management to be considered as part of the development process and detailed design.

This report encompasses the area within the Damper Bay property boundary shown in Appendix 2. Lake Wanaka and its foreshore were not surveyed, nor were any other areas outside of the property boundary. However, the potential indirect effects, or benefits of the proposed development on the ecology of any areas outside of the property boundary are considered.

2 Methods

2.1 Background research

A review of existing information on the ecological values of the area was undertaken from the following sources:

- A number of databases including: The New Zealand Freshwater Fish Database (FWFDB) (NIWA), Land Environments of New Zealand (LENZ) (Leathwick *et al.* 2003), Potential Vegetation Database (Leathwick *et al.* 2004) and the Land Cover Database Version 2 (LCDBII) (MfE 2004).
- The Alphaburn Crown Pastoral Land Tenure Review Conservation Resources Report (LINZ 2003).
- Queenstown Lakes District Plan.
- Boffa Miskell's internal reference collection.
- The Internet.

2.2 Site investigation

The site was visited on 9 April 2010. The weather during the site visit was fine and warm with no wind.

The internal access tracks and house sites were surveyed on foot. The plant communities and habitats within the wider property were not comprehensively surveyed; however several different parts of the property were walked or driven. Plant species and the vegetation communities present were noted, and their relative abundance was qualitatively assessed. Notes were made on the condition of the vegetation communities and the presence of weed and animal pests.

All species of birds sighted or heard were noted during the site visit. Although no specific surveys were undertaken for fish, terrestrial invertebrates, or lizards an assessment of the suitability of faunal habitats was made.

Photographs and GPS waypoints were taken to assist with descriptions of vegetation types and habitats.

Lists of the plant and bird species referred to in the text are provided in Appendices 4 and 5, respectively.

3 Existing Environment

3.1 Ecological context

Damper Bay lies within the Wanaka Ecological District (ED) in the Lakes Ecological Region. The Wanaka ED encompasses the broad glacier-formed basins of Lakes Wanaka and Hawea and surrounding steep mountains (McEwen 1987).

Damper Bay is situated on the southern shore of Lake Wanaka (Appendix 1). From the Wanaka-Mt Aspiring Road a relatively flat central fan slopes north and gently downwards towards the lake. On either side to the east and west are distinctive roche moutonnee landforms which rise to approximately 360 and 400 m a.s.l., respectively. These are typically rounded and undulating with rock outcrops, steep bluffs and wet depressions. An ephemeral stream drains the western roche moutonnee before flowing north-east into the lake through the central fan. Another more permanent stream drains a raupo wetland on the adjoining property to the east before flowing between the eastern roche moutonnee and into Damper Bay (Photo 1 in Appendix 6).

The geology of the site is comprised of schist (with strong schistosity and weak or no foliation) on the more elevated areas, with older quaternary rocks elsewhere. The soils of the more elevated landscape features are mapped as Pallic (Wanaka) and the flats are either moderately deep, gently undulating silt loam or, in the south-western corner of the property, blue-gley soils (GrowOtago online maps).

The climate is warm in summer and cold in winter (McEwen 1987) with a median annual temperature of 10.6 - 11°C. The median annual rainfall is 800-900 mm (GrowOtago online maps) and north-west winds prevail with occasional gales.

Formerly, tussock grassland, scrub and shrublands would have occupied the alluvial flats on the property with matai-kaihikatea-totara forest on the steeper slopes directly above the shoreline and silver beech forest on the more elevated areas (Leathwick *et al.* 2004).

3.2 Vegetation

The main vegetation communities on the property are:

- Low producing exotic grassland;
- Bracken fernland;
- *Coprosma*-matagouri scrub and shrubland;

- Wetland, wet depressions and seepages;
- Rock bluffs and boulderfields
- Kanuka shrubland/scrub
- Kanuka forest.

Each of these vegetation communities is described in more detail below and shown in Appendix 3.

Low producing exotic grassland

The large majority of the property is in low producing exotic grassland (Photo 2 in Appendix 6) of low ecological value. It is comprised of common pasture grass species such as brown top (*Agrostis capillaris*), sweet vernal (*Anthoxanthum odoratum*), cocksfoot (*Dactylis glomerata*), Yorkshire fog (*Holcus lanatus*) and crested dogstail (*Cynosurus cristatus*) and common introduced herbs, including weed species such as Scotch and Californian thistle (*Cirsium vulgare* and *C. arvense*), foxglove (*Digitalis purpurea*), woolley mullein (*Verbascium thapsis*), horehound (*Marrubium vulgare*) and rose campion (*Silene coronaria*). Native grasses include silver tussock (*Poa cita*) and hard tussock (*Festuca novae-zelandiae*) which grow as scattered individual plants on the elevated slopes and on the damper south and east facing slopes.

Patches of low bracken (*Pteridium esculentum*) are common on the hill slopes amongst the grassland.

The native matagouri (*Discaria toumatou*) and *Coprosma propinqua* and the introduced sweet briar (*Rosa rubiginosa*) are scattered throughout the grassland, forming open shrubland in places (see below).

Bracken fernland

Bracken fernland is very common as low, dense patches in open grassland on many of the hill slopes within the property (Photo 3 in Appendix 6) and amongst boulder fields and under bluffs. Bracken is often present in frequently fired areas and its abundance probably reflects a previous history of burning and subsequent grazing.

Matagouri – *Coprosma* – sweet briar shrubland and scrub

Aside from scattered shrubs which are common throughout the grasslands, shrubland and scrub communities (Photo 4 in Appendix 6) also occur on the steeper slopes of the property, particularly on south and east facing aspects which are cooler and damper. These communities are dominated by matagouri,

Coprosma propinqua and sweet briar. Although not particularly diverse, they also contain occasional *Coprosma rigida, C. rugosa, Coprosma sp.* (un-identifiable), *C. virescens, Olearia lineata,* and occasional bush lawyer (*Rubus schmidelioides*) and small leaved pohuehue (*Muehlenbeckia complexa*).

Of note is the presence of *Olearia lineata* (Declining) (de Lange *et al.* 2009) which is common in the shrublands on the south and eastern facing slopes on the eastern side of the property. A group of large plants (Photo 6 in Appendix 6) also grows in a damp area on the northern side of the access track to House sites 2 and 2A (Appendix 3). Several other large specimens are scattered throughout open pasture on the eastern side of the property.

Without exception, the shrublands and scrub on the property have been used by stock for shelter and shade and have been grazed by sheep and rabbits. They are currently in a degraded condition with no groundcover or understorey and with no regeneration occurring in areas that are accessible to stock.

Kanuka scrub

Small areas of kanuka shrubland and scrub (Photo 5 in Appendix 6) are present on dry north and west facing slopes, particularly near the lake. The porcupine shrub (*Melicytis alpinus*) and native broom (*Carmichaelia petriei*) are also present here.

Wetlands, wet depressions and seepages

There are a number of wetlands and seepages in the hollows and depressions of the property and at least two moderately large raupo (*Typha orientalis*) wetlands occur in the wider area, but outside the property.

From an ecological perspective, the best of the wetlands on the property is a large (100 x 130 m) *Carex secta - C. virgata* swamp (Photo 7 in Appendix 6) situated in an elevated position to the north-west of the farm shed near the Wanaka – Mount Aspiring Road. This wetland has largely retained its natural character, despite being un-fenced and having suffered some stock damage. Dominant species are the native *Carex secta, C. virgata, C. sinclarii, Carex* sp. (un-identified), sharp spike sedge and the exotic grass creeping bent (*Agrostis stolonifera*). Other exotic plant species are rare, but include soft rush, creeping buttercup, white clover, broad-leaved dock and *Epilobium* sp. The water table in this wetland fluctuates, and it becomes temporarily dry following prolonged periods of low rainfall which encourages the seasonal establishment of introduced terrestrial grasses and herbs. A seepage on the north-eastern side of

this wetland is dominated by *Carex coriacea*, and further to the east by *Carex virgata*.

A smaller more modified wetland (the 'Saddle Wetland' Appendix 3) lies in an elevated position on the eastern side of the saddle below the farm track on the western roche moutonnee. Although grazed by stock, it retains some of its natural character (Photo 8 in Appendix 6). It is dominated by the native rush wiwi and supports a small ribbon of *Carex secta* and scattered *Coprosma propinqua* and occasional *Carex comans*. Bog rush is prominent towards the top and edges of the wetland. Exotic grasses and herbs dominate the understorey.

Several wet depressions and seepages occur within the grazed exotic grasslands on the property. One of these areas on the western side of the central fan was probably once a more substantial wetland, but it has been drained and the reduced water levels have allowed introduced grasses and rushes to take over from the original native cover (Appendix 3 and Photo 9 in Appendix 6). These wet depressions and seepages are characterised by a sward forming *Carex sp.*, scattered bog rush, occasional *Carex virgata* and wiwi amongst exotic grasses and herbs. All of these areas have been extensively grazed and have low ecological values.

There is a small (75 x 20 m) sharp spike sedge marsh (Appendix 3) on the northern side of the proposed location of House Site 1A. This wetland is likely to have been formed following the construction of a farm track along its eastern side. While this area was dry during the site visit, runoff from the surrounding slopes is impounded behind the track during period with more frequent rainfall. The vegetation of this marsh is almost entirely dominated by the native sharp spike sedge (Photo 10 in Appendix 6) although the native rush wiwi and exotic grasses and herbs including creeping bent, kneed foxtail and white clover are also present.

Scattered patches of the native rush wiwi are also common throughout the property and often occur in drier grassland environments.

All the wetlands on the property are currently accessible to stock.

Rock bluffs/boulderfield

Rock bluffs and outcrops are a feature of the steeper areas of the property. Generally these are characterised by exotic grass species and bracken, although other native species such as blue tussock, *Helichrysum lanceolatum*, *Olearia arborescens*, *Melicytus alpinus* and several fern species were recorded.

An ecological feature of note is a boulderfield (Photo 11 in Appendix 6) under a south facing bluff directly upslope of the *Carex secta* - *C. virgata* swamp (Appendix 3). It is dominated by native species, primarily bracken but a diverse range of other native plants are also present but uncommon, including lowland flax (*Phormium tenax*) a tree fucshia (*Fucshia excorticata*), a wineberry (*Aristotelia serrata*), *Coprosma propinqua*, bush lawyer, tutu (*Coriaria sarmentosa*) and a variety of ferns including necklace fern (*Asplenium flabellifolium*), *Asplenium appendiculatum* and common shield fern (*Polystichum richardii*).

Kanuka forest

There is a single small (0.6 ha) patch of 10-12 m high kanuka (*Kunzea ericoides*) forest (Photo 12 in Appendix 6) directly behind the shoreline in the centre of Damper Bay (Appendix 3). While some of the kanuka is within the lakeside reserve, most lies within the property boundary. Despite its small size, it is one of the larger, more mature areas of lowland indigenous vegetation within the wider area. However, as with the shrublands and scrub elsewhere on the property, this vegetation community is almost totally devoid of any groundcover or understorey (Photo 13 in Appendix 6). The few other plants observed included the introduced hemlock (*Conium maculatum*), elderberry (*Sambuca nigra*), one of the currant species (*Ribes* sp.) and the native bush lawyer, matagouri and pohuehue (*Muehlenbeckia australis*). Rabbits and rabbit sign were common and stock have had access under the canopy.

3.3 Birds

During the site visit sixteen introduced and native bird species were recorded (Table 1). All of these species are widespread and common locally and nationally. None are classified as "Threatened" or at "At Risk" (Miskelly *et al.* 2008).

The list of bird species recorded during the site visit is not likely to represent a complete list of birds using the site. For example, other bird species such as Australian harrier, magpie and spur-winged plover will almost certainly use the site but were not recorded during the site visit. With the possible exception of one of the wetlands (which will not be adversely affected by the proposed development) that may provide habitat for crake species, the site does not provide core habitat for threatened native or endemic bird species.

Table 1: Bird species recorded on the Damper Bay property, 9 April 2010

Common name	Threat status*
Bellbird	Not threatened
Blackbird	Introduced and naturalised
California quail	Introduced and naturalised
Goldfinch	Introduced and naturalised
Greenfinch	Introduced and naturalised
Grey warbler	Not threatened
Hedge sparrow	Introduced and naturalised
Paradise shelduck	Not threatened
Redpoll	Introduced and naturalised
Silvereye	Not threatened
Skylark	Introduced and naturalised
Song thrush	Introduced and naturalised
South Island fantail	Not threatened
Starling	Introduced and naturalised
Welcome swallow	Not threatened
Yellowhammer	Introduced and naturalised

* Miskelly *et al.* 2008

3.4 Other fauna

Fish and aquatic invertebrates

There are no records in the Freshwater Fish Database for the streams within the property. The potential effects of the proposed development on aquatic values meant that specific surveys for fish or other aquatic invertebrates were considered unnecessary.

Invertebrates

The various habitats within the site will undoubtedly support various indigenous invertebrates, although the diversity of these communities is likely to be limited. Within the shrubland, scrub and kanuka forest invertebrate diversity will be limited by the almost complete absence of any ground cover and understorey.

Lizards

Common native skinks and geckos such as the common gecko (*Hoplodactylus maculatus*) and common skink (*Oligosoma nigriplantare*) are likely to occur around the boulderfields, bluffs, rock outcrops, rock-strewn grasslands, fernlands and shrublands on the property. The Data Deficient (Hitchmough *et al.* 2007) Roy's Peak gecko (*Hoplodactylus* "Roys Peak") has been recorded near the summit of Mt Roy immediately to the south of the property. Specific surveys for these species were not conducted because the proposed development will not affect these habitats.

Animal pests

Rabbits are present at high densities (5 on the modified Mclean scale (Otago Regional Council 2009), but at 7-8 on the steeper vegetated slopes). They are a major pest on the property and their abundance has ramifications for future land management, for example protecting restoration planting. Other pest mammals including possums, rats, mice, mustelids (weasels, stoats and ferrets) hedgehogs and feral cats are almost certainly present. Some possum control has been undertaken on the property, probably as part of the Animal Health Board TB vector control programme.

Summary of existing ecological values

Generally, the values of the vegetation and habitats on the property are low and the only fauna recorded are widespread and common. The property is typical of the extensively grazed rural farmland in the wider area and is currently in a degraded condition due to long history of grazing by domestic stock and the impact of rabbits. Despite this, there are a number of specific habitats that have ecological values that should be protected and/or restored. These include the existing shrublands, the small group of *Olearia lineata*, the more intact wetlands on the property, the rock bluffs and boulderfields and the kanuka forest directly behind the shoreline in the centre of Damper Bay.

4 Relevant Policies/Plans

The Queenstown Lakes District Plan

The relevant District Plan objectives relating to Natural Environment are:

Section 4.1.4

Objective 1 – Nature Conservation Values

> *The protection and enhancement of indigenous ecosystem functioning and sufficient viable habitats to maintain the communities and the diversity of indigenous flora and fauna within the District.*
>
> *Improved opportunity for linkages between the habitat communities.*
>
> *The preservation of the remaining natural character of the District's lakes, rivers, wetlands and their margins.*
>
> *The protection of outstanding natural features and natural landscapes.*

And the relevant related policies are:

1.1 To encourage the long-term protection of indigenous ecosystems and geological features.

1.5 To avoid the establishment of, or ensure the appropriate location, design and management of, introduced vegetation with the potential to spread and naturalise; and to encourage the removal or management of existing vegetation with this potential and prevent its further spread.

1.7 To avoid any adverse effects of activities on the natural character of the District's environment and on indigenous ecosystems; by ensuring that opportunities are taken to promote the protection of indigenous ecosystems, including at the time of resource consents.

1.13 To maintain or enhance the natural character and nature conservation values of the beds and margins of the lakes, rivers and wetlands.

1.16 To encourage and promote the regeneration and reinstatement of indigenous ecosystems on the margins of lakes, rivers and wetlands.

This objective and the relevant policies are taken into account in the assessment that follows.

5 Assessment of Effects

5.1 Introduction

The proposal shown in the Application Plan has some features that have potential positive or adverse effects on ecological values. In the following sections of the report, the potential effects of these features are described, and proposed mitigation is set out.

The effects discussed in this section are:

At the design stage:

- Location of buildings
- Location of access tracks

At the construction stage:

- Stormwater management
- Stream crossings
- Noise and dust

At the operational stage:

- Human disturbance
- Stormwater management
- Waste water management

5.2 Design

Location of buildings

The Existing Vegetation Plan (Appendix 3) shows that all but one of the proposed house sites will be located on land that is currently in low producing exotic pasture grassland. A small part of the northern corner of House Site 1 lies partly within the upper side of a wet depression with scattered bog rush, *Carex virgata* and wiwi amongst exotic grasses and herbs (Photo 14 in Appendix 6). It is part of a grazed pastoral area and is of low ecological value. Excluding stock from the higher value wetlands on the property and potentially restoring a drained wetland on the western side of the central fan will more than mitigate the partial loss of this feature.

The small number of house sites (six in total), and their paired layout reduces the design footprint thereby minimising the potential ecological impacts of both the buildings and the access tracks.

Location of access tracks

Following the site visit and onsite discussions with the project engineer several amendments to the access track alignments were made (the revised alignment is shown in Appendix 2) to avoid or minimise the potential for adverse effects on ecological values. These re-alignments are:

1) The access track to Lot 1 utilises an existing farm track as far as possible in order to contain the construction envelope to previously modified route.
2) The access tracks to Lots 2 and 3 have been re-aligned to be further from the raupo wetland on the adjoining property to the east of the access point off the Wanaka-Mount Aspiring Road.
3) The access track to House Sites 2 and 2A has been re-aligned to avoid any indigenous shrubs and reduce the number of crossings of a small ephemeral drain from two to one.
4) The access track to House Sites 3 and 3A has been re-aligned to reduce the number of stream crossings from two to one and minimise the clearance of scattered shrubs within open pasture.
5) The route of the access tracks has been designed to minimise the quantity of cut and fill. The amount of cut and fill required onsite is relatively, very small.

The proposed alignment of the access tracks is now entirely within low producing exotic grassland. Construction will not fragment any existing indigenous shrublands, scrub or important habitats for indigenous species and will not result in any significant adverse effects on terrestrial indigenous ecological values.

5.3 Construction

Stormwater management

Construction of the access tracks and house sites has the potential to create sediment-laden run-off which, if not properly managed could enter the stream on the eastern side of the property and ephemeral streams during rain events and be transported into Lake Wanaka.

If construction of the access tracks is undertaken during the summer months when ephemeral streams are dry as is recommended, stormwater and sediment run-off should only be potential issue where the access track to Lot 3 traverses alongside the true left bank of the stream, and where the driveway to House Site 3A crosses this stream (also see stream crossings below). If sediment enters this stream it will have an adverse effect on water quality and aquatic invertebrates and fish. Although the stream banks have been excavated on the upstream adjoining property in the past, and it is currently accessible to stock and probably regularly disturbed, sediment run-off must still be managed to reduce further effects.

Construction should not commence until erosion and sediment control works are in place and should ideally occur during the drier summer months to minimise stormwater and sediment run-off. At this time the ephemeral streams on the property will be dry which will avoid sediment laden discharges being transported downstream into the lake.

Management of surface run-off from the construction areas should be carried out in accordance with an Erosion and Sediment Control Management Plan. The contractor's Stormwater Management Plan should provide information about management of spills or accidental discharges during the construction stage. Providing that all works are carried out in accordance with these plans, effects on ecological values should be negligible.

Stream crossings

One stream crossing over the permanently flowing stream on the eastern side of the property is proposed (Appendix 2). This has the potential to disrupt normal flows of water (and hence fish or invertebrate passage up and downstream) if not correctly constructed. The construction details have not yet been decided, but provided that design ensures:

- Consideration of a bridge option (rather than a culvert);
- The continued natural flow of water through/under the crossing; and
- Protection or re-instatement of riparian vegetation

the adverse effects on aquatic ecological values will be minimal.

There are two proposed crossings of ephemeral streams. One of these flows through an existing culvert under a farm track. Culverts are appropriate for these crossings and installing, or upgrading the existing culverts will have negligible ecological effects on the low ecological values of these systems.

Culverts should be installed in the summer months when these ephemeral streams are likely to remain dry for longer periods.

Noise and dust

During the construction stage noise and possibly dust will be generated at levels not normally experienced on the property. However, given the dispersed nature of the construction sites, their relatively small and narrow areas and, in the main, their distance from features with indigenous ecological values, dust is unlikely to have anything other than a negligible effect. Noise and vibrations from contractor's vehicles may disturb some animals living in the area, but this will only be for a short period of time and all the species recorded from, and likely to occur on the site are widespread and common.

Weed management

Weed infestations are currently limited to common wind blown or bird dispersed species found in the local area such as sweet briar, Californian and Scotch thistle and other exotic pastoral herbs. However, if precautions are not put in place, construction works, particularly heavy machinery, gravel importation and vehicle movements are likely to result in the dispersal and establishment of other weed species through the introduction of seeds and/or plant fragments. Although the area of disturbed soil resulting from construction works will be relatively small, these sites are an ideal environment for weed establishment. Common wind dispersed pasture weeds already present in the local environment are likely to establish rapidly on disturbed soil; however the ecological effects of this weed establishment in a pastoral farmed environment are unlikely to be more than minor. A more serious issue is the potential for the importation of invasive or problem weeds.

Best practice guidelines are recommended to prevent weed establishment and should include washing all earthmoving machinery as it enters the site, promptly re-vegetating disturbed soil, sourcing clean gravel and implementing weed monitoring and control.

5.4 Operational

Human disturbance

Once the houses are occupied noise levels will be comparable with other rural house sites in the wider area. The common birds that utilise the site will not be affected or displaced by the presence of humans to any great degree.

The house sites will not have tended gardens. The only species to be planted are native species growing naturally on the site and those from within the Ecological District that are appropriate to the site. This will avoid the potential problem of weed spread from gardens.

Cats and dogs (and some other pets) can kill birds, lizards and some invertebrates. While the concept of making the development "cat and dog-free" has been considered, given the values present on the property, the site context and the mammalian predators already present, the benefits of banning cats or dogs from the site are negligible.

Stormwater management

Although waterways on the site are limited and predominantly ephemeral, stormwater run-off from the house sites and access tracks has the potential to carry contaminants and sediments into these systems, with resulting adverse effects on aquatic ecology, particularly on the permanently flowing stream on the eastern site of the property and Lake Wanaka which it flows into.

Using permeable surfacing materials, e.g. gravel, on the access tracks will reduce stormwater run-off and the potential ecological affects associated with this run-off. Where appropriate, the use of permeable surfaces around the house sites is also recommended.

Stormwater management is described by Hadley Consultants Limited in the resource consent application.

Waste water management

Similarly, waste water from the house sites could affect water quality. Waste water management is described by Hadley Consultants Limited in the resource consent application. A system that is constructed and operated to meet the requirements and standards of the Otago Regional Council should protect waterways from adverse effects.

6 Land Management

The following section outlines the management actions proposed for the property that are considered appropriate from an ecological perspective. The following management actions are not specifically required for mitigation purposes, however, their adoption would have substantial benefits for the

ecology of the property. A summary of the proposed management actions outlined below is provided in Table 2.

Animal pest control

Given their high densities on the property, rabbit control will be crucial to the restoration of the degraded condition of the terrestrial ecosystems on the property. At their current densities rabbits will severely compromise the survival of native plantings. There are various methods for controlling rabbits that could be considered, for example, rabbit proof fencing, poisoning using 1080 or pindone, and night shooting. Rabbit control should extend to the reserve between the northern property boundary and Lake Wanaka. Fencing areas of shrubland and scrub, retiring land from grazing and encouraging regeneration of shrublands will create habitat for rabbits, provide refuge areas and make rabbit control operations more difficult.

Hares or hare sign was not observed during the one day site visit; however hares can have significant detrimental effects on new plantings. Hare numbers could increase on the property in response to a reduction in rabbit numbers, but control measures for rabbits should also control the hare population.

Given the values present on the property that are threatened by mammalian predators (particularly rats, weasels, stoats, ferrets, and feral cats) and the site context, implementing and maintaining a predator control programme is unlikely to provide worthwhile benefits. Consequently, a predator control programme is not proposed, although if required, possum control could be beneficial to protect the regenerating shrublands and ecological enhancement plantings.

Weed control

Several problem weed species are present across the property. These include sweet briar, and weeds of open pasture such as Scotch and Californian thistle, foxglove, woolley mullein, horehound and rose campion. Removal of sweet briar is proposed, particularly from areas of open shrubland and scrub where it may slow or prevent the regeneration of native species. Other herbaceous pasture species should be controlled either by spot spraying or manual removal.

In the absence of domestic stock in areas that are retired from grazing, and with reduced rabbit numbers, weeds will establish and grow more easily. Concerted weed control efforts will be required across the property, but particularly in

areas retired from grazing to contain and prevent the establishment and spread of weeds.

Neither gorse, broom nor wilding conifers were observed on the property. Regular surveillance for these species, as well as weed species that may have been introduced to the site by construction machinery, or established on disturbed soil should be undertaken. If found, these species should be controlled before they have time to establish.

Re-vegetation

In areas retired from grazing (see below and Appendix 2), in the absence of fire and with ongoing weed control (particularly emergent species such as wilding conifers) kanuka matagouri, *Coprosma* species, and manuka would slowly spread across the grassland of the Damper Bay property, particularly in the damper, more sheltered lowland areas and southern and eastern facing slopes. Bracken fernland on the upper slopes would increase in coverage and height and eventually provide a nursery for native seedlings. However, without assistance, the vegetation communities of Damper Bay are unlikely to return to anything resembling their original state due to the lack of nearby seed sources and/or seed dispersal limitations.

Planting of appropriate native species would considerably assist and speed up the regeneration process. This would allow for greater diversity than would occur naturally and will provide improved habitats for birds, lizards and invertebrates and increase overall native biodiversity and ecological functioning.

Some revegetation in specific areas of the property is proposed as part of the overall Damper Bay development and should be undertaken in conjunction with fencing, planting and animal pest and weed control.

Four general types of planting will be undertaken:

- Ecological enhancement planting - areas of kanuka, manuka and other appropriate shrub and tree species which will be planted to enhance biological linkages across the landscape, create habitat for birds, lizards and invertebrates, provide a seed source to aid regeneration and improve the sustainability of the flora and fauna;
- Riparian planting – along the permanent stream on the eastern side of the property to protect and enhance aquatic values and along the ephemeral stream between the lake and the wetland proposed for restoration to improve connectivity between the two (Appendix 2);

- Wetland restoration planting in the drained wetland on the western side of the central fan (refer to Appendices 2 and 3); and
- Mitigation planting in appropriate locations in the vicinity of the house sites (refer to the Landscape and Visual Effects Assessment Report (BML 2010)).

Appendices 2 and 3 show the approximate locations of proposed ecological enhancement plantings and the location and types of existing vegetation, respectively. Details of species and a Revegetation Management Plan will be developed as part of the more detailed design stages. Further detailed design work may be required to maximise the ecological benefits of enhancement planting and minimise the adverse effects of plantings compromising landscape values, particularly views to Lake Wanaka and the mountains beyond.

The species used will reflect those in the adjacent areas of existing vegetation in patterns that are appropriate to the landforms and Ecological District. Plantings will also be complementary to those proposed at other sites around the lake. Seeds and/or plants will be sourced from within the site or as close to the site as possible.

Wetland restoration

There are several wetlands of high ecological value in the vicinity of Damper Bay. Specifically these include a large raupo wetland to the west of the property which is administered by DOC, and a smaller raupo wetland on adjoining land to the east. Taken in context, this increases the ecological value of the wetlands on the Damper Bay property as they currently, or have the potential to act as stepping stones for the dispersal of wetland fauna and flora in the wider area.

Currently stock have access to all of the wetlands, wet depressions and seepages on the property and they are grazed and trampled by stock. Excluding stock from the more valuable wetlands on the property will have substantial ecological benefits, and this can be achieved in conjunction with retiring parts of the property from grazing. This will also exclude stock from all of the wet depressions and seepages within the property.

On the western side of the central fan there is a wet area (Appendix 3) that was probably once a more substantial wetland, but it has been drained and grazed by stock. The reduced water levels and the impact of stock have resulted in invasion by introduced grasses and rushes. This wetland should be restored by fencing it off to exclude stock, blocking up the drains, and creating a bund to alter the existing hydrology and planting appropriate native wetland species.

Although not required, this would more than mitigate the loss of part of the wet depression partly within House Site 1.

Stock management and fencing

It is considered appropriate to retain extensive grazing on the flat central fan which is one of the more productive areas of the property that will be more challenging to revegetate. This will also maintain the views to Lake Wanaka and the more distant mountain ranges to the north..

Lots 1 and 3 and all but the central fan on Lot 2 will be retired from grazing. Although this will necessitate concerted weed management, it will promote regeneration of the native shrubland, and eventually perhaps, with the aid of enhancement planting, forest communities. These areas are shown in Appendix 2.

The areas to be retired from grazing shown in Appendix 2 encompasses all of the features of ecological value identified in Section 3 including the small group of *Olearia lineata* (Appendix 3 and Photo 6 in Appendix 6), the more intact wetlands on the property, the rock bluffs and boulderfields and the kanuka forest directly behind the shoreline in the centre of Damper Bay and the permanently flowing stream on the eastern side of the property.

Table 2: Summary of recommended land management options for Damper Bay, Wanaka.

Management Action	Objective	Method
Animal pest control	• Maintain rabbit populations at low densities to allow the recovery and regeneration of indigenous vegetation communities	• Carry out effective rabbit control
Weed control and monitoring	• Prevent the establishment of new weeds following construction works • Control existing weeds, and reduce the extent of woody weeds i.e. sweet briar	• Regular monitoring for weed species • Spot spraying or manual removal of weeds in open pastoral situations • Hand-cutting and stump painting of woody weeds where they are growing amongst native vegetation where spraying is inappropriate
Planting	• Create ecological linkages between fragmented indigenous habitats • Provide indigenous habitats for invertebrates, lizards and birds • Buffer riparian margins	• Native plantings to provide ecological linkages between fragmented indigenous habitats (refer Appendix 2) • Plants should be sourced from seed onsite, or from within the Wanaka ED
Wetland restoration	• Restore existing wetlands	• Fence wetlands of high ecological value, particularly the *Carex secta -C. virgata* swamp situated in the north-western corner of the property (Appendix 3) • Fill in drains, bund and undertake restoration planting of the wetland area on the western side of the central fan (Appendices 2 and 3)
Stock management and fencing	• Retire less productive land from grazing to encourage regeneration of indigenous vegetation communities • Retain most productive pastoral land for grazing and to retain the 'open character' of the landscape • Protect areas with higher indigenous ecological values from stock damage	• Retire the steeper, areas of the property from grazing (Appendix 2) • Exclude stock from areas with indigenous ecological values including wetlands, shrublands, scrub, kanuka forest and re-planted areas

7 Mitigation

The proposal as set out in the Application Plan, and the details of stormwater and waste water management set out in the resource consent application have been designed to protect and enhance existing ecological values on the site. "Mitigation" is thus already built into much of the design. In summary, the key points that have been addressed as mitigating potential effects, including recommendations for future land management are:

- The layout of the house sites and access tracks which avoid areas with indigenous ecological values and largely minimise adverse effects on waterways.
- Stormwater and waste water treatment systems ensure that only high quality water is discharged to water or land.
- Construction works to be undertaken in summer to reduce stormwater run-off and ensuring construction does not start on site until erosion and sediment control works are in place.
- Weed management to prevent the establishment of new weeds following earthworks. This includes washing all earthmoving machinery as it enters the site, promptly re-vegetating disturbed soil and sourcing clean gravel.
- Implementation of a weed surveillance and control programme for the wider property to prevent the establishment of new weeds such as wilding pines, and reduce the extent of existing weeds such as sweet briar and other problem weeds.
- Rabbit control to maintain rabbit populations at low densities and allow the recovery and regeneration of indigenous vegetation communities.
- Planting using locally sourced native species to establish ecological linkages between retired land and fragmented indigenous habitats, speed up the natural regeneration process, restore wetlands and provide habitats for invertebrates, lizards and birds.
- Exclude stock from wetlands to protect them from further damage and potentially restore one wetland that has been drained and modified.
- Retiring appropriate areas of the property from grazing and excluding stock from areas with indigenous ecological values including wetlands, shrublands, scrub, kanuka forest, waterways and planted areas.

8 Conclusions

The proposed Damper Bay Estate development should have negligible adverse effects on ecological values. The small number of proposed dwellings and the detailed design of the alignment of the proposed access tracks significantly minimises the potential for adverse effects on ecological values.

As long as appropriate measures are in place to prevent weed establishment following earthworks, sediment run-off into the permanently flowing eastern stream is managed and the stream crossing is designed and constructed correctly, the effects of construction will be no more than minor. Similarly, if stormwater and waste water treatment systems are correctly constructed and operated to meet the Otago Regional Council's requirements no significant adverse effects of any discharges to water or land are anticipated.

A number of management actions are proposed for the property. These include: rabbit and weed control; revegetation with locally sourced native plants; retiring a large proportion of the property from grazing, including the features with the highest ecological values; and undertaking wetland restoration. Overall, if these are adopted, the development will have substantial benefits for the ecology of the property. Further, they compliment and add to the value of similar restoration programmes being considered or undertaken around the southern end of Lake Wanaka.

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Boffa Miskell

Ref : W10014_A3_Ecology.indd - May 2010

SITE LOCATION & LANDSCAPE CONTEXT

DAMPER BAY ESTATES LTD

APPENDIX 1

Boffa Miskell

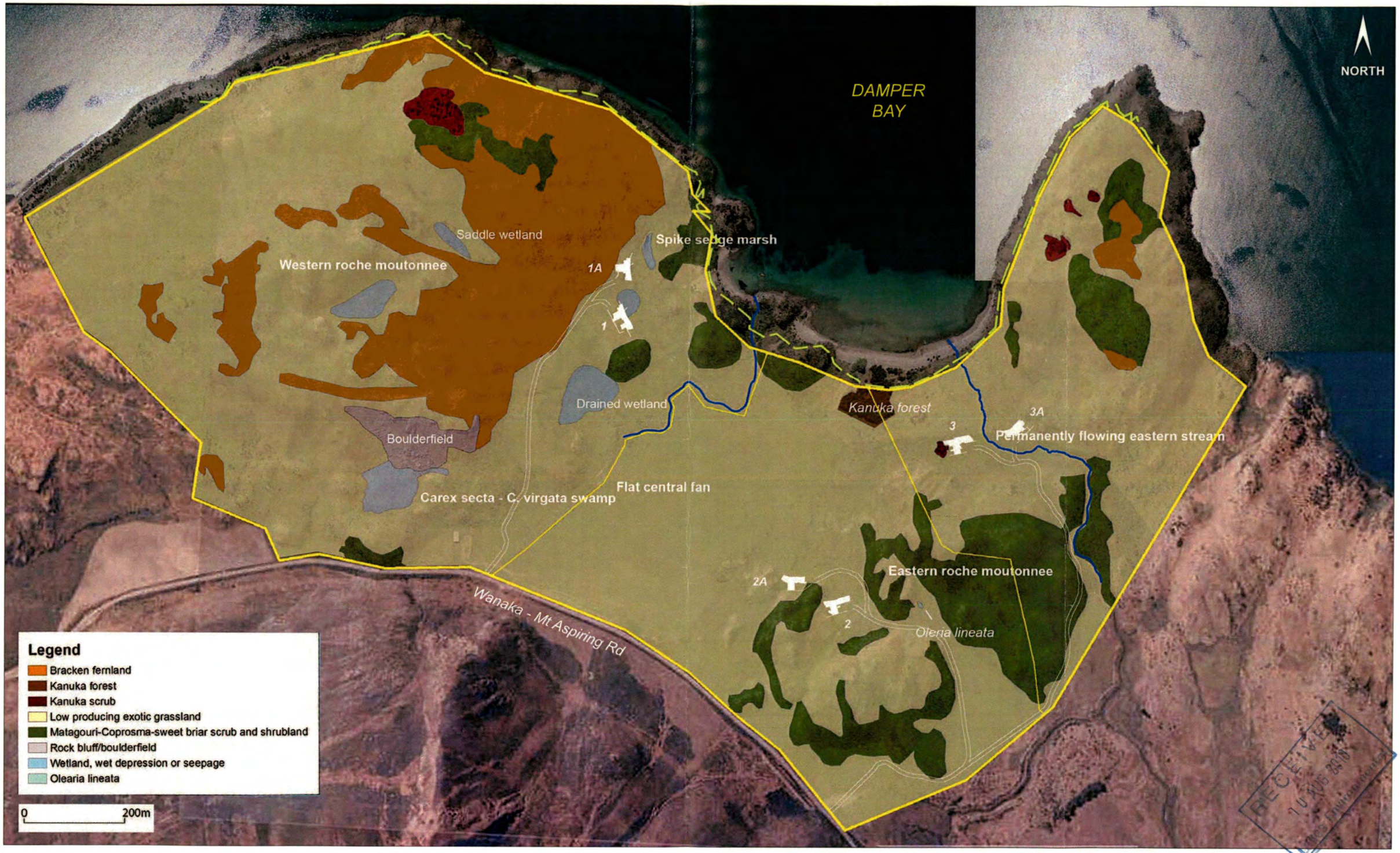
Ref : W10014_A3_Ecology.indd - May 2010

LANDSCAPE MANAGEMENT PLAN

DAMPER BAY ESTATES LTD

APPENDIX 2

Updated 7 July 2010



Boffa Miskell

Ref : W10014_A3_Ecology.indd - May 2010

EXISTING VEGETATION PLAN

DAMPER BAY ESTATES LTD

APPENDIX 3

Appendix 4: Scientific Names of Plant Species Mentioned in the Text

Common name	Scientific name
Current species	*Ribes sp.*
Blue tussock	*Poa colensoi*
Bog rush	*Schoenus pauciflorus*
Bracken	*Pteridium esculentum*
Briar	*Rosa rubiginosa*
Broad-leaved dock	*Rumex obtusifolius*
Broom	*Cytisus scoparius*
Browntop	*Agrostis capillaris*
Butterfly fern	*Asplenium flabellifolium*
Californian thistle	*Cirsium arvense*
Cocksfoot	*Dactylis glomerata*
Common shield fern	*Polystichum richardii*
Common tree daisy	*Olearia arborescens*
Creeping bent	*Agrostis stolonifera*
Creeping buttercup	*Ranunculus repens*
Crested dogstail	*Cynosurus cristatus*
Cutty grass	*Carex coriacea*
Desert broom	*Carmichaelia petriei*
Elderberry	*Sambucus nigra*
Hard tussock	*Festuca novae-zelandiae*
Foxglove	*Digitalis purpurea*
Gorse	*Ulex europaeus*
Hemlock	*Conium maculatum*
Horehound	*Marrubium vulgare*
Kahikatea	*Dacrycarpus dacrydioides*
Kanuka	*Kunzea ericoides*
Kneed foxtail	*Alopecurus geniculatus*
Kotukutuku	*Fuchsia excorticata*
Leafless rush	*Juncus effusus*
Lowland flax	*Phormium tenax*
Matagouri	*Discaria toumatou*
Matai	*Prumnopitys taxifolia*
Mikimiki	*Coprosma propinqua*
Pohuehue	*Muehlenbeckia australis*

Common name	Scientific name
Porcupine shrub	*Melicytus alpinus*
Purei	*Carex secta*
Raupo	*Typha orientalis*
Rose campion	*Silene coronaria*
Scotch thistle	*Cirsium vulgare*
Sharp spike sedge	*Eleocharis acuta*
Silver beech	*Nothofagus menziesii*
Silver tussock	*Poa cita*
Small-leaved pohuehue	*Muehlenbeckia complexa*
Spleenwort	*Asplenium appendiculatum*
Swamp sedge	*Carex virgata*
Sweet vernal	*Anthoxanthum odoratum*
Tataramoa	*Rubus schmidelioides*
Totara	*Podocarpus totara*
Tutu	*Coriaria sarmentosa*
White clover	*Trifolium repens*
Wineberry	*Aristotelia serrata*
Wiwi	*Juncus edgariae*
Woolly mullein	*Verbascum thapsus*
Yorkshire fog	*Holcus lanatus*
	Carex comans
	Carex sp.
	Carex sinclairii
	Coprosma rigida
	Coprosma rugosa
	Coprosma virescens
	Helichrysum lanceolatum
	Olearia lineata