Section G
APPENDICES

Appendix 1 : References & Bibliography

General Bibliography

Boffa Miskell. 2009. Marlborough Landscape Study 2009

Boffa Miskell. 2011. Draft Coastal Natural Character Report.

Davidson, R; Duffy, C; Gaze, P; Baxter, A; DuFresne, S; Courtney, S; Hamill, P. 2011. Ecologically Significant Marine Sites in Marlborough, New Zealand

Hayward, B.W; Kenny, J.A and Johnston, M.R (1999) Inventory and Maps of Important Geological Sites and Landforms in the Nelson and Marlborough Regions, including Kaikoura District. Geological Society of New Zealand Miscellaneous Publication 104.

Lucas, D; Head, J and Lynn, I (1997) Marlborough Sounds Land and Marine Ecosystems. Department of Conservation and Marlborough District Council.

Lynn, I.H (2009) Land Types of the Marlborough Region. Landcare Research New Zealand.

McRae, S.M; Lucas, D.J; Courtney, S.P; Baxter, A.S; Barrier, R.F and Lynn, I.H (2004) A Natural Character framework for the Marlborough Sounds. Department of Conservation, Nelson/ Marlborough Conservancy, Occasional Publication No. 62.

Molloy, L. and Smith, R (2002) Landforms: The Shaping of New Zealand. Craig Potton Publishing.

Walls, G; Simpson, P; Eade, N (2005) South Marlborough Significant Natural Areas Project: A summary of Results from an Ecological Survey of Significant Natural Areas on Private Land in Marlborough, South of the Wairau River. Marlborough District Council.

Walls, G & Eade, N (2009) North Marlborough Significant Natural Areas Project: A summary of Results from an Ecological Survey of Significant Natural Areas on Private Land in Marlborough, North of the Wairau River. Marlborough District Council.

Abiotic Bibliography and References

Begg JG, Johnston MR (compilers) 2000. Geology of the Wellington area. Institute of Geological & Nuclear Sciences 1:250 00 geological map 10. 1 sheet + 64 p. Lower Hutt, Institute of Geological & Nuclear Sciences.

Boffa Miskell Limited and Lucas Associates 1993. Canterbury regional landscape study. Vols 1 & 2. Prepared for the Canterbury Regional Council.

Breese ED, Timmins SM, Garrick AS, Owen JM, Jane GT 1986. Kaikoura Ecological Region: survey report for the Protected Natural Areas Programme. New Zealand Protected Natural Areas Programme No. 5. Wellington, Department of Lands and Survey. 113 p.

Brown LJ 1981. Late Quaternary geology of the Wairau Plain, Marlborough, New Zealand. New Zealand Journal of Geology and Geophysics 24: 477–489.

Campbell IB, Johnston MR 1992. Nelson and Marlborough. In: Soons JM, Selby MJ eds Landforms of New Zealand, 2nd edn. Auckland, Longman Paul. Pp. 424–438.

Hayward BW, Kenny JA, Johnston MR 1999. Inventory and maps of important geological sites and landforms in the Nelson and Marlborough Region including Kaikoura District. Miscellaneous Publication 104. Lower Hutt, Geological Society of New Zealand.

Kirk RM, Lauder GA 2000. Significant coastal lagoon systems in the South Island, New Zealand – coastal processes and logon mouth closure. Science for Conservation 146. Wellington, Department of Conservation.

Lauder WR 1970. The ancient drainage of Marlborough Sounds [Note]. New Zealand Journal of Geology and Geophysics 13: 747–749.

Lucas D, Lynn IH, Head J 1997. Natural character of the Marlborough Sounds. Report by Lucas Associates for Department of Conservation and Marlborough District Council. 52 p

Pelorus estuary

Abiotic Bibliography and References (continued)

Lynn IH 1996. Land Types of the Marlborough Sounds. A report for Department of Conservation, Nelson/ Marlborough Conservancy. Landcare Research Contract Report LC9697/049. 46 p, 10 maps.

Lynn IH 2009. Land Types of the Marlborough District. A report prepared for Marlborough District Council. Landcare Research Contract Report LC0809/07849. 82 p, 12 maps.

Lynn IH, Basher LR 1994. Principles underlying land systems in land resource assessment of hill and mountain lands in New Zealand. In: Webb TH ed. Soil-landscape modelling in New Zealand. Landcare Research Science Series No. 5. Lincoln, Manaaki Whenua Press. Pp. 38–51.

McEwen ME (ed.) 1987. Ecological regions and districts of New Zealand, Part 3. 3rd edn. New Zealand Biological Resources Centre Publication No. 5. Wellington, Department of Conservation.

McRae SM, Lucas, DJ, Courtney SP, Baxter AS, Barrier RF, Lynn IH 2004. A natural character framework for the Marlborough Sounds, Department of Conservation, Nelson/Marlborough Conservancy, Occasional Publication No. 62. 70 p.

Mortimer N 1993. Metamorphic zones, terranes, and Cenozoic faults in the Marlborough Schist, New Zealand. New Zealand Journal of Geology and Geophysics 36: 357–368.

Nicol A 2011. Landscape history of the Marlborough Sounds, New Zealand. New Zealand Journal of Geology and Geophysics 54: 195–208.

Pascoe RM 1983. The climate and weather of Marlborough. New Zealand Meteorological Service, Miscellaneous Publication 115(12).

Pickrill RA 1976. The evolution of coastal landforms of the Wairau valley. New Zealand geographer 32: 17–29.

Rattenbury MS, Townsend DB, Johnston MR (compilers) 2006. Geology of the Kaikoura area. Institute of Geological & Nuclear Sciences 1:250 00 geological map 13. 1 sheet + 70 p. Lower Hutt, GNS Science.

Walls GY, Laffan, MD 1986. Native vegetation and soil patterns in the Marlborough Sounds, South Island, New Zealand. New Zealand Journal of Botany 24: 293–313.

Ward WT 1961. Soils of Stephens Island. New Zealand Journal of Science 4: 493–505.

Webb TH, Atkinson, IAE 1982. Soils of Maud Island (Te Hoiere), Marlborough Sounds, New Zealand. New Zealand Journal of Science 25: 313–324.

Biotic - Southern Marlborough

1. North, M. 2004. Wairau Ecological Region – Blenheim, Grassmere, Flaxbourne, Wither Hills and Hillersden Ecological Districts. Survey report for the Protected Natural Areas Programme. Occasional Publication No. 60. Department of Conservation, Nelson.

2. Clayton-Greene, J.M. Pers comm.

3. Burrows, C.J. 2009. Genus *Pimelea* (Thymelaeaceae) in New Zealand 2. The endemic *Pimelea prostrata* and *Pimelea urvilliana* species compexes. New Zealand Journal of Botany Vol 47: 163-229.

4. Simpson, P. 1991. The characteristics, condition and conservation needs of indigenous vegetation in the lower Wairau catchment, Marlborough. (Reprinted from Water and Soil Resources of the Wairau Vol. 3: Land and Soil Resources) Nelson-Marlborough Regional Council.

5. Martin, W. 1932. The Vegetation of Marlborough. Reprinted from The Marlborough Express.

6. Walls, G., P. Simpson, N. Eade. 2005. South Marlborough Significant Natural Area Project, A summary of results from an Ecological Survey of Significant Natural Areas on Private Land in Marlborough, South of the Wairau River. Marlborough District Council.

7. Courtney, S.P. Pers comm

8. Breese, E.D., S.M. Timmins, A.S. Garrick, J.M. Owen and G.T. Jane. 1986. Kaikoura Ecological Region Survey Report for the Protected Natural Areas Programme. Department of Lands and Survey.

9. Williams, P.A. 1982. Scenic Reserves of Southern Marlborough. Department of Lands and Survey.

10. Jones, C. Pers comm.

11. Hayward, J. Unpublished Natural Heritage fund application.

Biotic - Marine

R Allibone, B David, R Hitchmough, D Jellyman, N Ling, P Ravenscroft & J Waters 2010. Conservation status of New Zealand freshwater fish, 2009, New Zealand Journal of Marine and Freshwater Research, 44:4, 271-287,

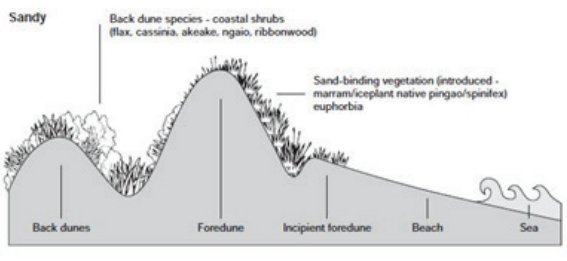
Acknowledgements

The authors of this report wish to acknowledge the following for their contributions:

Rob Davidson (Davidson Environmental), Phil Clerke (Department of Conservation), Peter Hamill (Marlborough District Council), Jeremy Head (Landscape Architect) and Dave Bradshaw.

The authors also wish to thank and acknowledge the assistance and support of Pere Hawes and Linda Craighead at Marlborough District Council during the development of this report

Appendix 2 : Glossary

Name	Description
Active Interface	*Intertidal zone which is under water at high tide and below water at low tide.*
aggradational	*Is the term used in geology for the increase in land elevation due to the deposition of sediment. Aggradation occurs in areas in which the supply of sediment is greater than the amount of material that the system is able to transport. The mass balance between sediment being transported and sediment in the bed is described by the Exner equation. (Wikipedia)*
alluvium / alluvial	*Sediments such as sand, silt or gravel that have been deposited by streams, rivers and other running waters*
ascidians	*Also known as seasquirts. Solitary or colony forming.*
barrier spit	*A long elongate sand and gravel ridge above the high tide and connected at one end to the mainland, extending generally parallel with the shore but separated from it by a lagoon*
benthic	*The surface of the seabed*
brachiopods	*Small clam-like animals which superficially look like bivalve molluscs*
brackish	*Water which is a mix of freshwater and saltwater; e.g. estuarine water*
basal	*Base as in basement rock*
bryozoan coral beds	*Colonial mound-forming animals which superficially look like corals but which belong to a totally different group of animals*
Cleavage	*Tendency to split along closely spaced, planar structures or textures*
colluvium / colluvial	*A general term for weathered soil and rock material mantling slopes which has been transported primarily by gravity and sheet wash.*
cuestas	*Hill or ridge with a steep slope on one side and a gentle slope on the other – an asymmetric ridge*
Cuspate Forelands	*The largest sharp, seaward-projecting point of beach material, built up by wave action, occurring as a cape or as a broadly triangular point of sand or shingle*
dendritic (drainage pattern)	*A drainage pattern in which the streams branch randomly in all directions and at almost any angle, resembling in plan the branching habit of certain trees*
dunes	*Dunes: An accumulation of sand built by wind or water. Refer to diagram below (Canterbury's Spectacular Coast, ECAN)* *Fore dune: The more active part of dunes located closest to the sea* *Back dune: the backshore areas of a beach* 

Name	Description
echinoderms	*Starfish, brittle stars, urchins and sea cucumbers*
ephemeral	*Water ways or waterbodies that are not permanent. Their surface expression changes depending on rainfall events or groundwater levels.*
estuarine	*Pertaining to or formed or living in an estuary, especially said of deposits and the sedimentary or biological environment of an estuary*
eutrophication	*Artificial elevation of natural nutrient levels by human activities- e.g. livestock defecating on river banks, septic tank discharges*
fans	*Gently sloping, fan-shaped masses of material formed along the margins of hills and mountain ranges by streams that drain their slopes. A fan commonly occurs where there is a marked decrease in gradient, for example where a stream meets the gentler floodplain or river terrace*
foliation	*The planar arrangement of textural or structural features, especially that which results from the flattening of constituent grains of metamorphic rocks*
fucoid algae	*A group of large brown algae including "flapjack" seaweed.*
Geopreservation Inventory	*Inventory and Maps of Important Geological Sites and Landforms in the Nelson and Marlborough Regions, including the Kaikoura District. Compiled by the Joint Earth Sciences' Societies Working Group on the New Zealand Geopreservation Inventory. Lists the best examples of the wide diversity of natural and physical features and processes that characterise each part of New Zealand.*
galaxiids	*Native fishes belonging to the family Galaxiidae-consisting of migratory (whitebait species such as inanga, kokopu's) and non migratory species (e.g. dwarf galaxias)*
herbfields	*A plant community where herbs are the dominant life-form. Herbs are defined as non-woody plants other than grasses, sedges and rushes, and are usually small-leaved and prostrate.*
Holocene	*An epoch of the Quaternary period, from the end of the Pleistocene, approximately 8000 years ago, to the present time; also, the corresponding series of rocks and deposits.*
hydroids or hydroid trees	*Colonial animals related to jelly fish that form upright feather-like structures.*
Intertidal	*The area of the shore which is covered and uncovered by the rise and fall of the tide*
Laminae	*The thinnest recognisable layers in a rock, differing from each other in colour, composition, and/or particle size*
Lithology	*The nature and composition of rocks*
macroalgae	*Large seaweeds.*
macrocystis	*A very large brown seaweed also known as giant kelp or giant bladder kelp*
Mica	*A mineral group consisting of phyllosilicates with sheet-like structures and characterised by very perfect basal cleavage*

Appendix 2: **Glossary**

Name	Description
offshore reef	*A ridge of rock with the top just below or just above the water surface which is located at some distance from the shore.*
Pleistocene	*An epoch of the Quaternary period, after the Pliocene of the Tertiary and before the Holocene. It began 2 to 3 million years ago and lasted until the start of the Holocene some 8000 years ago*
Phyllite	*A metamorphic rock, intermediate in grade between a slate and a schist, in which minute grains of sericite and chlorite impart a silky sheen to cleavage and schistosity surfaces*
phyllosilicates	*Silicate structures in which the SiO4 tetrahedra occur linked together in infinite two-dimensional sheets. An example is mica*
Prograding (Progradation)	*The building forward or outward toward the sea of a shoreline or coastline (as a beach , delta, or fan) by near-shore deposition of river-borne sediments or by continuous accumulation of beach material thrown up by waves or moved by long-shore drifting*
Regression	*is a geological process occurring when areas of submerged seafloor are exposed above the sea level. The opposite event, marine transgression, occurs when flooding from the sea covers previously exposed land. (Physical Geology: Exploring the Earth)*
relictual	*Of a natural area, community, vegetation type or population of species which is now remnant but which once had a wider, more continuous distribution, and/or greater numbers.*
rhodoliths	*Unattached, branching, benthic red algae that superficially resemble coral.*
rocklands	*A plant community where exposed rock is the main cover over which plants are sparsely scattered, such as bluff faces and escarpments.*
Sericite	*A fine-grained variety of mica occurring in small scales, especially in schists*
segregation	*Compositional banding derived from an originally more homogeneous rock*
Serpentenite	*An ultramafic rock consisting almost wholly of 'serpentine' minerals which are formed by the metamorphic alteration of olivine and similar minerals*
serpentinitic melange	*a mappable body of rock characterised by the inclusion of fragments and bodies of all sizes, both exotic and native embedded in a fragmented and generally sheared matrix of more than one traceable material, characterised by rocks dominated by the serpentine-group minerals (silica poor minerals high in magnesium and iron)*
serpentinitic breccias	*Rocks characterised by serpentenite dominated angular rock fragment in fine-grained material*
shrublands	*A plant community where shrubs are the dominant lifeform. Shrubs are defined as woody plants less than 5m high, and are usually multi-stemmed. Dense shrubland is also called scrub.*
Schist	*A strongly foliated regionally metamorphosed rock that can be readily split into slabs, and coarser grained than slate or phyllite; applies to t.z.III and IV subzones*

Name	Description
Schistosity	*The foliation ('fissility') in schist, often due to the parallel planar arrangement of micas*
Semi-schist	*An informal term applied to a foliated metamorphic rock intermediate in textural development between a sediment and a schist; applies to t.z.IIA and IIB textural subzones*
Slaty cleavage	*A penetrative fabric in low-grade metamorphosed mudstones which allows them to split along closely spaced planar structures or textures: applies to t.z. IIA and some t.z. IIB semi-schists (slates)*
Subtidal	*The area below the intertidal zone which remains permanently covered in water.*
textural zone (t.z.) , IIA, IIB, III and IV (descriptive terms for schist rocks)	*A method of mapping low grade metamorphic rocks.* *t.z.1: rocks retain their sedimentary (primary) appearance. Detrital grain texture is preserved, and bedding (when present) dominates outcrops, there is no foliation.* *t.z.IIA: rocks retain their primary appearance and texture, although detrital grains are flattened. Micas are fine grained and impart a weak cleavage to sandstones, mudstones have slaty cleavage, bedding and foliation are equally dominant in outcrop. Rocks are termed semischist* *t.z.IIB: rocks are well foliated, although primary sedimentary structures may still be seen. Bedding is transposed or flattened. Clastic grains are flattened, and metamorphic overgrowths are present and segregation appears. Rocks are termed semischist* *t.z.III: Planar schistosity identified by metamorphic micas is developed in all rocks. Bedding is barely recognisable, and is transposed and parallel to foliation. Clastic grains may still be recognisable in sandstones, but are recrystallized and overgrown, metamorphic segregation laminae are developed. Rocks are termed schist. Quartz veins develop parallel to foliation, metamorphic micas at least very fine sand sized.* *t.z. IV: Primary sedimentary structures and clastic grains are destroyed at a mm-cm scale. Schistosity tends to be irregular, metamorphic mica grain size is between fine and medium sand size. Schistosity and segregation are ubiquitous, quartz veins are abundant in most lithologies , rocks are termed schist.*
turbidity	*Discolouration of water caused typically by suspended sediment load.*
tombolo	*A sand or gravel bar or barrier that connects an island with the mainland or with another island*
ultrabasic	*Relates to igneous rocks with very high contents of dark-coloured minerals containing iron and magnesium and less than 44% silica. The term is frequently used interchangeably with ultramafic*
ultramafic	*Igneous rocks composed chiefly of mafic minerals*
Wave-dominated beaches	*Beaches exposed to persistent ocean swell and waves and low tides (range <2m). Consist of 3 types; Reflective, Intermediate (longshore bar and trough, rhythmic bar and beach, transverse bar and rip, low tide terrace) and Dissipative.*
Wave swash	*A turbulent layer of water that washes up on the beach after an incoming wave is broken.*

Appendix 3 : Common Plant Names

Common Plant Names for the Marlborough Sounds

Common Name	Latin Name
bamboo tussock	*Anemanthele lessoniana*
baumea	*Machaerina rubiginosa*
black maire	*Nestegis cunninghamii*
broad-leaved snow tussock	*Chionochloa flavescens* subsp. *flavescens*
carpetgrass	*Chionochloa australis*
cedar	*Libocedrus bidwillii*
comb sedge	*Oreobolus pectinatus*
Cook Strait bristle tussock	*Rytidosperma petrosum*
Cook Strait kōwhai	*Sophora molloyi*
Cooks scurvy grass	*Lepidium oleraceum*
coral mistletoe	*Korthalsella clavata, K. salicornioides*
crown fern	*Blechnum discolor*
deciduous tree daisy	*Olearia hectorii*
fierce lancewood	*Pseudopanax ferox*
filmy ferns	*Hymenophyllum* spp.
fivefinger	*Pseudopanax arboreus*
forest snowgrass	*Chionochloa cheesemanii*
giant spikerush	*Eleocharis sphacelata*
green mistletoe	*Ileostylus micranthus*
gully treefern	*Cyathea cunninghamii*
hangehange	*Geniostoma ligustrifolium*
hard beech	*Fuscospora truncata*
heketara	*Olearia rani*
hīnau	*Elaeocarpus dentatus*
horokaka, native iceplant	*Disphyma australe*
horopito	*Pseudowintera colorata*
horse's mane	*Ruppia polycarpa*
hūpiro, stinkwood	*Coprosma foetidissima*
hutu	*Ascarina lucida*
inaka	*Dracophyllum filifolium*
kamahi	*Weinmannia racemosa*
karaka	*Corynocarpus laevigatus*
kawakawa	*Macropiper excelsum*
kiekie	*Freycinetia banksii*
kohekohe	*Dysoxylum spectabile*
ladies' tresses	*Spiranthes novae-zelandiae*
large-leaved milktree	*Streblus banksii*
laurel daphne	*Pimelea gnidia*
leatherwood, stoppy-stop	*Olearia colensoi*
lowland ribbonwood	*Plagianthus regius*
mamaku	*Cyathea medullaris*
marsh clubrush	*Bolboschoenus caldwellii*

Common Name	Latin Name
mid-ribbed snow tussock	*Chionochloa pallens* subsp. *pallens*
mingimingi	*Leucopogon fasciculatus*
miro	*Prumnopitys ferruginea*
mountain beech	*Fuscospora cliffortioides*
mountain fivefinger	*Pseudopanax colensoi*
mountain toatoa	*Phyllocladus alpinus*
mountain tōtara, halls tōtara	*Podocarpus cunninghamii*
muttonbird groundsel	*Senecio sterquilinus*
narrow-leaved lacebark	*Hoheria angustifolia*
native iceplant, horokaka	*Disphyma australe*
native lilac	*Heliohebe hulkeana* subsp. *evestita*
nīkau	*Rhopalostylis sapida*
papauma, broadleaf	*Griselinia littoralis*
pigeonwood	*Hedycarya arborea*
pine*	*Pinus radiata*
ponga	*Cyathea dealbata*
porcupine shrub	*Melicytus crassifolius*
pukatea	*Laurelia novae-zelandiae*
pūkio	*Carex secta, C. virgata*
putaputāwētā	*Carpodetus serratus*
pygmy pine	*Lepidothamnus laxifolius*

*Above: Native lilac (**Heliohebe hulkeana** subsp. **evestita**)*

Appendix 3: **Common Plant Names**

Common Plant Names for the Marlborough Sounds (continued)

Common Name	Latin Name
rangiora	*Brachyglottis repanda*
raukawa	*Raukaua edgerleyi*
rautahi	*Carex geminata, C. lessoniana*
red beech	*Fuscospora fusca*
rengarenga	*Arthropodium cirratum*
rewarewa	*Knightia excelsa*
rimu	*Dacrydium cupressinum*
saltmarsh ribbonwood	*Plagianthus divaricatus*
sand spurge	*Euphorbia glauca*
scarlet rata vine	*Metrosideros fulgens*
seablite	*Suaeda novae-zelandiae*
shining karamu	*Coprosma lucida*
silver beech	*Lophozonia menziesii*
soft treefern	*Cyathea smithii*
southern rata	*Metrosideros umbellata*
square rush	*Lepidosperma australe*
speargrasses	*Aciphylla* spp.
stoppy-stop, leatherwood	*Olearia colensoi*
supplejack	*Ripogonum scandens*
swamp coprosma	*Coprosma tenuicaulis*
swamp maire	*Syzygium maire*
swamp nettle	*Urtica linearifolia*
tānekaha	*Phyllocladus trichomanoides*
tanglefern	*Gleichenia dicarpa*
taupata	*Coprosma repens*
tawa	*Beilschmiedia tawa*
titirangi	*Hebe speciosa*
toetoe	*Austroderia fulvida, A. richardii*
tōī	*Cordyline indivisa*
toro	*Myrsine salicina*
tree hebe	*Hebe parviflora*
tree fuchsia	*Fuchsia excorticata*
weeping māpou	*Myrsine divaricata*
wharangi	*Melicope ternata*
white maire	*Nestegis lanceolata*
white mistletoe	*Tupeia antarctica*
wineberry	*Aristotelia serrata*
woollyhead	*Craspedia uniflora*
yellow mistletoe	*Alepis flavida*

* = adventive species

Above: Titirangi (Hebe speciosa)

Appendix 3: **Common Plant Names**

Common Plan Names for South Marlborough

Common Name	Latin Name
akeake	*Dodonaea viscosa*
akiraho	*Olearia paniculata*
black beech	*Fuscospora solandri*
boxthorn*	*Lycium ferocissimum*
bracken	*Pteridium esculentum*
briar*	*Rosa rubiginosa*
cabbage tree	*Cordyline australis*
clubrush	*Schoenoplectus tabernaemontani*
coastal shrub daisy	*Olearia solandri*
coastal tree broom	*Carmichaelia muritai*
crack willow*	*Salix fragilis*
danthonia	*Rytidosperma* spp.
exotic ice plant*	*Carpobrotus edulis*
fescue, hard tussock	*Festuca novae-zelandiae*
glasswort	*Sarcocornia quinqueflora*
gorse*	*Ulex europaeus*
harakeke, swamp flax	*Phormium tenax*
harestail*	*Lagurus ovalis*
hīnau	*Elaeocarpus dentatus*
kahikatea	*Dacrycarpus dacrydioides*
kaikōmako	*Pennantia corymbosa*
kānuka	*Kunzea ericoides* agg.
karamū	*Coprosma robusta*
kneed foxtail*	*Polypogon monspeliensis*
knobby clubrush	*Ficinia nodosa*
kōwhai	*Sophora microphylla*
māhoe	*Melicytus ramiflorus*
mānuka	*Leptospermum scoparium*
māpou	*Myrsine australis*
Marlborough rock daisy	*Pachystegia insignis*
marram*	*Ammophila arenaria*
matagouri	*Discaria toumatou*
mataī	*Prumnopitys taxifolia*
native ice plant, horokaka	*Disphyma australe*
ngaio	*Myoporum laetum*
oioi	*Apodasmia similis*
pīngao	*Ficinia spiralis*
pōhuehue, scrambling pōhuehue	*Muehlenbeckia complexa*
poroporo	*Solanum aviculare* var. *aviculare*
puka	*Griselinia lucida*
raupō	*Typha orientalis*
remuremu	*Selliera radicans*
salt marsh ribbonwood	*Plagianthus divaricatus*

Common Name	Latin Name
sand daphne	*Pimelea villosa*
sand tussock	*Poa billardierei*
sea holly	*Eryngium vesiculosum*
sea rush	*Juncus kraussii* var. *australiensis*
shore convolvulus	*Calystegia soldanella*
shore primrose	*Samolus repens*
shrubby tororaro	*Muehlenbeckia astonii*
silver tussock	*Poa* aff. *cita*
spinifex	*Spinifex sericeus*
stonecrop*	*Sedum acre*
tall fescue*	*Schoedonorus phoenix*
tauhinu	*Ozothamnus leptophyllus*
three square	*Bolboschoenus pungens*
tītoki	*Alectryon excelsus*
tōtara	*Podocarpus totara*
tutu	*Coriaria arborea*
whaririki, coastal flax	*Phormium cookianum*

* = adventive species

*Above: Marlborough Rock Daisy (**Pachystegia insignis**)*

Appendix 4 : Potential for Restoration

Policy 14 of the New Zealand Coastal Policy Statement 2010 (NZCPS 2010) promotes the restoration or rehabilitation of the natural character of the coastal environment. Policy 14 directs the identification of areas and opportunities for restoration, and the inclusion of provisions in statutory plans. Direction is also given in relation to the use of restoration conditions when granting resource consents and designations. Guidance on the implementation of Policy 14 is available from the Department of Conservation. http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/coastal-management/guidance/policy-14.pdf

In the context of Marlborough, the potential for restoration is summarised in the Table 1 below.

Natural character restoration and rehabilitation can help address the effects of past management decisions. Restoration and rehabilitation can also assist with approvals for new resource uses in the coastal environment. Natural character restoration is also an important opportunity to benefit for human use, appreciation and enjoyment of the coast.

There are a number of practical measures to support ecological restoration that also benefit natural character restoration. Marlborough District Council has provided practical guidance and other programmes to support biodiversity restoration in partnership with landowners, resource users, communities and others including the Department of Conservation. Practical guidance on ecological restoration in Northern and Southern Marlborough is available from the Council:

http://www.marlborough.govt.nz/Environment/Biodiversity/Biodiversity-Publications-Reports.aspx

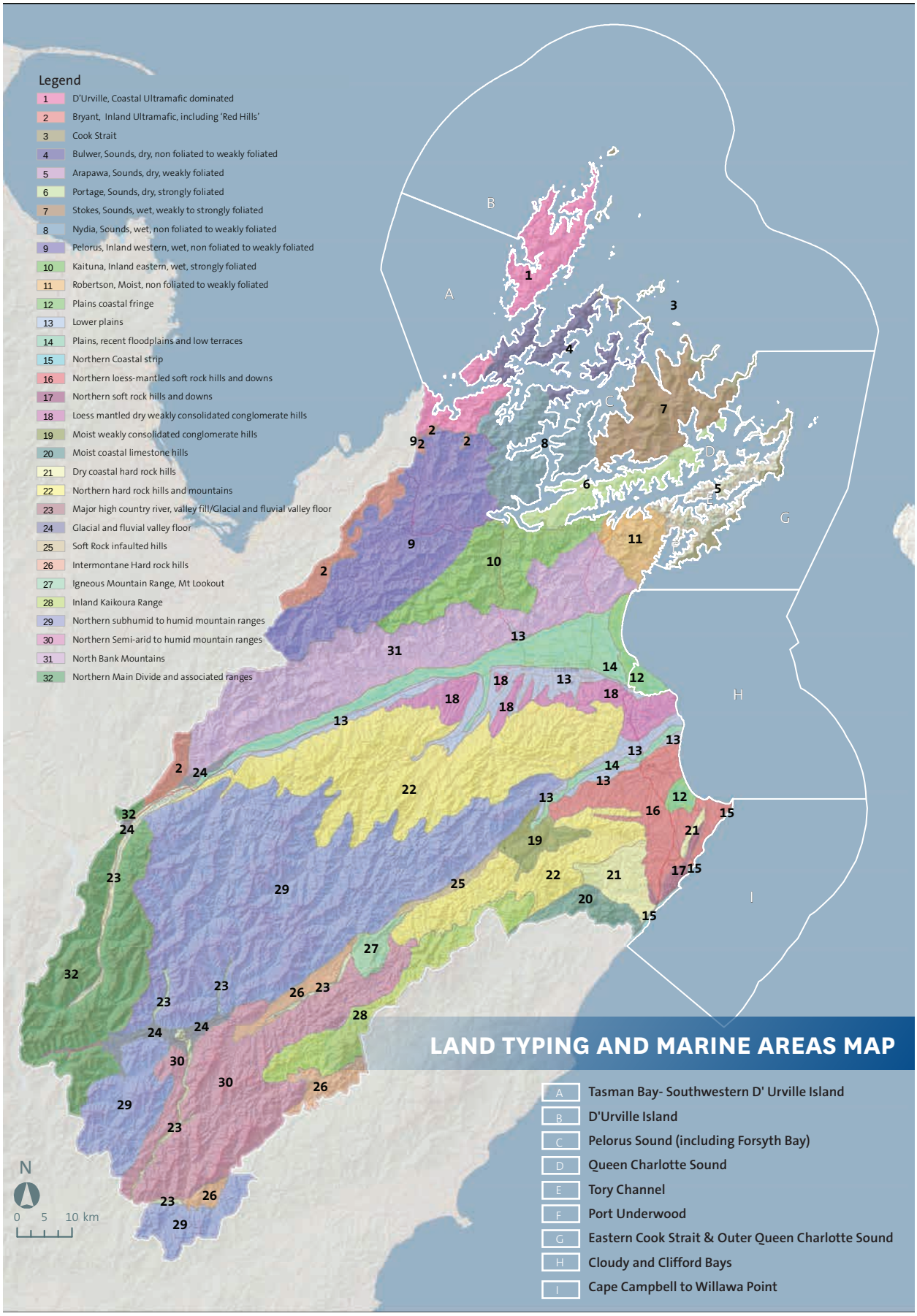
Table 1: Natural Character restoration priorities for Marlborough

Terrestrial	1. Re-establish natural patterns of indigenous vegetation. 2. Areas of secondary forest and regenerating shrublands provide excellent potential for lowland forest restoration. 3. Restoration of native duneland vegetation. 4. Potential for delta restoration to enhance estuarine margins, delta shrubland and forest communities, and whitebait spawning habitat. 5. Reduce weeds and pests so that the indigenous biodiversity elements can persist as significant components of natural character including: a. Reduce introduced pest mammals on islands where technically feasible. b. Maintain predator free status in applicable islands. c. Maintain the absence of major mammal pests from islands (e.g. deer and possums from Arapawa).
Freshwater	6. Re-establish natural riparian margins around rivers, streams, coastal and other wetlands, and estuaries. 7. Restore compromised fish passage and hydrological connectivity between freshwater ecosystem types e.g. wetlands and running water systems
Coastal Marine	8. Reduce disturbance to natural seabed communities particularly in various deeper areas of the Marlborough Sounds. 9. Reduce sedimentation and other contaminants entering the coastal marine area from point source and diffuse nutrient inputs from sources including river inflows, groundwater and general run-off.

Opposite: Sand tussock at Rarangi
Overleaf: Start of Queen Charlotte Track, Ship Cove

SECTION G

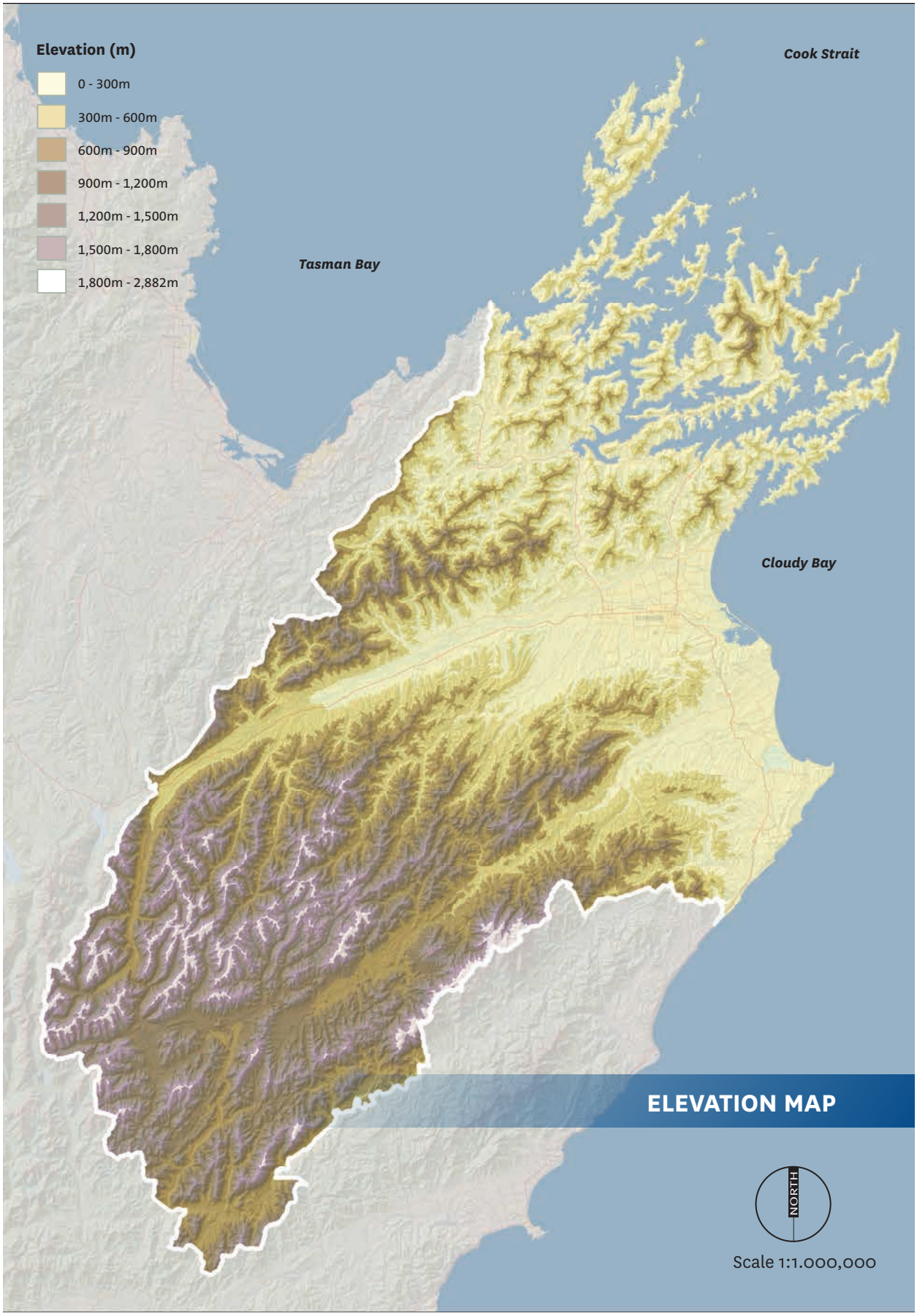
Appendix 5 : Maps from the Marlborough Landscape Study 2009

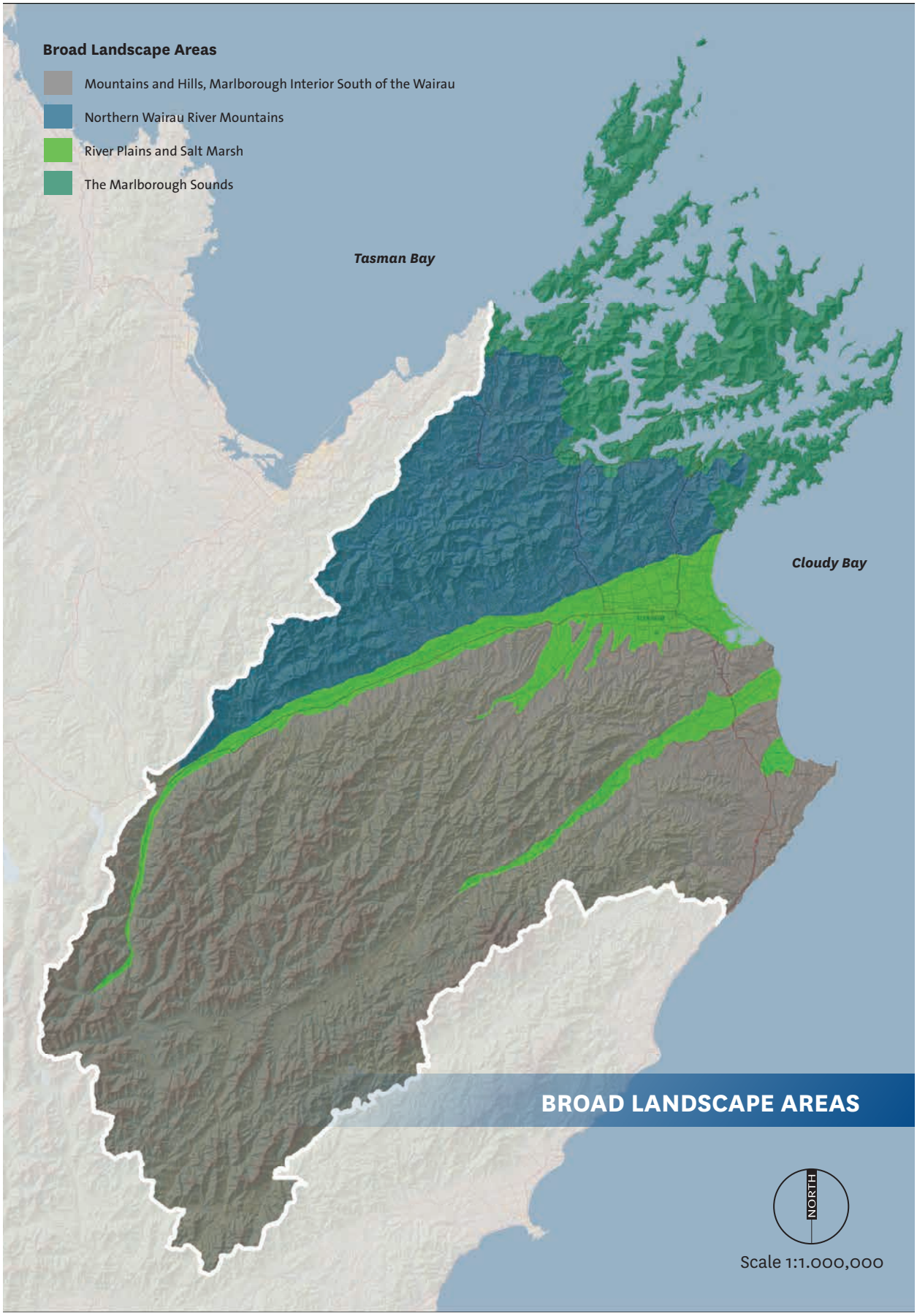


LAND TYPING AND MARINE AREAS MAP

- A Tasman Bay- Southwestern D' Urville Island
- B D'Urville Island
- C Pelorus Sound (including Forsyth Bay)
- D Queen Charlotte Sound
- E Tory Channel
- F Port Underwood
- G Eastern Cook Strait & Outer Queen Charlotte Sound
- H Cloudy and Clifford Bays
- I Cape Campbell to Willawa Point

Appendix 5: **Maps from the Marlborough Landscape Study 2009**




Broad Landscape Areas
Mountains and Hills, Marlborough Interior South of the Wairau
Northern Wairau River Mountains
River Plains and Salt Marsh
The Marlborough Sounds
Tasman Bay
Cloudy Bay
BROAD LANDSCAPE AREAS
NORTH
Scale 1:1.000,000

Appendix 6 : Technical Marine Methodology

Marine ecological components of Natural Character

An assessment of the natural character of Marlborough's marine environment was undertaken using several marine biophysical criteria outlined on the facing page These criteria were used to establish an overall rating for the marine ecological components of natural character for the nine marine natural character areas (at Level 3). Areas judged to be high or very high in natural character (from a marine ecological perspective) are mapped at the Level 4 and 5 scales at the end of each Coastal Marine Area.

Experiential attributes were not included in this particular assessment though have been assessed for the surface of the water and the land/sea interface in Sections C, D, E & F of this report. Much of the subtidal marine environment is hidden beneath the sea's surface and therefore unseen to many people. Most people's experience of the subtidal environment is generally limited to places where they go diving and snorkelling. Their choice of diving location often depends on factors such as accessibility and physical conditions at the time (e.g. sea state, currents and visibility), but also the presence of interesting underwater features (e.g. complex reefs, diverse species assemblages, marine protected areas, and ship wrecks) and harvestable species. Thus while people's experience of the underwater environment is patchy, it is also very rewarding.

While the coastal marine area extends out to the edge of the territorial sea (the 12 mile limit), information on seabed ecology is generally greatest close to shore and decreases appreciably with distance offshore. The strong connection between the land and the sea is also a pivotal feature in terms of defining the natural character of the coast. The present study therefore focused on the marine environment closer to shore, specifically:

- All enclosed waters of the Marlborough Sounds
- The outer Marlborough Sounds bounded by the main headlands and offshore islands and stacks;
- Out to 2 km offshore from the outer coast (including from offshore islands and stacks around the outer Sounds).

Recognition of scale is crucial when interpreting and applying the results of this marine ecological natural character assessment. The study area covers a very large and complex marine environment, especially within and around the Marlborough Sounds, making it necessary to limit the study to a scale that was manageable and meaningful. The assessment considered the marine ecological components of natural character within larger bays and inlets, reaches and stretches of outer coast typically extending over several to tens of kilometres; for example Beatrix Bay and Crail Bay combined, Tawhitinui Reach, Port Hardy, and the outer coast of Arapawa Island. At this scale, some smaller areas that may be important for preserving the natural character of the coast due to their particular values may not be documented; for example ecologically significant marine sites and sea areas next to some of the smaller yet regionally significant scenic reserves. Conversely, there may be small areas of lower natural character, such as some isolated marine farm sites, within broader areas of otherwise high or very high natural character.

The criteria are not independent of each other and many are closely linked. For example, horizontal and vertical biotic patterns are closely interlinked and are influenced by sedimentation and human activities such as trawling, dredging and aquaculture. Notwithstanding these linkages, it was helpful to consider them separately to ensure the multi-dimensional nature of natural character was fully considered and assessed. However, it also meant that the assessment of an area's overall rating could not be an additive numerical approach, but rather required a broad qualitative judgment across all the criteria.

Natural biotic patterns (**Criteria 1 and 2)** underpinned the assessment as these are considered to be a key integrating element of the marine ecological components of natural character. That is, they are the product of numerous biological and physical elements, as well as the effects of human pressures on the environment. Natural biotic patterns reflect the connectivity (or conversely fragmentation) of habitats and communities, and are fundamental for assessing the ecological "naturalness" of an area. Natural biotic patterns in the marine environment form a three dimensional ecological picture due to differences in marine community structure and function associated with:

Criteria: marine ecological components of natural character

1	**Continuity of natural biotic patterns parallel to the shore** – horizontal patterns in biophysical features, including natural habitats and their associated flora and fauna. i) High: natural biotic patterns extend horizontally with limited or no interruption over several kilometres or more, (including where intertidal and near-shore biotic patterns remain largely intact but values further offshore may be adversely affected); ii) Medium: - natural biotic patterns extend horizontally with some interruption over several kilometres or more; and/or - natural biotic patterns extend with limited interruption over a few (3-5) kilometres; iii) Low: - natural biotic patterns extend with some interruption over a few (3-5) kilometres; and/or - natural biotic patterns extend with limited interruption over one-two kilometres or less;
2	**Continuity of natural biotic patterns down the intertidal zone and sub-tidally** (vertical zonation patterns) to a distance/depth offshore reflective of the local topography and bathymetry: i) High: biotic patterns extend offshore with limited or no interruption; ii) Medium: biotic patterns extend offshore with some interruption (e.g. intertidal and near-shore biotic patterns remain largely intact but values further offshore may be adversely affected); iii) Low: biotic patterns extend offshore but with significant interruption
3	**The presence of special marine community assemblages/associations** which are notable or distinguishing features of the wider natural character area (including transition zones between adjoining natural character areas, and rare or atypical communities): i) High: special community association/s are a key feature; ii) Medium: special community association/s are a moderate feature; iii) Low: special community association/s are not a feature;
4	**Influence of marine-based human activities** (e.g. major structures, port dredging and dumping, aquaculture, commercial bottom fishing) on biological and physical processes and trophic/community structure and function: i) High: human activities have little or no influence; ii) Medium: human activities have a moderate influence; iii) Low: human activities have a significant influence;
5	**Influence of land-derived sedimentation** on trophic/community structure and function: i) High: sedimentation has little or no influence (e.g. catchments and adjacent lands are stable; or are naturally unstable; or the marine environment is naturally resilient to sedimentation (e.g. certain high energy coastlines)); ii) Medium: sedimentation has a moderate influence; iii) Low: sedimentation has a significant influence (e.g. catchments and adjacent lands are unstable due to human activities, and marine communities are sensitive to excess sedimentation);
6	**Influence of exotic species** on trophic/community structure and function: i) High: exotic species have little or no influence; ii) Medium: exotic species have a moderate influence; iii) Low: exotic species have a significant influence;
7	**Influence of water quality** (other than sedimentation) on trophic/community structure and function: i) High: Water quality is high or has little or no influence; ii) Medium: Water quality has a moderate influence; iii) Low: Water quality is low and has a significant influence;
8	**Protective status of the adjacent terrestrial environment** (for certainty of protection of terrestrial values, including natural biotic patterns which extend across the land/sea interface): i) High: much of the terrestrial environment is formally protected; ii) Medium: some of the terrestrial environment is formally protected; iii) Low: little of the adjacent land is formally protected

Appendix 6: **Technical Marine Methodology**

a) Along-shore variation in variables such as shelter/exposure, aspect, substrate composition, tidal and current patterns, salinity, turbidity levels, sedimentation and temperature. Local features such as bays, headlands, reef systems, tidal passages, estuaries, offshore algal beds and biogenic reefs add diversity and complexity to natural biotic patterns.

b) Depth and distance offshore. These are the zonation patterns observed intertidally and subtidally; for example, the transition from intertidal cobble boulder and bedrock reefs, to near-shore subtidal reefs, to sand/shell sediments, to finer sands and mud offshore.

Special marine community assemblages or associations (e.g. ecologically significant marine sites identified by Davidson et al. (2011) were considered in terms of their contribution to the values of the wider natural character areas **(Criterion 3).** Transition zones between adjoining natural character areas were also considered as the biotic patterns present in these locations are unique to these particular areas. While these values were influential in this natural character assessment, they were not considered pivotal. Representativeness was also considered and an area may rank high or very high for other reasons even if special community assemblages or associations were not present.

The influence of certain marine-based human activities **(Criterion 4)** had a major influence on the rankings, as these activities directly affect natural biotic patterns. Aquaculture and towed commercial fishing gear (e.g. trawling and dredging) in particular can adversely affect marine benthic communities over large areas. The nature and extent of these effects depends upon the distribution, intensity and frequency of the activity, and the resilience of the seabed community. The wider extractive effects of fishing have not been included in this assessment.

Aquaculture (primarily mussel farming and salmon farming) is widespread in various parts of the Marlborough Sounds, in particular within Pelorus Sound, Kenepuru Sound and certain large bays in the outer Sounds. Aquaculture modifies seabed habitats and communities through deposition of wastes (e.g. shell, faeces, pseudofaeces and uneaten food). These benthic effects tend to be confined to the area directly beneath individual farms and, for fish farms, a zone around the cages determined largely by the local current regime.

Commercial scallop dredging can have a significant effect on benthic communities in certain sheltered offshore areas within the Marlborough Sounds where there is suitable scallop habitat and favourable bathymetry. Commercial bottom trawling is widespread, mainly in offshore areas outside the Sounds, though the intensity of effort is variable. The influence of trawling will also vary depending on the resilience of the benthos. Coastal areas along South Marlborough's east coast will be accustomed to natural seabed disturbance due to this region's exposure to strong wave action and mobile sediments, which should make this area more resilient to trawling disturbance than more sheltered areas elsewhere in the region (e.g. Tasman Bay). Both scallop dredging and trawling tend to occur "offshore" where there is suitable depth, open topography (i.e. distant from headlands and reef systems) and flat or gently sloping seafloor, meaning that near-shore communities and biotic patterns can remain largely intact.

The distribution of aquaculture was determined from maps provided by the Marlborough District Council. The distribution and amount of trawling effort were based on annual average trawl catch effort over the fishing years 2002/2003 to 2010/2011 (unpublished fisheries data held by MPI). A similar database was not available for commercial scallop dredging; rather the extent and intensity of scallop dredging effort were based on maps of predicted fishing effort provided by the Ministry for Primary Industries (Osborne et al. in prep.), in particular fishing effort over the last six to nine years.

Wakes generated by the Cook Strait ferries have also altered shallow subtidal and intertidal communities along the ferry route. Since the introduction of speed controls and maximum wake criteria in 2000, and the subsequent removal of fast ferries from service, there was a significant recovery of shallow subtidal and intertidal marine life on various exposed shores (Davidson et al 2010). However, following the introduction of the largest conventional ferry in late 2005, a decline in invertebrate densities at exposed intertidal cobble and bedrock shores was also recorded (Davidson et al 2010). These latest ferry effects appear to be limited to the intertidal zone in exposed sites and do not extend subtidally

Outside of ports, marinas and dedicated mooring areas, the presence of jetties and moorings did not significantly influence the assessment as the ecological effects of these structures tend to be quite localised in their extent.

The influence of land-derived sedimentation on trophic/community structure and function **(Criterion 5)** varied within the assessment depending on the situation; e.g. the stability of catchments and adjacent lands; whether or not these processes are natural or due to human activities; and whether the marine environment was considered to be naturally resilient or sensitive to sedimentation effects. Relatively high sediment loads do not necessarily mean there are significant adverse effects as high sedimentation levels may be a natural feature (e.g. adjacent to naturally erodible shorelines and near significant river mouths) or the area may be naturally resilient to sedimentation (e.g. estuaries and the exposed shores of Marlborough's east coast where wave action readily re-suspends and disperses sediment). Land-derived sedimentation was primarily considered an issue next to large exotic forests in low current areas of the inner Sounds, and in Mahau and Kenepuru Sounds where flooding from the Kaituna and Pelorus Rivers has greatest influence.

There are a large number of exotic species established in New Zealand waters. Some are relatively recent arrivals whereas others are thought to date to the sealing and whaling era. Only two species – Japanese kelp *(Undaria pinnatifida)* and the Pacific oyster *(Crassostrea gigas)* – were considered to be distributed within the Marlborough region in sufficient quantities to warrant consideration in the current assessment **(Criterion 6).** While *Undaria* is now present through parts of Pelorus Sound, Queen Charlotte Sound and Tory Channel, especially on man-made structures, its occurrence in the wild is mostly sparse or sporadic. *Undaria* is most prevalent in Tory Channel. Pacific oysters are patchily distributed through the warmer parts of the Marlborough Sounds where there is suitable habitat and sufficient freshwater influence (e.g. near to Havelock and where small streams meet the coast), but tend to be quite localised in their occurrence due to their very specific habitat requirements. The presence of both species can fluctuate over time and while they can have localised impacts their effects on wider trophic/community structure and function are not considered to be significant. Although *Spartina* is also present in parts of the Marlborough Sounds, an extensive eradication and control programme means the ecological effects of this exotic species are limited.

Water quality did not feature as a major determining factor in the rankings **(Criterion 7).** Public health concerns (e.g. faecal contamination from sewage discharges) were not material to the assessment. Water quality is mostly high throughout the region; the main exceptions are in the immediate vicinities of Picton, Waikawa, Shakespeare Bay, Port Havelock and the mouth of the Wairau River (due to port/marina activities, urban run-off, and/or sewage discharges). Elevated nutrient levels are also present near fish farms in the Marlborough Sounds but at present levels the ecological effects of these activities appear to be restricted to their immediate environs. While the Pelorus and Kaituna River catchments are a significant source of nutrients, there are no signs these inputs are having a significant ecological effect in Pelorus Sound.

The nature and protective status of the adjacent terrestrial environment (e.g. Reserves Act and private covenants; **Criterion 8**) was based on information held by the Department of Conservation including maps and local staff knowledge.

Other ecological factors such as diversity, productivity and complexity were not considered within this natural character assessment, except in terms of their contribution to special marine community assemblages or associations (refer **Criterion 3** above). These values may be important for establishing an area's ecological significance and may contribute to natural character; however, they are not direct measures of natural character. All positions on the diversity, productivity and complexity spectra – from reefs and biogenic habitats to sand and mud – have their place in forming an area's natural character. Thus, areas of naturally low diversity, productivity or complexity may still have high natural character if these areas remain largely intact ecologically. For these reasons, while diversity, productivity and complexity are important for understanding the natural character of a marine area, they have not been used as particular criteria within this natural character assessment except within the context of Criterion 3.

Appendix 6: **Technical Marine Methodology**

The potential for restoration of natural character was considered across all the criteria. Apart from within port and marina areas, and where excess sedimentation may have permanently altered sea bed character, the effects of most activities within the marine environment are reversible, at least to some degree and given sufficient time.

Comment on specific marine areas

As noted earlier, assessments were made at a medium-scale (Level 3) that included significant reaches, large bays, inlets and harbours, and contiguous stretches of outer coast. Areas judged to be high or very high in natural character (from a marine ecological perspective) are mapped at the end of each Coastal Marine Area. Specific comments on these assessments (Levels 4 and 5), either individually or combined where there are similarities between adjoining areas, are further outlined following the evaluation table at the end of each Coastal Marine Area.

Opposite: The White Bluffs