

**ASHBURTON SECOND
URBAN BRIDGE**

**SITE DESCRIPTION
(TERRESTRIAL ECOLOGY)
AND ASSESSMENT
OF EFFECTS**

August 2013

Mike Harding
Environmental Consultant
mikeharding@ihug.co.nz

CONTENTS

1.0	Introduction	1
2.0	Background and Experience	1
3.0	Survey Method.....	1
4.0	Site Description	2
4.1	Vegetation	2
4.2	Indigenous Flora	4
4.3	Habitats of Indigenous Fauna	4
5.0	Assessment of Significance	6
5.1	Ecological Context.....	6
5.2	Indigenous Vegetation and Flora.....	6
5.3	Habitats of Indigenous Fauna	7
6.0	Assessment of Effects	8
7.0	Recommendations to Address Effects	9
8.0	Conclusion.....	9
9.0	Appendices	10
9.1	Scientific Names of Plant Species.....	10
9.2	Scientific Names of Bird Species	11
9.3	References Cited.....	12

Acknowledgements

Preparation of this report was supervised by Steve Baker, Opus International Consultants Limited, Christchurch. Steve provided information, including aerial images, for this project. Crissie Drummond, Ashburton District Council, arranged access to properties for the field survey. Wendy Sullivan, Department of Conservation, Raukapuka, provided information on habitat values of the Ashburton River. I thank these people and organisations for their assistance.

1.0 INTRODUCTION

This report presents the results of an assessment of the terrestrial ecology of the area affected by the proposed Ashburton Second Urban Bridge project (ASUB). In this report the area affected by the ASUB project (hereafter referred to as ‘the site’) is that delineated on the ‘Proposed East Tinwald Road Alignment Option A – Land Required – Overall Plan’ dated 4th March 2013.

The assessment described in this report was undertaken at the request of Steve Baker of Opus International Consultants Limited, Christchurch. The purpose of this ecological assessment is to describe, and assess the significance of, the indigenous vegetation and habitats of indigenous fauna at the site of the proposed works.

2.0 BACKGROUND AND EXPERIENCE

I have been operating as an environmental consultant for eighteen years, specialising in ecological surveys and strategic assessments of protection and conservation management priorities. In recent years, much of my work has involved ecological assessments of land for protection and management, management planning for reserves, strategic assessments of priorities for the protection of indigenous ecosystems, and assessments of significance for Resource Management Act planning and resource consents. Work I have undertaken that is particularly relevant to this project includes assessment and monitoring of the effects of road construction proposals on terrestrial ecology at Arthur’s Pass, assessment of the effects of bridge replacement on terrestrial ecology at Gates of Haast, surveys of significant indigenous vegetation on the low plains within Ashburton District, and surveys of indigenous vegetation throughout the South Island.

3.0 SURVEY METHOD

Initial inspection of the site was undertaken on 12th April 2010. A full field survey of the site was undertaken on 19th August 2013 in overcast cool weather. All parts of the site were traversed on foot, except for the properties between Grahams Road and Carters Creek (between Johnstone Street and Wilkins Road) and the property between Wilkins Road and Carters Terrace. These parts of the site were viewed from roads and/or adjacent properties.

Vegetation was surveyed and recorded in a field notebook using a simplified version of the standard inventory (RECCE plot) method (Allen, 1992) in which the dominance of each plant species in each height tier is recorded. Forest and riverbed birds were surveyed by recording all indigenous species seen or heard during the field survey. These observations are complemented by other records of riverbed birds.

Survey of other indigenous fauna (bats, lizards and invertebrates) was not possible or practical in the time available for this assessment.

4.0 SITE DESCRIPTION

The site affected by the proposed ASUB project extends from Grahams Road, adjacent to the Tinwald residential area, to Chalmers Avenue at the edge of the Ashburton commercial area. It is a level or gently sloping alluvial surface (terrace/plain) bisected by the Ashburton River. The site lies at approximately 90m above sea level. Parent rock of the area is river gravel, sand and silt of the Canterbury outwash plain (Cox and Barrell, 2007). The climate of the area is characterized by warm summers and cool winters, with annual rainfall of between 600 and 800 mm.

The southwest part of the site, between Grahams Road and Carters Terrace, comprises developed farmland with shelter or amenity plantings and occasional buildings. The northwest part of the site, along either side of the Ashburton River, comprises river-berm plantings and open riverbed. The only parts of the site that appear relatively undeveloped are a small part of the lower terrace between Carters Avenue and the river-berm forest, and the open flood channel (riverbed) of the Ashburton River.

4.1 Vegetation

Plant communities of the site are described below, from the southwest end at Grahams Road to the northeast end at Chalmers Avenue. Scientific names of species cited by common name are listed in Appendix 1. Scientific names follow de Lange and Rolfe (2010). Naturalized species are indicated by an asterisk*.

Grahams Road to Carters Terrace

Almost all of this area is dominated by paddocks with sown pasture. Shelter belts and hedges, mostly comprising exotic species, are present on property boundaries and between paddocks. No original or intact indigenous vegetation was observed at this part of the site.

The only part of this area that may have some ecological value for indigenous biodiversity is Carters Creek. The creek appears to follow an excavated channel in this area, though may have in-stream (freshwater) biodiversity values. The banks of the channel are dominated by exotic grasses. Native species planted here are cabbage tree (*Cordyline australis*) and matipo (*Pittosporum tenuifolium*). Just north of the site, flax (*Phormium tenax*), broadleaf (*Griselinia littoralis*) and pukio (*Carex secta*) have been planted around a small pond.

Carters Terrace to River Berm Forest

The southwest part of this area, on the higher terrace, comprises paddocks with sown pasture. The lower terrace, adjacent to the river berm forest, also supports pasture though appears less developed. It may even be an uncultivated surface. Scattered across this terrace are trees of crack willow* (*Salix fragilis*) and elder* (*Sambucus nigra*), shrubs of gorse* (*Ulex europaeus*) and patches of blackberry* (*Rubus fruticosus* agg.). The invasive climber, old man's beard* (*Clematis vitalba*), is present on trees. Stinking iris* (*Iris foetidissima*) is present on the terrace edge.

A shallow swale with an ephemeral stream (flowing at the time of survey) runs along this low terrace. This swale is dominated by exotic grasses, but also supports scattered plants of rautahi (*Carex coriacea*) and another, taller, sedge (*Carex* sp.).

Just upstream, and north of the proposed road alignment, is a depression (a shallow pond at the time of survey) which supports large patches of blackberry* and plants of *Carex* sp., rautahi and *Juncus edgariae*.

River Berm Forest to Ashburton River

This area, from the open terrace northeast to the Ashburton River, has been planted as part of flood protection works. Rows of tall deciduous trees, mostly poplar (*Populus* sp.), form an open forest through to the walking/bicycle track near the river. The forest understorey supports patches of young plum* (*Prunus cerasifera*), with scattered plants or patches of broom* (*Cytisus scoparius*), gorse*, elder* and old man's beard*.

The forest floor is dominated by blackberry*. Also present are patches of ivy* (*Hedera helix*) and periwinkle* (*Vinca major*). Other ground-cover species present are stinking iris*, male fern* (*Dryopteris filix-mas*), hemlock* (*Conium maculatum*), cleavers* (*Galium aparine*) and occasionally prickly shield fern (*Polystichum vestitum*).

Additional species present at the margin of the forest near the track are woolly mullein* (*Verbascum thapsus*), viper's bugloss* (*Echium vulgare*), velvety nightshade* (*Solanum chenopodioides*), bittersweet* (*Solanum dulcamara*), fleabane* (*Conyza sumatrensis*), broad-leaved dock* (*Rumex obtusifolius*), fireweed (*Senecio glomeratus*), mouse-ear chickweed* (*Cerastium fontanum*), cocksfoot* (*Dactylis glomerata*), Chewings fescue* (*Festuca rubra*) and other grasses.

The narrow strip of forest between the track and river is dominated by crack willow*. Also present here are blackberry*, broom*, old man's beard*, vetch* (*Vicia sativa*) and stinking iris*.

Ashburton River Bed

The Ashburton River was in flood at the time of this (August) survey, so the central islands of the riverbed were not closely inspected. The only tall plant visible on these islands at the time of survey was tree lupin* (*Lupinus arboreus*).

The riverbed islands were inspected more closely during an earlier (April 2010) visit. Plant species recorded during that visit were: tree lupin*, grey willow* (*Salix cinerea*), crack willow*, narrow-leaved plantain* (*Plantago lanceolata*), stonecrop* (*Sedum acre*), Californian poppy* (*Eschscholzia californica*), viper's bugloss*, cudweed* (*Euchiton* sp.), lotus* (*Lotus pedunculatus*), St John's wort* (*Hypericum perforatum*), jointed rush* (*Juncus articulatus*), Yorkshire fog* (*Holcus lanatus*), cocksfoot* and browntop* (*Agrostis capillaris*).

Additional plant species present at damp sandy sites were toad rush* (*Juncus bufonius*), wireweed* (*Polygonum* sp.), winter cress* (*Barbarea intermedia*) and clubrush (*Isolepis* sp.).

Ashburton River to Chalmers Avenue

The strip between the river and the foot track (Ashburton Walkway) is dominated by crack willow*. Other species present are willow* hybrids (*Salix* X), blackberry*, bittersweet*, lotus*, fireweed, stinking iris* and creeping buttercup* (*Ranunculus repens*).

Native shrubs have been planted alongside the walkway, including matipo, lemonwood (*Pittosporum eugenioides*) and koromiko (*Hebe salicifolia*).

A road formation and excavated ditch are present between the walkway and Chalmers Avenue. This area is dominated by exotic grasses. Other species commonly present are broom*, blackberry*, tree mallow* (*Malva dendromorpha*), velvety nightshade*, broad-leaved dock*, hemlock*, yarrow* (*Achillea millefolium*), cleavers* and old man's beard*. Additional species present along the ditch are monkey musk* (*Mimulus guttatus*), narrow-leaved plantain* and umbrella sedge* (*Cyperus eragrostis*).

Planted forest beside the road formation is dominated by crack willow* and white poplar* (*Populus alba*). Other species here are broom*, blackberry*, old man's beard*, winter heliotrope* (*Petasites fragrans*) and exotic grasses.

4.2 Indigenous Flora

Vegetation at the site is predominantly exotic. No original or intact indigenous plant communities are present. However, several indigenous plant species are present. These are: prickly shield fern (*Polystichum vestitum*), rautahi (*Carex coriacea*), *Juncus edgariae*, fireweed (*Senecio glomeratus*), and possibly *Carex diandra*. None of these species are considered threatened or at risk (de Lange *et al*, 2009).

4.3 Habitats of Indigenous Fauna

4.2.1 Bird Species Observed

Indigenous birds recorded in the river berm forest during the field survey were grey warbler (*Gerygone igata*) and fantail (*Rhipidura fuliginosa*). An additional indigenous bird species recorded on adjacent paddocks was spur-winged plover (*Vanellus miles*).

Indigenous birds recorded on or above the open river bed in the vicinity of the site during this survey were spur-winged plover, paradise shelduck (*Tadorna variegata*), welcome swallow (*Hirundo tahitica*) and black-fronted tern (*Sterna albobriata*). Black shag (*Phalacrocorax carbo*) was recorded over the open riverbed during the April 2010 inspection.

Of these bird species, the following are notable (Miskelly *et al*, 2008): black-fronted tern (nationally endangered) and black shag (at-risk, naturally uncommon).

4.2.2 Bird Distribution Records

Birds of the Ashburton River have been surveyed regularly since 1981 by agencies, groups and individuals, including Department of Conservation, Ornithological Society of NZ and Royal Forest and Bird Protection Society. Data from these surveys were provided by Department of Conservation (Wendy Sullivan, *pers.comm.*).

Indigenous bird species observed on the Ashburton River in reaches above and below State Highway 1 (between Blacks Road and Wakanui School Road) during the most recent (2012) survey were:

Australasian harrier.....	<i>Circus approximans</i>
banded dotterel.....	<i>Charadrius bicinctus</i>
black-backed gull.....	<i>Larus dominicanus</i>
black-billed gull.....	<i>Larus bulleri</i>
black-fronted dotterel.....	<i>Charadrius melanops</i>
black-fronted tern.....	<i>Sterna albostrata</i>
black shag.....	<i>Phalacrocorax carbo</i>
Caspian tern.....	<i>Sterna caspia</i>
kingfisher.....	<i>Halcyon sancta</i>
paradise shelduck.....	<i>Tadorna variegata</i>
pieb stilt.....	<i>Himantopus himantopus</i>
pukeko.....	<i>Porphyrio porphyrio</i>
red-billed gull.....	<i>Larus novaehollandiae</i>
South Island pied oystercatcher.....	<i>Haemotopus ostralegus</i>
spur-winged plover.....	<i>Vanellus miles</i>
white-faced heron.....	<i>Ardea novaehollandiae</i>
white-fronted tern.....	<i>Sterna striata</i>

(Bird species names follow Heather and Robertson, 1996)

Of these bird species, the following are notable (Miskelly *et al*, 2008): black-fronted tern, black-billed gull (nationally endangered); banded dotterel, Caspian tern, red-billed gull (nationally vulnerable), pieb stilt, white-fronted tern (at-risk, declining) and black shag (at-risk, naturally uncommon).

Most numerous of all bird species recorded in the 2012 survey was black-billed gull. A total of 9600 individual black-billed gulls were observed, almost all of which were recorded in three separate (but close) colonies in the vicinity of the State Highway 1 Bridge, i.e. at or near the ASUB project site. Two black-billed gull colonies, comprising approximately 5000 birds, were observed in the vicinity of the highway bridge during the 2010 survey.

5.0 ASSESSMENT OF SIGNIFICANCE

Relevant criteria for the assessment of significance of the site (under Section 6(c) Resource Management Act 1991) are those in Proposed Ashburton District Plan (2012) and those in the Canterbury Regional Policy Statement (2013).

5.1 Ecological Context

The ASUB project area is located in Low Plains Ecological District, within Canterbury Plains Ecological Region (McEwen, 1987). Only a very small proportion (approximately 1%) of this ecological district is formally protected (Harding, 2009).

The southwest part of the site, on the higher terrace, is located in Level IV Land Environment N1.2b; the lower terrace on the southwest side of the river is located in Level IV Land Environment J2.2b; and, the terrace on the northeast side of the river is located in Level IV Land Environment I3.2c (Leathwick *et al*, 2003). These three Level IV Land Environments have 0.2%, 4.5% and 1.1% indigenous vegetation cover remaining, respectively, and are all listed as ‘acutely threatened’ (Walker *et al*, 2006).

The open bed of the Ashburton River is not covered by the Land Environments classification. However, braided riverbeds are regarded as ‘originally rare’ ecosystems (Williams *et al*, 2007) and listed as ‘endangered’ (Holdaway *et al*, 2012).

5.2 Indigenous Vegetation and Flora

Most of the site comprises developed land, either farmland, residential sections or flood protection plantings. Vegetation is dominated by exotic plant species. There are very few indigenous plant species present and those species are either ubiquitous colonisers, such as fireweed and prickly shield fern, or deliberately planted species, such as matipo and flax. No threatened or locally uncommon plant species were recorded during this survey of the site.

Less developed habitats are present at two locations: the low terrace on the southwest side of the river (adjacent to the river berm forest); and, the open bed of the Ashburton River. The low terrace is dominated by exotic species (predominantly grasses) but has a small narrow swale with a few plants of rautahi (*Carex coriacea*) and *Carex* sp.. The open riverbed is not developed, but is dynamic, changing with every large flood. It is a natural surface but is dominated by stonefield or naturalized (exotic) plant species.

Indigenous vegetation at the site is not significant when assessed against criteria in the Proposed Ashburton District Plan (2012) and the Canterbury Regional Policy Statement (2013).

5.3 Habitats of Indigenous Fauna

The river berm forest at the site supports two common indigenous bird species (grey warbler and fantail) and numerous introduced bird species. It is part of a much larger area of planted forest, which forms a corridor of vegetation along the Ashburton River. The forest bird habitat at the site has some ecological value, but is not significant when assessed against criteria in the Proposed Ashburton District Plan (2012) and the Canterbury Regional Policy Statement (2013).

The open bed of the Ashburton River upstream (to Blacks Road) and downstream (to Wakanui School Road) of the site supports populations of 18 indigenous bird species (i.e. the 17 species observed in the 2012 survey; and welcome swallow, observed in August 2013).

The riverbed at or near the site has provided breeding habitat for the nationally endangered black-billed gull in 2010 and 2012. The area supported approximately 9600 black-billed gulls in 2012 and approximately 5000 in 2010. The total national population of black-billed gulls was estimated to be approximately 90,000 adult individuals in 2008 (McClellan and Habraken, 2013).

The Ashburton River has been long recognised as outstanding habitat for indigenous birds (O'Donnell and Moore, 1983; O'Donnell, 1992; Armstrong, 2006). This is recognised by its listing as an area of 'significant nature conservation value' in Appendix 3-2 of the Proposed Ashburton District Plan (2012).

The open riverbed habitat at the site is significant when assessed against criteria in the Proposed Ashburton District Plan (2012) and the Canterbury Regional Policy Statement (2013) (RPS). In particular it is:

- Habitat of indigenous fauna that is representative, typical or characteristic of the ecological district (RPS criterion 1).
- Habitat of indigenous fauna that is a relatively large example of its type in the ecological district (RPS criterion 2).
- Habitat of indigenous fauna that supports an indigenous species that is threatened or at-risk (RPS criterion 4).
- An association of indigenous species that occurs within an originally rare ecosystem (RPS criterion 6).
- Habitat of indigenous fauna that contains a high diversity of indigenous taxa (RPS criterion 7).
- Habitat of indigenous fauna that provides an important ecological linkage (RPS criterion 8).
- Habitat of indigenous fauna that provides important breeding habitat for indigenous species (RPS criterion 10).

6.0 ASSESSMENT OF EFFECTS

The proposed ASUB project will have effects on a significant habitat of indigenous fauna on the open bed of the Ashburton River. There are no other significant habitats of indigenous fauna, or areas of significant indigenous vegetation, that would be affected by the ASUB project.

The effects will be:

- disturbance of riverbed bird habitat during construction of the bridge and the bridge approaches;
- presence of a bridge over an area of formerly open riverbed bird habitat;
- increase in the locations where human disturbance (traffic) may affect the riverbed bird habitat (i.e. two bridges, instead of one).

While it is difficult to predict the magnitude of the effects of a second bridge across the Ashburton River at this location, it is likely that the adverse effects of the bridge (once constructed) will be minor. The area affected is only a small part of the riverbed habitat present along the length of the Ashburton River and black-billed gulls appear untroubled by the presence the existing bridge.

Over recent years, black-billed gulls have established breeding colonies adjacent to the existing highway bridge. The riverbed habitat in the vicinity of the bridge is either more favourable than habitat elsewhere along the Ashburton River; or the habitat is no different at the bridge, and the bridge has no adverse effect on the habitat.

In the absence of a clear indication of the potential adverse effects of a second bridge on this significant habitat of indigenous fauna, it is nonetheless prudent to assume that there may be adverse effects and to avoid and mitigate those potential adverse effects wherever possible.

7.0 RECOMMENDATIONS TO ADDRESS EFFECTS

Effects of bridge construction:

Construction of the bridge and its approaches will presumably involve the use of heavy machinery on, and disturbance of, the river bed and river banks. This activity has the potential to disturb, injure or kill indigenous birds. Methods to address adverse effects are:

- Avoid construction activity, in particular any disturbance of the river bed, during the bird breeding season, i.e. August to December.
- Avoid disturbance of riverbed birds at other times of the year by ensuring that no birds are resident (i.e. nesting or roosting) at proposed work sites immediately prior to construction activity.

Effects following bridge construction:

- Avoid disturbance of riverbed birds by providing publicity (on site and elsewhere) about the value and vulnerability of river bed birds at this location.

Ecological Enhancement:

If enhancement of riverbed bird habitat is necessary, this could be provided by controlling mammalian predators at bird nesting colonies, controlling invasive plant pests and/or restricting public access to bird nesting colonies.

8.0 CONCLUSION

The terrestrial ecological values of the area affected by the Ashburton Second Urban Bridge Project are substantially modified. Indigenous plant species are absent over most of the site, or only present in low numbers within vegetation dominated by exotic species. The only part of the site that is significant is the bird habitat on the bed of the Ashburton River. While the adverse effects of the project on riverbed bird habitat are difficult to predict, they are likely to be minor. Methods to address adverse effects are to avoid construction activity during the bird breeding season and to ensure birds are not nesting or roosting at proposed work sites immediately prior to construction activity.

9.0 APPENDICES

9.1 Scientific Names of Plant Species

Note: This is a list of plant species cited by common name in this report; it is not a full species list for the site.

<u>Common name</u>	<u>Scientific name</u>
Naturalised species are indicated by an asterisk (*).	
bittersweet*.....	<i>Solanum dulcamara</i>
blackberry*.....	<i>Rubus fruticosus</i>
broadleaf	<i>Griselinia littoralis</i>
broad-leaved dock*	<i>Rumex obtusifolius</i>
broom*	<i>Cytisus scoparius</i>
browntop*	<i>Agrostis capillaris</i>
cabbage tree.....	<i>Cordyline australis</i>
Californian poppy*	<i>Eschscholzia californica</i>
Chewings fescue*.....	<i>Festuca rubra</i>
cleavers*.....	<i>Galium aparine</i>
clubrush.....	<i>Isolepis</i> sp.
cocksfoot*.....	<i>Dactylis glomerata</i>
crack willow*	<i>Salix fragilis</i>
creeping buttercup*	<i>Ranunculus repens</i>
cudweed*	<i>Euchiton</i> sp.
elder*	<i>Sambucus nigra</i>
fireweed.....	<i>Senecio glomeratus</i>
flax	<i>Phormium tenax</i>
fleabane*	<i>Conyza sumatrensis</i>
gorse*	<i>Ulex europaeus</i>
grey willow*	<i>Salix cinerea</i>
hemlock*.....	<i>Conium maculatum</i>
ivy*.....	<i>Hedera helix</i>
jointed rush*.....	<i>Juncus articulatus</i>
koromiko.....	<i>Hebe salicifolia</i>
lemonwood.....	<i>Pittosporum eugenioides</i>
lotus*	<i>Lotus pedunculatus</i>
male fern*	<i>Dryopteris filix-mas</i>
matipo	<i>Pittosporum tenuifolium</i>
monkey musk*	<i>Mimulus guttatus</i>
mouse-ear chickweed*	<i>Cerastium fontanum</i>
narrow-leaved plantain*.....	<i>Plantago lanceolata</i>
old man's beard*.....	<i>Clematis vitalba</i>
periwinkle*.....	<i>Vinca major</i>
plum*.....	<i>Prunus cerasifera</i>
prickly shield fern	<i>Polystichum vestitum</i>
pukio.....	<i>Carex secta</i>
rautahi.....	<i>Carex coriacea</i>
St John's wort*.....	<i>Hypericum perforatum</i>
stinking iris*.....	<i>Iris foetidissima</i>
stonecrop*	<i>Sedum acre</i>

toad rush*	<i>Juncus bufonius</i>
tree lupin*	<i>Lupinus arboreus</i>
tree mallow*	<i>Malva dendromorpha</i>
umbrella sedge*	<i>Cyperus eragrostis</i>
velvety nightshade*	<i>Solanum chenopodioides</i>
vetch*	<i>Vicia sativa</i>
viper's bugloss*	<i>Echium vulgare</i>
white poplar*	<i>Populus alba</i>
winter cress*	<i>Barbarea intermedia</i>
winter heliotrope*	<i>Petasites fragrans</i>
wireweed*	<i>Polygonum</i> sp.
woolly mullein*	<i>Verbascum thapsus</i>
yarrow*	<i>Achillea millefolium</i>
Yorkshire fog*	<i>Holcus lanatus</i>

9.2 Scientific Names of Bird Species

(Bird species names follow Heather and Robertson, 1996)

Australasian harrier	<i>Circus approximans</i>
banded dotterel	<i>Charadrius bicinctus</i>
black-backed gull	<i>Larus dominicanus</i>
black-billed gull	<i>Larus bulleri</i>
black-fronted dotterel	<i>Charadrius melanops</i>
black-fronted tern	<i>Sterna albobriata</i>
black shag	<i>Phalacrocorax carbo</i>
Caspian tern	<i>Sterna caspia</i>
fantail	<i>Rhipidura fuliginosa</i>
grey warbler	<i>Gerygone igata</i>
kingfisher	<i>Halcyon sancta</i>
paradise shelduck	<i>Tadorna variegata</i>
piebald stilt	<i>Himantopus himantopus</i>
pukeko	<i>Porphyrio porphyrio</i>
red-billed gull	<i>Larus novaehollandiae</i>
South Island pied oystercatcher	<i>Haematopus ostralegus</i>
spur-winged plover	<i>Vanellus miles</i>
welcome swallow	<i>Hirundo tahitica</i>
white-faced heron	<i>Ardea novaehollandiae</i>
white-fronted tern	<i>Sterna striata</i>

9.3 References Cited

- Allen, R.B. 1992.** An inventory method for describing New Zealand vegetation. *FRI Bulletin No. 176*. Forest Research Institute, Christchurch. 25p.
- Armstrong, D. 2006.** Intrinsic values of the Ashburton River catchment. *Unpublished Report*. Department of Conservation.
- Cox, S.C; Barrell, D.J.A (compilers). 2007.** Geology of the Aoraki area. *Institute of Geological and Nuclear Sciences 1:250,000 geological map 15*. Institute of Geological and Nuclear Sciences Limited, Lower Hutt.
- de Lange, P.J.; Norton, D.A.; Courtney, S.P.; Heenan, P.B.; Barkla, J.W.; Cameron, E.K.; Hitchmough, R.; Townsend, A.J. 2009.** Threatened and Uncommon Plants of New Zealand (2008 Revision). *New Zealand Journal of Botany* 47:61-96.
- de Lange, P.J.; Rolfe, J.R. 2010.** *New Zealand Indigenous Vascular Plant Checklist*. New Zealand Plant Conservation Network, Wellington.
- Harding, M.A. 2009.** *Canterbury Land Protection Strategy*. Nature Heritage Fund, Wellington.
- Heather, B.D.; Robertson, H.A. 1996.** *The Field Guide to the Birds of New Zealand*. Viking, Penguin Books, New Zealand.
- Holdaway, R.J.; Wiser, S.K.; Williams, P.A. 2012.** Status assessment of New Zealand's naturally uncommon ecosystems. *Conservation Biology* 26: 619-629.
- Leathwick, J.; Wilson, G.; Rutledge, D.; Wardle, P.; Morgan, F.; Johnston, K.; McLeod, M.; Kirkpatrick, R. 2003.** *Land Environments of New Zealand*. David Bateman Ltd.
- McClellan, R.K.; Habraken, A. 2013.** *Black-billed gull*. In: Miskelly, C.M. (Editor) *New Zealand Birds Online*.
- McEwen, W.M. (editor) 1987.** Ecological regions and districts of New Zealand, third revised edition (Sheet 4). *New Zealand Biological Resources Centre Publication No.5*. Department of Conservation, Wellington, 1987.
- Miskelly, C.M.; Dowding, J.E.; Elliot, G.P.; Hitchmough, R.A.; Powlesland, R.G.; Robertson, H.A.; Sagar, P.M.; Scofield, R.P.; Taylor, G.A. 2008.** Conservation status of New Zealand birds, 2008. *Notornis* 55: 117-135.
- O'Donnell, C.F.J.; Moore, S.M. 1983.** The wildlife and conservation of braided river systems in Canterbury. *Fauna Survey Unit Report No. 33*. New Zealand Wildlife Service, Wellington.
- O'Donnell, C.F.J. 1992.** Birdlife of the Ashburton River, Canterbury, New Zealand. *Report No. R92(36) Vol. II*. Environment Canterbury, Christchurch.
- Walker, S.; Price, R.; Rutledge, D.; Stephens, R.T.; Lee, W.G. 2006.** Recent loss of indigenous cover in New Zealand. *NZ Journal of Ecology* 30: 169-177.
- Williams, P.A.; Wiser, S.; Clarkson, B.; Stanley, M.C. 2007.** New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. *NZ Journal of Ecology* 31: 119-128.