

Mair Bank Channel Edge Additional Characterisation:
Crude Freight Shipping Project,
Bream Bay, Whangarei

February 2016



Cover Photo: Transect 3 Photo Point A showing a large sand ripple formation and fine sand with some shell and shell hash component.

For: Chancery Green on behalf of the Refining NZ

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Kerr and Associates, Whangarei

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1 Introduction

Kerr and Associates has been requested to supply a photo series and survey notes of the sea bottom substrates along three transects located on the east and northeast channel bank of Mair Bank or otherwise referred to as the toe of the Ebb Tide delta at the entrance of Whangarei Harbour.

Objectives of this rapid survey project are to support the modeling work (in progress with MetOcean) associated with new capital dredging, widening and/or realignment of the channel at the entrance to Whangarei Harbour, and to provide some information on the ecological conditions (primarily with respect to any shellfish observed/counted).

The survey and photo series was designed to explore the depths and degree of shell content in the superficial substrate to a substrate depth of approximately 200mm of the channel bank. A photographic record was created along with positional and depth records.

2 Methods

2.1 Selection of sample sites

Following discussion with Sarah Gardiner at MetOcean and the Refinery project team it was decided to carry out a diver swim along three transects depicted on the Figures 1 and 2 maps below. The transects were selected to cover the depth range of shallow subtidal (1-3m) on the edge of Mair Bank to the deep edge of the slope of the channel (14-16m depth). The areas selected covered the range of positions from just before the toe of the Bank to further out on the most seaward extent of Mair Bank.

2.2 Information recorded

It was agreed that the diver would record a photographic record of the surficial substrate at 2m depth intervals or when there was a noticeable change in substrate composition, specifically any change in the shell component and the armouring character of the substrate. In addition the diver would look for evidence of live pipi or any other significant biological communities that were observed along the transect. At each observation point the diver recorded the depth.

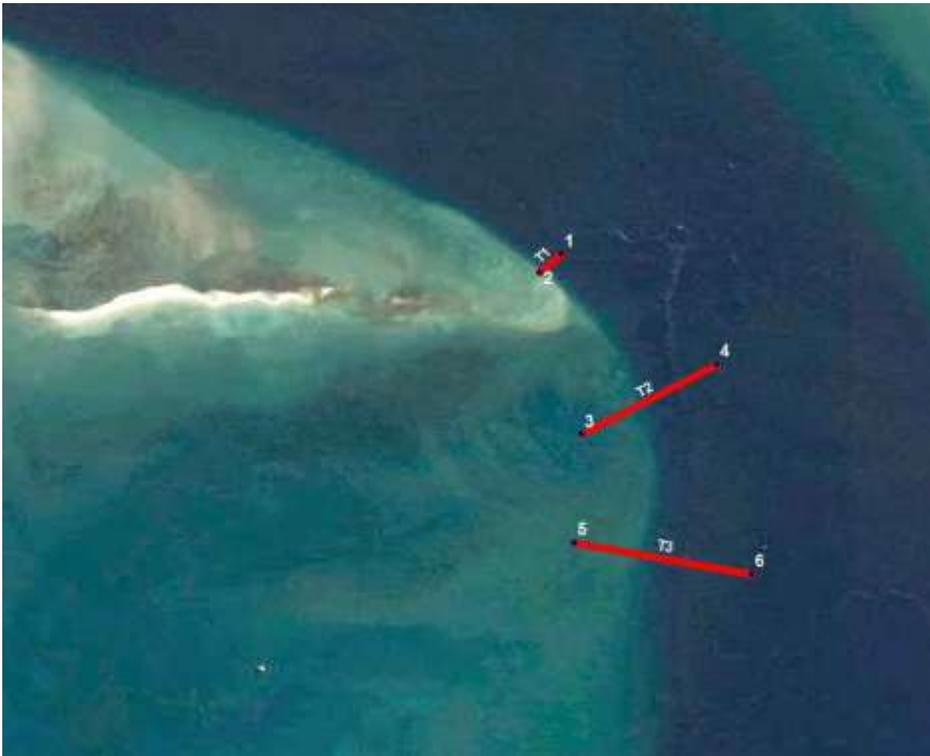


Figure 1 Proposed photo transects of the Mair Bank toe region. Transect locations T1, T2 and T3 were agreed following discussion with MetOcean.



Figure 2 Survey transects with start and finish target points shown over marine chart.

2.3 Navigation, bathymetry and photography

Design of the target points and transect was done on a GIS platform with target waypoint coordinates transferred to a Humminbird 847 sounder/chart plotter. Photography was done using natural light and a Cannon G12 camera in an Ikelite housing. On the bottom at each photo point a depth record was made by taking a photo of the diver's depth gauge. Several shots at different angles were taken of the bottom substrate at each photo point to capture localised variation of the surficial substrate if it existed.

At each photo point a hole was dug by hand with a garden trowel to a depth of approximately 200-300mm to observe the amount of shell that was below the surface and the uniformity of the shell component. The trowel was then thrust into the hole and a photograph taken to show how consolidated the substrate was. The rate at which the hole filled in from the sides provided a simple demonstration of how consolidated the top 200mm of the substrate was.

Underwater navigation along the transect line was done with a hand held diver compass. Transect start and finish locations were recorded with the boats' chart plotter. Location of photo points between the dive start and finish points is estimated from the time interval between each point along the line recorded by the camera and compared to fine scale multi-beam bathymetry data provided by Refining NZ. Observations of the variance of the line of travel taken by the diver compared to the target transect line were also made by the dive team in the boat.

2.4 Tide Correction

All depth recordings taken in the field had time recorded to allow for tide correction to chart datum level. All results in this report are corrected and relative to chart datum. Marsden Point tides for the days of on water survey were:

Day 1 Feb 13th High water 12:11 pm

Day 2 Feb 20th Low water 12:50 pm

The method used for tide correction is a standard method published in the Admiralty Tide Tables, reproduced and published online by LINZ.¹

¹ [Download the Method to Find Times or Heights Between High and Low Waters. \(PDF - 55KB\)](#)

3 Results

Results of the survey are presented in the form of a set of photos taken at each photo point along with specific notes recorded. At the end of this section there is a table of all photo sites with summary notes of date, time, depth, shell component relative value and brief substrate description. Locations of each photo site are shown in the map below, (Figure 3). The photo points in Figure 3 have been ranked qualitatively according to the amount of the shell component. (refer to legend in Figure 3).

GPS coordinates for each photo point are included in Appendix 1.

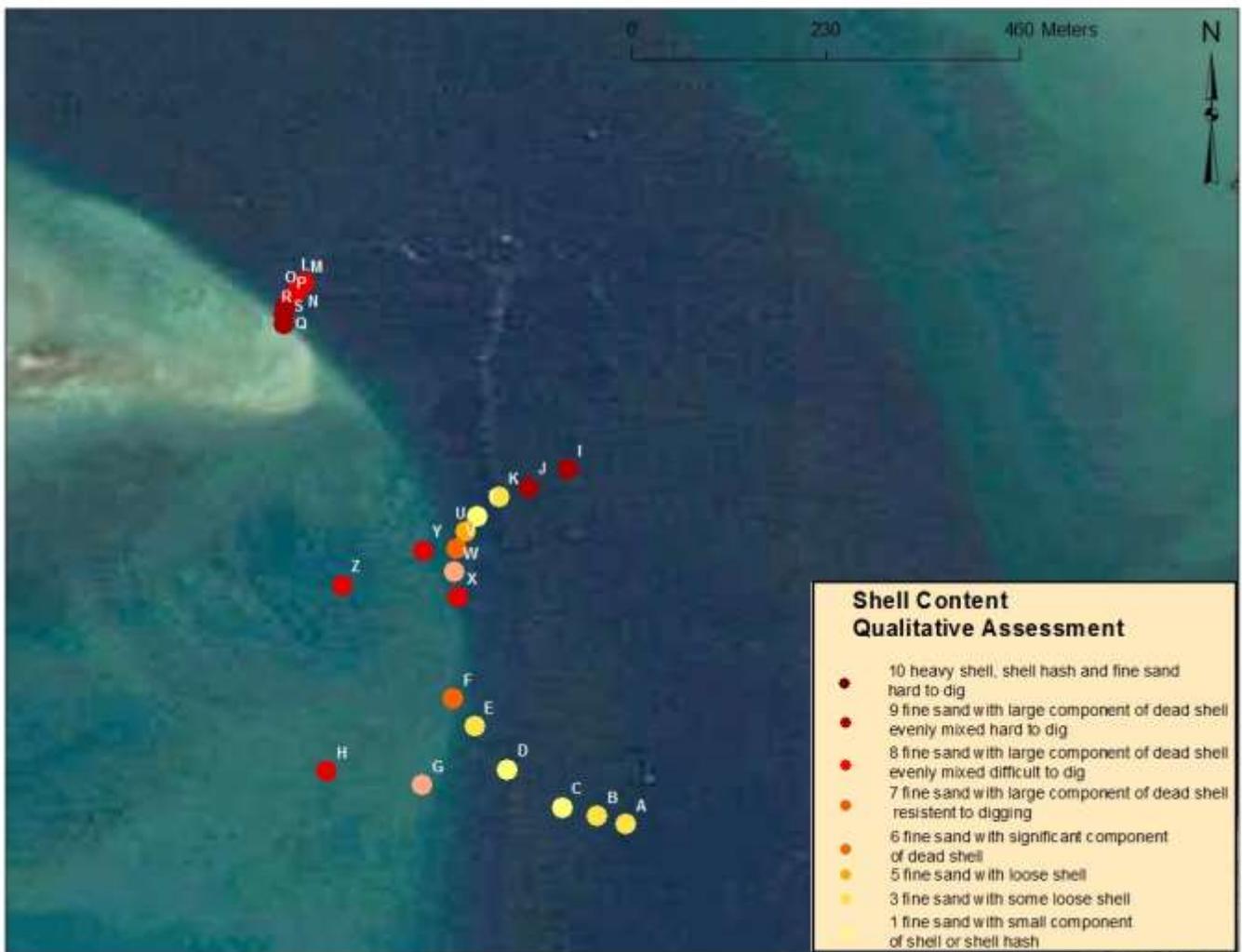


Figure 3 Map of photo points, labeled points represent completed photo points

3.1 Photo points, transect 3

3.1.1 Photo Point A

Notes:

Shell content rating = 3 (see Table 1 for description of rating)

Sediments were mainly fine sand with loose pipi, *Paphies australis* and *Tawera speciosa* shell. There were only very small quantities of silt and shell hash. Coarse sand and gravels were not observed in any significant quantity. Sand ripples are prominent and covered the entire area. The sand ripple wave period was approx. 2-3m and wave height approx. 200-300mm. Substrate did not appear to be consolidated to a great extent. . When digging, the trowel went in smoothly to full depth with little effort. The hole quickly filled in from the sides when dug. There was no change in substrate at 200-300mm depth. No live shellfish were seen.



Figure 4 Photo point A: (left) showing sand wave ridge, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length. Depth -14.1m.

3.1.2 Photo Point B

Notes:

Shell content rating = 3 (see Table 1 for description of rating)

There was essentially no change from Photo point A, sediments were mainly fine sand with loose pipi, *Paphies australis* and *Tawera speciosa* shell, with only very small quantities of silt and shell hash. Coarse sand and gravels were not observed in any significant quantity. Sand ripples are prominent and covered the entire area. The sand ripple wave period was approx., 2-3m and height approx. 200-300mm. Substrate did not appear to be consolidated to a great extent. When digging the trowel went in smoothly to full depth with little effort. The hole quickly filled in from the sides when dug. There was no change in substrate at 200-300mm depth. No live shellfish were seen. One small green algae was seen, *Codium sp.*



Figure 5 Photo point B: (left) showing sand wave ridge, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length. Depth -11.9m.

3.1.3 Photo Point C

Notes:

Shell content rating = 1 (see Table 1 for description of rating)

Substrate is predominantly fine sand with very little silt or gravel content. There is a small proportion of shell hash. Larger shells are present mixed through the substrate but are a relatively minor component. There is a dual pattern of wave ripples present with a large wave with approx. 2m period and small wave ripple with approx. 300mm period. The excavation hole filled constantly while digging indicating that the substrate is unconsolidated. There was no change in the substrate composition at 200mm depth. No live shellfish were seen.



Figure 6 Photo point C: (left) showing large and small wave ridges, (right) showing excavation hole filling in completely with loose sand as trowel is thrust in full length. Depth -10.1m

3.1.4 Photo Point D

Notes:

Shell content rating = 1 (see Table 1 for description of rating)

Substrate is predominantly fine sand with very little silt or gravel content. There is a very small proportion of shell hash. Larger shells are nearly absent. There is a dual pattern of wave ripples present with a large wave with approx. 2m period and small wave ripple with approx. 300mm period. The excavation hole filled constantly while digging indicating that the substrate is unconsolidated. There was no change in the substrate composition at 200mm depth. No live shellfish were seen.



Figure 7 Photo point D: (left) showing sand wave ridges, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length. Depth -8.1m.

3.1.5 Photo Point E

Notes:

Shell content rating = 3 (see Table 1 for description of rating)

Substrate is predominantly fine sand with very little silt or gravel content. There is a very small proportion of shell hash. Larger shells are present. There is a small pattern of wave ripples with an approx. 300mm period. While digging shells were encountered but it was easy to thrust the trowel into the substrate to its full length. The hole mostly filled back in while digging indicating that the substrate is largely unconsolidated. There was no change in the substrate composition at 200mm depth. One live pipi was seen while digging. Judging from the relatively fresh (non-living) shell present there could be a low density of pipi living here.



Figure 8 Photo point E: (left) showing small sand wave ridge, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length, two limpets seen at top right of hole. Depth -6m.

3.1.6 Photo Point F

Notes:

Shell content rating = 6 (see Table 1 for description of rating)

Substrate was fine sand with a component of shell hash. Large dead shells were a significant component. There were no sand ripples present. The substrate was fairly hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The shell and substrate composition was uniform down to 200mm depth. There were no live shellfish seen.



Figure 9 Photo point F: showing high shell content and armouring of seabed. Depth = -2.8m. Note depth gauge is an uncorrected high tide reading.

3.1.7 Photo Point G

Notes:

Shell content rating = 7 (see Table 1 for description of rating)

Substrate was fine sand with a component of shell hash. Large dead shells were a significant component. The surface was somewhat undulating but not in a formal wave pattern. Some small irregular sand ripples were present. The substrate was fairly hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The shell and substrate composition was uniform down to 200mm depth. There were no live shellfish seen. The small green algae *Codium sp.* were present in low density.

1



Figure 10 Photo point G: showing fine sand, high shell content and presence of green algae *Codium sp.* Depth -2.8m.

3.1.8 Photo Point H

Notes:

Shell content rating = 8 (see Table 1 for description of rating)

Substrate was fine sand with a component of shell hash. Large dead shells were a significant component. The surface was somewhat undulating but not in a formal wave pattern. Some small irregular sand ripples were present. The substrate was fairly hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The shell and substrate composition was uniform down to 200mm depth. There were no live shellfish seen. The small green algae *Codium sp.* were present in low density.



Figure 11 Photo point H: (left) showing flat armoured surface with high shell content, (right) showing excavation hole partially filling in with loose sand as trowel is thrust in full length. Depth -2.3m.

3.2 Photo points, transect 2

3.2.1 Photo Point I

Notes:

Shell content rating = 10 (see Table 1 for description of rating)

Substrate was a mix of shell hash loose shell and fine sand. There was a small amount of silt present. The shell hash and loose shell makes up a large proportion of the substrate and was evenly mixed down to 200mm. The substrate appeared to be quite consolidated and relatively stable. The excavation hole took some effort to dig due to the large shell content and filled in only slightly when digging. There was a fairly flat wave ridge pattern with an approx. 2m period. There were no live shellfish seen.



Figure 12 Photo point I: (left) showing wave pattern with ridges running left to right, (right) showing excavation hole. Depth -16.8m.

3.2.2 Photo Point J

Notes:

Shell content rating = 10 (see Table 1 for description of rating)

Substrate was a mix of shell hash, loose shell and fine sand. There was a small amount of silt present. The shell hash and loose shell made up a large proportion of the substrate and was evenly mixed down to 200mm. The substrate appeared to be quite consolidated and relatively stable. The excavation hole took some effort to dig due to the large shell content and filled in only slightly when digging. The surface was fairly flat with no real wave pattern present. There were no live shellfish seen.



Figure 13 Photo point J: showing high shell content. Depth -14.2m.

3.2.3 Photo Point K

Notes:

Shell content rating = 3 (see Table 1 for description of rating)

Substrate is predominantly fine sand with a significant component of shell hash but very little silt or gravel content. Larger shells are present mixed through the substrate but are a relatively minor component. There is a steep pattern of wave ripples present with a wave period of approx. 1m. The excavation hole filled constantly while digging indicating that the substrate is unconsolidated. There was no change in the substrate composition at 200mm depth. No live shellfish were seen.



Figure 14 Photo point K: (left) showing sand wave ridge, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length. Depth -13.2m.

3.2.4 Photo Point T

Notes:

Shell content rating = 1 (see Table 1 for description of rating)

Substrate is predominantly fine sand with a component of fine shell hash but very little silt or gravel content. Larger shells are present mixed through the substrate but are a relatively minor component There is a dual pattern of wave ripples present with a large wave period of approx. 2m and a small wave ripple with a period of approx.200mm. The excavation hole filled constantly while digging indicating that the substrate is unconsolidated. There was no change in the substrate composition at 200mm depth. No live shellfish were seen.



Figure 15 Photo point T: (left) showing sand wave ridges, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length. Depth -9.6m.

3.2.5 Photo Point U

Notes:

Shell content rating = 5 (see Table 1 for description of rating)

Substrate was fine sand with a small component of shell hash. Large dead shells were a significant component. There were no sand ripples present. The substrate was fairly hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen.

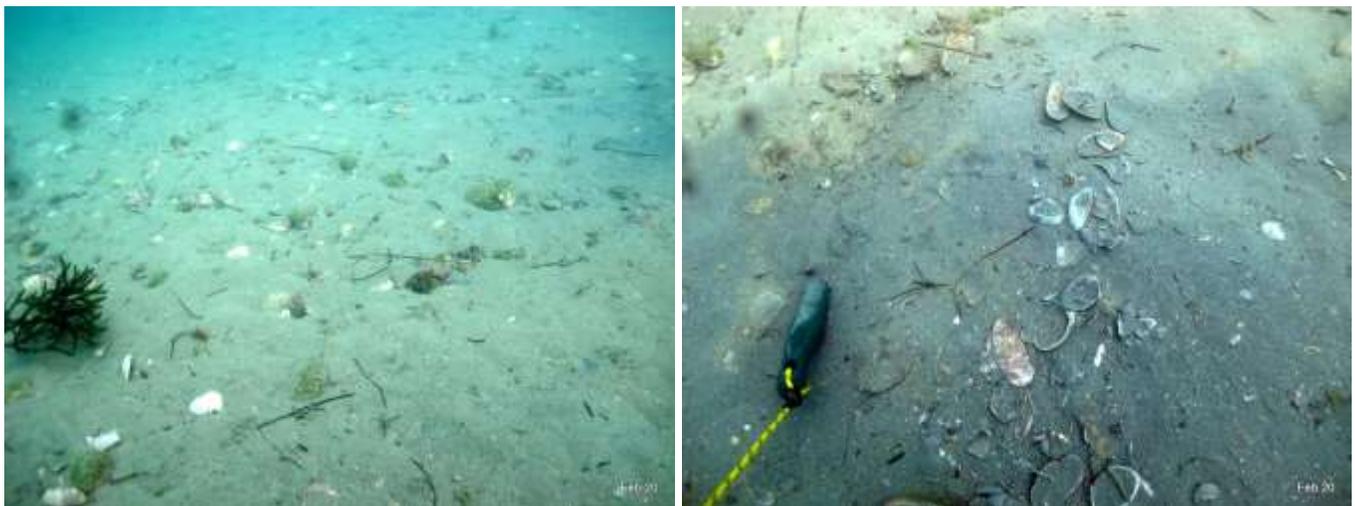


Figure 16 Photo point U: (left) showing flat surface and presence of large shells, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and large shells and shell hash to left excavated from the hole. Depth -7.4m

3.2.6 Photo Point V

Notes:

Shell content rating = 6 (see Table 1 for description of rating)

Substrate was fine sand with a significant component of shell hash. Large dead shells were also a significant component. There were no sand ripples present. The substrate was fairly hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen.



Figure 17 Photo point V: (left) showing significant shell content, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and shell fragments to the left excavated from the whole. Depth -4.9m.

3.2.7 Photo Point W

Notes:

Shell content rating = 7 (see Table 1 for description of rating)

Substrate was fine sand with a significant component of shell hash and large dead shell. Large dead shells cover most of the surface. There were no sand ripples present. The substrate was fairly hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen.



Figure 18 Photo point W: (left) showing high shell content and eleven armed starfish *Coscinasterias calamaria*, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and shell content to left excavated from the hole.. Depth -3.6m.

3.2.8 Photo Point X

Notes:

Shell content rating = 9 (see Table 1 for description of rating)

Substrate was fine sand with a significant component of shell hash and large dead shell. Large dead shells cover most of the surface. There were no sand ripples present. The substrate was fairly hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen.



Figure 19 Photo point X: (left) showing high shell content, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and high shell content. Depth -2.9m

3.2.9 Photo Point Y

Notes:

Shell content rating = 8 (see Table 1 for description of rating)

Substrate was fine sand with a significant component of shell hash and large dead shell. Large dead shells cover most of the surface although there were some signs of some sand moving. There were no sand ripples present. The substrate was fairly hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen.



Figure 20 Photo point Y: (left) showing high shell content, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and high shell content. Depth -3.5m

3.2.10 Photo Point Z

Notes:

Shell content rating = 8 (see Table 1 for description of rating)

Substrate was fine sand with a significant component of shell hash and large dead shell. Large dead shells cover much of the surface. There were no sand ripples present but evidence of some sand movement. The substrate was fairly hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen.



Figure 21 Photo point Z: (left) showing high shell content with some mobile sand, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and high shell content.. Depth - 3.4m.

3.3 Photo points, transect 1

3.3.1 Photo Point L

Notes:

Shell content rating = 8 (see Table 1 for description of rating)

Substrate was fine sand with a significant component of shell hash and large dead shell. Large dead shells cover much of the surface. There was evidence of some sand moving on the surface. There were no sand ripples present. The substrate was hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen.



Figure 22 Photo point L: (left) showing significant shell content, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and shell to left excavated from hole. Depth -15.6m.

3.3.2 Photo Point M

Notes:

Shell content rating = 9 (see Table 1 for description of rating)

Substrate was fine sand with a significant component of shell hash and large dead shell. Large dead shells cover much of the surface. There were no sand ripples present. The substrate was hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen.

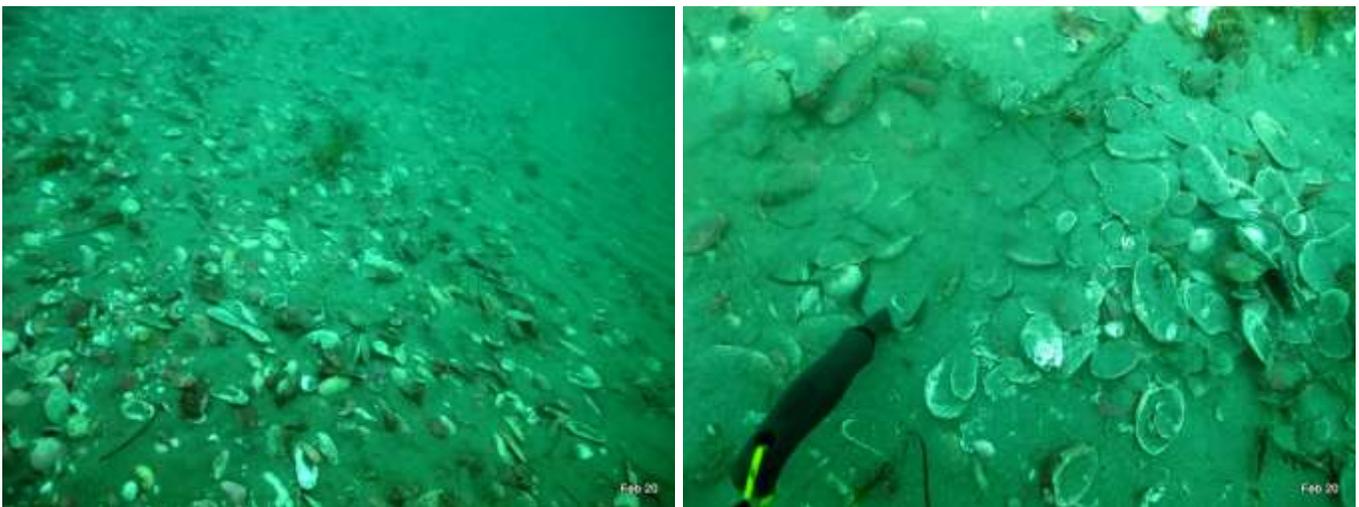


Figure 23 photo point M showing significant shell content, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and shell excavated to left from hole. Depth -14.4m.

3.3.3 Photo Point N

Notes:

Shell content rating = 8 (see Table 1 for description of rating)

Substrate was fine sand with a significant component of shell hash and large dead shell. Large dead shells cover much of the surface. There was evidence of some sand moving on the surface. There were no sand ripples present. The substrate was hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen.



Figure 24 Photo point N: (left) showing significant shell content, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and shell excavated to left from hole. Depth -12.6m.

3.3.4 Photo Point O

Notes:

Shell content rating = 9 (see Table 1 for description of rating)

Substrate was fine sand with a significant component of shell hash and large dead shell. Large dead shells cover much of the surface. There was evidence of some sand moving on the surface. There were no sand ripples present. The substrate was hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen.



Figure 25 Photo point O: (left) showing significant shell content, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and shell to left excavated from hole. Depth -10.4m.

3.3.5 Photo Point P

Notes:

Shell content rating = 9 (see Table 1 for description of rating)

Substrate was fine sand with a significant component of shell hash and large dead shell. Large dead shells cover much of the surface. There was evidence of some sand moving on the surface. There were no sand ripples present. The substrate was hard to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen.



Figure 26 Photo point P: (left) showing significant shell content, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and shell to left excavated from hole. Depth -8.4m.

3.3.6 Photo Point Q

Notes:

Shell content rating = 10 (see Table 1 for description of rating)

Substrate was fine sand with very high proportion of large dead shell. Large dead shells cover the surface. There were no sand ripples present. The substrate was very difficult to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen.



Figure 27 Photo point Q: (left) showing a high degree of shell content, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and shell to left excavated from hole. Depth - 5.6m.

3.3.7 Photo Point R

Notes:

Shell content rating = 10 (see Table 1 for description of rating)

Substrate was fine sand with very high proportion of large dead shell. Large dead shells cover the surface. There were no sand ripples present. The substrate was very difficult to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen.



Figure 28 Photo point R: (left) showing a high degree of shell content, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and shell to left excavated from hole. Depth - 3.1m.

3.3.8 Photo Point S

Notes:

Shell content rating = 10 (see Table 1 for description of rating)

Substrate was fine sand with a large dead shell content. Large dead shells cover most of the surface. There were no sand ripples present. The substrate was very difficult to dig due to the amount of large shell evenly mixed through the substrate to 200mm depth. The substrate was uniform in composition through the 200mm profile. There were no live shellfish seen. Depth -1.6m.



Figure 29 Photo point S: (left) showing high shell content, (right) showing excavation hole filling in with loose sand as trowel is thrust in full length and shell to left excavated from hole. Depth -1.6m.

photo point	date	time	Depth	shell content 1-5	surficial sediment description
Transect 3					
A	13-Feb	1155	-14.1	3.0	fine sand with loose shell
B	13-Feb	1200	-11.9	3.0	fine sand with loose shell
C	13-Feb	1203	-10.1	1.0	fine sand with small amount of loose shell (mobile)
D	13-Feb	1206	-8.1	1.0	fine sand with very small amount of loose shell (mobile)
E	13-Feb	1208	-6.0	3.0	fine sand with some loose shell (semi-mobile)
F	13-Feb	1210	-2.8	6.0	fine sand with large component of dead shell evenly mixed and armouring the seabed
G	13-Feb	1233	-2.8	7.0	fine sand with large component of dead shell evenly mixed and armouring the seabed
H	13-Feb	1243	-2.3	8.0	fine sand with large component of dead shell evenly mixed and armouring the seabed
Transect 2					
I	13-Feb	1308	-16.8	10.0	heavy shell, shell hash and fine sand well consolidated
J	13-Feb	1312	-14.2	10.0	heavy shell, shell hash and fine sand well consolidated
K	13-Feb	1314	-13.2	3.0	fine sand with very small amount of loose shell (mobile)

T	20-Feb	1250	-9.6	1.0	fine sand with a shell hash component and small amount of loose shell (mobile)
U	20-Feb	1254	-7.4	5.0	fine sand with some loose shell (semi-mobile)
V	20-Feb	1256	-4.9	6.0	fine sand with significant component of dead shell evenly mixed and armouring the seabed to some degree
W	20-Feb	1258	-3.6	7.0	fine sand with large component of dead shell evenly mixed and armouring the seabed
X	20-Feb	1314	-2.9	9.0	fine sand with large component of dead shell evenly mixed and armouring the seabed
Y	20-Feb	1322	-3.5	8.0	fine sand with large component of dead shell evenly mixed and armouring the seabed
Z	20-Feb	1334	-3.4	8.0	fine sand with large component of dead shell evenly mixed and armouring the seabed
Transect 1					
L	20-Feb	1224	-15.6	8.0	fine sand with significant component of dead shell evenly mixed and armouring the seabed
M	20-Feb	1227	-14.4	9.0	fine sand with large component of dead shell evenly mixed and armouring the seabed
N	20-Feb	1228	-12.6	8.0	fine sand with large component of dead shell evenly mixed and armouring the seabed
O	20-Feb	1230	-10.4	9.0	fine sand with large component of dead shell evenly mixed and armouring the seabed
P	20-Feb	1232	-8.4	9.0	fine sand with large component of dead shell evenly mixed and armouring the seabed
Q	20-Feb	1233	-5.6	10.0	heavy shell, shell hash and fine sand well consolidated
R	20-Feb	1235	-3.1	10.0	heavy shell, shell hash and fine sand well consolidated
S	20-Feb	1237	-1.6	10.0	heavy shell, shell hash and fine sand well consolidated

Table 1 Summarized substrate description of photo points

4 Discussion

4.1 Limitations of this study

This study was intended as a rapid characterization of the surface substrates and degree of the shell component of the channel edge in the vicinity of the toe of Mair Bank at the entrance to Whangarei Harbour.

Using the photos and the diver experience a written description was made for each site. A scale of 1:10 was devised to show the degree of shell component of the surface with 1 being fine sand, completely mobile, with no significant shell hash or large shells on the surface or within the first 200mm depth of the substrate. A 10 value was given to a high shell content where dead shells covered the entire surface and were consolidated in the substrate down to 200mm depth.

While these qualitative assessments cannot quantify the shell component or actual degree of ‘armouring effect’ it is suggested that, along with study of the photo set, they are valuable for judging how stable the surface sediments are in this area.

This observation and method could be used for monitoring large changes over time in shell content in these areas. Given what is known about how dynamic this area is (Williams and Hume 2014), it can be expected that there are significant changes happening over time. As such these results should be seen as information on the condition of the substrate at a single point in time.

4.2 General Observations

During the survey a watch was kept for signs of communities of live shellfish. Only one site had live pipi excavated while digging and there were no other areas where live animals were seen. At Transect 1, from the appearance of the surface at the upper 1/3 of steeply sloping bank, it looked as though dead shells were slipping down the bank from the top. It is possible that the high shell content on this face of the bank is the result of dead shell being washed over the crest of the bank with the incoming tidal current, as opposed to being sourced purely from pipi communities living there. In contrast, Transect 3 showed both high shell content in the shallow part next to the bank and more mobile fine sand areas deeper and further from the bank, indicating considerable movement of sand through that area.

Transect 2 had a shell component profile which was intermediate between Transects 1 and 3, with most but not all, parts of the profile having a large shell component in the surface substrate.

The hand digging with a small spade seemed to be a good method for observing how evenly spread the shell component was in the top 200mm layer of substrate. It was interesting to note that on all sites the shell component was consistent through the top 200mm layer of substrate.

5 References

Williams, J.R., Hume, T.M., 2014. Investigation into the decline of pipi at Mair Bank, Whangarei Harbour. Prepared for Northland Regional Council. June 2014 NIWA Client Report No: AKL2014-022

6 Appendix 1 GPS coordinates for photo points

Photo Point	Depth m	Shell Content	Longitude	Latitude
F	2.8	6	174.51841	-35.84768
G	2.8	7	174.51807	-35.8486
K	13.2	3	174.51889	-35.84553
L	15.6	8	174.5168187	-35.84324324
I	16.75	10	174.5196294	-35.84523287
H	2.32	8	174.5170571	-35.84845299
A	15.44	3	174.5202494	-35.84901427
B	11.93	3	174.5199422	-35.84892951
C	10.12	1	174.5195657	-35.84883902
D	8.1	1	174.5189843	-35.84843584
E	6	3	174.5186384	-35.84797614
J	14.2	10	174.5192128	-35.84542526
M	14.4	9	174.5167875	-35.84327101
N	12.6	8	174.5167493	-35.84332515
O	10.4	9	174.516696	-35.84338892
P	8.4	9	174.516637	-35.84344897
Q	5.6	10	174.516609	-35.8435107
R	3.1	10	174.5165934	-35.84358867
S	1.6	10	174.5165986	-35.84368984
T	9.6	1	174.5186625	-35.84573189
U	7.4	5	174.5185374	-35.84589761
V	4.9	6	174.5184468	-35.84608296
W	3.6	7	174.5184204	-35.84633218
X	2.9	9	174.518458	-35.84659645
Y	3.6	8	174.51809	-35.8461
Z	2.9	8	174.51722	-35.84647

Note: Depths are corrected to chart datum