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Far North Holdings Limited

ASHBYS BOATYARD MARITIME SERVICING AREA

For Far North Holdings Ltd

Assessment of Ecological Effects

September 2019

REPORT INFORMATION AND QUALITY CONTROL

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1 INTRODUCTION

4Sight Consulting (4Sight) has been commissioned by Far North Holdings Limited (FNH) to provide an Assessment of Ecological Effects (AEcE) of a proposed maritime servicing area at Ashby's Boatyard, Opua.

The proposed boatyard maritime servicing area involves a number of activities for which consent is required. Specifically:

- Limited mangrove removal;
- Reclamation;
- Capital dredging;
- Spoil disposal;
- Stormwater management; and
- New structures.

The proposal lies within a Marine 4 (Controlled Mooring) Management Area under the Northland Regional Coastal Plan[1] (Appendix A).

Key aspects of the proposal considered in this report are as follows:

- Effects of reclamation of a total marine area of approximately 2,400 m^2 (1,700 m^2 for new docks and 700 m^2 for a new boat ramp) which includes a few small mangroves, intertidal soft shore and an existing rock seawall.
- Effects of capital dredging 600 m^3 to 3.1 m depth (OTP) over an area of 1,200 m^2 of shallow subtidal soft sediment habitat. This material will be used as direct fill, along with 6,500 m^3 of additional fill imported for the reclamation.
- Stormwater will be managed by stormwater treatment devices capable of removing the required levels of copper, zinc and suspended solids and will be piped to an outfall to the Coastal Marine Area (CMA).
- Effects on the shallow subtidal marine area from piles and construction of a timber ramp and public timber jetty (42 m long x 3 m wide) with 12 m long aluminium gangway and 20 m long x 4 m wide concrete pontoon.
- Construction effects of a 4.5 m wide single lane road, 2.5 m high retaining wall, 6 m wide dual lane road, 2 m wide cycle trail, manoeuvring area to boat ramp, car parking and truck turning area.

An aerial plan showing the locality (Figure 1) and development layout (Figure 2) is presented below. Full plans are attached in Appendix B.

[1] Northland Regional Council (2003). Regional Coastal Plan for Northland, 19 November 2003.

Figure 1: Location of proposed maritime servicing area at Ashby's Boatyard, Opua.

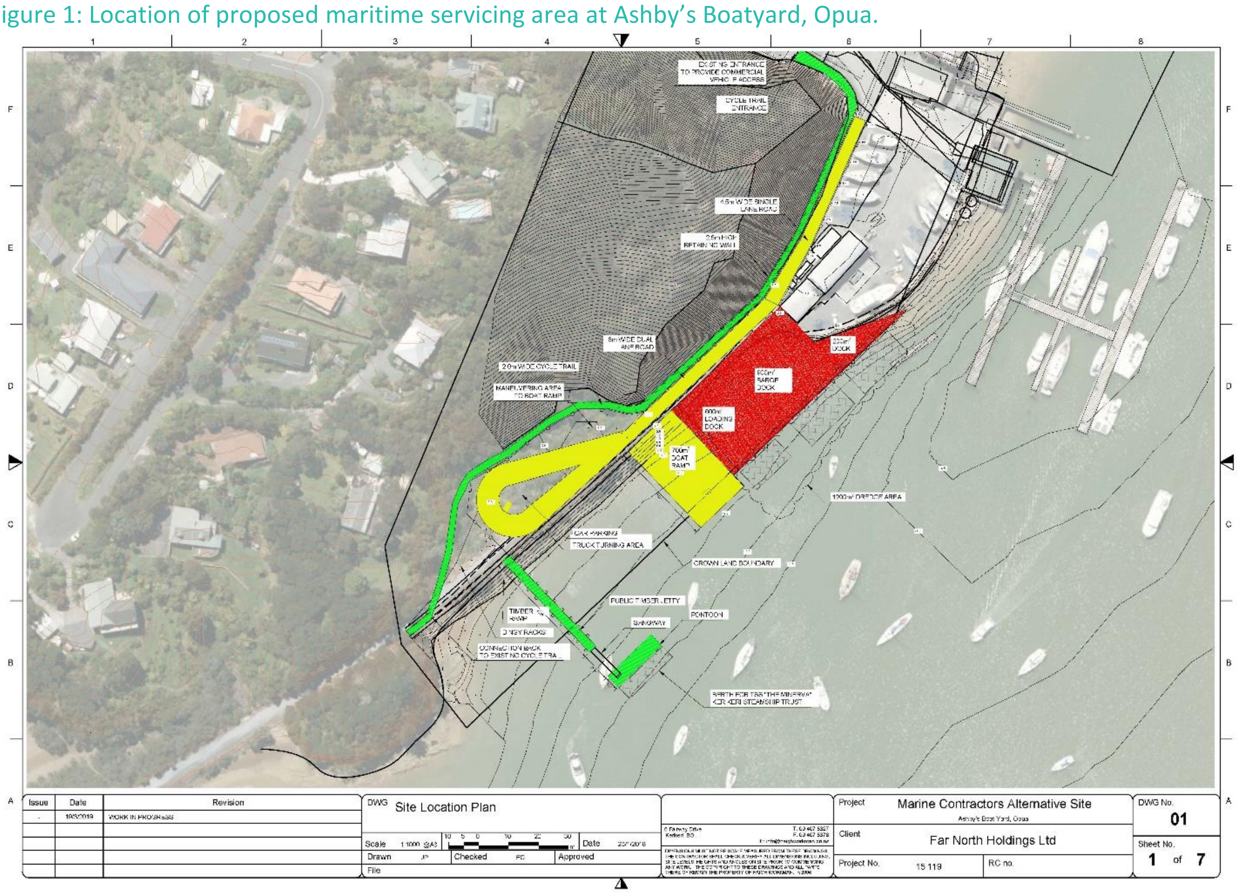

Figure 2: Development layout and site location plan of proposed maritime servicing area at Ashby's Boatyard, Opua.

2 WORK CARRIED OUT

The following work has been undertaken as part of this Assessment of Ecological Effects:

- A review of relevant data bases, coastal plan information and other sources of information as relevant.
- A field survey on 16 May 2019. The field investigations included a vegetation survey of the landward areas potentially impacted, a biological survey of the shoreline and subtidal areas, over a period of low water. Sediments were collected from the dredging, reclamation and proposed timber jetty zones for chemical and biological characterisation.
- Reporting on actual and potential effects and mitigation of effects.

3 EXISTING ENVIRONMENT

3.1 General

The site is located to the immediately upstream (south-west) of Opua Marina and Ashby's Boatyard at the entrance of Kawakawa (Taumarere) River estuary. The site is adjacent an area of swing moorings. The coastal edge is modified by an existing rock retaining wall, adjacent to which is the existing cycle trail on the old rail line. The coastal environment is muddy and estuarine.

The specific development area is relatively isolated from public activity but is accessible from the water or via the cycle trail entrance behind Ashby's Boatyard at the end of Baffin Street, Opua.

3.2 Terrestrial Vegetation

3.2.1 Method

The landward area (see Figure 2) was inspected on 16 May 2019 (See Photos 1-7, Appendix C). This area has proposed development of roads, a retaining wall, cycle trail, manoeuvring area to boat ramp, car parking and a truck turning area.

3.2.2 Results

At the northern entrance to the existing cycle trail (opposite the existing Ashby's Boatyard buildings), the lower parts of the rock scarp are unvegetated or contain weeds (Photo 1 and 2). The vegetation higher on the bank adjacent the cycle trail (Photos 1-3) is a mix of native and exotic species. Natives include kanuka (*Kunzea ericoides*), manuka (*Leptospermum scoparium*), totara (*Podocarpus totara*), red matipo (*Myrsine australis*), kawakawa (*Macropiper excelsum*), coastal five-finger (*Pseudopanax lessonii*) and pukatea (*Laurelia novae-zelandiae*). The exotics include rank grasses but also pest plants such as brush wattle (*Paraserianthes iophantha*), gorse (*Ulex europaeus*) and woolly nightshade (*Solanum mauritianum*).

Where the current boatyard ends and the proposed reclamation begins (Photo 4) the vegetation on the landward side of the cycle trail is more botanically diverse and contains ponga (*Cyathea* sp.), mahoe (*Melicytus ramiflorus*), flax (*Phormium tenax*) and ground ferns, in addition to the native species previously noted. Exotics and pest plants remain and additionally include wild ginger (*Hedychium gardnerianum*) and pampas (*Cortaderia* sp.).

At the southern end of the site, where the proposed car parking, truck turning and manoeuvring area to the boat ramp are to be located, there is a small area of scrub (Photo 7) containing pampas, woolly nightshade, brush wattle, gorse, pine, wild ginger along with the some native such as red matipo, ponga, totara, manuka, pukatea, kawakawa, ground ferns and pohutukawa (*Metrosideros excelsa*).

On the proposed reclamation side of the existing cycle trail, vegetation is mainly native (Photos 4-6) and includes red matipo, kanuka, manuka, small totara, pohutukawa, including a large pohutukawa up to eight metres, a cluster of flax and some small juvenile mangroves (*Avicennia marina* subsp. *australasica*) on the lower shore (Photo 6).

3.3 Intertidal Habitats

3.3.1 Method

The intertidal area was inspected at low tide on 16 May 2019 (See photos 8-14, Appendix C). The site includes a rock retaining wall adjacent to the cycle trail and a narrow beach of sandy/gravel which is wider at the northern end, near the current boatyard (Photo 8).

Four (0.5 x 0.5 metre) quadrats placed on the beach (Photos 9, 11, 13-14) were assessed for surface and infaunal biota. This included sieving sediment through a 5 mm sieve where substrate permitted (Sites 1 and 2; Photos 10 and 12), to locate any larger macroinvertebrates including shellfish. To assess relative abundance of crabs, mud holes were counted in the four locations. Intertidal sampling locations are shown in Figure 3.

3.3.2 Results

The intertidal habitat is very limited and hard surfaces are heavily silted. Pacific oysters (*Crassostrea gigas*) were the most abundant taxa observed on the rocky substrates (Table 1) and the burrows of the mudcrab (*Austrohelice crassa*) indicated this is the dominant soft shore animal. The coarse sand and gravel of the beach contained no larger biota.

There is no significant intertidal habitat or biota such as seagrass or shellfish at the site.

Table 1: Description of intertidal habitats and biota.

<table>
<tr><th>Intertidal Sampling Location</th><th>Description</th><th>No#</th><th>Biota / Species</th></tr>
<tr><td>1</td><td>Coarse sand with underlying hard clay. Gravel and cobble present. No species located from sieving.</td><td>1</td><td>Sandhopper (Bellorchestia quoyana)</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Cobbles and rock covered with thick sediment. Crab holes in vicinity. No species located from sieving.</td><td>3</td><td>Crab holes</td></tr>
<tr><td>1</td><td>Pacific oyster (Crassostrea gigas)</td></tr>
<tr><td>1</td><td>Unidentified polychaete</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Rock retaining wall/boulders with turfing algae, covered in thick sediment and presence of leaf litter.</td><td>6</td><td>Crab holes</td></tr>
<tr><td>25</td><td>Pacific oyster (Crassostrea gigas)</td></tr>
<tr><td>1</td><td>Orange-striped anemone (Haliplanella lineata)</td></tr>
<tr><td rowspan="4">4</td><td rowspan="4">Rock retaining wall/boulders covered in thick sediment. 5% coverage with Neptune's necklace (Hormosira banksia).</td><td>6</td><td>Crab holes</td></tr>
<tr><td>20</td><td>Pacific oyster (Crassostrea gigas)</td></tr>
<tr><td>1</td><td>Acorn barnacle</td></tr>
<tr><td>3</td><td>Limpet (Notoacmea sp.)</td></tr>
</table>

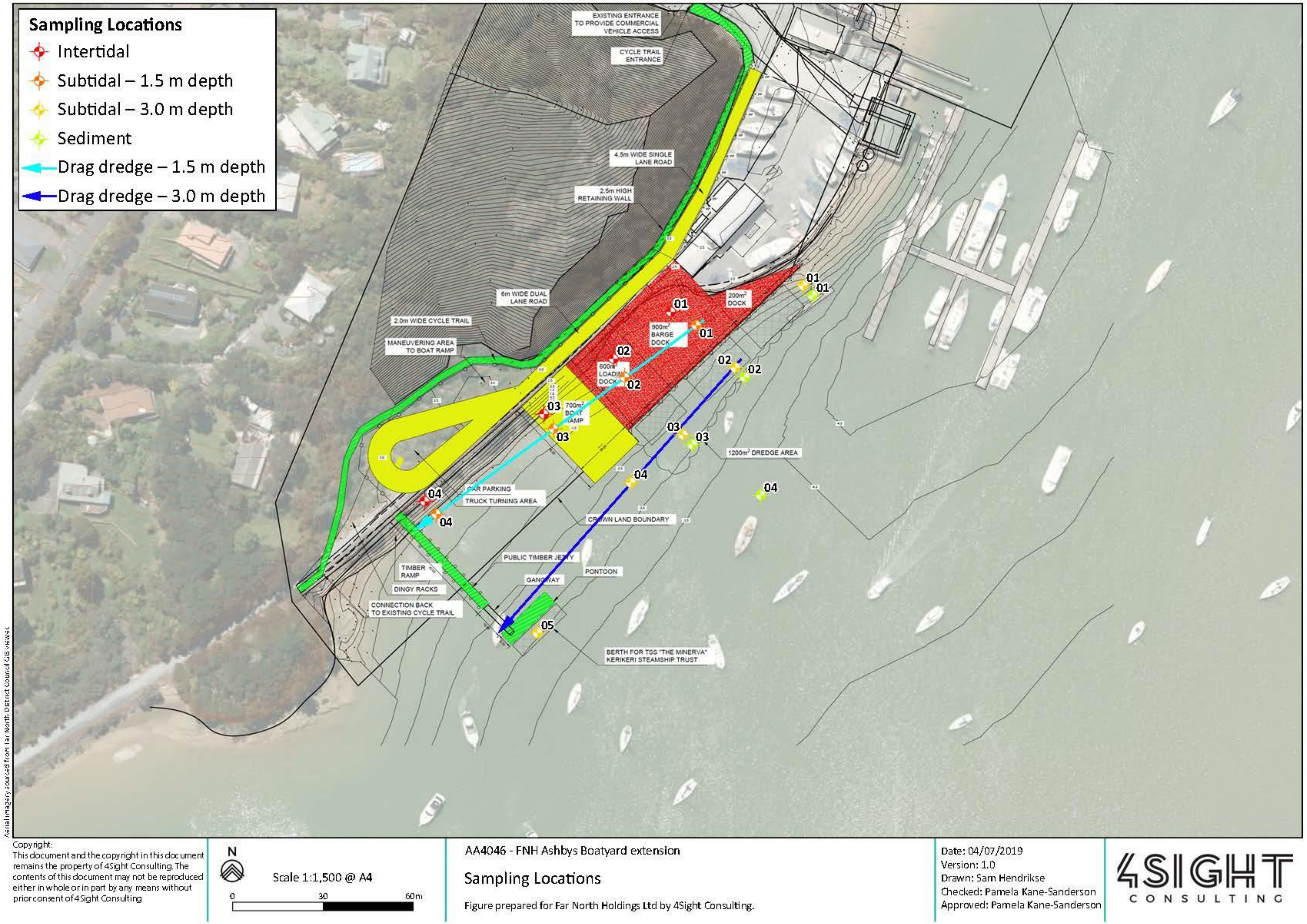

Figure 3: Sediment and biological sampling locations, overlaid on indicative plan.

3.4 Subtidal Habitats

3.4.1 Method

The subtidal marine community was assessed by sampling the *insitu* biota. Nine seabed samples were collected using a biological 'box' dredge towed behind a small boat (Photo 15, Appendix C). Four samples were at approximately 1.5 m depth below chart datum (subtidal-1.5 m depth: sites 1-4) and five at 3.0 m depth (subtidal-3 m depth: sites 1-5).

The dredge has a serrated leading edge and in relatively soft but cohesive seabed, it collects a semi quantitative sample of near surface sediment down to about 5 to 10 cm. In soft seabed where the dredge fills completely, the volume of each sample is about 5,030 cm^3. The dredge samples an area of about 0.02 to 0.03 m^2 of seabed.

The nine seabed samples were collected from the locations shown in Figure 3. These samples were all within or at the outer edge of the indicative dredging footprint, reclamation area or proposed jetty and pontoon.

Each sample was sieved through a 0.5 mm nylon sock on site and the biota retained was placed in a jar and fixed in ethanol. Each sample was later spiked with Rose Bengal dye to facilitate identification of small biota.

The biota in these samples was subsequently extracted and combined to form two samples (subtidal 1.5 m and 3.0 m depth) and sent to a marine invertebrate taxonomist (Martijn Spierings, Cawthron Institute, Nelson) for species identification.

This sampling approach provides a semi quantitative evaluation of the type of community, diversity and indication of general abundance of biota within the footprint area of the proposed boatyard maritime servicing area.

In addition to the box dredge tows, a modified scallop (drag) dredge was used to sample larger surface-dwelling biota such as starfish and large whelks. Two tows were undertaken at 1.5 and 3.0 metres depth, with locations shown in Figure 3.

Seabed sediment samples at locations 3.0 m depth (sediment sites 1-3) and a site beyond the dredging zone (sediment, site 4), were assessed for chemistry.

3.4.2 Subtidal Biota Results

Results are presented in Appendix D.

The total number of species recorded was 28. At 1.5 metres depth there were 17 species and 435 individual specimens and at 3.0 metres depth there were 23 species and 392 individual specimens.

Polychaetes (bristle worms) dominated the assemblage and comprised 16 taxa of which five species were numerically dominant and recorded at all sites. These were *Cossura consimilis* (mean 235.5/sample), *Paraonidae* (mean 31/sample), *Barantolla lepte* (mean 27.5/sample), *Heteromastus filiformis* (mean 22/sample) and *Phylo novazealandiae* (mean 13/sample).

The predominance of *C. consimilis* warrants comment. One literature source states that *C. consimillis* can tolerate a wide mud percentage of 5 to 65%, with an optimum range of 20 to 25%, therefore preferring habitats that are more sandy than muddy[2]. *C. consimilis* is also cited to have shown sensitivity to copper contamination. Where estuarine sediments become muddier and/or polluted (particularly with copper), the abundance of *C. consimilis* is likely to decline. This is considered by the Waikato Regional Council[2] to make *C. consimilis* a good indicator species with which to assess changes in the input of sediment and pollutants to estuaries.

Copper is the signature metal most likely to be elevated in an area with a high level of boat mooring and boat repair activity. The relatively high abundance of *C. consimilis* suggests that copper contamination is not significant at this

[2]https://www.waikatoregion.govt.nz/environment/natural-resources/coast/coastal-monitoring/regional-estuary-monitoring-programme/organisms/polychaetes/cossura-consimilis/

locality and this is consistent with sediment metals analysis which shows copper concentrations below ANZECC (2018)[3] guidelines.

Six crustacean species, three bivalve species, one oligochaete, one nemertean (ribbon worms) and one anthozoa species were also recorded. Next to the five abundant polychaetes, the bivalve *Theora lubrica* was the only other species that was also 'abundant'. It had a mean density of 35 individuals per sample and had similar representation at both sites.

T. lubrica is a mud tolerant species with an optimum range of 45-50% (and can tolerate a mud content of up to 65%) preferring muddy habitats with some sand[4]. *T. lubrica* is often found in organically enriched or polluted sediments to which it appears tolerant.

All other taxa were present at low abundance and or low occurrence. Specifically, 15 taxa had a mean density of one or less, and seven taxa had a mean density of between 1 and 10 individuals per sample.

The benthic fauna is not significant or unusual in terms of rarity, biodiversity or exotic species. The species recorded are common. The sampling is likely to have underestimated the presence of deep burrowing species such as shrimp and heart urchins, which may also be present.

These results are similar to a previous reclamation investigation (located approximately 400 metres south-west of the proposed works location) undertaken for Far North Holdings (4Sight, 2016)[5] . In that survey, three subtidal samples revealed 27 taxa at 18 – 20 taxa per sample. Polychaetes were also represented in similar numbers with 15 taxa, four (*C. consimilis, H. filiformis, Paraonidae* and *Prionospio aucklandica)* of these numerically dominant.

Results can also be compared to the 2014 study for the Opua Marina (Poynter, 2014)[6] in which ten subtidal samples recorded 36 taxa at 9 to 17 taxa per sample. Overall, Poynter (2014) had more taxa, which is predicted with more samples. Polychaetes also dominated (19 taxa) with the dominant species also recorded as *C. consimilis, Paraonidae* and *H. filiformis*.

Swales *et al*. (2012)[7] also investigated macro-benthic fauna in this general area. A site area nearest to this study area (a site located just north of Opua (Sample Site VNC in Swales et al., 2012)) was assessed as being dominated by an infauna, which had low diversity.

Two drag dredge samples were conducted at approximately 1.5 and 3.0 metres depth (see Figure 3 for drag dredge sample locations). No biota were collected, with the dredges collecting old oyster shells, organic and woody debris and polychaete calcareous tube casings.

3.4.3 Subtidal Sediment Quality

A summary of the benthic dredge information for the ten seabed samples is shown in Table 2. Sediments were not subjected to grain size analysis but were described based on the observations of the collected samples. Samples were generally fine dark grey muddy sand with a light brown surface layer and most had organic debris and shell hash present. A typical seabed sample is shown in Photo 15, Appendix C.

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[3] ANZECC (2018) Australian and New Zealand guidelines for fresh and marine water quality, August 2018. National Water Quality Management Strategy, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra, Australia.

[4]https://www.waikatoregion.govt.nz/environment/natural-resources/coast/coastal-monitoring/regional-estuary-monitoring-programme/organisms/bivalves/bthl/

[5] 4Sight, (2016). Oyster Industry Reclamation and Vintage Railway Facilities, Ecological and Water Quality Assessment. Prepared for Far North Holdings by 4Sight Consulting, June 2016.

[6] Poynter, M., (2014). Opua Marina: Stage 2 Expansion Ecological and Water Quality Assessment. Prepared for Far North Holdings Ltd by Poynter & Associates Environmental Ltd, January 2014.

[7] Swales, A., Gibbs, M., Hewitt, J., Hailes, S., Griffiths, R., Olsen, G., Ovenden, R., Wadhwa, S., (2012). Sediment sources and accumulation rates in the Bay of Islands and implications for macro-benthic fauna, mangrove and saltmarsh habitats. Prepared for Northland Regional Council by NIWA, May 2012.

Table 2: Summary of benthic dredge information of the ten seabed samples.

Sample Site	Description
Subtidal - 1.5 m depth, Site 1	Fine dark grey muddy sand with light brown surface layer. Organic debris and gravel present.
Subtidal - 1.5 m depth, Site 2	Fine dark grey muddy sand with light brown surface layer. Organic debris, gravel and shell hash present.
Subtidal - 1.5 m depth, Site 3	Fine dark grey muddy sand with light brown surface layer. Organic debris, gravel and shell hash present.
Subtidal - 1.5 m depth, Site 4	Fine light grey muddy sand with light brown surface layer. High organic debris. Oyster shell remnants, shell hash and gravel present.
Subtidal - 3.0 m depth, Site 1 Sediment, Site 1	Fine dark grey muddy sand, with light brown/grey surface layer. Woody debris, leaf litter, oyster shell remnants and seaweed present.
Subtidal - 3.0 m depth, Site 2 Sediment, Site 2	Fine dark grey muddy sand with light brown surface layer.
Subtidal - 3.0 m depth, Site 3 Sediment, Site 3	Fine dark grey muddy sand with light brown surface layer. Organic debris present.
Subtidal - 3.0 m depth, Site 4	Fine dark grey muddy sand with light brown surface layer. Organic debris and shell hash present.
Subtidal - 3.0 m depth, Site 5	Fine dark grey muddy sand with light brown surface layer. Organic debris and shell hash present.
Sediment, Site 4	Fine dark grey muddy sand with light brown surface layer. Organic debris and shell hash present.

Four sediment samples were collected from the locations shown in Figure 3. These were analysed for total recoverable concentrations of arsenic, cadmium, chromium, copper, lead, nickel and zinc. Tributyltin, organic matter, ash and total organic carbon were also analysed. Samples were analysed by Hill Laboratories.

The sediment quality results (Appendix E) are presented in Table 3. These are compared with background concentrations from Northland Regional Council's (NRC) sediment monitoring at Kawakawa River (NRC, 2016)[8] and the Australia and New Zealand Environment and Conservation Council (ANZECC) 2018 default guideline values (DGVs) and 'upper' guideline values (GV-high). DGVs are used to assess results against thresholds which should ensure the protection of aquatic ecosystems in relation to individual toxicants. GV-high values provide an indication of concentrations at which toxicity-related adverse effects are expected. Results are also compared to threshold effect levels (TEL) developed by MacDonald *et al*. (1996)[9]. These TELs are also approximately the same values as the Sediment Quality Guidelines (ISQG) for the Protection of Aquatic Life Threshold Effects Level (TEL) of the Canadian Council Ministers for the Environment (CCME) 1999 as updated in 2002[10]. Values at or below TEL's, are more indicative of typical background ranges in unpolluted sediments.

[8] Northland Regional Council (2016). Coastal Sediment Monitoring Programme Whangarei Harbour and Bay of Islands 2016 Results. October 2016.

[9] MacDonald, D.D., Carr, R.S., Calder, F.D., Long, E.R. and Ingersoll, C.G. (1996). Development and evaluation of sediment quality guidelines for Florida coastal waters. Ecotoxicology 5:253-278.

[10] Canadian Council of Ministers of the Environment. (2002) 'Sediment Quality Guidelines for the Protection of Aquatic Life'. CCME 1999 (CCME Updated 2002).

Table 3: Sediment metal concentrations compared to ANZECC 2018 Default Guideline Values (DGVs) - light pink, 'upper' guideline values (GV-high) - dark pink, TELs – blue and recent NRC monitoring at Kawakawa River.

Parameter (mg/kg)	Sed Site 1	Sed Site 2	Sed Site 3	Sed Site 4	TEL (MacDonald *et al.* (1996)	ANZECC (2018)		Kawakawa River (NRC)			
						DGVs	GV-high	2010	2012	2014	2016
Arsenic	22	16.9	14.9	19.1	7.24*	20	70				
Cadmium	0.040	0.035	0.035	0.027	0.68	1.5	10	0.06	<0.09	<0.09	0.09
Chromium	15.2	19.0	19.0	16.9	52.3	80	370	14.6	16	13	9.9
Copper	46	25	22	15.9	18.7	65	270	13.8	17	15	8
Lead	17.1	12.1	12.4	10.9	30.2	50	220	13	13	13	8.4
Nickel	9.5	8.9	9.0	8.2	15.9	21	52			9	7.3
Zinc	101	76	78	86	124	200	410	82	69	86	55
Tributyltin (TBT)	0.019	0.004	0.004	0.016		0.009	0.07				

*Arsenic value is sourced from the Sediment Quality Guidelines (ISQG) for the Protection of Aquatic Life Threshold Effects Level (TEL) of the Canadian Council Ministers for the Environment (CCME), 2002.

The sediment metal values are well within the most stringent of the reference sediment quality guidelines (TEL) for cadmium, chromium, lead, nickel and zinc, which suggests that the subtidal sediments are not polluted with these metals.

Arsenic was slightly elevated at sediment site 1, which is closest to the current boatyard/marina area. Here it was slightly higher than ANZECC DGV. At the other sediment sites, arsenic concentrations fell between the TEL and DGV value. The levels of arsenic may be partly attributable to marine timbers treated with arsenical compounds.

There was also slightly elevated levels of **tributyltin (TBT)** at sediment sites 1 and 4 compared to ANZECC DGV, which may warrant further investigation. This is likely reflective of past influences as during the 1960's TBT was found to be a highly effective antifoulant and was used in paint applications. However, the toxicity and persistence of TBT on the marine environment was greatly underestimated, with research indicating that concentrations as low as 0.1 µg/L could cause effects on marine organisms (Strong, 2005)[11]. These findings led to the international community deciding to deregulate the use of this antifoulant and as such it hasn't been sold or applied in New Zealand since 1993. However, areas associated with the repair and maintenance of boat hulls could have been a point source or contributor of TBT to the marine environment. Results indicate organo tin residuals are still present.

Copper results were well below ANZECC DGV however at sediment sites 1, 2 and 3 (inner sites), copper was above the more conservative TEL and also above recent background concentrations recorded by NRC from Kawakawa River. The elevation of copper at the inner sites is likely to reflect the proximity of the site to past and potentially also present influences from the current boatyard, possibly due to copper based antifoulant products.

ANZECC guidelines do not include trigger values for total organic carbon, organic matter and ash and there are currently no nationally accepted trigger values in marine sediment. However, Robertson and Stevens (2007)[12] developed a classification for total organic carbon concentrations. Southland Regional Council, Tasman District Council and Northland Regional Council have used this in monitoring programmes. Guidelines from Robertson and Stevens (2007) provide a relative measure of the degree to which sediments can be considered enriched with carbon. Results for total organic carbon are also compared with background concentrations from NRCs sediment monitoring

[11] Strong, J (2005). Antifoulant and trace metal contamination of sediments from the Napier inner harbour. Report prepared for Hawke's Bay Regional Council by Jason Strong, Environmental Assessment and Monitoring Ltd, July 2005.

[12] Robertson, B., Stevens, L., (2007). Waiwaka estuary 2007 fine scale monitoring and historical sediment coring. Prepared for Environment Southland. Wriggle limited, Nelson.

at Kawakawa River (Table 4). Total organic carbon levels were low to moderately enriched at all sites, which was greater than the most recent 'very good' rating in 2016, but contained lower enrichment compared to the previous years of 2012 and 2014.

Table 4: Summary of subtidal sediment chemistry for total organic carbon, organic matter and ash, compared to Robertson and Stevens (2007) guidelines and NRC monitoring at Kawakawa River for total organic carbon.

Parameter (g/100 g)	Sed Site 1	Sed Site 2	Sed Site 3	Sed Site 4	Total Organic Carbon (g/100 g) Rating				Kawakawa River		
					Very Good	Low- Mod Enrichment	Enriched	Very Enriched	2012	2014	2016
Total Organic Carbon	1.08	1.58	1.56	1.37	< 1	1 – 2	2 – 5	> 5	3.36	2.15	0.85
Organic Matter	6.2	7.7	7.4	7.1							
Ash	94	92	93	93							

3.4.4 Further Chemical Testing

In light of the TBT results at Sites 1 and 4, and to a lesser extent the arsenic result at Site 1, further work has been carried out to assess the potential for these contaminants in particular to be mobilised during the dredging, the disposal of dredged material to the reclamation, and in the decant/stormwater discharge from the reclamation area. Elutriate testing has been carried out to assess this risk.

An elutriate test is used to investigate what happens when sediments are removed from the seabed and exposed to aerated seawater. The test involves agitation of the sampled sediments under controlled laboratory conditions, then filtering and testing of residual liquid for target contaminants. This testing procedure simulates what happens during a dredging process as sediment is disturbed and lost to the water column during the excavation process and subsequent disposal.

3.4.4.1 Elutriate Test Results

Elutriate test results are shown in Table 5 and included as Appendix F. Applicable ANZECC reference triggers are 95% protection levels unless otherwise indicated by ANZECC where reference to 99% protection is indicated to reflect elements with greater risk.

All results, except for arsenic were below default detection limits, which resulted in a level of protection of 95% or greater compared to the ANZECC (2000)[13] trigger values.

[13] ANZECC (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australia and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

Table 5: Elutriation extraction results compared to ANZECC 2000 marine trigger values.

Parameter (g/m³)	Sed Site 1	Sed Site 2	Sed Site 3	Marine Trigger values (g/m³) ANZECC (2000) Level of protection (% species)	
				99%	95%
Total Arsenic	0.0106	0.0117	0.0090	nv	nv
Total Cadmium	< 0.00021	< 0.00021	< 0.00021	0.0007	0.0055
Total Chromium	< 0.0011	< 0.0011	< 0.0011	n/a	0.0044
Total Copper	< 0.0011	< 0.0011	< 0.0011	n/a	0.0013
Total Lead	< 0.0011	< 0.0011	< 0.0011	n/a	0.0044
Total Nickel	< 0.0070	< 0.0070	< 0.0070	0.007	0.070
Total Zinc	< 0.0042	< 0.0042	< 0.0042	0.007	0.015
Tributyltin (TBT) as µg/L Sn	< 0.00005	< 0.00005	< 0.00005	0.0004	0.006

*nv = no value; n/a = not applicable.

3.5 Opua Marina

A wide range of parameters have been monitored as a requirement of the consents for the Opua Marina. This information was reviewed as part of the application for the Opua Marina Stage resource consents (Poynter, 2014). The key findings of that work, which are relevant to the current proposal, are summarised below:

- In the period reviewed 2001-2013, the Opua Marina was compliant with water quality requirements expressed in the consents. These requirements related to avoiding impacts on local seawater in respect of salinity, temperature, dissolved oxygen measured as parts per million and percent saturation, pH and faecal coliforms.
- Water in the lower Kawakawa River can be significantly affected by storm (rainfall) discharge at which time turbidity, suspended solids and microbiological indicator levels rise and clarity declines.
- Diffuse stormwater discharges from the marina carparks did not contain and would not have been likely to cause, significant elevation in heavy metals or total petroleum hydrocarbons in the receiving waters or local sediments.
- Localised contamination of stormwater and sediments occurs at hot spots in the immediate vicinity of the Ashby's Boatyard.

3.6 Mangrove Habitat

There are a few small/juvenile mangroves along with pneumatophores on the lower shore and within the rock retaining wall (Photo 6). The reclamation and/or works area will potentially involve the removal of these small mangroves.

3.7 Birdlife

The small area of exposed sandflat at low tide offers soft shore habitats to common birdlife within or likely to feed within the vicinity. These birds include the New Zealand kingfisher (*Todiramphus sanctus vagans*), white faced heron (*Egretta novaehollandiae*), southern black-backed gull (*Larus dominicanus dominicanus*) and little shags (P*halocrocorax melanleucos brevirostris*) which are all native-not threatened species (Robertson et al., 2017)[14]. Also common to the area are pied shags (*Phalacrocorax varius varius*) (at risk – recovering), red-billed gulls (*Larus*

[14] Robertson, H.A.; Baird, K.; Dowding, J.E.; Elliott, G.P.; Hitchmough, R.A.; Miskelly, C.M.; McArthur, N.; O'Donnell, C.F.J.; Sagar, P.M.; Scofield, R.P.; Taylor, G.A. (2017): Conservation status of New Zealand birds, 2016. New Zealand Threat Classification Series 19. Department of Conservation, Wellington. 23 p.

novaehollandiae scopulinus) and white-fronted tern (*Sterna striata striata*) (both at risk – declining) and Caspian tern (*Hydropogne caspia*) (threatened – nationally vulnerable).

During the site survey, only red-billed gulls and pied shags were seen in the vicinity. No birds (i.e. shags) were seen roosting in the pohutukawa that fringed the site. There is extensive similar habitat available to bird species in this region of the Kawakawa River estuary.

It is noted that the general area is classed as a 'Significant Marine Mammal and Seabird Area' within the Proposed Regional Plan, however this also applies to the entire Northland region.

3.8 Fishlife

Fish have not been specifically surveyed. Poynter (1989)[15] commented that more than 30 common fish species are likely to use the local estuary for feeding, shelter, spawning and as a migratory route. Fish species likely to use the area at one time or another include yellow eyed mullet, grey mullet, flounders, piper, anchovy like fishes, kahawai, koheru, kingfish, snapper, trevally, parore, rays and small wrasses. These are common coastal species.

There is a significant movement of diadromous freshwater fishes in the Kawakawa River. Significant populations of migratory eels (both juveniles and adults; *Anguilla* sp.) as well as common smelt (*Retropinna retropinna*), inanga (*Galaxias maculatus*) and other whitebait species of this genus are likely to pass through or close to the area at different periods throughout the year.

4 ASSESSMENT OF ECOLOGICAL EFFECTS

The effects of the proposal are considered under the following headings:

- Effects on landward vegetated areas;
- Effects on marine invertebrates and other biota;
- Water quality effects;
- RMA Part 2 Status; and
- Conclusions

4.1 Removal of Vegetation Effects

The main area of vegetation removal occurs at the southern end of the site where the proposed car parking, truck turning and manoeuvring area to the boat ramp are to be located adjacent to the cycle trail extension. This will involve the removal of approximately 1,500 m^2 of scrubby vegetation. The effects of this vegetation removal is very low (based off criteria for describing level of effects (Roper-Lindsay et al., 2018))[16]. There will be no loss of botanical biodiversity or significant vegetation.

Native trees (including large pohutukawa) occur on the cycle trail edge and within the rock retaining wall. This vegetation will be required to be removed in order to allow for the construction of the proposed structures and reclamation area. This too is a small ecological effect which can be mitigated by subsequent plantings and improvements around the new facilities.

Vegetation which is not being removed but which currently boarders the proposed site or lies within the proposed site could be enhanced by the removal of pest species (brush wattle, gorse, woolly nightshade, wild ginger and pampas) and the planting of further natives such as kanuka, manuka, totara, red matipo, kawakawa, coastal five-finger, pukatea, ponga, mahoe, flax and ground ferns.

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[15] Poynter, M., (1989). Bay of Islands Harbour Plan. Kawakawa Subcatchment. Stream, Wetland, Estuarine Resource Survey. Report prepared for the Northland Regional Council.

[16] Roper-Lindsay, J., Fuller S.A., Hooson, S., Sanders, M.D., Ussher, G.T. 2018. Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.

4.2 Reclamation, Dredging and Jetty/Pontoon Construction Effects on Marine Invertebrates and Other Biota

Direct effects on marine invertebrates will arise from the reclamation, dredging and from piles associated with the construction of a jetty and pontoon structure. These effects are discussed below.

4.2.1 Reclamation

The proposed reclamation will cover about 2,400 m^2 of mostly shallow subtidal habitat, but will also include a few small mangroves, intertidal soft shore and seawall. As previously noted, subtidal and intertidal biota which occurs within the area proposed for reclamation is not notable ecologically.

The biota that will be lost involves species, which are common and therefore likely to be well represented elsewhere in mid and estuarine areas of the Bay of Islands.

The loss of a few small/juvenile mangrove is not significant relative to the extensive mangrove habitat present in the Kawakawa River estuary.

Overall, loss of marine biota or marine habitat within the reclamation is a very low adverse effect.

4.2.2 Dredged Area

The area of dredging to create adequate depth for vessels is 1,200 m^2. The dredging volume (600 m^3) is very small and will take approximately one week. The habitat generally consists of fine dark grey muddy sand. There are no special habitat values such as seagrass beds or shallow reefs.

Over the last century, this area is likely to have 'naturally' shallowed and become muddier because of silt deposition from land clearance. A 1997 Hydraulics report prepared for the Opua Marina (Christian, 1997)[17] refers to an unreferenced 1987 geotechnical report that indicates infilling with sediment of 2.5 to 3.0 metres in the Opua basin since European occupation.

All marine life within this dredged footprint will be removed. This is a minor effect given that the area affected is small and the benthic community is typical and is not characterised by any notable qualities in terms of its biodiversity or the presence of rare species.

This ecological effect on the seabed community is potentially largely reversible. The newly exposed seabed after dredging should be of a similar texture and grain size composition to that presently occurring. The exposure of the area to the periodically elevated storm silt loads and near-bed turbidity, which are likely to occur in the area, should encourage rapid 'aging' of the exposed sediments such that they are effectively indistinguishable from the general benthic environment in the area. The daily tidal exchange and the fact that there is free flow of water through the area should present a supply of planktonic larval organisms to recolonise the new substrate. Colonisation can also occur by mobile invertebrate such as whelks and starfish migrating from adjacent zones.

The resultant benthic community in the dredged area, should in a relatively short period be naturally remediated and reflect that which is currently present. However, any requirement for maintenance dredging will effectively repeat the cycle of loss and recovery.

Notwithstanding the potential for maintenance dredging, the footprint of the effect on subtidal benthic habitat is small. Taking this and the above considerations into account, the marine ecological effect of dredging is very low.

4.2.3 Jetty and Pontoon Construction

Direct effects on the shallow subtidal marine area will occur from piles and construction of a timber ramp and jetty, which connect to a gangway and pontoon. The 32 piles include:

- 22 jetty piles at 400 diameter, covering 2.8 m^2;

[17] Christian, C., (1997). Hydraulics report for the proposed marina at Opua. Prepared for Mair and Associates by Auckland Uniservices Ltd.

- 4 pontoon piles at 600 diameter, covering 1.2 m^2; and
- 6 fender piles at 400 diameter, covering 0.8m^2.

This will collectively cover a small area of approximately 5 m^2. The physical effect on the substrate will be small and is very low in terms of effects on habitat and biota.

Shore based machinery needing to cross any hard-intertidal shore will not cause other than minor effects and these are not significant ecologically.

4.2.4 Other Biota

Some marine algae and invertebrates may develop on and aggregate around any new structures within the tidal zone.

No significant intertidal bird feeding areas will be affected. Impacts on shorebirds will be negligible.

Movement of estuarine fish and migratory native freshwater fish will not be impeded.

4.3 Water Quality Effects

4.3.1 Reclamation, Dredging and Jetty/Pontoon Construction Effects

The reclamation, dredging and overall structure construction could take up to nine months. The construction methodology described by Haigh Workman (Haigh Workman, 2019)[18] envisages all the material to be dredged will be used in the reclamation.

An important characteristic limiting any potential for sediment- related contamination of adjacent zones is the physical characteristics of the sediment. The Haigh Workman geotechnical report indicates that the site is coastal marine and as such it is anticipated that the majority of the area will be directly underlain by alluvial marine deposits of potentially substantial thickness. This includes silts and potentially organic matter with shells and/or gravel sized fragments. This is likely to characterise the bulk sediments as well, particularly given the relatively limited depth of sediment to be removed. The physical observations of the biological samples indicate the material is quite cohesive. These sediments should be able to be removed relatively intact, which will limit exposure or loss of sediment particles to the surrounding waters.

This is not in a sensitive location either ecologically or visually (in the context of potentially observed turbid plumes associated with the dredging and reclamation). The reclamation footprint and nearby zones are already prone to natural elevation in sediment and turbidity.

Based on the surficial sediment analyses, the sediments to be dredged have been shown to contain concentrations of most metals (cadmium, chromium, copper lead, nickel and zinc) below the respective ANZECC DGVs. On this basis, in respect to these metals, the sediments can be considered as unpolluted and as being suitable for use in the reclamation (or land disposal).

Levels slightly above ANZECC DGVs were recorded for arsenic at sediment site 1 and TBT at sites 1 and 4. These exceedances are of a low magnitude relative to the DGV's. They are likely to reflect localised historical contamination rather than being characteristic of the bulk material to be dredged. Removing these sediments to the reclamation will effectively remove the small areas containing any TBT residuals from the marine environment.

Notwithstanding what 4Sight considers to be a low risk associated with arsenic and TBT at this site, further work has been carried out to assess the potential for these contaminants in particular to be mobilised during the dredging, disposal of dredged material to the reclamation, and in the decant/stormwater discharge from the reclamation area. Elutriate testing has been carried out. Those results are discussed in section 4.3.1.1 below.

There is a potential for the reclamation construction to generate localised turbidity in decant water discharged from the reclamation site. This may cause a visually conspicuous plume, but it should be relatively localised given the small

[18] Haigh Workman Ltd, (2019). Engineering Report for Opua Hard Stands, Opua Reclamation – Maritime Services for Far North Holdings Ltd.

scale and probably intermittent nature of the operation. Turbidity is unlikely to extend as a significant plume to areas frequented by the general public.

The risk of down current sedimentation or significant turbidity is considered to be very low taking into account the following considerations and strategies:

- The proposed hydraulic digger method of dredging which should limit the release and loss to the water column of significant amounts of silt.
- The short period and intermittent operation of the digger/barge.
- The shallow water that reduces the time that sediment can be lost from the digger bucket between the seabed and the barge.
- The tidal flows and flushing characteristics in the area, which should quickly dissipate intermittent small sediment plumes and prevent concentration of sediment within the area over success tidal cycles.
- The generally wide range in turbidity that characterises the area, particularly during significant discharge events from the Kawakawa River catchment.

4.3.1.1 Elutriate Test Results

All results were within 95% level of protection or 99% level as applicable (ANZECC, 2000), or below laboratory detection limits. Therefore, there is a very low risk for contaminants, and in particular for TBT, to be mobilised during the dredging, disposal of dredged material to the reclamation, and in the decant/stormwater discharge from the reclamation area at concentrations that pose a water quality risk.

4.3.2 Reclamation Stormwater

Stormwater management within the proposed development is designed to treat stormwater flows, reduce scour and ensure compliance with Northland Regional Plan rules.

Maintaining stormwater quality is the primary requirement. The activities on the reclamation are unlikely to generate other than small quantities of particulates and organic waterborne material. No specific or potentially significant contaminant sources or processes will occur on the reclamation.

Stormwater will be managed by stormwater treatment devices compliant with ARC Publication TP10/GD01 and are designed to remove the required levels of copper, zinc and suspended solids.

Vehicle parking and manoeuvring areas will slope to the southwest to discharge into a surface drain, with a piped outfall to the CMA. Stormwater treatment devices and management are discussed in the Engineering Report (Haigh Workman, 2019).

Effects from stormwater discharges are considered likely to be negligible.

4.3.3 General Water Quality Effects

The water quality to be maintained in the area is primarily focused on the faecal coliform limits identified in the CB water classification. The proposal does not generate any additional potential source of faecal contamination.

Default general water quality requirements (as per section 70(1) of the RMA) are also applicable. In particular, the reclamation discharge(s) after reasonable mixing must not give rise to any of the following effects:

- Production of conspicuous oil or grease films, scums or foams or floatable suspended material;
- Any conspicuous change in colour or visual clarity;
- Any emission of objectionable odour;
- Any significant adverse effect on aquatic life;
- Any significant adverse effect on aesthetics or amenity values.

Discharges from the boatyard and car parking are not expected to raise issues of colour, clarity, odour, aesthetics or amenity or adverse effects on biota.

It is concluded that the general water quality performance criteria will be achieved, and any water quality effects will be negligible arising from any discharge from the completed project.

4.4 Summary and Conclusions

1) The main area of vegetation removal occurs at the southern end of the site and consists of low value scrub. The botanical effect of removal of this vegetation is negligible.
2) Removal of vegetation on the reclamation side of the existing cycle trail, will involve mainly native shrubs and trees, including a large pohutukawa. This is a small adverse effect that is unavoidable, but which could be offset by enhancement plantings elsewhere around the site as well as removal of pest weeds.
3) The loss of a few small/juvenile mangrove is not significant relative to the extensive mangrove habitat present in the Kawakawa River estuary.
4) There is no significant intertidal habitats within the site of the reclamation and construction works. No particular restrictions need to be imposed on machinery working on or accessing the shore.
5) The subtidal biota is typical of that documented elsewhere in the area and is dominated by common species of polychaetes and crustacea.
6) The ecological significance of the dredging and construction effects on subtidal biota is minimal. Effects should be remediated in a short period of time by natural recruitment and recolonisation of the new seabed which will be of a similar texture to that which presently exists.
7) Although maintenance dredging, if required will repeat the cycle or biological loss and recovery, the overall significance of the potential ecological effect is very low.
8) No significant intertidal bird feeding areas will be affected. Impacts on shorebirds will be negligible.
9) Sediments to be dredged have been shown not to be polluted in cadmium, chromium, copper, lead, nickel or zinc. There is no significant risk of pollutant releases of these metals as a consequence of the dredging.
10) Tributyltin (TBT) was found at elevated levels at sediment sites 1 and 4 compared to ANZECC DGV.
11) Although localised small-scale elevation in arsenic and TBT were recorded in sediments to be dredged, elutriate tests show there is no water quality risk from mobilised metals including TBT.
12) There is a very low potential for the reclamation construction to generate unacceptable levels of turbidity beyond the site or cause potentially smothering sedimentation.
13) Current water and sediment quality characteristics are likely to reflect, and to be maintained by the flushing that occurs in response to tidal patterns and riverine outflows.
14) Any sedimentation effects on habitats and biota beyond the reclamation and construction works area will be minor and localised and are not of ecological significance.
15) Turbidity generated during dredging will be localised, short term, intermittent and is not of water quality significance.
16) There will be no adverse effects on water quality arising from the stormwater discharges from the reclamation. Local water quality targets as expressed in the applicable CB water classification and the general performance standards under the regional coastal plan (and RMAct) will be maintained in relation to any discharges.

Appendix A:

Northland Regional Council Coastal Plan Maps

Northland Regional Coastal Plan Map Legend

Regional Boundary Line

TLA Boundary

State Highway

Road

Aircraft Beacon

Boat Ramp

Jetty/Wharf

Pontoon

Grid Point

Slip

Protected Anchorage

Beacon

lit

unlit

Buoy

lit

unlit

Bridge

Foot Traffic

Train

Vehicle

Powerline

Underwater Cable

Underwater Pipe

Cliff Edge

Track & Walkway

River

Coastal Marine Area Boundary

Surfing Area

Land outside NRC Region

Prohibited Anchorage Area

Skilane

Marine 1 (Protection) Management Area

Marine 2 (Conservation) Management Area

Marine 3 (Marine Farms) Management Area

Coastal Permitted Marine Farms (Post 20 December 1994)

Marine 4 (Controlled Mooring) Management Area

Marine 4 (Discretionary Mooring) Management Area

Marine 5 (Port Facilities) Management Area

Marine 6 (Wharves) Management Area

Cultural Water Quality

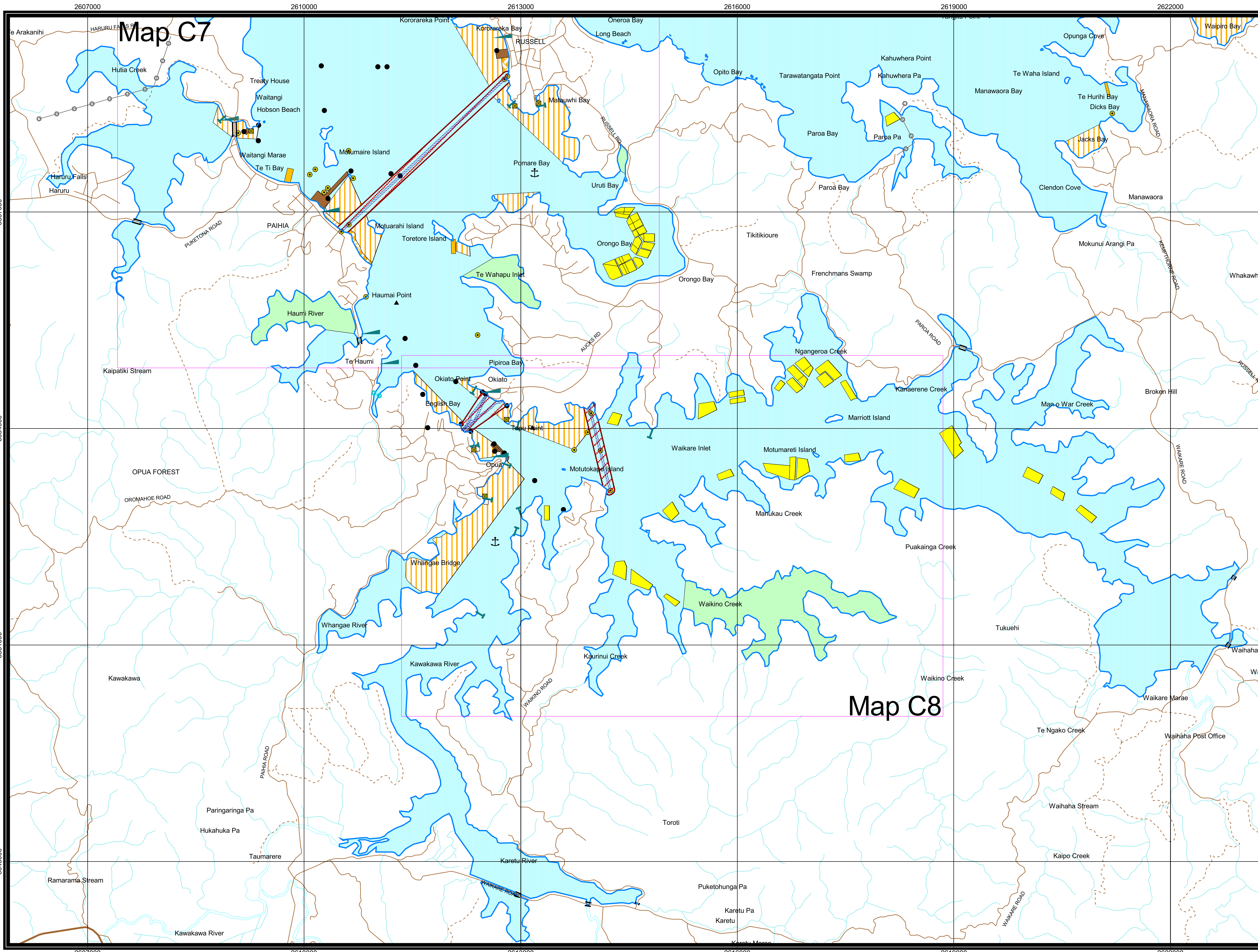
Water Quality

CA

CB

CN

Mixing Zones For Major Dishcarge



Map B17

Russell / Opua Waikare Inlet

N

Map Scale
1 :50000

LEGEND LOCATED AT BACK OF MAP FOLDER

Topographical and Cadastral Information derived from Land Information NZ. CROWN COPYRIGHT RESERVED

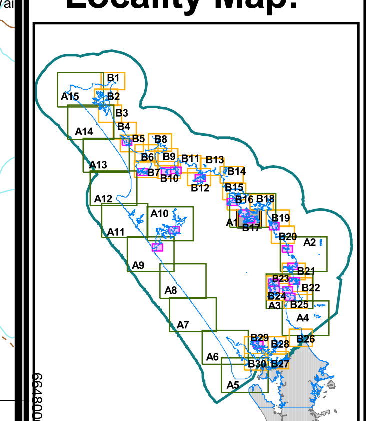
Map grid values are shown in NZMG co-ordinates, GD 1949.

These maps are an indicative representation, for more specific information contact the NRC.

The RCP for Northland covers the coastal marine area which extends from the landward extent of Mean High Water Springs and the negotiated cross river mouth boundary to the 12 Nautical Mile limit.

Caution: This map should not be used for navigational purposes.

Locality Map:

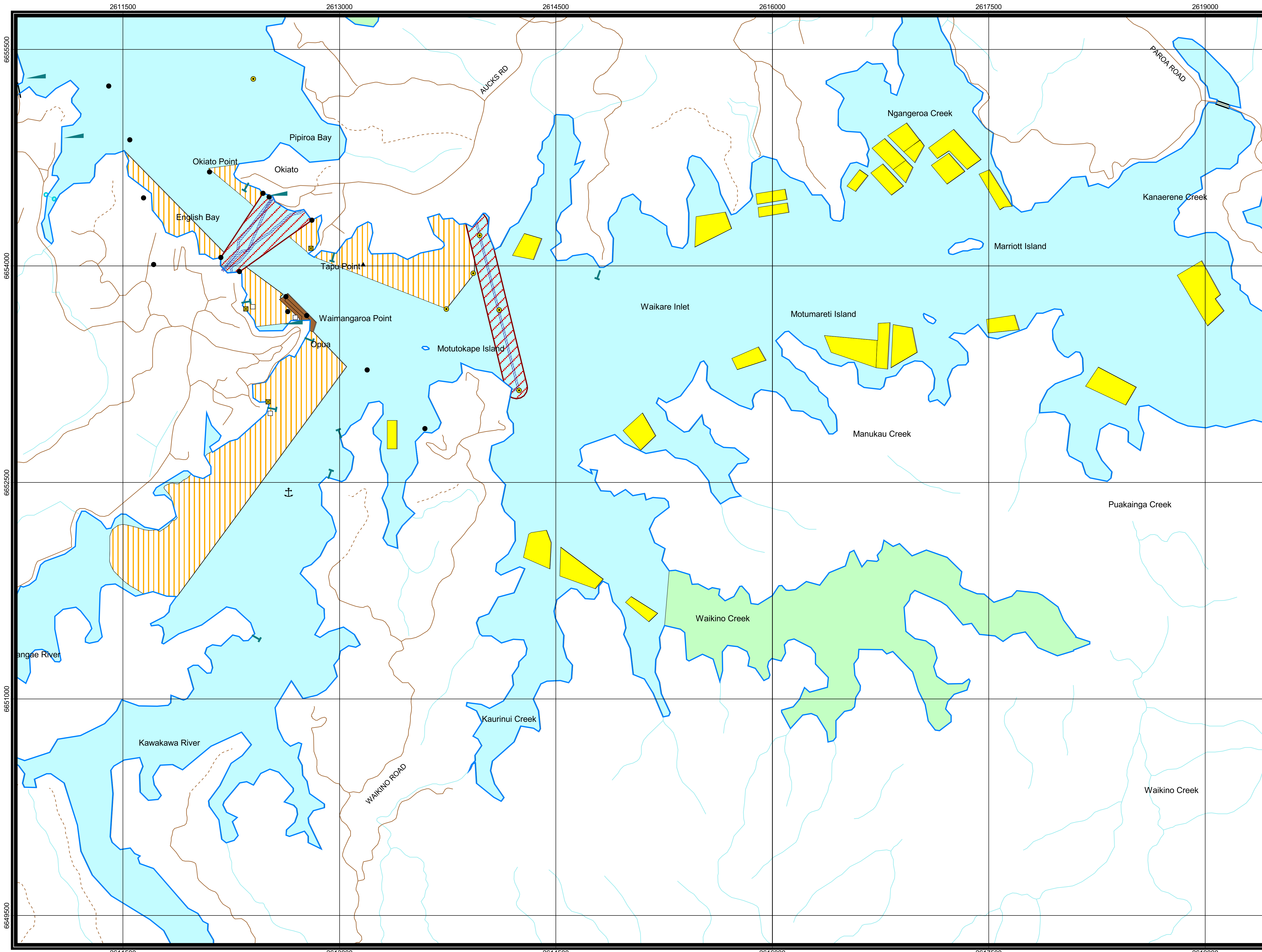


NORTHLAND REGIONAL COUNCIL
CARING FOR NORTHLAND AND ITS ENVIRONMENT

Map C8

Opua / Waikare Inlet

Map Scale 1 :25000



LEGEND LOCATED AT BACK OF MAP FOLDER

Map grid values are shown in NZMG co-ordinates, GD 1949.

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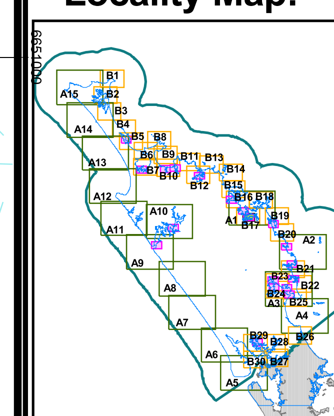
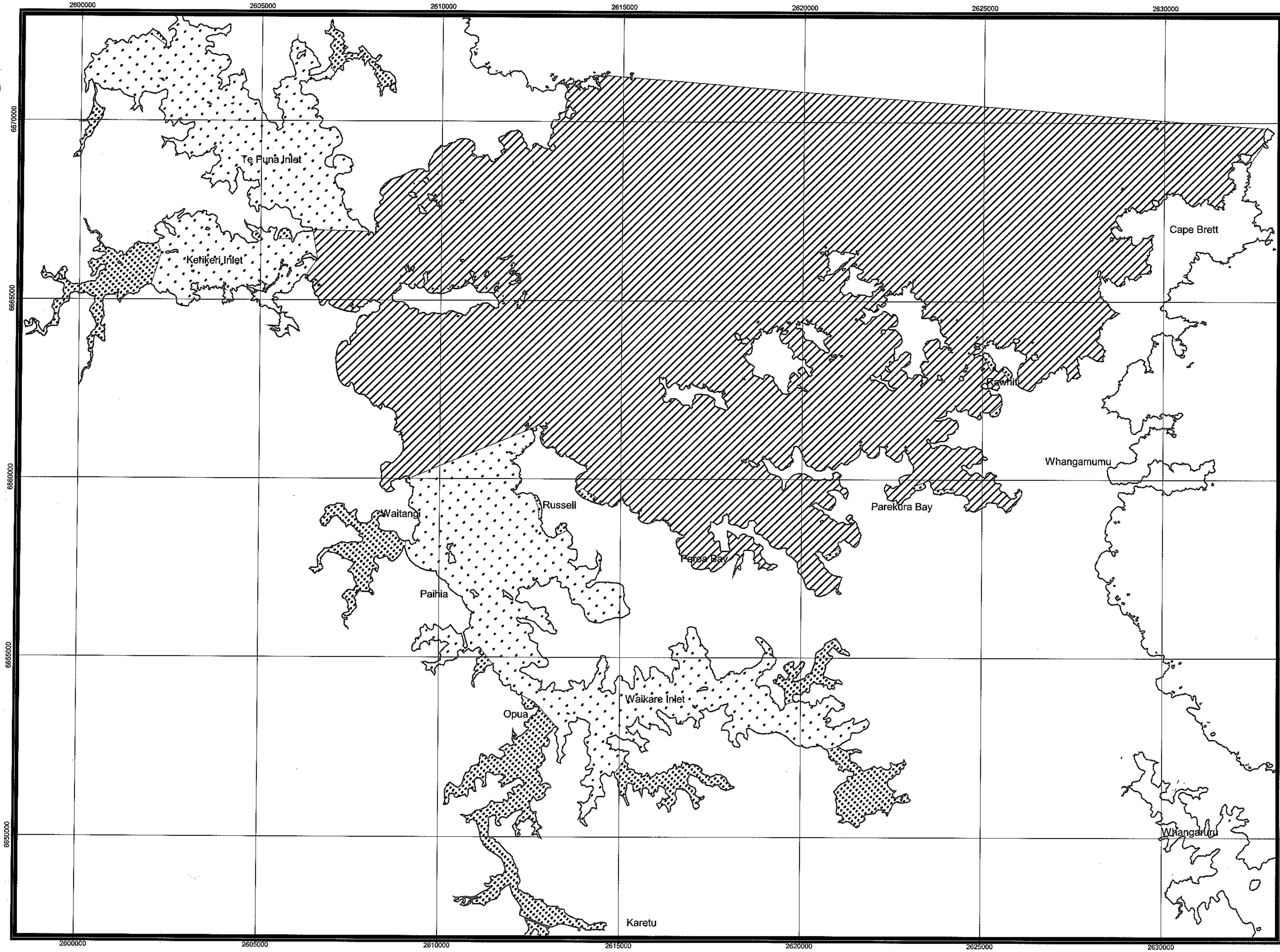


NORTHLAND REGIONAL COUNCIL
CARING FOR NORTHLAND AND ITS ENVIRONMENT



Water Quality

Bay of Islands

N

Map Scale
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LEGEND LOCATED AT BACK OF MAP FOLDER

Topographical and Cadastral Information derived from Land Information NZ.

Map grid values are shown in NZMG co-ordinates, GD 1949.

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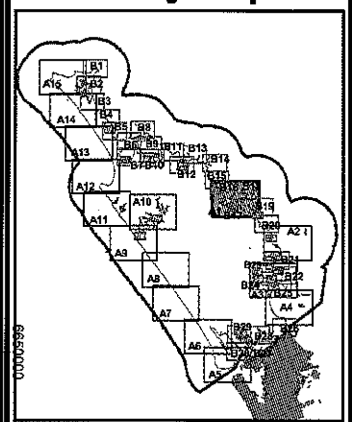
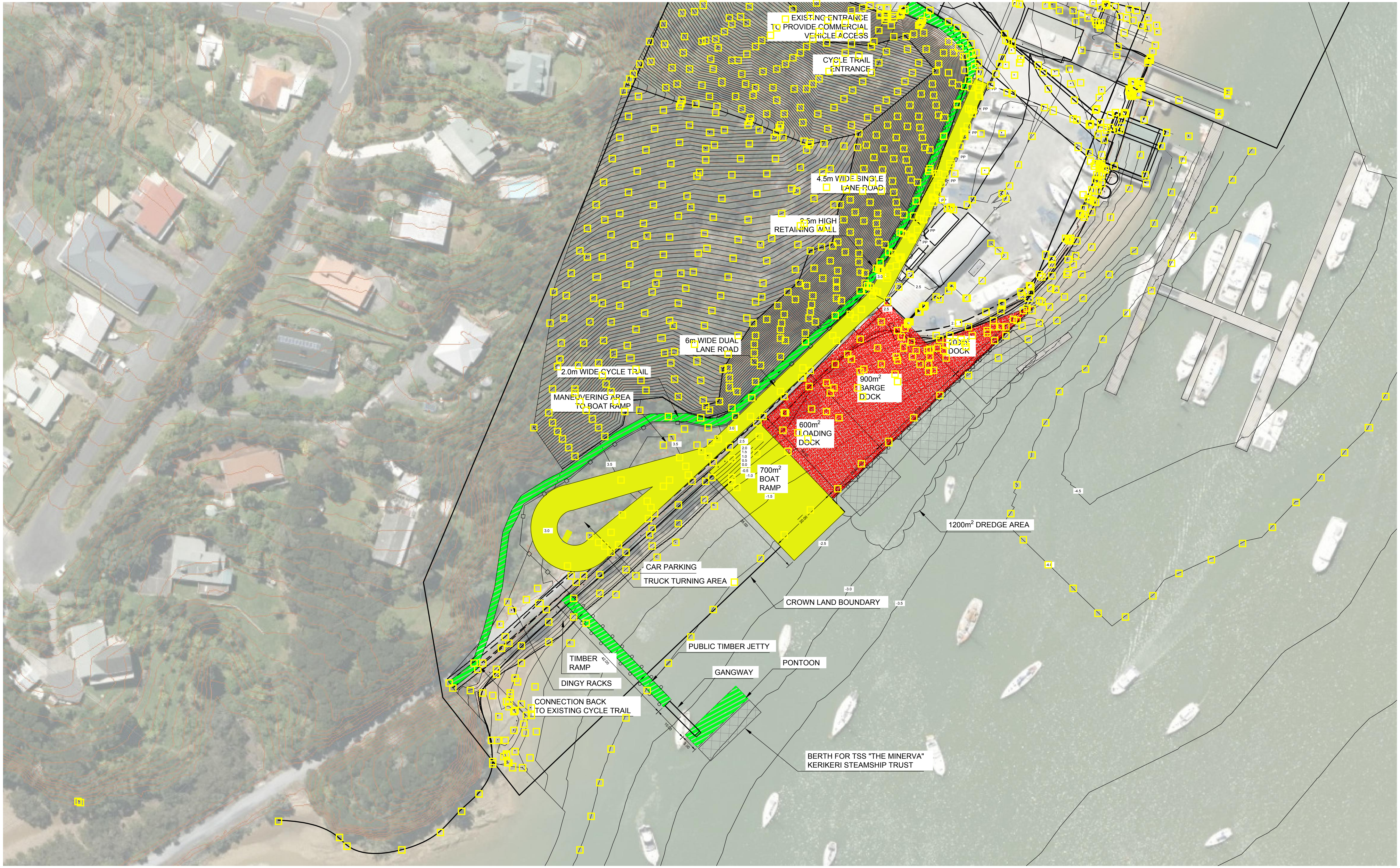


NORTHLAND REGIONAL COUNCIL
CARING FOR NORTHLAND AND ITS ENVIRONMENT

Appendix B:

Ashbys Boatyard Maritime Servicing Area Plans



Issue	Date	Revision
-	19/3/2019	WORK IN PROGRESS

DWG **Site Location Plan**

Scale 1:1000 @A3 (10 5 0 10 20 30 m) Date 23/1/2018

Drawn JP Checked EC Approved

File

6 Fairway Drive
Kerikeri, BOI.
T: 09 407 8327
F: 09 407 8378
E: info@haighworkman.co.nz

Project **Marine Contractors Alternative Site**

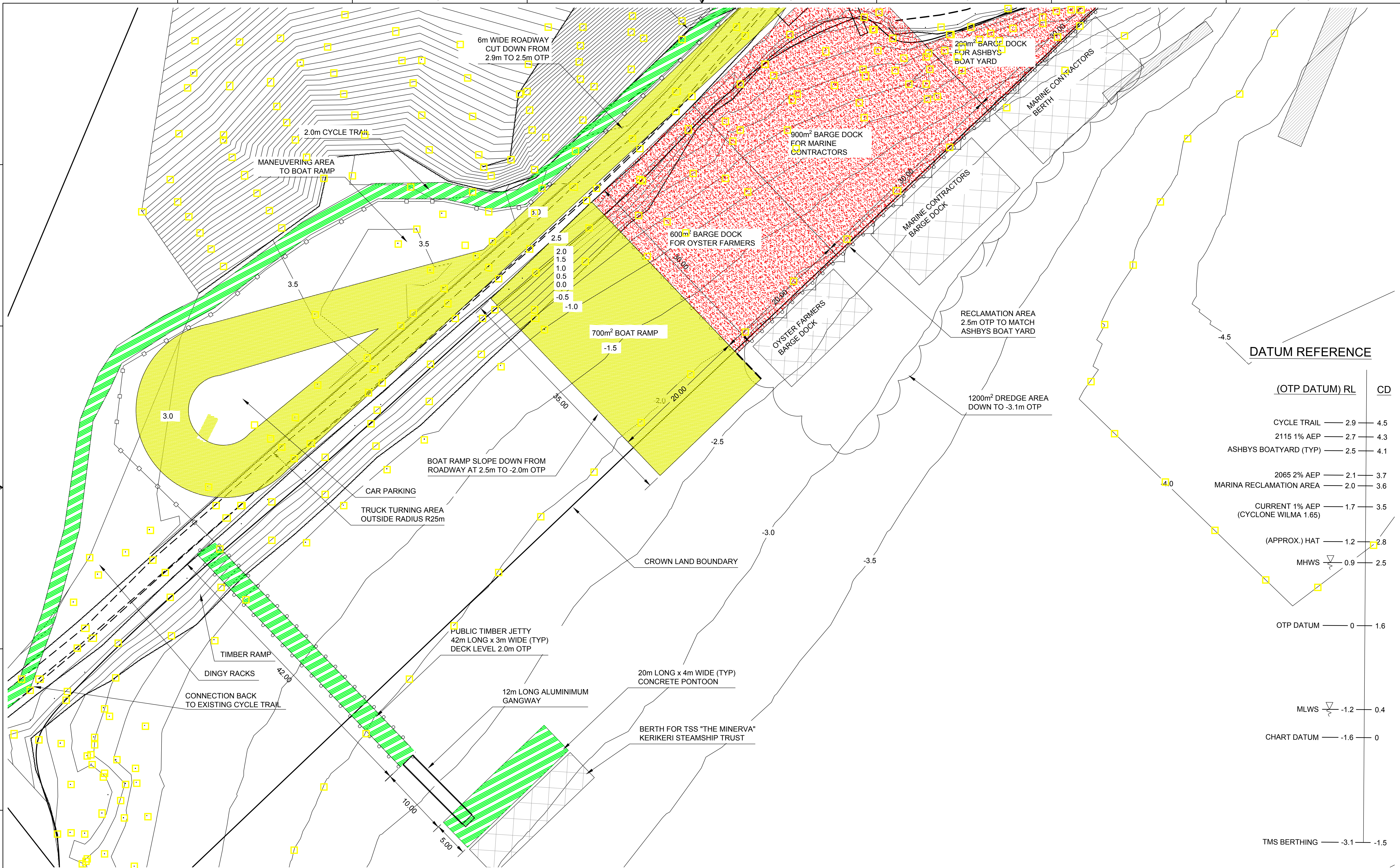
Ashby's Boat Yard, Opua

Client **Far North Holdings Ltd**

Project No. 15 119 RC no.

DWG No. **01**

Sheet No. **1 of 7**



Issue	Date	Revision
-	19/3/2019	WORK IN PROGRESS

DWG **Proposed Development Plan**

Scale 1:500 @A3 — 5 2.5 0 5 10 15 m — Date 23/1/2018

Drawn JP | Checked EC | Approved

File

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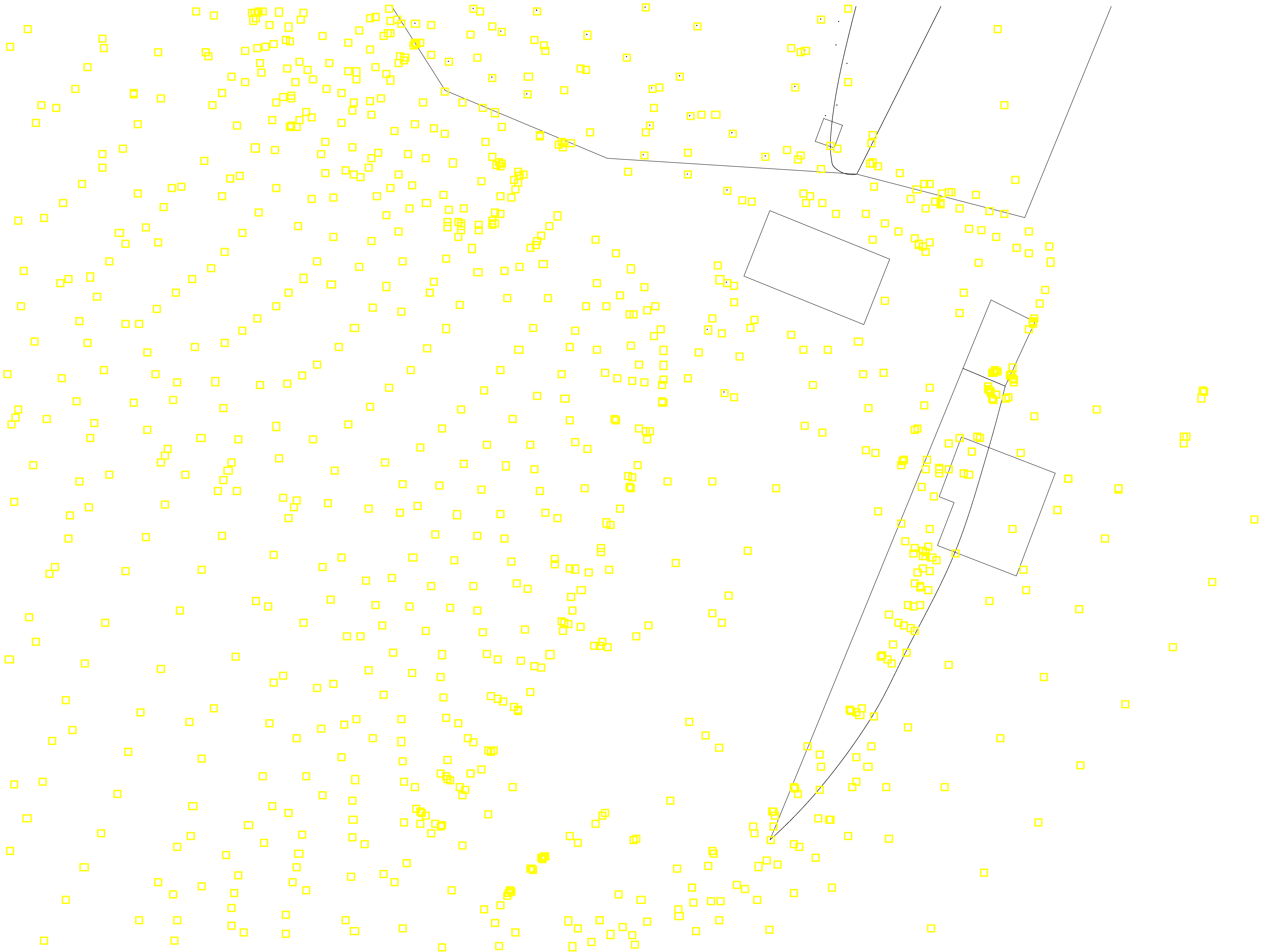
Project: **Marine Contractors Alternative Site**
Ashby's Boat Yard, Opua

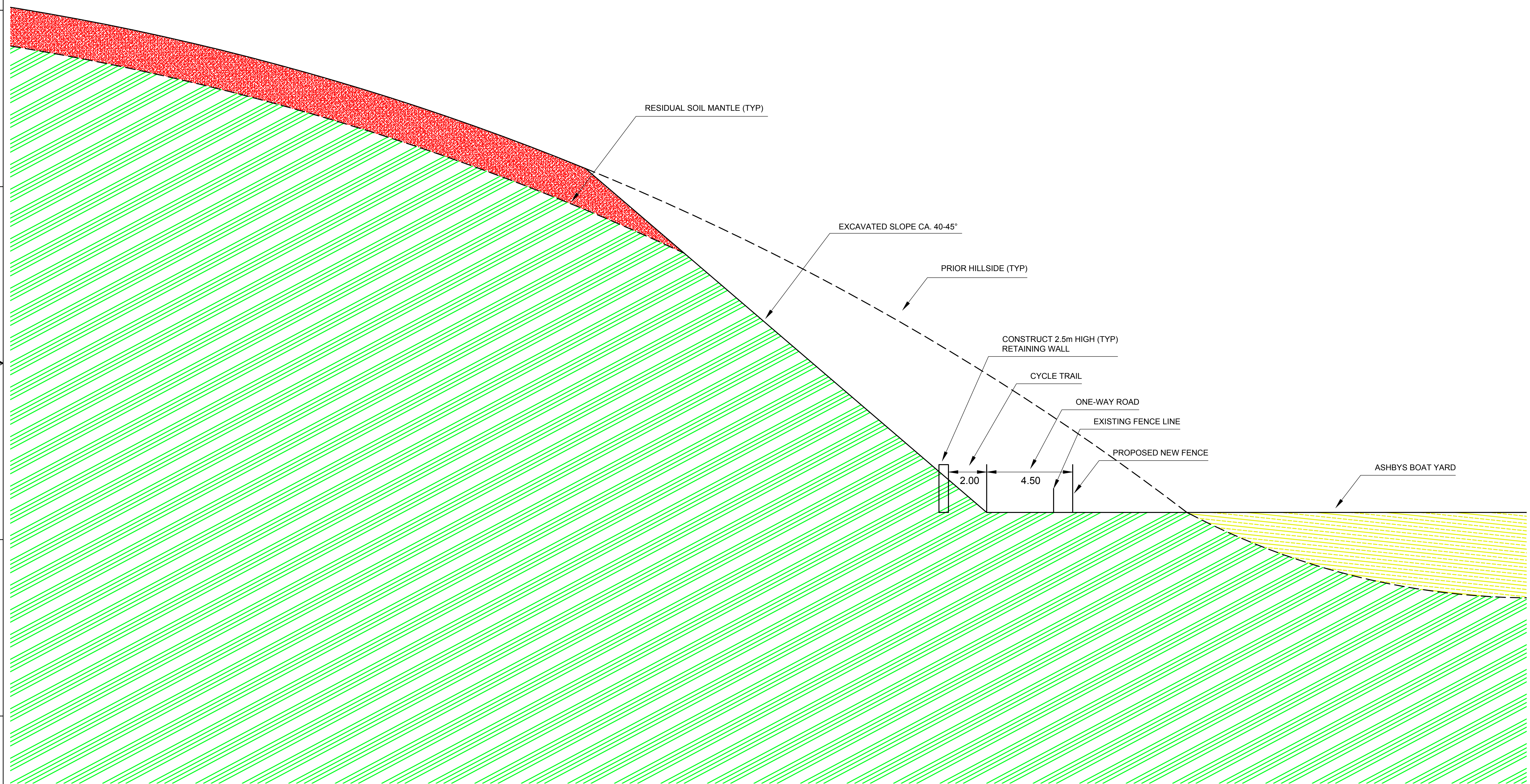
Client: **Far North Holdings Ltd**

Project No. 15 119 | RC no.

DWG No. **02**

Sheet No. **2 of 7**





Issue	Date	Revision
-	19/3/2019	WORK IN PROGRESS

DWG: Proposed Access - Typical Cross Section

Scale 1:200 @A3 — Date 23/1/2018

Drawn JP — Checked EC — Approved

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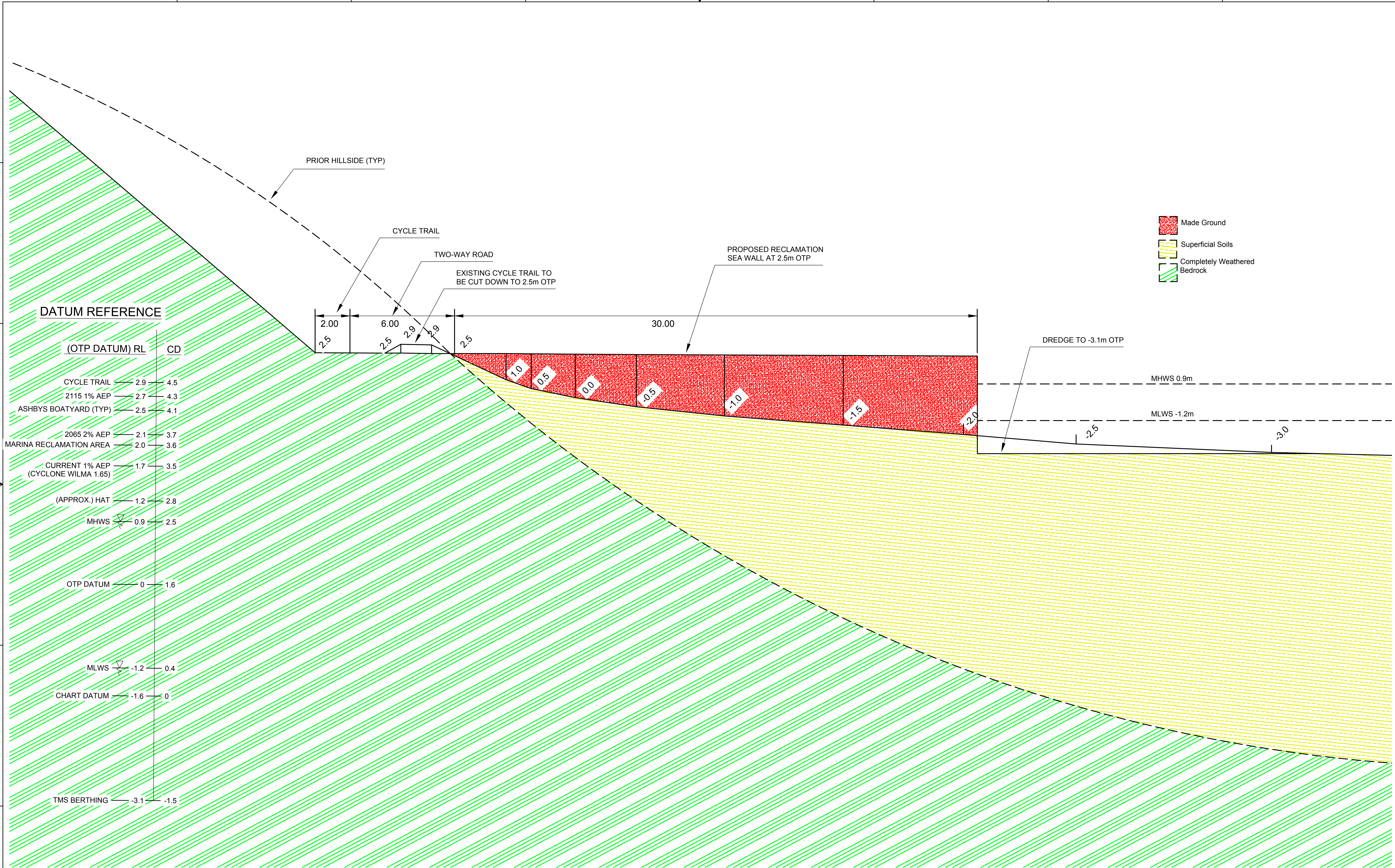
Project: Marine Contractors Alternative Site
Ashby's Boat Yard, Opua

Client: Far North Holdings Ltd

Project No. 15 119 — RC no.

DWG No. 04

Sheet No. 4 of 7



Issue	Date	Revision
-	19/3/2019	WORK IN PROGRESS

DWG: Proposed Reclamation - Typical Cross Section

Scale 1:200 @A3 — Date 23/1/2018

Drawn JP — Checked EC — Approved

File

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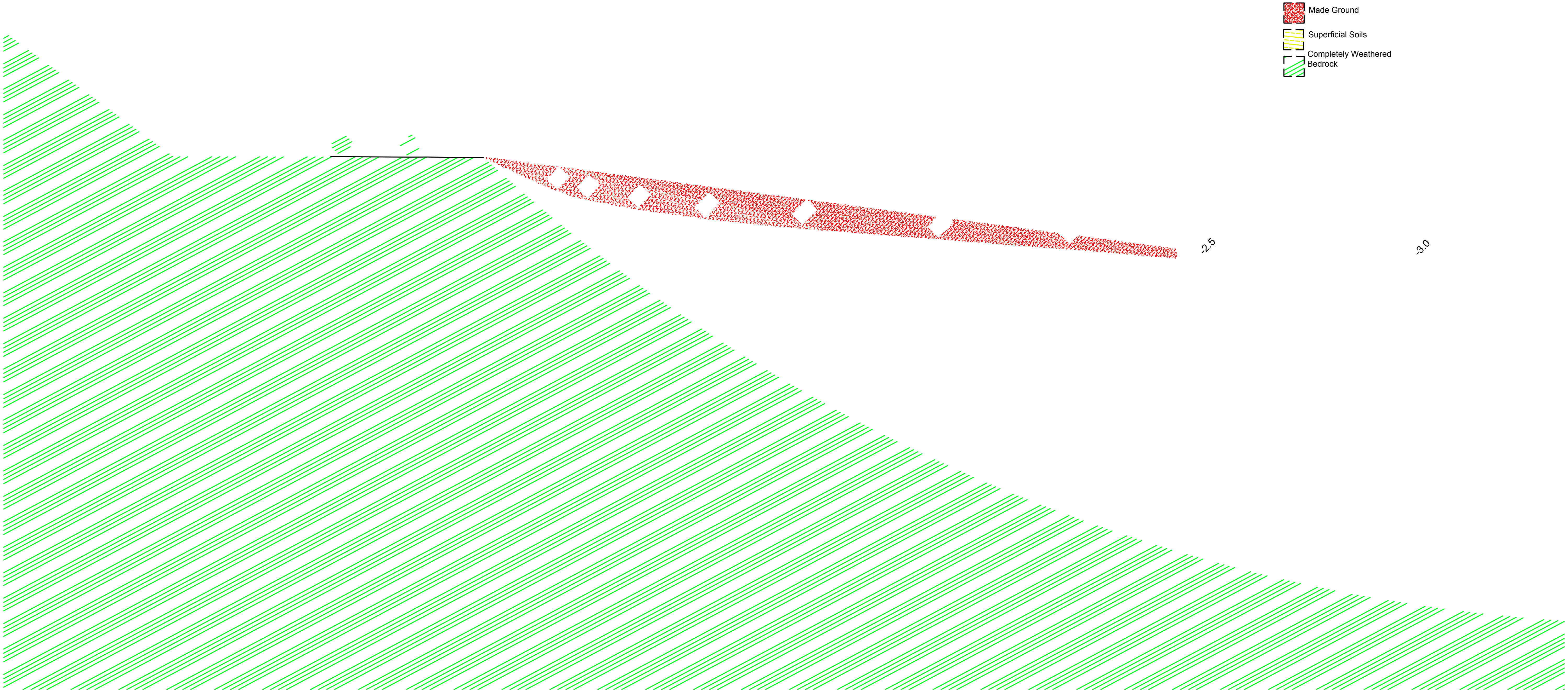
Project: Marine Contractors Alternative Site
Ashby's Boat Yard, Opua

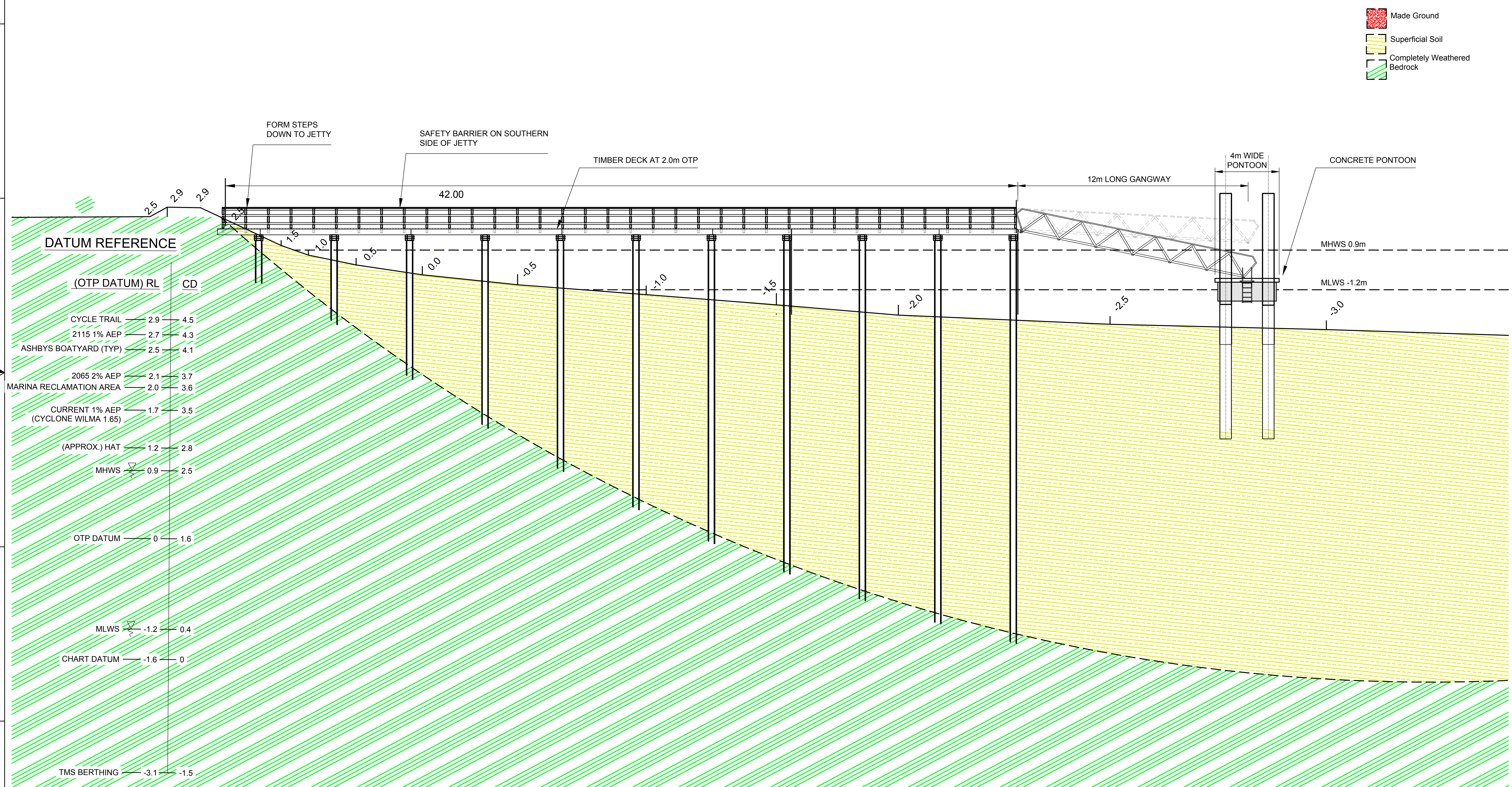
Client: Far North Holdings Ltd

Project No. 15 119 — RC no.

DWG No. 05

Sheet No. 5 of 7


Made Ground
Superficial Soils
Completely Weathered Bedrock
-2.5
-3.0



Issue	Date	Revision
-	19/3/2019	WORK IN PROGRESS

DWG **Proposed Jetty - Typical Cross Section**

Scale 1:200 @A3 — Date 23/1/2018

Drawn JP | Checked EC | Approved

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Project **Marine Contractors Alternative Site**
Ashby's Boat Yard, Opua

Client **Far North Holdings Ltd**

Project No. 15 119 — RC no.

DWG No. **07**

Sheet No. **7 of 7**

Appendix C:

Photographs

Photo 1: Entrance to existing cycle trail, at north of site. .

Photo 2: Vegetation on the cliff bank/landward side of cycle trail. Ashby's Boatyard on left.

Photo 3: Vegetation on the cliff bank/landward side of cycle trail increasing. Ashby's Boatyard on left.

Photo 4: Location where the current boatyard ends, and the proposed reclamation begins. Vegetation on the landward side of the cycle trail slightly increases in value with the presence of more native species.

Photo 5: The reclamation side of the cycle trail (left) showing predominantly natives on cycle trail edge and within the rock retaining wall.

Photo 6: Small juvenile mangroves on the lower shore.

Photo 7: Low value scrub at southern end of site.

Photo 8: Intertidal area inspected, rock retaining wall which leads up to cycle trail on right.

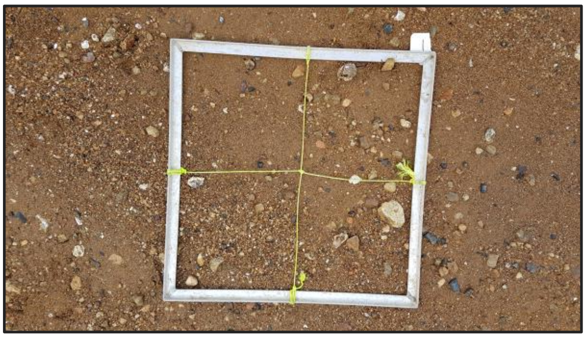

Photo 9: Intertidal quadrat site 1.

Photo 10: Sieved sediment at intertidal site 1.

Photo 11: Intertidal quadrat site 2.

Photo 12: Sieved sediment at intertidal site 2.

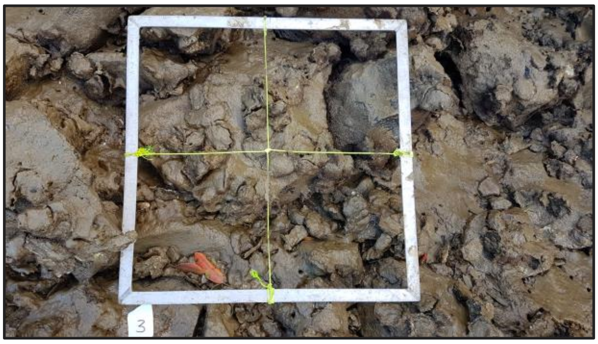

Photo 13: Intertidal quadrat site 3.

Photo 14: Intertidal quadrat site 4.

Photo 15: Box dredge sample at subtidal - 3.0 m depth, site 2.

Photo 16: Drag dredge at 1.5 m depth, showing no living biota.

Appendix D:

Subtidal Biota Results

Family	Genus	Taxa	Ashby's Boatyard Maritime Servicing Area 1.5 M	Ashby's Boatyard Maritime Servicing Area 3.0 M
		Anthozoa		1
		Nemertea	6	2
		Bivalvia indent.	1	
Veneridae	Austrovenus	Austrovenus stutchburyi		1
Semelidae	Theora	Theora lubrica	33	37
		Oligochaeta	7	8
Nereididae		Nereididae	1	
Orbiniidae	Orbinia	Orbinia papillosa	3	4
Orbiniidae	Phylo	Phylo novazealandiae	7	19
Paraonidae		Paraonidae	31	31
Paraonidae	Aricidea	Aricidea sp.	1	
Cossuridae	Cossura	Cossura consimilis	293	178
Spionidae	Prionospio	Prionospio sp.	5	4
Capitellidae	Barantolla	Barantolla lepte	11	44
Capitellidae	Heteromastus	Heteromastus filiformis	25	19
Opheliidae	Armandia	Armandia maculata		1
Polynoidae		Polynoidae	1	
Sigalionidae		Sigalionidae		1
Syllidae		Exogoninae		1
Glyceridae		Glyceridae	8	3
Lumbrineridae		Lumbrineridae	1	11
Dorvilleidae		Dorvilleidae		2
Corophiidae		Corophiidae		4
Phoxocephalidae		Phoxocephalidae		18
		Amphipoda indet.	1	
Pilumnidae	Pilumnopeus	Pilumnopeus serratifrons		1
		Copepoda		1
Balanidae	Balanus	Balanus sp.		1
		Total number of individuals	**435**	**392**
		Total number of Taxa	**18**	**24**

Appendix E:

Hill Laboratories Subtidal Surficial Sediment Chemical Analysis

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

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T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

SPv1

Client:	4SIGHT Consulting Limited	**Lab No:**	2178204
Contact:	Pamela Kane-Sanderson	**Date Received:**	18-May-2019
	C/- 4SIGHT Consulting Limited	**Date Reported:**	27-May-2019
	PO Box 402053	**Quote No:**	98921
	Tutukaka 0153	**Order No:**	AA4046
		Client Reference:	AA4046 - FNH_Ashbys Boatyard Extension
		Submitted By:	Pamela Kane-Sanderson

Sample Type: Sediment

Sample Name:		Ashbys Sed 1 16-May-2019 1:15 pm	Ashbys Sed 2 16-May-2019 1:30 pm	Ashbys Sed 3 16-May-2019 1:40 pm	Ashbys Sed 4 16-May-2019 2:00 pm	
Lab Number:		2178204.1	2178204.2	2178204.3	2178204.4	
Individual Tests						
Organic Matter*	g/100g dry wt	6.2	7.7	7.4	7.1	-
Ash*	g/100g dry wt	94	92	93	93	-
Total Organic Carbon*	g/100g dry wt	1.08	1.58	1.56	1.37	-
Heavy metal, trace level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	22	16.9	14.9	19.1	-
Total Recoverable Cadmium	mg/kg dry wt	0.040	0.035	0.035	0.027	-
Total Recoverable Chromium	mg/kg dry wt	15.2	19.0	19.0	16.9	-
Total Recoverable Copper	mg/kg dry wt	46	25	22	15.9	-
Total Recoverable Lead	mg/kg dry wt	17.1	12.1	12.4	10.9	-
Total Recoverable Nickel	mg/kg dry wt	9.5	8.9	9.0	8.2	-
Total Recoverable Zinc	mg/kg dry wt	101	76	78	86	-
Tributyl Tin Trace in Soil samples by GCMS						
Dibutyltin (as Sn)	mg/kg dry wt	0.042	< 0.005	< 0.005	0.042	-
Monobutyltin (as Sn)	mg/kg dry wt	< 0.007	< 0.007	< 0.007	< 0.007	-
Tributyltin (as Sn)	mg/kg dry wt	0.019	0.004	0.004	0.016	-
Triphenyltin (as Sn)	mg/kg dry wt	< 0.003	< 0.003	< 0.003	< 0.003	-

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.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Sediment

Test	Method Description	Default Detection Limit	Sample No
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-4
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%.	-	1-4
Organic Matter*	Calculation: 100 - Ash (dry wt).	0.04 g/100g dry wt	1-4
Soil Prep Dry for Organics,Trace*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-4
Heavy metal, trace level As,Cd,Cr,Cu,Ni,Pb,Zn	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level.	0.010 - 0.4 mg/kg dry wt	1-4
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	1-4
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-4
Ash*	Ignition in muffle furnace 550°C, 6hr, gravimetric. APHA 2540 G 23rd ed. 2017.	0.04 g/100g dry wt	1-4

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total Organic Carbon*	Acid pretreatment to remove carbonates present followed by Catalytic Combustion (900°C, O2), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	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.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Appendix F:

Hill Laboratories Elutriate Test Results

Hill Laboratories
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R J Hill Laboratories Limited
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W www.hill-laboratories.com

Certificate of Analysis

SPv2

Client:	4SIGHT Consulting Limited	**Lab No:**	2178204
Contact:	Oliver Bone	**Date Received:**	18-May-2019
	C/- 4SIGHT Consulting Limited	**Date Reported:**	07-Aug-2019 **(Amended)**
	PO Box 402053	**Quote No:**	100276
	Tutukaka 0153	**Order No:**	AA4046
		Client Reference:	AA4046 - FNH_Ashbys Boatyard Extension
		Submitted By:	Oliver Bone

Sample Type: Saline

Sample Name:		Elutriation Water 24-Jul-2019 10:30 am				
Lab Number:		2178204.5				
Individual Tests						
Total Arsenic	g/m³	< 0.0042	-	-	-	-
Total Cadmium	g/m³	< 0.00021	-	-	-	-
Total Chromium	g/m³	< 0.0011	-	-	-	-
Total Copper	g/m³	0.0014	-	-	-	-
Total Lead	g/m³	< 0.0011	-	-	-	-
Total Nickel	g/m³	< 0.0070	-	-	-	-
Total Zinc	g/m³	< 0.0042	-	-	-	-
Tributyl Tin Trace in Water samples by GCMS						
Dibutyltin (as Sn)*	g/m³	< 0.00006	-	-	-	-
Tributyltin (as Sn)*	g/m³	< 0.00005	-	-	-	-
Triphenyltin (as Sn)*	g/m³	< 0.00004	-	-	-	-

Sample Type: Sediment

Sample Name:		Ashbys Sed 1 16-May-2019 1:15 pm	Ashbys Sed 2 16-May-2019 1:30 pm	Ashbys Sed 3 16-May-2019 1:40 pm	Ashbys Sed 4 16-May-2019 2:00 pm	
Lab Number:		2178204.1	2178204.2	2178204.3	2178204.4	
Individual Tests						
Organic Matter*	g/100g dry wt	6.2	7.7	7.4	7.1	-
Ash*	g/100g dry wt	94	92	93	93	-
Total Organic Carbon*	g/100g dry wt	1.08	1.58	1.56	1.37	-
Heavy metal, trace level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	22	16.9	14.9	19.1	-
Total Recoverable Cadmium	mg/kg dry wt	0.040	0.035	0.035	0.027	-
Total Recoverable Chromium	mg/kg dry wt	15.2	19.0	19.0	16.9	-
Total Recoverable Copper	mg/kg dry wt	46	25	22	15.9	-
Total Recoverable Lead	mg/kg dry wt	17.1	12.1	12.4	10.9	-
Total Recoverable Nickel	mg/kg dry wt	9.5	8.9	9.0	8.2	-
Total Recoverable Zinc	mg/kg dry wt	101	76	78	86	-
Tributyl Tin Trace in Soil samples by GCMS						
Dibutyltin (as Sn)	mg/kg dry wt	0.042	< 0.005	< 0.005	0.042	-
Monobutyltin (as Sn)	mg/kg dry wt	< 0.007	< 0.007	< 0.007	< 0.007	-
Tributyltin (as Sn)	mg/kg dry wt	0.019	0.004	0.004	0.016	-
Triphenyltin (as Sn)	mg/kg dry wt	< 0.003	< 0.003	< 0.003	< 0.003	-

Sample Type: Aqueous

Sample Type: Aqueous						
	Sample Name:	Ashbys Sed 1 [Elutriation Ext]	Ashbys Sed 2 [Elutriation Ext]	Ashbys Sed 3 [Elutriation Ext]		
	Lab Number:	2178204.6	2178204.7	2178204.8		
Individual Tests						
Total Arsenic	g/m³	0.0106 #1	0.0117	0.0090	-	-
Total Cadmium	g/m³	< 0.00021	< 0.00021	< 0.00021	-	-
Total Chromium	g/m³	< 0.0011	< 0.0011	< 0.0011	-	-
Total Copper	g/m³	< 0.0011	< 0.0011	< 0.0011	-	-
Total Lead	g/m³	< 0.0011	< 0.0011	< 0.0011	-	-
Total Nickel	g/m³	< 0.0070	< 0.0070	< 0.0070	-	-
Total Zinc	g/m³	< 0.0042	< 0.0042	< 0.0042	-	-
Tributyl Tin Trace in Water samples by GCMS						
Dibutyltin (as Sn)	g/m³	< 0.00006	< 0.00006	< 0.00006	-	-
Tributyltin (as Sn)	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-
Triphenyltin (as Sn)	g/m³	< 0.00004	< 0.00004	< 0.00004	-	-

Analyst's Comments

#1 It should be noted that the replicate analyses performed on this sample as part of our in-house Quality Assurance procedures showed greater variation than would normally be expected. This may reflect the heterogeneity of the sample. The average of the results of the replicate analyses has been reported.

Amended Report: This certificate of analysis replaces an earlier report issued on 27 May 2019 at 3:28 pm
Reason for amendment: Additional testing added at the clients request.

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.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Saline

Test	Method Description	Default Detection Limit	Sample No
Tributyl Tin Trace in Water samples by GCMS*	Solvent extraction, ethylation, SPE cleanup, GC-MS SIM analysis	0.00003 - 0.00005 g/m³	5-8
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	5-8
Total Arsenic	Nitric acid digestion, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23rd ed. 2017.	0.0042 g/m³	5-8
Total Cadmium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23rd ed. 2017.	0.00021 g/m³	5-8
Total Chromium	Nitric acid digestion, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23rd ed. 2017.	0.0011 g/m³	5-8
Total Copper	Nitric acid digestion, ICP-MS, ultratrace. APHA 3125 B 23rd ed. 2017.	0.0011 g/m³	5-8
Total Lead	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23rd ed. 2017.	0.0011 g/m³	5-8
Total Nickel	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23rd ed. 2017.	0.0070 g/m³	5-8
Total Zinc	Nitric acid digestion, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23rd ed. 2017.	0.0042 g/m³	5-8

Sample Type: Sediment

Test	Method Description	Default Detection Limit	Sample No
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-4
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%.	-	1-4
Organic Matter*	Calculation: 100 - Ash (dry wt).	0.04 g/100g dry wt	1-4
Soil Prep Dry for Organics,Trace*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-4
Heavy metal, trace level As,Cd,Cr,Cu,Ni,Pb,Zn	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level.	0.010 - 0.4 mg/kg dry wt	1-4
Elutriation testing*	Extn with (client supplied) water, eg seawater, Sed:Water 1:4 by vol, mix 30 min, settle 1 hr, filtration or centrifugation. US EPA 503/8-91/001, "Evaluation of Dredged Material for Ocean Disposal".	-	1-3

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
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	1-4
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-4
Ash*	Ignition in muffle furnace 550°C, 6hr, gravimetric. APHA 2540 G 23rd ed. 2017.	0.04 g/100g dry wt	1-4
Total Organic Carbon*	Acid pretreatment to remove carbonates present followed by Catalytic Combustion (900°C, O2), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	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.

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Ara Heron BSc (Tech)
Client Services Manager - Environmental