Greenhithe Bridge Watermain Duplication and Causeway

Technical Report D: Ecological Assessment

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Watercare
An Auckland Council Organisation

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Executive Summary

Tonkin & Taylor Ltd (T&T) has been commissioned by Watercare Services Limited (Watercare) to assess the potential ecological and water quality effects related to the construction of the proposed Greenhithe Bridge Watermain Duplication (GBWD) and Causeway Project.

The terrestrial vegetation found at the site consists of four characteristic vegetation types: mangroves, saline vegetation, native revegetation, and exotic/native mixed forest vegetation. Terrestrial vegetation values in these habitats are low and therefore the effects from loss of terrestrial vegetation will be no more than minor.

The intertidal habitats present at the project site fall into five distinct marine habitat types, with the main habitat type consisting of “soft gloopy mud” (terminology from ARC Technical Publication 127). Field investigations found that the surface fauna within this area were comprised predominantly of oysters, snail species and mud crabs. Sub-benthic sampling found that oligochaete and polychaete worms were the main fauna types found. These habitats and species are typical of those found elsewhere in intertidal areas of the Waitemata Harbour.

Water quality results suggest that the receiving water quality of the project area has some nutrient and microbial issues, particularly near a stormwater drain that flows into the harbour. Sediment quality results showed that all tested sites were generally within the Auckland Council’s “Green” ERC category, but some sites had slightly elevated levels of lead and fell within the ‘Amber’ category.

A total of 289 birds from 17 different species were recorded as present within the survey area footprint, during surveys carried out from May 2014 to March 2015. Of the species recorded, four species are classified as nationally “Threatened” (Nationally Vulnerable). These species were the Caspian tern, red-billed gull, pied shag and banded dotterel. Six species are classified as “At Risk” (pied oystercatchers, pied stilts, white-fronted terns, banded rail, black shag and variable oystercatcher).

The project will result in the permanent loss of approximately 2.7 hectares of intertidal, supratidal and subtidal habitat. Intrinsic marine ecological values, and kaimoana values, of this area are deemed to be low, and the effects on these no more than minor in the context of the Waitemata Harbour. However, the majority of the area comprises foraging ground for threatened bird species, including those which are described above as nationally “Threatened”. Moreover, 0.22 ha of mangrove habitat serves as foraging habitat for the “At Risk” banded rail. While the loss of the habitat will result in more than minor effects on coastal birds due to their threat status, the effects are not considered to be significant.

Short-term, construction related effects may be managed by standard construction management techniques, such as sediment control, monitoring vegetation clearance and relocation of lizards and their habitat where possible, appropriate storage of environmentally hazardous substances so that they do not find their way into coastal environments, and selection of tracking routes to, through and around the active construction site, which avoid areas of highest ecological value.

A mitigation and compensation package is proposed, to address long-term effects on coastal birds from loss of foraging habitat. This includes the creation of an artificial roost site in the Project footprint, which will benefit most of the affected species, and a programme of predator control which will benefit all species, and particularly banded rail.

1 Introduction

Tonkin & Taylor Ltd (T&T) has been commissioned by Watercare Services Limited (Watercare) to assess the potential ecological and water quality effects related to the construction of the proposed Greenhithe Bridge Watermain Duplication (GBWD) and Causeway Project.

The project comprises:

- The construction of a new watermain on the northern side of the Greenhithe Bridge to duplicate the existing North Harbour 1 Watermain already located on the southern side of the bridge, and
- Widening of the causeway along the northern side of the existing State Highway 18 causeway to accommodate the new watermain, as well as wastewater pipelines and associated facilities which form part of Watercare's proposed Northern Interceptor (NI) project.

The proposed water and wastewater infrastructure is required in order to maintain water and wastewater service levels and to provide for future growth.

The proposed Greenhithe Bridge Watermain Duplication and Causeway project requires various resource consents under the Resource Management Act 1991 ("RMA"). This technical report provides specialist input for the *Greenhithe Bridge Watermain Duplication and Causeway – Assessment of Effects on the Environment* report ("the main AEE") report prepared by AECOM Consulting Services (NZ) Ltd which supports the resource consent application. The works described in the AEE have been considered in the technical assessment presented in this report.

This report provides the following:

- A brief overview of the proposed works.
- A description of the existing ecological, water quality and sediment quality values for the Greenhithe Bridge Watermain Duplication and Causeway Project area. Specifically, our scope of work investigates the following topics:
  - Marine benthic ecology;
  - Water quality;
  - Sediment quality;
  - Coastal seabirds;
  - Terrestrial and coastal vegetation;
  - Lizard habitat.
- A brief outline of relevant parts of the statutory framework relevant to the GBWD and Causeway Project area.
- An assessment of the actual or potential effects on the environment, having reference to the statutory framework and any other environmental factors considered relevant. This includes the identification of activities that could result in significant adverse effects and, in turn, identifying route refinements or construction methodologies that avoid such effects;
- Recommended ecological mitigation and management measures.
- The new watermain will eventually form part of Watercare's future North Harbour 2 Watermain project. The proposed widening of the motorway causeway will also incorporate wastewater pipelines and associated facilities which form part of Watercare's proposed Northern Interceptor

project. Separate technical reports have or will be prepared for the future North Harbour 2 Watermain project and for the balance of the NI project.

2 Greenhithe Bridge Watermain Duplication and Causeway Project

The proposed Greenhithe Bridge Watermain Duplication and Causeway works assessed in this report are the construction of:

- The proposed watermain from Station Street in Hobsonville, under the motorway to the coastal edge – this will involve open trenching from Station Street to the motorway, and trenchless construction under the motorway;
- Proposed causeway widening to accommodate the proposed watermain and wastewater pipelines – the proposed widening is approximately 860 m in length on the northern side of the existing motorway causeway. This consists of approximately 710 m of 15 m wide causeway, with a 150 m long by 50 m wide section part way along the causeway;
- The proposed watermain attached to the underside of the Greenhithe Bridge; and
- A proposed watermain cross connection chamber close to the eastern abutment of the Greenhithe Bridge.

The proposed works are described in detail in the AEE. Key drawings showing the proposed works and construction methodology are provided in the AEE, Volume 3 - Drawings. The works described in the AEE and as shown on the drawings are assessed in this report.

3 General Site Description

The project site is located in the north western section of the Waitemata Harbour near the Te Okoriki inlet on the northern side of Hobsonville, Auckland (Figure 3.1). The investigation site has already been modified with the development of the Upper Harbour Highway, and the proposed project constitutes an extension of an existing causeway on State Highway 18.

Figure 3-1 General location of project site. Source of base map: LINZ

4 Investigation Methods

4.1 Marine ecology

Semi-quantitative sampling of the estuarine benthic (surface) and sub-benthic (below surface) flora and fauna of the upper Waitemata Harbour affected by the proposed project was carried out at low tide on 30 May 2014. Sampling was conducted along five transects (T1 to T5) located within the project footprint. Transects extended from the existing rock wall towards the low tide mark. All five transects were 25 m in length, extending 10 m past the seaward extent of the proposed project area. Each transect had four stations positioned along it, three within the proposed footprint (5 m, 10 m and 15 m) and one outside of the footprint (25 m).

A further semi-quantitative survey was undertaken on 21 November 2014 to incorporate modifications to the project footprint. Three additional transects were surveyed: two (T6 and T7) within the footprint and one (T8) outside of the footprint. The transects were of varying length due to their position relative to the low tide mark, and differences in the works footprint at each location. T6 was approximately 65 m, T7 was approximately 15 m and T8 was approximately 100 m. Again, each transect had four stations positioned along it: three within the proposed footprint and one outside of the footprint.

The locations of all transects are shown on Figure A.2.

The benthic macro-fauna in three random 0.25 m^2 quadrats were recorded at each station. A single benthic core 0.013 m^2 in surface area and 100 mm deep was also collected at each station along the transect. Samples were preserved in ethanol for later macro-fauna identification and counting by Rod Asher of Biolive Invertebrate Identification Service. Shannon-Weiner evenness scores were calculated for each benthic fauna sample. At each station, records were also made of the habitat, dominant flora and fauna in the immediate vicinity and photographs were taken. Boundaries of various habitats were mapped based on the ARC (1999) criteria.

Finally, previous investigations into the existing environment within and near the project area by previous developments (Upper Highway Bridge upgrade, Hobsonville Land Company) and Council (Upper Waitemata Harbour ecological monitoring) were reviewed and relevant information is referred to within this report.

4.2 Water quality

Water quality samples were collected at four predetermined sites on the ebb tide on 2 July 2014 between 11:15 and 11:55 am. The locations of these sites are shown in Figure A.2. Samples were sent to RJ Hill Laboratories in Hamilton and tested for the following parameters:

- Carbonaceous Biochemical Oxygen Demand;
- Total Suspended Solids;
- Total Nitrogen;
- Nitrate + Nitrite;
- Total Ammoniacal Nitrogen;
- Total Kjeldahl Nitrogen;
- Total Phosphorus;

- Faecal coliforms and *Escherichia coli*;
- Total Petroleum Hydrocarbons.

Field measurements of dissolved oxygen, pH and temperature were also undertaken. Data were compared to ANZECC 95 % protection marine guidelines (ANZECC, 2000) and NZ Bathing Water guidelines (Ministry of Health/Ministry for the Environment, 2003).

4.3 Sediment quality

Five sediment samples were collected by Opus International Consultants (Opus) between 5-9 June 2014 and a further three sediment samples were collected by T&T on 21 November 2014. The locations of these additional sampling sites are shown in Figure A.2. All testing of the samples was done by RJ Hill Laboratories, Hamilton. To assess the ecological sediment quality status of the site, the results were compared to the Auckland Council Environmental Response Criteria (ERC) (ARC, 2004).

4.4 Coastal birds and their habitats

The coastal bird survey area encompasses 29.7 ha of inter-tidal zone, which is significantly larger than the 2.74 ha of inter-tidal habitat that will be directly affected by the Project (Figure A.3). The coastal bird survey area was selected to best ensure that all bird species that were likely to use habitat within the Project footprint were recorded in the survey and also to accommodate for potential changes in the project footprint location or extent[1].

The coastal bird survey included 24 bird counts between May 2014 and March 2015. The bird surveys were undertaken across the full range of seasons to better ensure that the surveys recorded all species that were likely to use the Project footprint and immediate surrounds. Some species, e.g. international migrants, are more likely to be present at certain times of the year. To this end, eight bird counts were completed between 27 May and 20 June 2014 (late autumn/winter), with another eight completed between 20 November 2014 and 4 December 2014 (spring/early summer) and a further eight between 16 February and 10 March 2015 (late summer/early autumn). Individual bird counts were undertaken at least a day apart to ensure temporal independence.

The site visits were timed to ensure that bird counts were undertaken across a range of tides, within an even number of counts undertaken at low, mid-low, mid-high and high tides. At the start and end time of each bird count, the weather state, tidal state and wind speed (Beaufort scale) were all recorded.

During the bird counts, all coastal bird species present were identified and their abundance within the study area recorded. To minimise duplication and maintain consistency of sampling effort, birds were recorded during a slow 30 minute walk in one direction along the Greenhithe causeway and bridge (approximately 1300 m). Birds were categorised as roosting or non-roosting.

Additionally, surveys for banded rail (*Gallirallus phillippensis assimilis*) were undertaken on 9 December 2014 within the saltmarsh vegetation and mangroves located to the immediate northwest and south of the Greenhithe Bridge (Figure A.3). Banded rail inhabit areas with salt marsh and

[1] We did not specifically record which birds were found within the direct Project footprint, as the surveys were carried out from May 2014 until March 2015, and the Project footprint was developed progressively during the course of the survey programme.

mangrove habitats and are known to be present but uncommon within the upper Waitemata Harbour. It is likely that banded rail are present in the salt marsh and mangrove habitat which runs parallel on the southern side of the causeway between the motorway and Buckley Ave. The mangrove areas on the eastern side of Monterey Park, fringing the Waiarohia Inlet and around Herald Island may also be inhabited by banded rail.

These surveys were undertaken due to the favourable habitat present in the footprint for banded rail and because this species is not usually observed in standard bird counts due to its secretive nature. The surveys included an assessment of habitat suitability and searches for footprints from landward to seaward boundaries of mangroves. Playback methods were also used to attempt to prompt banded rail call back response.

4.5 Terrestrial Vegetation

Vegetation and habitat types within the study area were also described during the site visits to assess the value of vegetation in the area, including its significance to coastal birds and herpetofauna. These are also shown on Figure A.3.

5 Description of existing environment

5.1 Marine Ecology

The marine ecology of the Greenhithe/Hobsonville area has previously been surveyed as part of the Upper Harbour Highway Bridge upgrade (Connell Wagner, 2001). Ecological monitoring of the upper Waitemata Harbour has also been carried out by Auckland Council (ARC, 2008).

In 2000, the study area was described as having a thin band of mangroves along the length of the northern side of the causeway with patches of Pacific oysters (*Crassostrea gigas*) on rocks and debris within the intertidal area. Surveys of sites in close proximity to the Greenhithe/Hobsonville area by Auckland Council found that bivalve molluscs, limpets, polychaete worms, spire shells and amphipods were the most abundant types of fauna encountered. The Upper Harbour Highway Bridge upgrade and reclamation was completed in 2007. As a result of this project the area of reclaimed coastal marine environment effectively doubled compared to the reclaimed area in 2000.

Coastal birds were not assessed in the Connell Wagner (2001) survey, although they were assessed in the Bioresearches (2009) survey for the Hobsonville Land Company. The Bioresearches study found that the locality is important for coastal birds, and recommended the establishment of artificial roost sites, to mitigate the net effects of intertidal dredging on these birds.

5.1.1 Intertidal habitat types

The intertidal habitats present at the project site fall into six habitat types based on the definitions in the ARC (1999), plus one further habitat type (Sandstone reef and Pacific Oyster bed). Sandstone reef and Pacific Oyster bed is similar to “Pacific Oysters over Old Cockles or Quaternary Rocks” as described in ARC (1999), but because oysters at the habitat at the GBWD and Causeway site are relatively sparse, we considered that this habitat warranted its own title and description.

The habitats found at the Greenhithe/Hobsonville area are listed below, and their locations are shown on Figures A.1a and A.1b.

Rock wall: representative of the seawall along Upper Harbour Highway.

Mangroves: representative of the Eastern corner of the site, the Southern side of the causeway and the South-Western corner of the causeway.

Sandstone reef: representative of areas along site.

Firm, muddy sand: representative of the Eastern sandflat section of the intertidal zone and section in the South-Western corner of the site.

Soft, gloopy mud: representative of the Western mudflat section of the intertidal zone.

Subtidal channel: at the eastern end of the Causeway extension.

Sandstone reef and Pacific Oyster bed: representative of the Western end of the intertidal zone.

5.1.2 Marine intertidal fauna

The marine intertidal fauna results of the ecological survey are presented in detail in Appendix B. Characteristic biota of the various habitat types found within the Greenhithe/Hobsonville area are outlined below:

Rock wall: The surface fauna of this habitat type comprised of Pacific oysters and barnacles (*Elminius modestus*).

Mangroves: The surface fauna of this habitat type comprised several snail species including the mud snail *Amphibola crenata*, the estuarine snail *Potamopyrgus estuarinus*, the spireshell *Zeacumantus lutulentus* and the small mud snail *Zeacumantus subcarinatus*. Pacific oysters and barnacles were also found living on the mangroves throughout the habitat type. The tunnelling mud crab (*Helice crassa*) was also present.

The infauna species of this habitat type were generally found in low abundances. Species found in samples included oligochaete worms and several polychaete worm species, of which rag worms (Nereidae) were most numerous. The Amphipods (Corophiidae and Talitridae) were also present, as were snapping shrimp *Alpheus* sp. and mites (Acarina). Several freshwater species were also found including the midges (Orthocladiinae) and crane flies (*Paralimnophila skusei*) and the axe-head caddis (*Oxyethira albiceps*). Shannon-Weiner evenness index scores for the samples taken from the mangrove habitat were generally high, with no particular taxon found to be dominant.

Sandstone reef: The surface fauna of this habitat type included the exotic dog whelk (*Nassarius burchardi*) and a single native mud flat whelk *Cominella glandiformis*. Cockles (*Austrovenus stutchburyi*) were found throughout the habitat type as were pacific oysters. A single nut shell (*Nucula hartvigiana*) and pipi (*Paphies australis*) were also identified.

The infauna species of this habitat type included oligochaete worms, several polychaete worm species, of which *Aricidea* sp. (29 individuals), *Cossura consimilis* (26 individuals) and *Heteromastus filiformis* (28 individuals) were most numerous. Amphipods and proboscis worms (Nemertea) were also found. The Shannon-Weiner eveness index scores for the samples were all generally high, indicating that no particular taxon was dominant.

Sandstone reef and Pacific Oyster bed: This habitat type was similar to the sandstone reef habitat with the exception of the large established pacific oyster bed which covered a significant part of the habitat. The surface fauna also included a mud snail, dog whelks and estuarine snails. A single exotic Asian mussel (*Musculista senhousia*) was also found at the site.

The infauna of this habitat type was comprised of mainly oligochaete and polychaete worms, of which *Polydora* sp. was particularly abundant (225 individuals in a single core). Other infauna species included *Tanaid* sp. shrimp, amphipods and midges. The Shannon-Weiner evenness scores for samples from this habitat type were generally comparable to the other habitat types although one lower score reflects that the sample was dominated by two taxa (*Polydora* sp. and oligochaete worms).

Firm Muddy Sand: The surface fauna of this habitat type included exotic dog whelks, cockles and a single wedge shell (*Macomona liliana*). A single stalk-eyed mud crab (*Macrophthalmus hirtipes*) was also identified.

The infauna of this habitat type were found in low abundances with polychaete worms the dominant type of species found. Of these, *Polydora* sp. and rag worms where the most abundant. Amphipods were also present, as were cumaceans. The Shannon-Weiner evenness index scores for this habitat type were generally high demonstrating that no particular species was dominant.

Soft Gloopy Mud: The surface fauna of this habitat type included dog whelks, the exotic window shell (*Theora lubrica*). Nut shells (*Nucula hartvigiana*) was also present.

The infauna of this habitat were generally dominated by oligochaete and polychaete worms, of which *Aricidea* sp. was particularly abundant (58 individuals in one sample). Mysid shrimp, tanaid shrimp, amphipods, midges and axe-head caddis were also identified in collected samples. The Shannon-Weiner evenness scores for samples from this habitat type were slightly lower than the other habitat types due to the greater abundances of a few taxa (Paraoinidae, Nereidae, *Aricidea* sp. and *Heteromastus filiformis*).

Subtidal channel: Due to lack of safe access, this habitat was not directly sampled, but according to ARC (1999), the coarse sediments of the main Waitemata Harbour channel support a highly diverse fauna comprising (in decreasing order): polychaete worms, amphipods, bivalves, crabs, isopods, gastropods (snails), echinoderms, decapod crustacea and chitons.

5.1.3 Marine flora

Mature stands of mangroves (*Avicennia marina*) were present on both the southern and northern sides of the Upper Harbour Highway causeway, with some other individuals spread sporadically along the northern rock seawall face. Neptune's necklace (*Hormosira banksii*) was also present in some areas of the Sandstone reef habitat.

5.1.4 Kaimoana

Kaimoana species identified in the study area included:

- Pacific oysters;
- Cockles;
- Pipi;
- Wedge shells;
- Gastropods (snails and whelks)

Pacific oysters were most numerous and were present along the rock wall habitat and on the Sandstone reef and Pacific oyster bed habitat. Cockles were mainly found in the Firm Muddy Sandflat habitat. A single pipi was found in a core taken on the fringe of Sandstone reef and Soft Gloopy Mud habitat while a single wedge shell was found on the Firm Muddy Sand habitat.

Several gastropod species were identified in low numbers in the surface fauna investigations. Gastropods were present throughout the site but were all small and not of an attractive edible size. Overall, the kaimoana value of the site is considered to be low.

5.1.5 Fish

No survey for fish was carried out as part of this investigation. However, the diversity of fish species frequenting the Project area during high water are likely to be similar to that recorded in the upper Waitemata Harbour (Auckland Regional Authority, 1983).

Although no specific fish survey was undertaken as part of this work, fish species probably present in the Project area include the Australian anchovy (*Engraulis australis*), the yellow-eye mullet (*Aldrichetta forsteri*), the striped mullet (*Mugil cephalus*), the yellow belly flounder (*Rhombosolea leporina*), the New Zealand flounder (*Rhombosolea plebeia*), Snapper (*Pagrus auratus*), Kahawai (*Arripus trutta*), the spiny dogfish (*Mustelus lenticulatus*), Spotties (*Notolabrus celidotus*), Parore (*Girella tricuspidata*), Jack Mackerel (*Trachurus novazelandiae*) and School Sharks (*Galeorhinus galeus*).

5.1.6 Threatened species

No nationally “Threatened” or “At Risk” species marine invertebrates were recorded during this survey (Freeman *et al.*, 2013).

5.2 Water quality

Results of the monitoring and relevant water quality guidelines are presented in Appendix C, as is the full laboratory transcript.

- Overall, the water quality results suggest that the receiving water quality has some nutrient and microbial issues, particularly at Site 1 which was located near a drain that flows into the harbour. The surface water monitoring data is summarised as follows:
- Dissolved oxygen levels were similar at Sites 2 – 4 and fell within the minimum and maximum ANZECC guideline values for marine systems. Dissolved oxygen levels at Site 1 were slightly lower and fell below the minimum ANZECC guideline (90%);
- Total suspended solids were below detection limit at Sites 2-4 but were relatively high (34 mg/L) at Site 1;
- Total Ammoniacal nitrogen levels were below ANZECC guidelines at all sites. Total nitrogen levels were below ANZECC guidelines at Sites 2-4, Site 1 (1.0 mg/L) exceeded the ANZECC guideline of 0.3 mg/L;
- Total phosphorus levels were slightly above the ANZECC guideline (0.025 mg/L) at all sites;
- Faecal coliforms and Escherichia coli levels were higher at Site 1 (200 cfu/100 mL) than values at Sites 2, 3 and 4 (24-27 cfu/100 mL), perhaps due to its proximity to the stormwater outfall which passes under the existing causeway. Applying the USEPA ratio of 126 Enterococci per 200 faecal coliforms, all values were well below the MoH and MfE guideline value for Enterococci of 280 cfu/100 mL. For further context, the E. coli level recorded falls into the best water quality category (Attribute State “A”) for recreation, under the National Policy Statement for Freshwater Management 2014;
- TPH values were below detection limits at all sites.

5.3 Sediment quality

The sediment quality analyses are presented in Appendix D, as are the full laboratory transcripts and sampling locations.

Overall, the sediment quality results show that the majority of copper, lead zinc levels were within the ARC "green" zone indicating that contaminant concentrations present a low risk to the biology of the site (ARC, TP 168)[3]. At some sites concentrations fell within the "amber" zone indicating that the biology of this site could possibly be impacted (ARC, TP 168)[3]. PAH results were only available for some sites, those available all fell within the "green zone" with the exception of Tab 1, which fell within the "amber zone". Overall, sediments have relatively low contaminant levels and are similar to previous data that was collected for the Upper Harbour Highway Bridge upgrade (Connell Wagner, 2001).

5.4 Coastal birds and their habitats

The study area is dominated by sand and mudflats that provide habitat for coastal birds. The focal area also includes a shellbank beach with saline/saltmarsh vegetation and an expanding patch of young mangroves. The saline/saltmarsh vegetation consisted primarily of sea rush (*Juncus kraussii* var. *australiensis*), needle grass (*Austrostipa stipoides*), (*Machaerina articulate*), glasswort (*Sarcocornia quinqueflora* subsp. *quinqueflora*), *Machaerina juncea*, oioi (*Apodasmia similis*), salt marsh ribbon wood (*Plagianthus divaricatus*), sea primrose (*Samolus repens*), remuremu (*Selleira radicans*) and arrow grass (*Triglochin striata*) was also present. Saline/saltmarsh vegetation is suitable nesting and foraging habitat for banded rail and mangrove habitat is suitable foraging habitat for banded rail.

During our coastal bird surveys, a total of 289 birds from 17 different species were detected within the survey area. This includes the presence of banded rail footprints, which were located in mangrove habitat at the Western end of the causeway. The detection of both adult and chick footprints suggests that banded rail are nesting within the saline/saltmarsh vegetation that is located in close proximity to (but outside) the Project footprint (see Plates 1 and 2, and Figure A.3 in Appendix A).

Of the species directly recorded in our surveys, four species are classified as nationally "Threatened" and six species as "At Risk" (Miskelly *et al.* 2008)[2] (Table 5-1). Note that this table excludes the At Risk" banded rail, as this species was detected through targeted surveys of bird sign in mangrove habitats rather than by direct counting methods.

[2] The New Zealand Threat Classification System was developed by the Department of Conservation and is used to assign native New Zealand taxa with a standardised threat status. The Criteria for categorising a species is outlined in the New Zealand Threat Classification Manual (Townsend *et al.,* 2008). An audit of all New Zealand bird taxa that have been categorised using this criteria and further details on the bird species listed above can be found in Robertson *et al*. (2013).

Plate 1 Banded rail footprints located within mangrove habitat located to the North-west of the Greenhithe Bridge (November 2014)

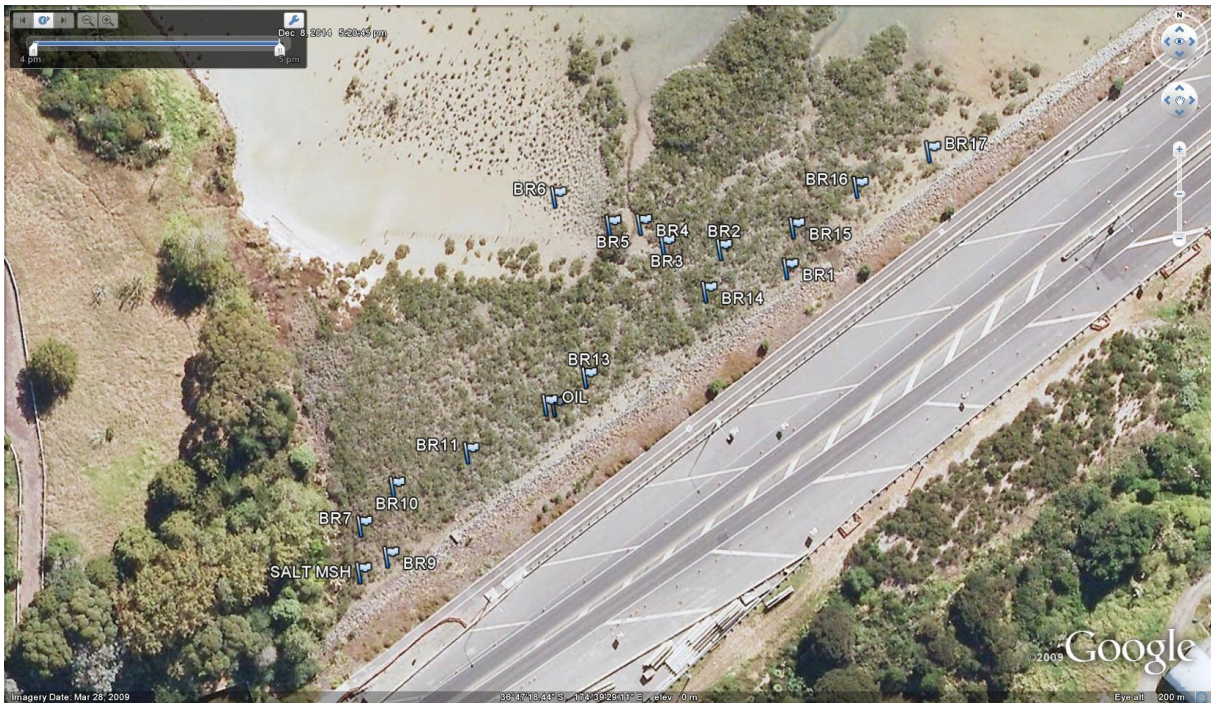

Plate 2 Locations of adult and chick banded rail footprints detected within the mangroves located to the North-west of the Greenhithe bridge (November 2014).

Table 5-1 Coastal bird species detected within the intertidal survey area during coastal bird surveys undertaken from May 2014 – March 2015

Species	Conservation status*	Mean observations per survey (range) May/June	Mean observations per survey (range) Nov/Dec	Mean observations per survey (range) Feb/March	Mean observations per survey (range)	Relative abundance % (n)
Red-billed gull (*Larus novaehollandiae*)	Threatened: Nationally Vulnerable	1.6 (0-7)	0.3 (0-1)	0.25 (0-2)	0.8 (0-7)	6.2 (18)
Pied shag (*Phalacocrorax varius*)	Threatened: Nationally Vulnerable	1.1 (0-4)	1.0 (0-2)	0.5 (0-2)	0.8 (0- 4)	6.6 (19)
Caspian tern (*Sterna caspia*)	Threatened: Nationally Vulnerable	0.9 (0-2)	0	0	0.3 (0-2)	2.4 (7)
Banded dotterel *(Charadrius bicinctus)*	Threatened: Nationally Vulnerable	0	0.1 (0-1)	0	<0.05 (0-1)	0.3 (1)
White-fronted tern (*Sterna striata*)	At Risk: Declining	0.1 (0-1)	1.3 (0-3)	0.6 (0-2)	0.8 (0-3)	6.6 (19)
Pied oystercatcher (*Heamatopus ostralegus*)	At Risk: Declining	2.8 (0-8)	0	0.25 (0-2)	1.1 (0-8)	8.3 (24)
Pied stilt (*Himantopus himantopus*)	At Risk: Declining	3.8 (0-11)	0.3 (0-1)	1 (0-3)	1.7 (0-11)	13.8 (40)
Variable oystercatcher (*Heamatopus unicolor*)	At Risk: Recovering	0.4 (0-2)	0.1 (0-1)	1 (0-2)	0.5 (0-2)	4.2 (12)
Little shag (*Phalacocrorax melanoleucos*)	Not threatened	0.5 (0-1)	0	0.3 (0-1)	0.3 (0-1)	2.4 (7)
Black shag (*Phalacocrorax carbo*)	At Risk: Naturally uncommon	0	0.1 (0-1)	0.1 (0-1)	0.01 (0-1)	0.7 (2)
White-faced heron (*Ardea novahollandiae*)	Not threatened	3 (0-9)	0.6 (0-2)	2.1 (0-7)	2.0 (0-9)	16.3 (47)
Black-backed gull (*Larus dominicanus*)	Not threatened	0.9 (0-8)	0.6 (0-2)	1.1 (1-4)	1.6 (0-7)	13.1 (38)
Kingfisher (*Halcyon sancta*)	Not threatened	3.6 (0-7)	0.5 (0-2)	0.1 (0-1)	1.4 (0-7)	11.8 (34)
Pukeko (*Porphyrio porphyrio*)	Not threatened	0.4 (0-2)	0	0	0.1 (0-2)	6.7 (2)
Spur winged plover *(Vanellus miles)*	Not threatened	0.00	0.6 (0-3)	0.5 (0-4)	0.4 (0-3)	3.1 (9)
Mallard duck *(Anas platyrhynchos)*	Not threatened	0	0.8 (0-3)	0.3 (0-2)	0.4 (0-3)	3.5 (10)

All nationally “Threatened or “At Risk” species are classified as “Least Concern” under the International Union for the Conservation of Nature’s Red Data List of threatened species (Hilton-Taylor, 2000), with the exception of pied oystercatcher, which is not listed.

Other bird species which were observed in proximity to the nearby study area or outside of survey times include the bar-tailed godwit (*Limosa lapponica baueri*) and royal spoonbill (*Platalea regia*). Both the bar-tailed godwit and royal spoonbill are considered "at risk" declining and naturally uncommon, respectively. The bar-tailed godwit is an international migrant and the International Union for Conservation of Nature (IUCN) considers the international population to be decreasing.

A coastal bird survey was undertaken in July 2009 by Bioresearches (2009) to support the consent application for a residential development at nearby Hobsonville Point. Survey results from the present study were similar to Bioresearches (2009): the only notable exception was that several nationally threatened Caspian tern were observed during our survey but this species was not recorded in the study area surveyed by Bioresearches.

Only 26 of the 289 birds recorded were roosting, while the majority were classified as non-roosting (and were predominantly foraging), indicating that this area is predominantly used by coastal birds for foraging. Roosting birds included shag species that use rock armour areas on the embankment.

5.5 Terrestrial vegetation

Within the footprint of the proposed works, three main habitat types were identified and include:

- a small shell beach;
- an artificial rocky bank of the developed causeway; and
- headlands.

Within these habitat types there are four characteristic vegetation types: mangroves, saline vegetation, native revegetation, and exotic/native mixed forest vegetation. The area and location of each vegetation type is depicted in Figure A.3.

The vegetation types are dominated by the following species:

Mangroves (0.22 ha)

- Mangroves – *Avicennia marina*

Saline vegetation (0.05 ha)

- Oioi - *Apodasmia similis*
- Sea rush - *Juncus kraussii*
- Needle grass - *Austrastipa stipoides*

Native Plantings (0.60 ha)

This habitat occurs along the causeway embankment and is approximately 8 years in age. While this is an area of native plantings a number of exotic species have colonised (most notably pampas and gorse). Common species include:

- Pohutukawa - *Metrosideros excelsa*
- Flax - *Phormium tenax*
- Small leaved pohuehue - *Muehlenbeckia complexa*

- Karamu - *Coprosma robusta*
- Native Toetoe - *Cortaderia* spp.
- Pampas – *Cortaderia* spp
- Gorse - *Ulex europaeus*
- Wattle sp.

Exotic/Native mixed forest (0.73 ha)

This habitat type occurs at the Western (0.33 ha) and Eastern ends (0.40 ha) of the Greenhithe causeway and bridge. This vegetation is dominated by large exotic species (including oaks, eucalyptus and pines), with a mixed exotic/native subcanopy and understory. Common species include:

- Eucalyptus species
- *Quercus* sp.
- Mapou - *Myrsine australis*
- Wattle sp.
- Pine - *Pinus radiata*
- Pampus
- Gorse - *Ulex europaeus*
- Mingimingi - *Leptecophylla* spp.
- Mahoe - *Melicytus ramiflorus*
- *Coprosma repens*
- Karamu - *Coprosma robusta*
- Kanuka - *Kunzea ericoides*
- Manuka - *Leptospermum scoparium*
- Totara - *Podocarpus totara*
- English privet - *Ligustrum sinense*
- Climbing asparagus - *Asparagus scandens*
- Silver fern - *Cyathea dealbata*
- Karaka - *Corynocarpus laevigatus*
- Lemonwood - *Pittosporum eugenioides*
- Ngaio – *Myoporum laetum*
- Wharangi - *Melicope ternate*

5.6 Herpetofauna

Exotic and native mixed forest located at the eastern and western ends of the causeway (Figure A.3) comprises habitat suitable for native copper skinks (*Oligosoma aeneum*). Suitable skink habitat within this vegetation type comprised thick leaf litter ground cover and woody debris.

No other lizard habitat was identified in the project area.

Although the native copper skink is not threatened, all native lizards in New Zealand are protected under the Wildlife Act 1953, with penalties for actions that deliberately lead to the destruction of their habitat or death of individuals. A permit is required from the Department of Conservation to survey, hold, capture, release or relocate any protected animal. This is discussed further in Section 7.3.

5.7 Areas of ecological value

The Project footprint and immediate surrounds includes a diversity of ecological characteristics and values. Some of these locations have been assessed as areas of ecological value[3] under different statutory contexts including the PAUP, relevant operative Auckland Council District Plans, the operative Auckland Council Regional Plan: Coastal (ACRP:C) and the operative Auckland Council Regional Policy Statement (Appendix E).

Part of the project footprint (along the existing causeway) is defined as an SEA (SEA_ T_3409) because it meets the following criteria (Appendix 5.1 of the PAUP - Significant Ecological Areas on Land).

- Criterion 2 - Threat status, rarity
- Criterion 4 - Stepping stones, migration pathways and buffers

From our observations during field surveys, it appears that Criterion 2 relates to the use of the rock armour as roost sites by the nationally "Threatened" pied shag and the "At Risk" black shag. However, it is unclear why this site meets significance criteria relating to stepping stones, migration pathways and buffers.

Several other areas of ecological value are located in close proximity to the Project footprint (Appendix E). The project footprint will be ecologically linked to these areas, as some of the less sedentary fauna that use the Project footprint will also use them (e.g., coastal and land birds).

While intertidal mud and sand flat habitat within the Project footprint is not designated as an SEA (PAUP) or CPA (ARP:C), the project footprint itself is considered to have ecological significance. Specifically, the Project footprint provides foraging habitat for "Nationally-Threatened" and "At Risk" species. These species are as listed in Table 5-1 above.

[3] "Areas of ecological value" is a non-statutory term used generically by the authors to cover areas such as Significant Ecological Areas, Coastal Protection Areas and Sites of Special Wildlife Interest (SSWI).

6 Assessment of ecological effects

6.1 Benthic ecology

6.1.1 Supratidal, upper intertidal and subtidal habitats

Figure A.1b (Appendix A) shows the footprint of the proposed works superimposed upon the existing marine macrohabitat types which have been recorded at the site. The footprint of the proposed works covers approximately 2.7 hectares. The areas of these habitats within the footprint and the percentage of total works footprint, at the time of our survey, are presented in Table 6-1. We note that muddy and sandy sediments are mobile, and that the actual percentages may vary through time.

Table 6-1 Areas of marine macrohabitats covered by proposed works

Macrohabitat type	Area covered by footprint (ha)	Percentage of total works footprint
Mangroves	0.22	8.0
Firm muddy sand	0.03	1.1
Sandstone reef	0.78	28.5
Soft gloopy mud	0.62	22.6
Sandstone reef with oyster bed	0.19	6.9
Rock wall	0.62	22.6
Subtidal channel	0.28	10.2
Total	**2.74**	**100.00**

The majority of the affected habitats are intertidal. Sandstone reef, soft gloopy mud and rock wall habitats constitute the majority of the footprint (approximately 74%).

Intertidal sandstone reef habitat was the largest habitat type found within the area of the GBWD and Causeway project footprint (28.5%). Intertidal sandstone reef habitat is common throughout the Waitemata Harbour and is found along most of the northern side of the Waitemata Harbour from Stanley Point near Devonport through to Greenhithe (ARC, 1999). Soft-gloopy mud and rock wall habitats were the second largest habitat types, each covering approximately 22.6% of the project footprint. The species found at both of these habitat types were dominated by oligochaete and polychaete worms, which are of low ecological value.

Rock walls have been used extensively around the Waitemata Harbour's edges to reduce erosion and as retaining walls for reclamations, roadways and railway embankments (ARC, 1999). This habitat will be also be re-instated as part of construction works and will be re-colonised by similar species.

Mangrove, Firm muddy sand and Sandstone reef with oyster bed habitats all comprised a small percentage of the GBWD and Causeway project footprint. Based on the Waitemata Harbour habitat map, the types of habitats affected by the GBWD and Causeway project footprint constitute a small percentage of the total habitat areas found throughout the Waitemata Harbour.

Overall, due to the small size of habitat loss compared to the available habitat throughout the Waitemata Harbour, and the fact that the species composition of the site was generally dominated by infaunal worm species and that no threatened marine invertebrate species were identified, it is considered that the loss of intertidal habitats in the project area will only have minor adverse direct effects on intrinsic marine ecological values.

Indirect effects on coastal birds from loss of foraging habitat are discussed below.

6.1.2 Kaimoana

The following assessment has been made with regard to the effects on kaimoana species present at the site:

- **Cockles:** A total of 28 individuals were present in samples from the vicinity of the works area (Transects 2 and 3) and from within the footprint of the proposed project, so some populations will be buried whilst others will not. These cockles were generally less than the attractive edible size, and therefore are not a significant kaimoana resource. While they are able to migrate vertically through up to 50 cm of sediment, most cockles within the footprint will not survive.
- **Pipi:** a single pipi was present at Transect 3 but was outside of the project footprint. The pipi was less than the attractive edible size and as only a single pipi was found, pipi are probably not a significant kaimoana resource.
- **Pacific oysters:** a large number are present in the project footprint and the wider project area. Oysters covered by the direct project footprint will not survive. They are however, expected to recolonise the newly created habitat along the proposed rock walls. This species was accidentally introduced to New Zealand, so is of no conservation concern.
- **Gastropods (whelks, topshells, mudsnails):** were found in low numbers across all habitat types. They will show some avoidance behaviour and some will not survive. This adverse effect is considered to be minor due to the large area of unaffected habitat at neighbouring intertidal sites such as around Herald Island.

6.2 Coastal birds

Long term effects of the project will include the loss of approximately 2.24 hectares (22,400 m^2) of inter-tidal foraging habitat for all of the 16 coastal birds listed in Table 5-1 above, which included four nationally “Threatened” and five “At Risk” species. The project will also result in the loss of approximately 0.22 hectares (2,200 m^2) of mangrove foraging habitat for the “At Risk” banded rail. These areas are shown on Figure A.1b (Appendix A).

Banded rail nesting habitat is present in the vicinity of the project footprint, and will be subject to temporary (e.g. noise) disturbance during construction, although not permanently lost as a result of the project. With the exception of banded rail foraging habitat (i.e. mangroves), intertidal foraging habitat for coastal birds is regionally in decline due largely to mangrove encroachment and human modification of this habitat type (Tonkin & Taylor, 2015).

On the basis that the project footprint and immediate surrounds includes habitat for ten nationally “Threatened” and “At Risk” species, we consider effects to be more than minor. However, we do not consider effects to be significant because:

- The project footprint will occupy only a small proportion of the foraging habitat available in the upper Waitemata Harbour;
- The area is not frequented by high numbers of any of the “Threatened” or “At Risk” coastal bird species recorded at the site;
- The inter-tidal foraging area within the footprint is not designated as a CPA under the ACRP:C, or an SEA in the PAUP, for coastal birds;
- No birds are likely to be killed or injured as a result of the project, rather birds are expected to move to other areas to forage.

In Section 7, we recommend and describe measures to avoid, mitigate and compensate for more than minor effects on coastal birds..

6.3 Terrestrial vegetation

Approximately 0.3 ha of mixed exotic/native forest and 0.6 ha of young native plantings will be lost. We consider terrestrial vegetation values in both these habitats to be low and therefore the effects of loss of terrestrial vegetation associated with this project to be no more than minor. Consequently, no specific mitigation is considered to be necessary.

6.4 Herpetofauna

Copper skink habitat has been identified in exotic/native vegetation that occurs within the Project footprint at the Western end of the causeway (i.e. in both the temporary access road on private property and within the footprint of the reclamation). Therefore, without mitigation there will be effects on copper skink through loss of habitat and possibly mortality or injury.

7 Ecological mitigation and compensation

7.1 Benthic ecology

Due to the relatively small affected area by the project footprint compared with the wider Waitemata Harbour and that part of the project footprint (the rock wall) will be re-colonised, we consider that no specific mitigation for the long-term effects on marine ecology is required.

Short-term, construction related effects may be managed by standard construction management techniques, such as sediment control, appropriate storage of environmentally hazardous substances so that they do not find their way into coastal environments, and selection of tracking routes to, through and around the active construction site, which avoid areas of highest ecological value. In general, these are the soft sediment habitats which are foraging areas for coastal birds.

7.2 Coastal birds

Potential adverse effects on coastal birds are expected to be more than minor due to the loss of 2.24 ha of foraging habitat (including inter-tidal sand/mud flats for nine nationally "Threatened" or "At Risk" coastal bird species), and 0.22 ha of foraging habitat (mangroves) for the "At Risk" banded rail.

This section sets out proposed mitigation and compensation measures that are proposed to address effects on coastal birds.

7.2.1 Mitigation of construction phase effects

To avoid or minimise potential adverse effects on birds, construction activities would ideally be undertaken outside of September-December, which is the breeding season for banded rail. However, we recognise that this is unlikely to be practicable for a project of this scale.

7.2.2 Mitigation and compensation of long-term effects

A mitigation and compensation package is proposed, to address long-term effects on coastal birds. This is described below, and depicted in Figure A.4.

It should be noted that the above package of ecological mitigation and compensation measures are a concept only, and will depend on the final configuration and area of the extension to the reclamation. The detailed design phase will include ecological input, to assist with the final design of this package, taking into account any subsequent changes to the footprint of the extension.

The proposed mitigation and compensation package is expected to adequately mitigate for loss of 0.22 ha of foraging habitat for banded rail. This will be achieved through a small increase in the quality of nesting and foraging habitat and through a reduction in the level of predation due to pest control efforts. Specifically, mitigation for banded rail will include:

- Approximately 10 m² of saltmarsh enrichment planting within the area outside the project footprint to the north-west of the Greenhithe Bridge, which has been identified as banded rail nesting and foraging habitat (Figure A.3, Plates 1 and 2).

- 5 years of mammalian pest control within the area described above and within SEA-T-4791, which is expected to include banded rail based on the size and availability of suitable nesting and foraging habitat for this species (Figure A.3, Plates 1 and 2)

The proposed package is expected to partially compensate for the loss of 2.24 ha of foraging habitat (inter-tidal sand/mud flats) for coastal birds, including nine nationally "Threatened" or "At Risk" species. This will be achieved by providing additional roosting habitat for most of the species that forage within the inter-tidal area that will be newly reclaimed. This roosting habitat will be in the form of an artificial shellbank, which will mimic the functions of the shellbank roost at nearby Nimrod Inlet and Bomb Bay (SEA-M1-56b – see table in Appendix E and plan map in Appendix E.4). All species that forage within the footprint are likely to use artificial roosting habitat, with the exception of the "At Risk" pied stilt, white faced heron and pukeko. Proposed compensation efforts include:

- The creation of an approximately 1,000 m² raised artificial shellbank roost site on the area known as 'The Tab' that is situated at least 20 m from the nearest pathway;
- The addition of at least 12 piled roosts located on the side slope of the reclamation extension, to the immediate west of the Greenhithe bridge;
- Fencing between the artificial shellbank roost site and the walkway to minimise disturbance from humans and disturbance from dogs;
- 5 years of mammalian pest control (traps and bait stations) along the northern causeway and "Tab" to protect roosting and possibly nesting birds from predation by hedgehogs, rats, cats and stoats; and
- Signage to highlight the importance of the wider area and artificial roost site for the protection of coastal birds.

7.3 Herpetofauna

To avoid or minimise adverse effects on copper skinks associated with the loss of terrestrial vegetation, we recommend pre-construction and construction-assisted salvaging be undertaken by a DOC-permitted herpetologist. Any salvaged skinks captured should be relocated into the terrestrial vegetation at the eastern end of the Greenhithe Bridge that is located within the project footprint. This habitat should be enhanced for copper skinks through the addition of logs from trees felled during vegetation clearance activities associated with this Project.

8 References

ANZECC. 2000. Guidelines for Fresh and Marine Water Quality. Chapter 3 – Aquatic Ecosystems.

Auckland Council. Proposed Auckland Unitary Plan (2013). Appendix 6.1: Schedule of Significant Ecological Areas – Marine

Auckland Regional Authority (1983). *Ecology of the Upper Waitemata Harbour*. Auckland Regional Water Board 29 pp.

Auckland Regional Council (1999). *The intertidal and subtidal biota and habitats of the central Waitemata Harbour*. ARC Technical Publication No. 127.

Auckland Regional Council. (2004). *Blueprint for monitoring urban receiving environments.* Technical Publication No. 168 revised edition.

Auckland Regional Council (2008). *Upper Waitemata Ecological Monitoring, 2005 – 2008*. ARC Technical Report No. 013.

Bioresearches Ltd (2009). Preliminary Assessment of Coastal Birds for Hobsonville Land Company.

Connell Wagner. (2001). Transit New Zealand – PA1981 – Upper Harbour Highway Bridge Duplication Project Assessment of Environmental Effects: Appendices. 186 pp.

Forest & Bird (2014). *New Zealand Seabirds: Important Bird Areas and Conservation*. The Royal Forest and Bird Protection Society of New Zealand, Wellington, New Zealand, pp. 72

Freeman, D, Schnabel, K, Marshall, B, Gordon, D, Wing, S, Tracey, D, Hitchmough, R (2013). *Conservation status of New Zealand invertebrates, 2013.* Department of Conservation.

Heather, B & Robertson, H. *The Field Guide to the Birds of New Zealand.* London, Penguin Books.

Hilton-Taylor, C. 2000 (compiler). *2000 IUCN Red List of Threatened Species*. IUCN, Gland, Switzerland and Cambridge, UK.

Ministry of Health/Ministry for the Environment. 2003. *Microbiological water quality guidelines for the marine and freshwater recreational areas.*

Miskelly, C.J., Dowding, J., Elliott, G. (2008). Conservation status of New Zealand birds, 2008. *Notornis* **55**: 117-135.

Robertson *et al*. (2013) *Conservation Status of New Zealand Birds, 2012*. New Zealand Threat Classification Series 4, Department of Conservation, ISBN 978–0–478–22662-1 (web PDF).

Tonkin & Taylor 2015. Mangrove Management Guidelines Report: Henderson-Massey prepared for the Henderson-Massey Local Board and Auckland Council.

Townsend, A.J. *et al*. (2008). *New Zealand Threat Classification System manual*. Department of Conservation, ISBN 978–0–478–14363–8.

9 Applicability

This report has been produced in accordance with our proposal dated 12 May 2014, as amended by subsequent instructions from Watercare and URS/AECOM as its agent. This report has been prepared for the benefit of Watercare Services Limited with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

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Project Director

pp. Kieran Miller

Terrestrial Ecologist

Report reviewed by:
Brett Ogilvie, Senior Marine Ecologist; Matt Baber, Senior Terrestrial Ecologist.

Appendix A Figures

LEGEND

- Mangroves
- Sandstone reef
- Sandstone reef with oyster bed
- Soft gloopy mud
- Firm, muddy sand
- Rock wall

Aerial photo provided by Watercare Services Ltd.

Tonkin & Taylor
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DRAWN	RBS	Mar. 15
DRAFTING CHECKED		
APPROVED		
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SCALES (AT A3 SIZE) N.T.S.		
PROJECT No. 29718		

Watercare
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GREENHITHE BRIDGE WATERMAIN DUPLICATION & CAUSEWAY

Benthic Habitat Map – Oblique view at Low Tide

FIG. No. Figure A. 1a

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WAITEMATA HARBOUR

UPPER HARBOUR HIGHWAY

BUCKLEY AVENUE

N

LEGEND

- Mangroves
- Sandstone reef
- Sandstone reef with oyster bed
- Soft gloopy mud
- Firm, muddy sand
- Rock wall

SCALE 1: 2,500

0 50 100 150 (m)

Aerial photo and boundaries sourced from Auckland Council GIS Website

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PROJECT No. 29718		

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GREENHITHE BRIDGE WATERMAIN DUPLICATION & CAUSEWAY

Benthic Habitat Map – Aerial View at High Tide

FIG. No. Figure A. 1b

REV. 0

WAITEMATA HARBOUR

UPPER HARBOUR HIGHWAY

BUCKLEY AVENUE

T1
T2
T3
T4
T5
T6
T7
T8

Site1
Site2
Site3
Site4

TAB1
TAB2
TAB3

LEGEND

Water quality sampling site

Sediment sample location

25m transect

SCALE 1: 2,500

0 50 100 150 (m)

Aerial photo and boundaries sourced from Auckland Council GIS Website

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GREENHITHE BRIDGE WATERMAIN DUPLICATION & CAUSEWAY

Sediment & Water Quality Sampling Location Plan

FIG. No. Figure A.2

REV. 0

LEGEND

- Project Area
- Mangroves
- Exotic/Native forest edge
- Native revegetation
- Saline vegetation
- Works platform

Bird Survey Area

CA END

S.118 CAUSEWAY

CA START

N

SCALE 1: 5000

0 50 100 150 200 250 (m)

Aerial photo and boundaries sourced from Auckland Council GIS Website

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SCALES (AT A3 SIZE) 1: 5000		
PROJECT No. 29718		

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GREENHITHE BRIDGE WATERMAIN DUPLICATION & CAUSEWAY
Bird Survey Areas

FIG. No. Figure A.3

REV. 0

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Upper Harbour

LEGEND / EXPLANATION

SHOREBIRD HABITAT / STORMWATER SWALE AREA

This area is designed to provide roosting habitat for shorebirds and simultaneously provide stormwater treatment through swales.

1. Raised shell bank – roosting habitat which may be used by oystercatcher, dotterels and seasonal migrants such as godwits. May also be a suitable breeding site for oystercatcher and dotterels. Indicative only.
2. Substrate yet to be determined. Options include biofiltration bark, shell or low stature ground cover such as sand coprosma (*Coprosma acerosa*) or swampweed (*Selliera radicans*), which is already present in the intertidal area of the footprint.
3. Dog proof fencing

PEST CONTROL

4. Pest control (Bait Stations)
5. Pest Control (Traps)

DOC 200 traps and bait stations to be alternating at 25 m intervals around the roost site and seaward site of causeway. Traps provide increased protection to the shell bank area. Bait stations at 50 m intervals around the mangrove/salt marsh SEA on southern side of causeway and salt marsh area at western end of causeway.

WOODEN PILLAR STRUCTURES

6. Wooden pillar structures – for roosting of gulls and shags and potentially white fronted terns. Generates a wharf/ marine tone to landscaping. Located away from the shell bank and wetland to minimise predation and harassment from dominant species such as black backed gulls. Suggested size approximately 2 -3 m in height and 0.3 m diameter.

Each cluster of pillars should have a different surface on the top which may be preferential to different species. The concept (Figure 6a) has no modified top, intended to replicate piers at a wharf. By creating a hollow dish shape (Figure 6b), white-fronted terns may use the structure for nesting. An enlarged surface area may promote for groups of birds to roost together (Figure 6c).

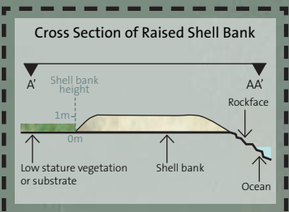
MANGROVE / SALT MARSH AREA, WEST END OF CAUSEWAY

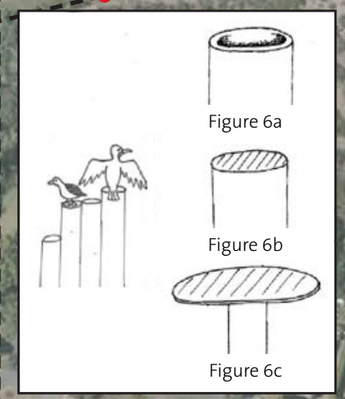
Pest control to be established in this area because banded rail is currently present and it is connecting habitat in close proximity to the construction platform.

Bush Salt Marsh Mangrove

Te Okariki Inlet

Indicative habitat areas





State Highway 18

MANGROVE / SALT MARSH (SEA)

Hobsonville Point

Boffa Miskell
www.boffamiskell.co.nz

N

1:1,200 @ A3

Data Sources: Design Based on Watercare and URS Engineering drawings NH2x149a_NI_Reclamation_Layout_ RevB_500scale.dwg.Model, received: 10.03.2015

GREENHITHE BRIDGE WATERMAIN DUPLICATION & CAUSEWAY RECLAMATION

Indicative Bird Mitigation Concept Plan

Concept designed by Tonkin & Taylor and drawn by Boffa Miskell Limited

| Date: 10 June 2015 | Revision: _ 2 |

Plan prepared for Watercare by Boffa Miskell Limited

Project Manager: **Shannon.Bray@boffamiskell.co.nz** | *Drawn:* JPa | *Checked:* JGo

Figure A.4

Appendix B Benthic Fauna Data

Macrofauna Identification and Counts for Upper Waitemata Harbour core samples.

			T1				T2				T3				T4				T5				T6					T7				T8			
GenGroup	**Taxa**	**Common Name**	**T1-05**	**T1-10**	**T1-15**	**T1-25**	**T2-05**	**T2-10**	**T2-15**	**T2-25**	**T3-05**	**T3-10**	**T3-15**	**T3-25**	**T4-05**	**T4-10**	**T4-15**	**T4-25**	**T5-05**	**T5-10**	**T5-15**	**T5-25**		**T6-A**	**T6-B**	**T6-C**	**T6-D**	**T7-A**	**T7-B**	**T7-C**	**T7-D**	**T8-A**	**T8-B**	**T8-C**	**T8-D**
Nemertea	Nemertea	Proboscis worms										1	1			1							1	1				1	1			1	1		
Gastropoda	Amphibola crenata	Mud Snail		1	1	1														1														
Gastropoda	Cominella glandiformis	Mud Flat Whelk							1																									
Gastropoda	Nassarius burchardi	Dog whelk							1	2	2	10	2	12	2		7	5	4		4					1			1	1				
Gastropoda	Potamopyrgus estuarinus	Estuarine snail					1													1			1											
Gastropoda	Zeacumantus lutulentus	Spireshell					3																											
Gastropoda	Zeacumantus subcarinatus	Small Mud Snail					1																											
Bivalvia	Austrovenus stutchburyi	Cockle (Huangi)						2	3	14	3			1	1														1			2			
Bivalvia	Arthritica bifurca	Small bivalve																																
Bivalvia	Macomona liliana	Wedge shell (Hanikura)								1																								
Bivalvia	Musculista senhousia	Asian mussel																		1														
Bivalvia	Nucula hartvigiana	Nut Shell												1			1												4						
Bivalvia	Paphies australis	Pipi												1																				
Bivalvia	Theora lubrica	Window shell													1			2	2																
Oligochaeta	Oligochaeta	Oligochaete worms		1	2	9	11	4								32	6	5		59	24	23	1	11	5	2	3		3		7	5		5	1
Polychaeta: Orbiniidae	Scoloplos cylindrifer	Polychaete worm							1	1																								
Polychaeta: Paraonidae	Paraonidae	Polychaete worm															6	4	11					64	29	20	145	14	45	31	9	56	6		
Polychaeta: Paraonidae	Aricidea sp.	Polychaete worm									2	29	19	5	3	9	52	28	58	1	8	1	31											
Polychaeta: Cossuridae	Cossura consimilis	Polychaete worm										26	23	40	10		5	6	5				10	4	1	1				3		1		
Polychaeta: Spionidae	Boccardia sp.	Polychaete worm																							1	12	1			4	1		3		
Polychaeta: Spionidae	Polydora sp.	Polychaete worm						6	3	2	9	1	1	2	1	27	4	1	1	225	13	23	3											
Polychaeta: Spionidae	Prionospio aucklandica	Polychaete worm																1					3	1		2	1			1	6	1			
Polychaeta: Spionidae	Scolecolepides benhami	Polychaete worm		2				2																										1
Polychaeta: Capitellidae	Capitella capitata	Polychaete worm																															1	
Polychaeta: Capitellidae	Heteromastus filiformis	Polychaete worm							1	2		28	28	10	17	12	23	12	7	1	10	5	20	18	16	5	31	32	25	33	8	15	1	1	
Polychaeta: Syllidae	Syllidae	Polychaete worm																										1						
Polychaeta: Syllidae	Sphaerosyllis sp.	Polychaete worm												1		2				1		5		5	11	1	9		1		1			
Polychaeta: Nereidae	Nereidae (juvenile)	Rag worms		1	2	1	4	9	8	3	8	8	26	9	23	5	3	7	1	2	2	2	15				1		1			2	1	4
Polychaeta: Nereidae	Nicon aestuariensis	Rag worms			1																				1			2	2					
Polychaeta: Nereidae	Perinereis vallata	Rag worms				1																					1							
Polychaeta: Glyceridae	Glyceridae	Polychaete worm									1		1		1		1	1			1		1	1	1		4	3	5	2	1				
Polychaeta: Cirratulidae	Cirratulidae	Polychaete worm							5	3										2		1		4	4	2	6		2						
Polychaeta: Pectinariidae	Pectinaria australis	Polychaete worm																														2			
Crustacea	Nebalia sp.	Small crustacea																											2						
Mysidacea	Mysidacea	Mysid shrimp															1		1																
Cumacea	Cumacea	Cumaceans								1		2	2																1						
Tanaidacea	Tanaid sp.	Tanaid Shrimp														1				2					5	1	2							
Isopoda	Anthuridea	Isopod																						4	4		2							
Amphipoda	Corophiidae	Amphipod (family)			1	2		1	1											1		2			2	1	2				1		5	128
Amphipoda	Lysianassidae	Amphipod (family)																						1			1							
Amphipoda	Phoxocephalidae	Amphipod (family)																						3	2		22				1				
Amphipoda	Talitridae	Amphipod (family)					1															1													
Amphipoda	Amphipoda Unid.	Amphipod									6		2					1	1								2								
Decapoda	Alpheus sp.	Snapping shrimp			1																														
Decapoda	Helice crassa	Tunnelling Mud Crab		3	2																				2	2	1		2	1	1		7	6	
Decapoda	Macrophthalmus hirtipes	Stalk-eyed Mud Crab								1			3											1							1				
Diptera	Orthocladiinae	midges			1											1						2												
Diptera	Paralimnophila skusei	crane fly				1	1																												
Trichoptera	Oxyethira albiceps	axe-head caddis															1																		
Arachnida	Acarina	Mites					1																												
Ostracoda	Diasterope grisea	Ostracod																						1											
Ascidiacea	Asterocarpa sp.	Sea squirt																						1											
	Count: No of Individuals		**8**	**11**	**15**	**23**	**24**	**24**	**30**	**31**	**105**	**108**	**82**	**59**	**90**	**110**	**73**	**91**	**296**	**63**	**65**	**86**	**120**	**84**	**50**	**234**	**53**	**96**	**77**	**35**	**84**	**20**	**19**	**134**
	Count: No of Taxa		**5**	**8**	**6**	**8**	**6**	**9**	**10**	**7**	**8**	**11**	**10**	**9**	**9**	**12**	**12**	**10**	**11**	**8**	**10**	**10**	**15**	**14**	**12**	**17**	**6**	**15**	**9**	**9**	**9**	**6**	**6**	**4**
	SW Diversity		**1.4942**	**2.0198**	**1.2973**	**1.6043**	**1.5596**	**1.875**	**1.8113**	**1.7169**	**1.6377**	**1.7791**	**1.6066**	**1.5692**	**1.6229**	**1.7042**	**1.9546**	**1.3187**	**0.7466**	**1.6636**	**1.6438**	**1.7031**	**1.6829**	**2.053**	**1.8455**	**1.434**	**1.0923**	**1.708**	**1.33**	**1.8187**	**1.1349**	**1.543**	**1.5315**	**0.2217**
	SW Evenness		**0.9284**	**0.9713**	**0.724**	**0.7715**	**0.8704**	**0.8533**	**0.7866**	**0.8823**	**0.7875**	**0.7419**	**0.6977**	**0.7142**	**0.7386**	**0.6858**	**0.7866**	**0.5727**	**0.3114**	**0.8**	**0.7139**	**0.7397**	**0.6214**	**0.7779**	**0.7427**	**0.5061**	**0.6096**	**0.6307**	**0.6053**	**0.8277**	**0.5165**	**0.8612**	**0.8548**	**0.1599**

Appendix C Water Quality Data and Laboratory Transcripts

Table-C-1 Water Quality results from four sampled sites (2/7/14)

Parameter	Relevant guidelines	Site 1	Site 2	Site 3	Site 4
Time	-	11:55 a.m.	11:45 a.m.	11:25 a.m.	11:15 a.m.
Analysis					
Temperature	N/A	13.0	13.4	13.6	13.7
Dissolved oxygen (%)	90-110[A]	86.7	90.3	92.4	92.3
Dissolved oxygen (mg/L)	N/A	9.13	9.43	9.61	9.57
Total Suspended Solids (mg/L)	N/A	34	< 6	< 5	< 5
Total Nitrogen (mg/L)	0.3	1.0	0.2	< 0.3	< 0.3
Total Ammoniacal-N (mg/L)	0.91[B]	0.011	0.014	0.011	0.011
Nitrite-N (mg/L)	N/A	0.015	0.002	0.002	0.002
Nitrate-N (mg/L)	0.7[C]	0.73	0.077	0.065	0.055
Nitrate-N + Nitrite-N (mg/L)	N/A	0.75	0.079	0.067	0.057
Total Kjeldahl Nitrogen (TKN) (mg/L)	N/A	0.3	< 0.2	< 0.2	< 0.2
Total Phosphorus (mg/L)	0.025[D]	0.028	0.028	0.028	0.024
Carbonaceous Biochemical Oxygen Demand (g O_2/m^3)	N/A	< 2	< 2	< 2	< 2
Faecal Coliforms and *Escherichia coli* profile					
Faecal Coliforms (cfu / 100mL)	280/100mL[E]	200	26	27	24
Escherichia coli (cfu / 100mL)	N/A	200	26	26	24
Total Petroleum Hydrocarbons in Water					
C7 - C9 (mg/L)	N/A	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14 (mg/L)	N/A	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36 (mg/L)	N/A	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36) (mg/L)	N/A	< 0.7	< 0.7	< 0.7	< 0.7

[A] Value is a high reliability marine trigger value for 95 % level of protection (% species) from ANZECC 2000.

[B] Value is a default trigger value for slightly disturbed marine ecosystems for south-east Australia used in the absence of values currently available for New Zealand from ANZECC 2000.

[C] Value is a low reliability marine trigger value for 95 % level of protection (% species) from ANZECC 2000.

[D] Value is a default trigger value for slightly disturbed marine ecosystems for south-east Australia used in the absence of values currently available for New Zealand from ANZECC 2000.

[E] Value for action mode. Value from Ministry for Health and Ministry for the Environment (2003). Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas, Part II - Guidelines for Recreational Water Quality. Please note that the value is for Enterococci.

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Hamilton 3240, New Zealand

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Web www.hill-labs.co.nz

Client:	Tonkin & Taylor	**Lab No:**	1294642	SPv1
Contact:	C Sjardin	**Date Registered:**	03-Jul-2014	
	C/- Tonkin & Taylor	**Date Reported:**	11-Jul-2014	
	PO Box 5271	**Quote No:**	61761	
	AUCKLAND 1141	**Order No:**		
		Client Reference:	Harbour Samples	
		Submitted By:	C Sjardin	

Sample Type: Saline

Sample Name:		Site 1 02-Jul-2014 11:55 am	Site 2 02-Jul-2014 11:44 am	Site 3 02-Jul-2014 11:25 am	Site 4 02-Jul-2014 11:15 am	
Lab Number:		1294642.1	1294642.2	1294642.3	1294642.4	
Individual Tests						
Total Suspended Solids*	g/m³	34	< 6 #2	< 5 #2	< 5 #2	-
Total Nitrogen*	g/m³	1.0	0.2	< 0.3	< 0.3	-
Total Ammoniacal-N*	g/m³	0.011	0.014	0.011	0.011	-
Nitrite-N	g/m³	0.015	0.002	0.002	0.002	-
Nitrate-N	g/m³	0.73	0.077	0.065	0.055	-
Nitrate-N + Nitrite-N	g/m³	0.75	0.079	0.067	0.057	-
Total Kjeldahl Nitrogen (TKN)*	g/m³	0.3	< 0.2	< 0.2	< 0.2	-
Total Phosphorus*	g/m³	0.028	0.028	0.028	0.024	-
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)*	g O_2/m³	< 2	< 2	< 2	< 2	-
Faecal Coliforms and E. coli profile						
Faecal Coliforms	cfu / 100mL	200 #1	26 #1	27 #1	24 #1	-
Escherichia coli	cfu / 100mL	200 #1	26 #1	26 #1	24 #1	-
Total Petroleum Hydrocarbons in Water						
C7 - C9*	g/m³	< 0.10	< 0.10	< 0.10	< 0.10	-
C10 - C14*	g/m³	< 0.2	< 0.2	< 0.2	< 0.2	-
C15 - C36*	g/m³	< 0.4	< 0.4	< 0.4	< 0.4	-
Total hydrocarbons (C7 - C36)*	g/m³	< 0.7	< 0.7	< 0.7	< 0.7	-

Analyst's Comments

#1 It was noted that the sample was tested using a container which may not be sterile as the sterile container provided were partially frozen between the initial sample receipt and the time of analysis. As such, please interpret these microbiological results with caution.

#2 The Total Suspended Solids test had to be repeated to check original results, but there was insufficient sample left to filter the usual amount so the detection limit is higher than normal.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Saline

Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved*	Sample filtration through 0.45µm membrane filter.	-	1-4
Total Kjeldahl Digestion*	Sulphuric acid digestion with copper sulphate catalyst.	-	1-4
Total Phosphorus Digestion*	Acid persulphate digestion.	-	1-4
Total Suspended Solids*	Saline sample. Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D 22nd ed. 2012.	3 g/m³	1-4

Sample Type: Saline			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total Nitrogen*	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m^3 is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m^3, the Default Detection Limit for Total Nitrogen will be 0.11 g/m^3.	0.05 g/m^3	1-4
Total Ammoniacal-N*	Saline, filtered sample. Phenol/hypochlorite colorimetry. Discrete Analyser. (NH_4-N = NH_4+-N + NH_3-N). APHA 4500-NH_3 F (modified from manual analysis) 22nd ed. 2012.	0.010 g/m^3	1-4
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012.	0.002 g/m^3	1-4
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-4
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012.	0.002 g/m^3	1-4
Total Kjeldahl Nitrogen (TKN)*	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 22nd ed. 2012.	0.10 g/m^3	1-4
Total Phosphorus*	Total phosphorus digestion, ascorbic acid colorimetry. Discrete Analyser. APHA 4500-P B & E (modified from manual analysis) 22nd ed. 2012. Also modified to include the use of a reductant to eliminate interference from arsenic present in the sample. NWASCA, Water & soil Miscellaneous Publication No. 38, 1982.	0.004 g/m^3	1-4
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)*	Incubation 5 days, $CBOD_5$, DO meter, nitrification inhibitor added, dilutions, seeded. Analysed at Hill Laboratories - Microbiology; 1 Clow Place, Hamilton. APHA 5210 B (modified) 22nd ed. 2012.	2 g O_2/m^3	1-4
Total Petroleum Hydrocarbons in Water*	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734]	0.10 - 0.7 g/m^3	1-4
Faecal Coliforms and E. coli profile			
Faecal Coliforms	Membrane Filtration, Count on mFC agar, Incubated at 44.5°C for 22 hours, Confirmation. Analysed at Hill Laboratories - Microbiology; 1 Clow Place, Hamilton. APHA 9222 D, 22nd ed. 2012.	1 cfu / 100mL	1-4
Escherichia coli	Membrane filtration, Count on mFC agar, Incubated at 44.5°C for 22 hours, MUG Confirmation. Analysed at Hill Laboratories - Microbiology; 1 Clow Place, Hamilton. APHA 9222 G, 22nd ed. 2012.	1 cfu / 100mL	1-4

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

Appendix D Sediment Quality Data and Laboratory Transcripts

Table-D-1 Sediment Quality Results

Site	Copper (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)	HMW – PAH* (mg/kg)
Relevant guideline**	**< 19**	**< 30**	**< 124**	**< 0.66**
BH201 0.1m	10.0	14.2	31.0	-
BH201 1m	15.0	8.3	17.0	-
BH 201 10m	5.0	16.1	33.0	-
BH204 0.1m	15.0	40.0	25.0	-
BH 204 1m	10.0	7.0	16.0	-
HA206 0m (total sample)	19.6	22.0	97.0	0.04
HA206 0m (63 µm fraction)	20.0	27.0	110.0	-
HA211 0m (total sample)	11.7	15.9	58.0	0.33
HA211 0m (63 µm fraction)	22.0	24.0	89.0	-
HA212a 0m(total sample)	18.0	29.0	95.0	0.10
HA212a 0m (63 µm fraction)	19.0	28.0	105.0	-
Tab 1 0-0.2m (total sample)	12.2	24.0	89.0	1.12
Tab 1 0-0.2m (63 µm fraction)	21.0	30.0	124.0	-
Tab 2 0-0.2m (total sample)	10.2	25.0	91.0	0.25
Tab 2 0-0.2m (63 µm fraction)	22.0	30.0	121.0	-
Tab 3 0-0.2m (total sample)	11.0	18.7	78.0	0.61

*High Molecular Weight (HMW) Polycyclic Aromatic Hydrocarbons (PAH) after normalisation to 1% Total Organic Carbon as recommended in the ANZECC 2000 guidelines.

**Values are for the “green” environmental response criteria for sediment contaminants.

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ANALYSIS REPORT

Client:	OPUS International Consultants	**Lab No:**	1289075	SPv1
Contact:	Mr Roger High	**Date Registered:**	19-Jun-2014	
	C/- OPUS International Consultants	**Date Reported:**	18-Jul-2014	
	PO Box 5848	**Quote No:**	61048	
	AUCKLAND 1141	**Order No:**		
		Client Reference:		
		Submitted By:	Mr Roger High	

Sample Type: Soil

Sample Name:		BH204 0.1m 05-Jun-2014 1:28 pm	BH204 1.0m 05-Jun-2014 1:29 pm	BH201 0.1m 09-Jun-2014 10:34 am	BH201 1.0m 09-Jun-2014 10:36 am	BH201 10m 09-Jun-2014 10:50 am
Lab Number:		1289075.1	1289075.2	1289075.4	1289075.5	1289075.7
Individual Tests						
Dry Matter	g/100g as rcvd	79	78	77	75	77
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	3	3	3	3	3
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	0.11	< 0.10	0.11
Total Recoverable Chromium	mg/kg dry wt	17	14	7	14	9
Total Recoverable Copper	mg/kg dry wt	15	10	10	15	15
Total Recoverable Lead	mg/kg dry wt	40	7.0	14.2	8.3	16.1
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Nickel	mg/kg dry wt	17	8	6	9	11
Total Recoverable Zinc	mg/kg dry wt	25	16	31	17	33
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
alpha-BHC	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
beta-BHC	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
delta-BHC	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
gamma-BHC (Lindane)	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
cis-Chlordane	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
trans-Chlordane	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	< 0.04	-	< 0.04	-	< 0.04
2,4'-DDD	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
4,4'-DDD	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
2,4'-DDE	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
4,4'-DDE	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
2,4'-DDT	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
4,4'-DDT	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Dieldrin	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Endosulfan I	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Endosulfan II	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Endosulfan sulphate	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Endrin	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Endrin aldehyde	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Endrin ketone	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Heptachlor	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Heptachlor epoxide	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Hexachlorobenzene	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010
Methoxychlor	mg/kg dry wt	< 0.010	-	< 0.010	-	< 0.010

Sample Type: Soil						
Sample Name:		BH204 0.1m 05-Jun-2014 1:28 pm	BH204 1.0m 05-Jun-2014 1:29 pm	BH201 0.1m 09-Jun-2014 10:34 am	BH201 1.0m 09-Jun-2014 10:36 am	BH201 10m 09-Jun-2014 10:50 am
Lab Number:		1289075.1	1289075.2	1289075.4	1289075.5	1289075.7
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Anthracene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[a]anthracene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	mg/kg dry wt	0.03	< 0.03	0.03	< 0.03	< 0.03
Fluorene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Naphthalene	mg/kg dry wt	< 0.14	< 0.14	< 0.14	< 0.15	< 0.15
Phenanthrene	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	mg/kg dry wt	0.04	< 0.03	0.04	< 0.03	0.04
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 9	< 9	< 9	< 9	< 9
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 40	< 40	< 40	< 40	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	< 70	< 70	< 70	< 70

Sample Type: Sediment						
Sample Name:		HA211 0.0m 11-Jun-2014 9:55 am	HA206 0.0m 12-Jun-2014 12:15 pm	HA212a 0.0m 13-Jun-2014 11:00 am	HA211 0.0m [63um Fraction]	HA206 0.0m [63um Fraction]
Lab Number:		1289075.17	1289075.23	1289075.28	1289075.30	1289075.31
Individual Tests						
Dry Matter	g/100g as rcvd	53	40	55	-	-
Extractable Copper*	mg/kg dry wt	-	-	-	22	20
Extractable Lead*	mg/kg dry wt	-	-	-	24	27
Extractable Zinc*	mg/kg dry wt	-	-	-	89	110
Total Organic Carbon*	g/100g dry wt	0.99	4.0	1.56	-	-
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	15.8	7.3	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.031	0.089	-	-	-
Total Recoverable Chromium	mg/kg dry wt	11.4	14.5	-	-	-
Total Recoverable Copper	mg/kg dry wt	11.7	19.6	-	-	-
Total Recoverable Lead	mg/kg dry wt	15.9	22	-	-	-
Total Recoverable Mercury	mg/kg dry wt	0.081	0.117	-	-	-
Total Recoverable Nickel	mg/kg dry wt	4.9	8.7	-	-	-
Total Recoverable Zinc	mg/kg dry wt	58	97	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	-	-	18	-	-
Total Recoverable Cadmium	mg/kg dry wt	-	-	< 0.10	-	-
Total Recoverable Chromium	mg/kg dry wt	-	-	22	-	-
Total Recoverable Copper	mg/kg dry wt	-	-	18	-	-
Total Recoverable Lead	mg/kg dry wt	-	-	29	-	-
Total Recoverable Mercury	mg/kg dry wt	-	-	0.10	-	-
Total Recoverable Nickel	mg/kg dry wt	-	-	7	-	-
Total Recoverable Zinc	mg/kg dry wt	-	-	95	-	-
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	< 0.010	< 0.010	-	-
alpha-BHC	mg/kg dry wt	-	< 0.010	< 0.010	-	-

Sample Type: Sediment						
Sample Name:		HA211 0.0m 11-Jun-2014 9:55 am	HA206 0.0m 12-Jun-2014 12:15 pm	HA212a 0.0m 13-Jun-2014 11:00 am	HA211 0.0m [63um Fraction]	HA206 0.0m [63um Fraction]
Lab Number:		1289075.17	1289075.23	1289075.28	1289075.30	1289075.31
Organochlorine Pesticides Screening in Soil						
beta-BHC	mg/kg dry wt	-	< 0.010	< 0.010	-	-
delta-BHC	mg/kg dry wt	-	< 0.010	< 0.010	-	-
gamma-BHC (Lindane)	mg/kg dry wt	-	< 0.010	< 0.010	-	-
cis-Chlordane	mg/kg dry wt	-	< 0.010	< 0.010	-	-
trans-Chlordane	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	-	< 0.04	< 0.04	-	-
2,4'-DDD	mg/kg dry wt	-	< 0.010	< 0.010	-	-
4,4'-DDD	mg/kg dry wt	-	< 0.010	< 0.010	-	-
2,4'-DDE	mg/kg dry wt	-	< 0.010	< 0.010	-	-
4,4'-DDE	mg/kg dry wt	-	< 0.010	< 0.010	-	-
2,4'-DDT	mg/kg dry wt	-	< 0.010	< 0.010	-	-
4,4'-DDT	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Dieldrin	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Endosulfan I	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Endosulfan II	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Endosulfan sulphate	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Endrin	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Endrin aldehyde	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Endrin ketone	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Heptachlor	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Heptachlor epoxide	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Hexachlorobenzene	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Methoxychlor	mg/kg dry wt	-	< 0.010	< 0.010	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Acenaphthylene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Anthracene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Chrysene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Fluoranthene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Fluorene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Naphthalene	mg/kg dry wt	< 0.3	< 0.6	< 0.3	-	-
Phenanthrene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Pyrene	mg/kg dry wt	< 0.05	< 0.11	< 0.05	-	-
Tributyl Tin Trace in Soil samples by GCMS						
Dibutyltin (as Sn)	mg/kg dry wt	-	< 0.005	< 0.005	-	-
Monobutyltin (as Sn)	mg/kg dry wt	-	< 0.007	< 0.007	-	-
Tributyltin (as Sn)	mg/kg dry wt	-	< 0.004	< 0.004	-	-
Triphenyltin (as Sn)	mg/kg dry wt	-	< 0.003	< 0.003	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 13	< 40	< 13	-	-
C10 - C14	mg/kg dry wt	< 30	< 70	< 30	-	-
C15 - C36	mg/kg dry wt	< 50	< 140	< 50	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 90	< 300	< 90	-	-

Sample Type: Sediment						
Sample Name:		HA212a 0.0m [63um Fraction]				
Lab Number:		1289075.32				
Individual Tests						
Extractable Copper*	mg/kg dry wt	19.0	-	-	-	-
Extractable Lead*	mg/kg dry wt	28	-	-	-	-
Extractable Zinc*	mg/kg dry wt	105	-	-	-	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

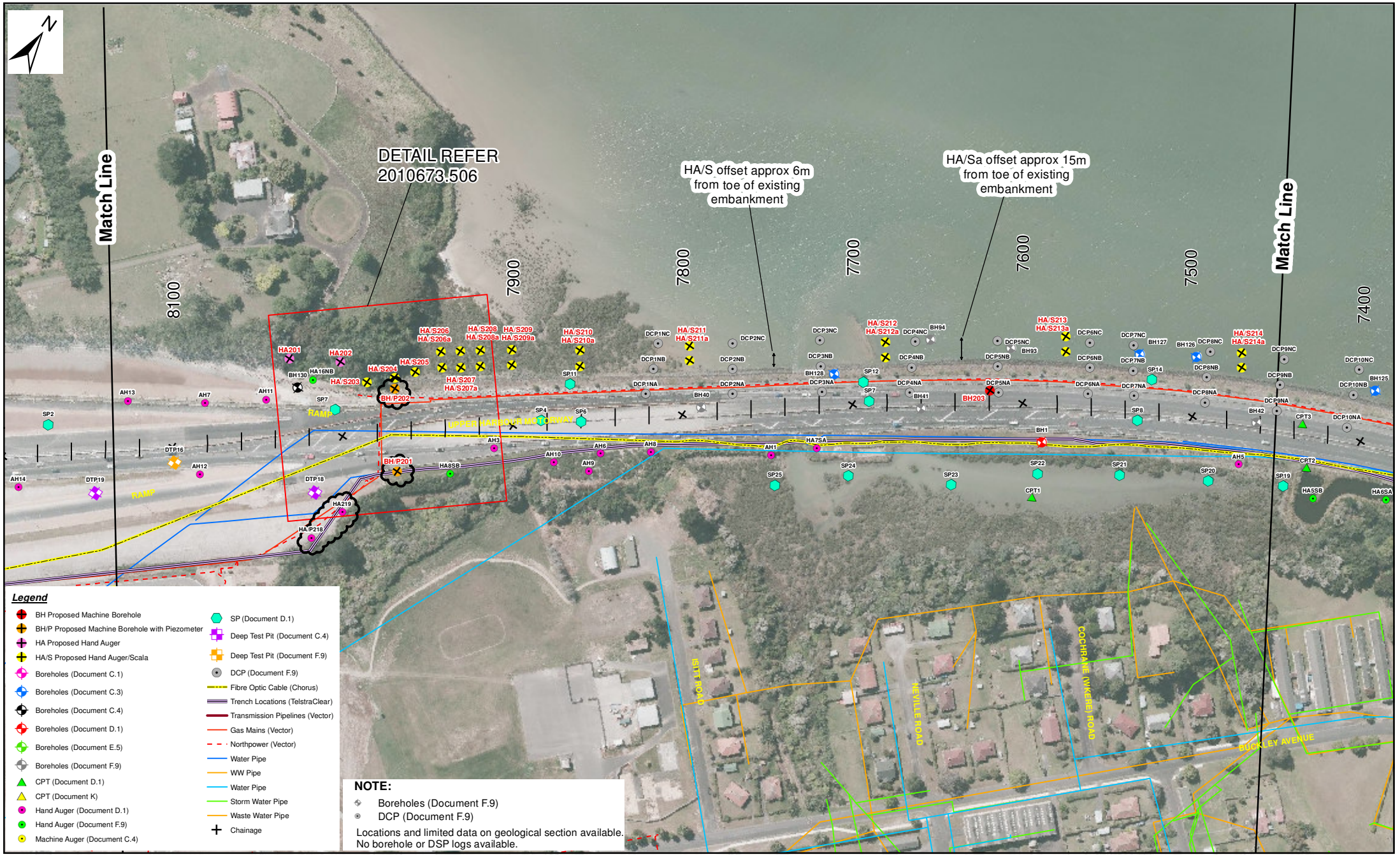
Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-2, 4-5, 7, 17, 23, 28
TPH Oil Industry Profile + PAHscreen	Sonication in DCM extraction, SPE cleanup, GC-FID & GC-MS analysis. Tested on as received sample. US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:5786,2805,10734;2695]	0.010 - 60 mg/kg dry wt	1-2, 4-5, 7, 17, 23, 28
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	1-2, 4-5, 7, 28
Organochlorine Pesticides Screening in Soil	Sonication extraction, SPE cleanup, dual column GC-ECD analysis (modified US EPA 8082).. Tested on dried sample	0.010 - 0.04 mg/kg dry wt	1, 4, 7, 23, 28
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1-2, 4-5, 7, 17, 23, 28
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-2, 4-5, 7, 17, 23, 28

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level.	0.010 - 0.4 mg/kg dry wt	17, 23
Tributyl Tin Trace in Soil samples by GCMS	Solvent extraction, ethylation, SPE cleanup, GC-MS SIM analysis. Tested on dried sample	0.003 - 0.007 mg/kg dry wt	23, 28
ARC 2M HCl Extraction*	<63µm Sieved Fraction, extracted with 2M HCl. Solid:Liquid 1:50 w/v. ARC Tech Publication No. 47, 1994.	-	30-32
Sieving through 63 um sieve, no gravimetric result*	<63µm Wet Sieved with no gravimetric determination.	-	17, 23, 28
Extractable Copper*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	1.0 mg/kg dry wt	30-32
Extractable Lead*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	0.2 mg/kg dry wt	30-32
Extractable Zinc*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	2 mg/kg dry wt	30-32
Total Organic Carbon*	Acid pretreatment to remove carbonates if present, neutralisation, Elementar Combustion Analyser.	0.05 g/100g dry wt	17, 23, 28

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division



ISSUE	DATE	AMENDMENT	BY	APPD.
2	04-14	REVISED PIEZOMETERS	SS	DF
1	03-14	DRAFT FOR COMMENT	SS	AH

DESIGNED	Y.T.	03-14
DES. CHECKED	A.H.	03-14
DRAWN	S.S.	03-14
DWG. CHECKED	Y.T.	03-14
PROJECT LEADER	M.E.	03-14
INFRAST'R APP'D	C.T.	03-14

OPERATIONS

INFRASTRUCTURE

Watercare

NORTH HARBOUR NO2 WATER MAIN
GREENHITHE BRIDGE ADVANCED WORKS

GEOTECHNICAL INVESTIGATION LOCATION PLAN
BOREHOLE LOCATIONS - Sheet 2 of 6

DRAFT

GIS FILE: 42073300\Boreholes.mxd	DATE 28-03-14
ORIGINAL SCALE A3 1:2,000	CONTRACT No. 5663
REF No. WMNH2-91-G-503	ISSUE -
DRAWING No. 2010673.503	2

Legend

- BH Proposed Machine Borehole
- BH/P Proposed Machine Borehole with Piezometer
- HA Proposed Hand Auger
- HA/S Proposed Hand Auger/Scala
- Boreholes (Document C.1)
- Boreholes (Document C.3)
- Boreholes (Document C.4)
- Boreholes (Document D.1)
- Boreholes (Document E.5)
- Boreholes (Document F.9)
- CPT (Document D.1)
- CPT (Document K)
- Hand Auger (Document D.1)
- Hand Auger (Document F.9)
- Machine Auger (Document C.4)
- SP (Document D.1)
- Deep Test Pit (Document C.4)
- Deep Test Pit (Document F.9)
- DCP (Document F.9)
- Fibre Optic Cable (Chorus)
- Trench Locations (TelstraClear)
- Transmission Pipelines (Vector)
- Gas Mains (Vector)
- Northpower (Vector)
- Water Pipe
- WW Pipe
- Water Pipe
- Storm Water Pipe
- Waste Water Pipe
- Chainage

NOTE:

- Boreholes (Document F.9)
- DCP (Document F.9)

Locations and limited data on geological section available.
No borehole or DSP logs available.

ISSUE	DATE	AMENDMENT	BY	APPD.
2	04-14	REVISED PIEZOMETERS	SS	DF
1	03-14	DRAFT FOR COMMENT	SS	AH

DESIGNED	Y.T.	03-14
DES. CHECKED	A.H.	03-14
DRAWN	S.S.	03-14
DWG. CHECKED	Y.T.	03-14
PROJECT LEADER	M.E.	03-14
INFRAST'R APP'D	C.T.	03-14

OPERATIONS

INFRASTRUCTURE

Watercare

NORTH HARBOUR NO2 WATER MAIN
GREENHITHE BRIDGE ADVANCED WORKS

GEOTECHNICAL INVESTIGATION LOCATION PLAN
BOREHOLE LOCATIONS - Sheet 3 of 6

DRAFT

GIS FILE: 42073300\Boreholes.mxd	DATE 28-03-14
ORIGINAL SCALE A3 1:2,000	CONTRACT No. 5663
REF No. WMNH2-91-G-504	ISSUE -
DRAWING No. 2010673.504	2

Hill Laboratories
BETTER TESTING BETTER RESULTS

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ANALYSIS REPORT

Client:	Jacobs New Zealand Limited	**Lab No:**	1355272	SPv1
Contact:	W Starke	**Date Registered:**	25-Nov-2014	
	C/- Jacobs New Zealand Limited	**Date Reported:**	09-Dec-2014	
	PO Box 9806	**Quote No:**	65091	
	Newmarket	**Order No:**		
	AUCKLAND 1149	**Client Reference:**	AE04521	
		Submitted By:	C Sjardin	

Sample Type: Sediment

Sample Name:		Tab 1 0-0.2 21-Nov-2014 2:30 pm	Tab 2 0-0.2 21-Nov-2014 2:15 pm	Tab 3 0-0.2 21-Nov-2014 3:05 pm	Tab 1 0-0.2 [<63um Fraction]	Tab 2 0-0.2 [<63um Fraction]
Lab Number:		1355272.1	1355272.2	1355272.3	1355272.4	1355272.5
Individual Tests						
Dry Matter	g/100g as rcvd	60	67	62	-	-
Extractable Copper*	mg/kg dry wt	-	-	-	21	22
Extractable Lead*	mg/kg dry wt	-	-	-	30	30
Extractable Zinc*	mg/kg dry wt	-	-	-	124	121
Total Organic Carbon*	g/100g dry wt	0.94	0.84	0.87	-	-
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	35	30	17.6	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.040	0.046	0.039	-	-
Total Recoverable Chromium	mg/kg dry wt	15.1	12.1	14.1	-	-
Total Recoverable Copper	mg/kg dry wt	12.2	10.2	11.0	-	-
Total Recoverable Lead	mg/kg dry wt	24	25	18.7	-	-
Total Recoverable Mercury	mg/kg dry wt	0.093	0.103	0.095	-	-
Total Recoverable Nickel	mg/kg dry wt	6.6	6.5	6.6	-	-
Total Recoverable Zinc	mg/kg dry wt	89	91	78	-	-
Organochlorine Pesticides Trace in Soil						
Aldrin	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
alpha-BHC	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
beta-BHC	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
delta-BHC	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
gamma-BHC (Lindane)	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
cis-Chlordane	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
trans-Chlordane	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
2,4'-DDD	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
4,4'-DDD	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
2,4'-DDE	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
4,4'-DDE	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
2,4'-DDT	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
4,4'-DDT	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Dieldrin	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Endosulfan I	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Endosulfan II	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Endosulfan sulphate	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Endrin	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Endrin aldehyde	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Endrin ketone	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Heptachlor	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Heptachlor epoxide	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-

Sample Type: Sediment						
Sample Name:		Tab 1 0-0.2 21-Nov-2014 2:30 pm	Tab 2 0-0.2 21-Nov-2014 2:15 pm	Tab 3 0-0.2 21-Nov-2014 3:05 pm	Tab 1 0-0.2 [<63um Fraction]	Tab 2 0-0.2 [<63um Fraction]
Lab Number:		1355272.1	1355272.2	1355272.3	1355272.4	1355272.5
Organochlorine Pesticides Trace in Soil						
Hexachlorobenzene	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Methoxychlor	mg/kg dry wt	< 0.0010	< 0.0010	< 0.0010	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	< 0.002	< 0.002	< 0.002	-	-
Polycyclic Aromatic Hydrocarbons Trace in Soil						
Acenaphthene	mg/kg dry wt	0.017	0.003	0.008	-	-
Acenaphthylene	mg/kg dry wt	0.008	0.003	0.005	-	-
Anthracene	mg/kg dry wt	0.039	0.007	0.015	-	-
Benzo[a]anthracene	mg/kg dry wt	0.121	0.025	0.062	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.147	0.032	0.078	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.169	0.040	0.091	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	0.093	0.024	0.052	-	-
Benzo[k]fluoranthene	mg/kg dry wt	0.064	0.015	0.035	-	-
Chrysene	mg/kg dry wt	0.123	0.027	0.065	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	0.018	0.005	0.010	-	-
Fluoranthene	mg/kg dry wt	0.34	0.064	0.168	-	-
Fluorene	mg/kg dry wt	0.015	0.003	0.007	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.093	0.022	0.051	-	-
Naphthalene	mg/kg dry wt	< 0.012	< 0.011	< 0.011	-	-
Phenanthrene	mg/kg dry wt	0.25	0.042	0.095	-	-
Pyrene	mg/kg dry wt	0.30	0.059	0.152	-	-
Tributyl Tin Trace in Soil samples by GCMS						
Dibutyltin (as Sn)	mg/kg dry wt	< 0.005	-	-	-	-
Monobutyltin (as Sn)	mg/kg dry wt	< 0.007	-	-	-	-
Tributyltin (as Sn)	mg/kg dry wt	< 0.004	-	-	-	-
Triphenyltin (as Sn)	mg/kg dry wt	< 0.003	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 12	< 11	< 11	-	-
C10 - C14	mg/kg dry wt	< 30	< 30	< 30	-	-
C15 - C36	mg/kg dry wt	< 50	< 50	< 50	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	< 80	< 80	-	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-3
Heavy metals, trace As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level.	0.010 - 0.4 mg/kg dry wt	1-3
Organochlorine Pesticides Trace in Soil	Sonication extraction, SPE cleanup, GPC cleanup (if required), dual column GC-ECD analysis. Tested on dried sample	0.0010 - 0.002 mg/kg dry wt	1-3
Polycyclic Aromatic Hydrocarbons Trace in Soil	Sonication extraction, SPE cleanup, GC-MS SIM analysis US EPA 8270C. Tested on as received sample [KBIs:5784,4273,2695]	0.002 - 0.010 mg/kg dry wt	1-3
Tributyl Tin Trace in Soil samples by GCMS	Solvent extraction, ethylation, SPE cleanup, GC-MS SIM analysis. Tested on dried sample	0.003 - 0.007 mg/kg dry wt	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	8 - 60 mg/kg dry wt	1-3
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1-3

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
ARC 2M HCl Extraction*	<63µm Sieved Fraction, extracted with 2M HCl. Solid:Liquid 1:50 w/v. ARC Tech Publication No. 47, 1994.	-	4-5
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-3
Sieving through 63 um sieve, no gravimetric result*	<63µm Wet Sieved with no gravimetric determination.	-	1-2
Extractable Copper*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	1.0 mg/kg dry wt	4-5
Extractable Lead*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	0.2 mg/kg dry wt	4-5
Extractable Zinc*	2M HCl extraction (<63µm fraction), ICP-MS. ARC Tech Publication No. 47, 1994.	2 mg/kg dry wt	4-5
Total Organic Carbon*	Acid pretreatment to remove carbonates if present, neutralisation, Elementar Combustion Analyser.	0.05 g/100g dry wt	1-3

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

Appendix E Location of Areas Designated for Ecological Values in Proposed and Operative Plans

Table-E-1 Areas of ecological value in or near the project footprint

Title	Location in relation to Project footprint	Description and Values (per ACRP:C, District Plan or PAUP)
Proposed Unitary Plan		
SEA-T-3409	Within Project footprint (existing rock armour on northern side of Greenhithe Bridge causeway)	Criteria 2 (threat status and rarity), Criteria 4 (stepping stones, migration pathways and buffers)
SEA-T-4791	Outside Project footprint	Criteria 2 (threat status and rarity), Criteria 4 (stepping stones, migration pathways and buffers)
SEA-T-8313	Outside Project footprint	Criteria 2 (threat status and rarity), Criteria 4 (stepping stones, migration pathways and buffers)
SEA-T-8319	Outside Project footprint	Criteria 3 (Diversity), Criteria 4 (stepping stones, migration pathways and buffers)
SEA-T-8433	Outside Project footprint	Criteria 4 (stepping stones, migration pathways and buffers)
SEA-M2-57b	Outside Project footprint	This area is the best example of the muddy, mangrove-lined inlets of the inner Waitemata Harbour. The diversity and productivity of the flora and fauna is generally large with extensive beds of shellfish and abundances of birds and fish. Gradations between the marine environment and either natural freshwater or natural terrestrial systems are a major characteristic of the ramifying arms of the system. These arms are also important as pathways for migration by native freshwater fish. The mangroves and saline vegetation is an important habitat for threatened secretive coastal fringe birds, particularly where it abuts terrestrial vegetation, which provides roosts and potential nest sites for birds. Brighams, Rangitopuni, Paremoremo, Lucas and Hellyers creeks in the upper reaches of the Waitemata Harbour offer largely unspoilt tidal inlets with hill sides of regenerating native forest in the area of Lucas and Paremoremo Creeks. The forest cover here consists of kauri on the ridges with puriri and kahikatea dominant on the slopes and in the gullies. The coastal forest is comprised of pohutukawa, kowhai and karaka. The extensive sheltered intertidal areas retain large quantities of soft sediment derived from the watershed. The mangroves and salt marshes are important as wildlife habitats. Birds which can be found in the area include black shag, kingfisher and white-fronted tern. A large area of regenerating kauri/tanekaha-broadleaved forest occurs on the northern Lucas Creek escarpment. It forms part of the largest block of continuous forest in the Tamaki Ecological District. Pohutukawa line the coastal edge of Paremoremo Creek mouth, and significant remnants of coastal forest grade into mangroves.
SEA-M1-58a	Outside Project footprint	The most significant areas where mangroves grade into coastal forest. Hellyers Creek is important because of the extensive natural connections between the marine and terrestrial environments. Almost all of the block of land to the south of View Road on the northern side of Hellyers Creek is covered with forest (kahikatea, kauri, kohekohe, puriri, taraire, kowhai, and kanuka). This natural vegetation adjoins mangroves which occupy large areas of the upper shore. There is a continuous corridor of regenerating coastal kauri-tanekaha-kanuka-pohutukawa broadleaved forest from the head of Hellyers Creek to Greenhithe, on the northern side of the creek, with intact

Title	Location in relation to Project footprint	Description and Values (per ACRP:C, District Plan or PAUP)
		sequences from mangrove to kauri forest on the ridge. Hard beech is also found along the Hellyers Creek escarpment.
SEA-M2-58b	Outside Project footprint	Hellyers Creek is important because of the extensive natural connections between the marine and terrestrial environments. Almost the entire block of land to the south of View Road on the northern side of Hellyers Creek is covered with forest (kahikatea, kauri, kohekohe, puriri, taraire, kowhai, and kanuka). This natural vegetation adjoins mangroves which occupy large areas of the upper shore. There is a continuous corridor of regenerating coastal kauri-tanekaha-kanuka-pohutukawa broadleaved forest from the head of Hellyers Creek to Greenhithe, on the northern side of the creek, with intact sequences from mangrove to kauri forest on the ridge. Hard beech is also found along the Hellyers Creek escarpment.
SEA-M1-56b	Outside Project footprint	At the mouth of Nimrod Inlet and Bomb Bay is a shellbank (56b) that is one of the two major roosts on the Waitemata Harbour for wading birds, including threatened species.
SEA-M2-56a	Outside Project footprint	Contains wide intertidal mudflats and mangrove shrublands. Wading birds, including threatened species feed in the intertidal area to the east of the peninsula (56a).
Auckland Council District Plan: Waitakere		
Coastal Natural areas	Inside and outside project footprint	No identifying criteria for this category was found in the Waitakere District Plan.
Managed Natural areas	Inside and outside Project footprint	No identifying criteria for this category was found in the Waitakere District Plan.
Restoration Natural areas	Outside Project footprint	No identifying criteria for this category was found in the Waitakere District Plan.
Ecological Linkage opportunity	Outside Project footprint?	No identifying criteria for this category was found in the Waitakere District Plan.
Auckland Council District Plan: North Shore		
Site of Special Wildlife Interest (SSWI) 6	Outside Project footprint	Type 1 – Forest/shrubland. Rank – moderate. Key elements - Regeneration stage to kauri forest. Important food source for kereru and tui. Diversity of flora and fauna. Landscape feature.
SSWI 12	Outside Project footprint	Type 3 – coastal/estuarine wetland. Rank – moderate-high. Key elements - Mangrove areas, intertidal mudflats, saltmarsh, coastal bush. Important food source for shore birds.
Coastal Conservation area	Inside and outside Project footprint	The Coastal Conservation Area has been determined on the basis of the land possessing one or more of the following characteristics: • Any habitat or association of flora adjacent to the foreshore which derives its intrinsic character from a maritime location • Any landform adjacent to the foreshore which has been formed or modified by processes of marine erosion or deposition

Title	Location in relation to Project footprint	Description and Values (per ACRP:C, District Plan or PAUP)
		• Any feature, either natural or physical, which substantially contributes to the visual amenity of the coastal environment • Any site or part thereof adjacent to the foreshore from which natural surface drainage may flow to the coastal marine area • Any reserve or part thereof adjoining mean high water springs where activities may take place which have a connection with or impact on the coastal marine area • Any commercial or industrial land use located adjacent to the foreshore which engages in any activity, which may have a direct effect on the coastal environment • Any part of any road or any transport or communication facility including any wharf, jetty or quay adjoining mean high water springs
Auckland Council Regional Plan: Coastal		
CPA1 - 57	Outside Project footprint	Herald Island to Lucas Creek - This area is the best example of the muddy, mangrove-lined inlets of the inner Waitemata Harbour. The diversity and productivity of the flora and fauna is generally large with extensive beds of shellfish and abundances of birds and fi sh. Gradations between the marine environment and either natural freshwater or natural terrestrial systems are a major characteristic of the ramifying arms of the system. These arms are also important as pathways for migration by native freshwater fi sh. The saline vegetation is an important habitat for threatened secretive coastal fringe birds, particularly where it abuts terrestrial vegetation, which provides roosts and potential nest sites for birds.
CPA1 - 58	Outside Project footprint	Hellyers Creek North - Hellyers Creek is important because of the extensive natural connections between the marine and terrestrial environments. Almost all of the block of land to the south of View Road on the northern side of Hellyers Creek is covered with trees (kahikatea, kauri, kohekohe, puriri, taraire, kowhai, and kanuka). This natural vegetation adjoins mangroves which occupy large areas of the upper shore.
CPA1 – 56b & CPA2 – 56a	Outside Project footprint	Hobsonville Peninsula At the mouth of Nimrod Inlet and Bomb Bay is a shellbank (56b) that is one of the two major roosts on the Waitemata Harbour for wading birds, including threatened species. These birds feed in the intertidal area to the east of the peninsula (56a). On the southern coast of the Hobsonville Peninsula is a geological exposure of primary tephra from the Taupo Volcanic Zone both above and below Mean High Water Springs. The exposure is one of the few where pumice silts exists at sea level. It was not extensively modified by estuarine processes during deposition and is therefore considered to be nationally important. The Department of Conservation has selected this area as an Area of Significant Conservation Value (ASCV).
Area of Significant Conservation Value - 56	Outside Project footprint	Hobsonville Peninsula Landslide (formerly Kaiwaneke Point Landslide)

APPENDIX E.1: SIGNIFICANT ECOLOGICAL AREAS IN THE PROPOSED AUCKLAND UNITARY PLAN, WITHIN OR NEAR THE PROJECT FOOTPRINT

SCALE 1: 15,000

0 150 300 450 600 750 (m)

Aerial photo sourced from Auckland Council GIS Website

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Tonkin & Taylor
Environmental and Engineering Consultants
105 Carlton Gore Road, Newmarket, Auckland
www.tonkin.co.nz

DRAWN	RBS	Jun. 15
DRAFTING CHECKED		
APPROVED		
CADFILE : 29718-CPA-AppE-1.dwg		
SCALES (AT A3 SIZE) 1: 15000.		
PROJECT No. 29718		

Watercare
An Auckland Council Organisation

GREENHITHE BRIDGE WATERMAIN DUPLICATION & CAUSEWAY
Significant Ecological Areas in the Project Area
(Proposed Auckland Unitary Plan)

FIG. No. Appendix E.1 REV. 0

APPENDIX E.2: NATURAL AREAS IN THE AUCKLAND COUNCIL DISTRICT PLAN: WAITAKERE, WITHIN OR NEAR THE PROJECT FOOTPRINT

A9

A10

B9

C9

C10

FERRY PDE

Herald Island

Clark Point

Sunderland Cove

Harrier Point

Catalina Bay

Bomb Bay

Orion Point

Nimrod Inlet

Bofors Point

Scott Point

10

CLARK RD

CALDER CR

STRATTON PL

CARNEGIE CR

CLARK RD

SCOTT RD

SCOTT RD

SCOTT RD

Auckland Council

Te Kaunihera o Tamaki Makaurau

District Plan - Natural Areas

1:8,000 0 100 200 300 400 500 Metres

B10

Natural Areas

- General
- Managed
- Protected
- Restoration
- Coastal
- Natural Water Body
- Non Riparian Stream
- Riparian Margin (5m)
- Riparian Margin (7m)
- Riparian Margin (10m)
- Riparian Margin (15m)
- Riparian Margin (20m)
- Riparian Margin (30m)
- 5 metre Coastal Edge
- 10 metre Coastal Edge
- 15 metre Coastal Edge
- 20 metre Coastal Edge
- Natural Ridge Centreline
- Modified Ridge Centreline
- Sensitive Ridge - Steep (25m)
- Sensitive Ridge - Moderate (65m)
- Sensitive Ridge - Broad (100m)
- Ecological Linkage Opportunity
- Headland, Scarp or Cliff
- Structure Plan Area Boundary
- Urban Concept Plan Area Boundary
- Area Under Appeal
- Protected Point
- Adjacent Territorial Local Authority
- Coastal Marine Area
- Area of Plan Change
- Proposed District Plan
- Decision Notice
- Oratia Local Area
- Waiatarua Local Area

Proposed October 1995
This version September 2013

Auckland Council
Te Kaunihera o Tamaki Makaurau

APPENDIX E.3: SPECIAL PROVISION SITES IN THE AUCKLAND COUNCIL DISTRICT PLAN: NORTH SHORE CITY, LOCATED WITHIN OR NEAR THE PROJECT FOOTPRINT

Herald Island

Marae Res

Marae Pt

KOKI RD

POURAMU LN

AUSTIN RD

REMU PL

TAUHINU RD

THE CLOS

THE KNOLL

156

160

25

20

30

UPPER HARBOUR DR

SSWI 6

SSWI 12

Upper Harbour Bridge

WAITEMATA HARBOUR

WAITAKERE CITY

WAITEMATA HARBOUR

N

Cadastral Base Updated October 2014

100 0 100 200 300

Scale 1:10,000

NORTH SHORE CITY COUNCIL PLAN

DESIGNATIONS & SPECIAL PROVISIONS

NOTE: These maps do not identify properties subject to Natural Hazards.
Refer to Section 8 of the District Plan and contact Council directly for information on hazards.

NORTH SHORE CITY

17
22 23

NORTH SHORE CITY DISTRICT PLAN
LEGEND

DESIGNATIONS AND SPECIAL PROVISIONS

Designations
(Refer Appendix 14A of Volume I for details) — 20

Road, Service Lane, Accessway
(Designated / Vested)

Proposed Road or Service Lane

Building Line Restriction
(Refer Appendix 5 for map enlargements)

Road to be closed

Proposed Reserves

Notable Trees
(Refer Appendix 8C of Volume I for details) — 967

Notable Grove of Trees
(Refer Appendix 8C of Volume I for details) — 346

Historic Building, Object or Place
(Refer Appendix 11A of Volume I for details) — 410

Business Policy Overlay B1

Site of Special Wildlife Interest
Refer Appendix 8A of Volume 1 for details)
N.B. Those parts of the Sites of Special Wildlife Interest within the Coastal Marine Area subject to the control of the Auckland Regional Plan: Coastal — SSWI 14

Coastal Conservation Area
(Refer Section 8 of Volume I for details)

Geological Site
(Refer Appendix 8B of Volume I for details) — 12

Small Geological Site
(Refer Appendix 8B of Volume I for details) — 12

Archaeological Site
(Refer Appendix 11B of Volume I for details) — 63

Coastal Marine Area Boundary
(Refer to Auckland Regional Plan: Coastal for details and co - ordinates)

Significant Landscape Features

Reserve / Open Space Linkages

Stormwater Ponds (location indicative)

Long Bay Protection and Management Areas
(see Appendix 11A for Land Use Strategy & Appendix 11B for Additional Controls)

Piripiri Point Protection Area

Park Interface Protection Area

Landscape Protection Area - Conservation

Landscape Protection Area - Restoration

Heritage Management Plan Area

Ecology / Stormwater Management Area

Landscape Protection Area - Enhancement

Stream Interface Management Area

10m Vaughans Road Setback

Service Utility (location indicative)

Long Bay Streams

Riparian Margins in Long Bay 6 Zone

Ridgeline Height Control

Foreshore Yard measured from Mean High Water Springs — 9
The figure is the width of the yard in metres. (Refer Appendix 21E of Volume II for details)

Foreshore Yard measured from a surveyed reference line — 9*
The figure is the width of the yard in metres from the reference line. (Refer Appendix 8 for map enlargements)

ZONINGS

Residential 1 to 8 Zones — 4B

Business 1 to 12 Zones — 9

Recreation 1 to 4 Zones — 1

Rural 1 to 4 Zones — 3

Residential Expansion Zone

Special Height Restriction

Structure Plan Zones — A(A)

A(A)	Area A: Environmental Protection (Albany)
A(G)	Area A: Environmental Protection (Greenhithe)
B(A)	Area B: Environmental Protection (Albany)
B(G)	Area B: Environmental Protection (Greenhithe)
C	Area C: Standard Residential (Albany & Greenhithe)
D	Area D: Standard Residential (Albany & Greenhithe)
MX	Mixed Use Overlay Area (Albany & Greenhithe)
LB1A	Long Bay 1A (Large Lot Residential 2500m2)
LB1B	Long Bay 1B (Rural Residential 5000m2)
LB1C	Long Bay 1C (Piripiri Point Rural)
LB2	Long Bay 2 (Suburban Neighbourhood)
LB3A & 3B	Long Bay 3A & 3B (Urban Neighbourhood)
LB4	Long Bay 4 (Urban Village)
LB5A & 5B	Long Bay 5A & 5B (Village Centre)
LB6	Long Bay 6 (Stormwater Management)
LB7	Long Bay 7 (Heritage Protection)

12

1	Health
2	Education
3	Wastewater Treatment Plant
4	Cemetery & Crematorium
5	Transitional Quarry
6	Boat Building
7	Marinas
8	Awataha Marae
9	Community Use
10	Centrepoint Community Growth Trust
11	Albany Centre Amenity Area
12	North Shore Domain & Stadium
13	Chelsea Sugar Refinery Disposal Area
14A	Devonport Naval Base (Health & Administration)
14B	Devonport Naval Base (HMNZS Philomel)
15	Devonport Naval Base HMNZ Dockyard

Zone Boundary

a) boundary between two different zones of the same type

b) a zone boundary which does not follow a cadastral boundary

GENERAL FEATURES

City Boundary

Road, Service Lane, Accessway

Preferred Road

APPENDIX E.4: COASTAL PROTECTION AREAS IN THE AUCKLAND COUNCIL REGIONAL PLAN: COASTAL, LOCATED WITHIN OR NEAR THE PROJECT FOOTPRINT

AUCKLAND REGIONAL PLAN: COASTAL MAPS

UPPER WAITEMATA EAST | **Map Series 1 - Sheet 28**

0 250 500 1,000 1,500 Metres

1:30,000

N

Auckland Regional Council
TE RAUHITANGA TAIAO

Joins Sheet 27

Joins Sheet 31

Joins Sheet 29

ALBANY
PAREMOREMO
GREENHITHE
HERALD IS.
RNZAF BASE
HOBSONVILLE
BEACH HAVEN
KAURI POINT DOMAIN
BIRKENHEAD

Lucas Ck
Te Wharao Ck
Hellyers Creek
Kaipatiki Ck
Waiarohia Inlet
Onetaipu Pt
Catalina Bay
Bomb Bay
Limeburners Bay
Westpark Marina
Lucken Pt
Island Bay
Soldiers Bay
Onetaunga
Chelsea Bay

North Shore Treatment Works

179 180 181 182 183 184 185 186 187 188

57 58 59 56b 56 56a 55c 55a 30 44 42 41 40 39 38 37

208 20 70 227 345 330 181

65m 60m 40m 20m

GILLS ROAD
HOBSON ROAD
(S.H. 1)
RIDGE ROAD
THE AVENUE
LIBRARY LANE
ALBANY EXPRESSWAY
GREVILLE ROAD
GLENMORE ROAD
DONALDSON DRIVE
COLLINGS DRIVE
GODLEY LANE
RIDGE RD
ELMORE ROAD
PAREMOREMO ROAD
ALBANY HIGHWAY
CONSTELLATION DRIVE
HARDENS LANE
SANDERS ROAD
MEREWHIRA ROAD
ATTWOOD ROAD
KITTERA ROAD
KAURI ROAD
HOBSONVILLE RD (S.H. 18)
BUCKLEY AVENUE
CLARKS LANE
CONNELL ROAD
SINTON ROAD
CLARK ROAD
SCOTT RD
UPPER HARBOUR DRIVE
GLENFIELD ROAD
BEACH HAVEN ROAD
ESKDALE ROAD
BIRKDALE ROAD
RANGATIRA ROAD
VERRAN ROAD
WAIPA STREET
MOKOIA ROAD
HIGHBURY BYPASS
BIRKENHEAD AVENUE
PUPUKE RO
MARINA VIEW DRIVE

AUCKLAND REGIONAL PLAN: COASTAL MAPS

MAP SERIES 1 LEGEND

- General Management Area
- Tangata Whenua Management Area
- Airport Management Area
- Mooring Management Area (see Schedule 5)
- Marina Management Area
- Aquaculture Management Area (AMA) - (Variations 2, 4 - 6*, see Schedule 9)
- Land Associated with Coastal Protection Areas (CPA)
- Coastal Protection Area (CPA) 1
- Coastal Protection Area (CPA) 2
- Coastal Protection Area 1 (small sites)
- 23 Coastal Protection Area number (see Schedule 3)
- Cultural Heritage Places and Areas for Preservation (see Schedule 1)
- Cultural Heritage Places and Areas for Protection (see Schedule 2)
- 23 Area of Significant Conservation Value (see Schedule 4)
- Gazetted Marine Reserve
- Marine Park
- Regionally Significant Landscape (Rating 5)
- Outstanding Landscape (Rating 6)
- Outstanding Landscape (Rating 7)
- 23 Coastal Marine Area (CMA) boundaries (see Schedule 7)
- Airport Height Restriction
- Airport Runway Protection Area (see Appendix H)
- Special Activity Area
- Defence Exercise Area
- Prohibited Anchorage
- Main Trunk Rail
- Motorway/State Highway
- Major Road
- Gas Line
- Auckland Regional Council (ARC) Boundary

* Variation 3 was withdrawn on 24 May 2006.