Boffa Miskell

Ohau proposed golf course Ecological Assessment

Douglas Links Golf Course
Prepared for Grenadier Ltd.

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The lower Ōhau River from the seaward edge of the salt marsh looking toward the active duneland © Boffa Miskell, 2021

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1.0 Introduction

A golf course is proposed to be built at 765 Muhunoa Road West, Ōhau. Boffa Miskell Ltd. has been engaged by Grenadier Ltd. to undertake an ecological assessment of freshwater, vegetation, avifauna, and herpetofauna on site, particularly in those locations which golf course design will interact with ecological components on site. The results of these findings are outlined in the following report and compared to the relevant significance schedules in the Horizons Regional Council One Plan (Horizons Regional Council, 2014).

The site is located directly north and adjacent to the Ohau River, and covers approximately 120 ha of low, rolling and flat land. At the time of survey, the majority of the site was an active farm, with areas of vegetation toward the coast fenced from stock. The site is in direct proximity to the Ohau River mouth, Ohau River, and the western coastline.

2.0 Freshwater

2.1 Methods

2.1.1 Desktop survey

Published literature and databases were searched, including the NIWA administered Freshwater Fish Database.

2.1.2 Field survey

The site was visited on 12 April 2021 to understand and describe the aquatic physical habitat condition of the Ōhau River. Descriptions were made from the river edge as depths precluded access into the river at the time of survey. Descriptions included a Rapid Physical Habitat Assessment (RPHA) (Clapcott, 2015) which is comprised of 10 habitat parameters of which each is given a score out of 10 based on its condition. The habitat parameters are as follows:

i. Deposited sediment
ii. Invertebrate habitat diversity
iii. Invertebrate habitat abundance
iv. Fish cover diversity
v. Fish cover abundance
vi. Hydraulic heterogeneity
vii. Bank erosion
viii. Bank vegetation
ix. Riparian width
x. Riparian shade

2.2 Results

2.2.1 Desktop

The Ōhau River (Map 1 and Figure 1 - The lower Ōhau RiverFigure 1), alongside the proposed golf course, is a 5th order river. The lower, tidally influenced reach extends approximately 3 km upstream (Todd et al., 2016) and can be considered modified due to the surrounding land use (agriculture) and corresponding land clearance, as well as flood mitigation measures resulting in a new straight reach being creating to effectively isolate an approximately 3.5 km meandering stretch (Smith et al., 2011).

Figure 1 - The lower Ōhau River

A range of fish have been recorded from the lower Ōhau River, including within the main stem and the Ōhau Loop. The NIWA administered New Zealand Freshwater Fish Database (NZFFD; accessed 15/06/2021) only contains records for an unnamed wetland near the Ōhau estuary with no records in the main river channel itself. The species recorded in this unnamed wetland near the estuary includes migratory *Galaxiidae* (including inanga and unidentified galaxias spp.) and eels (only noted as unidentified) suggesting there is a source population in the river and that inanga likely spawn in the lower, tidally influenced reaches. In total, the NZFFD identifies 16 species of freshwater fish within the catchment, including 13 that are, or may be, migratory, and seven which may reside within the lower estuarine habitats as adults (Table 1). The NZFFD also includes records of the Not Threatened[1] kōura (freshwater crayfish; *Paranephrops planifrons*).

Table 1: Fish species recorded in the Ōhau River catchment on the New Zealand Freshwater Fish Database (NZFFD), including their conservation status, if they may be migratory, number of NZFFD records, and whether they may be resident within the estuarine area (and therefore near the site).

Common name	Scientific name	Conservation status[2]	Migratory	No of NZFFD records	Potential resident near site?
Shortfin eel	*Anguilla australis*	Not Threatened	Yes	4	Yes

[1] (Grainger et al., 2018)

[2] (Dunn et al., 2018)

Common name	Scientific name	Conservation status[2]	Migratory	No of NZFFD records	Potential resident near site?
Longfin eel	*Anguilla dieffenbachii*	At risk - declining	Yes	37	No
Torrentfish	*Cheimarrichthys fosteri*	At risk - declining	Yes	16	No
Koaro	*Galaxias brevipinnis*	At risk - declining	Yes	14	No
Banded kōkopu	*Galaxias fasciatus*	Not Threatened	Yes	6	Yes
Inanga	*Galaxias maculatus*	At risk - declining	Yes	9	Yes
Shortjaw kōkopu	*Galaxias postvetis*	Threatened - nationally vulnerable	Yes	19	No
Lamprey	*Geotria australis*	Threatened - nationally vulnerable	Yes	3	Yes
Crans bully	*Gobiomorphus basalis*	Not threatened	No	1	No
Upland bully	*Gobiomorphus breviceps*	Not threatened	No	16	No
Common bully	*Gobiomorphus cotidianus*	Not threatened	Yes	5	Yes
Bluegill bully	*Gobiomorphus hubbsi*	At risk - declining	Yes	1	No
Redfin bully	*Gobiomorphus huttoni*	Not threatened	Yes	30	No
Common smelt	*Retropinna retropinna*	Not threatened	Yes	1	Yes
Rainbow trout	*Oncorhynchus mykiss*	Introduced and naturalised	No	7	No
Brown trout	*Salmo trutta*	Introduced and naturalised	Yes	81	Yes

Existing literature also provides details on the fish populations that are likely present in the lower reaches of the Ōhau River and the Ōhau Loop (which now has fish friendly flood gates installed (Todd et al., 2016)). These results are presented in Table 2 below. The literature includes records of marine wanderers, giant bully (*Gobiomorphus gobioides*), rudd (*Scardinius erythrophthalmus*), common shrimp (freshwater shrimp; *Paratya curvirostris*), and kākahi (freshwater mussels; *Echyridella menziesi*) which are not found on the NZFFD (noting common shrimp and kākahi are macroinvertebrates).

Table 2: Species observed in the lower Ōhau River from key literature sources.

Reference	(Lucas Associates, 1998)	Kaumātua knowledge (from Lucas Associates, 1998)	(Todd et al., 2016)	(Allen et al., 2011)
Species	Inside Ōhau Loop: Common bully, common shrimp, common smelt; Downriver of Ōhau Loop: Common bully, common shrimp, common smelt, black flounder, inanga, grey mullet.	Tuna (eel), kokopu (adult inanga, whitebait), lamprey, patiki (black flounder), kanae (grey mullet), aua (yellow eyed mullet), kakahi (freshwater mussels), koura (freshwater crayfish).	List species also found in NZFFD records, with the addition of: Black flounder, kahawai, rough skate.	Common smelt, mullet, brown trout, inanga, longfin eel, shortfin eel, black flounder, common bully, giant bully, rudd, freshwater shrimp.

2.3 Field observations

The Ōhau River, adjacent to the proposed golf course is a wide, tidally influenced, soft-bottomed river with limited riparian cover and instream flow and habitat variability. It is expected, based on observed topography and vegetation, that the width of the river increases to approximately 150-160 m at high tide, an approximately 60 m wide base channel. The rapid habitat assessment indicates condition of the section of river alongside the proposed golf course to be suboptimal (35/100; Table 3); however, this score is limited by features which are typical of estuarine/tidally influenced, wide rivers where sand is prominent and shade capabilities are limited. The lowland, wide nature of tidally influenced rivers also limits the score of the invertebrate and fish components of the RPHA due to the homogenous flow and habitat conditions; however, these are to be expected in these environments.

Table 3: Rapid physical habitat assessment results for the section of Ōhau River alongside the proposed golf course.

Habitat parameter	Description	Score
Deposited sediment	Deposited fine sediment (predominantly sand) covered the entire riverbed.	1
Invertebrate habitat diversity	Two notable substrate types considered invertebrate habitat, including sand and wood (noting woody debris was rare).	2
Invertebrate habitat abundance	Less than 5% of the visible substrate was favourable for EPT colonisation, including an absence of cobbles/gravels, macrophytes, and filamentous algae.	1
Fish cover diversity	Substrate types which may be utilised as fish cover is limited to woody debris and some overhanging vegetation (noting the overhanging vegetation was limited to small shrubs, rushes, and sedges).	2
Fish cover abundance	Fish cover was less than 5% of the stream channel, limited to isolated pieces of woody debris.	2
Hydraulic heterogeneity	Slow run conditions are the only notable hydraulic component.	1
Bank erosion	There are no signs of recent or active erosion, scouring, or slumping that aren't in response to tidal influences.	10
Bank vegetation	Bankside vegetation is a mixture of grazed pasture, sparse tree cover, and tidal flax/sedge/salt marsh.	6
Riparian width	The width of the riparian buffer constrained by vegetation, fencing, or other structures is typically approximately 10 m on the true left and at least approximately 20 m on the true right.	9
Riparian shade	Less than 5% of the river channel is expected to be shaded throughout the day.	1
	Total score	**35/100**

2.4 Schedule B - Significance

The Ōhau River, at the section alongside the proposed golf course, is considered significant in Schedule B of the Horizons Regional Council One Plan for the following reasons:

- Trout fishery
- Site of significance - riparian
- Inanga spawning

- Whitebait migration
- Life supporting capacity

3.0 Vegetation

3.1 Methods

3.1.1 Desktop review

A Horizons report containing ecological survey information from within the site was read to inform the methods of carrying out the site visit and to become familiar with site history and expected vegetation (*Site Visit Report – 765 Muhunoa West Road, Ōhau., Horizons Regional Council, 2020*). Personal vegetation lists of the foredune area were provided by accompanying botanist Pat Enright from previous surveys along the beach dune reserve area. The Plant Conservation Networks published plant lists were also interrogated.

3.1.2 Site survey

A vegetation survey was undertaken over the 7th and 8th of April 2021 by a Boffa Miskell ecologist, assisted by local botanist Pat Enright. Over the course of the survey, walking transects were undertaken throughout the site, during which all plant species were recorded, and photographs taken. GPS locations of any notable plants were collected. Distinct vegetation communities within the wider site context were recognised over the site and the species compositions of these communities were noted, with prioritisation of areas closer to the coastline (as opposed to the working farm). Vegetation community descriptions are outlined in Section 3.2.1.

3.1.3 Mapping

A map of all vegetation communities was created following the survey on ArcGIS software. The mapping was done by the same person that undertook the vegetation surveys. The process involved using a combination of walking GPS tracks, vegetation community notes, and recent high quality drone aerial imagery of the site. Mapping was done at a scale of 1:1,500 throughout the process. The contrasts in colour and texture provided by the drone imagery provided enough clarity to outline vegetation communities, and in any areas of uncertainty the images and descriptions from the site survey were used to aid delineation.

3.2 Results

3.2.1 Vegetation communities

The vegetation communities determined on site and their total areas as calculated by ArcGIS software are outlined in Table 4 below. Refer to Map 2 for vegetation community outlines.

Table 4 - Vegetation communities and their area identified on site at 765 Muhunoa Road West, Ōhau

Number	**Vegetation community**	**Total area** (ha)
1	Grazed grassland	59.57
2	Rank grassland	1.17
3a	Mixed wattle treeland	1.77
3b	Mixed pine treeland	14.17
4a	Poplar treeland	0.55
4b	Poplar treeland over exotic scrub	0.10
5	Macrocarpa	9.52
6a	Exotic scrub	10.45
6b	Exotic scrub under pine	2.12
7	Exotic native mix	0.34
8a	Kānuka treeland	0.70
8b	Thin kānuka treeland	0.24
9	Knobby clubrush stable duneland	7.31
10	Spinifex active duneland	6.53
11	Wetland	0.03
12	Saltmarsh	1.98

3.2.2 Community 1 - Grazed grassland

Figure 2 - Grazed pasture community at 765 Muhunoa Road West

This community is dominated by pasture grasses which are frequently grazed by stock. The community is typical of dry, coastal pasture in New Zealand and among common grass species such as cocksfoot (*Dactylis glomerata*), sweet vernal (*Anthoxanthum odoratum*), and tall fescue (*Lolium arundinaceum*), the community contains occasional pasture and pasture associated species including tarweed (*Parentucellia viscosa*), dandelion (*Taraxicum officinale*), clover (*Trifolium* sp.), creeping buttercup (*Ranunculus repens*), and fleabane (*Erigeron sumatrensis*). Some of the grassland areas appeared to have been recently modified, and as such there were higher densities of tree lupin growing in these areas. Overall, this community type covered the largest area on site, and was dominated by exotic species.

3.2.3 Community 2 - Rank grassland

Figure 3 - Rank grass community at the north western edge of the surveyed area

This community is characterised by its pasture grasses, dominated by cocksfoot (*Dactylis glomerata*) with occasional tall fescue (*Lolium arundinaceum*) Creeping bent (*Agrostis stolonifera*) and Yorkshire fog (*Holcus lanatus*) interspersed to about 45cm in height. Occasional knobby clubrush, heather, pampas, gorse, and *Pinus radiata* were scattered throughout. One cabbage tree (*Cordyline australis*) at approximately 2.5m height and two jointed rush plants (*Apodasmia similis*) were noted near the mānuka tree (*Leptospermum scoparia*) (~3m height) in the centre of the area. This community is dominated by exotic species, mostly pasture grasses.

3.2.4 Community 3a - Mixed wattle treeland

Figure 4 - Wattle amongst the farmland at 765 Muhunoa Road West, Ōhau

Fenced areas of acacia wattle (*Acacia sorophorae, A. decurrens*) were present within the grazed grassland. A variety of exotic trees and grasses, ranging between 1-4m in height were identified. Wattle dominated the community with occasional pine (*Pinus sp.),* some regenerating at the edges of the area, alongside pampas grass (*Cortaderia selloana, C. jubata*). Tree lucerne (*Chamaecytisus palmensis*) was present in few condensed patches throughout, and gorse (*Ulex europaeus*) and lupin (*Lupinus arboreus*) to about 1m in height were present in gaps between the wattle and pine. No indigenous species were identified in the community.

3.2.5 Community 3b - Mixed pine treeland

Figure 5 - Pine plantation on the back slopes of the farmland at 765 Muhunoa Road West, Ōhau

This community is dominated by young pine (*Pinus sp.)* (approximately 4m in height) over pasture grasses. In areas devoid of pine, tree lucerne becomes prominent, with small pockets of gorse in bare pasture areas. The edges of the community contain some wattle trees approximately 4m in height. No indigenous species were identified in the community.

3.2.6 Community 4a - Poplar treeland

Figure 6 - White poplar over rank grass and ferns

This community is characterised by its white poplar (*Populus alba*) canopy and occurs in pockets throughout site. Groundcover is leaf litter from the recently fallen poplar leaves, with rank cocksfoot grass, occasional lupin, and gorse in clear canopy gaps. Occasionally, native ferns were noted at the base of the poplar trees, such as *Polystichum vestitum, Hypolepis ambigua, Asplenium oblongifolium, Microsorum pustulatum,* and a lone mahoe (*Melicytus ramiflorus*) sapling. Scattered pampas grass was present, as across most of the site. This community is dominated by the poplar canopy and pasture grass understorey.

3.2.7 Community 4b - Poplar over exotic scrub

Figure 7 - White poplar canopy over exotic scrub

This community differs from the 4a poplar treeland by its understorey which is a mix of exotic and scrub and occasional native knobby clubrush (*Ficinia nodosa*) and *Cyperus ustulatus*. Native species include totara (*Podocarpus totara*), Glen Murray tussock (*Carex flagellifera*), mahoe, *Myrsine australis*, tree fern (*Dicksonia squarossa*), *Cyperus ustulatus*, knobby clubrush, kānuka (*Kunzea robusta*), and *Asplenium oblongifolium*. These native species are growing among frequent exotic species gorse, lupin, scotch thistle (*Cirsium vulgare*), fleabane (*Erigeron sumatrensis*), wattle, and pampas grass, which overtop the native species present.

3.2.8 Community 5 - Macrocarpa

Figure 8 - Understorey of the macrocarpa community

Macrocarpa (*Cypressus macrocarpa*) across site reached to approximately between 7- 10m in height, with overlapping canopy and scattered *Pinus radiata* acting as canopy species. Under the canopy very little vegetation was present, with no subcanopy species and varying degrees of cover from New Zealand spinach, more prominent toward the dunes, occasional diversity of *Asplenium* sp. (*A. appendiculatum, A. flabellifolium, A. flaccidum, A. oblongifolium*, and *A. polyodon*), low *Coprosma repens*, houndstongue (*Microsorum pustulatum*), *Paesia scaberula*, Glen Murray tussock, and shaking brake (*Pteris tremula*) were present, rarely scattered throughout, more condensed toward light edges. The groundcover was largely bare, open ground with dropped branches and leaf litter from the macrocarpas, otherwise very sparse. Where macrocarpa met the margins of grassland, there were pockets of silver poplar over rank grass and gorse, with occasional kānuka seedlings, lucerne, tree lupin, and pampas grass. Where macrocarpa met stable duneland communities, native spinach, knobby clubrush, lupin, *Gazania* sp. and *Arctosis stoechadifolia* were present. The community is growing on duneland sands but is almost entirely exotic.

3.2.9 Community 6a - Exotic scrub

Figure 9 - Heather, pampas grass, gorse, and lupin with emergent pine to the north of the salt marsh

The exotic scrub community on site contains a mixture of gorse, lupin, heather (*Erica lusitania*), and pampas primarily. These four species are common throughout all exotic scrub areas on site in different proportions, but all exist on disturbed ground. Among these four main species, other less common ones include pine and wattle. Some native species are interspersed throughout these areas, such as knobby clubrush, which has a presence throughout most ungrazed areas on site, and occasional *Juncus* species or *Cyperus ustulatus*. Blackberry (*Rubus ulmifolius*), fleabane, and scotch thistle also persist in some areas, and boxthorn (*Lycium ferocissimum*) is present only on the southern edge of site in one location. Pasture grasses persist in otherwise bare locations, and are generally common throughout (mostly tall fescue, sweet vernal, and cocksfoot). Overall, even though these areas have few native plants dispersed throughout, they are dominated by exotic species.

3.2.10 Community 6b- Pine over exotic scrub

Figure 10 - Pine canopy over exotic scrub

This community contains pine (8m+) over a scrub community dominated by exotic species, similar to that described in Section 3.2.9 but slightly less dense, with higher proportions of gorse and incidental native species (*Myrsine australis*, young mahoe and kānuka, and occasional *Asplenium* sp.) interspersed among the other exotic scrub species common across site such as pampas and lupin.

3.2.11 Community 7 - Exotic native mix

Figure 11 - Silver poplar and totara emergent above exotic and native regenerating species

Figure 12 - Myrsine australis and knobby clubrush growing among pampas and pine.

Figure 13 - Totara trees in the centre of the vegetation community

This community contains an almost equal mix of both native and indigenous species, with emergent silver poplar and totara *(Podocarpus totara*). Silver poplar is spread commonly throughout the community, slightly more condensed at the northern end where it meets the poplar treeland, over 5m in height. The totara is contained largely to the centre of the community, where a cluster of approximately seven very narrow-trunked trees have grown alongside each other and are in varying states of health with heights between 2m and 8m. Rarely, tall (4m+) wattles (*A. sorophorae* and *A. decurrens*) are present at the southern edge. Groundcover contains pasture grasses (clover, cocksfoot, tall fescue), gorse, lupin, boxthorn,

lucerne, wilding pine, and pampas, intertwined with blackberry encroaching from the neighbouring community at common densities. Among these are a mix of young native species, similar in height to the exotic species at 1-2m in height. Mahoe (*Melicytus ramiflorus*), *Myrsine australis*, and knobby clubrush were common in comparison to totara, pōhuehue, hangehange (*Geniostomia ligustrifolium*), cabbage tree (*Cordyline australis*), pseudopanax, and coprosma hybrid species which were infrequent. One titoki (*Alectryon excelsus*) of 1m height was identified in amongst a further group of silver poplar of similar height to the native scrub.

3.2.12 Community 8a - Kānuka treeland

Figure 14 - The understorey of pure kānuka treeland at 765 Muhunoa Road West

The kānuka (*Kunzea robusta)* treeland areas at the northern end of the site varied between 3 and 6 m in height, forming a dense canopy. The westernmost stand contained mānuka (*Leptospermum scoparium*) which also comprised part of the canopy. Cabbage trees (*cordyline australis*) were encountered rarely as an element of the canopy. Subcanopy species were infrequent tree fern (*Dicksonia squarossa*) and C*oprosma propinqua* at edges, though the interior of fragments was largely devoid of any groundcover or subcanopy. The groundcover at the edges of fragments included dense levels of fern species *Histiopteris incisa* and *Polystichum vestitum*, with encroaching veldt grass and cocksfoot among other grasses.

3.2.13 Community 8b - Thin kānuka treeland

Figure 15 - Exposed kānuka treeland poles

This area of kānuka (*K. robusta*) differs from the other kānuka stands identified on site. The kānuka trees are thinner with reduced health and smaller crowns which do not overlap. Many were standing with no live foliage visible. One pine tree and one cabbage tree were also present in the canopy. The stand is located in a grazing paddock with full stock access, and no regeneration of native species was seen in the understorey. Groundcover was entirely pasture species, as well as creeping buttercup *(Ranunculus repens*), two *Juncus pallidus*, and occasional pasture weeds. Some recent felling of the stand was apparent.

3.2.14 Community 9 - Stable duneland

Figure 16 - Knobby clubrush dominated stable dune with lupin on the right, edged by macrocarpas

Knobby clubrush (*Ficinia nodosa*) dominates large areas of stable duneland along the western edge of site, growing densely at approximately 60 – 70 cm in height, and sometimes over 1m. *Muehlenbeckia complexa* made up a small, rare component of the community. This landscape is commonly interspersed with oioi (*Apodasmia similis),* and tree lupin which forms large clumps on its own up to 1.5m in height. The lupin is particularly dominating toward the coast, more so than the club rush, where it forms a dense boundary between the active and stable duneland. Gorse is infrequent, though becomes common toward the active and stable duneland boundary in the same way as lupin. Gravel groundsel (*Senecio skirrhodon*), *Olearia solandri*, and tauhinu (*Ozothamnus leptophyllus*) are present in low numbers as a gradient between the active and stable duneland, while pampas is occasional throughout the community, sometimes forming competitive clusters. Rarely, coastal wattle (*Acacia sophorae*) and flax (*Phormium cookanium* subsp. *hookerii*, *P. tenax*) were present, and one *Coprosma acerosa* individual was noted.

Figure 17 - Knobby clubrush, flax, and lupin in the stable duneland

Figure 18 - Lupin and gorse dominating the coastal edge of the stable dune

3.2.15 Community 10 - Spinifex active duneland

Figure 19 - Pingao and spinifex on the active duneland

Figure 20 - Sand daphne and trifolium arvensis growing among pingao

Figure 21 - Tauhinu present among spinifex on the duneland

The foredune bounds the entire western side of the site and is dominated by duneland grasses adapted to the shifting sands, namely spinifex (*Spinifex sericeus*), commonly with areas of pingao (*Finicia spiralis*). Marram grass (*Ammophila arenaria*) was successfully competing with the native grasses in several areas along the dune. Small numbers of sand wind grass (*Lachnagrostis billardierei*), *Carex pumila, Acaena novae-zealandiae,* shore bindweed (*Convolvulus soldanella*) and *Oxalis rubens* are spread throughout the dune landscape. Scattered occasionally through the grasses and generally further inland where sands are slightly more contained are tauhinu (*Ozothamnus leptophyllus*), knobby clubrush, *Plantago coronopus*, and common *Trifolium arvensis* and gravel groundsel growing among the larger vegetation species. Sand daphne (*Pimelea villosa*) was infrequently present, at the inland edge of the active sand dune and concentrated at the northern end of site. *Carex testacea* was present in very low numbers in the dune strip in an unusual coastal form with fine red leaves and small seed heads. Pampas is rare, scattered throughout the length of the dunes. Individual specimens of yucca, evening primrose, and banksia were noted. Wheel tracks from motor vehicles have caused erosion of the dunes but these are present only toward the southern end. Some large patches of gorse and tree lupin are establishing at the northern end, encroaching from the neighbouring stable dune.

3.2.16 Community 11 - Wetland

Figure 22 - Raupō surrounded by isolepis in the centre of the exotic scrub community

There was one wetland located on site during the survey which is perfectly circular (perhaps because it was once a stock pond). It is surrounded entirely by pampas grass, lucerne, gorse, and coastal wattle. The interior is raupō (*Typha orientalis*) dominated, approximately 6 m x 6 m, with isolepis (*Isolepis prolifera*) surrounding the raupō in a ~2m wide radius. One 2 x 2 m area of deep mud, which appears to be open water during wet times, is entirely covered by *Lemna disperma*.

3.2.17 Community 12 - Saltmarsh

Figure 23 - Bolboshoenus caldwellii and Typha orientalis growing in the salt marsh near the Ōhau River

The saltmarsh follows a gradient from the eastern upper edge with exotic scrub and rank pasture with flax, lupin, pampas, and gorse, and rare cabbage trees, which graduates into rushland containing large swathes of raupō, *Bolboschoenus caldwellii,* threesquare, sea rush (*Juncus kraussii*) with lower proportions of oioi, marsh ribbonwood (*Plagianthus divaricatus), Schoenoplectus pungens*, all around 1m in height, making up a significant proportion of the saltmarsh area. This then transitions into a smaller area of herbfield and mudflats, which at the transition zone contained shore celery (*Apium prostratum*), *Triglochin striata*, bachelors' button (*Cotula coronopifolia*), and pink bindweed (*Calystegia roseacea*) among the previous rush species. The mudflat habitat had large bare areas, though a diverse array of typically small species were scattered over the fine mud and sands including *Selliara radicans, Isolepis ceruna var. ceruna*, shore cotula (*Leptinella dioca*), and mudwort (*Limosella lineata*). Large areas of woody debris were washed up at the river edge of the mudflats.

3.3 Plants of Interest

Large Kānuka

Figure 24 - A large kānuka tree growing at the edge of the macrocarpa community

Though it does not form its own community, one kānuka (*Kunzea robusta*) tree at the edge of the macrocarpa community was identified which is particularly large (6m+), multi-stemmed, and expected to be quite old. While its ecological function is not likely to be very high, it is a tree which should be retained. The threat status of kānuka moved from Not Threatened in 2013 to Threatened - Nationally Vulnerable in 2018 following the recent arrival and spread of myrtle rust in New Zealand (de Lange et al., 2018).

Sand Daphne

Figure 25- Sand daphne (Pimelea villosa) growing over pingao at the margin of the active and stable sand dune

The active duneland parallel to the beach contained several individual sand daphne (*Pimelea villosa*) plants, ranging from smaller than 10 x 10 cm to over 4 x 2 m. These were widespread throughout the active foredune, most commonly at one cluster at the northern end of the property. Sand daphne was searched for throughout the entire active dune area and at the edges of the stable dune and are marked on Map 2, though it is possible that the specimens found are only a subset of those present. In total, 44 individual sand daphne plants were noted. Sand daphne has a national threat status of At Risk – Declining, with a predicted population decline between 10-50% due to Partial Decline and Recruitment Failure (de Lange et al., 2018).

4.0 Avifauna

4.1 Methods

4.1.1 Desktop review

Data from the Ornithological Society of New Zealand's (OSNZ) atlas (Robertson et al., 2017) were collated from the two 10 x 10 km grid squares (269, 605 and 269, 606), which encompass the project site and surrounds.

Further literature and website searches were undertaken to obtain additional information regarding bird species known to occur within the surrounding habitats. This included the eBird citizen science database; species lists were derived from hotspot survey locations near the project site as well as from specific searches for some rarer and less detectable species (cryptic bird species) to determine local distributions and their likely presence on site.

The species list obtained from the desktop review was filtered to exclude species that do not have primary habitat on site and/or have only been recorded historically at the site or surrounds[3]; this served as a base list of avifauna species present, or potentially present, at or near, the project site. The threat status of each species was obtained from the current New Zealand Threat Classification for avifauna (Robertson et al., 2017).

4.1.2 Field investigation

On 12 April 2021 an avifauna field investigation was conducted on site and in the adjacent surrounding areas by two Boffa Miskell ecologists. This involved:

- Observing and traversing through the middle of the saltmarsh wetland habitat (Figure 23). Four playbacks for Australasian bittern were opportunistically undertaken while traversing the wetland, however it is noted that the survey was not conducted during the optimal survey period for cryptic bird species (i.e. spring). The playback surveys involved playing a bittern call through speakers to illicit a potential response from any birds possibly present in the area. These observations and the description from the vegetation surveys (Section 3.2.17), together with the desktop review, were used as a proxy to determine the suitability of the wetland as potential habitat for cryptic bird species.
- A count of all bird species, and their abundances, in/along Ōhau River, at the rivermouth and the adjacent sandspit (Map 1, Figure 26).
- A walking transect along the beach from directly north of the Ōhau rivermouth to the northern extent of the project site (Figure 27). During the survey all bird species observed along the beach and the adjacent duneland were recorded, as well as their abundances.
- Walking through the duneland vegetation and areas of kānuka treeland on site (Figure 17, Figure 14) with the purpose of using habitat as a proxy, together with the desktop review, to determine what species these habitats provide potential habitat for.

[3] The primary and secondary habitats[3] for each bird species was obtained from Heather and Robertson (2015).

- Recording incidental observations of other bird species observed in non-Schedule F areas while walking or driving through site (i.e. grazed pasture, areas dominated by pest plant species; Figure 28).

Figure 26 - The Ohau river mouth beach and sandspit.

Figure 27 - The coastline adjacent to the property

Figure 28 - Grazed grassland, rank grassland, and weedy margins

4.2 Results

Avifauna habitats on site, and or within close proximity of the project site, that meet the requirements of Schedule F of the Horizons One Plan include: saltmarsh wetland, duneland (active and stable), and kānuka forest/treeland.

In total the desktop review listed 63 species that use, or potentially use these habitats at, or in close proximity, to the project site. This includes six Threatened species, 14 At Risk species, 22 Not Threatened species, one non-resident native species and 20 introduced species (*Table 5*). Two of these species, eastern bar-tailed godwit and red knot, are international migrant birds. During the site visit, 27 of these species were observed, including five At Risk species (black shag, pied shag, royal spoonbill, variable oystercatcher and white-fronted tern), 11 Not Threatened species and 11 introduced species (*Table 5*).

The primary habitats for Threatened and At Risk species on site and in the immediate surrounds include freshwater/wetlands (the Ōhau River and potentially the saltmarsh wetland) as well as coastal/estuarine areas (the Ōhau River mouth, beach and dunelands) (Figure 26, Figure 21)

- The Ōhau River, Ōhau River mouth/estuary, the beach and dunelands provide foraging and roosting habitat for waders, gulls, terns and shorebirds. There are also two recent records on eBird (2016 and 2021) of Australasian bittern sightings (one and two birds respectively) at the Ōhau estuary. The beach and dunelands at the estuary also provide nesting habitat for variable oystercatcher (Todd et al., 2016) and potentially New Zealand pipit. The Ōhau estuary is recognised as an 'important area for birds' (B. M. Robertson & Stevens, 2016).

- The saltmarsh wetland is relatively small (1.98 ha) but is in reasonably good condition, with a dense swathes of native saltmarsh vegetation (refer to Section 3.2.17 for a vegetation description). It is part of a network of wetlands in the wider area in which one to two bittern and banded rail have occasionally been recorded (e.g. Te Hakari dune wetland, Lake Horowhenua)[4]. Given the small size of the wetland, it is unlikely to provide permanent habitat for these species, however it may on occasion provide temporary foraging habitat for these mobile species, together with the Ōhau estuary.

The kānuka treeland habitat (refer to Map 2) provides habitat for common, Not Threatened native species and introduced species.

The freshwater wetland (refer to Figure 22) is small (0.03 ha) and isolated and provides habitat for common, Not Threatened native species and introduced species.

The grassland habitat on site, in addition to the coastal habitat, may provide foraging, roosting and possibly nesting habitat (areas of rank grassland) for New Zealand pipit.

The macrocarpa trees along the dune edge may provide roosting and/or nesting habitat for shags.

The remaining vegetation communities on site (exotic scrub, exotic scrub under pine, poplar treeland types, brush wattle treeland, mixed pine treeland exotic native mix; refer to Section 3.2.1 for vegetation community descriptions) provide habitat for native, Not Threatened species and introduced species.

Table 5. Avifauna species that use, or potentially use, habitat at, or in close vicinity to the project site as determined from the field investigation and desktop review (Robertson et al., 2007; Todd et al., 2016)[5]. The conservation status of each species is indicated as well as their primary and secondary habitats.

SPECIES (Robertson et al. 2012)		**CONSERVATION STATUS (Robertson et al. 2017)**	Native forest	Exotic Forest	Scrub / shrubland	Farmland / open country	Freshwater / wetlands	Coastal / Estuary	Oceanic	Urban/Residential	Desktop Review	Observed at, or near, Site
Bellbird	*Anthornis m. melanura*	Not Threatened									✓	
Kereru	*Hemiphaga novaeseelandiae*	Not Threatened									✓	
Kingfisher	*Todiramphus sanctus vagans*	Not Threatened									✓	✓
Morepork	*Ninox n. novaeseelandiae*	Not Threatened									✓	
North Island fantail	*Rhipidura fuliginosa placabilis*	Not Threatened									✓	✓
Shining cuckoo	*Chrysococcyx l. lucidus*	Not Threatened									✓	

[4] eBird Citizen Science Database Australasian bittern species map: https://ebird.org/newzealand/map/ausbit1?neg=true&env.minX=&env.minY=&env.maxX=&env.maxY=&zh=false&gp=false&ev=Z&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2021

[5] eBird Citizen Science Database: https://ebird.org/newzealand/explore

Tui	*Prosthemadera n. novaeseelandiae*	Not Threatened										✓	
Grey warbler	*Gerygone igata*	Not Threatened										✓	✓
Silvereye	*Zosterops lateralis lateralis*	Not Threatened										✓	✓
Blackbird	*Turdus merula*	Introduced										✓	✓
California quail	*Callipepla californica*	Introduced										✓	
Eastern rosella	*Platycercus eximius*	Introduced										✓	
Pheasant	*Phasianus colchicus*	Introduced										✓	✓
NZ pipit	***Anthus n. novaeseelandiae***	**At Risk - Declining**										✓	
Spur-winged plover	*Vanellus miles novaehollandiae*	Not Threatened										✓	✓
Swamp harrier	*Circus approximans*	Not Threatened										✓	✓
Welcome swallow	*Hirundo n. neoxena*	Not Threatened										✓	✓
Magpie	*Gymnorhina tibicen*	Introduced										✓	✓
Canada goose	*Branta canadensis*	Introduced										✓	✓
Chaffinch	*Fringilla coelebs*	Introduced										✓	✓
Dunnock	*Prunella modularis*	Introduced										✓	
Wild turkey	*Meleagris gallopavo*	Introduced										✓	
Goldfinch	*Carduelis carduelis*	Introduced										✓	✓
Greenfinch	*Carduelis chloris*	Introduced										✓	✓
House sparrow	*Passer domesticus*	Introduced										✓	
Redpoll	*Carduelis flammea*	Introduced										✓	
Skylark	*Alauda arvensis*	Introduced										✓	✓
Song thrush	*Turdus philomelos*	Introduced										✓	✓
Starling	*Sturnus vulgaris*	Introduced										✓	✓
Yellowhammer	*Emberiza citrinella*	Introduced										✓	
Australasian bittern	***Botaurus poiciloptilus***	**Threatened – Nationally Critical**										✓	
Black-billed gull	***Larus bulleri***	**Threatened – Nationally Critical**										✓	
Pied shag	***Phalacrocorax varius varius***	**At Risk – Recovering**										✓	✓
South Island pied oystercatcher	***Haematopus finschi***	**At Risk – Declining**										✓	
Spotless crake	***Porzana t. tabuensis***	**At Risk – Declining**										✓	
Black shag	***Phalacrocorax carbo novaehollandiae***	**At Risk – Naturally Uncommon**										✓	✓
Black-fronted dotterel	***Charadrius melanops***	**At Risk – Naturally Uncommon**										✓	
Little black shag	***Phalacrocorax sulcirostris***	**At Risk – Naturally Uncommon**										✓	
Paradise shelduck	*Tadorna variegata*	Not Threatened										✓	
Pied stilt	*Himantopus h. leucocephalus*	Not Threatened										✓	✓

Pukeko	*Porphyrio m. melanotus*	Not Threatened										✓	
NZ scaup	*Aythya novaeseelandiae*	Not Threatened										✓	
NZ shoveler	Anas rhynchotis variegata	Not Threatened										✓	
Black swan	*Cygnus atratus*	Not Threatened										✓	✓
Grey teal	*Anas gracilis*	Not Threatened										✓	✓
Little shag	*Phalacrocorax melanoleucos brevirostris*	Not Threatened										✓	
Feral goose	*Anser anser*	Introduced										✓	
Mallard	*Anas platyrhynchos*	Introduced										✓	✓
Lesser knot	***Calidris canutus rogersi***	**Threatened – Nationally Vulnerable**										✓	
Wrybill	***Anarhynchus frontalis***	**Threatened – Nationally Vulnerable**										✓	
Banded dotterel	***Charadrius bicinctus bicinctus***	**Threatened – Nationally Vulnerable**										✓	
Caspian tern	***Hydroprogne caspia***	**Threatened – Nationally Vulnerable**										✓	
Northern NZ dotterel	***Charadrius obscurus aquilonius***	**At Risk – Recovering**										✓	
Red-billed gull	***Larus novaehollandiae scopulinus***	**At Risk – Declining**										✓	
Royal spoonbill	***Platalea regia***	**At Risk – Naturally Uncommon**										✓	✓
Variable oystercatcher	***Haematopus unicolor***	**At Risk – Recovering**										✓	✓
White-fronted tern	***Sterna s. striata***	**At Risk – Declining**										✓	✓
Banded rail	***Gallirallus philippensis assimilis***	**At Risk – Declining**										✓	
Eastern bar-tailed godwit	***Limosa lapponica baueri***	**At Risk – Declining**										✓	
White-faced heron	*Egretta novaehollandiae*	Not Threatened										✓	
Black-backed gull	*Larus d. dominicanus*	Not Threatened										✓	✓
Turnstone	*Arenaria interpres*	Non-resident Native										✓	
Rock pigeon	*Columba livia*	Introduced										✓	

5.0 Herpetofauna

5.1 Methods

5.1.1 Desktop survey

Relevant data was retrieved from the DOC-administered BioWeb database, which provides known records of lizard species across the country. Published and unpublished reports on lizard surveys or presence within the area were also reviewed.

5.1.2 Site visit

Site visits were carried out on the 15th and 23rd of April. During these visits, potential lizard habitats present within the site were mapped. In addition to habitat mapping, five CritterPic units were deployed across the site, focusing in the established and higher value duneland habitats (and in one location, rank grass habitat: Figure 29). CritterPic units are a variation on trail cameras that have proven very effective in monitoring for lizards (as well as a number of other small animal species). The camera is triggered by an animal entering the unit, which is typically baited (in this case with canned pear). The CritterPic units were left in place for 8 nights.

Figure 29: Locations of CritterPic units deployed throughout the study site (Google Earth, 2021).

5.2 Results

5.2.1 Desktop survey

The DOC administered BioWeb herpetofauna database has only 10 lizard records <30 years old[6] within 15 km of the study area. The species recorded are summarised below in Table 6. There are no records at all (including older records) of lizards within 9 km of the site, and there are several records of surveys that returned a nil result (i.e. no lizards found).

Table 6: Native lizard species recorded within 15 km of the study site (DOC BioWeb Database). Conservation status and nomenclature follows Hitchmough et al., 2016

Common Name	Scientific Name	Conservation Status	Habitat Preferences	Number of records
Northern grass skink	*Oligosoma polychroma*	Not Threatened	Dry open areas with low vegetation or debris such as logs or stones for cover.	1
Copper skink	*O. aeneum*	Not Threatened	Open and shaded areas where sufficient cover is available (e.g., rock piles, logs, dense vegetation).	1
Ornate skink	*O. ornatum*	At Risk – Declining	Open and shaded areas where sufficient cover is available (e.g., rock piles, logs, dense vegetation).	5
Unidentified gecko	N/A	N/A	N/A	3

5.2.2 Habitat Assessment

The habitat most likely to contain lizard populations are the active and stable dunelands present at the site (Communities 9 and 10). Vegetated dunelands provide high quality habitat to a number of indigenous lizard species, including northern grass skink (which have been recorded in the wider area). However, there was evidence of high pest numbers across the site; considerable densities of pest tracks were observed in the dunes (Figure 30 and Figure 31 below), and a feral cat was observed onsite. High pest numbers considerably reduce the quality of lizard habitat, and the ability for populations to persist in an area.

Also potentially providing terrestrial lizard habitat are the areas of rank grass and scrublands which provide sufficient ground cover (Communities 2, 4a, 6a, 6b, 7). As with the dunelands, the most likely species to occupy these communities would be the northern grass skink, which are able to persist in modified and exotic habitats such as these. As above, the quality of the habitat is greatly reduced by the presence of a number of pest species within the site.

There are areas of kānuka treeland on the site. Kānuka is a preferred habitat type for a number of arboreal gecko species (barking gecko, ngahere gecko). However, these patches of kānuka are small and isolated from potential source populations, which makes it very unlikely that there are arboreal lizards present. The very high pest numbers present on the site further reduces the likelihood.

[6] Older records are considered to be out of date.

The areas of grazed pasture and exotic tree lands (with grazed or sparse ground cover) are considered to be unsuitable habitat to indigenous lizards, due to a lack of refugia and appropriate food source.

Figure 30 - Pest tracks in the dunes near the river mouth

Figure 31 - Animal tracks in the sand

5.2.3 Survey results

No lizard observations were captured by the CritterPic units during the 8 nights they were onsite. There were, however, 97 visits from mice across the five units (Figure 32), as well as two visits from hedgehogs (Figure 33). Both of these species are predators of lizards, and their presence in addition to the mustelid and cat signs observed during the walkover (as well as the lack of observations from the CritterPics) make it unlikely that a healthy population of lizards can persist within the site. If there is a population present, it is likely the common and robust northern grass skink and would likely be in low densities.

Figure 32 - A mouse recorded in a CritterPic unit

Figure 33 - A hedgehog recorded in a CritterPic unit

6.0 Schedule F - Significance

In the Horizons One Plan (Horizons Regional Council, 2014) the identification and protection of significant vegetation and habitats is covered by Policy 13-4. Under this policy, At- Risk, Threatened, or Rare habitat types are defined in Schedule F (Indigenous Biological Diversity). To be deemed significant, a community must meet at least one criterion in Table F.2a which identifies Rare, Threatened and At-Risk plant communities and habitats, and must not be excluded by Table F.2b which identifies a range of community types that are not considered to be Rare, Threatened, or At-Risk.

Schedule F only considers those habitats which are indigenous, defined in the plan as '*vegetation comprised predominantly of indigenous species, but which may include scattered exotic species*'. To further inform use of this definition, the One Plan definition of 'scattered' is also required: '*species that contribute less than species which are occasional, common, abundant, or dominant and can be expected to be encountered infrequently, and with a sparse distribution within the area of interest. This is a measure of the contribution to an area of interest (e.g., the same habitat type or forest tier) of a species in relation to other species in the same area, and is not simply a frequency count as both biomass and density of a given species are considered'.*

Note that significance is based purely on habitat type at the time of survey and does not consider future health (e.g. predator impacts, regeneration outlook), or the wider context in which the community exists.

Table 7 below summarises the significance outcomes of the vegetation community types identified on site when assessed against Schedule F of the One Plan. The significant vegetation communities are shown on Map 3.

Table 7 - Community types and their outcome when compared to Schedule F of the Horizons One Plan

Number	Vegetation community	Significance
1	Grazed grassland	These communities are not found significant under Schedule F as the vegetation does not meet the One Plan definition for Indigenous. **Not Significant.**
2	Rank grassland	
3a	Mixed wattle treeland	
3b	Mixed pine treeland	
4a	Poplar treeland	
4b	Poplar treeland over exotic scrub	
5	Macrocarpa	
6a	Exotic scrub	
6b	Exotic scrub under pine	
7	Exotic native mix	
8a	Kānuka treeland	One out of seven areas of kānuka treeland is larger than 0.25ha and is considered Threatened and **Significant**. **The remainder are excluded** on the

		basis of size (<0.25ha) and/or height (>4.5m)
8b	Thin kānuka treeland	This area is less than 0.25ha and is not well-developed kānuka. **Not significant**.
9	Knobby clubrush stable duneland	Classified as Stable Duneland – Rare. **Significant.**
10	Spinifex active duneland	Classified as Active Duneland – Rare. **Significant**
11	Wetland	Excluded on the basis of size (less than 0.05ha). **Not significant.**
12	Saltmarsh	Classified as Saltmarsh wetland – Threatened. **Significant.**

Those areas identified as Significant according to Schedule F fit the following definitions:

- Kānuka Forest or Treeland - *Kānuka forest or treeland is dominated by almost pure stands of well-developed kānuka. This habitat type is differentiated from kānuka scrub by size (greater than 4.5m tall or 20cm diameter measured at 1.4m above the ground.* Seven areas of kānuka treeland on site were identified (community 8a), though only one of these fits the height and size specifications outlined in Table F.1 which defines the required height (at least 4.5m) and size in Table F.2a, (must be at least 0.25ha). The one area of thin kānuka treeland is also excluded on the basis of size and is not considered well-developed as per the definition.
- Saltmarsh wetland – *Saltmarsh wetlands support low growing indigenous herbfield, rushland, and scrub, form within areas of tidal intertidal zones, and are fed from groundwater and estuary waters. Saltmarsh wetlands occur in association with mudflats*. The saltmarsh wetland is an estimated 1.98ha in size and fits the description of salt marsh wetland as according to Schedule F.
- Active duneland – *Indigenous grassland or sedgeland occurring on active duneland formed on raw coastal sand.* The active duneland on site (i.e. the fore dune with spinifex dominance) fits this description and is not excluded by any F2.b factors
- Stable duneland – *Indigenous grassland, tussock land, herbfield (including Pimela actea and P arenaria), or shrubland occurring on stable duneland formed on recent coastal sand.* The stable duneland (hind dune) on site fits (to a degree) this description and is not excluded by any F.2b factors.

The wetland on site is 0.03ha and so is excluded in the factors listed in Schedule F.2a, which states threatened wetland habitat must be at least 0.05ha in size to be considered significant. However, we also note that under the new NPS-FM the wetland will classify as a natural wetland, but again there is no clear direction as to a minimum size that should be considered. It is noted that the NPS-FM directs Councils to consider 0.05 ha wetlands, or smaller if appropriate. We do not consider a raupō-isolepis wetland as a typically small wetland type (less than 0.05ha) and consider a wetland of this type should be at least 0.05 ha to be functional and representative.

All other areas of vegetation not listed above do not meet the One Plan definition of 'indigenous' due to level of exotic species present (more than 'scattered) and so are not considered against Schedule F for Indigenous Biological Diversity.

It is worth noting that Table F.2a also states that any woody vegetation, exotic or indigenous, is Significant if it lies within 20 m of the riverbank of a 'Site of Significance – Aquatic' (mapped in Schedule B of the One Plan). The stretch of the Ōhau River adjacent to site is not a 'Site of Significance – Aquatic' and so this 20 m margin extending into the property is not considered Significant, unless already outlined as significant habitat type above.

7.0 Ecological values

Sites which are not considered significant under Schedule F of the Horizons One Plan may still have potential for ecological values, in the same way that sites determined to be significant may have low ecological value. For this reason, an assessment of ecological value is carried out to further inform ecological considerations for the project.

An assessment of ecological value guides our consideration of site sensitivity to change, the magnitude and importance of ecological effects, and the need for, and quantum, of required mitigation. For this we use four criteria outlined in the EIANZ Guidelines (2018): Representativeness, Rarity/distinctiveness, Diversity/pattern, and Context. Each of these criteria are rated between Low and Very High for each vegetation community assessed. Continuing the process outlined in the EIANZ, when these four ratings are combined, they aid in determining the ecological value of the vegetation community: Very high, High, Moderate, Low, or Negligible.

In some circumstances we look at individual species where they are present and relevant to the effects. This is not the case here and we do not therefore step through all the threatened and at-risk taxa individually – their value is however, recognised in the habitat evaluation below.

The table below outlines the ecological value of each habitat type identified (as in Map 2).

Grazed grassland is common throughout New Zealand and being almost entirely composed of exotic species is not considered to be representative habitat of what would be historically expected. While the habitat is not threatened, New Zealand Pipit – At Risk - Declining (not seen during field surveys) are known to use grazed grassland as supplementary habitat. Diversity is low considering the lack of native species, and contextually, the functions and contributions of this habitat to the wider ecological network are minimal.	Low
Rank grassland mostly comprised of exotic species is not a representative habitat type of pre-European times. No lizard species are likely to be present in this area when considering the results of the herpetofauna surveys (high predator presence) and the diversity is lacking over a large area. As with above, this habitat is secondary to New Zealand pipit (At Risk- Declining), though none were identified at the time of site surveys. Contextually, this habitat sits as modified and historically grazed, with little native species cover or diversity.	Low

Mixed wattle treeland, mixed pine treeland, poplar treeland, poplar treeland over exotic scrub, exotic scrub, and **exotic scrub under pine** are all exotic communities with little ecological function in the landscape. They are exotic dominated and provide habitat for only exotic or native, not threatened birds. The context of these areas is that they are isolated exotic treelands, common locally, with little to no native diversity, and the dominant exotic species in each habitat provide little value to the wider ecological systems and are unlikely to support any key species. Pattern, diversity, and complexity are low in regard to the indigenous species present. The areas do not increase indigenous diversity or endemism in the ecological district, however mixed wattle treeland can provide off-season food for native birds.	Negligible
Macrocarpa trees are present as casual shelterbelt arrangements along the shore side of the site. These are exotic trees with largely bare understories, which is unlikely to provide habitat for any key species. No potential successions are likely without management. Diversity is extremely low in terms of flora, though some macrocarpa nearer to the river mouth have the potential to act as shag roosting habitat. The trees are common throughout the district and are not a representative habitat structure or community expected regionally.	Low
Exotic native mix, while containing some diversity of native species, is outweighed by several exotic species which hamper potential native regeneration of the habitat. Because of these exotic species, the habitat is not representative, and it also does not contain any rare indigenous species, communities, or features. This area does not increase indigenous diversity or endemism in the ecological district. However, the habitat contains some degree of complexity with taller native trees and scrub, and the diversity provides somewhat more complex habitat availability for indigenous fauna.	Low
Kānuka treeland is representative of expected habitat in the ecological district (acknowledging modification throughout of ED of this vegetation type on dune lands), and with only a few exotic species present in the understorey, which are not likely to hinder the future succession of the habitat. There is a wide range of indigenous species growing in the understorey, and the potential for native mistletoe presence, which has been found in the area previously (but was not sighted during the surveys). Kanuka has a threat status of Threatened – nationally vulnerable, however this is due to the threat of myrtle rust and the species is still common throughout the region. Kanuka treeland as a community type is threatened, uncommon in the district but would have once covered a much larger area. The area this covers is small, and it is isolated from other native vegetative patches, but is well developed and provides a habitat otherwise lacking from the district.	High
Thin kānuka treeland is not a representative habitat, as the trees themselves are not in good health so maintain only a small level of cover, and stand over a mixture of exotic species, with some native Juncus. The regeneration potential of this area is hampered by grazing and current groundcover, and the area of this habitat is very small. As above, kanuka is a Nationally Vulnerable species, but considering this is solely due to the threat of myrtle rust it is not considered in this assessment as such. Indigenous diversity consists only of kanuka and native juncus in low quantities, and the present exotic species do not provide complex or protective habitat for fauna to use. It does not have a linkage to other areas on site and as it currently stands provides little value to the ecological landscape.	Negligible

Knobby clubrush stable duneland is not very representative habitat of the region on dune lands because it is largely monocultural. It contains many pockets of exotic species cover, it is however, high in indigenous cover of expected species. The rarity of this community is considered High but only where the population of the at-risk sand daphne (declining) is present. Diversity and pattern is considered moderate, as the community is largely a monoculture of knobby clubrush with few other common indigenous species scattered throughout, where exotic species have not outcompeted, though the sequence of active duneland proceeding landward to stable duneland is a noted ecological linkage. Contextually, while this habitat is relatively common over the Ohau shoreline, it is an important buffering function between the inland and foredune systems.	Moderate
Spinifex active duneland is a fully representative dune community and contains the expected flora of such habitat. Sand daphne and pingao (at risk – declining) are both present, and the habitat type itself is considered rare. Diversity and pattern are natural and as expected, with a sequence leading from the shore to inland encompassing the active duneland, and the dunes are largely untouched aside from occasional vehicle tracks and marram grass presence. The fore dune with a natural indigenous cover has considerable contextual functions related to the dune system.	High
The freshwater **wetland** is a representative community and contains native species though they are common and of low diversity. Due to its small size, it does not provide a large amount of potential habitat for fauna. Indigenous wetland habitats have reduced significantly since European habitation in New Zealand and are considered a rare habitat type. Only three species of indigenous wetland plant were identified however, all common in the area, and the surrounds of the wetland are largely comprised of exotic trees which do not contribute to a normal sequence, and due to its isolation does not form a wider pattern in the landscape. Contextually, the habitat is rated low, mostly due to its small size, lack of species, and unlikely habitat potential.	Moderate
The **saltmarsh** wetland is a representative community expected in the landscape, and contains a diverse number of species, as well as being a possible, at least transitory, habitat for rare cryptic bird species (in the absence of proof of their use rarity is moderate). The location of the saltmarsh, large size, location near the river mouth and mudflats (moderate contextual values), and flora species diversity, combined with the habitat being considered rare in the wider landscape, and recent sightings of bittern at the river mouth all contribute to the habitat being considered High value.	High

The table below provides a summary of the ecological values overviews of each habitat.

Table 8 - Ecological values of each habitat type on site

	Represent-ative	Rarity	Diversity	Context	Conclusion
Exotic dominated communities					
Grazed grassland	Very low	Moderate	Very low	Very low	Low
Rank grassland	Very low	Moderate	Very low	Very low	Low
Mixed wattle treeland	Very low	Very low	Very low	Low	Negligible
Mixed pine treeland	Very low	Very low	Very low	Low	Negligible
Poplar treeland	Very low	Very low	Very low	Low	Negligible
Poplar treeland over exotic scrub	Very low	Very low	Very low	Low	Negligible
Macrocarpa	Very low	Very low	Very low	Moderate	Low
Exotic scrub	Very low	Very low	Very low	Very low	Negligible
Exotic scrub under pine	Very low	Very low	Very low	Very low	Negligible
Exotic native mix	Very low	Very low	Low	Low	Low
Indigenous dominated communities					
Kānuka treeland	High	Moderate	Moderate	Moderate	High
Thin kānuka treeland	Low	Low	Very low	Very low	Negligible
Knobby clubrush stable duneland	Moderate	High (where daphne)	Moderate	High	High (where daphne)
Spinifex active duneland	High	Moderate	High	Moderate	High
Wetland	Moderate	Moderate	Low	Low	Moderate
Saltmarsh	High	Moderate	High	Moderate	High

8.0 Ecological effects & their management

The method used to undertake this assessment is consistent with the EIANZ guidelines for undertaking ecological impact assessments (Roper-Lindsay et al., 2018), whereby ecological values are assigned (Table 9) and the magnitude of effects identified (Table 10) in order to determine the overall level of effect of the proposal (Table 11) prior to any consideration to remediation or offset.

According to Roper-Lindsay et al. (2018), the overall level of effect can then be used to guide the extent and nature of the ecological management response required (including the need for biodiversity offsetting):

- Very High adverse effects require a net biodiversity gain.

- High and Moderate adverse effects require no net loss of biodiversity values.
- Low and Very Low effects should not normally be a concern.

Table 9: Criteria for assigning ecological value to species (Roper-Lindsay et al., 2018).

ECOLOGICAL VALUE	SPECIES CRITERIA
Very High	*Nationally Threatened* (Nationally Critical, Nationally Endangered, Nationally Vulnerable) species found in the ZOI[7] either permanently or seasonally.
High	Species listed as *At Risk – Declining* found in the ZOI either permanently or seasonally.
Moderate	Species listed as any other category of *At Risk* (Recovering, Relict, Naturally Uncommon) found in the ZOI either permanently or seasonally; or Locally (ED) uncommon or distinctive species.
Low	Nationally and locally common indigenous species.
Negligible	Exotic species, including pests, species having recreational value.

Table 10: Criteria for describing magnitude of effect (Roper-Lindsay et al., 2018)

MAGNITUDE	DESCRIPTION
Very High	Total loss of, or very major alteration, to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element / feature.
High	Major loss or major alteration to key elements/ features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element / feature.
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element / feature.
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances/patterns; AND/OR Having a minor effect on the known population or range of the element / feature.
Negligible	Very slight change from existing baseline condition. Change barely distinguishable, approximating to the “no change” situation; AND/OR Having a negligible effect on the known population or range of the element / feature.

[7] Roper-Lindsay et al. (2018) define the Zone of Influence (ZOI) as “the areas/resources that may be affected by the biophysical changes caused by the proposed project and associated activities.”

Table 11: Criteria for describing the level of effect (Roper-Lindsay et al., 2018)

LEVEL OF EFFECT		ECOLOGICAL AND / OR CONSERVATION VALUE				
		Very High	**High**	**Moderate**	**Low**	**Negligible**
MAGNITUDE	**Very High**	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very Low
	Moderate	High	High	Moderate	Low	Very Low
	Low	Moderate	Low	Low	Very Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low
	Positive	Net gain	Net gain	Net gain	Net gain	Net gain

Effects analysis

The potential direct and indirect adverse ecological effects associated with the proposal that have been considered in this assessment involve the following:

- Clearance or disturbance of indigenous vegetation;
- Loss of *Threatened* or *At Risk* species;
- Increases in edge effects on indigenous habitats;
- Dune erosion;
- Habitat fragmentation;
- Disturbance to wildlife;
- Construction phase earthworks and sedimentation of waterways;
- Golf course management – mowing, fertiliser, watering, weed sprays, golfers.

In considering these effects we only look at and analysis the ecological change within the Schedule F areas and any other ecologically valuable area, we do not access the effects on grasslands and pasture or exotic treelands (for example).

Clearance or disturbance of indigenous vegetation

8.1.1 Dune

There is around 16.12 ha of dune areas on site. Of these areas, 2.12 ha of the stable hind dune is proposed to be converted to fairways permanently. There are two dune land types present , 1.67 ha of the knobby rush stable duneland (Moderate value - where there is no sand daphne) and 0.34ha of the foredune Spinifex active duneland (High value). We have identified and are assured that the sand daphne area (the active sand dune) is not part of the stable knobby clubrush dune system that is affected.

In terms of specific areas of foredune effect, we note that the area of effect may fall into the category of active foredune, it is not schedule F indigenous dominated sedgeland but predominantly exotic vegetation cover (marram grass, and dense lupin) and bare sand. . The conversion of this habitat to fairway would be a technical loss of Schedule F area (the areas are

within the analysis undertaken above) but not actual loss of indigenous habitat listed in schedule F that is synonymous with the values of such a schedule F area. With that in mind the small area that would be impacted (0.34 ha) by hole 14, would be of minimal ecological concern. For that reason we also do not consider that this effect triggers Policy 11 of the NZ Coastal Policy Statement as it is not a loss of predominantly indigenous biodiversity in the coastal environment (it does not contain threatened indigenous taxa), is not representative (as the wider foredune is), of the naturally rare and threatened coastal environment, or at its range limit, and the effect is low (not significant).

The magnitude of effect relates to the amount of habitat affected against the quantum remaining at a particular scale, often the Ecological District is the relevant scale. In this case, we first consider the foredune between Ohau River and the next river outlet (Waiwiri Stream). There are approximately 8.8 ha of foredune in this coastal space. The sites effect removes 3.86% of that system. At a wider scale between the Otaki River and the Manawatu River there is approximately 40ha meaning a loss of 0.85%. We consider at either scale, and because of the paucity of indigenous representation in the clearance area, this change to be at the lower end (Negligible magnitude) of the scale of effects.

In terms of the stable knobby clubrush hind dune there is some approximately 15 ha between the Ohau and Waiwiri Streams and over 100 ha in the wider ED. The effect equates to an 11% loss on site and a 1.7% loss at a wider scale and so a magnitude of effect is considered low.

High habitats suffering a Negligible magnitude of adverse effect result in (pre-effects management) a very low level of effects and Moderate value areas suffering low magnitude effects result in a **Low level of adverse ecological effect** (when Table 11 is applied). This low level of effect requires effects management to return a no net loss of values and functions.

In both cases the change on site will not threaten or otherwise sufficiently diminish those habitats such that they are not self-sustaining or reduced in their functions or as habitat for their supported fauna. In terms of the level of effect, as per the EIA NZ guidance, low and very low levels of effect are not normally of concern and can be considered synonymous with “less than minor” adverse effect in the planning sense.

8.1.1.1 Salt Marsh

The salt marsh (1.98 ha, threatened) will not be impacted by the golf course, and an additional edge buffer is proposed through enrichment planting. **No direct effect.**

8.1.1.2 Kanuka Treeland

The Schedule F area of kanuka (0.29 ha, Map 3) will be avoided. Accessways between fairways and services have not been quantified, but these would be additional to the current areas calculated. **No direct effect**

8.1.1.3 Freshwater Wetland

The small raupō wetland discovered, although smaller than a typical assemblage of its type, can be conservatively considered a Natural Wetland. Following the recent (2020) National Policy Statement on freshwater management the Council are directed to avoid any loss of extent of natural wetlands. The current course design avoids this feature, and no earthworks downslope of this are proposed We recommend ensuring that any water takes (if within 100m) do not draw down this wetland. **No direct effect.**

Loss of *Threatened* or *At-Risk* species

Through design we are confident that there will not be any loss of recorded or even suspected threatened and at-risk taxa.

Increases in edge effects on indigenous habitats

The current level of edge effects through farming has been significant in the past from weed invasion and stock and pest animals (rabbits, hedgehogs etc), especially the kānuka areas. The change in land use will actually reduce these threats as the golf course itself (but also the management required) will reduce animal and weed threats and the revegetation proposed will help secure them to be protected indigenous islands and edges (including the landward side of the salt marsh).

Habitat fragmentation

Given the current level of fragmentation inland of the stable hind dune the only habitats that could potentially suffer further fragmentation are the active and stable dune system. The foredune is 90% avoided and the effects are only to be at the edge near the river mouth, and so there is no potential to fragment or divide the foredune community between the Ohau and Waiwiri streams.

In regard to the stable knobby clubrush hind dune, the fairways of three holes and several tees (holes 4, 16 and 17) remove some of this vegetation but the effects area on the inland edge away from the better more intact stable dune system and the area and corridor remains sufficiently intact and large as to not be fragmented or suffer any fragmentation issues.

Disturbance to wildlife

Another potential adverse effect is that of disturbance to wildlife, by way of both direct impacts (e.g., loss or degradation of habitat – including feeding, flocking, roosting and nesting sites) and indirect impacts (e.g., effective loss of habitat as a result of noise). *Threatened* and *At-Risk* species are generally considered to be more vulnerable to the potential impacts of disturbance due to their small population sizes and / or declining numbers.

Also, the magnitude of the adverse effects associated with disturbance activities can be proportional to the extent of habitat or population affected compared to that which remains unaffected. Where habitat loss as a result of disturbance is comparatively minimal, then the adverse effects are reduced since any disturbed wildlife are likely to have sufficient alternative available habitat nearby.

8.1.2 Avifauna

The vegetation or habitat to be removed is predominantly exotic with large old pine and macrocarpa (in the main) and grasslands and some weed fields and small areas of hind dune. The avian studies recognised 63 bird species that use, or potentially use the area, or in close proximity, to the project site. This included six Threatened species, 14 At Risk species. Two of these species, eastern bar-tailed godwit and red knot, are international migrant birds.

27 of these species were observed, including five At Risk species (black shag, pied shag, royal spoonbill, variable oystercatcher and white-fronted tern). The primary habitats for Threatened and At Risk species on or near site are freshwater/wetlands (the Ōhau River and potentially the saltmarsh wetland) as well as coastal/estuarine areas (the Ōhau River mouth, beach and dunelands), not the farmlands. The macrocarpa trees along the dune edge may provide roosting and/or nesting habitat for shags.

The remaining vegetation communities on site (exotic scrub, exotic scrub under pine, poplar treeland types, brush wattle treeland, mixed pine treeland exotic native mix) provide habitat for common native, Not Threatened species and introduced species.

By and large the habits of greatest value and which would have the greatest negative impact are avoided. The magnitude of the predominantly exotic vegetation change for avian habitat resource use is considered negligible and temporary as either most habitat use is coastal, Ohau river or salt marsh and beach directed, or the areas of native habitat which will be retained and will be still available as habitat.

The common native and exotic species may be temporarily displaced but will have better than current opportunity in the future.

During golf course operation there is likely to be less disturbance than farming land use but there will be the addition of increased native vegetation and pest management and the site as a whole is likely to be better for avian populations than prior to the golf course.

8.1.3 Lizards

There is little to no potential for direct or indirect effects on any skink inhabiting the coastal dunes. Evidence is however, that there are few or very low abundances of the ”common” northern grass skink.

8.1.3.1 Construction phase earthworks and sedimentation of waterways

There are no perennial flowing streams occurring within the proposed development area and the sandy soils of the site avoid the generation of fine silts or sediment. It is our understanding that with standard well-maintained earthwork sediment management regimes any discharges to the Ohau River, the salt marsh or the one freshwater wetland identified will be avoided.

Consequently, there is no risk of sediment-laden water being generated or reaching the Ohau River, the lagoon, or the ocean.

8.1.3.2 Golf course management – fertiliser, watering, weed sprays, golfer access.

There is an outside chance that golf course greens and fairway management could have adjacent effects on the sustainability or weed threat to the indigenous systems, in particular the stable knobby clubrush hind dune, the kanuka treeland and the freshwater wetland. These effects relate to small scale but frequent disturbances. The most substantive one is golfer access off fairways to retrieve balls in the salt marsh, foredune or hind dunes. The affect of this is minimal but constant egress and trampling can open ways for weed incursion into the salt marsh or dunes. The weed management proposed will mitigate the effect but another option and one we understand the developers are willing to install is to make retrieval of the balls in those areas not an option, that is they can not be retrieved. Golf balls lying in these areas over time will not be averse to flora or fauna. The Applicant informs us that there is an intension that course employees that are responsible for ongoing pest management within the dune areas will collect any lost balls. Those employees will be trained to identify key indigenous vegetation and avoid 'trampling'.

In terms of fertilizers and irrigation we understand that to attain and maintain good greens and tees the balance of fertilisers and water are carefully modulated to ensure appropriate biomass is achieved. Modern golf courses are not known to overuse resource (fertiliser and water) on golf infrastructure, as it is understood that excessive fertilising etc. does not lead to better outcomes (with respect to ecology or golf management). Due to the nature of the soils (all sands) it is highly unlikely that there will be lateral subsurface fertiliser or water travel. The potentially vulnerable features are the salt marsh and Ohau River (the freshwater wetlands, kanuka and hind dunes could absorb substrative water and fertilizer without change), and both of these systems will be buffered by native plantings and space. We see the risk as being minimal and manageable.

8.1.4 Cumulative Effects

In some landscapes and circumstances there can be a range of developments and projects affecting a wider similar ecological resource. It is therefore appropriate to consider the proposal in the wider landscape and if it adds significantly to an effect of a particular ecological resource.

As far as we are aware there are no other nearby land use changes or consents for development that would impact on the coastal margin, foredune, hind dune, river or salt marsh.

The Councils "pot" (waste water treatment) changes, a little north, may affect a small area of stable hind dune but more likely in a restorative effect.

The waste water disposal areas for the course facilities are located inland and east of any areas identified as being ecologically significant.

We know of and see nothing to indicate that these effects, minimal though we consider them, add to other local effects on similar values.

8.2 Pre-Effects Management Effects Conclusion

Through the design responses, ecological effects have been restricted to areas of negligible or very low value, primarily the reductions in stable hind dune and a small area of exotic dominant

foredune. These ecological effects are considered equivalent to “less than minor”. From an ecological perspective the values affected are to be managed through the mitigation hierarchy (avoidance, remedy, offset or compensation). The following considers these aspects.

8.2.1 Avoidance and minimisation and remedy

Through design responses the project has now avoided direct adverse effects to the freshwater wetland, the salt marsh and the kanuka treeland. These are the most sensitive and valuable habitats. The great majority and certainly the best foredune is avoided. In terms of the small area of foredune effect by the river mouth, we have recommended that the golf interaction look to reduce its foot print as much as possible but given the condition of this area of foredune (with largely bare sand and weed species) the impact – as noted above is low and can be managed.

Within the stable knobby clubrush hind dunes the most valuable areas relating to sand daphne populations have been avoided (these bound the hind and foredune).

In terms of the kanuka on the property, aside from the more intact area recognised there are numerous other thin and single trees and small thin clusters. The value of these (although not schedule F) are also recognised by the project course designer, and as such any reduction in these non-Schedule F areas of kanuka are sought to be minimised, and carried out thoughtfully and selectively as their value in future restoration and habitat creation is acknowledged.

Habitat Offset

An offset is an action to amend any residual effect to ecology after avoidance and remediation. Such that there is no net loss or a net gain. It is not a response to significant adverse effects or only applied to affects that are greater than minor. It is a normal response to a no net loss policy common in today’s plans. There is a proposed revegetation programme of indigenous coastal community / haitat systems (discussed below) which we label as the “offset which returnms a net gain for the area in terms of indigenous habitat.

8.2.2 Stable Dunes

A draft ecological restoration plan has been developed by the project landscape architect and Dr Boffa. We assume and expect that the existing native trees such as the titoki and totara will form part of that restoration effort. An indication of the species to be used and the areas to be revegetated and provided is shown in **Error! Reference source not found.**. While additional native plant species could be added to the current list, the backbone of the assemblages in the plan are ecologically appropriate, and the areas and sizes of ther revegetation will result in a net indigenous habitat, biodiversity and functional gain for the site / area. We indicate on this figure by way of the yellow circles the areas for ecological offset focus, either to enhance the existing (back dunes) or recreate new native assemblages. The communities outlined by the yellow circles include: active duneland (and sand daphne), stable duneland knobby clubrush, kanuka treeland, exotic native mix, saltwater marsh and freshwater wetland.

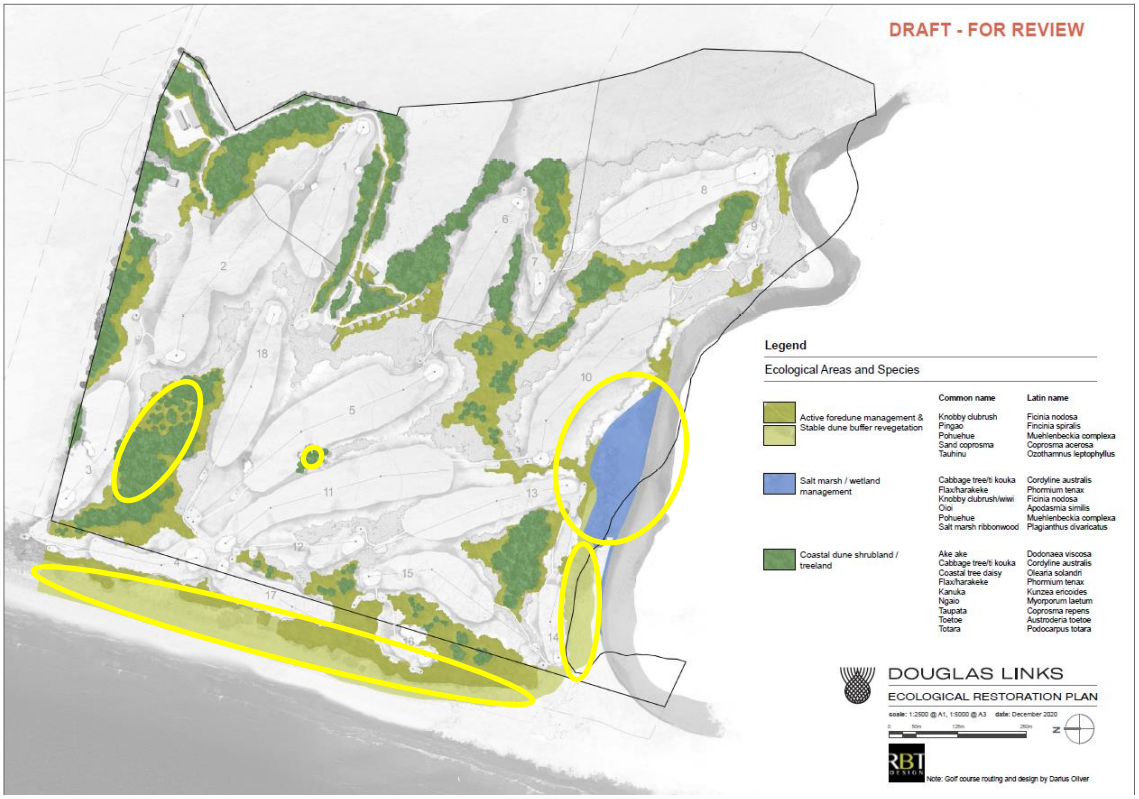

Figure 34. Draft ecological restoration plan and areas considered a focus for mitigation / enhancement.

8.3 Conclusion and recommendations

There are a range of values mostly associated with the coastal environment. Most valued features and species have been avoided, at least by direct adverse effects but also through management of indirect effects.

In the main this has been possible because of the differentiation in space between the majority of the proposed course and the valuable native habitats. There is some habitat loss in valued habitats, and this can be managed through the proposed revegetation program outlined by Dr Boffa and RBT Design.

Over the site and project as a whole, the level and nature of revegetation and pest control will result in a net ecological benefit to the local indigenous habitat and fauna. I.e. there will be a net ecological gain through increased quality and quantity of indigenous habitat and biodiversity.

8.3.1 Recommendations:

a. Avoid those areas outside the golf course (holes, tees and greens) recommended to be avoided in this report – the freshwater wetland, the salt marsh, the kānuka treeland, the active foredune.
b. Identify by accurate GPS and flag tape the habitats requiring avoidance, i.e., set a physical buffer to this exclusion.
c. Ensure specifically that the sand daphne population is not affected.
d. Carry out the indigenous revegetation as indicated by the revegetation plan of Dr Boffa. Begin this programme with areas that have a buffer function first or early in the programme.
e. When felling the large coastal trees, do so from late morning (10 am) on and not after dusk to avoid affecting roosting native species.
f. Ensure well set up and maintained earthworks sediment management occurs along the border with the Ohau River and the salt marsh.

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Appendix 1: Maps

About Boffa Miskell

Boffa Miskell is a leading New Zealand professional services consultancy with offices in Auckland, Hamilton, Tauranga, Wellington, Christchurch, Dunedin and Queenstown. We work with a wide range of local and international private and public sector clients in the areas of planning, urban design, landscape architecture, landscape planning, ecology, biosecurity, cultural heritage, graphics and mapping. Over the past four decades we have built a reputation for professionalism, innovation and excellence. During this time we have been associated with a significant number of projects that have shaped New Zealand's environment.

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