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A preliminary assessment of salt marsh rehabilitation options for Waimea Inlet

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GLOSSARY

DOC	Department of Conservation
GIS	Geographic Information System
MHWS	Mean High Water Spring tide
NCC	Nelson City Council
NRSBU	Nelson Regional Sewerage Business Unit
TDC	Tasman District Council
TET	Tasman Environmental Trust
SLR	Sea Level Rise

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A preliminary assessment of salt marsh rehabilitation options for Waimea Inlet

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March 2021

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For the People
Mō ngā tāngata

TABLE OF CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

Estuaries are dynamic ecosystems located at the interface between the land and the sea. They provide habitat for a wide variety of species including birds, fish, invertebrates and plants. In recognition of the significance of past losses, and the very high ecological and human use values provided by salt marsh and estuarine habitat generally, estuary restoration initiatives are becoming increasingly common.

In this context, Tasman District Council engaged Salt Ecology to provide advice about the relative priority, key considerations and potential issues associated with a proposed short-list of 16 estuary restoration projects identified by TDC within Waimea Inlet. Sites were visited by a team of subject experts on 23 September 2020 to evaluate sites and discuss restoration options in light of experience gained from similar initiatives undertaken both locally and elsewhere in New Zealand.

A preliminary scoring framework was developed and used to capture and evaluate site data. The framework includes high-level screening criteria for determining initial site priorities, and more detailed criteria for scoring habitat features, as well as considerations regarding the implementation of restoration options, and their subsequent upkeep.

A spatial mapping Geographic Information System (GIS) approach was also applied so existing data on sea level, coastal structures and habitat features could be used to identify areas suitable for future restoration based on their potential for inundation as a consequence of predicted SLR.

The overarching objectives of the programme were to help TDC identify:

- a diverse mix of 'shovel ready' projects that can be undertaken relatively easily and quickly using proven restoration methodologies.
- where locally untested methods can be trialled to determine their future efficacy.
- habitat for important ecological communities or species that have been lost or are now rare.
- cost-effective methods for achieving long-term outcomes.
- potential areas for future salt marsh expansion in response to SLR so they can be protected from inappropriate development.

Five 'shovel-ready' projects were identified as initial priorities:

- Borck Creek to Sandeman Reserve
- Waimea River Delta
- Sandeman Reserve
- Bests Island Golf Course
- Lower Queen Street

These projects reflect 'low hanging fruit', that can be easily implemented with a high level of confidence of success, and which will have ecological benefits in the short and long term. Each offer different outcomes and challenges and reflect a mix of simple and easy to implement options extending current restoration work, alongside more challenging options that extend restoration into new areas or habitats.

1. INTRODUCTION

1.1 BACKGROUND

Estuaries are dynamic ecosystems located at the interface between the land and the sea. They provide habitat for a wide variety of species including birds, fish, invertebrates and plants. Vegetated estuarine habitats (commonly referred to as salt marsh) are one of the most productive on Earth. They support multiple food webs and play an important role in atmospheric gas regulation, with their prolific plant growth creating 'carbon sinks' where carbon dioxide is absorbed as part of plant photosynthesis, and terrestrial and estuarine-derived carbon is deposited and locked up in the estuary sediment. They also provide tremendous additional benefits for humans including flood and erosion control, maintenance of water quality, nutrient and sediment assimilation, and a wide variety of opportunities for recreation.

Worldwide, and in New Zealand, there has been extensive loss of estuary habitat, primarily through direct displacement from roading and urban developments, or conversion to farmland. There has also been a significant reduction in the extent or quality of salt marsh through species losses or fragmentation, alterations to drainage and flow paths, terrestrial weed invasions and disconnection from terrestrial ecosystems, in particular coastal wetlands and forests.

Estuaries and salt marshes have, to date, generally been able to respond to, or assimilate, natural physical changes in sea level, tidal inundation and/or sediment supply. However, where changes are significantly above natural rates (e.g. accelerating sea level rise (SLR), increased flood intensity and frequency, or land development causing excessive sediment inputs), then this dynamic balance can be disrupted. This is compounded by infrastructure developments commonly associated with coastal defences (e.g. flap gates, seawalls, bunds) that seek to reduce tidal inundation and shoreline erosion.

The capacity of salt marsh to respond to SLR relies to a large extent on salt marsh being able to migrate landward to maintain suitable growing conditions. The presence of hard barriers around the upper margins of estuaries prevents this migration and creates what is commonly referred to as 'coastal squeeze' resulting in the loss of both salt marsh and intertidal estuary flats.

In recognition of the significance of past losses, emerging SLR threats, and the very high ecological and human use values provided by salt marsh and estuarine habitat generally, estuary restoration initiatives are becoming increasingly common. Within Waimea Inlet there have been a large number of initiatives to improve and expand terrestrial habitat, and some salt marsh, undertaken by various agencies and interest groups. These include the Department of Conservation (DOC), Tasman Environmental Trust (TET), Waimea Inlet Forum, Nelson City Council (NCC), Tasman District Council (TDC) and many private landowners.

In this context, TDC engaged Salt Ecology to provide advice about the relative priority, key considerations and potential issues associated with a proposed short-list of estuary restoration projects identified by TDC within Waimea Inlet.

The project objectives were to help:

- identify 'shovel ready' projects that can be undertaken relatively easily and quickly using proven restoration methodologies,
- identify options to trial novel or untested methods to determine their future efficacy,
- identify habitat for critical or important ecological communities or species that have been lost or are now rare. These include marshbird nesting and feeding habitat (bittern, crake, rail, heron), Caspian tern nesting (e.g. at the Best Island shellbanks) etc.,
- identify a diverse mix of restoration options, e.g. expanding traditional terrestrial riparian planting, habitat creation, returning of the sea to cut-off areas, replanting of salt marsh, shoreline recontouring, beach replenishment, weed and pest control.
- define the most cost-effective methods for achieving long-term outcomes,

- highlight potential areas for future salt marsh expansion in response to predicted SLR so they can be protected from inappropriate development,
- facilitate a simple way for recording and spatially displaying information on current restoration initiatives.

A list of established restoration projects is presented in Table 1 based on information provided by TET, with locations shown in Fig. 1. As there is currently no coordinated recording of restoration activities, this list not comprehensive and reflects the information supplied by TDC and TET for use in this report.

Restoration sites proposed for consideration by TDC as part of the current project are presented in Fig. 1. These are mostly on public land although some private low-productivity land is also included.

In contrast to most of the existing restorations which focus on the terrestrial margins, the sites proposed by TDC primarily target salt marsh restoration directly adjacent to, or within, the intertidal zone of the estuary. Work in this zone is particularly challenging and often requires different methods and approaches to terrestrial initiatives. This report aims to assist TDC in identifying opportunities for successful restoration within this estuarine zone.

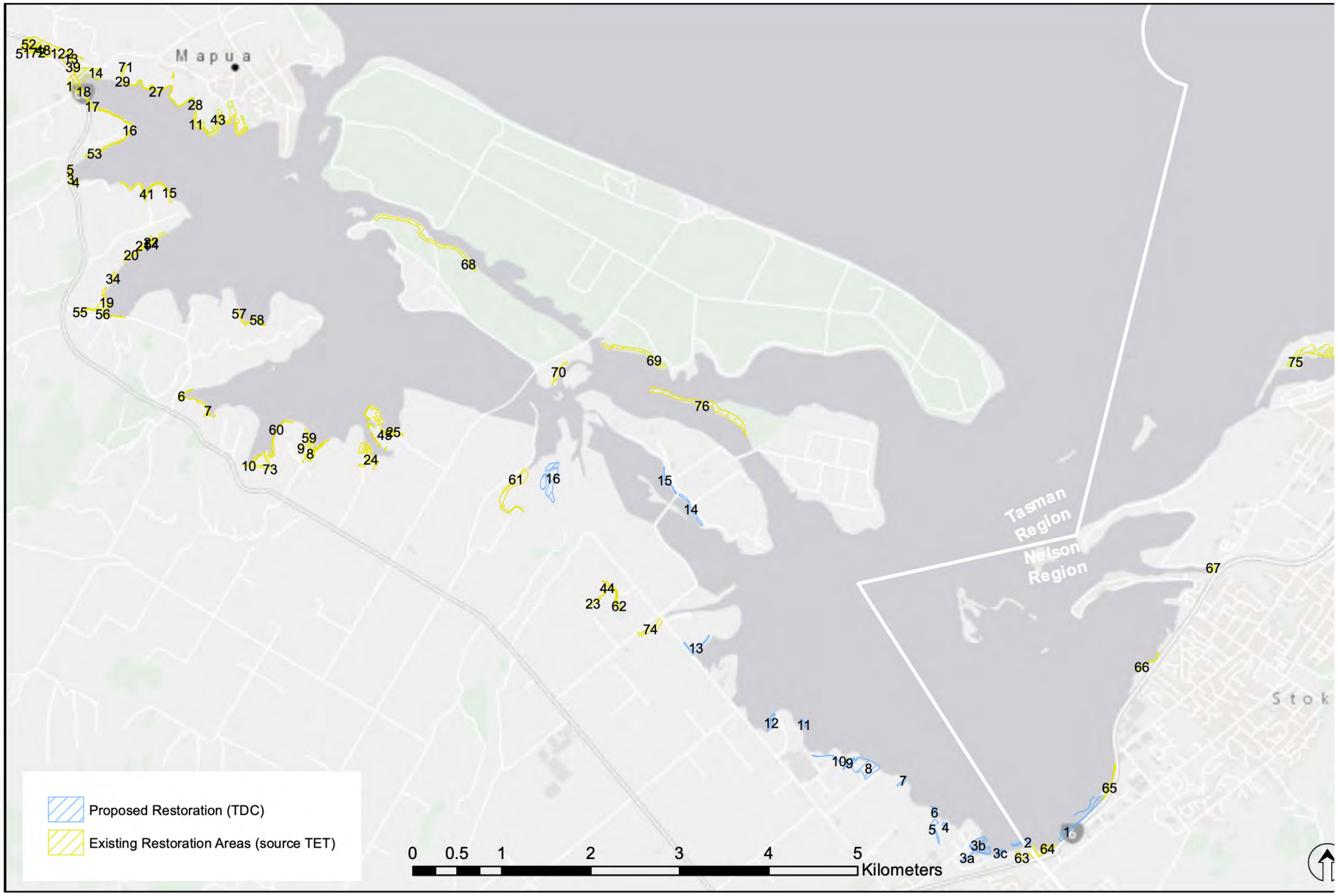


Fig. 1 Location of known and proposed restoration projects in and around Waimea Inlet (source TET and TDC).

Table 1. List of known restoration projects in and around Waimea Inlet (source TET).

No.	Name (source TET)	Area_Ha	NZTM_East	NZTM_North
1	Nile Road Block	1.1	5433046	1605945
2	Dominion Flats	0.3	5433387	1605962
3	Trafalgar Embayment	0.2	5431997	1605920
4	Trafalgar Embayment	0.2	5431960	1605965
5	Trafalgar Embayment	0.4	5432039	1605917
6	Maisey Embayment	0.7	5429490	1607322
7	Maisey Embayment	0.2	5429400	1607460
8	Research Orchard Road	1.1	5428963	1608629
9	Research Orchard	1.3	5428982	1608554
10	Hoddy Estuary Park	1.7	5428860	1608072
11	QE II Nyce	4.7	5432640	1607617
12	Dominion Flats	4.5	5433402	1605782
13	Dominion Flats	0.3	5433343	1605939
14	Dominion Embayment	3.0	5433172	1606104
15	Bronte Peninsula NW	0.8	5431881	1606849
16	Dominion Embayment	0.3	5432574	1606564
17	Dominion Embayment	1.2	5432660	1606303
18	Dominion Embayment	0.4	5432935	1606102
19	Stringer Creek	2.3	5430562	1606272
20	Bronte Peninsula on Stringer	1.0	5431252	1606780
21	Bronte Peninsula on Stringer	0.3	5431293	1606792
22	Bronte Peninsula on Stringer	0.1	5431277	1606807
23	Neimann Creek	1.0	5427298	1611887
24	Manuka Island	3.8	5429058	1609297
25	Manuka Island	0.5	5429152	1609493
27	QEII Thawley	1.2	5432975	1606917
28	QEII Thawley	0.2	5432830	1607321
29	QEII Thawley	0.3	5433139	1606499
34	1bt 9 Stringer Embayment 22-24 Bronte	0.3	5430896	1606394
39	1BT 4 Dominion Flats	8.9	5433280	1605916
41	1bt 7 Cardno Way - Bronte Peninsular	1.5	5431876	1606802
43	1bt 1 Nyce-Pearson	2.0	5432606	1607691
44	1bt 15 Neimann Creek	0.4	5427356	1611995
45	1bt 13 Manuka Challies	0.7	5429141	1609520
48	1bt 5 Mamaku block 1 2020	0.5	5433454	1605563
51	1bt 5 Mamaku year 2 2021	0.6	5433428	1605442
52	1bt 5 Mamaku year 3 2022	0.5	5433486	1605461
53	1bt 6 Dominion Matahua	1.7	5432431	1606288
54	1bt 8 East Bronte Rd	1.0	5431188	1606682
55	1bt 10 Stringer Stream Riparian	0.4	5430518	1606107
56	1bt 9a Stringer Stream delta	1.4	5430595	1606301
57	1bt 11 Hoddy Peninsula	0.3	5430450	1607827
58	1bt 11a Hoddy Peninsula	0.4	5430387	1607981
59	1bt 12a Hoddy Estuary Park/Research Orchard Road	1.0	5429042	1608645
60	12b Hoddy Estuary Park/Research Orchard Road	0.7	5429134	1608255
61	1bt 14 Pearl Creek infill planting	3.4	5428513	1610893
62	1bt 15a Neimann Creek extension	0.2	5427192	1612082
63	1bt 16 Reservoir Creek Alliance	0.6	5424392	1616631
64	1bt 20 NCC Reservoir Creek	0.8	5424464	1616875
65	1bt 21 NCC Orphanage Stream Mouth	0.8	5425192	1617601
66	1bt 22 NCC Orchard Stream Mouth	0.3	5426551	1618019
67	1bt 23 NCC Poormans Delta	0.2	5427607	1618758
68	1bt 19 Hunter Brown	4.3	5431343	1609930
69	Rabbit Islabd	2.3	5430041	1612265
70	1bt 17 Greenslade Park	0.7	5429814	1611399
71	1bt 1Thawleys	0.3	5433209	1606676
72	Mamaku block	1.3	5433438	1605536
73	1bt 12c ROR - HEP year 2/3 plantings	0.4	5428755	1608128
74	1bt 15c Neimann Creek Wildlife Reserve	1.3	5426942	1612445
75	1bt 24 NCC Back Beach	5.7	5430021	1619928
76	Bells Island peninsula	6.1	5429436	1613035

1.2 GENERAL APPROACH

Fig 2. shows the location and names of restoration sites in the eastern main basin of Waimea Inlet proposed for consideration by TDC as part of the current project. Sites were visited by a team of subject experts (see Appendix 1) on 23 Sep. 2020 to evaluate sites and discuss restoration options in light of experience gained from similar initiatives undertaken both locally and elsewhere in New Zealand.

For each site, field maps were prepared in advance showing tidal extent, shoreline armouring, property boundaries and habitat features. These were used to guide discussion

#	Site	Area (ha)	#	Site	Area (ha)
1	Wakatu Drive	2.1	9	Sandeman Reserve (stream)	0.3
2	Reservoir Creek (west)	0.5	10	Sandeman Reserve (coast)	0.3
3	Vercoes Drain and Delta	2.9	11	Bark Processors east	0.3
4	"Greenwaste"	0.1	12	Bark Processors west	0.6
5	Pastoral Stream	0.8	13	Lower Queen Street	0.8
6	A&P reclamation	0.3	14	Best Island Golf Course	0.8
7	Estuary Place	0.1	15	Best Island	0.9
8	Borck Creek to Sandeman	4.5	16	Waimea River Delta	4.2

Fig. 2 Location of potential restoration sites identified by TDC as initial options for assessment in the eastern arm of Waimea Inlet.

and assist with recording field notes. Supporting the field discussions, a preliminary scoring framework was also developed and used to capture and evaluate site data (Table 2). The rationale for the criteria are presented in Table 3, with an expanded narrative to guide scoring presented in Appendix 2.

The framework was trialled as a tool for rapidly characterising and documenting the key features at each site, so that they could subsequently be compared in a consistent manner. The framework includes high-level screening criteria for determining initial site priorities, and more detailed criteria for scoring habitat features, as well as considerations regarding the implementation of restoration options, and their subsequent upkeep. While the proposed sites had been chosen by TDC because of their obvious restoration benefits and relative ease of implementation, the framework was evaluated primarily to see if it would assist in helping identify and set priorities in a wider a regional application, and over long-term planning timeframes.

To further assist in the latter, a spatial mapping Geographic Information System (GIS) approach was applied to enable existing data on sea level, coastal structures and habitat features to be used to identify areas that could be suitable for future restoration based on their potential for inundation as a consequence of predicted SLR. These areas often provide the greatest restoration benefits for the lowest relative cost, but may require significant lead-in time or stakeholder engagement to be realised. By taking a GIS-based approach to assessment, it is hoped it will be possible to identify areas for potential restoration relatively cheaply and consistently at a region-wide scale to optimise priority setting. The spatial framework of the GIS-based approach is also ideal for mapping and recording data on restoration work already initiated or proposed.

Table 2. Preliminary restoration scoring criteria (see Appendix 2 for further detail).

	Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)
PRELIMINARY HIGH LEVEL SCREENING				**5**
1	Land ownership	Private	Conservation ownership	Council owned
2	Tidal inundation	Terrestrial	Within current tidal range	Within 100yr SLR range
3	Extent of historic degradation	Largely intact	Modified	Heavily degraded
4	Biodiversity benefit	No change	Some benefits	Large improvements
5	Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	Adjoining
6	Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	Adjoining
7	Value of infrastructure assets potentially affected within restoration	>$100k	$10-$100k	<$10k
HABITAT CRITERIA				
1	Area available at site	<1ha	1-5ha	>5ha
2	Mean width of intertidal area	0-50m	50-500m	>500m
3	Protection from currents/waves	Unprotected	Partially protected	Mostly protected
4	Extent of shoreline armouring	75-100%	25-75%	<25%
5	Width of riparian buffer	Absent	0-10m	>10m
6	Adjacent land suitable for coastal retreat in response to SLR	No	Yes (with changes)	Yes (without changes)
7	Degree of local habitat connectivity/diversity	Degraded	Significantly modified	Largely intact
8	Likely benefit to birds compared to current state	Small	Moderate	Large
9	Likely benefit to fish compared to current state	Small	Moderate	Large
IMPLEMENTATION CRITERIA				
1	Proven restoration methodology	Unproven	Demonstrated	Well established
2	Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	Low
3	Likely cost of initial restoration	High (>$50k/ha)	Moderate ($10-50k/ha)	Low (<10k/ha)
4	Likely cost of ongoing site maintenance	High (>$10k pa)	Moderate ($5-10k pa)	Low (<$5k pa)
5	Site accessibility	Difficult	Moderate	Easy
6	Extent of physical site preparation required	High	Moderate	Low
7	Is resource consent likely to be required?	Notified consent	Non-notified consent	Permitted
8	Potential adverse impact from restoration works	Significant	Moderate	Slight
9	Likely human amenity value	Low	Moderate	High
10	Time frame for establishing desired changes	Slow	Moderate	Fast

Table 3. Rationale supporting preliminary restoration scoring criteria

PRELIMINARY HIGH LEVEL SCREENING RATIONALE	
1	Council led-restoration will be more straightforward on land they already own and manage.
2	Predicted SLR will place significant pressure on existing habitats and infrastructure. Long-term management will require a focus on terrestrial areas likely to become intertidal in future.
3	Areas that previously supported salt marsh habitat are more likely to be sucessfully restored that areas that have never supported such habitat naturally. It is assumed that largely intact areas will not be allowed to degrade from current state.
4	Maintaining and increasing biodiversity is an important part of building coastal resilence to environmental change.
5	There are many benefits in linking with existing restoration initiatives, such as overflow effects from biodiversity improvements and halo effects from pest control.
6	Expanding existing habitat and reducing fragmentation significantly increases the liklihood of long-term planting success.
7	The presence of infrastructure (e.g. pump station, culvert, power pole, manhole, flap-gate, building, accessway) can interfere with ecological processes or create uncertainty regarding future asset security. The risk and potential costs increase with increasing asset presence and value.
HABITAT CRITERIA RATIONALE	
1	Large sites have proportionally smaller edge areas and are therefore less susceptible to documented margin effects such as weed invasion or wildlife disturbance.
2	Intertidal width has a strong influence on potential erosion (wide flats dissipate wave energy over much of the tidal cycle) and facilitate increased sediment and nutrient assimilation.
3	Physical protection from wave energy (e.g. reef areas, peninsulas, dunes, embayments) is an important determinant of salt marsh presence and stability.
4	Shoreline armouring can protect against erosion, but commonly comes at the cost of displacing natural features (in particular salt marsh). It also creates a significant barrier to and natural migration of salt marsh in response to SLR, affects drainage, and can deflect and increase wave scouring.
5	Wide plantings have proportionally smaller edge areas and are therefore less susceptible to documented margin effects such as weed invasion or wildlife disturbance. They also provide greater nutrient and sediment assimilation.
6	Past modification means there are limited areas where estuaries can migrate landward to in response to SLR. Where areas of retreat exist they create very good opportunities for long-term restoration and increased natural resilance to change.
7	Spatially connected and diverse habitats have relatively high resilence and ecological value compared to disconnected and low diversity areas.
8	Restoration initiatives favourable to birds can include screening of human activity, redirection of activities like dog walking, planting of food sources, predator control, and creation of roost sites.
9	Restoration initiatives favourable to fish can include stream shading, stock exclusion, protecting or enhancing spawning habitat, removal of fish barriers, rediced seidmentaiton and improved water quality.
IMPLEMENTATION CRITERIA RATIONALE	
1	Demonstrated methods provide a high level of confidence in success. New methods may prove useful but there is lower confidence in the outcomes.
2	A high potential for restoration failure (primarily in relation to re-vegatation) may be a barrier to restoration.
3	High initial restoration costs including planning, consenting, site works and planting may be a barrier to restoration.
4	High ongoing maintenance costs may be a may be a barrier to restoration.
5	Easy site accessibility will reduce costs and increase ease of working.
6	Sites requiring significant preparation will add time, cost and potential planning and consenting delays to any project.
7	Resource consenting is unlikely to be a barrier to restoration but can be time consuming and may require expert input and stakeholder agreement.
8	Adverse impacts may result from restoration activities, e.g. earthworks, machinery use, reclamation. While the net result is likely to be positive, these impacts need to be assessed which will add costs through consultation, site mitigation or consent monitoring requirements.
9	Human amenity values may be associated with some restorations, but may not be a primary aim. Areas with high amenity or recreation value may promote further restoration support.
10	Long-term restoration initiatives may accrue cumulative costs and be slow to demonstrate success. This does not mean they are low-value initiatives but may require "expectation management".

As part of the current work, proposed sites were mapped onto existing GIS data layers showing land ownership, salt marsh features, barriers to coastal retreat (e.g. seawalls), existing restoration projects, and low-lying land where tidal inundation is predicted to occur within the next 10-20 years or where land may be inundated if existing barriers were removed.

The general restoration options considered are outlined in Table 4. These are not described in detail in the current report.

Table 4. General restoration options.

Restoration options
Shoreline recontouring
Beach nourishment
Chenier ridges / islands
Reinstatement of tidal flows
Armour removal
Flap gate removal
Dike or berm removal
Physical exclusion
Weed control
Pest control
New salt marsh planting
Infill salt marsh planting
Riparian planting
Wetland planting

Section 2 of this report summarises the results of the field survey and assessments undertaken. For each site a brief description is provided of the key features, restoration opportunities and issues are identified, and restoration options recommended. A table of the restoration scoring criteria for the site are presented in a summary table, and the potential restoration footprint shown on a site map.

Section 3 presents a combined table of scoring criteria for all sites and a ranking of relative priority. A brief evaluation of the scoring framework is also provided.

Following this initial stage of work, it is proposed that the GIS approach be applied to estuaries throughout the region, highlighting where coastal squeeze will be most pressing, where current restoration efforts may in future be at risk from predicted rises in sea level, and where wider opportunities for restoration could be explored further.

2. SITE ASSESSMENTS

2.1 WHAKATU DRIVE

2.1.1 Key features

Planning for the Whakatu Drive (Stoke bypass) started in the 1960s with the aim to congestion on Main Road Stoke. At that time, it was relatively common practice to route coastal roads through estuary margins with little regard to habitat loss or implications relating to climate change such as SLR. Although such issues were well understood by the time construction started in the late 1990's, a commitment to the earlier plans resulted in further reclamation and armouring of the estuary margin between Richmond and Monaco. Subsequent to the road construction, a narrow cycleway was also added to the seaward side of the expressway.

The road and cycleway development mean there is now very little connection between the estuary and natural terrestrial habitat, many of the smaller streams are piped or culverted (including tidal flap-gates), and freshwater flood flow paths have been interrupted. The latter has reduced the supply of coarse sediments entering the estuary, material which creates elevated fans which provide habitat for salt marsh, high tide bird roosting sites, and is the source of sediment that naturally creates beaches and helps mitigate shoreline erosion.

The roading, and associated urban developments, have also increased the potential for inputs of contaminants to the estuary from vehicles, nearby industrial areas and land disturbance in the catchment. At present there is no specific treatment of stormwater, and very little natural filtering of stormwater due to the habitat losses that have occurred.

On the coastal margin, the estuary edge is dominated by earth banks reinforced in many places by steep rip rap walls and cobble. In these areas, salt marsh has been displaced either during construction, or from subsequent changes in substrate elevation, inundation and wave exposure.

In recent years there has been a significant amount of terrestrial riparian planting between the road edge and the estuary, and residual pockets of salt marsh remain, primarily around the stream deltas (Fig. 3).

Restoration scoring criteria are presented in Table 5.

Artificial rip-rap and cobble protection adjacent to the cycle lane and Whakatu Drive

2.1.2 Opportunities/Issues

The upper shoreline comprises a relatively narrow and steep strip of cobbles and boulders to protect the roading infrastructure from erosion and which has greatly reduced the available salt marsh habitat zones.

Existing gravel substrate in the mid-tidal flats seaward of the road is currently subjected to relatively extensive fine sediment deposition.

Wave exposure is relatively high due to large fetch.

There is virtually no capacity for salt marsh to migrate inland in response to SLR. Any restoration initiatives would need to be seaward of the current road/cycleway.

Current ecological values are relatively low and therefore no significant issues are anticipated with regard to physical works associated with potential restoration.

Gravel currently removed from the incoming streams for flood control would be ideal for beach replenishment purposes.

The site is directly adjacent to a well-used cycleway and heavily used road so public exposure is high.

Vehicle access is limited by the expressway, although restricted access is possible in several places along the shoreline.

It is likely that in future maintenance work will be undertaken on the seawalls to mitigate erosion or to further improve (widen) the cycleway.

When such work is being proposed it may be possible to incorporate beach reshaping into the maintenance plans, and to utilise machinery while it is on-site to undertake restoration work.

Note this site is within the NCC region and there will be a need for consultation and collaboration.

2.1.3 Recommended Restoration

Because of the modified upper shoreline and relatively high wave exposure, the following is recommended.

- Construct low (~20cm high) undulating Chenier ridges in the mid shore zone to reduce wave energy and create a sill to trap fine sediment and contribute to a natural reshaping of the upper shore to be more gradually sloping.
- Undertake beach reshaping and nourishment (add sediment) to the upper shore to create a wider zone for salt marsh to grow. Reshaping will dampen wave impacts and reduce erosion.
- Extend the footprint of existing salt marsh at either end of the identified zone through targeted planting of intertidal rushland to improve the spatial extent and connectiveness of existing habitat.
- Explore options to encourage Waka Kotahi-NZTA to treat stormwater through wetland/salt marsh filters and contribute to shoreline recontouring or reinstatement.

Table 4. Summary of restoration scoring criteria for Whakatu Drive.

Wakatu Drive Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	**Modified**	Heavily degraded	3
4 Biodiversity benefit	No change	**Some benefits**	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	**Nearby (within 500m)**	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
7 Value of infrastructure assets potentially affected within restoration	**>$100k**	$10-$100k	<$10k	1
			Screening Score	**25**
HABITAT CRITERIA				
1 Area available at site	<1ha	**1-5ha**	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	**>500m**	5
3 Protection from currents/waves	**Unprotected**	Partially protected	Mostly protected	1
4 Extent of shoreline armouring	**75-100%**	25-75%	<25%	1
5 Width of riparian buffer	**Absent**	0-10m	>10m	1
6 Adjacent land suitable for coastal retreat in response to SLR	**No**	Yes (with changes)	Yes (without changes)	1
7 Degree of local habitat connectivity/diversity	Degraded	**Significantly modified**	Largely intact	3
8 Likely benefit to birds compared to current state	**Small**	Moderate	Large	1
9 Likely benefit to fish compared to current state	**Small**	Moderate	Large	1
			Habitat Score	**17**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	**Demonstrated**	Well established	3
2 Likely risk of failure (e.g. erosion, plant desiccation)	**High**	Moderate	Low	1
3 Likely cost of initial restoration	High (>$50k/ha)	**Moderate ($10-50k/ha)**	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	**High (>$10k pa)**	Moderate ($5-10k pa)	Low (<$5k pa)	1
5 Site accessibility	**Difficult**	Moderate	Easy	1
6 Extent of physical site preparation required	**High**	Moderate	Low	1
7 Is resource consent likely to be required?	**Notified consent**	Non-notified consent	Permitted	1
8 Potential adverse impact from restoration works	Significant	**Moderate**	Slight	3
9 Likely human amenity value	Low	**Moderate**	High	3
# Time frame for establishing desired changes	Slow	**Moderate**	Fast	3
			Implementation Score	**20**
			Overall Site Score	**62**

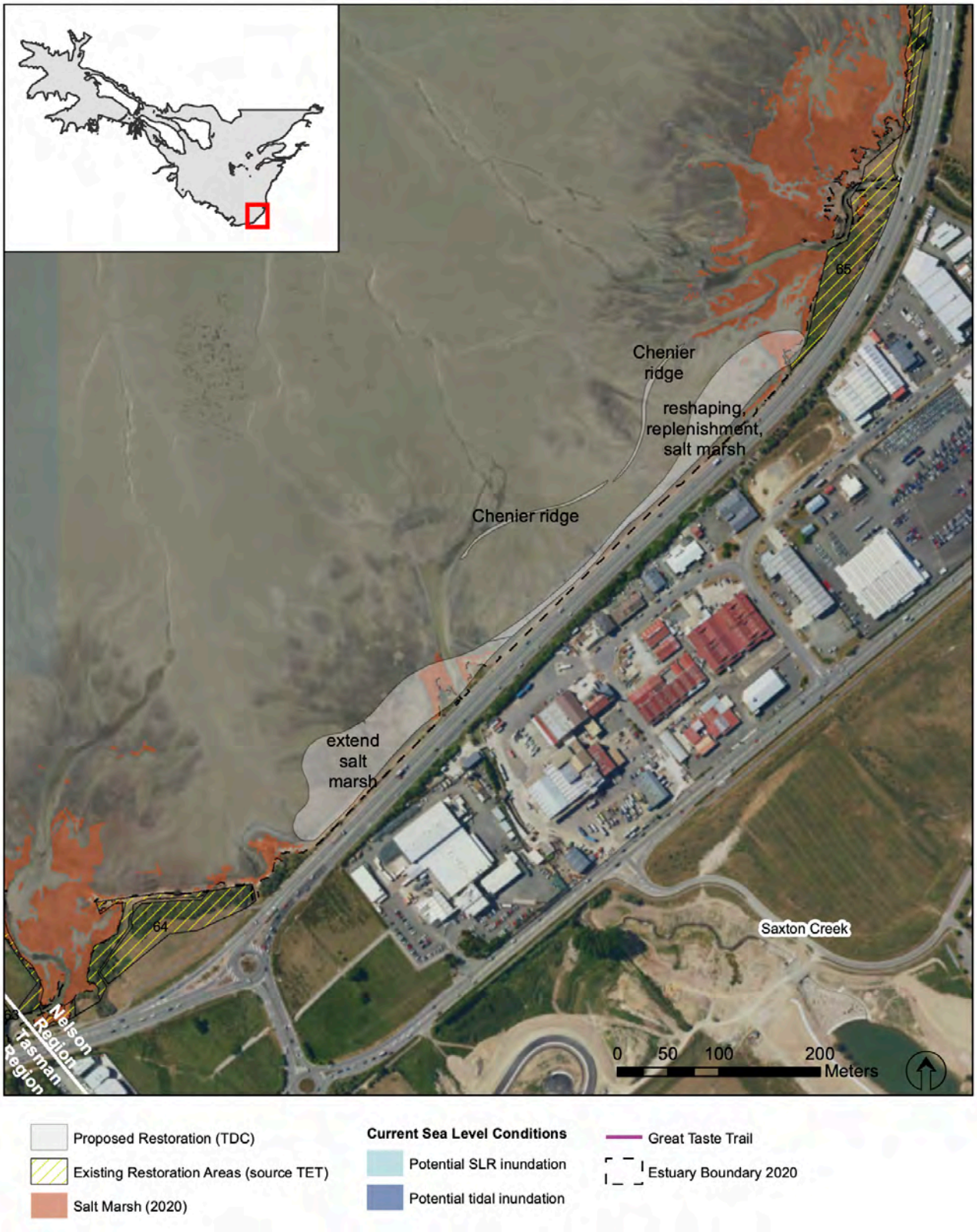


Fig. 3 Outline of proposed restoration footprint, Whakatu Drive.

2.2 RESERVOIR CREEK

2.2.1 Key features

Reservoir Creek enters Waimea Inlet near the regional boundary between Nelson and Tasman. The streamway has a high-quality area of salt marsh around the creek mouth, and several large gravel mounds seaward which support a variety of salt marsh rushland and herbfield species. As the gravel beds extend further offshore, vegetation becomes sparse and dominated by herbfield. Riparian plantings have been established in several locations on the terrestrial margins (Fig. 4).

The site is located adjacent to the Great Taste Trail and there is a 100-200m wide buffer of land between the estuary and the highway suitable for terrestrial planting.

The upper shoreline comprises a relatively narrow and steep strip of gravel immediately in front of a 0.5-1m high vertical clay bank. Seaward is a near horizontal muddy intertidal flat with slightly elevated unvegetated gravel beds located 80-100m offshore. Over the past decade the shoreline has eroded and migrated ~10m landwards as a consequence of the relatively high wave energy at the site. Large rock reinforcing has been introduced to protect power poles on the shoreline (see photo below). There has been minor disturbance of the estuary bed as a result of digger access for maintenance of power poles in the estuary.

Restoration scoring criteria are presented in Table 6.

Eroding shoreline (foreground) and rock rip-rap protecting power poles in the background west of Reservoir Creek.

2.2.2 Opportunities/Issues

Very little salt marsh is present on the shoreline and salt marsh is unlikely to establish naturally due to the current erosion and the steep vertical face of the upper shore creating an abrupt transition from estuary to terrestrial habitat.

There is an opportunity to dampen current wave energy by placing Chenier ridges offshore on the gravel beds, and to soften the upper shoreline by reshaping and replenishment.

Wave exposure is relatively high due to large fetch.

The mid-tidal zone is currently dominated by extensive fine sediment flats and thus presents a potential source of material that may be naturally trapped by salt marsh if it was present.

There is limited potential for salt marsh to migrate inland in response to SLR due to the current height of the surrounding land, but there is potential to reshape areas to allow for a more natural transition between estuary and terrestrial areas.

Current ecological values are relatively low and therefore no significant issues are anticipated with regard to physical works associated with potential restoration.

Gravel currently removed from the nearby streams for flood control would be ideal for beach replenishment purposes.

The site is directly adjacent to a well-used cycleway and heavily used road so public exposure is high.

There is vehicle access to the site and safe working areas away from road traffic.

Note this site is partially within the NCC region and there will be a need for consultation and collaboration.

2.2.3 Recommended Restoration

Because of the modified upper shoreline and relatively high wave exposure, the following is recommended.

- Construct a series of Chenier ridges in the mid shore zone to reduce wave energy

and create a sill to trap fine sediment. This would ideally comprise several small low ridges (10-20cm high) situated 80-100m from the shoreline at the edge of the gravel bed (Fig. 4). Ridges should be undulating to create eddies and deflect waves in different directions, and have sufficient gaps to allow tidal water to drain, but also have sufficient coverage to trap sediment. Rocks used should be man-manageable to avoid the need for diggers entering the estuary.

- Shoreward of the Chenier ridges, plant searush at high densities (10-15 plants/m^2) on the seaward edge, and at moderate densities (5-10 plants/m^2) further landward. This is to encourage dense stands of growth on the most exposed edge but to minimise the cost of plants overall. Planting in several patches is recommended initially to trial different planting densities and configurations.
- Following establishment of the Chenier ridges and planting of searush, reshape the upper shore to be more gradually sloping Undertake beach nourishment (add sediment) to the upper shore to create a wider zone for saltmarsh to grow. Reshaping will dampen wave impacts and reduce erosion. Plant salt tolerant species along the landward edge of the terrestrial margin (e.g. saltmarsh ribbonwood, searush, jointed

Table 5. Summary of restoration scoring criteria for Reservoir Creek.

Reservoir Creek (west)				
Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	**Modified**	Heavily degraded	3
4 Biodiversity benefit	No change	**Some benefits**	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	**Nearby (within 500m)**	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
7 Value of infrastructure assets potentially affected within restoration	>$100k	**$10-$100k**	<$10k	3
			Screening Score	**27**
HABITAT CRITERIA				
1 Area available at site	<1ha	**1-5ha**	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	**>500m**	5
3 Protection from currents/waves	**Unprotected**	Partially protected	Mostly protected	1
4 Extent of shoreline armouring	75-100%	**25-75%**	<25%	3
5 Width of riparian buffer	Absent	**0-10m**	>10m	3
6 Adjacent land suitable for coastal retreat in response to SLR	No	**Yes (with changes)**	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	**Significantly modified**	Largely intact	3
8 Likely benefit to birds compared to current state	Small	**Moderate**	Large	3
9 Likely benefit to fish compared to current state	**Small**	Moderate	Large	1
			Habitat Score	**25**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	**Demonstrated**	Well established	3
2 Likely risk of failure (e.g. erosion, plant desiccation)	**High**	Moderate	Low	1
3 Likely cost of initial restoration	High (>$50k/ha)	**Moderate ($10-50k/ha)**	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>$10k pa)	**Moderate ($5-10k pa)**	Low (<$5k pa)	3
5 Site accessibility	Difficult	Moderate	**Easy**	5
6 Extent of physical site preparation required	High	**Moderate**	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	**Permitted**	5
8 Potential adverse impact from restoration works	Significant	**Moderate**	Slight	3
9 Likely human amenity value	Low	Moderate	**High**	5
# Time frame for establishing desired changes	Slow	**Moderate**	Fast	3
			Implementation Score	**34**
			Overall Site Score	**86**

wirerush) where wave run-up is expected.

- Extend the footprint of existing salt marsh at either end of the current growth through targeted planting of intertidal species to improve the spatial extent and connectiveness of existing habitat.
- Extent the existing terrestrial plantings to create continuous margin cover where possible.

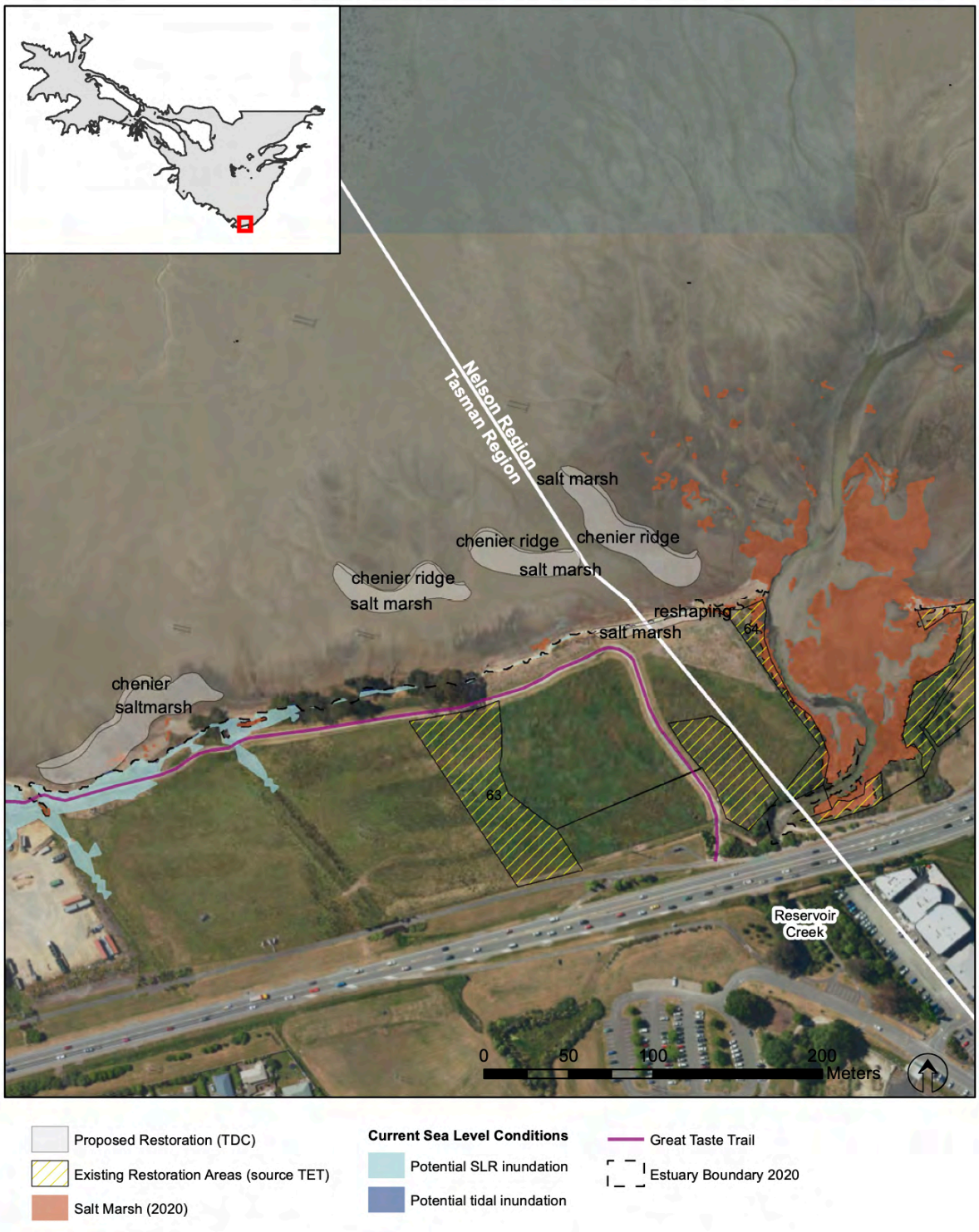


Fig. 4 Outline of proposed restoration footprint, Reservoir Creek.

2.3 VERCOES DRAIN AND DELTA

2.3.1 Key features

Vercoes Drain and Jimmy Lee Creek (Fig. 5) enter the estuary east of the refuse transfer station. The shoreline has been extensively modified through historical reclamation and drainage, with the waterways straightened and channelised. Reclamations extend to the edge of the estuary where they are protected by rock walls or concrete rubble.

Vercoes Drain delta showing herbfield growing on raised gravel beds.

Where the streams discharge, there has been a build-up of intertidal gravels over time. These areas are elevated relative to the surrounding mud flats and support patchy areas of salt marsh (predominantly herbfield and some searush). There are virtually no terrestrial plantings or salt marsh on the upper shore (see photo above).

The site is adjacent to the Great Taste Trail which is located on the edge of the shoreline. There is very little available land between the estuary and the cycleway for terrestrial planting. Surrounding land use is predominantly industrial. Restoration scoring criteria are presented in Table 7.

Vercoes Drain showing channelisation and surrounding landuse. Note the presence of salt marsh along the channel edge.

2.3.2 Opportunities/Issues

Very little salt marsh is present on the shoreline and salt marsh is unlikely to establish naturally due to the steep vertical face of the upper shore creating an abrupt transition from estuary to terrestrial habitat.

Wave-driven erosion appears moderate due to partial sheltering from the Beach Road transfer station reclamation, and the presence of raised gravel beds in the upper shore.

The mid-tidal zone is currently dominated by extensive fine sediment flats and thus presents a potential source of material that may be naturally trapped by salt marsh if it was present.

There is no capacity for salt marsh to migrate inland in response to SLR due to the surrounding land use. However, there is limited potential to reshape the edges of Vercoes Drain to reduce bank steepness and allow for shade trees and salt marsh to be planted.

Current ecological values are relatively low and therefore no significant issues are anticipated with regard to physical works associated with potential restoration.

Gravel currently removed from the nearby streams for flood control would be ideal for beach replenishment purposes.

The site is directly adjacent to the Great Taste trail so public exposure is high.

There is potential vehicle access to the site through adjacent industrial properties.

2.3.3 Recommended Restoration

Because of the modified upper shoreline and limited land available for restoration, the following is recommended.

- Plant pockets of searush at high densities (10-15 plants/m^2) on the gravel delta to see if rushland can be established in the mid-intertidal reaches.
- Protect the seaward edge of plantings with small rock Cheniers (e.g. 10cm high). Planting in several patches is recommended initially to trial different planting densities and configurations.

- Reshape the upper shore to be more gradually sloping. Undertake beach nourishment (add sediment) to the upper shore to create a wider zone for saltmarsh to grow. Plant salt tolerant species along the landward edge of the terrestrial margin (e.g. saltmarsh ribbonwood, searush, jointed wirerush).
- Reshape and ideally widen the footprint of Vercoes Drain to reduce bank steepness and allow for shading plants to be established. Gravel excavated from the mouth of Vercoes Drain can be used for beach nourishment in this area, assuming there are no issues with potential sediment contamination. Note that redevelopment of the cycleway offers potential opportunities to incorporate changes as part of any work undertaken.

Table 6 Summary of restoration scoring criteria for Vercoes Drain and Delta.

Vercoes Drain and delta Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	Modified	**Heavily degraded**	5
4 Biodiversity benefit	**No change**	Some benefits	Large improvements	1
5 Proximity to existing restoration initiative	Unconnected (>500m)	**Nearby (within 500m)**	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	**Nearby (within 500m)**	Adjoining	3
7 Value of infrastructure assets potentially affected within restoration	>$100k	**$10-$100k**	<$10k	3
			Screening Score	**25**
HABITAT CRITERIA				
1 Area available at site	<1ha	**1-5ha**	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	**>500m**	5
3 Protection from currents/waves	**Unprotected**	Partially protected	Mostly protected	1
4 Extent of shoreline armouring	**75-100%**	25-75%	<25%	1
5 Width of riparian buffer	**Absent**	0-10m	>10m	1
6 Adjacent land suitable for coastal retreat in response to SLR	**No**	Yes (with changes)	Yes (without changes)	1
7 Degree of local habitat connectivity/diversity	Degraded	**Significantly modified**	Largely intact	3
8 Likely benefit to birds compared to current state	**Small**	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	**Moderate**	Large	3
			Habitat Score	**19**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	**Demonstrated**	Well established	3
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	**Moderate**	Low	3
3 Likely cost of initial restoration	High (>$50k/ha)	**Moderate ($10-50k/ha)**	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>$10k pa)	**Moderate ($5-10k pa)**	Low (<$5k pa)	3
5 Site accessibility	Difficult	**Moderate**	Easy	3
6 Extent of physical site preparation required	High	**Moderate**	Low	3
7 Is resource consent likely to be required?	**Notified consent**	Non-notified consent	Permitted	1
8 Potential adverse impact from restoration works	Significant	**Moderate**	Slight	3
9 Likely human amenity value	Low	**Moderate**	High	3
# Time frame for establishing desired changes	Slow	**Moderate**	Fast	3
			Implementation Score	**28**
			Overall Site Score	**72**

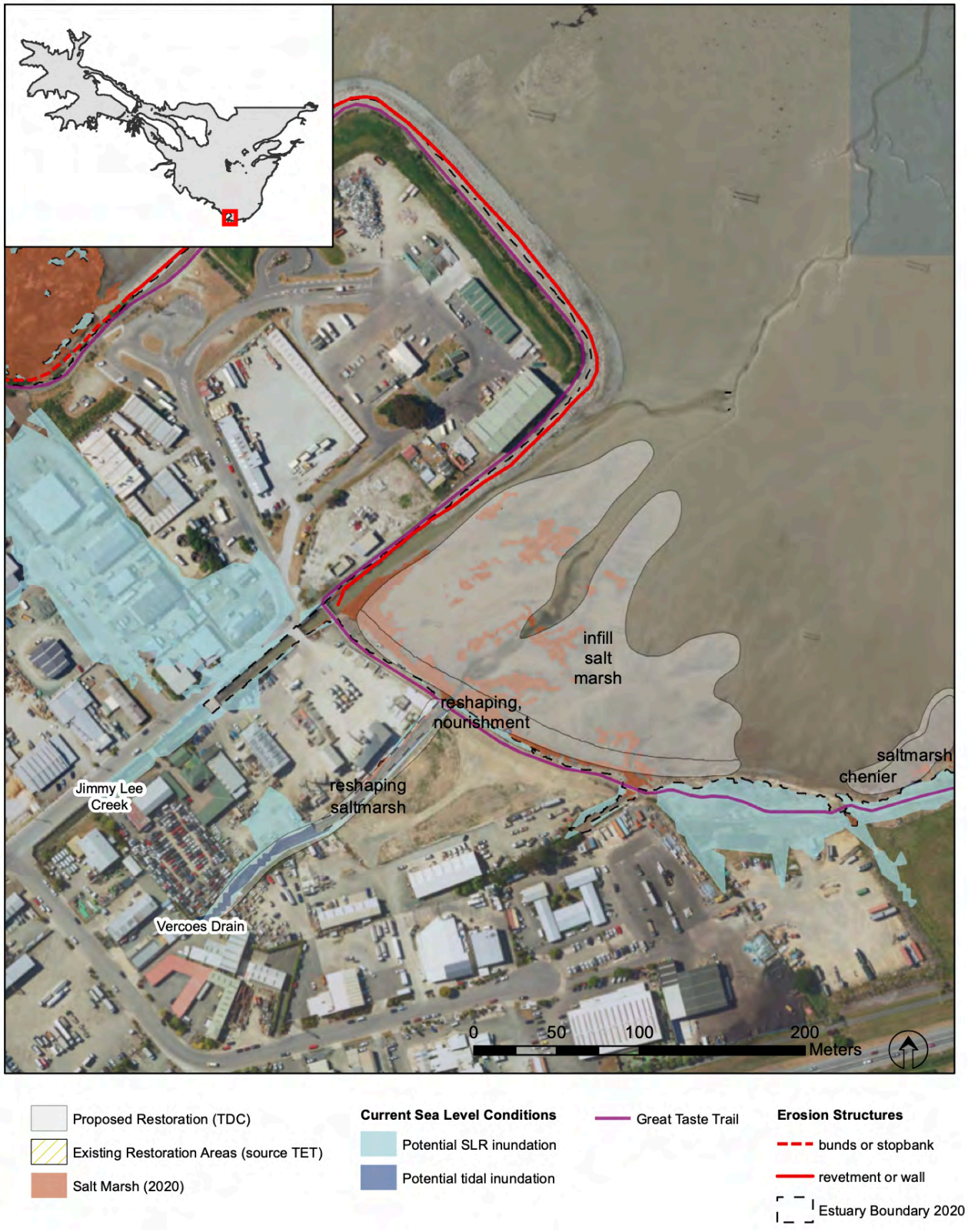


Fig. 5 Outline of proposed restoration footprint, Vercoes Drain and Delta.

2.4 GREENWASTE SITE, PASTORAL STREAM, A&P RECLAMATION

2.4.1 Key features

There are three potential restoration areas immediately west of the Transfer Station (Fig. 6) that have been nominally called 'Greenwaste', 'Pastoral Stream', and 'A&P Showgrounds' (Sites 4, 5 and 6 on Fig. 2). Restoration scoring criteria for each are presented in Table 8, Table 9 and Table 10 respectively.

The Greenwaste site is an area of established salt marsh located immediately seaward of the Great Taste trail which is constructed on a raised earth bund that runs along the foreshore (Fig. 6). The salt marsh is relatively intact and in good condition but contains a small (80m^2) patch of tall fescue grassland and various terrestrial weeds (see photo below).

Grassland and weeds growing within salt marsh adjacent to the Greenwaste site

Pastoral Stream enters the estuary via a constricted entrance that passes through the shoreline bund. It is currently cut-off from tidal flows but, as indicated by the blue shading on Fig. 6, is at an elevation where tidal flows would currently enter the site if allowed to, and where predicted SLR will in future inundate the site if tidal flows are reinstated. There is little native vegetation growing near the streamway.

The A&P reclamation site is an area of salt marsh seaward of the bunded shoreline that was disturbed during attempts to reclaim ~2ha of land ~15 years ago (see following photo). Salt marsh in this area is relatively extensive but has been very slow to recover from the earlier disturbance.

Recovering salt marsh at the A&P Showgrounds reclamation site

Overall, the shoreline by all three sites has been extensively modified through historical reclamation and drainage, with waterways straightened and channelised. Reclamations extend to the edge of the estuary where they are protected by concrete rubble and earth bunds.

The sites are adjacent to the Great Taste Trail which is located on the edge of the shoreline. There is very little available land between the estuary and the cycleway for terrestrial planting, although there appears to be good potential for future salt marsh expansion on adjacent private land.

2.4.2 Opportunities/Issues

Established salt marsh appears stable and is not eroding. It is relatively free of weeds apart from along the terrestrial margin, likely due to salt water inundation on spring tides limiting the ability of weeds to survive lower on the shore. The exception is the slightly elevated zone where tall fescue has established.

Wave-driven erosion appears moderate due to partial sheltering from raised gravel beds in the upper shore near the Beach Road transfer Station reclamation.

The mid-tidal zone is currently dominated by extensive fine sediment flats and thus presents a potential source of material that may be naturally trapped by salt marsh if beds were extended.

There is currently no capacity for salt marsh to migrate inland in response to SLR due to the current bunding. However, surrounding land use (greenwaste processing, low quality pasture and

hardfill dumping), present opportunities for this in future.

Current ecological values are moderate, but no significant issues are anticipated with regard to physical works associated with potential restoration.

The site is directly adjacent to the Great Taste trail so public exposure is high.

There is vehicle access to the site through adjacent roads and properties.

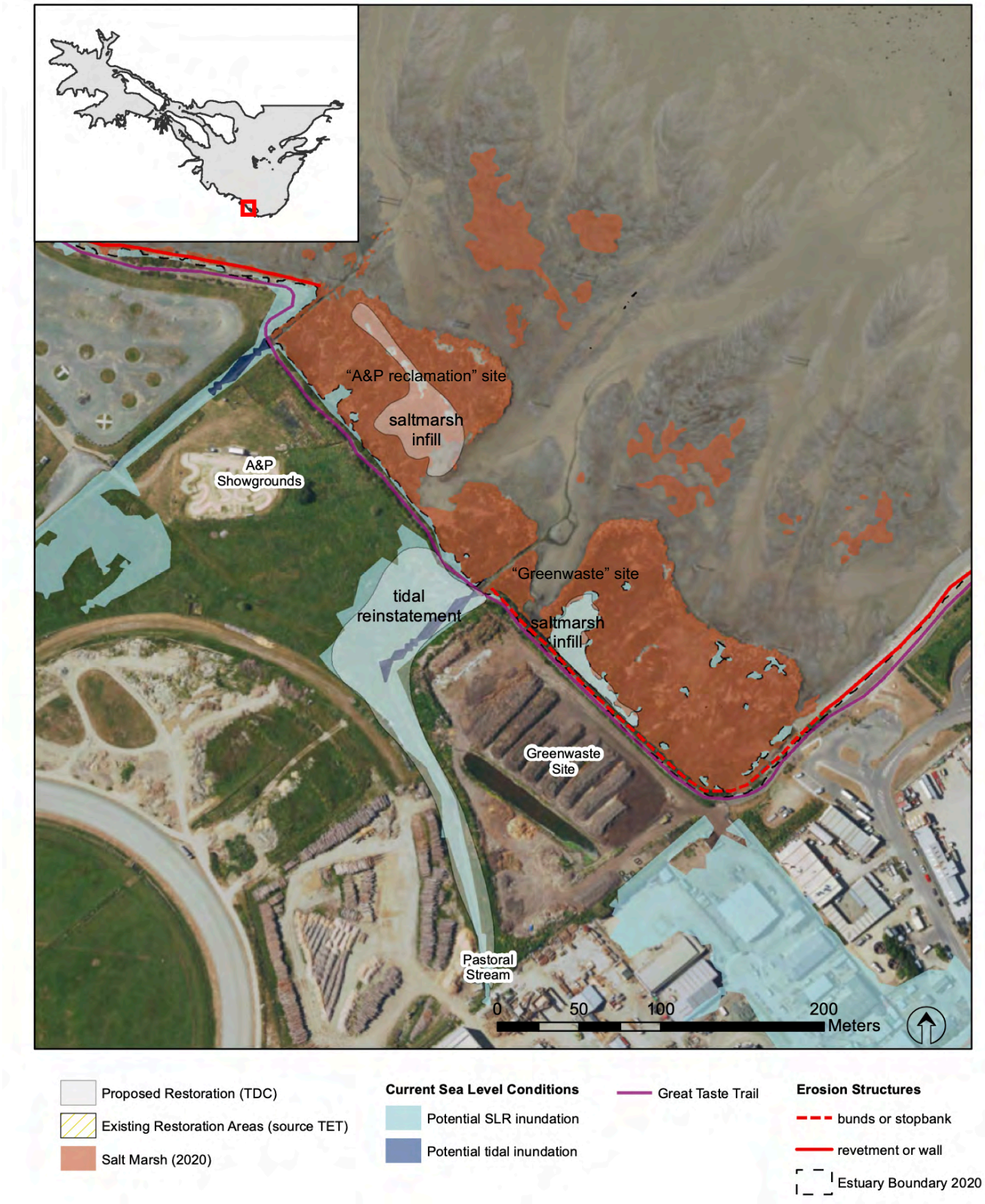


Fig. 6 Outline of proposed restoration footprint, Greenwaste site, Pastoral Stream and A&P Reclamation.

2.4.3 Recommended Restoration

Because of the modified upper shoreline and limited land available for restoration, the following is recommended.

- Spray weeds and tall fescue grassland along the terrestrial margins of the salt marsh in front of the Greenwaste site and plant with salt tolerant coastal species e.g. salt marsh ribbonwood, flax, cabbage trees.
- Explore the potential to reinstate tidal flows to Pastoral Stream, and to the wider low-lying land adjacent to the stream. At a minimum, seek to limit ongoing infilling of low-lying areas (currently being used as a hard fill dump site).
- Re-contour and plant shading vegetation along Pastoral Stream.
- Undertake a second trial planting of searush within the recovering A&P Showgrounds reclamation area to see if rushland can be established in the upper-intertidal reaches.

Table 7 Summary of restoration scoring criteria for the "Greenwaste" site.

"Greenwaste" site Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	**Modified**	Heavily degraded	1
4 Biodiversity benefit	No change	**Some benefits**	Large improvements	1
5 Proximity to existing restoration initiative	Unconnected (>500m)	**Nearby (within 500m)**	Adjoining	1
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
7 Value of infrastructure assets potentially affected within restoration	>$100k	$10-$100k	**<$10k**	5
			Screening Score	**23**
HABITAT CRITERIA				
1 Area available at site	**<1ha**	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	**>500m**	5
3 Protection from currents/waves	Unprotected	**Partially protected**	Mostly protected	3
4 Extent of shoreline armouring	**75-100%**	25-75%	<25%	1
5 Width of riparian buffer	**Absent**	0-10m	>10m	1
6 Adjacent land suitable for coastal retreat in response to SLR	**No**	Yes (with changes)	Yes (without changes)	1
7 Degree of local habitat connectivity/diversity	Degraded	**Significantly modified**	Largely intact	3
8 Likely benefit to birds compared to current state	**Small**	Moderate	Large	1
9 Likely benefit to fish compared to current state	**Small**	Moderate	Large	1
			Habitat Score	**17**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	**Well established**	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	**Low**	5
3 Likely cost of initial restoration	High (>$50k/ha)	Moderate ($10-50k/ha)	**Low (<10k/ha)**	5
4 Likely cost of ongoing site maintenance	High (>$10k pa)	Moderate ($5-10k pa)	**Low (<$5k pa)**	5
5 Site accessibility	Difficult	Moderate	**Easy**	5
6 Extent of physical site preparation required	High	Moderate	**Low**	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	**Permitted**	5
8 Potential adverse impact from restoration works	Significant	Moderate	**Slight**	5
9 Likely human amenity value	**Low**	Moderate	High	1
# Time frame for establishing desired changes	Slow	Moderate	**Fast**	5
			Implementation Score	**46**
			Overall Site Score	**86**

Table 8 Summary of restoration scoring criteria for the Pastoral Stream site.

Pastoral Stream Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	**Private**	Conservation ownership	Council owned	1
2 Tidal inundation	Terrestrial	**Within current tidal range**	Within 100yr SLR range	3
3 Extent of historic degradation	Largely intact	Modified	**Heavily degraded**	5
4 Biodiversity benefit	No change	Some benefits	**Large improvements**	5
5 Proximity to existing restoration initiative	**Unconnected (>500m)**	Nearby (within 500m)	Adjoining	1
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
7 Value of infrastructure assets potentially affected within restoration	>$100k	$10-$100k	**<$10k**	5
			Screening Score	**25**
HABITAT CRITERIA				
1 Area available at site	**<1ha**	1-5ha	>5ha	1
2 Mean width of intertidal area	**0-50m**	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	**Mostly protected**	5
4 Extent of shoreline armouring	75-100%	25-75%	**<25%**	5
5 Width of riparian buffer	**Absent**	0-10m	>10m	1
6 Adjacent land suitable for coastal retreat in response to SLR	No	**Yes (with changes)**	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	**Largely intact**	5
8 Likely benefit to birds compared to current state	Small	**Moderate**	Large	3
9 Likely benefit to fish compared to current state	Small	**Moderate**	Large	3
			Habitat Score	**27**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	**Well established**	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	**Low**	5
3 Likely cost of initial restoration	**High (>$50k/ha)**	Moderate ($10-50k/ha)	Low (<10k/ha)	1
4 Likely cost of ongoing site maintenance	High (>$10k pa)	**Moderate ($5-10k pa)**	Low (<$5k pa)	3
5 Site accessibility	Difficult	**Moderate**	Easy	3
6 Extent of physical site preparation required	High	**Moderate**	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	**Permitted**	5
8 Potential adverse impact from restoration works	Significant	Moderate	**Slight**	5
9 Likely human amenity value	**Low**	Moderate	High	1
# Time frame for establishing desired changes	Slow	**Moderate**	Fast	3
			Implementation Score	**34**
			Overall Site Score	**86**

Table 9 Summary of restoration scoring criteria for the "A&P Reclamation" site.

"A&P Reclamation" site Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	**Private**	Conservation ownership	Council owned	1
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	**Largely intact**	Modified	Heavily degraded	1
4 Biodiversity benefit	**No change**	Some benefits	Large improvements	1
5 Proximity to existing restoration initiative	**Unconnected (>500m)**	Nearby (within 500m)	Adjoining	1
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
7 Value of infrastructure assets potentially affected within restoration	>$100k	$10-$100k	**<$10k**	5
			Screening Score	**19**
HABITAT CRITERIA				
1 Area available at site	**<1ha**	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	**>500m**	5
3 Protection from currents/waves	Unprotected	**Partially protected**	Mostly protected	3
4 Extent of shoreline armouring	**75-100%**	25-75%	<25%	1
5 Width of riparian buffer	**Absent**	0-10m	>10m	1
6 Adjacent land suitable for coastal retreat in response to SLR	No	**Yes (with changes)**	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	**Significantly modified**	Largely intact	3
8 Likely benefit to birds compared to current state	**Small**	Moderate	Large	1
9 Likely benefit to fish compared to current state	**Small**	Moderate	Large	1
			Habitat Score	**19**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	**Well established**	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	**Moderate**	Low	3
3 Likely cost of initial restoration	High (>$50k/ha)	Moderate ($10-50k/ha)	**Low (<10k/ha)**	5
4 Likely cost of ongoing site maintenance	High (>$10k pa)	Moderate ($5-10k pa)	**Low (<$5k pa)**	5
5 Site accessibility	Difficult	Moderate	**Easy**	5
6 Extent of physical site preparation required	High	Moderate	**Low**	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	**Permitted**	5
8 Potential adverse impact from restoration works	Significant	Moderate	**Slight**	5
9 Likely human amenity value	**Low**	Moderate	High	1
# Time frame for establishing desired changes	Slow	**Moderate**	Fast	3
			Implementation Score	**42**
			Overall Site Score	**80**

2.5 ESTUARY PLACE

2.5.1 Key features

The site is a significant(~2ha) restoration area developed over recent years by TDC as a requirement of the development of Estuary Place (Fig. 7). It comprises tidal reinstatement following the removal of a section of bund and reshaping of previously reclaimed land to create a meandering streamway with relatively gently sloping sides. A smaller area of earth previously used for reclamation was also removed to re-create a small intertidal flat (see photo below). Material from the latter was used to re-contour the surrounding land. A comprehensive planting programme has followed with a mix of both salt marsh and terrestrial plants.

The area has been set aside allowing for SLR and developed as a space for various types of recreation and the Great Taste Trail passes through the middle of the site.

Tidal reinstatement through the previously bunded mouth, and restoration plantings at Estuary Place

Meanders were built into the lower streamway and the edges reshaped to have a gentle slope prior to planting

The restoration is quite different to the adjacent salt marsh which provides a good indication of what it would have been like prior to reclamation. The reason the restoration is so different to the natural salt marsh is primarily because of logistical constraints and costs in removing excess earth dumped when the site was reclaimed. It provides a good example of how retaining existing salt marsh is far more straightforward and cost effective that trying to recreate it. Restoration scoring criteria are presented in Table 11.

2.5.2 Opportunities/Issues

The restored area is quite extensive, but predominantly terrestrial, and there is limited capacity for salt marsh to migrate inland in response to SLR due to the current site elevations.

The site is relatively sheltered from the main body of the estuary by residual bunding so erosion is likely to be relatively low.

Intertidal rushland plantings have struggled, possibly due to wide spacing of plants and limited tidal inundation.

Current ecological values are relatively low but will significantly increase over time. No significant issues are anticipated with regard to physical works associated with any further potential restoration.

The site is directly adjacent to the Great Taste trail so public exposure is high.

There is overland vehicle access to the site.

2.5.3 Recommended Restoration

Because most of the hard work establishing the site has already been undertaken, the following is recommended.

- Maintain existing plantings through regular weed and pest control.
- Infill plant within intertidal rushland to increase shoot densities and increase cover. This will help protect against desiccation and limit the damage from animals (rabbits and hares).

- Scrape/reshape the area seaward of the cycleway to allow for additional salt marsh planting.
- Plant additional salt tolerant rushland and herbfield species near the tidal margin.

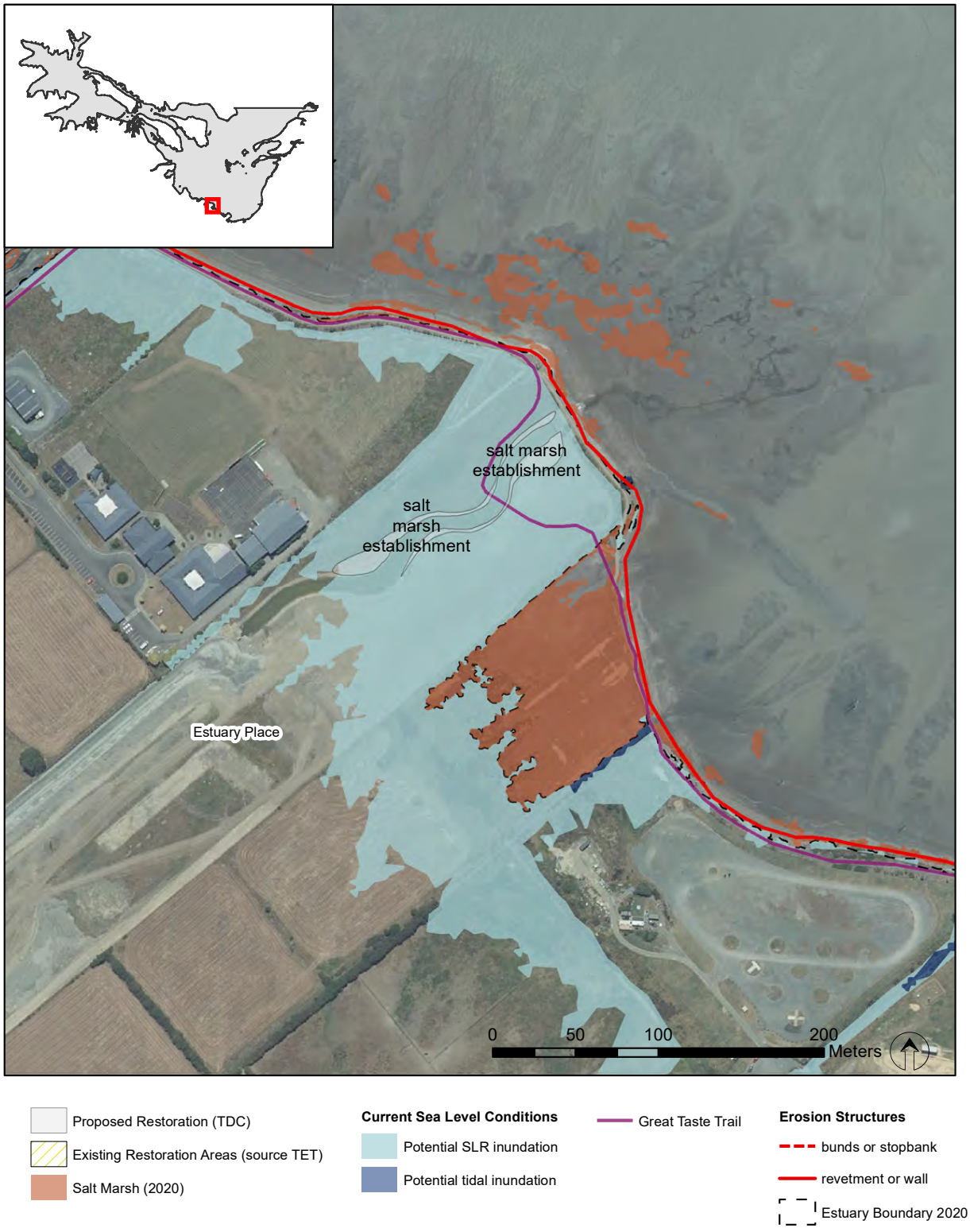


Fig. 7 Outline of proposed restoration footprint, Estuary Place.

Table 10 Summary of restoration scoring criteria for Estuary Place.

Estuary Place Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	Modified	**Heavily degraded**	5
4 Biodiversity benefit	No change	Some benefits	**Large improvements**	5
5 Proximity to existing restoration initiative	**Unconnected (>500m)**	Nearby (within 500m)	Adjoining	1
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
7 Value of infrastructure assets potentially affected within restoration	>$100k	$10-$100k	**<$10k**	5
			Screening Score	**31**
HABITAT CRITERIA				
1 Area available at site	**<1ha**	1-5ha	>5ha	1
2 Mean width of intertidal area	**0-50m**	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	**Mostly protected**	5
4 Extent of shoreline armouring	75-100%	25-75%	**<25%**	5
5 Width of riparian buffer	Absent	**0-10m**	>10m	3
6 Adjacent land suitable for coastal retreat in response to SLR	No	**Yes (with changes)**	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	**Significantly modified**	Largely intact	3
8 Likely benefit to birds compared to current state	Small	**Moderate**	Large	3
9 Likely benefit to fish compared to current state	Small	**Moderate**	Large	3
			Habitat Score	**27**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	**Well established**	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	**Moderate**	Low	3
3 Likely cost of initial restoration	**High (>$50k/ha)**	Moderate ($10-50k/ha)	Low (<10k/ha)	1
4 Likely cost of ongoing site maintenance	High (>$10k pa)	Moderate ($5-10k pa)	**Low (<$5k pa)**	5
5 Site accessibility	Difficult	Moderate	**Easy**	5
6 Extent of physical site preparation required	High	Moderate	**Low**	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	**Permitted**	5
8 Potential adverse impact from restoration works	Significant	Moderate	**Slight**	5
9 Likely human amenity value	Low	Moderate	**High**	5
# Time frame for establishing desired changes	Slow	Moderate	**Fast**	5
			Implementation Score	**44**
			Overall Site Score	**102**

2.6 BORCK CREEK TO SANDEMAN RESERVE

2.6.1 Key features

The Borck to Sandeman section is a large (~4ha) low-lying area of salt marsh largely cut off from the estuary by bunds constructed along the foreshore. The remaining salt marsh is in a compromised state due to limited inundation, historical modification and stock grazing. Tidal flows reach the site through small pipes under the earth bund, while flow paths within the salt marsh have been channelised in an attempt to drain the area (see photos below).

Grazed salt marsh cut off from the sea by a large earth bund (right) and channelising to drain water

Rushland and herb field currently within paddocks used for grazing stock

Borck Creek enters the coast to the east. This streamway has been significantly enhanced through channel widening and planting over the past decade and is regaining much of its ecological value lost from past channelisation. It is currently separated from the site by a large bund, but this could be opened to enhance connectivity.

The site connects to the Sandeman Reserve to the west where restoration enhancement has also been undertaken (see following section).

Restoration scoring criteria are presented in Table 12.

2.6.2 Opportunities/Issues

The available area is extensive, retains residual populations of most salt marsh species, and there is capacity for salt marsh to migrate inland in response to SLR.

The site is within the range of predicted SLR inundation, and parts are within the current tidal range.

Land use is limited to low density grazing and there is little infrastructure that will be affected by restoration. Noting this, there is a sewage pump station at the back of the site that could potentially require protection from tidal inundation in the future.

The site is relatively sheltered from the main body of the estuary by bunds so erosion is likely to be relatively low. However, a small exposed part of the bund supporting the cycleway is currently prone to erosion. Re-routing the cycleway to the inland boundary of the area is considered feasible.

Current ecological values are moderate but will significantly increase over time. No significant issues are anticipated with regard to physical works associated with any further potential restoration.

There is vehicle access to the site but the site is not near main roads so is ideal for school groups to become involved in restoration.

The Great Taste trail follows two sides of the site and so public exposure is high.

2.6.3 Recommended Restoration

This represents the one of the most promising sites for tidal reinstatement in this part of the estuary. There is extensive remaining salt marsh that is expected to flourish if tidal exchange is increased, and grazing pressure is removed. The following is recommended.

- Remove stock and fencing.

- Significantly increase culvert size or open bunds to reinstate tidal flows at both east and west ends of the site.
- Maintain existing salt marsh through weed and pest control.
- Infill plant within the rushland to increase shoot densities and increase cover. This will help protect against desiccation.
- Open the eastern side of the site to improve connection to Borck Creek particularly for flood flows to create a delta system with sediment retention.
- Investigate re-routing the cycleway to the inland side of the site.

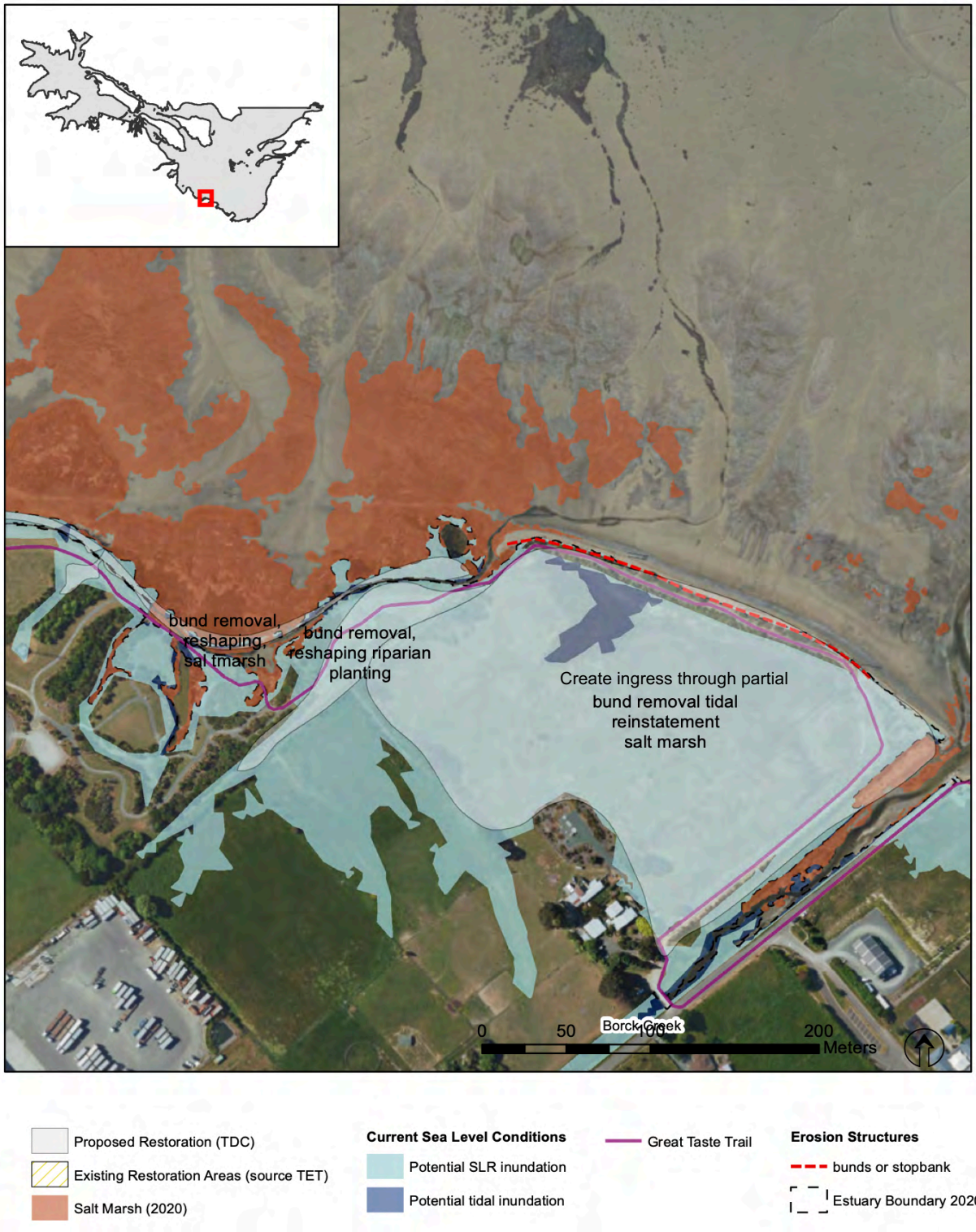


Fig. 8 Outline of proposed restoration footprint, Borck Creek to Sandeman Reserve.

Table 11 Summary of restoration scoring criteria, Borck Creek to Sandeman Reserve.

Borck Creek to Sandeman Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	Modified	**Heavily degraded**	5
4 Biodiversity benefit	No change	Some benefits	**Large improvements**	5
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	**Nearby (within 500m)**	Adjoining	3
7 Value of infrastructure assets potentially affected within restoration	**>$100k**	$10-$100k	<$10k	1
			Screening Score	**29**
HABITAT CRITERIA				
1 Area available at site	<1ha	**1-5ha**	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	**>500m**	5
3 Protection from currents/waves	Unprotected	Partially protected	**Mostly protected**	5
4 Extent of shoreline armouring	**75-100%**	25-75%	<25%	1
5 Width of riparian buffer	Absent	**0-10m**	>10m	3
6 Adjacent land suitable for coastal retreat in response to SLR	No	**Yes (with changes)**	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	**Largely intact**	5
8 Likely benefit to birds compared to current state	Small	Moderate	**Large**	5
9 Likely benefit to fish compared to current state	Small	**Moderate**	Large	3
			Habitat Score	**33**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	**Well established**	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	**Low**	5
3 Likely cost of initial restoration	High (>$50k/ha)	**Moderate ($10-50k/ha)**	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>$10k pa)	**Moderate ($5-10k pa)**	Low (<$5k pa)	3
5 Site accessibility	Difficult	Moderate	**Easy**	5
6 Extent of physical site preparation required	High	**Moderate**	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	**Permitted**	5
8 Potential adverse impact from restoration works	Significant	**Moderate**	Slight	3
9 Likely human amenity value	Low	Moderate	**High**	5
# Time frame for establishing desired changes	Slow	Moderate	**Fast**	5
			Implementation Score	**42**
			Overall Site Score	**104**

2.7 SANDEMAN RESERVE

2.7.1 Key features

Sandeman Reserve comprises ~3ha of well-maintained council reserve east of the MDF plant (Fig. 9). The reserve has walking tracks, amenity plantings and several restored wetland areas. A small stream flows along the east of the site.

The reserve is cut-off from the estuary by a drainage channel and bund that runs along the shoreline. There is a stand of pine trees growing on the bund (see photo below). Water quality in the drainage channel is frequently poor due to flows being trapped and water becoming stagnant.

Pine trees growing on an earth bund seaward of a drainage channel running parallel to the shore

Relatively wide and intact beds of salt marsh, and gravelfields interspersed with soft muds, are present seaward of the bund.

There are several possible restoration options at the site, all reasonably small and readily achievable. Restoration scoring criteria are presented in Table 13 for the coastal margin, and Table 14 for the streamway.

2.7.2 Opportunities/Issues

The available area is extensive, retains residual populations of most salt marsh species, and there is capacity for salt marsh to migrate inland in response to SLR.

Many parts of the site are within the range of predicted SLR inundation, and parts are within the current tidal range.

Low lying areas are likely to undergo natural restoration with limited intervention needed.

The bund and drainage channel running parallel to the shore appear to serve no obvious purpose and could be modified to improve drainage and water flow. Tree removal will impact current shag roosting.

Currently tidal flows to the site are restricted by pipes, bunds and drains.

The site is relatively sheltered from the main body of the estuary by salt marsh and gravel beds so erosion is unlikely to be significant.

There is little infrastructure that will be affected by restoration.

Current ecological values are moderate but will significantly increase over time. No significant issues are anticipated with regard to physical works associated with any further potential restoration.

There is vehicle access to the site but the site is not near main roads so is ideal for school groups.

The Great Taste trail passes through the middle of the site so public exposure is high.

The site has already been substantially improved by previous council work.

2.7.3 Recommended Restoration

- Significantly increase culvert size or open bunds to reinstate tidal flows at both east and west ends of the site.
- Remove a section of bund at NZTM 1614515 E, 5425488 N to flood adjacent low lying land (currently with residual salt marsh).
- Remove pine trees and other weeds on the seaward side of the site.
- On the margins of the stream to the east of the site, re-shape banks to a shallower gradient, and plant vegetation to shade the waterway.
- Open the bund at the north-eastern end of the site to facilitate tidal ingress and connect to the adjacent Borck to Sandeman restoration.
- Infill plant areas where salt marsh species are present but not well established.

- Maintain existing salt marsh through weed and pest control.

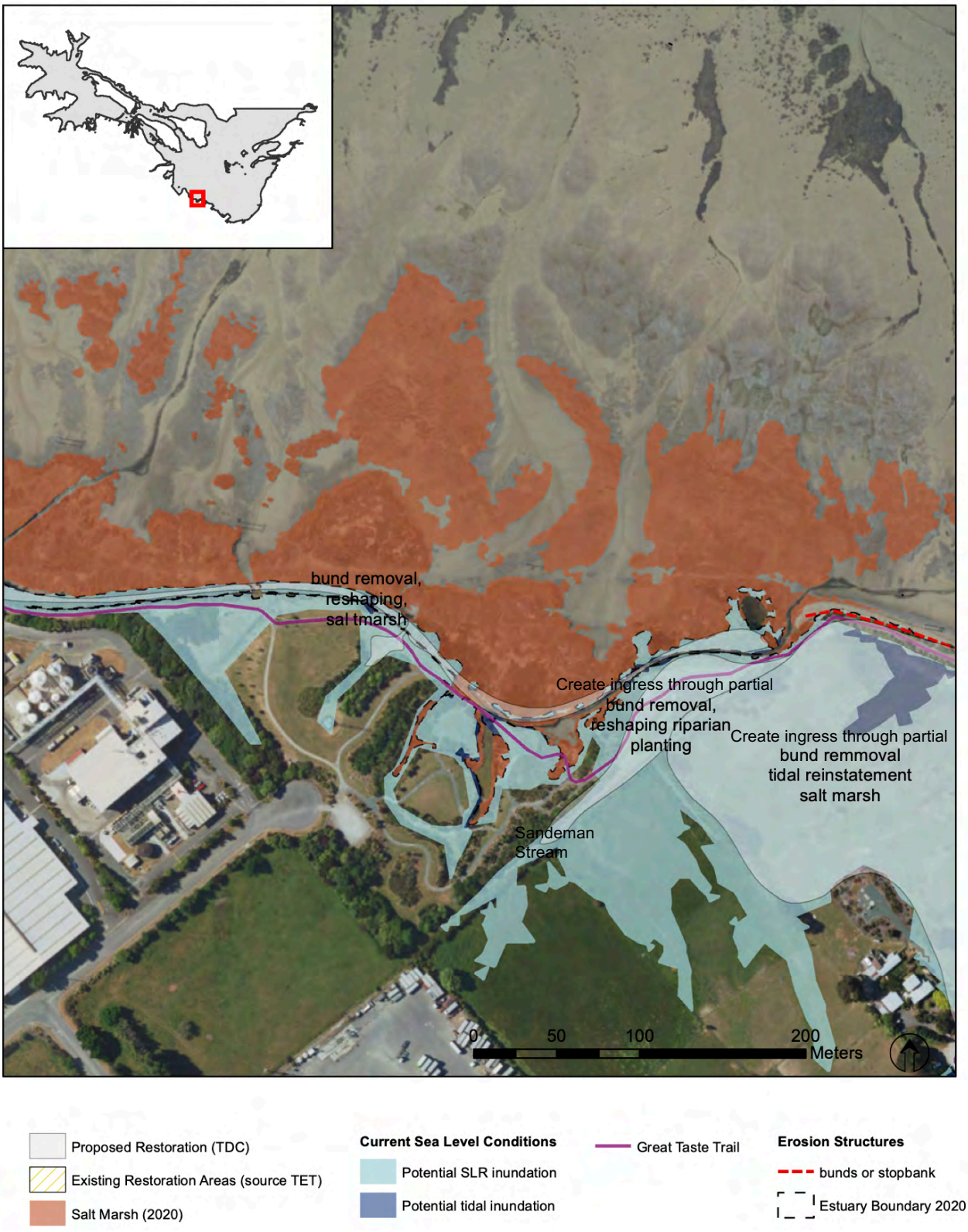


Fig. 9 Outline of proposed restoration footprint, Sandeman Reserve.

Table 12 Summary of restoration scoring criteria, Sandeman Reserve (coastal margin).

Sandeman Reserve (coast)				
Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	**Modified**	Heavily degraded	3
4 Biodiversity benefit	**No change**	Some benefits	Large improvements	1
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
7 Value of infrastructure assets potentially affected within restoration	>$100k	**$10-$100k**	<$10k	3
			Screening Score	**27**
HABITAT CRITERIA				
1 Area available at site	**<1ha**	1-5ha	>5ha	1
2 Mean width of intertidal area	0-50m	50-500m	**>500m**	5
3 Protection from currents/waves	Unprotected	Partially protected	**Mostly protected**	5
4 Extent of shoreline armouring	**75-100%**	25-75%	<25%	1
5 Width of riparian buffer	**Absent**	0-10m	>10m	1
6 Adjacent land suitable for coastal retreat in response to SLR	No	**Yes (with changes)**	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	**Significantly modified**	Largely intact	3
8 Likely benefit to birds compared to current state	**Small**	Moderate	Large	1
9 Likely benefit to fish compared to current state	**Small**	Moderate	Large	1
			Habitat Score	**21**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	**Well established**	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	**Low**	5
3 Likely cost of initial restoration	High (>$50k/ha)	**Moderate ($10-50k/ha)**	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>$10k pa)	Moderate ($5-10k pa)	**Low (<$5k pa)**	5
5 Site accessibility	Difficult	Moderate	**Easy**	5
6 Extent of physical site preparation required	High	**Moderate**	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	**Permitted**	5
8 Potential adverse impact from restoration works	Significant	**Moderate**	Slight	3
9 Likely human amenity value	Low	Moderate	**High**	5
# Time frame for establishing desired changes	Slow	Moderate	**Fast**	5
			Implementation Score	**44**
			Overall Site Score	**92**

Table 13 Summary of restoration scoring criteria, Sandeman Reserve (streamway).

Sandeman Reserve (stream)				
Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	Modified	**Heavily degraded**	5
4 Biodiversity benefit	No change	**Some benefits**	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
7 Value of infrastructure assets potentially affected within restoration	>$100k	$10-$100k	**<$10k**	5
			Screening Score	**33**
HABITAT CRITERIA				
1 Area available at site	**<1ha**	1-5ha	>5ha	1
2 Mean width of intertidal area	**0-50m**	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	**Mostly protected**	5
4 Extent of shoreline armouring	75-100%	25-75%	**<25%**	5
5 Width of riparian buffer	Absent	**0-10m**	>10m	3
6 Adjacent land suitable for coastal retreat in response to SLR	No	**Yes (with changes)**	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	**Largely intact**	5
8 Likely benefit to birds compared to current state	**Small**	Moderate	Large	1
9 Likely benefit to fish compared to current state	Small	**Moderate**	Large	3
			Habitat Score	**27**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	**Well established**	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	**Low**	5
3 Likely cost of initial restoration	High (>$50k/ha)	**Moderate ($10-50k/ha)**	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>$10k pa)	Moderate ($5-10k pa)	**Low (<$5k pa)**	5
5 Site accessibility	Difficult	Moderate	**Easy**	5
6 Extent of physical site preparation required	High	**Moderate**	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	**Permitted**	5
8 Potential adverse impact from restoration works	Significant	**Moderate**	Slight	3
9 Likely human amenity value	Low	Moderate	**High**	5
# Time frame for establishing desired changes	Slow	**Moderate**	Fast	3
			Implementation Score	**42**
			Overall Site Score	**102**

2.8 BARK PROCESSORS EAST

2.8.1 Key features

The estuary margin to the north and east of the Bark Processors site is dominated by a steep armoured rock wall that protects the reclaimed land from erosion, and a large earth bund landward that screens the industrial sites beyond. The Great Taste trail runs along the top of the rock wall.

Seaward, the mid-tidal zone is dominated by extensive fine sediment flats and nuisance macroalgal growths indicating a source of nutrient enrichment is present in this part of the estuary (Fig. 10).

Wave energy is potentially relatively high due to the large fetch and exposure to sea breezes from the north/north-east.

Very little salt marsh is present on the shoreline and salt marsh is unlikely to establish widely due to the steep vertical face of the upper shore creating an abrupt transition from estuary to terrestrial habitat. The upper rock wall is dominated by weeds and the terrestrial margin is planted in native shrubs. There is no capacity for salt marsh to migrate inland in response to SLR due to the surrounding land use.

Restoration scoring criteria are presented in Table 15.

2.8.2 Opportunities/Issues

The estuary margin is highly modified and has low ecological value.

The site is relatively exposed to the main body of the estuary so wave energy is likely to be relatively high.

There is little infrastructure that will be affected by restoration and no significant issues are anticipated with regard to physical works associated with any potential restoration.

There is limited vehicle access to the site.

The Great Taste trail passes through the middle of the site so public exposure is high.

The site is not significantly different in terms of water depth or exposure to the nearby Sandeman Reserve which supports extensive salt marsh habitat.

2.8.3 Recommended Restoration

In light of the significant site modification and limited scope for restoration at the estuary margin, the following is recommended:

- Construct a Chenier ridge in the mid shore zone to reduce wave energy and create a sill to trap fine sediment. This would ideally comprise several small low ridges (10-20cm high) situated 50-80m from the shoreline.
- Ridges should be undulating to create eddies and deflect waves in different directions, and have sufficient gaps to allow tidal water to drain, but also have sufficient coverage to deflect waves and trap sediment.
- Rocks used should be man-manageable to avoid the need for diggers entering the estuary.
- Shoreward of the Chenier ridges, plant searush at high densities (10-15 plants/m^2) on the seaward edge, and at moderate densities (5-10 plants/m^2) further landward. This is to encourage dense stands of growth on the most exposed edge but to minimise the cost of plants overall. Planting in several patches is recommended initially to trial different planting densities and configurations. Match plant heights with those at the adjacent Sandeman Reserve area.

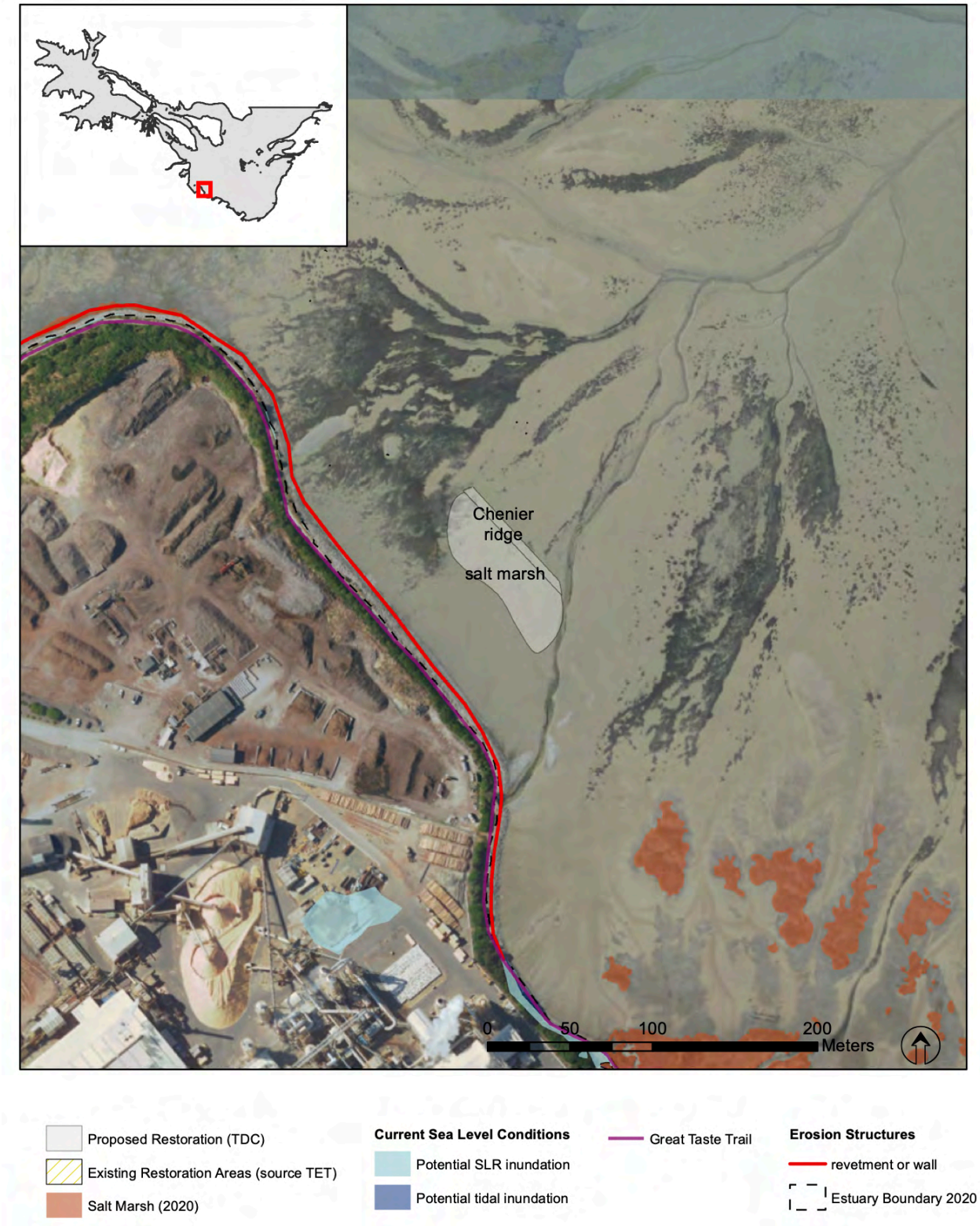


Fig. 10 Outline of proposed restoration footprint, Bark Processors East.

Table 14 Summary of restoration scoring criteria, Bark Processors East.

Bark Processors east Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	**Modified**	Heavily degraded	3
4 Biodiversity benefit	**No change**	Some benefits	Large improvements	1
5 Proximity to existing restoration initiative	**Unconnected (>500m)**	Nearby (within 500m)	Adjoining	1
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	**Nearby (within 500m)**	Adjoining	3
7 Value of infrastructure assets potentially affected within restoration	>$100k	$10-$100k	**<$10k**	5
			Screening Score	**23**
HABITAT CRITERIA				
1 Area available at site	<1ha	**1-5ha**	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	**>500m**	5
3 Protection from currents/waves	**Unprotected**	Partially protected	Mostly protected	1
4 Extent of shoreline armouring	**75-100%**	25-75%	<25%	1
5 Width of riparian buffer	**Absent**	0-10m	>10m	1
6 Adjacent land suitable for coastal retreat in response to SLR	**No**	Yes (with changes)	Yes (without changes)	1
7 Degree of local habitat connectivity/diversity	Degraded	**Significantly modified**	Largely intact	3
8 Likely benefit to birds compared to current state	Small	**Moderate**	Large	3
9 Likely benefit to fish compared to current state	**Small**	Moderate	Large	1
			Habitat Score	**19**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	**Demonstrated**	Well established	3
2 Likely risk of failure (e.g. erosion, plant desiccation)	**High**	Moderate	Low	1
3 Likely cost of initial restoration	High (>$50k/ha)	**Moderate ($10-50k/ha)**	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>$10k pa)	Moderate ($5-10k pa)	**Low (<$5k pa)**	5
5 Site accessibility	Difficult	**Moderate**	Easy	3
6 Extent of physical site preparation required	High	**Moderate**	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	**Permitted**	5
8 Potential adverse impact from restoration works	Significant	Moderate	**Slight**	5
9 Likely human amenity value	Low	**Moderate**	High	3
# Time frame for establishing desired changes	**Slow**	Moderate	Fast	1
			Implementation Score	**32**
			Overall Site Score	**74**

2.9 BARK PROCESSORS WEST

2.9.1 Key features

The estuary margin to west of the Bark Processors site is dominated by a steep armoured rock wall that protects the reclaimed land from erosion, and a large earth bund landward that screens the industrial sites beyond. The Great Taste trail runs along the top of the rock wall.

A large area of reclamation was removed from the estuary ~15 years ago, the footprint of which is still visible in the intertidal flats (Fig. 11). There has been very limited recolonisation of the declamation area by salt marsh,

The mid-tidal zone is dominated by mixed gravel and fine sediment flats.

Wave energy appears relatively low on the sheltered western edge of the Bark Processors reclamation.

A few small pockets of salt marsh are present on the shoreline (e.g. glasswort, grey salt bush) and salt marsh is unlikely to form expansive beds due to the steep vertical face of the upper shore. The upper rock wall is dominated by weeds and the terrestrial margin is planted in native shrubs. There is no capacity for salt marsh to migrate inland in response to SLR due to the surrounding land use.

Restoration scoring criteria are presented in Table 16.

2.9.2 Opportunities/Issues

The estuary margin is highly modified and has low ecological value.

The site is relatively sheltered from the main body of the estuary so wave energy is likely to be relatively low.

There is little infrastructure that will be affected by restoration and no significant issues are anticipated with regard to physical works associated with any potential restoration.

There is limited vehicle access to the site.

The Great Taste trail passes through the middle of the site so public exposure is high.

The site is not significantly different in terms of water depth or exposure to extensive salt marsh habitat nearby.

The site is within the current tidal range of the estuary.

2.9.3 Recommended Restoration

In light of the significant site modification and limited scope for restoration at the estuary margin, the following is recommended:

- Construct a Chenier ridge in the mid shore zone to reduce wave energy and create a sill to trap fine sediment. This would ideally comprise several small low ridges (10-20cm high) situated 20-30m from the shoreline.
- Ridges should be undulating to create eddies and deflect waves in different directions, and have sufficient gaps to allow tidal water to drain, but also have sufficient coverage to deflect waves and trap sediment.
- Rocks used should be man-manageable to avoid the need for diggers entering the estuary.
- Reshape the upper shore to a shallow gradient with mixed sand and gravel substrate.
- Shoreward of the Chenier ridges, plant searush at high densities (10-15 plants/m^2) on the seaward edge, and at moderate densities (5-10 plants/m^2) further landward. This is to encourage dense stands of growth on the most exposed edge but to minimise the cost of plants overall. Planting in several patches is recommended initially to trial different planting densities and configurations. Match plant heights with those in adjacent areas.

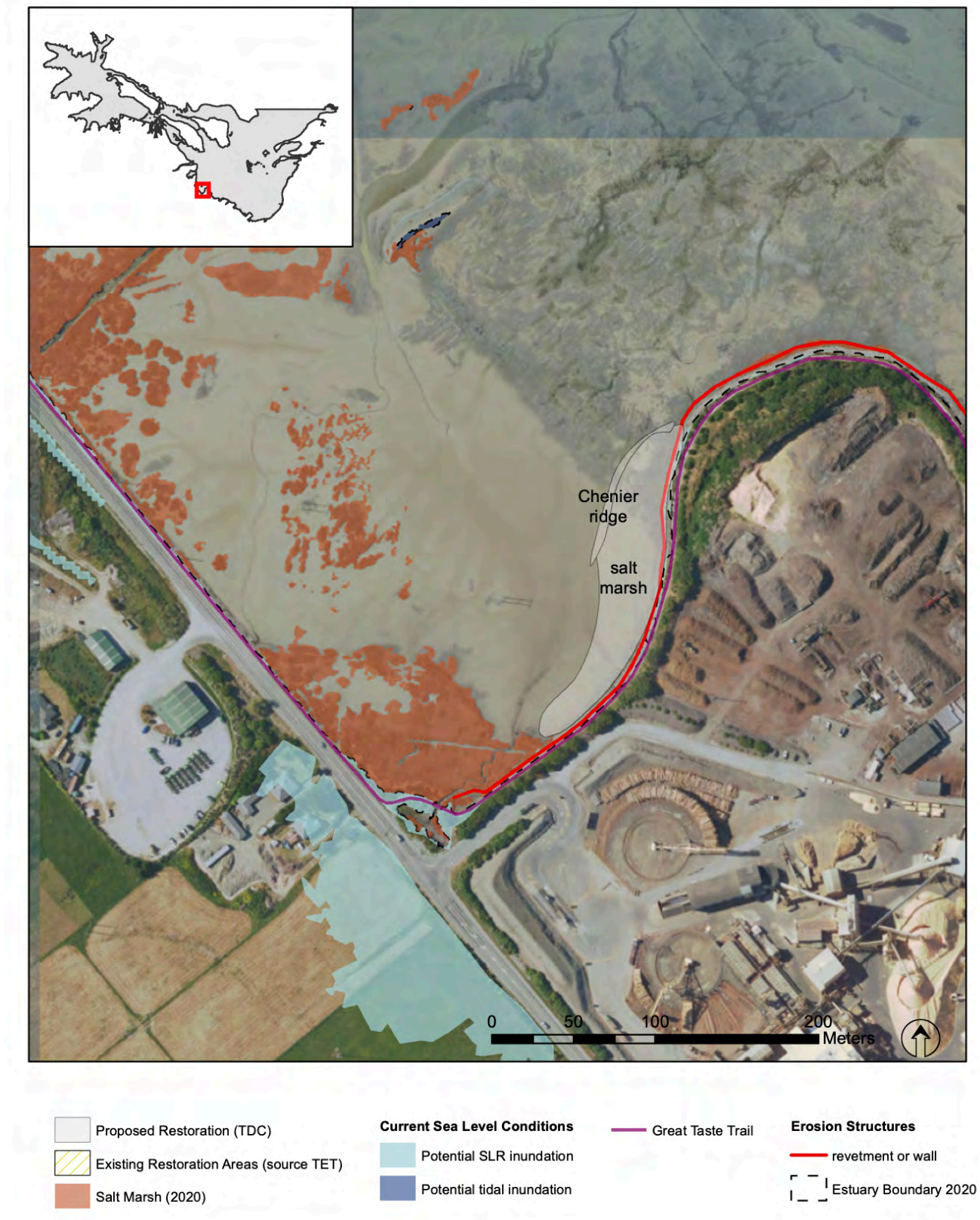


Fig. 11 Outline of proposed restoration footprint, Bark Processors West.

Table 15 Summary of restoration scoring criteria, Bark Processors West.

Bark Processors west Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	Modified	**Heavily degraded**	5
4 Biodiversity benefit	No change	**Some benefits**	Large improvements	3
5 Proximity to existing restoration initiative	**Unconnected (>500m)**	Nearby (within 500m)	Adjoining	1
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	**Nearby (within 500m)**	Adjoining	3
7 Value of infrastructure assets potentially affected within restoration	>$100k	$10-$100k	**<$10k**	5
			Screening Score	**27**
HABITAT CRITERIA				
1 Area available at site	<1ha	**1-5ha**	>5ha	3
2 Mean width of intertidal area	0-50m	50-500m	**>500m**	5
3 Protection from currents/waves	Unprotected	**Partially protected**	Mostly protected	3
4 Extent of shoreline armouring	**75-100%**	25-75%	<25%	1
5 Width of riparian buffer	**Absent**	0-10m	>10m	1
6 Adjacent land suitable for coastal retreat in response to SLR	**No**	Yes (with changes)	Yes (without changes)	1
7 Degree of local habitat connectivity/diversity	Degraded	**Significantly modified**	Largely intact	3
8 Likely benefit to birds compared to current state	Small	**Moderate**	Large	3
9 Likely benefit to fish compared to current state	**Small**	Moderate	Large	1
			Habitat Score	**21**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	**Well established**	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	**Moderate**	Low	3
3 Likely cost of initial restoration	High (>$50k/ha)	**Moderate ($10-50k/ha)**	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>$10k pa)	Moderate ($5-10k pa)	**Low (<$5k pa)**	5
5 Site accessibility	Difficult	**Moderate**	Easy	3
6 Extent of physical site preparation required	High	**Moderate**	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	**Permitted**	5
8 Potential adverse impact from restoration works	Significant	Moderate	**Slight**	5
9 Likely human amenity value	Low	**Moderate**	High	3
# Time frame for establishing desired changes	**Slow**	Moderate	Fast	1
			Implementation Score	**36**
			Overall Site Score	**84**

2.10 LOWER QUEEN STREET

2.10.1 Key features

The Lower Queen Street site is a stream and stormwater detention area located within elevated bunds constructed within the estuary (Fig. 12). The bunds and tidegate separate the site from contiguous salt marsh which is extensive to the east. The site is bounded to the north by an industrial site, and to the west by the main road.

Fig. 12 also highlights how low-lying the site is. The areas shaded dark blue are within the current potential tidal elevation of the estuary, and the pale blue areas are within the potential SLR inundation zone, although barriers may limit tidal ingress.

The confined site area is highly modified and disconnected from the main body of the estuary. It is not subjected to wave energy but may be occasionally impacted by flood flows.

Currently tidal flows to the site are restricted by tidal gates and bunds.

Within the bunding, extensive terrestrial planting has already been undertaken.

Restoration scoring criteria are presented in Table 17.

2.10.2 Opportunities/Issues

The available area is small (~0.4ha) but retains residual populations of several salt marsh species, some of which have been planted as part of the restoration undertaken to date.

The site is within the current tidal range and is surrounded by low-lying land within the range of predicted SLR inundation.

It retains a moderate ecological value due to the enhancement work undertaken to date.

There is no capacity for salt marsh to migrate inland in response to SLR.

There is little infrastructure that will be affected by restoration and no significant issues are anticipated with regard to physical works associated with any potential restoration.

There is vehicle access to the site.

2.10.3 Recommended Restoration

In light of the significant site modification and limited scope for restoration at the estuary margin, the following is recommended:

- Undertake salt marsh infill planting to further enhance the existing restoration effort.
- Install a device to hold the tidegate open for more of the tide.

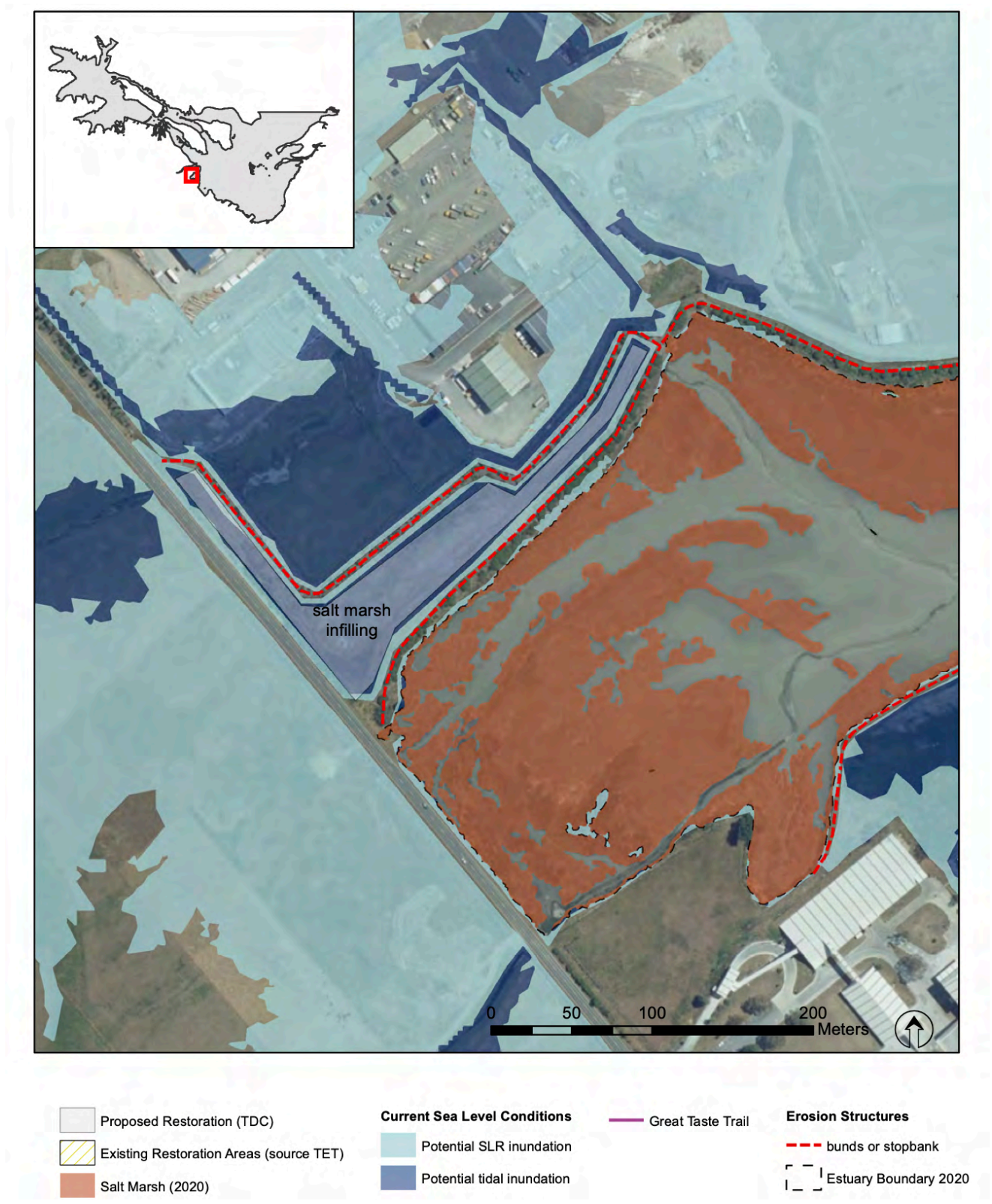


Fig. 12 Outline of proposed restoration footprint, Lower Queen Street.

Table 16 Summary of restoration scoring criteria, Lower Queen Street.

Lower Queen Street Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	Modified	**Heavily degraded**	5
4 Biodiversity benefit	No change	**Some benefits**	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	**Nearby (within 500m)**	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	**Nearby (within 500m)**	Adjoining	3
7 Value of infrastructure assets potentially affected within restoration	>$100k	**$10-$100k**	<$10k	3
			Screening Score	**27**
HABITAT CRITERIA				
1 Area available at site	**<1ha**	1-5ha	>5ha	1
2 Mean width of intertidal area	**0-50m**	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	**Mostly protected**	5
4 Extent of shoreline armouring	**75-100%**	25-75%	<25%	1
5 Width of riparian buffer	Absent	**0-10m**	>10m	3
6 Adjacent land suitable for coastal retreat in response to SLR	**No**	Yes (with changes)	Yes (without changes)	1
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	**Largely intact**	5
8 Likely benefit to birds compared to current state	Small	**Moderate**	Large	3
9 Likely benefit to fish compared to current state	Small	**Moderate**	Large	3
			Habitat Score	**23**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	**Well established**	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	**Low**	5
3 Likely cost of initial restoration	High (>$50k/ha)	Moderate ($10-50k/ha)	**Low (<10k/ha)**	5
4 Likely cost of ongoing site maintenance	High (>$10k pa)	Moderate ($5-10k pa)	**Low (<$5k pa)**	5
5 Site accessibility	Difficult	Moderate	**Easy**	5
6 Extent of physical site preparation required	High	Moderate	**Low**	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	**Permitted**	5
8 Potential adverse impact from restoration works	Significant	Moderate	**Slight**	5
9 Likely human amenity value	Low	**Moderate**	High	3
# Time frame for establishing desired changes	Slow	Moderate	**Fast**	5
			Implementation Score	**48**
			Overall Site Score	**98**

2.11 BEST ISLAND GOLF COURSE

2.11.1 Key features

The Best Island Golf Course site is located along the south-western side of Best Island (Fig. 13). To the north-west an access road, in place since before the 1970's, runs along the southern edge of the golf course and in many places is below MHWS. The road was used as access to the rock revetment project undertaken by council a few years ago to protect from erosion from the Waimea River.

The north-west access road is now no longer needed and has recently been decommissioned. Part of the decommissioning requires site reinstatement of a displaced strip of upper tidal salt marsh ~200m long x 5m wide (1000m^2). This is within an area known as being important for banded rail.

Although there are ongoing legal and public access considerations for TDC to resolve regarding the complete removal of the road, the sections that run through the salt marsh zone are ready to be prepared (soil ripping) and planted.

The site margins have been modified and Fig. 13 shows how low-lying the area is with areas shaded dark blue within the current potential tidal elevation of the estuary, and pale blue areas within the potential SLR inundation zone, although barriers may limit tidal ingress.

Initial work by TDC has removed some pine trees and planted narrow strips of salt marsh along the upper shore (see photo below).

Grassland and weeds growing among salt marsh plantings adjacent to the Golf Course entrance

Restoration scoring criteria are presented in Table 18.

2.11.2 Opportunities/Issues

The site is narrow and has been significantly modified and steepened and reinforced in places, but remains connected to the main body of the estuary.

The site is sheltered and not subjected to significant wave energy.

Despite past modification, the site retains moderate ecological value due to the residual salt marsh and enhancement work undertaken to date.

There is little infrastructure that will be affected by restoration and no significant issues are anticipated with regard to physical works associated with any potential restoration.

There is good vehicle access to the site.

Pest browsing and desiccation of plants has been an issue with existing restoration plantings.

2.11.3 Recommended Restoration

In light of the significant site modification and limited scope for restoration at the estuary margin, the following is recommended:

- Undertake infill planting to further enhance the existing plantings.
- Continue with ongoing weed removal and pest control. Consider exclusion fencing (for vehicles).
- Rip and plant decommissioned road areas in the northwest.

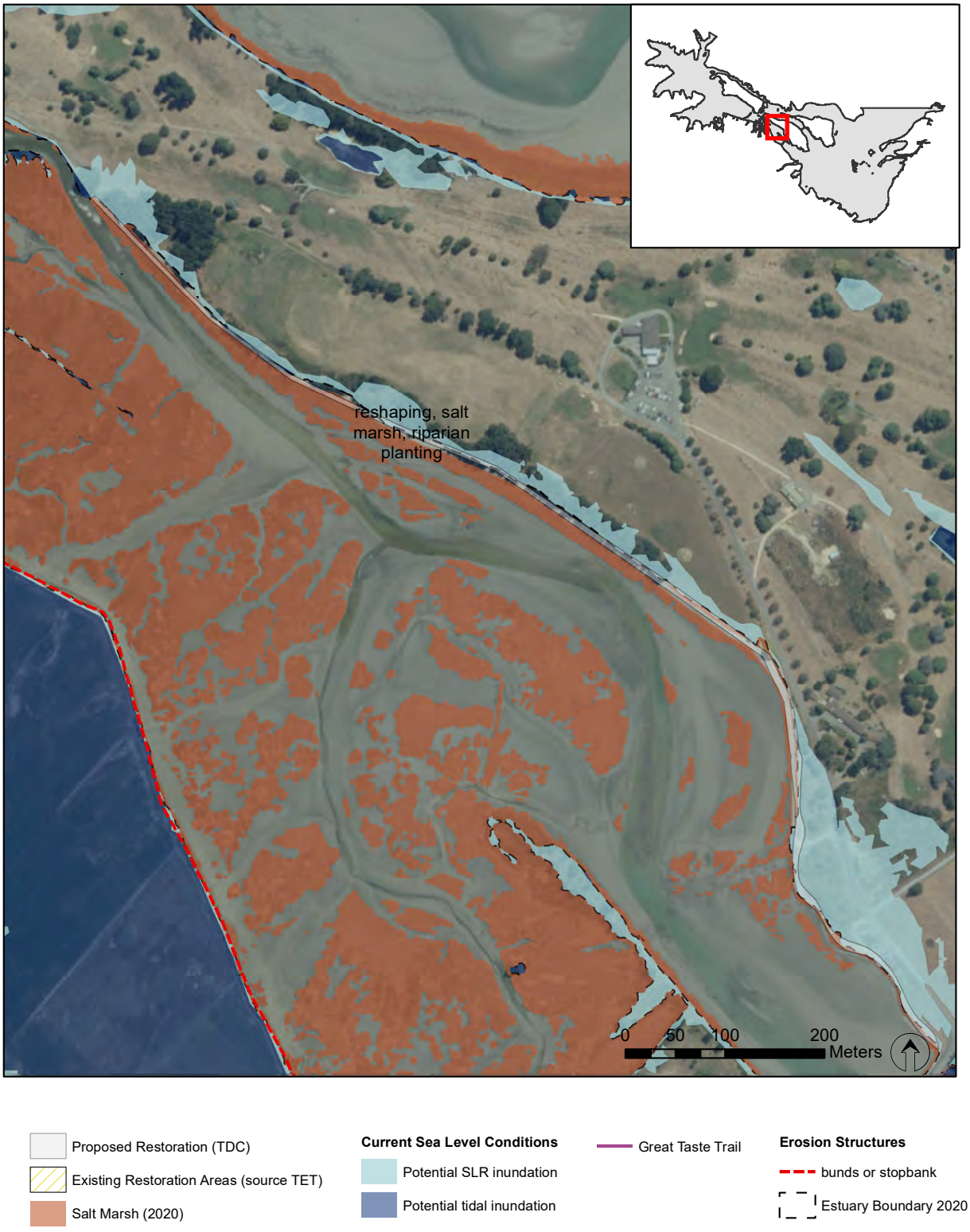


Fig. 13 Outline of proposed restoration footprint, Best Island Golf Course.

Table 17 Summary of restoration scoring criteria, Best Island Golf Course.

Bests Island Golf Course Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	**Modified**	Heavily degraded	3
4 Biodiversity benefit	No change	**Some benefits**	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
7 Value of infrastructure assets potentially affected within restoration	>$100k	$10-$100k	**<$10k**	5
			Screening Score	**31**
HABITAT CRITERIA				
1 Area available at site	<1ha	**1-5ha**	>5ha	3
2 Mean width of intertidal area	**0-50m**	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	Mostly protected	5
4 Extent of shoreline armouring	75-100%	25-75%	**<25%**	5
5 Width of riparian buffer	Absent	**0-10m**	>10m	3
6 Adjacent land suitable for coastal retreat in response to SLR	No	**Yes (with changes)**	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	**Significantly modified**	Largely intact	3
8 Likely benefit to birds compared to current state	Small	**Moderate**	Large	3
9 Likely benefit to fish compared to current state	**Small**	Moderate	Large	1
			Habitat Score	**27**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	**Well established**	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	**Moderate**	Low	3
3 Likely cost of initial restoration	High (>$50k/ha)	**Moderate ($10-50k/ha)**	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>$10k pa)	**Moderate ($5-10k pa)**	Low (<$5k pa)	3
5 Site accessibility	Difficult	Moderate	**Easy**	5
6 Extent of physical site preparation required	High	**Moderate**	Low	3
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	**Permitted**	5
8 Potential adverse impact from restoration works	Significant	Moderate	**Slight**	5
9 Likely human amenity value	Low	**Moderate**	High	3
# Time frame for establishing desired changes	Slow	Moderate	**Fast**	5
			Implementation Score	**40**
			Overall Site Score	**98**

2.12 BEST ISLAND

2.12.1 Key features

The Best Island site is located along the south-western side of Best Island (Fig. 13) and forms part of the access road to the Best Island residential areas. The road runs along the top of the shore and is occasionally tidally inundated.

The site margins have been modified and reinforced with rock barriers to protect against erosion or inundation. Fig. 13 shows how low-lying the area is with areas shaded dark blue within the current potential tidal elevation of the estuary, and pale blue areas within the potential SLR inundation zone, although barriers may limit tidal ingress.

Restoration scoring criteria are presented in Table 19.

2.12.2 Opportunities/Issues

The site is narrow and has been significantly modified and often steepened and reinforced but remains connected to the main body of the estuary.

The site is sheltered and not subjected to significant wave energy.

Despite past modification, the site retains moderate ecological value due to the residual salt marsh present.

There is little infrastructure that will be affected by restoration and no significant issues are anticipated with regard to physical works associated with any potential restoration.

There is good vehicle access to the site.

Adjacent land (owned by the NRSBU) on the inland side of the road has excellent potential to be used for salt marsh creation and there is a great opportunity for creating marshbird (including bittern) habitat around the existing rectangular ponds on the island.

Pest browsing and desiccation of plants has been an issue with existing restoration plantings.

2.12.3 Recommended Restoration

In light of the significant site modification and limited scope for restoration at the estuary margin, the following is recommended:

- Undertake infill planting to further enhance the existing plantings.
- Continue with ongoing weed removal and pest control. Consider exclusion fencing (for vehicles).
- Investigate options for further enhancement on NRSBU land.

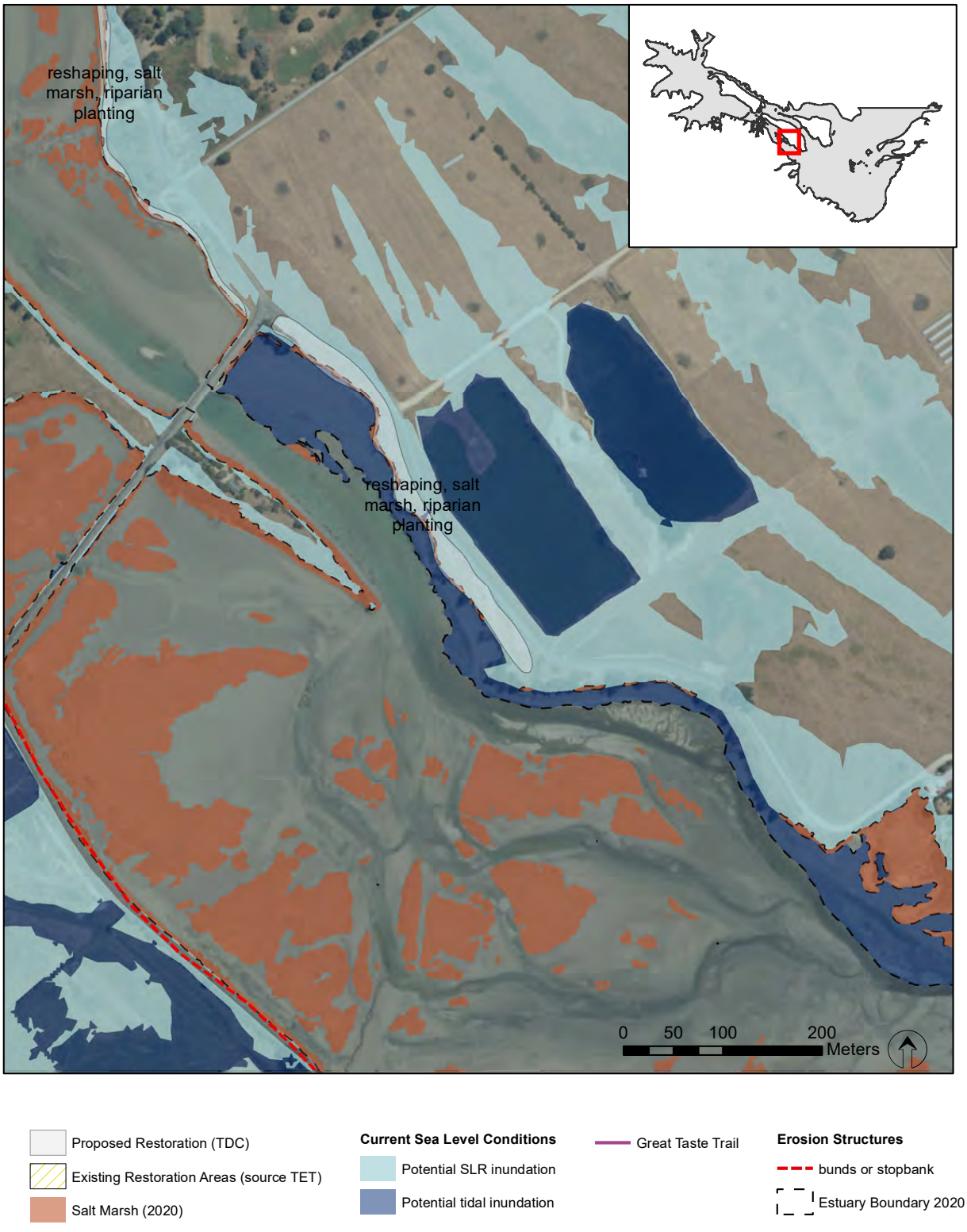


Fig. 14 Outline of proposed restoration footprint, Best Island.

Table 18 Summary of restoration scoring criteria, Best Island.

Bests Island Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	**Modified**	Heavily degraded	3
4 Biodiversity benefit	No change	**Some benefits**	Large improvements	3
5 Proximity to existing restoration initiative	Unconnected (>500m)	**Nearby (within 500m)**	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
7 Value of infrastructure assets potentially affected within restoration	>$100k	**$10-$100k**	<$10k	3
			Screening Score	**27**
HABITAT CRITERIA				
1 Area available at site	<1ha	**1-5ha**	>5ha	3
2 Mean width of intertidal area	**0-50m**	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	**Mostly protected**	5
4 Extent of shoreline armouring	75-100%	25-75%	**<25%**	5
5 Width of riparian buffer	Absent	**0-10m**	>10m	3
6 Adjacent land suitable for coastal retreat in response to SLR	No	**Yes (with changes)**	Yes (without changes)	3
7 Degree of local habitat connectivity/diversity	Degraded	**Significantly modified**	Largely intact	3
8 Likely benefit to birds compared to current state	Small	**Moderate**	Large	3
9 Likely benefit to fish compared to current state	**Small**	Moderate	Large	1
			Habitat Score	**27**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	**Well established**	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	**Moderate**	Low	3
3 Likely cost of initial restoration	High (>$50k/ha)	**Moderate ($10-50k/ha)**	Low (<10k/ha)	3
4 Likely cost of ongoing site maintenance	High (>$10k pa)	**Moderate ($5-10k pa)**	Low (<$5k pa)	3
5 Site accessibility	Difficult	Moderate	**Easy**	5
6 Extent of physical site preparation required	High	Moderate	**Low**	5
7 Is resource consent likely to be required?	Notified consent	Non-notified consent	**Permitted**	5
8 Potential adverse impact from restoration works	Significant	Moderate	**Slight**	5
9 Likely human amenity value	Low	**Moderate**	High	3
# Time frame for establishing desired changes	Slow	Moderate	**Fast**	5
			Implementation Score	**42**
			Overall Site Score	**96**

2.13 WAIMEA RIVER DELTA

2.13.1 Key features

This site was not able to be viewed during the field visit and the assessment is based on previous knowledge of the area and information provided by Trevor James (TDC).

There is a large area of undeveloped land on the Waimea Delta (Fig. 15) that is within the flood control stopbanks. Large parts of this area remain in salt marsh, but slightly higher areas are dominated by introduced grass and weeds, while wetter areas retain pockets of freshwater vegetation including stands of raupō (bullrush). There is huge potential to re-establish freshwater wetlands, natural delta processes (including sediment removal and inanga spawning) and habitat for a variety of marshbirds in this area.

Restoration scoring criteria are presented in Table 20.

2.13.2 Opportunities/Issues

The site area is large, freshwater dominated, and remains connected to the main body of the estuary.

It is not subjected to wave energy but may be occasionally impacted by flood flows.

It retains a moderate ecological value due to the past modification of the site, primarily disruption to natural water flows.

The site is within the current tidal range and is surrounded by low-lying land within the range of predicted SLR inundation.

There is extensive capacity for salt marsh to migrate inland in response to SLR.

There is no infrastructure that will be affected by restoration and no significant issues are anticipated with regard to physical works associated with any potential restoration.

There is off-road vehicle access to the site.

2.13.3 Recommended Restoration

In light of the extensive scope for restoration, the following is recommended:

- Reshape channel areas to increase freshwater and tidal ingress to the area.
- Extend the footprint of existing salt marsh through targeted planting of intertidal species to improve the spatial extent and connectiveness of existing habitat to the new zones.
- Create shallow ponded areas (akin to rice paddies) to restore freshwater wetlands suitable for planting with key species (e.g. raupō).
- Implement weed removal and pest control as appropriate.

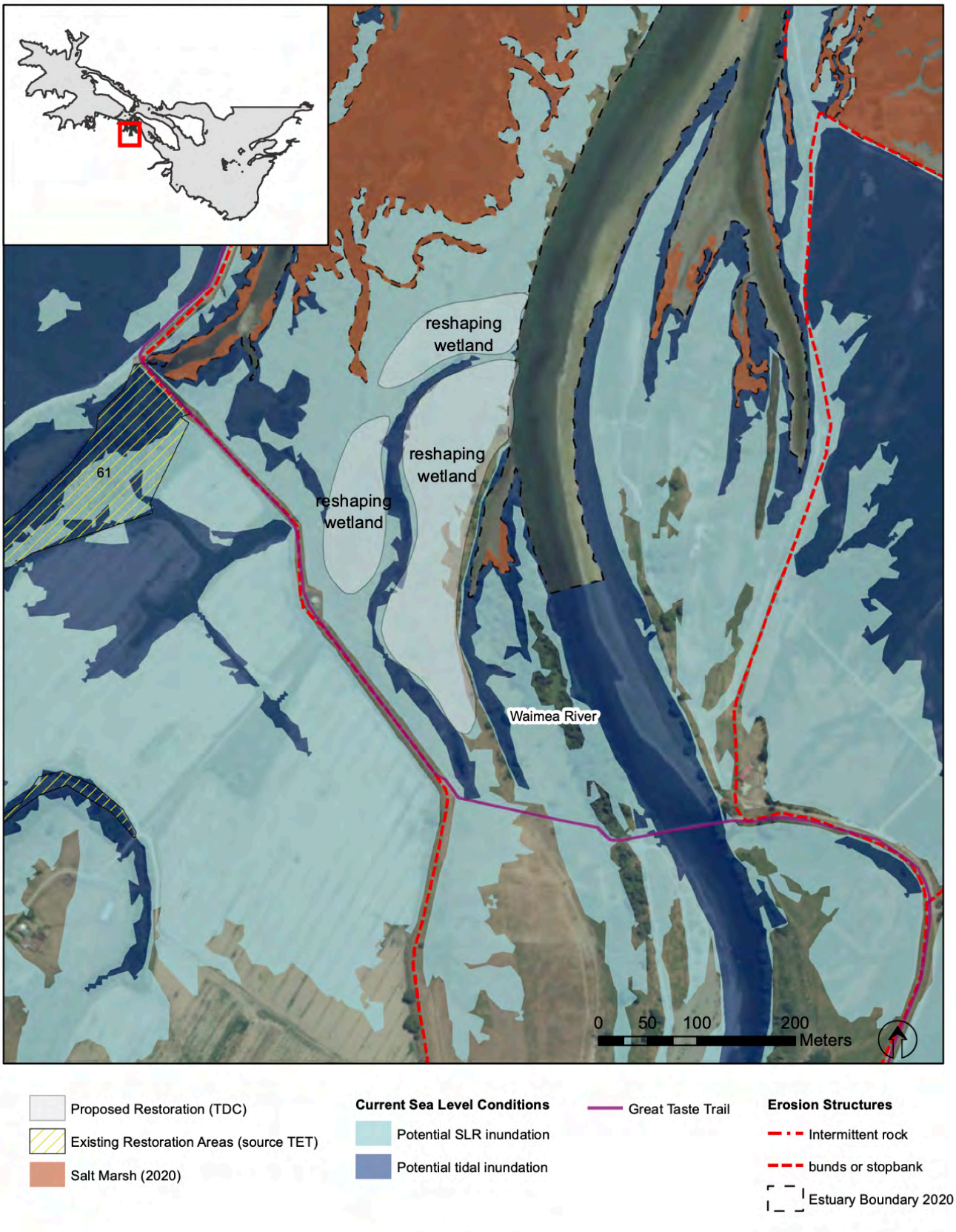


Fig. 15 Outline of proposed restoration footprint, Waimea Delta.

Table 19 Summary of restoration scoring criteria, Waimea Delta.

Waimea River Delta Proposed criteria for prioritising salt marsh restoration	Low (1)	Moderate (3)	High (5)	
PRELIMINARY HIGH LEVEL SCREENING				
1 Land ownership	Private	Conservation ownership	**Council owned**	5
2 Tidal inundation	Terrestrial	Within current tidal range	**Within 100yr SLR range**	5
3 Extent of historic degradation	Largely intact	**Modified**	Heavily degraded	3
4 Biodiversity benefit	No change	Some benefits	**Large improvements**	5
5 Proximity to existing restoration initiative	Unconnected (>500m)	**Nearby (within 500m)**	Adjoining	3
6 Proximity to ecologically important vegetated area	Unconnected (>500m)	Nearby (within 500m)	**Adjoining**	5
7 Value of infrastructure assets potentially affected within restoration	>$100k	$10-$100k	**<$10k**	5
			Screening Score	**31**
HABITAT CRITERIA				
1 Area available at site	<1ha	1-5ha	**>5ha**	5
2 Mean width of intertidal area	**0-50m**	50-500m	>500m	1
3 Protection from currents/waves	Unprotected	Partially protected	**Mostly protected**	5
4 Extent of shoreline armouring	75-100%	25-75%	**<25%**	5
5 Width of riparian buffer	Absent	**0-10m**	>10m	3
6 Adjacent land suitable for coastal retreat in response to SLR	No	Yes (with changes)	**Yes (without changes)**	5
7 Degree of local habitat connectivity/diversity	Degraded	Significantly modified	**Largely intact**	5
8 Likely benefit to birds compared to current state	Small	Moderate	**Large**	5
9 Likely benefit to fish compared to current state	Small	Moderate	**Large**	5
			Habitat Score	**39**
IMPLEMENTATION CRITERIA				
1 Proven restoration methodology	Unproven	Demonstrated	**Well established**	5
2 Likely risk of failure (e.g. erosion, plant desiccation)	High	Moderate	**Low**	5
3 Likely cost of initial restoration	**High (>$50k/ha)**	Moderate ($10-50k/ha)	Low (<10k/ha)	1
4 Likely cost of ongoing site maintenance	High (>$10k pa)	**Moderate ($5-10k pa)**	Low (<$5k pa)	3
5 Site accessibility	Difficult	**Moderate**	Easy	3
6 Extent of physical site preparation required	High	**Moderate**	Low	3
7 Is resource consent likely to be required?	**Notified consent**	Non-notified consent	Permitted	1
8 Potential adverse impact from restoration works	Significant	**Moderate**	Slight	3
9 Likely human amenity value	Low	**Moderate**	High	3
# Time frame for establishing desired changes	Slow	Moderate	**Fast**	5
			Implementation Score	**32**
			Overall Site Score	**102**

3. PRIORITISATION CRITERIA

Prioritisation criteria were proposed to enable information to be collected in a systematic manner so sites could be compared consistently to help TDC in selecting restoration options. It was not a focus of this project to develop a formal system for definitively ranking sites. This is because the specific criteria used, and the endpoints sought, will have a strong influence on how different components should be weighted. For example, heavier weightings could be given to habitat criteria if ecological outcomes were of primary importance, or to implementation criteria if ease of undertaking projects was the key concern. In order to allow options to be assessed in a variety of ways, Table 21 presents a combined summary of site scores with each of the criteria used given equal weighting.

Table 20 Summary of scores for preliminary criteria for prioritising salt marsh restoration.

	Proposed criteria for prioritising salt marsh restoration	Wakatu Drive	Reservoir Creek (west)	Vercoes Drain and delta	"Greenwaste" site	Pastoral Stream	"A&P Reclamation" site	Estuary Place	Borck Creek to Sandeman	Sandeman Reserve (stream	Sandeman Reserve (coast)	Bark Processors east	Bark Processors west	Lower Queen Street	Bests Island Golf Course	Bests Island	Waimea River
PRELIMINARY HIGH LEVEL SCREENING																	
1	Land ownership	5	5	5	5	1	1	5	5	5	5	5	5	5	5	5	5
2	Tidal inundation	5	5	5	5	3	5	5	5	5	5	5	5	5	5	5	5
3	Extent of historic degradation	3	3	5	1	5	1	5	5	5	3	3	5	5	3	3	3
4	Biodiversity benefit	3	3	1	1	5	1	5	5	3	1	1	3	3	3	3	5
5	Proximity to existing restoration initiative	3	3	3	1	1	1	1	5	5	5	1	1	3	5	3	3
6	Proximity to ecologically important vegetated area	5	5	3	5	5	5	5	3	5	5	3	3	3	5	5	5
7	Value of infrastructure assets potentially affected within restoration	1	3	3	5	5	5	5	1	5	3	5	5	3	5	3	5
	High Level screening Score	**25**	**27**	**25**	**23**	**25**	**19**	**31**	**29**	**33**	**27**	**23**	**27**	**27**	**31**	**27**	**31**
	Rank	11	6	11	14	11	16	2	5	1	6	14	6	6	2	6	2
HABITAT CRITERIA																	
1	Area available at site	3	3	3	1	1	1	1	3	1	1	3	3	1	3	3	5
2	Mean width of intertidal area	5	5	5	5	1	5	1	5	1	5	5	5	1	1	1	1
3	Protection from currents/waves	1	1	1	3	5	3	5	5	5	5	1	3	5	5	5	5
4	Extent of shoreline armouring	1	3	1	1	5	1	5	1	5	1	1	1	1	5	5	5
5	Width of riparian buffer	1	3	1	1	1	1	3	3	3	1	1	1	3	3	3	3
6	Adjacent land suitable for coastal retreat in response to SLR	1	3	1	1	3	3	3	3	3	3	1	1	1	3	3	5
7	Degree of local habitat connectivity/diversity	3	3	3	3	5	3	3	5	5	3	3	3	5	3	3	5
8	Likely benefit to birds compared to current state	1	3	1	1	3	1	3	5	1	1	3	3	3	3	3	5
9	Likely benefit to fish compared to current state	1	1	3	1	3	1	3	3	3	1	1	1	3	1	1	5
	Habitat Criteria Score	**17**	**25**	**19**	**17**	**27**	**19**	**27**	**33**	**27**	**21**	**19**	**21**	**23**	**27**	**27**	**39**
	Rank	15	8	12	15	3	12	3	2	3	10	12	10	9	3	3	1
IMPLEMENTATION CRITERIA																	
1	Proven restoration methodology	3	3	3	5	5	5	5	5	5	5	3	5	5	5	5	5
2	Likely risk of failure (e.g. erosion, plant desiccation)	1	1	3	5	5	3	3	5	5	5	1	3	5	3	3	5
3	Likely cost of initial restoration	3	3	3	5	1	5	1	3	3	3	3	3	5	3	3	1
4	Likely cost of ongoing site maintenance	1	3	3	5	3	5	5	3	5	5	5	5	5	3	3	3
5	Site accessibility	1	5	3	5	3	5	5	5	5	5	3	3	5	5	5	3
6	Extent of physical site preparation required	1	3	3	5	3	5	5	3	3	3	3	3	5	3	5	3
7	Is resource consent likely to be required?	1	5	1	5	5	5	5	5	5	5	5	5	5	5	5	1
8	Potential adverse impact from restoration works	3	3	3	5	5	5	5	3	3	3	5	5	5	5	5	3
9	Likely human amenity value	3	5	3	1	1	1	5	5	5	5	3	3	3	3	3	3
10	Time frame for establishing desired changes	3	3	3	5	3	3	5	5	3	5	1	1	5	5	5	5
	Implementation Criteria Score	**20**	**34**	**28**	**46**	**34**	**42**	**44**	**42**	**42**	**44**	**32**	**36**	**48**	**40**	**42**	**32**
	Rank	16	11	15	2	11	5	3	5	5	3	13	10	1	9	5	13
	Total Score	**62**	**86**	**72**	**86**	**86**	**80**	**102**	**104**	**102**	**92**	**74**	**84**	**98**	**98**	**96**	**102**
	Overall Rank	16	9	15	9	9	13	2	1	2	8	14	12	5	5	7	2

Scores and ranks have been presented for each of the criteria groupings (i.e. high level screening for site selection and habitat and implementation criteria) to enable component parts to be assessed individually.

Clearly there is room to refine and extend this approach. Some criteria were difficult to apply because there was limited information to populate them, while others scored consistently across all sites so had little influence.

However, as TDC are in the relatively early stages of restoration there are many projects with 'low hanging fruit' that can be undertaken relatively easily. As such, the need for a further refinement in scoring is likely warranted only when decisions regarding which options to choose become more nuanced.

To help prioritise the projects assessed, unweighted scores were summed across all categories to get a nominal overall ranking. This ranking should be considered a transparent starting point for reaching final decisions on priority rather than a definitive outcome. It is noted that the rankings based on scoring criteria largely matched the prioritisation conclusions reached by the expert group during the field evaluation. At this point in time the following projects are considered the top five 'shovel-ready' projects:

- Borck Creek to Sandeman Reserve
- Waimea River Delta
- Sandeman Reserve
- Bests Island Golf Course
- Lower Queen Street

These projects are considered to have a high chance of success with ecological benefits in both the short and long term. Each offer different outcomes and challenges and reflect a mix of easy to implement options extending current work, as well as more challenging but higher reward options that extend restoration into new areas or habitats. Note that this list does not include the highly ranked Estuary Place site because significant restoration work has already been undertaken and will be ongoing.

4. ADDITIONAL CONSIDERATIONS

It is beyond the scope of this evaluation to incorporate sites outside the initial selection parameters defined by TDC, namely sites on private land. However, these sites often represent some of the greatest opportunities for restoration, or for preventing the further loss of high value habitat. The GIS framework used as part of the current assessment process has enabled currently undeveloped or lightly developed areas within either the current predicted tidal range (noting that barriers often prevent tidal flows from reaching these areas), or within areas with the potential to be inundated as a consequence of predicted SLR to be highlighted for further evaluation.

Example of fenced farmland subjected to estuary inundation at high tide

Farmland at the same tidal elevation as the estuary, but separated by an earth bund that restricts tidal inundation

Due to the potential sensitivity of highlighting such locations in advance of talking to landowners, it is recommended that the GIS outputs be used as an in-house tool to prioritise areas where further investigation would be potentially valuable.

It is also recommended that the GIS tools be used as part of regional planning to highlight current and potential sites on TDC-managed land throughout the wider region.

Although not yet available at a resolution detailed enough for fine scale planning, TDC have tidal height data that in future could be used to predict the likely extent and location of salt marsh losses due to coastal squeeze, where rising sea levels displace existing salt marsh that is unable to migrate due to coastal barriers. This information would be exceedingly valuable for long-term planning of management and restoration initiatives.

It is clear from the current exercise that a lot of time, money and effort has been put into restoration by the Council, other government agencies, community groups and individual landowners. However, there currently seems to be no easy way of finding out who has done what, and where. The GIS framework can be used to capture consistent details on any of the current and proposed restoration activities being undertaken.

Reporting on the success (and failures) of any restoration, and co-ordinating projects, will go a long way towards maximising the returns from current effort. Such reporting is also likely to be a mandatory requirement for government schemes such as Jobs for Nature and the One Billion Trees programme. It would be a relatively simple job to define the minimum desirable information to be collected, and any associated metadata, so that consistent and informative data can be compiled and made available to all interested parties.

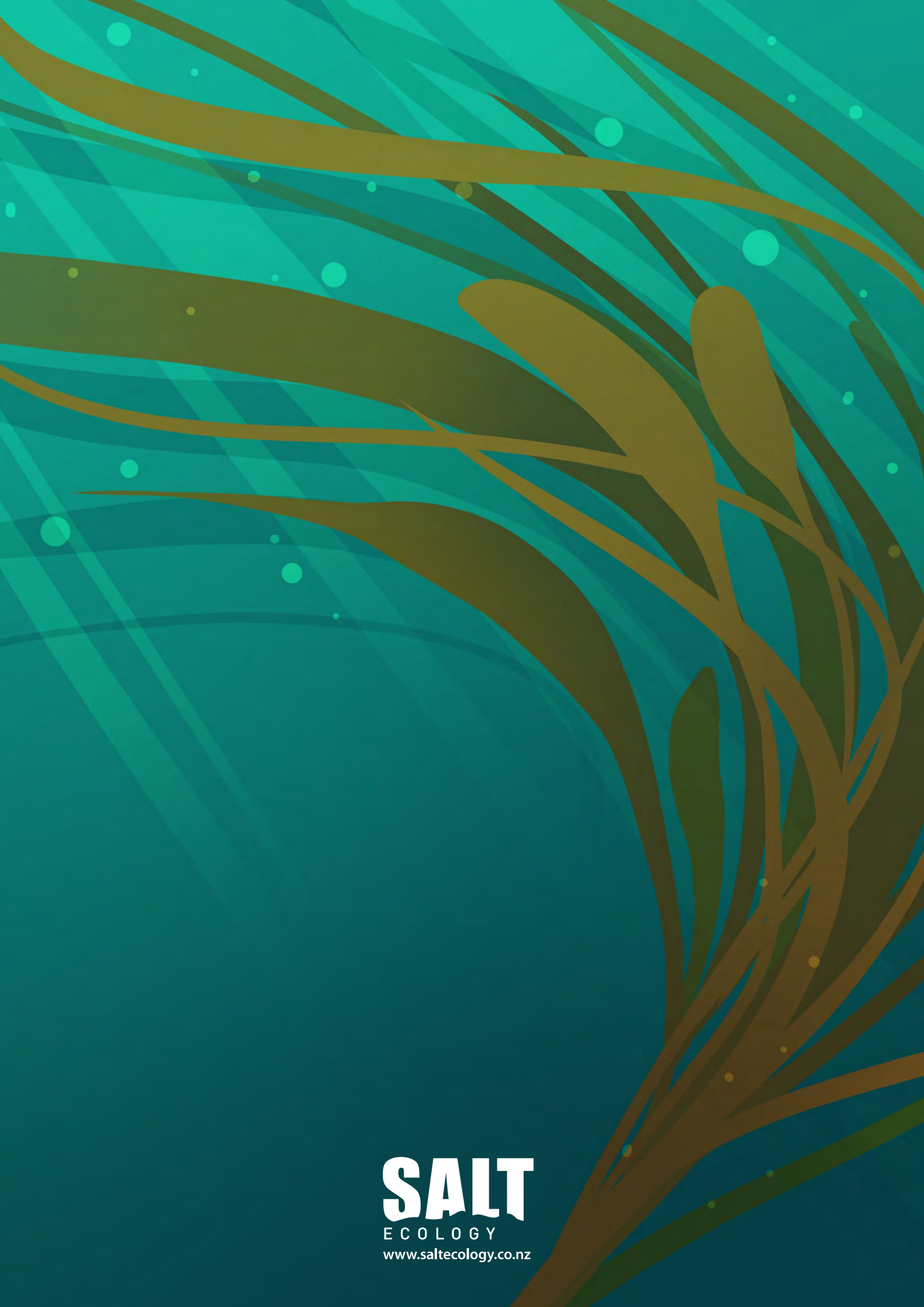
APPENDICES

Appendix 1. Field survey participants

Participant	Role	Affiliation
Trevor James	Senior Resource Scientist - Environmental	TDC
Richard Hilton	Horticultural Officer	TDC
Craig Allen	Catchment Enhancement Officer	TDC
Vikki Ambrose	Coastal & Marine Scientist	NCC
David Sissons	Landscape Architect	Waimea Inlet Forum
Leigh Stevens	Senior Scientist	Salt Ecology

Appendix 2. Expanded narrative of preliminary scoring criteria

PRELIMINARY HIGH LEVEL SCREENING		1	3	5
1	Land ownership	Land with private ownership and site governance	Crown or covenanted land with defined site management objectives or approvals required. eg. Scenic reserve, QE2 covenant	Council owned and managed land
2	Tidal inundation	Terrestrial land with no predicted tidal inundation	Land within currently defined MHWS	Land within predicted 100yr SLR scenario
3	Extent of historic degradation	Natural habitat is largely intact, but can be improved	Natural habitat is modified, but most key features remain	Natural habitat is significantly degraded or absent, but was historically present
4	Biodiversity benefit	No significant change to current state	Some benefits through enhancement of existing values	Large improvements through combined enhancement of existing state and restoring lost biodiversity
5	Proximity to existing restoration initiative	Unconnected to existing or proposed restoration project	Within 500m of existing or proposed restoration project	Directly adjoining existing or proposed restoration project
6	Proximity to ecologically important vegetated area	Unconnected to existing important vegetated area (e.g. seagrass, salt marsh, wetland, indigenous forest)	Within 500m of important vegetated area (e.g. seagrass, salt marsh, wetland, indigenous forest)	Adjoining important vegetated area (e.g. seagrass, salt marsh, wetland, indigenous forest)
7	Value of infrastructure assets potentially affected within restoration	Value of infrastructure assets in footprint potentially affected >$100k	Value of infrastructure assets in footprint potentially affected is $10-$100k	Value of infrastructure assets in footprint potentially affected <$10k
HABITAT CRITERIA		**1**	**3**	**5**
1	Area available at site	Site small (<1ha)	Site moderate (1-5ha)	Site large (>5ha)
2	Mean width of intertidal area	Intertidal width <50m	Intertidal width 50-500m	Intertidal width >500m
3	Protection from currents/waves	Site un-protected from prevailing wave energy	Site partially protected from prevailing wave energy	Site mostly protected from prevailing wave energy
4	Extent of shoreline armouring	75-100% armouring	25-75% armouring	<25% armouring
5	Width of riparian buffer	No riparian vegetation present	Riparian vegetation 0-10m wide	Riparian vegetation >10m wide
6	Adjacent land suitable for coastal retreat in response to SLR	No adjacent land suitable for coastal retreat	Adjacent land suitable for coastal retreat with land changes needed	Adjacent land suitable for coastal retreat without land changes needed
7	Degree of local habitat connectivity/diversity	Monoculture or isolated habitat areas significantly degraded from natural state	Mixed species assemblages but with limited diversity and connectivity compared to natural state	Species assemblages are relatively diverse and in close proximity
8	Likely benefit to birds compared to current state	No change or small increase in habitat area or quality	Moderate increase in habitat area or quality	Large increase in habitat area or quality
9	Likely benefit to fish compared to current state	No change or small increase in habitat area or quality	Moderate increase in habitat area or quality	Large increase in habitat area or quality
IMPLEMENTATION CRITERIA		**1**	**3**	**5**
1	Proven restoration methodology	Novel method	Method used successfully elsewhere	Many examples of sucessful use, including within NZ
2	Likely risk of failure (e.g. erosion, plant desiccation)	Physical conditions at the edge of tolerances of key habitat forming species	Physical conditions mostly within tolerances of key habitat forming species	Physical conditions well within of tolerances of key habitat forming species
3	Likely cost of initial restoration	High (>$50k/ha)	Moderate ($10-50k/ha)	Low (<$10k/ha)
4	Likely cost of ongoing site maintenance	High maintenance costs (>$10kpa), e.g. labour intensive, high plant losses, extensive weed control)	Moderate maintenance costs ($5-10kpa),e.g. Limited labour, low plant losses, annual weed spraying)	Very little ongoing maintenance required (<$5kpa)
5	Site accessibility	Access difficult e.g., no vehicle access to site or traffic management required	Access constraints manageable e.g., fence removal, 4wd access	No access constraints
6	Extent of physical site preparation required	Extensive works needed over >50% of site using machinery	Works needed over 10-50% of site with some machinery	Works needed over <10% of site without using machinery
7	Is resource consent likely to be required?	Notified consent required	Non-notified consent	Permitted activity with no consent required
8	Potential adverse impact from restoration works	Significant adverse impacts that may persist or which can not be readily mitigated through appropriate management	Some short-duration adverse impacts that can be mitigated through appropriate management	No significant adverse impacts
9	Likely human amenity value	No current or future recreational opportunities	Indirect and limited use (e.g. walkway/cydeway, remore view-point)	Direct and frequent use (e.g. park with multiple passive and active uses)
10	Time frame for establishing desired changes	Desired changes occur over a long timeframe (>10 years)	Desired changes occur over a moderate timeframe (5-10 years)	Desired changes occur over a rapid timeframe (<5 years)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